



Together, Investing in Municipal Excellence

CITY COUNCIL MEETING AGENDA

SEPTEMBER 23, 2024

723 S. Lewis Street, Room 1122 B

Stillwater, OK 74074

5:30 PM

Mayor Will Joyce, Vice Mayor Amy Dzialowski, Councilors Kevin Clark, Christie Hawkins,
& Tim Hardin

1. Call Meeting to Order
2. Pledge of Allegiance
3. Consent Docket

Items listed on the consent docket are routine administrative matters that may be approved without discussion. The Council will take action on these items collectively with a single vote. The requested City Council action is indicated for each item listed. Should a Councilor elect to discuss, amend, revise, or table any item listed on the consent docket, the item will be moved to the section of the agenda titled "Items Removed from the Consent Docket" for consideration and possible action. Additionally, a Councilor or the City Manager may simply ask the Mayor to remove an item from the consent docket prior to action by the City Council and no action will be taken on the removed item at this meeting.

a.	Approve September 9, 2024 regular and executive session meeting minutes		
b.	Approve and execute Concurrence Letter for school speed zone modifications in the vicinity of Highland Park Elementary	CC-24-111	Travis Small
c.	Approve Professional Services Agreement with Meshek & Associates, LLC for engineering, planning, grant management and GIS services required to review and update the City of Stillwater's Hazard Mitigation Plan.	CC-24-112	Rob Hill
d.	Approve Amendment #2 with Meshek & Associates for expanded Stormwater CIP to cover	CC-24-113	Zack Henson

	all areas in City Limits; approve associated budget amendment and authorize the City Manager to sign related documents.		
e.	Approve budget amendments reflecting receipt and appropriation of \$23,363 in donations to the Stillwater Public Library	CC-24-114	Stacy Delano

4. Public Comment on Items not Scheduled for Public Hearings

Stillwater City Code, Section 2-53(a) & (b), provides that taxpayers or residents of the city, or their authorized legal representatives, may address the Council at a regularly scheduled meeting on **any item of business listed on the meeting agenda** provided they have submitted a written request prior to the meeting either online at Request to speak form or via the form found in the lobby outside Council chambers.

5. Items Removed from the Consent Docket

Items removed from the consent docket are placed on this section of the agenda for discussion, revision, amendment and/or tabling prior to action by the City Council. The City Council may take action, including a vote or series of votes, on items removed to this section of the agenda after the requested discussion, revision or amendment.

6. General Orders

The City Council will hear a staff presentation, discuss, and take action including a vote or series of votes on each item listed as presented or as amended or revised by the City Council unless the agenda entry specifically states that no action will be taken. The requested action is indicated in each agenda entry but may be amended or revised prior to action by the City Council.

a.	An update from the Parks & Community Resources Director to provide a report on the Arrowhead Park survey, implementation of site and neighborhood surveys, and communication related to opportunities for community involvement in the city parks discussion. (No action will be taken on this item).	Barbara Bliss

7. Resolutions

The City Council will hear a staff presentation, discuss, and take action including a vote or series of votes on each resolution listed as presented or as amended or revised by the City Council.

a.	RESOLUTION NO. CC-2024-28: A RESOLUTION AUTHORIZING THE CITY OF STILLWATER TO SUBMIT A GRANT APPLICATION FOR THE FEMA HAZARD MITIGATION GRANT PROGRAM (HMGP) ADMINISTERED BY THE OKLAHOMA DEPARTMENT OF EMERGENCY MANAGEMENT AND FEMA FOR THE PURPOSE OF ASSISTING IN IMPLEMENTATION OF LONG-TERM HAZARD MITIGATION PLANNING; AUTHORIZING MESHEK & ASSOCIATES, LLC TO SUBMIT THE GRANT APPLICATION ON BEHALF OF THE CITY OF STILLWATER IN CONNECTION WITH ITS GRANT ADMINISTRATION SERVICES; APPROVING THE ASSOCIATED BUDGET AMENDMENT; AND AUTHORIZING THE MAYOR OR VICE-MAYOR TO SIGN GRANT APPLICATION DOCUMENTS		
b.	RESOLUTION CC-2024-29: A RESOLUTION	CC-24-115	Terry Essary

	ADOPTING A REVISED RATE SCHEDULE FOR FIRE SERVICE FEES PURSUANT TO THE STILLWATER CITY CODE CHAPTER 20, FIRE PREVENTION AND PROTECTION, ARTICLE II, FIRE DEPARTMENT, SECTION 20-30, FIRE SERVICE FEES.		

8. Ordinances

The City Council will hear a staff presentation, discuss, and take action including a vote or series of votes on each ordinance listed as presented or as amended or revised by the City Council.

First Read

a.	ORDINANCE NO. 3545: AN ORDINANCE AMENDING THE STILLWATER CITY CODE BY AMENDING CHAPTER 20, FIRE PREVENTION AND PROTECTION, ARTICLE II, FIRE DEPARTMENT, BY AMENDING SECTION 20-30, FIRE SERVICE FEES BY DESIGNATING HOW FUNDS COLLECTED ARE TO BE USED AND BY INCREASING THE RURAL FIRE SERVICES CONTRACT ANNUAL FEE; REPEALING ALL ORDINANCES TO THE CONTRARY; AND PROVIDING FOR SEVERABILITY.

9. Reports from Officers and Boards

Announcements and remarks of general interest may be made by Councilors, City Manager or City Attorney. Items of City business that may require discussion or action including a vote or series of votes are listed below.

a.	Miscellaneous items from the City Attorney
b.	Miscellaneous items from the City Manager
c.	Miscellaneous items from the City Council
i.	The City Council would like to inform residents that the Public Hearings for the Data Center Project Plan, originally scheduled for September 23, 2024, and October 7, 2024, have been removed from the agendas. Due to an error in publishing the project plan area map in the public notice, new notices will be published for two upcoming public hearings, now scheduled for October 7, 2024, and November 4, 2024. We appreciate your understanding and welcome your continued participation in these proceedings. The Data Center Project Plan is available at www.stillwaterok.gov/datacenterprojectplan .

10. Questions and Inquiries

11. Adjourn

On September 19, 2024 at 4:30 p.m., a true and correct copy of this agenda was posted on the kiosk outside City Hall, 723 S. Lewis Street, Stillwater, OK.

The City of Stillwater encourages participation from all citizens. If participation at any public meeting is not possible due to a disability, please notify the City Manager's office at least 48 hours prior to the meeting by calling 405.742.8243.

- Meetings are televised on AT&T U-verse channel 99 and Optimum channel 14.
- Find meeting agendas and minutes online at [Agendas and Minutes](#)
- Official minutes are archived in the City Clerk's office.

IN ACCORDANCE WITH THE OKLAHOMA OPEN MEETING LAW
THE AGENDA WAS POSTED SEPTEMBER 6, 2024 AT 9:00 A.M.
AT THE MUNICIPAL BUILDING, 723 SOUTH LEWIS, STILLWATER, OKLAHOMA

MINUTES
STILLWATER CITY COUNCIL
REGULAR MEETING
COUNCIL HEARING ROOM
723 S. LEWIS
SEPTEMBER 9, 2024

PRESENT: MAYOR WILLIAM H. JOYCE, VICE MAYOR AMY DZIALOWSKI,
COUNCILORS CHRISTIE HAWKINS, KEVIN CLARK AND TIM HARDIN
ABSENT: NONE

1. CALL MEETING TO ORDER

Mayor Joyce called the meeting to order at 5:30 p.m.

2. PLEDGE OF ALLEGIANCE

The Stillwater City Council led the audience in the Pledge of Allegiance.

3. CONSENT DOCKET

- a. Approve August 19, 2024 regular meeting minutes and August 20, 2024 and August 26, 2024 special meeting minutes
- b. Accept the dedication of the electric easement at 513 West 7th Avenue
- c. Approve contract between the City of Stillwater and OKC L Dev., LLC for street improvements located on South Western Road between West 26th Avenue and West 32nd Avenue and Addendum thereto and authorize the City Manager to execute
- d. Appropriate funds from the Galie May Koch Donation Fund for Police Department gym equipment maintenance.

MOTION BY COUNCILOR HAWKINS, SECOND BY COUNCILOR CLARK TO APPROVE THE CONSENT DOCKET AS PRESENTED.

ROLL CALL VOTE: JOYCE-YEA, DZIALOWSKI-YEA, HAWKINS-YEA, CLARK-YEA, HARDIN-YEA. NAY-NONE. MOTION CARRIED WITH FIVE YEA VOTES.

4. PUBLIC COMMENT ON AGENDA ITEMS NOT SCHEDULED FOR PUBLIC HEARING

There were no requests to speak on agenda items not scheduled for public hearing.

5. ITEMS REMOVED FROM CONSENT DOCKET

None.

6. PUBLIC HEARINGS

- a. Receive public comment regarding a request from Series 7 of Gofourth Murray Properties, LLC for a Map Amendment, to rezone the property addressed as 320 South Walnut Street from Small Lot Single Family Residential (RSS) to Two-Family and Multi-Family Residential (RTM).

Mayor Joyce stated that this map amendment has been withdrawn at the request of the applicant so no further action is needed on this item.

7. GENERAL ORDERS

- a. Discussion and possible action of Washington School Advisory Committee's recommended workplan for 2024

Assistant City Manager and Human Resources Director Christy Driskel introduced the Chair of the Washington School Advisory Committee Karen Washington. She is accompanied by Washington School Heritage Foundation Member Jim Beckstrom.

Ms. Washington stated she would like to express her thanks to the City for getting the Washington School back in the hands of the City and for creating the Washington School Advisory Committee to help keep the legacy alive. She reported that they have established a Washington School Project Team to look for different ways of fundraising and the team leader for that group is Jim Beckstrom. Ms. Washington stated that Mr. Beckstrom will present the plan and the team is asking for support of the plan. She stated that she understands that fundraising is difficult these days, but a plan is still needed to move forward. She requested support from the City in the form of in-kind help such as roll-offs and volunteers. Ms. Washington asked residents to put November 16 on their calendars as a workday at the Washington School.

Mr. Beckstrom presented the history of the school that was built in 1938. He highlighted the Washington School Heritage Project work that was underway. He explained key findings and general recommendations from the preliminary assessment report that was done by Tweny20 Management. Mr. Beckstrom reported that the ancillary buildings need to be cleared out leaving the original structure. He stated there was a cleanup day in 2023 and another cleanup day scheduled for November 16, 2024. This fall he would like to take trees and breezeways down and have an asbestos inspection to make sure the facility is safe to work in. If funding can get established, the team would like to get the auditorium and breezeways cleared away to reveal the original front of the school building. Fiscal Year 25-26, pending funding, the team would like to get the wings cleared out. Mr. Beckstrom stated that the team would like to hear from Council if they think this is a reasonable path forward. He stated they understand that funding is an issue and that nothing will happen without the funding but having a plan is step #1.

Mayor Joyce stated with volunteer work there will probably be a liability form that will need to be completed by each volunteer. City Attorney Kimberly Carnley stated that after the asbestos study is completed and a City sponsored work day is scheduled, it would require a release to be signed by the participants. Mayor Joyce thanked the Committee, and everyone involved with this project.

Vice Mayor Dzialowski stated that there are buckets of funding available for environmental work, asbestos, designing and much more. She encouraged the committee to research all avenues to pursue funding for projects. She also suggested getting a lead-based paint assessment.

MOTION BY COUNCILOR CLARK, SECOND BY COUNCILOR HARDIN TO APPROVE THE PROPOSED WORK PLAN AS IT RELATES TO THE WORK PROCESS ON THE FACILITY VIA ACCESS AGREEMENT AND FUNDED BY THE WASHINGTON SCHOOL HERITAGE FOUNDATION, DIRECT STAFF TO CONTINUE TO INCLUDE THE WASHINGTON SCHOOL IN CONVERSATIONS OF FUNDING NEEDS FOR PUBLIC SPACES AND AMENITIES AND DIRECT STAFF TO CONTINUE WORK ON THE COORDINATION OF A WORKDAY SCHEDULED FOR NOVEMBER 16 FOR THE EXTERIOR AND GROUNDS OF THE FACILITY AND TO PROVIDE SUPPORT AND ROLL-OFF CONTAINERS FOR THE VOLUNTEER WORKDAY.

ROLL CALL VOTE: JOYCE-YEA, DZIALOWSKI-YEA, HAWKINS-YEA, CLARK-YEA, HARDIN-YEA.

NAY-NONE. MOTION CARRIED WITH FIVE YEA VOTES.

8. RESOLUTIONS

- a. Resolution No. CC-2024-27: A resolution of the Stillwater City Council approving the submission of an application for Fiscal Year 2024 Airport Improvement Program (AIP) Discretionary Funds administered by the Federal Aviation Administration (FAA) for airport infrastructure improvements at Stillwater Regional Airport; and approving the associated budget amendments for the required sponsor match

City Attorney Kimberly Carnley reported that this is a resolution authorizing the airport to apply for AIP Discretionary Grant Funds for Phase #2 of the terminal project. Phase #2 includes improvement of Airport Industrial Access Road and the round-a-bout development. The anticipated cost share is FAA AIP Discretionary Grant Funds is \$3 million and the City of Stillwater 10% sponsor match would be \$330,334. Ms. Carnley stated that the approval of this resolution authorizes the submission of the grant application and approves the budget amendment authorizing the sponsor match and authorizes the Mayor or Vice Mayor to sign any related documents.

Assistant City Manager and Finance Director Christy Cluck and Airport Director Kellie Reed answered Council's questions.

MOTION BY COUNCILOR HAWKINS, SECOND BY VICE MAYOR DZIALOWSKI TO ADOPT RESOLUTION NO. CC-2024-27 AS PRESENTED.

ROLL CALL VOTE: JOYCE-YEA, DZIALOWSKI-YEA, HAWKINS-YEA, CLARK-YEA, HARDIN-YEA. NAY-NONE. MOTION CARRIED WITH FIVE YEA VOTES.

9. APPOINTMENTS

- a. Audit Committee

MOTION BY MAYOR JOYCE, SECOND BY VICE MAYOR DZIALOWSKI TO APPOINT LES AUSTIN TO THE AUDIT COMMITTEE TO A TERM ENDING IN 2027.

ROLL CALL VOTE: JOYCE-YEA, DZIALOWSKI-YEA, HAWKINS-YEA, CLARK-YEA, HARDIN-YEA. NAY-NONE. MOTION CARRIED WITH FIVE YEA VOTES.

10. QUESTIONS & INQUIRIES

None.

11. REPORTS FROM OFFICERS & BOARDS

- a. Miscellaneous items from the City Attorney:
 - i. Request for Executive Session pursuant to 25 O.S. Section §307 (B)(1) of the Oklahoma Open Meeting Act for the purpose of confidential communication regarding the employment, appointment, promotion, demotion, disciplining or resignation of Stillwater City Attorney Kimberly Carnley.
 - ii. Request for Executive Session pursuant to 25 O.S. Section §307 (B)(1) of the Oklahoma Open Meeting Act for the purpose of confidential communication regarding the employment, appointment, promotion, demotion, disciplining or resignation of City Manager Kimberly Meek.
- b. Miscellaneous items from the City Manager:

- City Manager Kimberly Meek invited everyone to attend the MESO Lineworkers Rodeo on Thursday, September 19, beginning at 8 a.m. at Boomer Lake Park. The annual event is an electrifying competition to showcase the electric profession and our talented individuals from different cities. Thank you to our electric professionals for all that they do to keep the lights on.
- c. Miscellaneous items from the City Council:
- i. The City Council would like to inform citizens that the 2nd Public Hearing for the Project Plan, originally scheduled for September 9, 2024, has been removed from the agenda. Due to updates in the legal descriptions for the incentive districts, a new notice has been published for two upcoming public hearings, now scheduled for September 23, 2024, and October 7, 2024. We appreciate your understanding and welcome your continued participation in these proceedings.
 - Councilor Hardin announced that OSU Athletics, City of Stillwater, and Visit Stillwater have teamed up to offer free OSU home football gameday parking, shuttle service, and more. Park downtown and utilize the Park and Ride Shuttle Service. It begins 3 hours before the game and runs every 30 minutes. The pick-up and drop-off location is at 7th Avenue and Lewis Street.
 - Councilor Clark reminded residents that the Annual Friends fall book sale at Stillwater Public Library will be Thursday, September 19th through Sunday, the 22nd. Thursday is the preview sale which is \$10 at the door, and Sunday is the \$1 per bag sale. There are thousands of books priced \$0.25 to \$1. Funds raised from the book sales pay for summer reading programs, community reading initiatives, new library materials and much more. The library is located at 1107 S. Duck St.
 - Councilor Hawkins announced that the City is accepting applications for citizen representatives to serve on various committees including the Stillwater Re-Investment Plan Implementation Policy Committee, also known as the Downtown TIF #3. Committees are essential for increased development and infrastructure projects within our community. If anyone would like to get involved in their local government and help make Stillwater even greater, please consider serving on one or more of these committees.
 - Vice Mayor Dzialowski invited residents to join the City on Monday, September 16, beginning at 5:30 p.m., at the Community Center for the next community meeting where staff will discuss land use, transportation, and housing. Also, anyone that has not yet taken the brief survey, please do so online at stillwaterok.gov/envision or in person at the Stillwater Public Library. Citizen feedback is needed for Stillwater's new Comprehensive Plan which serves as a vision for the next 10 to 20 years of our city's growth.
 - Mayor Joyce announced that September is Firefighter Appreciation Month. We greatly appreciate our firefighters and staff with the Stillwater Fire Department for their continued efforts to keep our community safe. The sacrifices they make, as well as their families, is from their sincere commitment to serve. They are typically the first on scene with emergency calls in addition to fire related emergencies and are always ready to assist other cities, when possible.
 - i. Discussion about scheduling items for future meetings.

12. EXECUTIVE SESSION

- a. Confidential communication regarding the employment, appointment, promotion, demotion, disciplining, or resignation of City Attorney Kimberly Carnley.
- b. Confidential communication regarding the employment, appointment, promotion, demotion, disciplining or resignation of City Manager Kimberly Meek.

MOTION BY MAYOR JOYCE, SECOND BY COUNCILOR CLARK TO RECESS THE STILLWATER CITY COUNCIL MEETING AT 6:05 P.M.

ROLL CALL VOTE: JOYCE-YEA, DZIALOWSKI-YEA, HAWKINS-YEA, CLARK-YEA, HARDIN-YEA. NAY-NONE. MOTION CARRIED WITH FIVE YEA VOTES.

Stillwater City Council meeting recessed at 6:05 p.m. to convene the Stillwater Economic Development Authority meeting.

Stillwater City Council reconvened at 6:11 p.m.

MOTION BY HARDIN, SECOND BY CLARK TO ENTER INTO EXECUTIVE SESSION AT 6:11 P.M.

ROLL CALL VOTE: JOYCE-YEA, DZIALOWSKI-YEA, HAWKINS-YEA, CLARK-YEA, HARDIN-YEA. NAY-NONE. MOTION CARRIED WITH FIVE YEA VOTES.

13. RETURN FROM EXECUTIVE SESSION

MOTION BY COUNCILOR HARDIN, SECOND BY CLARK TO RECONVENE THE REGULAR STILLWATER CITY COUNCIL MEETING AT 7:03 P.M.

ROLL CALL VOTE: JOYCE-YEA, DZIALOWSKI-YEA, HAWKINS-YEA, CLARK-YEA, HARDIN-YEA. NAY-NONE. MOTION CARRIED WITH FIVE YEA VOTES.

- a. Consideration, discussion, and possible action with regard to the employment, appointment, promotion, demotion, disciplining or resignation of City Attorney Kimberly Carnley.

No action was taken on this item.

- b. Consideration, discussion, and possible action with regard to the employment, appointment, promotion, demotion, disciplining or resignation of City Manager Kimberly Meek.

No action was taken on this item.

14. ADJOURN

MOTION BY COUNCILOR CLARK, SECOND BY COUNCILOR HARDIN TO ADJOURN THE SEPTEMBER 9, 2024 REGULAR MEETING OF THE STILLWATER CITY COUNCIL.

ROLL CALL VOTE: JOYCE-YEA, DZIALOWSKI-YEA, HAWKINS-YEA, CLARK-YEA, HARDIN-YEA. NAY-NONE. MOTION CARRIED WITH FIVE YEA VOTES.

The September 9, 2024 regular meeting of the Stillwater City Council adjourned at 7:03 p.m.

WILLIAM H. JOYCE, MAYOR
STILLWATER CITY COUNCIL

TERESA KADAVY
CITY CLERK

**IN ACCORDANCE WITH THE OKLAHOMA OPEN MEETING LAW,
THE AGENDA WAS POSTED SEPTEMBER 6, 2024 AT 9:00 A.M. AT
THE MUNICIPAL BUILDING, 723 SOUTH LEWIS, STILLWATER, OKLAHOMA**

**MINUTES
STILLWATER CITY COUNCIL
EXECUTIVE SESSION
723 S. LEWIS
STILLWATER, OK 74074
SEPTEMBER 9, 2024
6:11 P.M.**

**PRESENT: MAYOR WILLIAM H. JOYCE, VICE MAYOR AMY DZIALOWSKI,
COUNCILORS CHRISTIE HAWKINS, KEVIN CLARK AND TIM HARDIN**
ABSENT: NONE

- a. Confidential communication regarding the employment, appointment, promotion, demotion, disciplining, or resignation of City Attorney Kimberly Carnley.

Discussion was held regarding the employment, appointment, promotion, demotion, disciplining, or resignation of City Attorney Kimberly Carnley, pursuant to 25 O.S. §307 (B)(1).

- b. Confidential communication regarding the employment, appointment, promotion, demotion, disciplining, or resignation of City Manager Kimberly Meek.

Discussion was held regarding the employment, appointment, promotion, demotion, disciplining, or resignation of City Manager Kimberly Meek pursuant to 25 O.S. §307 (B)(1).

The Executive Session concluded at 7:03 p.m.

WILLIAM H. JOYCE, MAYOR

TERESA KADAVY, CITY CLERK

REPORT TO: CITY COUNCIL

MEETING DATE: SEPTEMBER 23, 2024

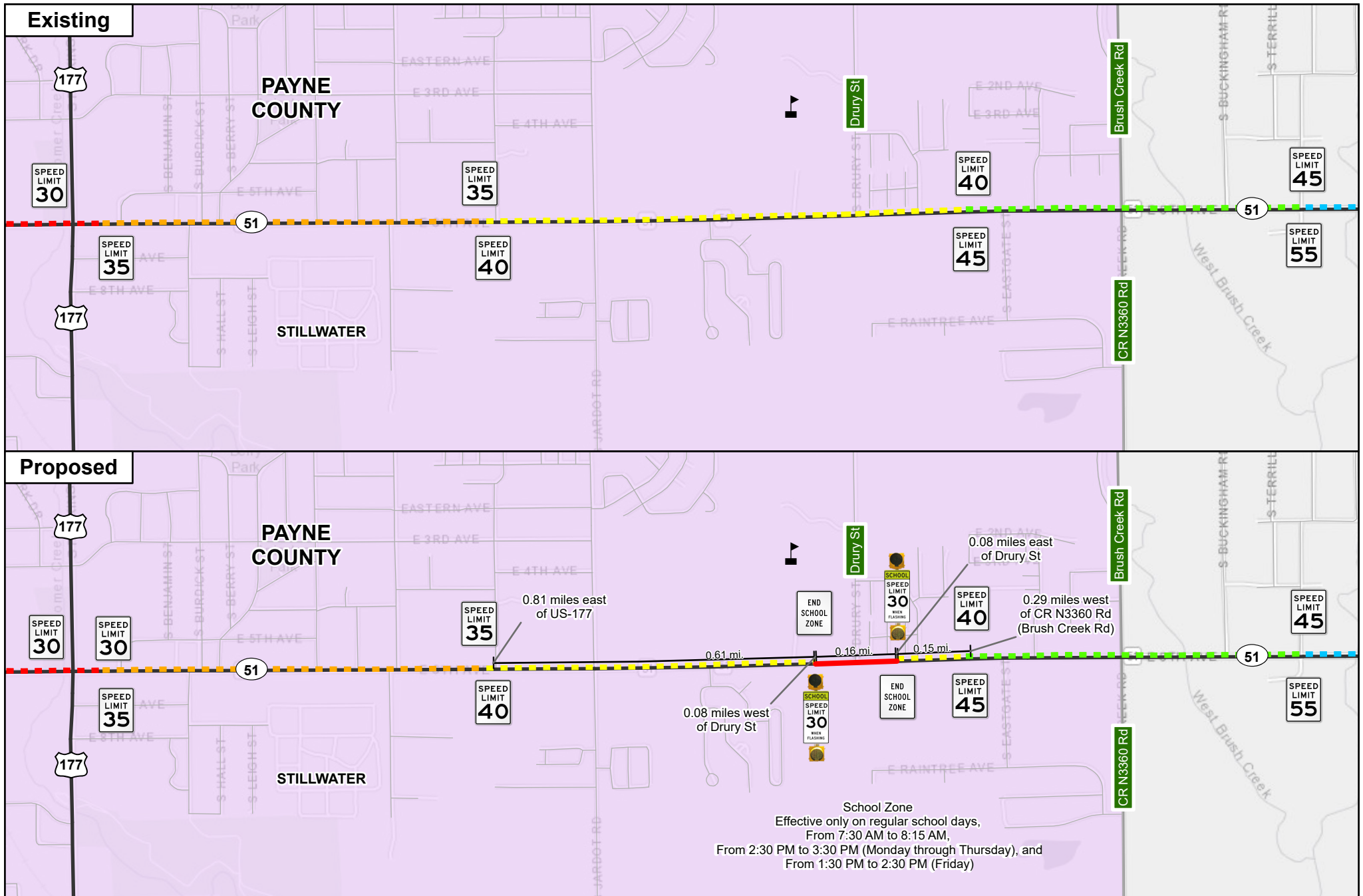


Agenda Item:	3.b. CC-24-111
Previous/Related Action:	CC-24-68, May 2, 2024. Approve agreement with Oklahoma Department of Transportation (ODOT) for installation of advance school warning signs and flashing beacons along SH-51.
Background/Issue:	• As a required practice, City and ODOT staff coordinate and agree in advance on any changes to state highways passing through City Limits (i.e. SH51, SH177) for topics such as signaling, posted speed limits, safety improvements, pavement management, reconstruction, etc. • City Council previously approved an agreement with ODOT to install advance school warning signs and flashing beacons in the vicinity of Highland Park Elementary along SH51 / 6th Avenue (Project). • To facilitate implementation of the Project, ODOT has requested concurrence from the City to modify the current speed zone in the vicinity of the Project from 40 MPH to a reduced speed of 30 MPH on regular school days during morning and afternoon rush hours.
Proposal/Solution:	Staff has reviewed ODOT's proposed school speed zone modifications and has prepared a Concurrence Letter approving the proposed changes. The Concurrence Letter indicates that the City will notify ODOT in advance of any future speed zone modifications at this location. A map is attached showing the proposed modifications to the speed zone.
Financial Source/Impact:	No financial impact will be incurred.
Related Strategic Priority:	#3 SAFE COMMUNITY
Recommended Action/Motion:	Approve and execute Concurrence Letter for school speed zone modifications in the vicinity of Highland Park Elementary on 6th Avenue (SH51).
Prepared By:	Travis Small, Division Manager Transportation & Drainage
Reviewed By:	Candy Staring

	Brady Moore
	Teresa Kadavy
Submitted By:	Kimberly Meek, City Manager

Attachments

1. 2024 Div 4, SH-51, Stillwater, Payne Co MAP
2. Highland Park Elementary School Zone Modification Concurrence Letter - Modified



01-14-000061-2024065



SH-51 Stillwater Speed Zone Revision

- Legend**
- Existing 30 mph
 - Existing 35 mph
 - Existing 40 mph
 - Existing 45 mph
 - Existing 55 mph
 - Proposed 30 mph
 - School
 - Highways
 - Non-Highways
 - Cities



Concurrence Letter to the Oklahoma Department of Transportation for Speed Limit Modification

September 23, 2024

To: State Traffic Engineer, Oklahoma Department of Transportation

From: City of Stillwater Mayor William H. Joyce

The City of Stillwater ("City") has received the school zone speed limit modification proposal from the Oklahoma Department of Transportation (ODOT) to 1) install an WB Flashing Beacon with a SCHOOL SPEED LIMIT 30 WHEN FLASHING sign and an EB END SCHOOL ZONE sign at approximately 0.08 miles east of Drury St and 2) install an EB Flashing Beacon with a SCHOOL SPEED LIMIT 30 WHEN FLASHING sign and an WB END SCHOOL ZONE sign at approximately 0.08 miles west of Drury St.

The Stillwater City Council has approved the submission of this letter to you in which we concur with the following proposed school zone speed limit modifications and corresponding locations for SH-51, within the City limits:

30 MPH School Zone*

Zoning & Posting Change – Presently Zoned & Currently Posted 40 MPH

Control Section: 51-60-20

Start: MM 1.42 – 0.08 miles west of Drury St

End: MM 1.58 – 0.08 miles east of Drury St

Length: 0.16 Miles

TOTAL APPROXIMATE LENGTH ZONED: 0.16 MILES

*30 MPH School Zone will only be effective on regular school days at the following days/times:

Monday through Friday from 7:30am to 8:15am

Monday through Thursday from 2:30pm to 3:30pm

Friday from 1:30pm to 2:30pm

AS SHOWN ON THE ATTACHED MAP

We understand that, if, at a future time, the City feels the subject speed limits need further modification, such modification will require another approved Council action, and the City of Stillwater will notify ODOT to investigate, concur, and start the process.

We are in agreement with the above proposed school zone speed limit modifications and corresponding locations, and we will make a request to the Oklahoma Transportation Council for approval. Once approved, ODOT will install the appropriate signs.

Respectfully,

William H. Joyce
Mayor

REPORT TO: CITY COUNCIL

MEETING DATE: SEPTEMBER 23, 2024



Agenda Item:	3.c. CC-24-112
Previous/Related Action:	The Emergency Management Department, on behalf of the City of Stillwater, is updating the current hazard mitigation plan (HMP). This plan, which expires every five years, is essential for applying for state and most federal grants. It is a partnership between the City of Stillwater and Stillwater Public Schools, aimed at mitigating the impact of natural disasters and climate change on our community. The City has selected Meshek & Associates, LLC, through an RFQ process, as the qualified professional for this project. Meshek & Associates, LLC, will apply for a FEMA HMP grant through the State of Oklahoma Emergency Management Department and FEMA, on our behalf. This grant will cover 75% of our expenses. Additionally, Meshek & Associates, LLC, will administer the grant, handle reporting, and submit for reimbursement on the City's behalf. The project cost is \$182,346.00, with a grant reimbursement of 75%. To date, this plan has enabled us to access approximately \$47M in grant funding.
Background/Issue:	The City's hazard mitigation plan expires every five years. Our current plan expires in September 2025. This plan is required to apply for most state and federal grants. The City of Stillwater is eligible for the FEMA HMP grant.
Proposal/Solution:	Allow the City to contract with Meshek & Associates, LLC. Allow Meshek & Associates, LLC, to apply for the FEMA HMP grant, and approve the budget amendment of \$182,346.00 to emergency management.
Financial Source/Impact:	The City of Stillwater will pay the initial cost of \$182,345.98. Simultaneously, Meshek & Associates, LLC., on behalf of the City, will apply for a FEMA Hazard Mitigation Plan (HMP) grant and ensure the plan is approved to qualify for reimbursement. Upon approval, FEMA will reimburse the City of Stillwater, up to 75% of the project cost, amounting to \$136,759.49. The total out of pocket for this project will be: \$45,586.50, after grant reimbursement.
Related Strategic Priority:	#1 EFFECTIVE SERVICES & ACCOUNTABLE GOVERNMENT #3 SAFE COMMUNITY #6 ENGAGED & INVESTED RESIDENTS
Recommended Action/Motion:	Approve Professional Services Agreement with Meshek &

Associates, LLC for engineering, planning, grant management and GIS services required to review and update the City of Stillwater's Hazard Mitigation Plan. Action to apply for grant funds to support this project will be considered in Resolution No. CC-2024-28 on the agenda.

Prepared By:	Rob Hill, Emerg.Mgmt. Dir.
Reviewed By:	Rob Hill Teresa Kadavy
Submitted By:	Kimberly Meek, City Manager

Attachments

1. 23STW01_HMP_Meshek_2025_Agreement
2. RFQ_5_2024_Meshek_SOQ_2024_Stillwater_HMP_Update

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the Controlling Laws and Regulations.

Stillwater Hazard Mitigation Plan – Review, Update & Re-write 2025

Owner: City of Stillwater, Oklahoma, a Municipal Corporation

Engineer: Meshek & Associates, LLC

Project #:

AGREEMENT BETWEEN OWNER AND ENGINEER FOR PROFESSIONAL SERVICES

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE



and
Issued and Published Jointly

by



This Agreement has been prepared for use with the Standard General Conditions of the Construction Contract (EJCDC C-700, 2007 Edition). Their provisions are interrelated, and a change in one may necessitate a change in the other. For guidance on the completion and use of this Agreement, see EJCDC User's Guide to the Owner-Engineer Agreement, EJCDC E-001, 2009 Edition.

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(703) 684-2882
www.nspe.org

American Council of Engineering Companies
1015 15th Street N.W., Washington, DC 20005
(202) 347-7474
www.acec.org

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
(800) 548-2723
www.asce.org

Associated General Contractors of America
2300 Wilson Boulevard, Suite 400, Arlington, VA 22201-3308
(703) 548-3118
www.agc.org

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ENGINEERS JOINT CONTRACT
DOCUMENTS COMMITTEE

AGREEMENT BETWEEN OWNER AND ENGINEER FOR PROFESSIONAL SERVICES

THIS IS AN AGREEMENT effective as of _____, 2024 (“Effective Date”) between

City of Stillwater, Oklahoma, a Municipal Corporation (“Owner”) and

Meshek & Associates, LLC (“Engineer”).

Owner's Project, of which Engineer's services under this Agreement are a part, is generally identified as follows:

Stillwater Hazard Mitigation Plan – Grant Application, Grant Management, Review,
Update & Rewrite 2025 Hazard Mitigation Plan

Engineer's services under this Agreement are generally identified as follows:

Engineering, planning, grant management and GIS services required to update the City's Multi-Hazard Mitigation Plan in accordance with the requirements of the Stafford Act and Title 44 Code of Federal Regulations (CFR) §201.6..

Owner and Engineer further agree as follows:

ARTICLE 1 – SERVICES OF ENGINEER

1.01 Scope

- A. Engineer shall provide, or cause to be provided, the services set forth herein and in Exhibit A.

ARTICLE 2 – OWNER'S RESPONSIBILITIES

2.01 General

- A. Owner shall have the responsibilities set forth herein and in Exhibit B.

- B. Owner shall pay Engineer as set forth in Exhibit C.
- C. Owner shall be responsible for, and Engineer may rely upon, the accuracy and completeness of all requirements, programs, instructions, reports, data, and other information furnished by Owner to Engineer pursuant to this Agreement. Engineer may use such requirements, programs, instructions, reports, data, and information in performing or furnishing services under this Agreement.

ARTICLE 3 – SCHEDULE FOR RENDERING SERVICES

3.01 *Commencement*

- A. Engineer is authorized to begin rendering services as of the written Notice to Proceed as provided by the Owner.

3.02 *Time for Completion*

- A. Engineer shall complete its obligations within a reasonable time. Specific periods of time for rendering services are set forth or specific dates by which services are to be completed are provided in Exhibit A, and are hereby agreed to be reasonable.
- B. If, through no fault of Engineer, such periods of time or dates are changed, or the orderly and continuous progress of Engineer's services is impaired, or Engineer's services are delayed or suspended, then the time for completion of Engineer's services, and the rates and amounts of Engineer's compensation, may be adjusted equitably based on the schedules provided in Exhibit C.
- C. If Owner authorizes changes in the scope, extent, or character of the Project, then the time for completion of Engineer's services, and the rates and amounts of Engineer's compensation, may be adjusted equitably based on the schedules provided in Exhibit C.
- D. Owner shall make decisions and carry out its other responsibilities in a timely manner so as not to delay the Engineer's performance of its services.
- E. If Engineer fails, through its own fault, to complete the performance of any task required in this Agreement within the time set forth, as duly adjusted, then Owner shall be entitled, as its sole remedy, to the recovery of direct damages, if any, resulting from such failure.

ARTICLE 4 – INVOICES AND PAYMENTS

4.01 *Invoices*

- A. *Preparation and Submittal of Invoices:* Engineer shall prepare invoices in accordance with its standard invoicing practices and the terms of Exhibit C. Engineer may submit its invoices to Owner on a monthly basis. Invoices are due and payable within 30 days of receipt.

4.02 *Payments*

- A. *Application to Interest and Principal:* Payment will be credited first to any interest owed to Engineer and then to principal.

- B. *Failure to Pay:* If Owner fails to make any payment due Engineer for services and expenses within 30 days after receipt of Engineer's invoice, then:
 - 1. Engineer may, after giving seven days written notice to Owner, suspend services under this Agreement until Owner has paid in full all amounts due for services, expenses, and other related charges. Owner waives any and all claims against Engineer for any such suspension.
- C. *Disputed Invoices:* If Owner contests an invoice, Owner shall promptly advise Engineer of the specific basis for doing so, may withhold only that portion so contested, and must pay the undisputed portion.

ARTICLE 5 – OPINIONS OF COST

5.01 *Opinions of Probable Cost*

- A. Engineer's opinions of probable Cost are to be made on the basis of Engineer's experience and qualifications and represent Engineer's best judgment as an experienced and qualified professional generally familiar with the industry. However, because Engineer has no control over the cost of labor, materials, equipment, or services furnished by others, or over contractors' methods of determining prices, or over competitive bidding or market conditions, Engineer cannot and does not guarantee that proposals, bids, or actual Cost will not vary from opinions of probable Cost prepared by Engineer. If Owner requires greater assurance as to probable Cost, Owner must employ an independent cost estimator as provided in Exhibit B.

5.02 *Designing to Construction Cost Limit -Not Included*

5.03 *Opinions of Total Project Costs*

- A. The services, if any, of Engineer with respect to Total Project Costs shall be limited to assisting the Owner in collating the various cost categories which comprise Total Project Costs. Engineer assumes no responsibility for the accuracy of any opinions of Total Project Costs.

ARTICLE 6 – GENERAL CONSIDERATIONS

6.01 *Standards of Performance*

- A. *Standard of Care:* The standard of care for all professional engineering and related services performed or furnished by Engineer under this Agreement will be the care and skill ordinarily used by members of the subject profession practicing under similar circumstances at the same time and in the same locality. Engineer makes no warranties, express or implied, under this Agreement or otherwise, in connection with Engineer's services.
- B. *Technical Accuracy:* Owner shall not be responsible for discovering deficiencies in the technical accuracy of Engineer's services. Engineer shall correct deficiencies in technical accuracy without additional compensation, unless such corrective action is directly attributable to deficiencies in Owner-furnished information.

- C. *Consultants:* Engineer may employ such Consultants as Engineer deems necessary to assist in the performance or furnishing of the services, subject to reasonable, timely, and substantive objections by Owner.
- D. *Reliance on Others:* Subject to the standard of care set forth in Paragraph 6.01.A, Engineer and its Consultants may use or rely upon design elements and information ordinarily or customarily furnished by others, including, but not limited to, specialty contractors, manufacturers, suppliers, and the publishers of technical standards.
- E. *Compliance with Laws and Regulations, and Policies and Procedures:*
1. Engineer and Owner shall comply with applicable Laws and regulations.
 2. Prior to the Effective Date, Owner provided to Engineer in writing any and all policies and procedures of Owner applicable to Engineer's performance of services under this Agreement provided to Engineer in writing. Engineer shall comply with such policies and procedures, subject to the standard of care set forth in Paragraph 6.01.A, and to the extent compliance is not inconsistent with professional practice requirements.
 3. This Agreement is based on Laws and Regulations and Owner-provided written policies and procedures as of the Effective Date. Changes after the Effective Date to these Laws and Regulations, or to Owner-provided written policies and procedures, may be the basis for modifications to Owner's responsibilities or to Engineer's scope of services, times of performance, or compensation.
- F. Engineer shall not be required to sign any documents, no matter by whom requested, that would result in the Engineer having to certify, guarantee, or warrant the existence of conditions whose existence the Engineer cannot ascertain. Owner agrees not to make resolution of any dispute with the Engineer or payment of any amount due to the Engineer in any way contingent upon the Engineer signing any such documents.
- G. The general conditions for any construction contract documents prepared hereunder are to be the "Standard General Conditions of the Construction Contract" as prepared by the Engineers Joint Contract Documents Committee (EJCDC C-700, 2007 Edition) unless both parties mutually agree to use other general conditions by specific reference in Exhibit J (*Not included*).
- H. Engineer shall not at any time supervise, direct, control, or have authority over any contractor work, nor shall Engineer have authority over or be responsible for the means, methods, techniques, sequences, or procedures selected or used by any contractor, or the safety precautions and programs incident thereto, for security or safety at the Site, nor for any failure of a contractor to comply with Laws and Regulations applicable to such contractor's furnishing and performing of its work.
- I. Engineer neither guarantees the performance of any Contractor nor assumes responsibility for any Contractor's failure to furnish and perform the Work in accordance with the Contract Documents.
- J. Engineer shall not provide or have any responsibility for surety bonding or insurance-related advice, recommendations, counseling, or research, or enforcement of construction

insurance or surety bonding requirements.

- K. Engineer shall not be responsible for the acts or omissions of any Contractor, Subcontractor, or Supplier, or of any of their agents or employees or of any other persons (except Engineer's own agents, employees, and Consultants) at the Site or otherwise furnishing or performing any Work; or for any decision made regarding the Contract Documents, or any application, interpretation, or clarification, of the Contract Documents, other than those made by Engineer.
- L. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's and Owner's safety programs of which Engineer has been informed in writing.

6.02 *Design Without Construction Phase Services-Not Included*

- A. Engineer shall be responsible only for those Construction Phase services expressly required of Engineer in Exhibit A, Paragraph A1.05. With the exception of such expressly required services, Engineer shall have no design, Shop Drawing review, or other obligations during construction and Owner assumes all responsibility for the application and interpretation of the Contract Documents, review and response to Contractor claims, contract administration, processing Change Orders, revisions to the Contract Documents during construction, construction surety bonding and insurance requirements, construction observation and review, review of payment applications, and all other necessary Construction Phase engineering and professional services. Owner waives all claims against the Engineer that may be connected in any way to Construction Phase engineering or professional services except for those services that are expressly required of Engineer in Exhibit A, Paragraph A1.05.

6.03 *Use of Documents*

- A. All tracings, plans, computations, specifications, data, documents, and maps prepared or obtained under the terms of the contract shall be delivered to and become property of the Owner. All basic survey notes and sketched, charts, computations, and other data prepared or obtained under this contract shall be made available upon request to the Owner without restriction or limitation on their use. When a contract is for preliminary plans only, no commitment is made or implied that would constitute a limitation on the subsequent use of the plans or the ideas incorporated therein for preparation of construction plans.
- B. Either party to this Agreement may rely that data or information set forth on paper (also known as hard copies) that the party receives from the other party by mail, hand delivery, or facsimile, are the items that the other party intended to send. Files in electronic media format of text, data, graphics, or other types that are furnished by one party to the other are furnished only for convenience, not reliance by the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern. If the parties agree to other electronic transmittal procedures, such are set forth in Exhibit J.
- C. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party

shall be deemed to have accepted the data thus transferred. Any transmittal errors detected within the 60-day acceptance period will be corrected by the party delivering the electronic files.

- D. When transferring documents in electronic media format, the transferring party makes no representations as to long-term compatibility, usability, or readability of such documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the documents' creator.
- E. Owner may make and retain copies of Documents for information and reference in connection with use on the Project by Owner. Owner may use the Documents on the Project, extensions of the Project, and for related uses of the Owner, subject to receipt by Engineer of full payment for all services relating to preparation of the Documents and subject to the following limitations: (1) Owner acknowledges that such Documents are not intended or represented to be suitable for use on the Project unless completed by Engineer, or for use or reuse by Owner or others on extensions of the Project, on any other project, or for any other use or purpose, without written verification or adaptation by Engineer; (2) any such use or reuse, or any modification of the Documents, without written verification, completion, or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Owner's sole risk and without liability or legal exposure to Engineer or to its officers, directors, members, partners, agents, employees, and Consultants;; and (3) such use shall not create any rights in third parties.
- F. If Engineer at Owner's request verifies the suitability of the Documents, completes them, or adapts them for extensions of the Project or for any other purpose, then Owner shall compensate Engineer at rates or in an amount to be agreed upon by Owner and Engineer.

6.04 *Insurance*

- A. Engineer shall procure and maintain insurance as set forth in Exhibit G, "Insurance." Engineer shall cause Owner to be listed as an additional insured on any applicable general liability insurance policy carried by Engineer.
- B. Owner shall require Contractor to purchase and maintain policies of insurance covering workers' compensation, general liability, property damage (other than to the Work itself), motor vehicle damage and injuries, and other insurance necessary to protect Owner's and Engineer's interests in the Project. Owner shall require Contractor to cause Engineer and its Consultants to be listed as additional insureds with respect to such liability and other insurance purchased and maintained by Contractor for the Project.
- C. Engineer shall deliver to the Owner certificates of insurance evidencing the coverages indicated in Exhibit G. Such certificates shall be furnished prior to commencement of Engineer's services and at renewals thereafter during the life of the Agreement.
- D. All policies of property insurance relating to the Project shall contain provisions to the effect that Engineer's and its Consultants' interests are covered and that in the event of payment of any loss or damage the insurers will have no rights of recovery against Engineer or its Consultants, or any insureds, additional insureds, or loss payees thereunder.
- E. All policies of insurance shall contain a provision or endorsement that the coverage afforded will not be canceled or reduced in limits by endorsement, and that renewal will not be refused, until at

least 30 days prior written notice has been given to Owner and Engineer and to each other additional insured (if any) to which a certificate of insurance has been issued.

- F. At any time, Owner may request that Engineer or its Consultants, at Owner's sole expense, provide additional insurance coverage, increased limits, or revised deductibles that are more protective than those specified in Exhibit G. If so requested by Owner, and if commercially available, Engineer shall obtain and shall require its Consultants to obtain such additional insurance coverage, different limits, or revised deductibles for such periods of time as requested by Owner, and Exhibit G will be supplemented to incorporate these requirements.

6.05 *Suspension and Termination*

A. *Suspension:*

1. By Owner: Owner may suspend the Project for up to 90 days upon seven days written notice to Engineer.
2. By Engineer: Engineer may, after giving seven days written notice to Owner, suspend services under this Agreement if Engineer's performance has been substantially delayed through no fault of Engineer.

B. *Termination:* The obligation to provide further services under this Agreement may be terminated:

1. For cause,
 - a. By either party upon 30 days written notice in the event of substantial failure by the other party to perform in accordance with the terms hereof through no fault of the terminating party.
 - b. By Engineer:
 - 1) upon seven days written notice if Owner demands that Engineer furnish or perform services contrary to Engineer's responsibilities as a licensed professional; or
 - 2) upon seven days written notice if the Engineer's services for the Project are delayed or suspended for more than 90 days for reasons beyond Engineer's control.
 - 3) Engineer shall have no liability to Owner on account of such termination.
 - c. Notwithstanding the foregoing, this Agreement will not terminate under Paragraph 6.05.B.1.a if the party receiving such notice begins, within seven days of receipt of such notice, to correct its substantial failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt thereof; provided, however, that if and to the extent such substantial failure cannot be reasonably cured within such 30 day period, and if such party has diligently attempted to cure the same and thereafter continues

diligently to cure the same, then the cure period provided for herein shall extend up to, but in no case more than, 60 days after the date of receipt of the notice.

2. For convenience,

a. By Owner effective upon Engineer's receipt of notice from Owner.

C. *Effective Date of Termination:* The terminating party under Paragraph 6.05.B may set the effective date of termination at a time up to 30 days later than otherwise provided to allow Engineer to demobilize personnel and equipment from the Site, to complete tasks whose value would otherwise be lost, to prepare notes as to the status of completed and uncompleted tasks, and to assemble Project materials in orderly files.

D. *Payments Upon Termination:*

1. In the event of any termination under Paragraph 6.05, Engineer will be entitled to invoice Owner and to receive full payment for all services performed or furnished in accordance with this Agreement and all Reimbursable Expenses incurred through the effective date of termination. Upon making such payment, Owner shall have the limited right to the use of Documents, at Owner's sole risk, subject to the provisions of Paragraph 6.03.E.

6.06 *Controlling Law*

A. This Agreement is to be governed by the law of the state or jurisdiction in which the Project is located, which is the State of Oklahoma for the purposes of this project.

6.07 *Successors, Assigns, and Beneficiaries*

A. Owner and Engineer are hereby bound and the successors, executors, administrators, and legal representatives of Owner and Engineer (and to the extent permitted by Paragraph 6.07.B the assigns of Owner and Engineer) are hereby bound to the other party to this Agreement and to the successors, executors, administrators and legal representatives (and said assigns) of such other party, in respect of all covenants, agreements, and obligations of this Agreement.

B. Neither Owner nor Engineer may assign, sublet, or transfer any rights under or interest (including, but without limitation, moneys that are due or may become due) in this Agreement without the written consent of the other, except to the extent that any assignment, subletting, or transfer is mandated or restricted by law. Unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under this Agreement.

C. Unless expressly provided otherwise in this Agreement:

1. Nothing in this Agreement shall be construed to create, impose, or give rise to any duty owed by Owner or Engineer to any Contractor, Subcontractor, Supplier, other individual or entity, or to any surety for or employee of any of them.

2. All duties and responsibilities undertaken pursuant to this Agreement will be for the sole and exclusive benefit of Owner and Engineer and not for the benefit of any other party.
3. Owner agrees that the substance of the provisions of this Paragraph 6.07.C shall appear in the Contract Documents.

6.08 *Dispute Resolution*

- A. Owner and Engineer agree to negotiate all disputes between them in good faith for a period of 30 days from the date of notice prior to invoking the procedures of Exhibit H (Not Included) or other provisions of this Agreement, or exercising their rights under law.
- B. If the parties fail to resolve a dispute through negotiation under Paragraph 6.08.A, then either or both may invoke the procedures of Exhibit H. If Exhibit H is not included, or if no dispute resolution method is specified in Exhibit H, then the parties may exercise their rights under law.

6.09 *Environmental Condition of Site*

- A. Owner has disclosed to Engineer in writing the existence of all known and suspected Asbestos, PCBs, Petroleum, Hazardous Waste, Radioactive Material, hazardous substances, and other Constituents of Concern located at or near the Site, including type, quantity, and location.
- B. Owner represents to Engineer that to the best of its knowledge no Constituents of Concern, other than those disclosed in writing to Engineer, exist at the Site.
- C. If Engineer encounters or learns of an undisclosed Constituent of Concern at the Site, then Engineer shall notify (1) Owner and (2) appropriate governmental officials if Engineer reasonably concludes that doing so is required by applicable Laws or Regulations.
- D. It is acknowledged by both parties that Engineer's scope of services does not include any services related to Constituents of Concern. If Engineer or any other party encounters an undisclosed Constituent of Concern, or if investigative or remedial action, or other professional services, are necessary with respect to disclosed or undisclosed Constituents of Concern, then Engineer may, at its option and without liability for consequential or any other damages, suspend performance of services on the portion of the Project affected thereby until Owner: (1) retains appropriate specialist consultants or contractors to identify and, as appropriate, abate, remediate, or remove the Constituents of Concern; and (2) warrants that the Site is in full compliance with applicable Laws and Regulations.
- E. If the presence at the Site of undisclosed Constituents of Concern adversely affects the performance of Engineer's services under this Agreement, then the Engineer shall have the option of (1) accepting an adjustment in its compensation or in the time of completion, or both; such adjustment shall be based on the schedules provided in Exhibit C, or (2) terminating this Agreement for cause on 30 days notice.
- F. Owner acknowledges that Engineer is performing professional services for Owner and that Engineer is not and shall not be required to become an "owner" "arranger," "operator," "generator," or "transporter" of hazardous substances, as defined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, which are or

may be encountered at or near the Site in connection with Engineer's activities under this Agreement.

6.10 *Indemnification*

- A. *Indemnification by Engineer:* To the fullest extent permitted by law, Engineer shall indemnify and hold harmless Owner, and Owner's officers, directors, members, partners, agents, consultants, and employees from reasonable claims, costs, losses, and damages arising out of or relating to the Project, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Engineer or Engineer's officers, directors, members, partners, agents, employees, or Consultants.

6.11 *Miscellaneous Provisions*

- A. *Notices:* Any notice required under this Agreement will be in writing, addressed to the appropriate party at its address on the signature page and given personally, by email, by registered or certified mail postage prepaid, or by a commercial courier service. All notices shall be effective upon the date of receipt.
- B. *Survival:* All express representations, waivers, indemnifications, and limitations of liability included in this Agreement will survive its completion or termination for any reason.
- C. *Severability:* Any provision or part of the Agreement held to be void or unenforceable under any Laws or Regulations shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Engineer, which agree that the Agreement shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- D. *Waiver:* A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Agreement.

ARTICLE 7 – DEFINITIONS

7.01 *Defined Terms*

- A. Wherever used in this Agreement (including the Exhibits hereto) terms (including the singular and plural forms) printed with initial capital letters have the meanings indicated in the text above, in the exhibits, or in the following provisions:
 - 1. *Additional Services* – The services to be performed for or furnished to Owner by Engineer in accordance with Part 2 of Exhibit A of this Agreement.

2. *Agreement* – This written contract for professional services between Owner and Engineer, including all exhibits identified in Paragraph 8.01 and any duly executed amendments.
3. *Asbestos* – Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
4. *Basic Services* – The services to be performed for or furnished to Owner by Engineer in accordance with Part 1 of Exhibit A of this Agreement.
5. *Construction Contract* – The entire and integrated written agreement between Owner and Contractor concerning the Work.
6. *Construction Cost* – The cost to Owner of those portions of the entire Project designed or specified by Engineer. Construction Cost does not include costs of services of Engineer or other design professionals and consultants; cost of land or rights-of-way, or compensation for damages to properties; Owner's costs for legal, accounting, insurance counseling or auditing services; interest or financing charges incurred in connection with the Project; or the cost of other services to be provided by others to Owner pursuant to Exhibit B of this Agreement. Construction Cost is one of the items comprising Total Project Costs.
7. *Constituent of Concern* – Any substance, product, waste, or other material of any nature whatsoever (including, but not limited to, Asbestos, Petroleum, Radioactive Material, and PCBs) which is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§1801 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; and (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
8. *Consultants* – Individuals or entities having a contract with Engineer to furnish services with respect to this Project as Engineer's independent professional associates and consultants; subcontractors; or vendors.
9. *Contract Documents* – Those items so designated in the Construction Contract, including the Drawings, Specifications, construction agreement, and general and supplementary conditions. Only printed or hard copies of the items listed in the Construction Contract are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
10. *Contractor* – The entity or individual with which Owner has entered into a Construction Contract.

11. *Documents* – Data, reports, Drawings, Specifications, Record Drawings, and other deliverables, whether in printed or electronic media format, provided or furnished in appropriate phases by Engineer to Owner pursuant to this Agreement.
12. *Drawings* – That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings are not Drawings as so defined.
13. *Effective Date* – The date indicated in this Agreement on which it becomes effective, but if no such date is indicated, the date on which this Agreement is signed and delivered by the last of the parties to sign and deliver.
14. *Engineer* – The individual or entity named as such in this Agreement.
15. *Hazardous Waste* – The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
16. *Laws and Regulations; Laws or Regulations* – Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
17. *Owner* – The individual or entity with which Engineer has entered into this Agreement and for which the Engineer's services are to be performed. Unless indicated otherwise, this is the same individual or entity that will enter into any Construction Contracts concerning the Project.
18. *PCBs* – Polychlorinated biphenyls.
19. *Petroleum* – Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-hazardous waste and crude oils.
20. *Project* – The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.
21. *Radioactive Material* – Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
22. *Record Drawings* – Drawings depicting the completed Project, prepared by Engineer as an Additional Service and based solely on Contractor's record copy of all Drawings, Specifications, addenda, change orders, work change directives, field orders, and written interpretations and clarifications, as delivered to Engineer and annotated by Contractor to show changes made during construction.
23. *Reimbursable Expenses* – The expenses incurred directly by Engineer in connection with the performing or furnishing of Basic and Additional Services for the Project.

24. *Resident Project Representative* – The authorized representative of Engineer assigned to assist Engineer at the Site during the Construction Phase. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative agreed to by Owner. The duties and responsibilities of the Resident Project Representative, if any, are as set forth in Exhibit D (Not included).
25. *Samples* – Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
26. *Shop Drawings* – All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
27. *Site* – Lands or areas to be indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
28. *Specifications* – That part of the Contract Documents consisting of written technical descriptions of materials, equipment, systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto.
29. *Subcontractor* – An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
30. *Substantial Completion* – The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.
31. *Supplier* – A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.
32. *Total Project Costs* – The sum of the Construction Cost, allowances for contingencies, and the total costs of services of Engineer or other design professionals and consultants, together with such other Project-related costs that Owner furnishes for inclusion, including but not limited to cost of land, rights-of-way, compensation for damages to properties, Owner's costs for legal, accounting, insurance counseling and auditing services, interest and financing charges incurred in connection with the Project, and the cost of other services to be provided by others to Owner pursuant to Exhibit B of this Agreement.
33. *Work* – The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce

such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

ARTICLE 8 – EXHIBITS AND SPECIAL PROVISIONS

8.01 *Exhibits Included:*

- A. Exhibit A, Engineer's Services.
- B. Exhibit B, Owner's Responsibilities.
- C. Exhibit C, Payments to Engineer for Services and Reimbursable Expenses.

Appendix 1 to Exhibit C- Reimbursable Expenses and Standard Hourly Rates

- D. ~~Exhibit D, Duties, Responsibilities and Limitations of Authority of Resident Project Representative. Not Included.~~
- E. ~~Exhibit E, Notice of Acceptability of Work. Not Included.~~
- F. ~~Exhibit F, Construction Cost Limit. Not Included.~~
- G. Exhibit G, Insurance.
- H. ~~Exhibit H, Dispute Resolution. Not Included.~~
- I. ~~Exhibit I, Limitations of Liability. Not Included.~~
- J. ~~Exhibit J, Special Provisions. Not Included~~
- K. Exhibit K, Amendment to Owner-Engineer Agreement. As Issued.

8.02 *Total Agreement:*

- A. This Agreement, (together with the exhibits identified above) constitutes the entire agreement between Owner and Engineer and supersedes all prior written or oral understandings. This Agreement may only be amended, supplemented, modified, or canceled by a duly executed written instrument based on the format of Exhibit K to this Agreement.

8.03 *Designated Representatives:*

- A. With the execution of this Agreement, Engineer and Owner shall designate specific individuals to act as Engineer's and Owner's representatives with respect to the services to be performed or furnished by Engineer and responsibilities of Owner under this Agreement. Such an individual shall have authority to transmit instructions, receive information, and render decisions relative to the Project on behalf of the respective party whom the individual represents.

8.04 *Engineer's Certifications:*

A. Engineer certifies that it has not engaged in corrupt, fraudulent, or coercive practices in competing for or in executing the Agreement. For the purposes of this Paragraph 8.04:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the selection process or in the Agreement execution;
2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the selection process or the execution of the Agreement to the detriment of Owner, or (b) to deprive Owner of the benefits of free and open competition;
3. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the selection process or affect the execution of the Agreement.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement, the Effective Date of which is indicated on page 1.

Owner:
City of Stillwater, Oklahoma, a Municipal
Corporation

By: _____

Title: Kimberly Meek, City Manager

Date _____

Signed: _____

Engineer:
Meshek & Associates, LLC

By: 

Title: Brandon Claborn, CEO/Member

Date 09/04/2024

Signed: _____

Engineer License or Firm's Certificate No. 1487

State of: Oklahoma

Address for giving notices:

723 S. Lewis Street

Stillwater, OK 74074

Address for giving notices:

1437 S Boulder Ave., Ste 1550

Tulsa, OK 74119

Designated Representative (Paragraph 8.03.A):

Rob Hill

Title: Director, Emergency Management

Phone Number: 405.742.8380

E-Mail Address: rob.hill@stillwaterok.gov

Designated Representative (Paragraph 8.03.A):

Brandon Claborn, PE, CFM

Title: CEO

Phone Number: 918.392.5620

E-Mail Address: BClaborn@meshekengr.com

Approved as to form and legality this _____ day of _____, 20____.

Kimberly Carnley, City Attorney

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This is **EXHIBIT A**, consisting of 12 pages, referred to in and part of the **Agreement between Owner and Engineer for Professional Services** dated [REDACTED].

Engineer's Services

Article 1 of the Agreement is supplemented to include the following agreement of the parties.

The services to be performed by the ENGINEER under this AGREEMENT will consist of those engineering, planning, grant management and GIS services required to update the City's Multi-Hazard Mitigation Plan in accordance with the requirements of the Stafford Act and Title 44 Code of Federal Regulations (CFR) §201.6.

Further, it is understood and agreed that the date of beginning, rate of progress, and time of completion of the work to be done hereunder are essential provisions of this AGREEMENT. It is further understood and agreed that the work embraced in this AGREEMENT shall commence upon execution of this AGREEMENT and notification of grant award.

PART 1 – BASIC SERVICES

A1.01 *Pre-Award Services*

- A. Meshek will complete the Notice of Intent, HMGP Grant Application and any subsequent Requests for Information generated by the application submission for the City of Stillwater prior to the notification of grant award.

A1.02 *Phase 1: The Planning Process*

- A. Organize the Planning Process and Resources, including (1) Developing the Planning Process and Meeting Schedule, (2) Coordination with Key Stakeholders, (3) Data Collection, (4) Internal and External Meetings, and (5) Documentation of the Planning Process.
- B. Meshek will meet with The City of Stillwater to discuss the project scope and schedule, discuss convening the Stillwater Hazard Mitigation Team, gather initial data and documents, and plan the project kickoff meeting. To ensure key stakeholders' participation in the Stillwater Hazard Mitigation Planning Team Meetings for the update process, Meshek will develop "Save-the Date" e-mails to provide advance notice of scheduled meeting dates.
- C. Meshek will suggest a comprehensive list of stakeholders to be involved either as planning team members or as part of the general public to be involved in the plan. Stakeholder Meeting 1 will be held. Communications with other pertinent agencies will begin and continue through the process.
- D. Meshek will compile data and research for the plan during this time and work with stakeholders to begin work on developing a meaningful capability assessment.
- E. Grant compliance/management activities as needed

A1.03 Phase 2: Risk and Capability Assessment(s)

- A. This task will consist of updating the City's risk assessment and capability assessment, including: (1) Review of Previous Plan; (2) Hazard Identification and Research (3) Hazard Analysis (4) Capability Assessment and Analysis (4) Social Vulnerability Assessment (5) GIS Mapping.
- B. The risk assessment will be updated and enhanced to provide the most current and robust data and information.
- C. The list of hazards currently addressed in the plan will be revisited. A hazard analysis will be conducted based on hazards identified by the Stillwater Hazard Mitigation Planning Team for the 2025 Update.
- D. Meshek will analyze the effectiveness of current local mitigation policies, programs, and capabilities. This task will include describing the effectiveness of local policies, programs, and capabilities, including challenges to implementing local mitigation policies, programs, and capabilities and opportunities for implementing mitigation actions through local capabilities.
- E. A GIS Analysis will be conducted to include any new/modified/updated information (including hazard, land use, and development trends), findings, research, and risk data. New, readily available, credible technical data will be incorporated into the analysis as appropriate. The Hazard Analysis will be available to the City on a GIS web viewer.
- F. A GIS Analysis will be conducted to include any new/modified/updated information (including hazard, land use, and development trends), findings, research, and risk data. New, readily available, credible technical data will be incorporated into the analysis as appropriate. The Hazard Analysis will be available to the City on a GIS web viewer.
- G. Grant compliance/management activities as needed

A1.04 Phase 3: Develop Mitigation Strategy and Prepare Draft Plan, including (1) Review Previous Mitigation Strategy; (2) Develop Mitigation Goals; (3) Address Repetitive Loss and Severe Repetitive Loss Properties; (4) Develop Mitigation Action Items

- A. Meshek will conduct a review of mitigation actions in the previous plan and facilitate Stakeholder Meeting 3 to facilitate the review and update of the plan's mitigation strategy. This will include the identification and development of new actions for the plan.
- B. Meshek will assist Stillwater in identifying goals and a comprehensive range of specific actions and projects to be considered over the five-year update period.
- C. A cost benefit review of the actions will be conducted to assist with prioritization. Potential funding sources for these actions will be identified to assist with future implementation.
- D. Integration of Bent Ear Solutions GIS platform/datasets.

A1.05 ***Phase 4: Draft Plan and Submit to OEM and FEMA, including (1) Draft and Format Planning Document; (2) Coordinate with OEM and FEMA; (3) Additional GIS tasks for FEMA Review; (4) Local Adoption.***

- A. The draft plan and completed Plan Review Tool (PRT) will be submitted to OEM for review no later than 12 months from the date of FEMA planning Grant Award.
- B. Meshek will address any concerns brought forth by OEM after their review of the submitted draft.
- C. The plan will be submitted to FEMA for review.
- D. Meshek will address any concerns brought forth by FEMA after their review of the submitted draft.
- E. The FEMA will approve the final draft of the plan and return to Stillwater for local adoption.
- F. Grant compliance/management/closeout activities as needed.

PART 2 – ADDITIONAL SERVICES

A2.01 ***Additional Services Requiring Owner’s Written Authorization***

- A. If authorized in writing by Owner, Engineer shall provide Additional Services of the types listed below. These services are not included as part of Basic Services and will be paid for by Owner as indicated in Exhibit C.
1. Preparation of applications and supporting documents (in addition to those furnished under Basic Services) for private or governmental grants, loans, or advances in connection with the Project; preparation or review of environmental assessments and impact statements; review and evaluation of the effects on the design requirements for the Project of any such statements and documents prepared by others; and assistance in obtaining approvals of authorities having jurisdiction over the anticipated environmental impact of the Project.
 2. Services to make measured drawings of existing conditions or facilities, to conduct tests or investigations of existing conditions or facilities, or to verify the accuracy of drawings or other information furnished by Owner or others.
 3. Services resulting from significant changes in the scope, extent, or character of the portions of the Project designed or specified by Engineer, or the Project’s design requirements, including, but not limited to, changes in size, complexity, Owner’s schedule, character of construction, or method of financing; and revising previously accepted studies, reports, Drawings, Specifications, or Construction Contract Documents when such revisions are required by changes in Laws and Regulations enacted subsequent to the Effective Date or are due to any other causes beyond Engineer’s control.
 4. Services resulting from Owner’s request to evaluate additional Study and Report Phase alternative solutions beyond those agreed to in Paragraph A1.01.A.1 and 2.

5. Services required as a result of Owner's providing incomplete or incorrect Project information to Engineer.
6. Providing renderings or models for Owner's use, including services in support of building information modeling or civil integrated management.
7. Undertaking investigations and studies including, but not limited to:
 - a. detailed consideration of operations, maintenance, and overhead expenses;
 - b. the preparation of feasibility studies (such as those that include projections of output capacity, utility project rates, project market demand, or project revenues) and cash flow analyses, provided that such services are based on the engineering and technical aspects of the Project, and do not include rendering advice regarding municipal financial products or the issuance of municipal securities;
 - c. preparation of appraisals;
 - d. evaluating processes available for licensing, and assisting Owner in obtaining process licensing;
 - e. detailed quantity surveys of materials, equipment, and labor; and
 - f. audits or inventories required in connection with construction performed or furnished by Owner.
8. Furnishing services of Consultants for other than Basic Services.
9. Providing data or services of the types described in Exhibit B, when Owner retains Engineer to provide such data or services instead of Owner furnishing the same.
10. Providing the following services:
 - a. Services attributable to more prime construction contracts than specified in Paragraph A1.03.D.
 - b. Services to arrange for performance of construction services for Owner by contractors other than the principal prime Contractor, and administering Owner's contract for such services.
11. Services during out-of-town travel required of Engineer, other than for visits to the Site or Owner's office as required in Basic Services (Part 1 of Exhibit A).
12. Preparing for, coordinating with, participating in and responding to structured independent review processes, including, but not limited to, construction management, cost estimating, project peer review, value engineering, and constructibility review requested by Owner; and performing or furnishing services required to revise studies, reports, Drawings, Specifications, or other documents as a result of such review processes.

Exhibit A – Engineer's Services

EJCDC® E-500, Agreement Between Owner and Engineer for Professional Services.

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and American Society of Civil Engineers. All rights reserved.**

13. Preparing additional bidding-related documents (or requests for proposals or other construction procurement documents) or Construction Contract Documents for alternate bids or cost estimates requested by Owner for the Work or a portion thereof.
14. Assistance in connection with bid protests, rebidding, or renegotiating contracts for construction, materials, equipment, or services.
15. Preparing conformed Construction Contract Documents that incorporate and integrate the content of all Addenda and any amendments negotiated by Owner and Contractor.
16. Providing Construction Phase services beyond the original date for completion and readiness for final payment of Contractor, but only if such services increase the total quantity of services to be performed in the Construction Phase, rather than merely shifting performance of such services to a later date.
17. Preparing Record Drawings, and furnishing such Record Drawings to Owner.
18. Supplementing Record Drawings with information regarding the completed Project, Site, and immediately adjacent areas obtained from field observations, Owner, utility companies, and other reliable sources.
19. Conducting surveys, investigations, and field measurements to verify the accuracy of Record Drawing content obtained from Contractor, Owner, utility companies, and other sources; revise and supplement Record Drawings as needed.
20. Preparation of operation, maintenance, and staffing manuals.
21. Protracted or extensive assistance in refining and adjusting of Project equipment and systems (such as initial startup, testing, and balancing).
22. Assistance to Owner in training Owner's staff to operate and maintain Project equipment and systems.
23. Assistance to Owner in developing systems and procedures for (a) control of the operation and maintenance of Project equipment and systems, and (b) related recordkeeping.
24. Preparing to serve or serving as a consultant or witness for Owner in any litigation, arbitration, lien or bond claim, or other legal or administrative proceeding involving the Project.
25. Overtime work requiring higher than regular rates.
26. Providing construction surveys and staking to enable Contractor to perform its work; any type of property surveys or related engineering services needed for the transfer of interests in real property; and providing other special field surveys.
27. Providing more extensive services required to enable Engineer to issue notices or certifications requested by Owner.
28. Extensive services required during any correction period, or with respect to monitoring Contractor's compliance with warranties and guarantees called for in the Construction Contract (except as agreed to under Basic Services).

Exhibit A – Engineer's Services

EJCDC® E-500, Agreement Between Owner and Engineer for Professional Services.

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and American Society of Civil Engineers. All rights reserved.**

29. Other additional services performed or furnished by Engineer not otherwise provided for in this Agreement.

A2.02 Additional Services Not Requiring Owner's Written Authorization

- A. Engineer shall advise Owner that Engineer is commencing to perform or furnish the Additional Services of the types listed below. For such Additional Services, Engineer need not request or obtain specific advance written authorization from Owner. Engineer shall cease performing or furnishing such Additional Services upon receipt of written notice to cease from Owner.
1. Services in connection with Work Change Directives and Change Orders to reflect changes requested by Owner.
 2. Services in making revisions to Drawings and Specifications occasioned by the acceptance of substitute materials or equipment other than "or equal" items; services after the award of the Construction Contract in evaluating and determining the acceptability of a proposed "or equal" or substitution which is found to be inappropriate for the Project; evaluation and determination of an excessive number of proposed "or equals" or substitutions, whether proposed before or after award of the Construction Contract.
 3. Services resulting from significant delays, changes, or price increases occurring as a direct or indirect result of materials, equipment, or energy shortages.
 4. Additional or extended services arising from (a) the presence at the Site of any Constituent of Concern or items of historical or cultural significance, (b) emergencies or acts of God endangering the Work, (c) damage to the Work by fire or other causes during construction, (d) a significant amount of defective, neglected, or delayed Work, (e) acceleration of the progress schedule involving services beyond normal working hours, or (f) default by Contractor.
 5. Services (other than Basic Services during the Post-Construction Phase) in connection with any partial utilization of the Work by Owner prior to Substantial Completion.
 6. Evaluating unreasonable or frivolous requests for interpretation or information (RFIs), Change Proposals, or other demands from Contractor or others in connection with the Work, or an excessive number of RFIs, Change Proposals, or demands.
 7. Reviewing a Shop Drawing or other Contractor submittal more than three times, as a result of repeated inadequate submissions by Contractor.
 8. While at the Site, compliance by Engineer and its staff with those terms of Owner's or Contractor's safety program provided to Engineer subsequent to the Effective Date that exceed those normally required of engineering personnel by federal, State, or local safety authorities for similar construction sites.

This is **EXHIBIT B**, consisting of 3 pages, referred to in and part of the **Agreement between Owner and Engineer for Professional Services** dated [].

Owner's Responsibilities

Article 2 of the Agreement is supplemented to include the following agreement of the parties.

B2.01 RECORDS In addition to other responsibilities of Owner as set forth in this Agreement, the Owner shall at its expense:

- A. Provide ENGINEER with all criteria and full information as to Owner's requirements for the Project, including records, reports, studies, plans, drawings and other data available in the files of the City that may be useful in the work involved under this AGREEMENT.
- B. Provide ENGINEER with financial records necessary for grant compliance/reimbursements such as copies of checks, accounts payable ledgers, invoices etc.
- C. ENGINEER will reasonably rely upon the accuracy, timeliness, and completeness of the information provided by the CITY.

B2.02 Staff Assistance

- A. Designate in writing a person to act as its representative in respect to the work to be performed under this AGREEMENT, and such person shall have complete authority to transmit instructions, receive information, interpret and define CITY'S policies and decisions with respect to materials, equipment, elements, and systems pertinent to the services covered by this AGREEMENT.

B2.03 Review

- A. Examine all studies, reports, sketches, estimates, specifications, drawings, proposals and other documents presented by ENGINEER and render in writing decisions pertaining thereto within a reasonable time so as to not delay the services of ENGINEER.

This is **EXHIBIT C**, consisting of 4 pages, referred to in and part of the Agreement between Owner and Engineer for Professional Services dated [].

Payments to Engineer for Services and Reimbursable Expenses

COMPENSATION PACKET BC-1: Basic Services – Lump Sum

Article 2 of the Agreement is supplemented to include the following agreement of the parties:

ARTICLE 2 – OWNER’S RESPONSIBILITIES

C2.01 Compensation for Basic Services (other than Resident Project Representative) – Lump Sum Method of Payment

- A. Owner shall pay Engineer for Basic Services set forth in Exhibit A, except for services of Engineer’s Resident Project Representative, if any, as follows:
1. A Lump Sum amount of \$182,345.98 based on the following estimated distribution of compensation:

a. Pre-award Services	\$3,400.00
b. Post-Award HMP update	\$152,695.98
c. Supplemental GIS Services	\$26,250.00
 2. Engineer may alter the distribution of compensation between individual phases noted herein to be consistent with services actually rendered, but shall not exceed the total Lump Sum amount unless approved in writing by the Owner.
 3. The Lump Sum includes compensation for Engineer’s services and services of Engineer’s Consultants, if any. Appropriate amounts have been incorporated in the Lump Sum to account for labor costs, overhead, profit, expenses (other than any expressly allowed Reimbursable Expenses), and Consultant charges.
 4. The portion of the Lump Sum amount billed for Engineer’s services will be based upon Engineer’s estimate of the percentage of the total services actually completed during the billing period. If any Reimbursable Expenses are expressly allowed, Engineer may also bill for any such Reimbursable Expenses incurred during the billing period.
- B. *Period of Service:* The compensation amount stipulated in Compensation Packet BC-1 is conditioned on a period of service not exceeding 24 months. If such period of service is extended, the compensation amount for Engineer's services shall be appropriately adjusted.

**COMPENSATION PACKET AS-1:
Additional Services – Standard Hourly Rates**

Article 2 of the Agreement is supplemented to include the following agreement of the parties:

C2.05 Compensation for Additional Services – Standard Hourly Rates Method of Payment

A. Owner shall pay Engineer for Additional Services, if any, as follows:

1. *General:* For services of Engineer's personnel engaged directly on the Project pursuant to Paragraph A2.01 or A2.02 of Exhibit A, except for services as a consultant or witness under Paragraph A2.01.A.24, (which if needed shall be separately negotiated based on the nature of the required consultation or testimony) an amount equal to the cumulative hours charged to the Project by each class of Engineer's personnel times Standard Hourly Rates for each applicable billing class for all Additional Services performed on the Project, plus related Reimbursable Expenses and Engineer's Consultant's charges, if any.

B. *Compensation For Reimbursable Expenses:*

1. For those Reimbursable Expenses that are not accounted for in the compensation for Basic Services under Paragraph C2.01 and are directly related to the provision of Additional Services, Owner shall pay Engineer at the rates set forth in Appendix 1 to this Exhibit C.
2. Reimbursable Expenses include the expenses identified in Appendix 1 and the following categories: transportation (including mileage), lodging, and subsistence incidental thereto; providing and maintaining field office facilities including furnishings and utilities; toll telephone calls, mobile phone charges, and courier charges; reproduction of reports, Drawings, Specifications, bidding-related or other procurement documents, Construction Contract Documents, and similar Project-related items; and Consultants' charges. In addition, if authorized in advance by Owner, Reimbursable Expenses will also include expenses incurred for the use of highly specialized equipment.
3. The amounts payable to Engineer for Reimbursable Expenses, if any, will be the Additional Services-related internal expenses actually incurred or allocated by Engineer, plus all invoiced external Reimbursable Expenses allocable to such Additional Services, the latter multiplied by a factor of 1.05.

C. *Other Provisions Concerning Payment for Additional Services:*

1. Whenever Engineer is entitled to compensation for the charges of Engineer's Consultants, those charges shall be the amounts billed by Engineer's Consultants to Engineer times a factor of 1.05.
2. *Factors:* The external Reimbursable Expenses and Engineer's Consultant's Factors include Engineer's overhead and profit associated with Engineer's responsibility for the administration of such services and costs.
3. To the extent necessary to verify Engineer's charges and upon Owner's timely request, Engineer shall make copies of such records available to Owner at cost.

This is **Appendix 1 to EXHIBIT C**, consisting of 1 page, referred to in and part of the **Agreement between Owner and Engineer for Professional Services** dated [REDACTED].

Reimbursable Expenses and Standard Hourly Rates Schedule

A. Standard Hourly Rates:

- Standard Hourly Rates are set forth in this Appendix 1 to this Exhibit C and include salaries and wages paid to personnel in each billing class plus the cost of customary and statutory benefits, general and administrative overhead, non-project operating costs, and operating margin or profit.
- The Standard Hourly Rates apply only as specified in Article C2.

B. Schedule:

Hourly rates for services performed on or after the date of the Agreement are:

Allowance for Office Work			
Project Principal II	\$ 325.00	GIS Project Principal	\$ 240.00
Project Principal I	\$ 300.00	GIS Project Manager II	\$ 230.00
Project Manager II	\$ 265.00	GIS Project Manager I	\$ 185.00
Project Manager I	\$ 190.00	GIS Specialist II	\$ 145.00
Project Engineer II	\$ 190.00	GIS Specialist I	\$ 115.00
Project Engineer I	\$ 135.00	GIS Analyst	\$ 110.00
Engineering Intern	\$ 130.00	GIS Technician	\$ 95.00
Engineering Technician II	\$ 125.00	GPS Field Technician	\$ 85.00
Engineering Technician I	\$ 100.00	ROW Project Manager II	\$ 230.00
CAD Designer	\$ 100.00	ROW Project Manager I	\$ 210.00
3 Man Survey Crew	\$ 315.00	Assistant ROW Project Manager	\$ 140.00
2 Man Survey Crew	\$ 215.00	Acquisition/Relocation Agent	\$ 120.00
Survey CAD Technician	\$ 95.00	Real Estate Trainee	\$ 90.00
Survey Crew Chief I	\$ 100.00	Planning/Grant Project Manager II	\$ 205.00
Survey Crew Chief II	\$ 130.00	Planning/Grant Project Manager I	\$ 170.00
Survey Crew Technician	\$ 85.00	Planner II	\$ 135.00
Survey Project Manager	\$ 205.00	Planner I	\$ 125.00
LiDAR Survey Crew	\$ 250.00	Contract Administrator	\$ 210.00
LiDAR Data Specialist	\$ 140.00	Administrative	\$ 115.00
Allowance for Travel			
Mileage	Billed at Current IRS Rate		
Per Diem	Billed at Current IRS Rate		
Per Diem	Billed at Current GSA Rate		
Reproduction Costs			
8-1/2"x11" print	\$ 0.15	Billed per page printed	
8-1/2"x14" print	\$ 0.20		
11"x17" print	\$ 0.30		
Black and White Plots	\$ 5.00		
Color Plot	\$ 8.00		
Mylars	\$ 13.00		
Miscellaneous Outside Expenses and Fees			
Outside Direct Project Expenses	Passthrough at Cost		
Subconsultant Services	Cost plus 5% management fee		

Exhibit G – Insurance.

EJCDC® E-500, Agreement Between Owner and Engineer for Professional Services.

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Insurance

Paragraph 6.04 of the Agreement is supplemented to include the following agreement of the parties:

G6.04 Insurance

- A. The limits of liability for the insurance required by Paragraph 6.05.A and 6.05.B of the Agreement are as follows:

1. By Engineer:

- a. Workers' Compensation: Statutory
- b. Employer's Liability --
 - 1) Bodily injury, each accident: \$1,000,000
 - 2) Bodily injury by disease, each employee: \$1,000,000
 - 3) Bodily injury/disease, aggregate: \$1,000,000
- c. General Liability --
 - 1) Each Occurrence (Bodily Injury and Property Damage): \$1,000,000
 - 2) General Aggregate: \$2,000,000
- d. Excess or Umbrella Liability --
 - 1) Per Occurrence: \$1,000,000
 - 2) General Aggregate: \$1,000,000
- e. Automobile Liability --Combined Single Limit (Bodily Injury and Property Damage):
\$1,000,000
- f. Professional Liability --
 - 1) Each Claim Made \$2,000,000
 - 2) Annual Aggregate \$2,000,000
- g. Other (specify): N/A

2. By Owner:

- a. Workers' Compensation: Statutory

b. Employer's Liability --

1) Bodily injury, Each Accident	\$1,000,000
2) Bodily injury by Disease, Each Employee	\$1,000,000
3) Bodily injury/Disease, Aggregate	\$1,000,000

c. General Liability --

1) General Aggregate:	\$1,000,000
2) Each Occurrence (Bodily Injury and Property Damage):	\$2,000,000

d. Excess Umbrella Liability

1) Per Occurrence:	\$1,000,000
2) General Aggregate:	\$1,000,000

e. Automobile Liability – Combined Single Limit (Bodily Injury and Property Damage):

\$1,000,000

f. Other (specify):

N/A

B. *Additional Insureds:*

1. The following individuals or entities are to be listed on Engineer's general liability policies of insurance as additional insureds:

a. City of Stillwater

2. During the term of this Agreement the Engineer shall notify Owner of any other Consultant to be listed as an additional insured on Owner's general liability policies of insurance.
3. The Owner shall be listed on Engineer's general liability policy as provided in Paragraph 6.05.A.

This is **EXHIBIT K**, consisting of 2 pages, referred to in and part of the **Agreement between Owner and Engineer for Professional Services** dated [].

AMENDMENT TO OWNER-ENGINEER AGREEMENT
Amendment No. _____

The Effective Date of this Amendment is: _____.

Background Data

Effective Date of Owner-Engineer Agreement:

Owner:

Engineer:

Project:

Nature of Amendment: [Check those that are applicable and delete those that are inapplicable.]

- _____ Additional Services to be performed by Engineer
- _____ Modifications to services of Engineer
- _____ Modifications to responsibilities of Owner
- _____ Modifications of payment to Engineer
- _____ Modifications to time(s) for rendering services
- _____ Modifications to other terms and conditions of the Agreement

Description of Modifications:

Here describe the modifications, in as much specificity and detail as needed. Use an attachment if necessary.

Agreement Summary:

Original agreement amount:	\$ _____
Net change for prior amendments:	\$ _____
This amendment amount:	\$ _____
Adjusted Agreement amount:	\$ _____

Change in time for services (days or date, as applicable): _____

The foregoing Agreement Summary is for reference only and does not alter the terms of the Agreement, including those set forth in Exhibit C.

Owner and Engineer hereby agree to modify the above-referenced Agreement as set forth in this Amendment. All provisions of the Agreement not modified by this or previous Amendments remain in effect.

OWNER:

ENGINEER:

By: _____
Print
name: _____

Title: _____

Date Signed: _____

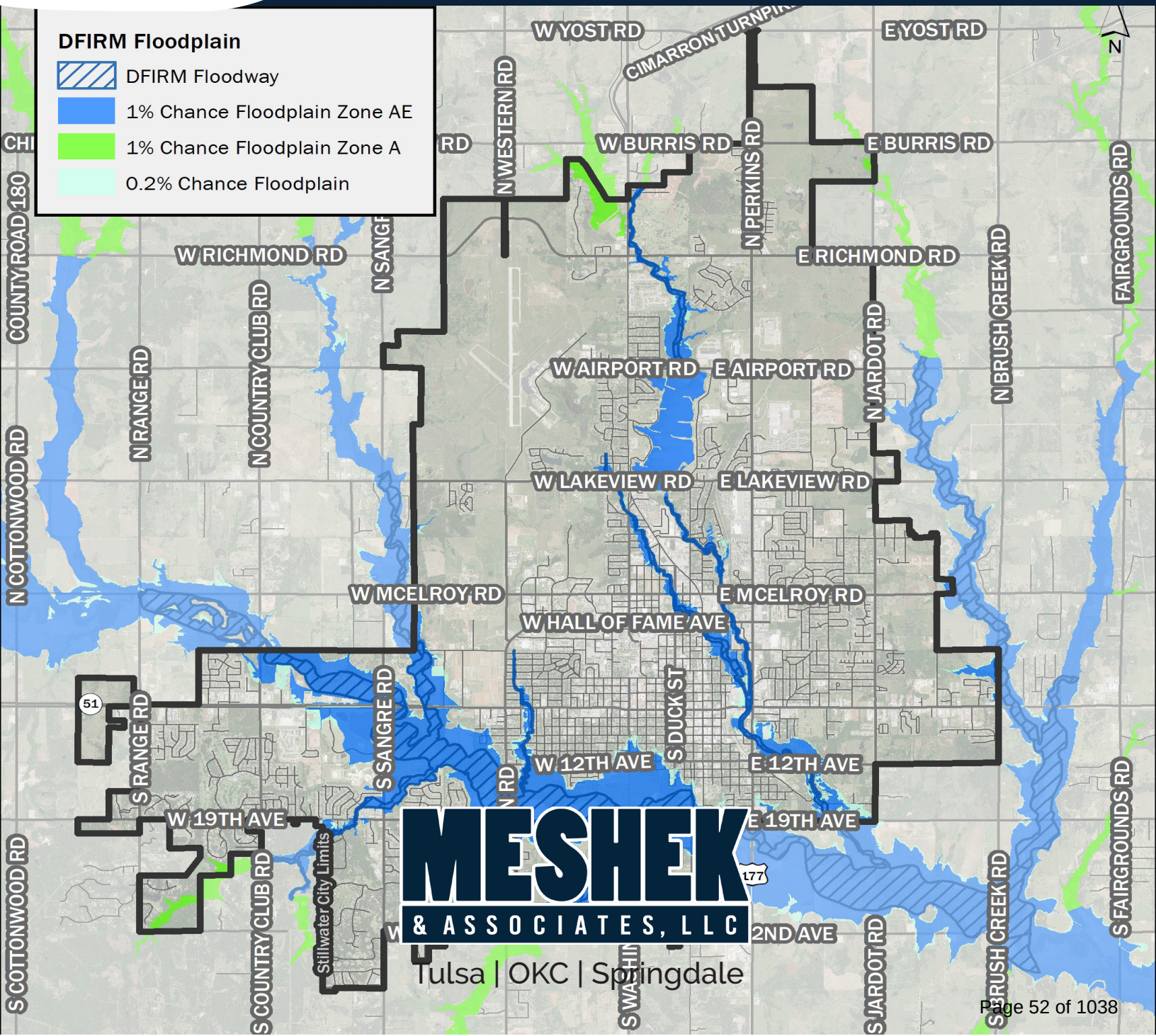
By: _____
Print
name: _____

Title: _____

Date Signed: _____



2024 City of Stillwater Hazard Mitigation Plan Update



MESSAGE FROM TEAM LEADER



Allison Whitsitt
Planning Department Manager
awhitsitt@meshekengr.com
918.728.5617

Meshek & Associates, LLC (Meshek) is excited to provide a proposal for the preparation of the City of Stillwater's Hazard Mitigation Plan (HMP) Update. Our Planning & Grants Department, led by Allison Whitsitt, a former Northeast Area Coordinator for the Oklahoma Department of Emergency Management (OEM), is comprised of emergency management experts who have served in local and state capacities, meteorologists who provide valuable insight into hazard/risk assessment, and professional engineers. Our group is supported by engineering interns and technicians, GIS (Geographical Information Systems) professionals, land surveyors, right-of-way specialists, and design professionals. Our team is uniquely qualified to deliver a successful hazard mitigation plan update to the City of Stillwater.

Our group recently welcomed Daniel Piltz to the Planning Department. Daniel worked for OEM overseeing all grants activities as the Director of Grants Management and an EMGrants Administrator. Additionally, he developed and executed plans as the Preparedness and Response Director for all hazards across the State of Oklahoma. He is very familiar with the requirements and procedures of OEM and FEMA.

The Meshek Planning & Grants Team holds unique experience including boots-on-the-ground insight into the City of Stillwater. Our team members have worked in the City and with key stakeholders on various deployment assignments, giving us a unique insight into the complex nature of your community. Meshek assisted in the previous HMP Update and recently completed a Master Drainage Plan for the City. We have extensive knowledge of your community and what hazard mitigation planning and beyond can bring to you and your partners. We look forward to continuing our work with the City of Stillwater and appreciate the ability to provide a glimpse of what we can offer.

Imagine a community that is sustainable, resilient, and prosperous — let's achieve it together.

**BUILDING
A STRONGER
TOMORROW**

Communities need trusted partners to safeguard today and build a stronger tomorrow — it's why we exist.

Qualifications

Meshek & Associates was founded in 1988 with the sole focus of providing hydrologic and hydraulic analysis to communities across Oklahoma. Since then, Meshek has strategically added additional service lines to support the needs of our clients. These services include: Hydrologic & Hydraulic Engineering, Civil & Roadway Design, Geographic Information Systems, Hazard Mitigation & FEMA Grant Management, Land Survey and LiDAR Scanning, and Right-of-Way and Land Acquisition Services.

Meshek was founded over 35 years ago to provide H&H services to communities and engineering firms. As the needs of our local partners have grown, so has our firm. Our founder, Janet Meshek, strategically added services as she saw the need in local communities. Our firm contains not only H&H experts but also Design, Right-of-Way, GIS, Survey, and our department, Planning & Grants.

From planned event management to local and national disaster deployments, and from emergency and command post operations to the fire line, our team brings every aspect of public safety to the City of Stillwater planning table. Our meteorologists provide expert insight into your natural hazard risk and supply unique actions to mitigate the effects of hazard events. Meshek holds the capacity to transform the City of Stillwater Hazard Mitigation Plan into a dynamic document that will enhance community resilience from natural hazards and become an investment you can truly be proud of.

Our team collaborates closely with our GIS team for every plan update. Meshek is known statewide for our GIS capabilities in risk identification and mitigation, Community Rating System (CRS) utilization, drainage complaint and problem area mapping, floodplain mapping, and flood mitigation project Benefit-Cost Analysis (BCAs). Our team of GIS experts is committed to crafting tailor-made maps and conducting a thorough data analysis to support the update of your hazard mitigation plan. Their services can be customized to your specifications, as discussed in the innovation section of this proposal.



Project Goals

Meshek is well-versed in the range of services essential to efficiently update the City's Hazard Mitigation Plan. We refine our project approach to effectively support your community needs.

Meshek's established methodology for Hazard Mitigation Planning, focuses on a distinctive, community-centered approach. We assess your current needs, review past and existing mitigation action items, and integrate new 2023 FEMA planning guidance to create a cohesive, precise, and impactful Hazard Mitigation Plan tailored to Stillwater's present and future needs. We offer more than just an updated plan; we provide a roadmap for successful implementation. The true value lies not just in the document itself, but in what we can help you accomplish with your updated Hazard Mitigation Plan.

Comprehensive Plan Update and Maps

After crafting the 2020 Stillwater Hazard Mitigation Plan Update and collaborating extensively with the City on various master drainage plan projects, Meshek has proven ourselves to be thoroughly familiar with the community's dynamics in order to develop the most thorough and community-focused Hazard Mitigation Plan possible. Following the implementation of FEMA's new planning directives in 2023, our team promptly adjusted our planning strategies to adhere to the new guidelines, resulting in the approval of 4 plans by FEMA under the updated guidance. New planning guidance necessitates meeting specific update criteria and adhering to new guidance requirements, which will be achieved during your current plan update process. Leveraging Meshek's existing repository of information and existing data from the 2020 plan update and stormwater projects ensures a streamlined approach, resulting in reduced time and cost compared to previous planning endeavors.

GIS plays a vital role in Meshek's Hazard Mitigation Planning process, and we are committed to equipping communities with datasets and visualization tools to ensure your hazard mitigation plan is meaningful, interactive, and sustainable. Meshek's nationally recognized GIS Department excels not only in producing high-quality maps for the printed plan, but also specializes in creating completely customizable online experiences through project HUBs and dashboards to enhance stakeholder engagement. The Meshek Planning and GIS team will work hand-in-hand with the City of Stillwater to ensure your map and GIS needs are met in the planning process.

Remain Current with Threats and Mitigation Projects

Meshek advocates local ownership of the Hazard Mitigation Plan and ongoing community engagement in both maintaining the plan and the planning process itself. After updating Stillwater's Hazard Mitigation Plan to align with FEMA's 2023 Mitigation Planning Guidance, and incorporating your action items, we propose several maintenance methods, including a crosswalk that will enable staff to keep the plan current and simplify the required 5-year update process. Additionally, our planning team offers an annual update model that streamlines the extensive 5-year update, transforming your investment into a dynamic, perpetually current and actionable document.

Features to be Incorporated Into the Plan – Checklists, and More

Meshek tailors Hazard Mitigation Plans to each communities specific needs before initiating the writing process. In the regular review of action item statuses, we include the opportunity to update progress, add new projects, and assess ongoing projects, including any inspired by the planning process. We understand that a Hazard Mitigation Plan should evolve as a living document, serving as a foundation for projects to bolster Stillwater's resilience and safety against its hazards. Our goal is to ensure you fully maximize the benefits of this plan. Once a comprehensive list of action items is compiled, tracking mechanisms can be implemented either in paper format or within our GIS platform in an interactive digital format.

Project Process

We are honored to continue our trusted partnership with the City of Stillwater and are fully equipped to guide the City through the process of updating your Hazard Mitigation Plan.

Community Involvement/Input

Internal and external partnerships are key to a successful planning process and implementation. During project kickoff meetings, the Meshek Planning Team will facilitate discussions with the Stillwater project manager to help identify internal and external partners, community members, and stakeholders who will play a vital role in future planning initiatives and begin building contact lists. Members of these lists will include representatives of at-risk populations such as nursing homes, assisted living facilities, and retirement villages, and the health and medical community such as hospitals and dialysis centers. Additionally, private businesses will be included in this process through individual contacts and the Stillwater Chamber of Commerce.

The Meshek Planning Team employs diverse strategies to actively involve and keep the community engaged during the planning phase. We facilitate this through online bilingual surveys distributed across social media platforms and websites, enabling public input and feedback. To ensure broad participation, we offer virtual attendance options for all stakeholder workshops and public meetings and often participate in external gatherings such as LEPC or Chamber of Commerce meetings to educate community members on their role in hazard mitigation planning. Additionally, we provide flyers featuring QR codes for the city to promote engagement in planning activities.

Stillwater Public Schools

Meshek recognizes the significance and benefit of engaging public schools in the Hazard Mitigation Process. Acknowledging that Stillwater Public Schools are susceptible to the same hazards as government buildings and critical infrastructure, we integrate them into the planning process on par with the City. This inclusion will empower them to understand their strengths and vulnerabilities, enabling them to identify strategies to mitigate risks effectively. School systems often stand to gain from initiatives such as building retrofits, safe room installations, generator projects, and lightning detection systems. By involving Stillwater Public Schools in the planning process, we not only ensure their eligibility for federal funding for such endeavors but also cultivate a comprehensive awareness of the hazards and risks confronting the City of Stillwater.

Oklahoma State University

Meshek understands the significance of collaboration between the City of Stillwater and Oklahoma State University (OSU), not only as the city's largest employer but also as a key ally in ensuring a safer environment for the campus community. Exploring the resources and expertise the University provides to the City is crucial as we evaluate jurisdictional capabilities and vulnerabilities during the planning process. Acknowledging the potential for collaboration, involving OSU as a significant stakeholder proves advantageous across various aspects of hazard mitigation planning. Our team eagerly anticipates incorporating input from this invaluable partner into our efforts.

Website

Throughout the duration of the plan update process, a webpage will be available with information on the plan and a short survey for the public. The website will explain hazard mitigation and the planning process, solicit public input through online surveys and emailed comments, and feature a GIS map showing geographic specific hazard data throughout the City.

Public survey links, QR codes, and digital-friendly content will be furnished to the City for dissemination across its diverse social media platforms to facilitate the distribution of public information and enhance engagement.

Communications

Effective and consistent communication plays a vital role in the hazard mitigation planning process. Meshek will collaborate with the City of Stillwater project manager to create a dynamic communication strategy that integrates both in-person and virtual meeting options, aiming to enhance participation and accessibility for all involved parties. Internally, Meshek ensures daily communication within the Planning Department to uphold transparency throughout the planning phase. Alongside meetings, email correspondence and phone calls are

key channels for communication between planners and team members. Before scheduled events, reminders are distributed, and after each gathering, summary emails are crafted to maintain transparency across all stakeholders. Regular updates will be shared with all participants throughout the process, including during the adoption phase and review stages.

Plan Approval

The Meshek planning team has mastered the process of crafting and refining plans. We employ a blend of methodologies including SWOT analysis (assessing Strengths, Weaknesses, Opportunities, and Threats) and HVA (Hazard Vulnerability Analysis) conducted during interactive planning workshops and public engagements. Through these methods, we pinpoint the capabilities and vulnerabilities of our communities, collaborating closely with stakeholders to identify and prioritize mitigation action items and goals.

To guarantee the acceptance and adherence to State and Federal standards, Meshek meticulously crafts plans in accordance with the latest federal guidance, as of April 2023, which includes planning elements such as equity in mitigation planning, at-risk population planning, future conditions and climate change, building codes and land use, and NFIP regulations. These plans undergo rigorous evaluation using FEMA's Plan Review Tool (PRT) by our team before submission for approval.

Project Outcomes

Together, with the City, Meshek's planning team will continue to help make communities strong, successful, and sustainable. We will achieve this by providing the best possible efficient services, developing, and implementing smart planning strategies.

OEM/FEMA Standards

Meshek's Planning Team nurtures a strong collaborative bond with the Oklahoma Department of Emergency Management's (OEM) Hazard Mitigation Team throughout the plan review phase. Before your plan is forwarded to FEMA for approval, OEM meticulously examines all submissions for thoroughness and adherence to guidelines. Their constructive feedback and comments allow us to address any deficiencies or ambiguities before submission to FEMA. This streamlined process significantly reduces waiting for FEMA approval once the plan is formally submitted.

FEMA's most recent guidelines prioritize considerations such as climate change, equitable outcomes, underserved communities, and socially vulnerable groups. Our team has collaborated extensively with FEMA reviewers to grasp the expectations of local communities in meeting the updated guidelines so that we may serve our communities during times of change. We are well-prepared to guide Stillwater through the process, ensuring outcomes that not only fulfill FEMA requirements but also bring tangible benefits to all entities involved in the planning process.

Step and Processes for an Effective Plan

The Meshek Planning Team has devised a refined methodology aimed at streamlining the planning process and ensuring its efficient progression. Initially, this involves collaborating with Stillwater's project manager to promptly pinpoint three essential groups: a "core group," typically comprising a jurisdictional project manager along with one or two additional key members and a Meshek project manager, a "planning group" encompassing representatives from all participating entities, and a "stakeholder group" comprising community members, local response experts, volunteer groups, and other pertinent local officials.

To initiate the planning process, the Meshek Planning Team promptly coordinates with the Stillwater project manager to gather any necessary paperwork, relevant plans, crucial names, and contact details. Discussions ensue regarding timelines, schedules, objectives, and expectations. This meeting also serves to identify participants for forthcoming core group meetings and planning workshops, with invitation lists compiled accordingly. Dates, times, and venues are earmarked for all upcoming gatherings, accompanied by the crafting of invitation/save-the-date emails. We anticipate utilizing two core group meetings, two planning workshops, and one public/VOAD meeting but this schedule remains flexible to accommodate the community's requirements.

Plan of Action

- **Kickoff** – The team will discuss project schedule, new/updated guidance requirements, and invitees for upcoming Planning Workshops, and will explore avenues for integrating the Hazard Mitigation Plan with

Timeline

Your Meshek team will manage the project schedule from Day One - proactively, not reactively. This approach avoids regression while also providing opportunities for all stakeholders to discuss upcoming milestones, ask questions, consider options, and receive real-time answers.

other initiatives such as Comprehensive, Capital Improvement, Floodplain Management, and Stormwater Management Plans.

- **Planning Workshop #1** - Our planning team will discuss hazards that threaten the City and its partners, mitigation action items identified in the current plan, and the need for any new actions. Additionally, a SWOT analysis (Strengths – Weaknesses – Opportunities – Threats)/Hazard Vulnerability Analysis will be facilitated to assist in updating the capability and risk assessments. A Public Survey will be launched and kept live for the duration of the planning process.
- **Core Group Meeting #1** - We address the planning workshop outcomes, evaluate jurisdictional capabilities/vulnerabilities, assess any alterations in land use, development, or building codes, and pinpoint areas with vulnerable populations requiring mitigation efforts.
- **Planning Workshop #2** – We will focus on key activities, including the development and prioritization of mitigation action items, formulation of implementation strategies, identification of funding streams, and discussions on the process and significance of adopting the approved Hazard Mitigation Plan (HMP). This workshop will also focus on identifying top projects of concern in the City, and how to set out and achieve successful implementation of those missions.
- **Core Group #2** – Used to assess the listed mitigation actions and priorities. Prioritization may be aided by a benefit-cost analysis discussion. Any lingering questions/comments will be addressed at this time to facilitate a final draft of the updated plan.
- **Public/VOAD Meeting** - Organized to gather feedback from residents and business owners in the City regarding their concerns about vulnerabilities and hazards. Additionally, discussions with VOADs are held to comprehend their roles and involvement during response and recovery efforts. During this final meeting, a draft of the plan will be presented, and our team will also provide insight into expected timelines for the approval and adoption process.

Timeline

Stillwater's current Hazard Mitigation Plan will expire on September 20, 2025, and our planning team aims to create a draft plan for review by Stillwater's Core Group and Planning Group within 6 months of the notice to proceed. The last stage of the process, which includes the review and approval of the plan by the Oklahoma Department of Emergency Management and FEMA, followed by local adoption, is expected to last around 60 days. However, the actual timeline will depend on external factors affecting OEM and FEMA, such as the number of plans awaiting approval when the Stillwater plan is submitted, disaster response and recovery efforts, staff changes and training, and other unforeseen limitations. Meshek maintains a close working relationship with OEM which enables us to address any concerns that arise during the review process quickly and facilitate a prompt turnaround.

We will submit a final draft for approval to OEM and FEMA by July 2025, avoiding a gap due to the expiration of Stillwater's current Hazard Mitigation Plan. By September 2025, we aim to deliver a comprehensive Hazard Mitigation Plan Update to the City of Stillwater and Stillwater Public Schools, aligning with FEMA's 2023 requirements. This plan is designed to alleviate the burden of response efforts, enhance city resilience, and serve as a roadmap for implementing prioritized mitigation actions identified during the planning process.

We recognize that time is valuable, and in order to efficiently collaborate with the City and its stakeholders throughout the planning process, we will maintain a process of communication through two stakeholder meetings, two core group meetings, and maintaining an open line of communication between Meshek and the City of Stillwater.

Results

Meshek planning team members have roots in the City, have responded to disaster events within Stillwater, and uphold significant relationships with key stakeholders in the community.

Having worked with the City on various master drainage plans and authored the 2020 HMP update, Meshek has intimate knowledge of your community, giving our team a unique perspective and knowledge of the effects and impacts of hazards in the planning area.

Services

The Meshek team provides unrivaled experience and expertise in FEMA hazard mitigation planning, hazard identification, risk analysis project management, public meetings, stakeholder coordination, grant application, grant management, property acquisition, cost estimating, and engineering design. Below are our recommended services.



Grant Management

Effectively managing grants, maintaining compliance, and timely reporting can consume significant time, diverting key staff from essential tasks. Meshek takes pride in offering end-to-end grant management services to alleviate this administrative load for our communities. From application to compliance tasks like quarterly reporting and closeouts, the Meshek Planning and Grants Team is dedicated to supporting you throughout the grant lifecycle.

As a longstanding partner, Stillwater holds a valued position among Meshek's grant management patrons. Our grants team consistently delivers quarterly reporting, handles reimbursement requests, and oversees grant closeout services for Stillwater's Engineering Department. We also maintain active login credentials for OK-EM Grants on behalf of Stillwater. Most recently, our grants manager finalized the closeout for Project F2019002-S3, the BRIC Grant supporting the Stillwater Master Drainage Plan, on April 16, 2024.

Expertise

As Oklahoma's leading Hazard Mitigation Planning firm, Meshek & Associates boasts a seasoned planning team with the necessary experience and expertise to deliver not just a comprehensive update to the City of Stillwater's Hazard Mitigation Plan, but one that surpasses mere compliance. Our expectation is to continue our working relationship with the City of Stillwater while fostering a dynamic collaboration that ultimately builds resilience in the City and increases preparedness for future disaster events. Through our working partnership, collaborative efforts will enhance community resilience while underscoring specific ways mitigation can make the City of Stillwater better prepared. The result is helping you build a stronger tomorrow – it is why Meshek exists.

Meshek has written FEMA-approved Hazard Mitigation Plans for over 131 communities across the state of Oklahoma. These plans include a compilation of data providing each community with an in-depth analysis of strengths and weaknesses while highlighting areas where mitigation actions could be beneficial. Our familiarity and prior work on Stillwater's Plan ensures a quick turnaround time between plan submittal and approval for the City of Stillwater. We recognize the importance of fulfilling FEMA requirements when it comes to the hazard mitigation process. Our commitment to your update includes providing a long-term, FEMA-compliant plan that will position the city for federal grant funding on projects identified during the risk assessment and beyond.

Strong Partnerships

We have developed long-lasting working relationships with the Oklahoma Department of Emergency Management (OEM), Oklahoma Water Resources Board (OWRB), and the Federal Emergency Management Agency (FEMA), along with many other valued partners across local, state, and federal agencies. Since 2011, we have served as the State of Oklahoma's contractor to implement FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) program initiatives statewide. Through these efforts, we have gained valuable experience working with local, state, and federal stakeholders to identify, prioritize, and mitigate risk for communities across Oklahoma.



\$24M

Community Development Block
Grant Disaster Recovery
(CBDG-DR)



\$21.8M

Building Resilient Infrastructure
and Communities
(BRIC)



\$88M

Hazard Mitigation Grant Program
(HMGP)



Innovative Services

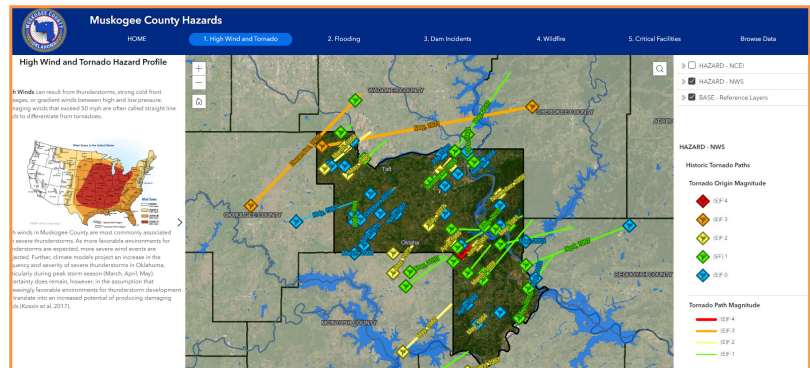
At Meshek, our hazard mitigation planning process integrates community GIS datasets and geospatial data to deliver tailored GIS figures and products beyond FEMA's requirements. Our cutting-edge GIS solutions are flexible, offering hosting options on either our server or yours, and can be tailored to your specifications. Whether you need damage assessment tools, interactive tracking tools for stakeholder engagement, or other solutions, our team is adept at finding answers to almost any challenge. Additionally, we offer an online, digital version of your approved plan for ease of access, alongside the traditional paper copy for those who prefer a tangible format.

GIS (Geographic Information Systems) is an integral part of Meshek's Hazard Mitigation Plan process. Meshek has invested in providing communities with datasets and visualization tools that allow your hazard mitigation plan to be interactive and sustainable. Our approach provides tools during the planning process to allow for stakeholder engagement, including summaries of important datasets used in the analysis of all hazards affecting the City of Stillwater.

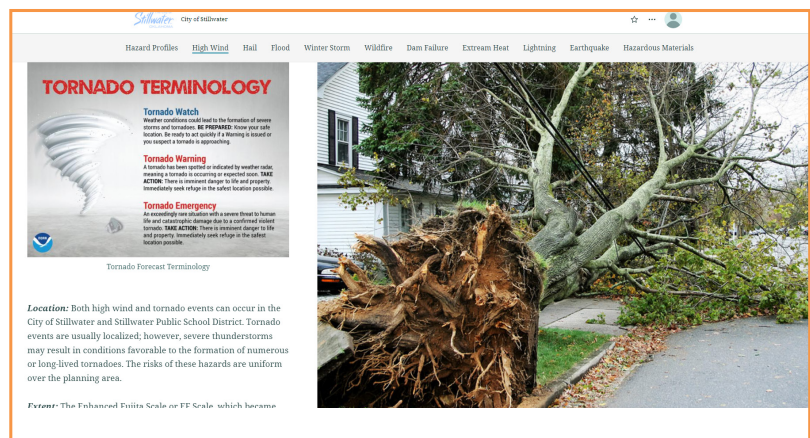
Meshek works with local community officials to ensure we have the best local, state, and federal data to provide comprehensive risk analysis and recommendations. These datasets will include but are not limited to, historic weather disaster events, flooding problem areas, critical facility locations/classifications, jurisdictional boundaries, wildfire risk areas, and other hazard-related datasets.

To improve citizen feedback, Meshek has also invested in creating online survey forms and other engagement options to collect input from the community and stakeholders during the planning process.

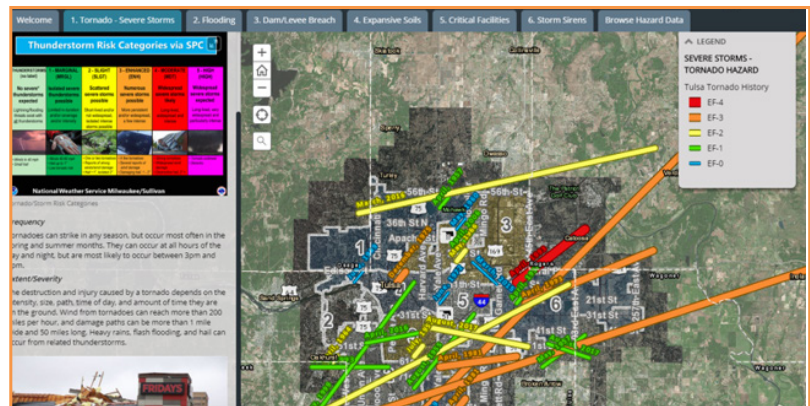
For the City of Stillwater Hazard Mitigation Plan Update, our goal will be to complement the existing GIS work Meshek created for the Hazard Mitigation Plan completed in 2020. We will provide updates to critical datasets and work with the City's GIS group to create new tools and applications for risk communication and hazard plan outreach. Any applications developed for this Hazard Mitigation Plan can be created, managed, and facilitated using the city's online GIS system. Meshek's team has worked directly with Stillwater's GIS group and with many other communities on their Hazard Mitigation Plan efforts, and we are comfortable working with Hub Pages, Dashboards, Viewers, Story Maps, and other application-oriented GIS project deliverables in a collaborative environment.



Muskogee County Hazard Mitigation Dashboard



Stillwater Hazard Mitigation Dashboard



Tulsa Hazard Mitigation HUB Site

Staff Experience

The Meshek Team is led by the former Northeast Area Coordinator for the Oklahoma Department of Emergency Management and Homeland Security, and supported by our entire team of grant managers, planners, GIS professionals, surveyors, engineers, voluntary acquisition and relocation agents, and external partners.

Stillwater[®] OKLAHOMA



Allison Whitsitt, AEM
Project Manager



Janet Meshek, PE, CFM, SR/WA
Planning Principal



Michael Couch, GISP, CFM
GIS Principal



Daniel Piltz
Senior Planning Manager



Wendi Lemons, MEP
Grant Project Manager



Chris Hill, GISP, CFM
GIS Project Manager



Archie Losey, CFM
Hazard Mitigation Planner



Gena Barnwell
GIS Analyst

Meet Our Project Team

The Meshek Team has extensive experience identifying mitigation solutions and developing grant proposals. Our team members have expert knowledge in the FEMA Benefit Cost Analysis and Hazard Mitigation Assistance process.



Allison Whitsitt AEM

Planning and Grants Department Manager

Allison brings valuable insight and expertise to the team as a former Northeast Area Coordinator for the Oklahoma Department of Emergency Management. Allison collaborates with all departments within the Meshek family, overseeing all hazard mitigation plans, grant applications, grant projects, and various other work. Allison brings insight to communities across Oklahoma and brings valuable technical expertise and boots-on-the-ground knowledge to Meshek and the communities we serve.



Janet Meshek PE, CFM, SR/WA

Planning Department Principal

With over 40 years of experience in engineering, Janet has prepared hazard and flood mitigation planning studies, written or updated ordinances and criteria manuals, including the City of Tulsa Design Criteria Manual, and supervised several municipal studies, including the prioritization of capital improvement projects and the updating of municipal fee schedules.



Daniel Piltz

Senior Planning Manager

Daniel began his career in emergency management at the Oklahoma Department of Emergency Management as a GIS Specialist in 2015. Since then, he has taken on various roles such as Northeast Regional Coordinator, Director of Grants Management, Preparedness and Response Director, and most recently, served as the Acting Deputy Director. He is also a co-owner of the Sperry-Piltz Ice Accumulation (SPIA) Index, which helps forecast the impacts of ice storms on electric utilities.



Wendi Lemons MEP

Grants Project Manager

Wendi joined the Meshek Hazard Mitigation Planning team as a Planning Project Manager. Wendi's 20+ years of professional experience combined with her formal education has allowed her to diversify her background so that she brings something to the table in nearly every aspect of public safety, from the fire line to the EOC, planned event management to national disaster deployment.



Archie Losey CFM

Hazard Mitigation Planner

Archie joined Meshek in 2022 with over 20 years of experience in meteorology and severe weather. A graduate of the University of Oklahoma, he brings a vast knowledge of the wide range of hazards that affect Oklahoma to Meshek's planning team. His skillset is complemented with expertise in data analysis, data science, and statistical analysis, as well as an insatiable desire to expand his repertoire.



Michael Couch GISP, CFM

GIS Principal

Since joining Meshek in 2006, Michael has helped many Oklahoma communities implement stormwater utility fees, perform FEMA mapping updates, launch municipal GIS programs, and map municipal utility systems. His largest projects include the mapping and necessary FEMA benefit-cost analyses for the multi-million-dollar City of Kingfisher floodplain property buyout, and the launch and ongoing support of the City of Enid GIS programs.



Chris Hill GISP, CFM

GIS Project Manager

Chris has been involved in numerous mapping and GIS projects for local communities since joining Meshek in 2000. He has municipal mapping, data visualization, project data organization, and project administration expertise. His current projects include developing GIS Web Applications for communities and working with Esri's ArcGIS Online resources to create mapping solutions.



Gena Barnwell

GIS Analyst

Gena joined Meshek in 2021, and has since summarized CMS survey features into condition ratings per stream segment for the City of Stillwater. She has designed a focused web application viewer and QA/QC surface and subsurface for the City of Tulsa. Gena has also created a public meeting map for the City of Jenks drainage study and assisted our planning team on many projects.



Supporting Services



Design
Engineering



H&H
Engineering



GIS



Land
Surveying



Right-of-Way

References & Work Examples

Meshek has enjoyed strong partnerships with municipalities and state agencies since our inception over three decades ago. From our founder to our field technicians, we manage projects with our communities best interests in mind. We have created a legacy in building trusted partnerships throughout the State.



City of Grove
104 West 3rd
Grove, OK 74344

Frank Close
Emergency Management Director

918.787.4357

fclose@cityofgroveok.gov

Grove is a unique community on the shores of Grand Lake in northeast Oklahoma, with an economy heavily dependent upon the lake for tourism. Another important factor taken into consideration during the composition of this plan was the significant number of retirement facilities, as a significant portion of their population chose to retire in Grove due to its location on Grand Lake. Meshek's Planning and GIS Teams collaborated to develop maps and risk vulnerability analyses to identify the hazards, how the community is affected, and what actions can be taken to mitigate those vulnerabilities.



City of Ponca City
PO Box 1450
Ponca City, 74602

Jesse Beck El, CFM
Environmental Services Director

580-767-0339

beckje@poncacityok.gov

Ponca City provided Meshek with a unique opportunity to showcase our adaptability to address specific requirements. As a CRS community, Ponca City aimed to enhance its CRS classification while fulfilling the requisites in the 600 series of the program alongside the development of their HMP. Integrating this addition into our conventional process proved to be an efficient method to fulfill the criteria for both programs simultaneously.

Additionally, the proximity to the Phillips 66 Refinery required an analysis of the City's Tier II facilities and their impact on the community. Following the development of Ponca City's HMP, we collaborated with the City to write and conduct a dam breach response exercise, meeting their request to fulfill the requirements of the CRS program's 600 Series.



Muskogee County
220 North State Street
Muskogee, OK 74401

Jeff Smith
Emergency Management Director

918.348.5014

jsmith@readymuskogee.org

Muskogee County selected Meshek to develop an update to its 2019 Hazard Mitigation Plan. Meshek was already managing two grants for the County and working on a hazard mitigation project to reduce the effects of flooding on a section of roadway in the County.

Planning activities began in late August 2023, and the first submission to OEM took less than 6 months. After approximately 75 days combined of review at OEM and FEMA, the plan was approved in mid-April 2024.

Key Project Employees Still Employed by Meshek

City of Grove - Janet Meshek, Allison Whitsitt, Wendi Lemons, Gena Barnwell, Archie Losey, Michael Couch, and Chris Hill

City of Ponca City - Janet Meshek, Allison Whitsitt, Wendi Marcy, Martha Ortega and Chris Hill

Muskogee County - Janet Meshek, Allison Whitsitt, Wendi Lemons, Archie Losey, Michael Couch, Chris Hill, and Gena Barnwell

Completed Over the Past Three Years

Client	Relevant Projects
City of Broken Arrow	Hazard Mitigation Plan
City of Grove	Hazard Mitigation Plan
City of Ponca City	Hazard Mitigation Plan
City of Stillwater	- HMGP Planning Application - Hazard Mitigation Plan - Master Drainage Plan
City of Tahlequah	Hazard Mitigation Plan
City of Tulsa	FEMA Hazard Mitigation Plan and Grant Management
Delaware County	Hazard Mitigation Plan
LeFlore County	Hazard Mitigation Plan
Muscogee Creek Nation	- Hazard Mitigation Plan - Tribal Complex MDP - Master Drainage Plan
Muskogee County	Muskogee County Multi-Hazard Mitigation Plan
Oklahoma County	Triple X Road HMGP Application Development
Okmulgee County	Hazard Mitigation Plan
Wagoner County	Hazard Mitigation Plan





GROVE OKLAHOMA

City of Grove 2023 Hazard Mitigation Plan



MESHEK
& ASSOCIATES, LLC



FEMA

July 25, 2023

Kim Jenson, Mitigation Planning Team Lead
Oklahoma Department of Emergency Management and Homeland Security
P.O. Box 53365
Oklahoma City, OK 73152-3365

RE: Approval of the Grove, Oklahoma Single Jurisdiction Hazard Mitigation Plan
Funding Source: HMGP; FEMA-DR-4587-OK #0006

Dear Mrs. Jenson:

This office has concluded its review of the referenced plan and we are pleased to provide our approval of this plan in meeting the criteria set forth by 44 CFR § 201.6. By receiving this approval, eligibility for the Hazard Mitigation Assistance Grants will be ensured for five years from the date of this letter, expiring on July 24, 2028.

This approval does not demonstrate approval of projects contained in the plan. This office has provided the enclosed Local Hazard Mitigation Planning Tool with reviewer's comments, to further assist the community in refining the plan going forward. Please advise the referenced community of this approval.

If you have any questions, please contact Shanene Thomas, HM Community Planner, at (940) 898-5492.

Sincerely,

A handwritten signature in black ink, appearing to read "Ronald C. Wanhanen".

Ronald C. Wanhanen
Chief, Risk Analysis Branch

Enclosure

cc: Shona Gibson, R6-MT-HM

Approved Participants

Attached is the list of approved participating governments included in the July 25, 2023 review of the referenced Hazard Mitigation plan.

Community Name

- | |
|---------------|
| 1) Grove city |
|---------------|

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Chapter 1 Introduction



1.1 Introduction

This document is the Multi-Hazard Mitigation Plan 2023 Update for the City of Grove. This plan update is developed in accordance with the Building Resilient Infrastructure and Communities Program (BRIC) and Hazard Mitigation Grant Program (HMGP) requirements. It also fulfills the requirements for the Flood Mitigation Assistance Program (FMA) from FEMA. The City of Grove is the sole jurisdiction that participated in this Plan. This Plan addresses natural and manmade hazards that can affect people and property in Grove.

1.1.1 Purpose and Scope

Mitigation is most effective when based on a comprehensive, long-term plan developed before a disaster occurs. The purpose of mitigation planning is to identify local policies and actions that can be implemented in the long term to reduce risk and future losses from hazards. The objective of this plan is to guide mitigation activities for the next five years. It will ensure that Grove implements hazard mitigation activities that are most effective and appropriate for the hazards that threaten the community. Given geographic jurisdiction of the planning area, the scope of the 2023 City of Grove's Multi-Hazard Mitigation Plan Update is citywide. The plan addresses both short-term and long-term hazard mitigation opportunities beyond existing federal, state, and local funding programs.

1.1.2 Goal

The overall goal of the Grove Hazard Mitigation plan is to create a disaster-resistant community and improve the safety and well-being of Grove by reducing deaths, injuries, property damage, environmental and other losses from natural and technological hazards in a manner that advances community goals, quality of life, and results in a more livable, viable, and sustainable community. The planning team solicited input from stakeholders and the public to develop this goal (see Chapter 2). Five of the top priority goals for the City of Grove include:

- Increase citywide ability to communicate and respond quickly and efficiently to disasters.
- Enhance public awareness and facilitate understanding of hazard mitigation.
- Reduce repetitive flooding impacts in high-risk areas of Grove.
- Educate first responders and health care providers regarding mitigation measures of specific hazards.
- Enhance pre-disaster and overall preparedness activities citywide.

1.1.3 The Planning Process

Planning for the City of Grove Hazard Mitigation Plan Update follows the ten-step process outlined in Chapter 2 of this plan and is based on guidance and requirements provided by the Federal Emergency Management Association (FEMA). Those ten steps are previewed below while Chapter 2 of this document dives into each step in greater detail.

1. Organize to prepare the plan
2. Involve the public
3. Coordinate with other agencies and organizations
4. Assess the hazard
5. Assess the problem
6. Set goals
7. Review possible activities
8. Draft the action plan
9. Adopt the plan
10. Implement, evaluate, and revise

1.1.4 Plan Organization

The plan and planning process are built from the community and hazard assessments to create a specific and actionable mitigation strategy. The surveys, assessments, research, and analysis are organized into the following six chapters:

Chapter 1: Introduction

Chapter 2: The Planning Process

Chapter 3: Capability Assessment

Chapter 4: Hazard Identification and Risk Assessment

Chapter 5: Mitigation Strategy and Action Plan

Chapter 6: Implementation and Maintenance

1.2 Community Description

1.2.1 Governance

The City of Grove has a council-manager form of government with five elected officials, including four elected by ward and one at-large. The council elects the Mayor and the Vice Mayor but is also responsible for hiring the City Manager, City Treasurer, City Attorney and City Judge. Administrative services are conducted by City Council under the direction of the City Manager, and together, the Mayor and Council will:

- Set policies and ordinances for the City of Grove
- Hold bi-monthly meetings
- Listen to citizens' concerns and complaints
- Appoint members to other boards and trusts
- Review and approve annual budgets

1.2.2 Geography

Grove is in northeast Oklahoma, within Delaware County and Cherokee Nation, at 36.59°N, 94.78°W. It sits along the eastern shores of the Grand Lake o' the Cherokees, within the foothills of the Ozark Mountains to the east. The city has a total area of 9.34 mi² (24.19 km²), and its elevation is 774 ft (236 m) above mean sea level. The 2020 U.S. Census recorded a population estimate of 6,956 residents.

1.2.3 Climate

Grove's climate is classified as humid subtropical (Cfa) under the Köppen climate classification system. Summers tend to be somewhat longer on average, with more heat and humidity, while winters are shorter and less severe than those of more northern latitudes.

Temperatures in Grove average around 60°F on an annual basis, while monthly averages can dip as low as 28°F in January and climb to an average high of 93°F in July. All-time temperature extremes, however, have a much broader range. Delaware County set an all-time record low in the City of Grove back on March 12, 1948, when the mercury plummeted to -14°F. On the opposite end of the spectrum, the County's all-time warmest temperature was set in Jay on July 18, 1954 when temperatures reached 118°F.

Annual precipitation in Grove averages around 46.48", with the driest year being 1963 when only 16.87" fell. Ten years later, Grove set an all-time record for the most annual rainfall when 81.66" were measured. Over the winter season, Grove sees frozen precipitation in one form or another. Oklahoma Climatological Survey shows Delaware County averages around 10.0" of snowfall each year, with snowfall on the ground for an average of eight days per year. October 31st is when the first freeze typically occurs, while the final freeze of the cold season can occur as late as April 6th. Records indicate that the highest 24-hour snowfall took place on March 7, 1941, when 14.0"

accumulated. Other climatological facts: the average humidity is 71%, with 53 days annually where a thunderstorm is observed, 3 of them containing hail.¹

1.2.4 History

Grove Quick History²

- May 22, 1902 – founded as Grove Indian Territory
- November 22, 1902 – incorporated as the Town of Grove
- October 7, 1980 – Voters approve changing the Town of Grove to the City of Grove with a council-manager form of government

Grove has its early roots as a trading post in the early 19th century, established near a grove of trees along the eastern bluffs and hills of the Neosho River, also known as the Grand River.

Federal troops during the Civil War referred to the Grove area as “Round Grove” in their official reports. Some other earlier names included Monroe Grove, Tabor’s Grove, and more frequently, Grove Springs, which came to be a small settlement near a freshwater spring that served as a resting place for weary travelers along the Texas Road. The word “Grove” was incorporated into each name, which allowed it to naturally become adopted as the official name. The Town of Grove was the only incorporated municipality in Delaware County when Oklahoma became a state.

In 1907, the Oklahoma Constitutional Convention delegates originally selected Grove as their choice for the county seat during statehood because it was the largest town and the first to have a railroad. Eventually, the county’s southern residents complained that the distance to Grove was too far to travel to conduct business. After it was put to a vote, and some subsequent legal contention, the county seat was moved to Jay in 1911.

In 1905 oil was discovered in a mineshaft near the Grand River. Another deposit was discovered in 1917, northwest of town. The construction of Pensacola Dam to the south between Langley and Disney a couple of decades later, however, would become a seminal milestone in this municipality's development.

In September 1937, upon federal approval of \$20 million in funding through the New Deal’s Public Works Administration, Grove’s destiny was forever changed, and construction of the Pensacola Dam began the following February under the supervision of the Grand River Dam Authority.

The Dam was completed in 1940, and became the world’s longest, continuous, multiple-arch dam. It also has the distinction of being the state’s first hydroelectric facility.³ It measures one mile across the Grand River Valley and reaches ten stories high. The lake's surface behind the dam has a total area of 59,200 acres, with 1,300 miles of shoreline, and stretches about 66 miles from its headwaters near Miami to the Dam. 99% of the lake lies within the boundaries of Delaware County.

Upon creation of the lake, bridges were needed to connect Grove to the other side. To the north, Sailboat Bridge was built, while on the south, Honey Creek Bridge was torn down and rebuilt.

The lake is an important part of Grove, its identity, and its economy. It’s a popular attraction for visitors, recreation, and retirees. In 1987, Rand McNally rated the Grand Lake area, which includes Grove, as the fourth best place in the United States to retire due to the beautiful scenery of the Lake, in addition to the low cost of

¹ [Oklahoma Climatological Survey | Delaware County Climate](#)

² [City of Grove History | City of Grove Oklahoma](#)

³ [History | GRDA](#)

living.⁴ This once small trading post has become one of the foremost recreation and tourist areas in Oklahoma, and the nation.

1.3 Community Assets

Community assets are defined broadly to include anything that is important to the character and function of a community and can be organized very generally into the following four categories: People, Economy, Built Environment, Natural Environment.

Although all assets may be affected by hazards, some assets are more vulnerable because of their physical characteristics or socioeconomic uses. This section describes assets in the Planning Area.

1.3.1 People

Population Growth

Census data indicates a continuous trend of slight increases in Grove's population since the 2010 assessment. The 2020 Census observed 6,956 permanent residents in Grove, up 2.1% from the 2010 Census. Current estimates indicate that the population has continued to increase modestly and is currently at 7,033 permanent residents. Due to the recreational nature of the lake, the number of people in the Grove area fluctuates upward during the warmer months and recedes during the colder months.

Vulnerable Population Indicators

People are the most important asset for all jurisdictions in the planning community. Every person who lives in the planning area can experience some level of exposure to the hazards assessed in this plan. It is important to understand the demographic characteristics that make some residents in the planning area more vulnerable to hazards. This section will inform the vulnerability assessments found in Chapters 3 and 4 and allow for targeted mitigation actions (Chapter 5) that will increase the resiliency of the participating communities. Seven of these vulnerable population indicators were identified by the planning team.

1. Children under the age of 5

Young children have vulnerabilities to some hazards due to their physiological makeup, such as extreme temperatures or hazardous materials. In addition, they rely on caretakers to fulfill all their needs. Young children's higher levels of need, compounded by a lack of awareness of hazards, increase a family or community's vulnerability to hazards. Table 1-1 below provides 2021 ACS estimates for residents under the age of 5.

2. Elderly over the age of 65

People over age 65 are also vulnerable to hazards. They are more susceptible to extreme temperatures and may have less of an ability to preserve life and property during or after extreme events. They are also more likely to be retired and on a fixed income, which could limit their ability to recover financially from disasters. This is a factor to be considered, since the percentage of people over 65 throughout Grove considerably outpaces the state average, as noted in Table 1-1 below.

3. People who speak a language other than English

Non-English or Limited English-speaking residents may need outreach in another language to understand hazard warning and advisory products, and how to respond. Additional study is needed to confirm which languages would be best for targeted outreach to minority communities. According to American Community Survey (ACS) data, the language spoken most frequently throughout Grove after English is Spanish.

⁴ [Ranking The Best Places To Retire - The New York Times \(nytimes.com\)](https://www.nytimes.com/2021/05/14/us/best-places-to-retire/)

4. People who did not graduate from high school

A lack of high school education can often limit one's ability to earn high-paying jobs. A lack of education can therefore inhibit one's ability to earn an income that exceeds the national poverty level. This vulnerable population may have less income potential and is more likely to be living near or under the federal poverty line. A lack of income can limit one's housing options, with those in poverty frequently occupying low-income housing development, with can often be at a greater risk of seeing damages from hazardous events. Furthermore, a lack of education can potentially limit one's ability to understand or comprehend public education/outreach materials. Table 1-1 shows how Grove compares to the County and State in terms of high school graduation in 2021.

Table 1-1 Vulnerable Population Indicators 1–4 According to 2021 ACS data

	Residents Under 5 Years Old	Residents Over 65 Years Old	First Language other than English	Did not graduate high school
Oklahoma	6.2%	16.2%	10.6%	11.4%
Delaware Co.	5.1%	24.8%	4.6%	14.8%
City of Grove	3.3%	29.2%	2.9%	8.5%

5. Racial Demographics: Marginalized Populations

Race can also play a role in vulnerability, especially for historically marginalized groups. Race is correlated with other indicators profiled by the planning team, including poverty and education. Historical marginalization can also negatively affect a racial group's access to resources and capabilities. These groups also can be suspicious of authorities, making mitigation and recovery more difficult. Some non-white minority groups may have access to additional or extra-community resources, such as Native American Tribal citizens, which may decrease their vulnerability.

Table 1-2 Vulnerable Population Indicators 5 According to 2021 ACS Data

	Caucasian	Black/African American	Native American	Asian	Other	Two or more races
Oklahoma	73.2%	7.8%	9.7%	2.5%	2.7%	6.6%
Delaware Co.	65.0%	0.6%	24.8%	1.4%	1.1%	8.9%
City of Grove	78.0%	0.5%	11.6%	0.8%	1.6%	3.9%

The Planning Area has a notable Native American population, slightly above the state average, but less than half of the county average. Grove, and all of Delaware County, are completely within the bounds of Cherokee Nation, which has a large influence in this statistic. Members of this nation are important members of the City of Grove. The Tribal governments can be important partners to local governments and fire departments; these partnerships are key to increasing the planning area's resiliency.

6. People Living with a Reported Disability

American Community Census (ACS), estimates the percentage of the population living with a disability through self-reported surveys. Individuals with different disabilities may need secondary methods of receiving warnings, assistance during isolation, a constant flow of electricity to power life-sustaining apparatus, or help evacuating. ACS's definition of disability includes hearing, vision, ambulatory, cognitive, self-care, and independent living

difficulties.⁵ Grove's disability rate is about 27.2%, compared to Delaware County (23.4%) and the state of Oklahoma (16.0%).

Table 1-3 Vulnerable Population Indicators 6 According to 2021 ACS Data

	Hearing Difficulty	Vision Difficulty	Cognitive Difficulty	Ambulatory Difficulty	Self-Care Difficulty	Independent Living Difficulty
Oklahoma	5.1%	3.4%	6.3%	9.1%	3.0%	6.8%
Delaware Co.	7.7%	4.8%	9.1%	11.5%	4.1%	10.0%
City of Grove	8.6%	4.9%	9.2%	12.3%	4.5%	10.7%

7. People who live below the poverty line

The planning area also has a slightly higher percentage of people living below the poverty line than the Oklahoma average. Low-income populations may be susceptible to damages from hazards, due to factors like poorer structural construction of their shelters, lack of access to resources, and shelter location. Lower-income populations also may take longer to recover financially from the impact of a hazard (see Chapter 3).

Table 1-4 Vulnerable Population Indicators 7 According to 2021 ACS Data

	Below 100 percent of the poverty level	Total Households	Household Median Income	Household Mean Income
Oklahoma	15.6%	1,493,569	\$53,840	\$74,195
Delaware Co.	18.1%	16,988	\$44,268	\$60,838
City of Grove	16.9%	2,995	\$42,780	\$71,803

⁵ [American Community Survey and Puerto Rico Community Survey 2019 Subject Definitions \(census.gov\)](https://www.census.gov/popest/data/totals/2019/states/00.html), pg 61.

Figure 1-1 Percent of the Population Under the Age of 5

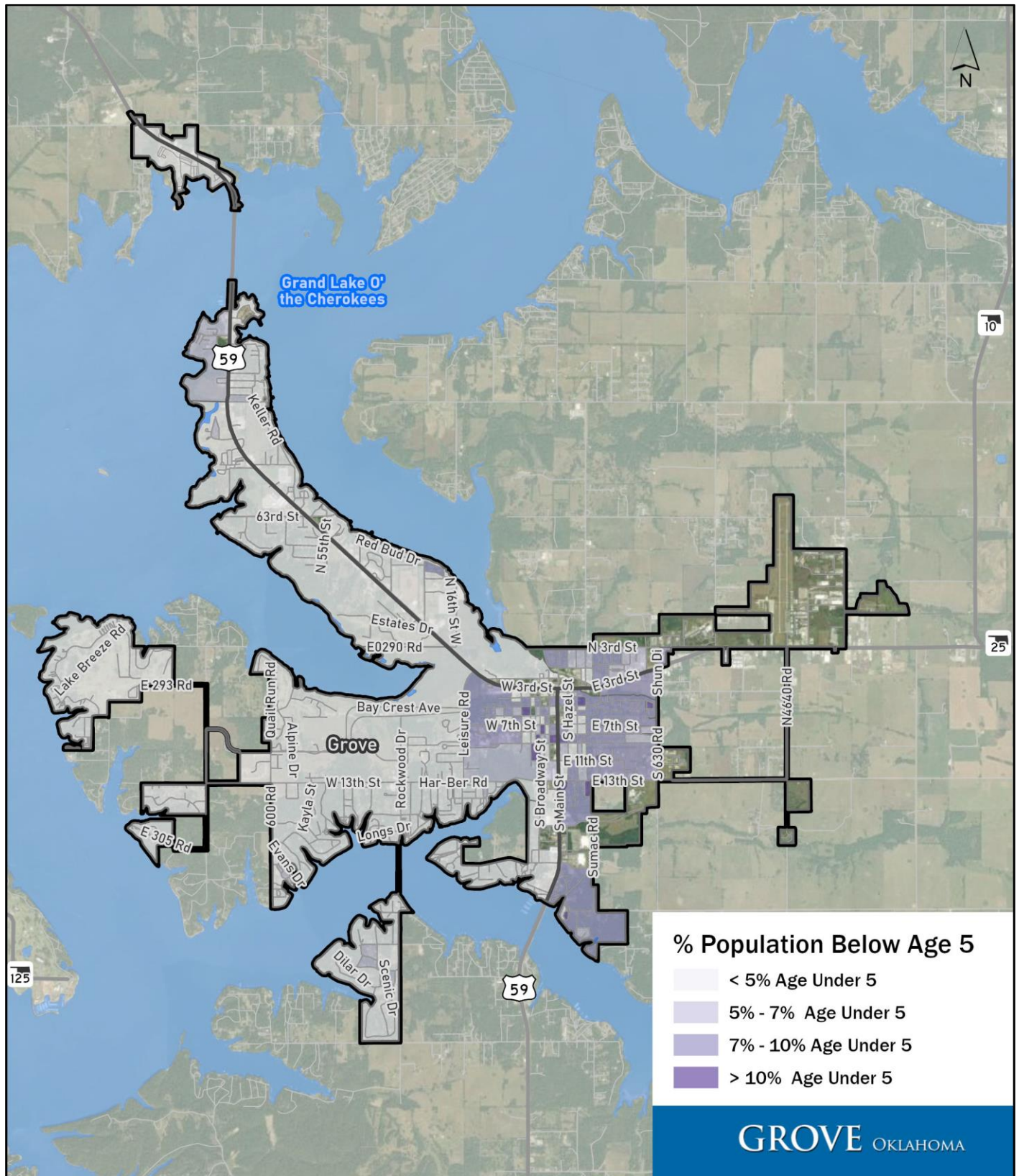


Figure 1-3 Percent of the Population Who Speak a Language Other Than English at Home

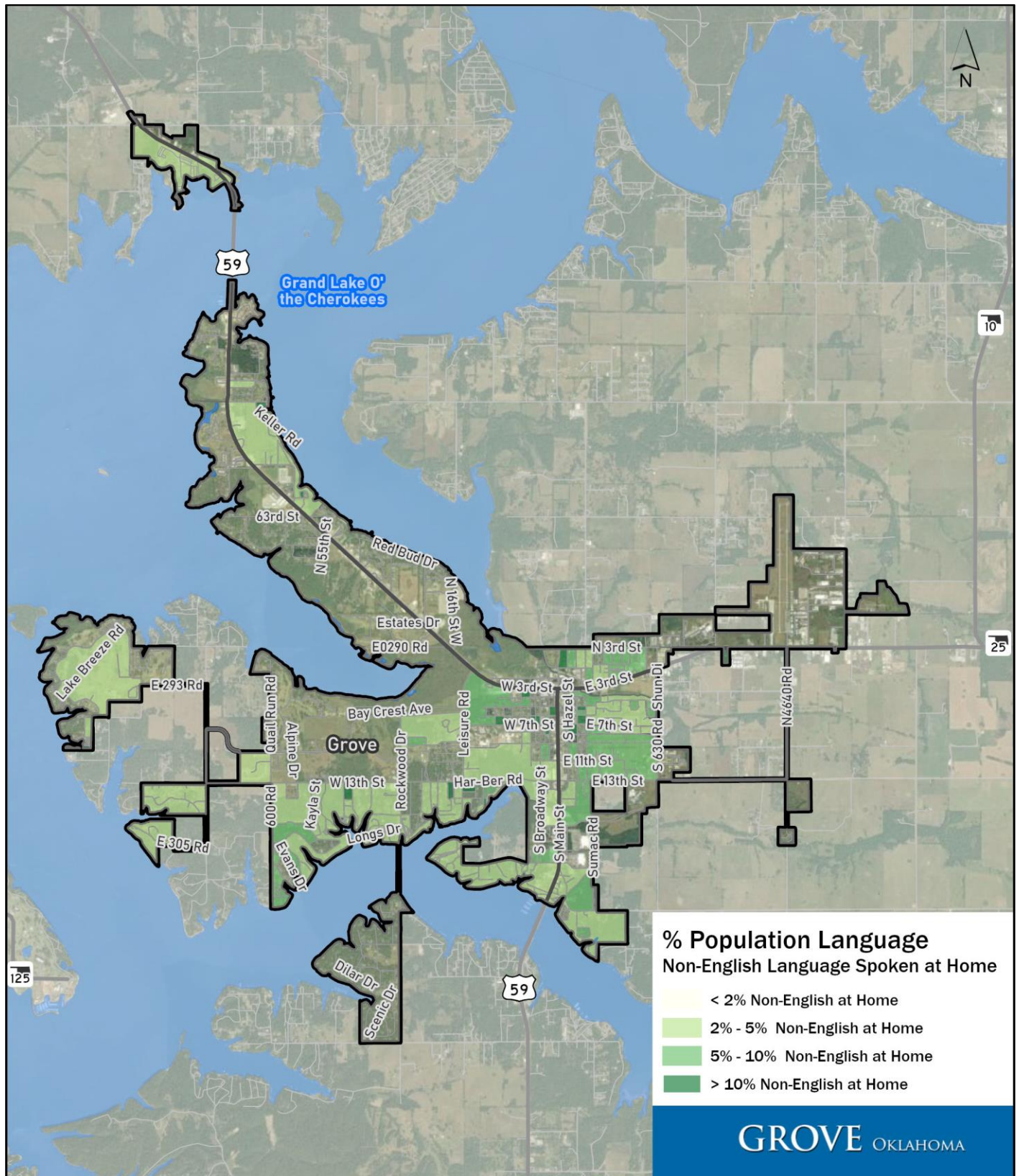


Figure 1-4 Percent of the Population Who Did Not Graduate High School

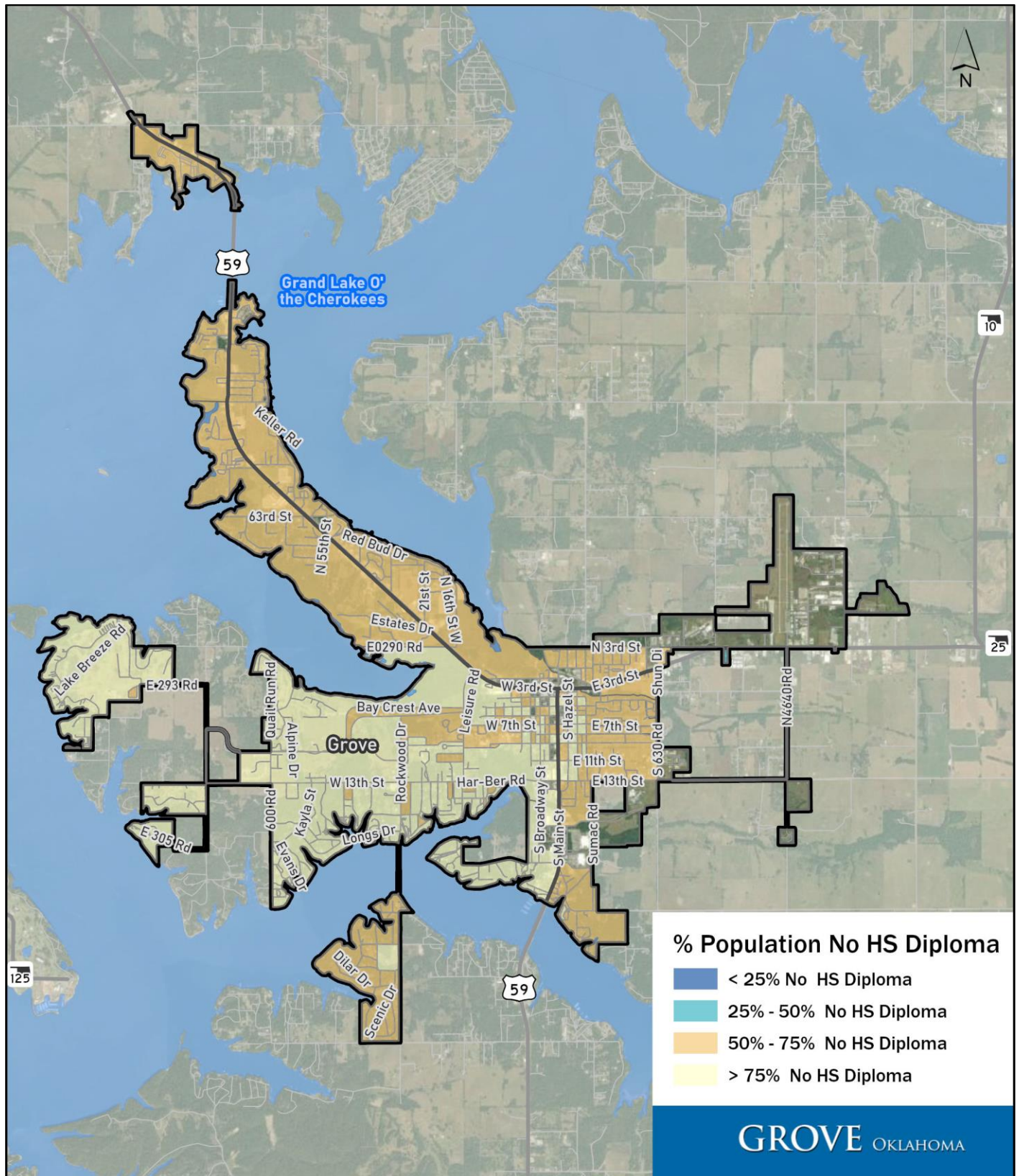


Figure 1-5 Percentage (%) of Non-White Population

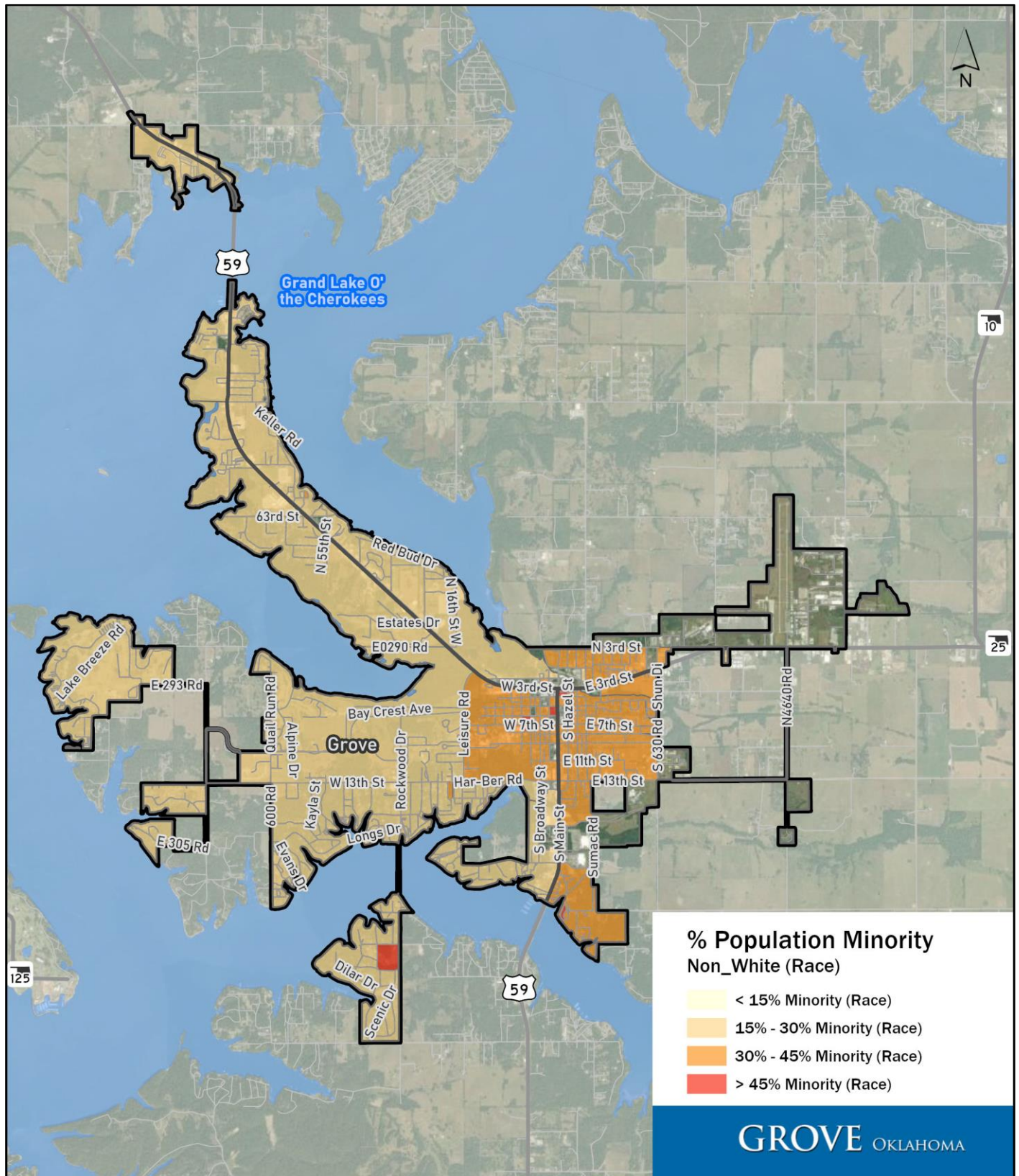


Figure 1-6 Percent of the Population with at Least One Reported Disability

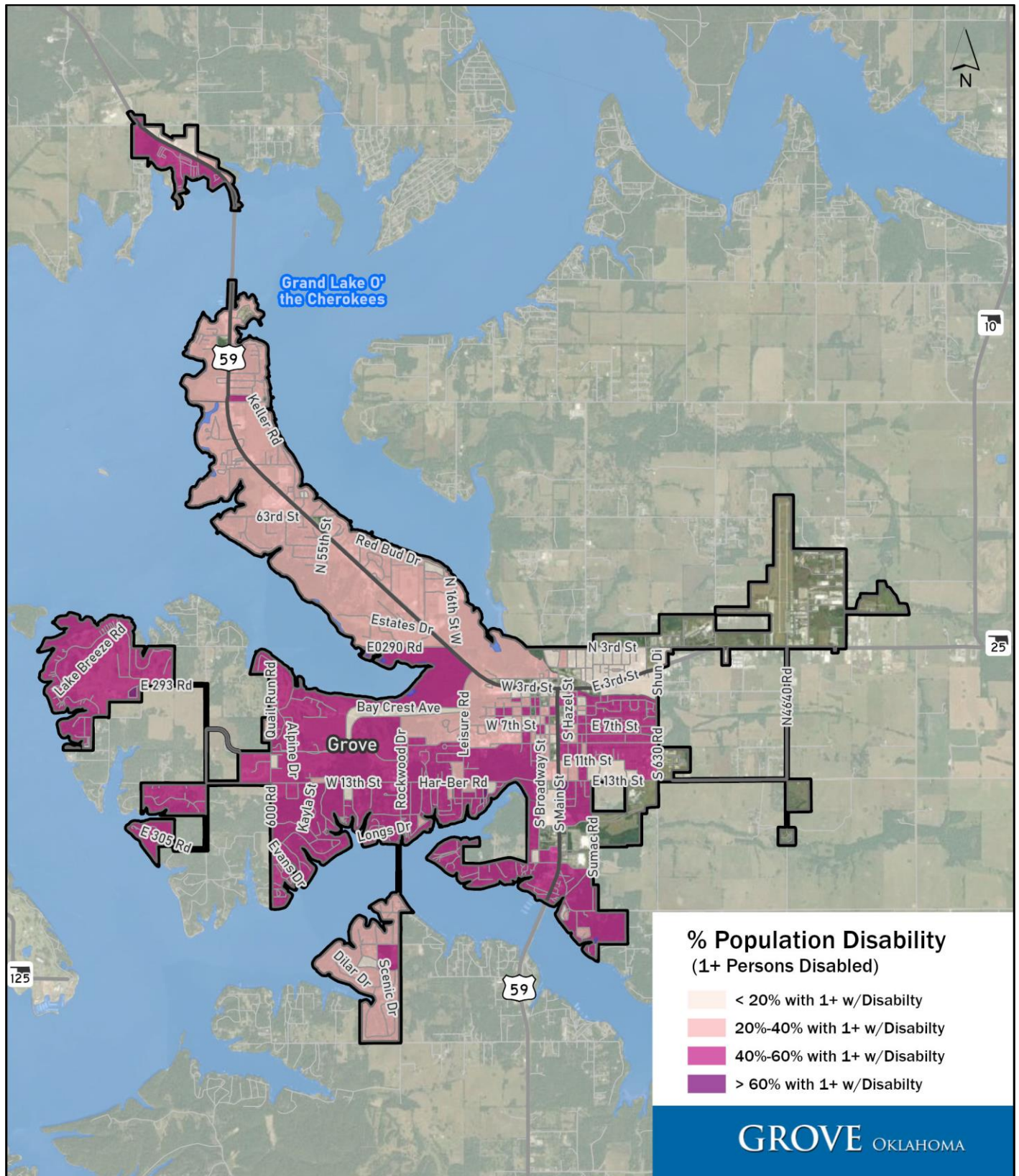
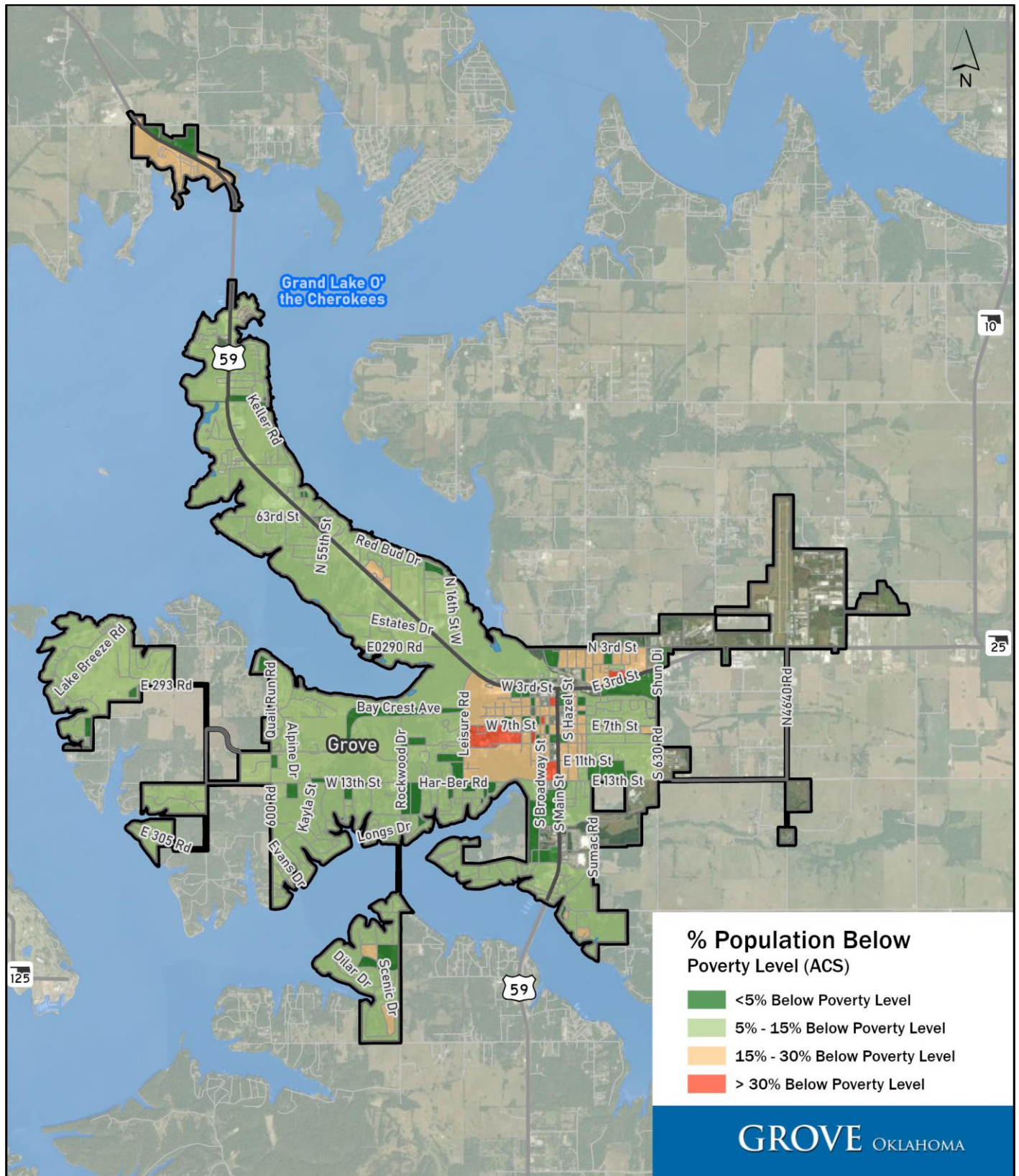


Figure 1-7 Percent of the Population Living Below the Poverty Line



1.3.2 Economy

Grove's economy is heavily dependent upon the Grand Lake o' the Cherokees for the recreation and tourism it provides, as well as its effect on other factors such as business profitability, property values and electric power generation from Pensacola Dam. Agriculture, while a much smaller portion of the economy here, is a secondary economic factor for the community. The City of Grove promotes itself as being "progressive and pro-business."

The City of Grove operates the Grove Municipal Airport, located on the city's northeastern outskirts, through the Grove Municipal Airport Managing Authority. This facility is a critical lifeline to major employers in the city. During construction of the hospital, it was utilized by several contractors, and is often used by the medical community for life flight services. Several companies in and around Grove also utilize the airport as their home base.

1.3.3 Built Environment

The built environment includes existing structures, infrastructure systems, and cultural resources within the planning area. Given the importance of understanding their direct and varied risks, critical facilities and lifelines are discussed at length in Chapter 4.

This section describes critical facilities and FEMA lifelines, given their importance in maintaining the continuity of basic and life-sustaining services in the planning area. The planning team has identified critical facilities that are exposed to increased flooding risk, which is the baseline standard for FEMA. The planning team then expanded their study to identify critical facilities that are at risk for any of the identified hazards across the entire planning area, when possible. A map of critical facilities can be found in Figure 1-8 below while each Lifeline is described in Table 1-5.

Critical facilities can impact one or more community lifelines. Lifelines, however, provide officials and residents a system-wide approach to mitigation.⁶ FEMA's community lifelines are *systems* that are essential a community's basic functioning by supporting key government, business, and other essential functions. Lifelines can be composed of chains of critical facilities and other assets.

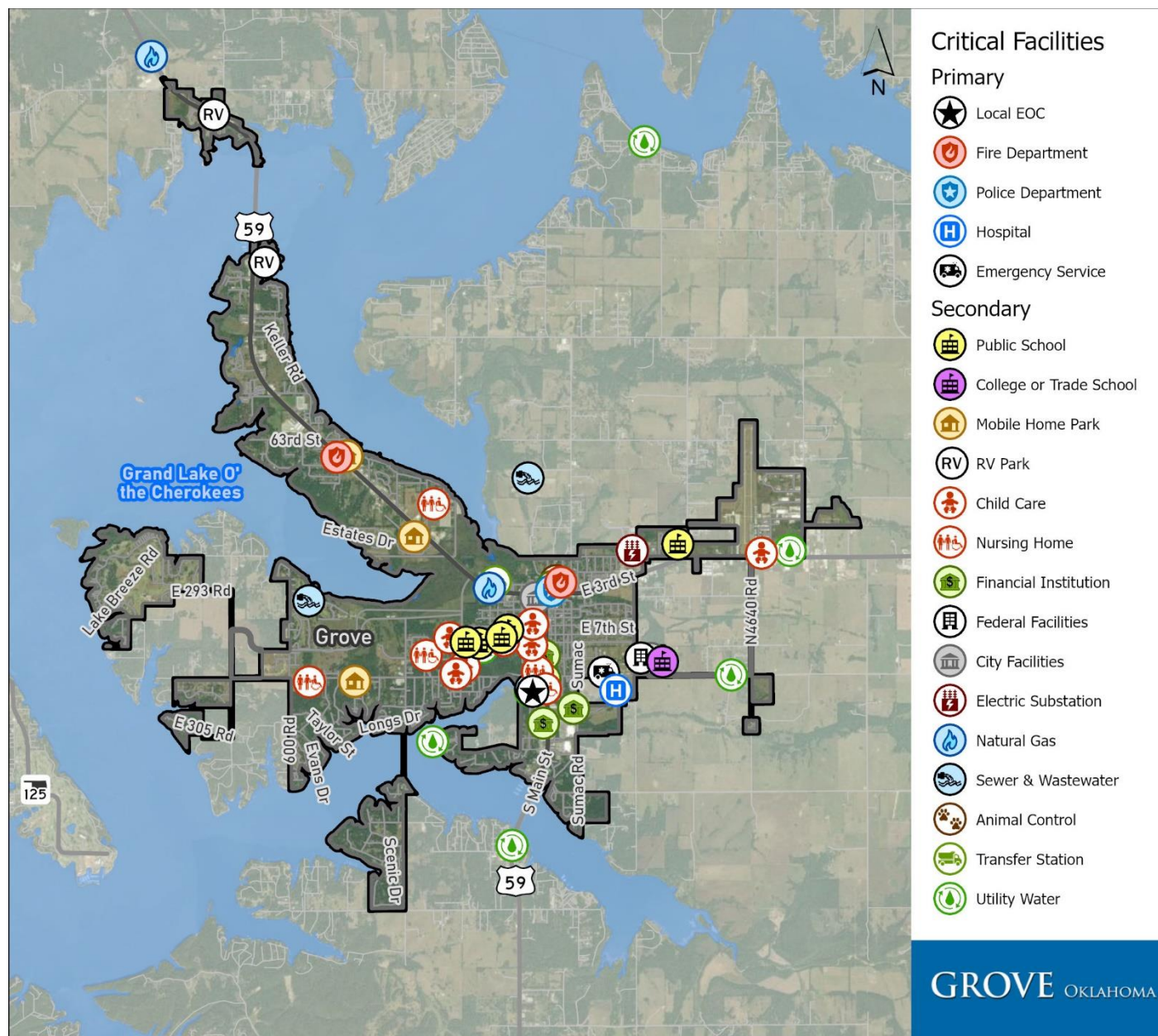
⁶ <https://www.fema.gov/emergency-managers/practitioners/lifelines>

Table 1-5 FEMA Community Lifeline List

	Safety and Security - Law Enforcement/Security, Fire Service, Search and Rescue, Government Service, Community Safety
	Food, Water, Shelter - Food, Water, Shelter, Agriculture
	Health and Medical - Medical Care, Public Health, Patient Movement, Medical Supply Chain, Fatality Management
	Energy - Power Grid, Fuel
	Communications - Infrastructure, Responder Communications, Alerts Warnings and Messages, Finance, 911 and Dispatch
	Transportation - Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Maritime
	Hazardous Material - Facilities, HAZMAT, Pollutants, Contaminants

Along with a profile of each natural hazard, Chapter 4 contains a discussion surrounding Grove's critical facilities and how FEMA Lifelines pertain to each of the seven shown above. To further understand the relationship between these facilities and FEMA Lifelines, additional maps can be found on the [Grove Hazard Mitigation HUB](#) webpage, with one such example being a map layer for the major components of the Energy Lifeline given its outsized impact on the delivery of basic services in the planning area.

Figure 1-8 Critical Facilities in the Planning Area



Systems and Infrastructure

Critical components of the systems and infrastructure that deliver electricity, water/wastewater, and natural gas to Grove, as well as the transportation network across the planning area, are an important factor that was considered in hazard risk assessment (see Chapter 4).

Grove Municipal Services Authority (GMSA) is operated by the City of Grove and provides water/wastewater and natural gas services to residents of the city. Electrical delivery is primarily provided by American Electric Power (AEP), though Northeast Oklahoma Electric Cooperative (NOEC) also provides electrical service to portions of the planning area⁷.

⁷ WHO WE ARE – Northeast Oklahoma Electric COOP (noec.coop)

Transportation across the planning area is overwhelmingly defined by the network of surface roads. Grove Municipal Airport is northeast of the primary incorporated section of the city and serves as a base for life flight services for medical care stakeholders in the community, such as INTEGRIS Health Grove.

Existing Structures

Many different types of structures comprise the built environment fabric of the City, and Table 1-6 below breaks down the structure type as well as their combined estimated market value as determined by GIS analysis.

Table 1-6 City of Grove Built Environment Breakdown

Structure Type	Number	Estimated Market \$
Residential	2,596	\$468,578,000
Residential – Multi	40	\$10,956,000
Commercial	710	\$216,448,802
Government	73	\$3,712,500
Education	26	\$1,573,700
Tribal	32	\$11,243,000
Rural Ag & Rural Residential	36	\$3,790,939
Church & Other Exempt	77	\$11,898,800
TOTAL	3,590	\$728,201,741

Hazards presented in this plan can impact all of these structures, and each is exposed to risk. In addition to structural vulnerabilities, the nature of where these buildings are located in the City can also determine their individual vulnerability. Things such as location, building age, construction type, condition or use are just a few of these determining factors.

Infrastructure

Infrastructure systems are critical for life safety and economic viability and include transportation, power, communication, and water and wastewater systems. Many critical facilities depend on infrastructure to function. For example, hospitals need electricity, water, and sewer to continue helping patients. The continued operations of infrastructure systems during and following a disaster are key factors in the severity of impacts and the speed of recovery. Appendix C of this document lists all critical facilities identified by officials, including hospitals and medical facilities.

Utilities

Utilities in the City are managed under the Grove Municipal Services Authority (GMSA), who ensure gas, water, and wastewater systems of the city are available and remain reliable. Multiple electricity providers service the area; however, the two primary providers are the Northeast Oklahoma Electric Cooperative and Public Service Company of Oklahoma (PSO).⁸

Transportation

U.S. Highway 59 is the primary thoroughfare that passes through the planning area, entering Grove from the northwest across Sailboat Bridge, making a turn to the south in the center of town, crossing the Lake once again as Honey Creek Bridge, then continuing southward across Delaware County after exiting town.

Two state highways also pass through the planning area: OK-10 and OK-25. OK-10 continues eastward from US-59 after it makes its southward turn in central Grove. It also makes a turn northward as it conjoins with S 665 Road. OK-25 picks up and continues eastward to the Missouri state line after this turn.

No interstate systems or railroad lines cross through Grove and the Municipal Airport on the eastern fringes of the city limits serves general aviation (non-commercial) air traffic.

⁸ <https://poweroutage.us/area/county/1879>

Cultural Resources

The National Register of Historic Places lists 3 preserved properties in Grove – one historic site and two historic buildings. The site listing is the Bassett Grove Ceremonial Grounds, an asset of the Seneca-Cayuga Nation. The two historic buildings in the City are the Corey House-Hotel near the center of town, and Splitlog Church (Cayuga Mission Church), near the Carr Branch of Grand Lake.

1.3.4 Natural Environment

Grove is in the western extent of the Springfield Plateau of the Ozark Mountain System. The City is along the eastern shores of Grand Lake of the Cherokees, created with the completion of the Pensacola Dam in 1940. Prior to this point, Grove overlooked the Grand River Valley. This lake is a defining characteristic for Grove and is a significant part of its livelihood. Residents and visitors utilize the lake for recreation, and the Academy Sports + Outdoors Bassmaster Classic has been held on this lake twice recently, in 2013 and 2016.

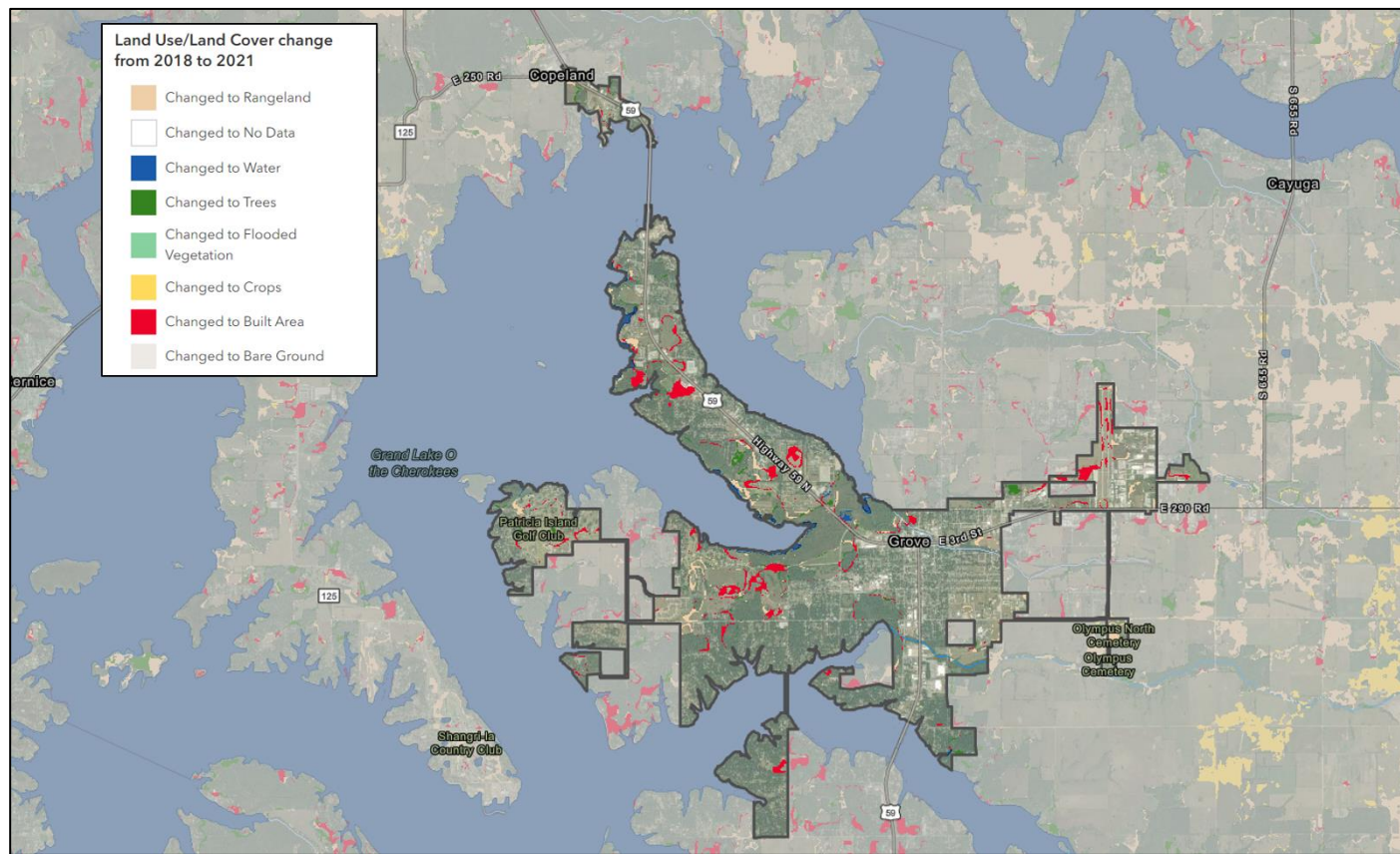
1.3.5 Recent and Future Development

Recent Development

City of Grove did not experience significant growth or development since the 2012 plan. Development, including school district growth, was discussed in the planning process. It was determined any growth was minimal and had no impact on the exposure of the planning area to hazards addressed in this plan. Future buildings, infrastructure, and critical facilities are not expected to have any different vulnerability than existing structures. Continued public education, building code and Flood Damage Prevention Ordinance enforcement, and the encouragement of future public and private safe room construction will have a positive impact in reducing vulnerability. The Committee is unable to approximate associated costs, numbers, and types for future structures.

Using Sentinel-2 10m satellite data available on Esri, Figure 1-9 provides a graphical depiction of what changes have occurred in recent years across the City of Grove. Aside from annexing the parcel of land near Copeland, primary changes are the expansion of built areas within the city's boundaries.

Figure 1-9 Land Use Change from 2018-2021



Future Development

Commercial construction including buildings, infrastructure and critical facilities built in the City of Grove may enjoy a reduced vulnerability over residential construction because many of these facilities will be designed by a professional architect using nationally accepted building codes. The size, value, and employment implications of the commercial buildings will bring attention to community leaders who may provide guidance to local conditions affecting the construction. Residential construction builders in Grove are required to purchase permits, have in-progress inspections, and follow any building or zoning codes set forth by the city.

Chapter 2 The Planning Process

The planning process for the City's 2023 Hazard Mitigation Plan (HMP) Update followed ten-steps which were based on the guidance and requirements of the Federal Emergency Management Association (FEMA). These steps are detailed at length in the following sections.

2.1 Step One: Organize to Prepare the Plan

2.1.1 Core Planning Group

To facilitate step one, the City of Grove Hazard Mitigation Core Planning Team (see Table 2-1) was formed to provide guidance during the preparation of this Plan. As a single jurisdiction plan, the majority of this team was comprised of representatives from local government. Input was solicited from local businesses/industries, state government and non-governmental organizations as needed to complete the plan. The four-month long planning process included regular planning meetings held by the team and culminated in early 2023 when the plan was completed. The goal of the team is to mitigate the loss of life and property as well as the subsequent monetary loss resulting from natural and man-made disasters. The team is able to do this by implementing cost effective recommendations of publicly accepted, prioritized, and multi- objective mitigation measures.

The planning meetings were designed for public involvement to explain the basis of the State Hazard Mitigation Plan and requirements for local jurisdictions within the State of Oklahoma such as the City of Grove. During these meetings, residents of the City of Grove and local officials are encouraged to provide input regarding the hazards they believe the City of Grove faces and the capabilities the city has access to in order to respond to disasters effectively. Grove's Director of Emergency Management confirmed that the public's involvement and participation was solicited on through social media outlets as well as through announcements issued by City Hall. Appendix C of this document contains official meeting sign-in sheets and meeting agendas, including January's Public Meeting.

For the City of Grove, Core Planning Team participants provided local history, reviewed NCEM data, addressed and analyzed issues of cost versus health/safety, and made recommendations to the plan. Then, as the HMPC team, they discussed these items in open meetings, approved the Plan and recommended to the City of Grove Council for Plan approval.

Effort was made to solicit public input during the planning process through the LEPC public meetings at the Emergency Operation Center for which each agenda was posted according to the Oklahoma Open Meeting Law. Feedback received from the public proved valuable in the development of the Plan. Comments and open discussion led to addressing and prioritizing mitigation actions (i.e. warning devices, communication, education and training).

Table 2-1 Core Planning Team Participating in the 2023 City of Grove HMP Update

Name	Jurisdiction	Title/Role	POC
Deric Douthit	City of Grove Public Works	Public Works Director	
Frank Close	City of Grove Emergency Management	Director	✓
Mark Morris	City of Grove Police Department	Chief of Police	

The Planning Process was comprised of a variety of community members, stakeholders, and City officials in what this plan will refer to as the Stakeholder Group. Table 2-3 details the meeting times in which members of the Stakeholder group (or planning team) were invited to participate, and while these meetings were held in person at the EOC, they were also hosted online via Microsoft Teams.

2.1.2 Stakeholder Planning Group

Efforts to update the City's Hazard Mitigation Plan were accelerated by community stakeholders and City personnel (see Table 2-2). Stakeholders provided updated information pertaining to their specific roles as well as any changes that have occurred since the previous hazard mitigation plan. The City EM director provided a detailed list of City stakeholders, and each of these individuals were ones who had worked directly with the City EM to update the 2012 City HMP. In late 2022, planners from Meshek & Associates joined the City-wide effort to help complete the 2023 Update which has already begun by the City EM Director. While the numerous stakeholders listed in Table 2-2 were ones who were involved in the planning process, only the bolded names were members who were involved after Meshek was hired. Stakeholders were invited to each of the three planning meetings detailed in Table 2-3.

Table 2-2 Community Members & Representatives Invited to Participate

Name	Role	City Affiliation	POC
Art Kopp	Member	City of Grove Planning and Zoning	
Brenda Bryant		ODEMHS	
Calvin Igney	Inspector / Floodplain	City of Grove	
Chuck Perry	Member	Zoning Board of Adjustments	✓
Corey Reeves	Director	Grove EMS	
Darren Cook	City Attorney	City of Grove	
David Adzigan	Member	Grove Economic Development Authority	
Debbie Bottoroff	City Manager	City of Grove	
Ed Trumbull	Mayor	Grove City Council	
Ileta Bray	Member	Zoning Board of Adjustments	
Ivan Devitt	Councilman	Grove City Council	✓
Jaime Johnson	Administrator	Grove Nursing Center	
Jeff Reeves	Director	Delaware County Emergency Management	
John Kosted		Betty Ann Nursing Center / Grand Lake Villa	
Jonas Rabel	Administrator	Integris Grove Hospital	
Josh Wilheelm	Member	City of Grove Planning and Zoning	
Kaston Johnson	GIS Mapping	Grove Municipal Services Authority	
Keith Martin	Member	Grove Economic Development Authority	
Kevin Clement	Administrator	Grand Lake Villa	
Lisa Allred	City Treasure	City of Grove	
Lisa Slayton	Administrator	Betty Anne Nursing Home	
Marty Dyer	Councilman	Grove City Council	
Matt Henderson	Councilman	Grove City Council	
Mike Lewandowski	Vice Chairman	Grove Economic Development Authority	
Mike Reed	Fire Chief	City of Grove Fire Department	
Pat Dodson	Superintendent	Grove Public Schools	
Peggy Keifer-Steed	Member	City of Grove Planning and Zoning	
Pierce Taylor	D.P.S.	American Red Cross	

Name	Role	City Affiliation	POC
Richard Cannon	Vice Chairman	City of Grove Planning and Zoning	
Ron Lay	Chairman	Grove Economic Development Authority	✓
Samuel Rauh	D.P.M.	American Red Cross	✓
Sharon Stewart	Administrator	Grandwood Assisted Living	
Stan Weese	Member	Zoning Board of Adjustments	
Steve Ward	Chairman	City of Grove Planning and Zoning	✓
Steven Thomas	Councilman	Grove City Council	
Thomas Coleman		Grove Nursing	

**bolded names were those who participated in the planning process once Meshek & Associates, LLC were hired to help complete the City's HMP Update.*

Table 2-3 Stakeholder Workshop Meetings hosted by Meshek & Associates

Meeting	Date	Purpose
Stakeholder Workshop #1	09/26/2022	Review the Planning Process, new FEMA HMP guidance, discussion of community capabilities, as well as hazard profile and overview discussion
Stakeholder Workshop #2	11/17/2022	Collection of additional capability information, a review of previous mitigation actions, proposal of new mitigation action items, discussion of City MOUs and Long-Term Care Facilities,
Public Meeting	01/11/2023	In addition to demonstrating the City's GIS HMP Viewer, attendees heard an overview of the HMP adoption process, the importance of HMP documents for community resiliency, as well as how the plan's adoption process occurs.

2.2 Step Two: Involve the Public

The City of Grove allows multiple opportunities for public involvement in the continual reshaping and updating of the Hazard Mitigation Plan. One method used in this 2023 update was an online survey which went “live” on September 23, 2022. Participation in the online survey provides the public an opportunity to comment on their perception of hazards identified by the planning team and the severity of those hazards. Invitations to participate in the survey were provided via e-mailed links, QR codes, as well as public survey “promo” flyers like the one shown in Figure 2-1. Communicating digitally in this manner allowed for recipients to share the announcements in public spaces (City Hall), city buildings (fire stations and EOC), as well as through postings on the City's Facebook page, and collectively, these avenues allowed for planners to solicit public involvement during the planning process.

Furthermore, additional solicitation for public involvement was achieved through the City's official public meeting. In advance of this gathering, planners created a secondary promo flyer in an effort to convey the importance of public involvement (see Figure 2-2). Like the first flyer, the Public Meeting Flyer asked for public's involvement by attending the in-person meeting (see Table 2-3) and/or through completion of the online survey. Like the Public Survey Flyer, the Public Meeting Flyer was similarly shared via email with each Stakeholder and Core Planning Member. It too was shared on the City's EM Facebook page as well as at City Hall.

Figure 2-1 City of Grove Public Survey Flyer



At the Grove Public Meeting, planners presented the City's Hazard Mitigation Plan in its entirety as well as a demonstration of the [City of Grove Hazard Mitigation Plan Viewer](#) (see Figure C-6 in Appendix C). Audience members were invited to offer comments, ideas, or concerns for discussion. Comments received at the Public Meeting as well as through email correspondence in the days that followed were all reviewed and incorporated into the plan before submission to FEMA. Areas of the HMP where public input was added were in the Capability Assessment (Chapter 3), Risk Assessment (Chapter 4) and the Mitigation Strategy (Chapter 5) whenever applicable.

Figure 2-2 City of Grove Public Meeting Flyer

2023 CITY OF GROVE HAZARD MITIGATION PLAN UPDATE









Please join us for the presentation of the recently drafted 2023 City of Grove Hazard Mitigation Plan Update. Since April of this year, Meshek & Associates has been partnering with the City of Grove Emergency Management to develop a comprehensive and multi-hazard mitigation plan that aims to raise community awareness on eleven natural hazards that threaten the City.

Through targeted research and collaborative efforts, the 2023 Plan presents hazard risks & vulnerabilities as well as a variety of potential mitigation actions/projects that can help build long-term resiliency in your neighborhood before the next disaster strikes. By early February, the document will go through a series of reviews at both the State and Federal level, and once approved, FEMA funding opportunities for your area will be possible for the next five years.

Reducing (or even preventing) impacts from future disasters starts with mitigation efforts today – come join our team of experts to hear how together, we can build a better tomorrow.



Wednesday, January 11, 2023
1:00 pm – 2:00 pm
Grove Emergency Operations Center
1411 S. Broadway Street

Scan the QR code to take part in a brief, public survey that will help planners & City officials know how to better serve you! Survey will remain active through Feb. 1st.

In an effort to solicit feedback from underserved communities and vulnerable populations, Meshek and Grove Emergency Management reached out to area nursing homes, long-term care facilities, as well as various Volunteer Organizations Active in Disasters (VOAD) groups, welcoming them to an in-person meeting with planners in order to share how their agencies/organizations serve vulnerable populations in the City of Grove. A virtual meeting link was provided for those who could not attend in person. Survey responses and feedback were incorporated into applicable sections of the 2023 HMP update.

The public will always play a vital role in the mitigation planning process in the City of Grove, and this includes during the maintenance process after the 2023 HMP is formally approved by FEMA. Every attempt will be made to ensure the public will be able to directly comment on and provide feedback about the Plan. Public Meeting agendas will be posted at city hall as well as through sharing via social media platforms such as Facebook. Meetings will be publicized and open to the public for comment and they will be a space where Grove residents can express their concerns, opinions, or ideas about the Plan. Meeting notices will be posted in accordance with the policies for the Oklahoma Open Meeting Law and meetings at City Hall, which is located at 104 W. 3rd Street Grove, OK.

A copy of the approved plan will be available at Grove City Hall and is also available to any citizen upon request. Additionally, the City's Emergency Management Director also maintains a digital copy of the file which can also be shared upon written request. Local newspapers and the city website will also be utilized to notify the public and additional stakeholders of the opportunity to comment as well as serving as a tool they can utilize to submit comments for review. Upon completion of the update process, the plan will be resubmitted to the State and FEMA for approval.

2.3 Step Three: Coordinate with Other Agencies and Organizations

As a single jurisdiction plan, the City of Grove is the only Government entity adopting this HMP update, however, there are many public agencies, private organizations, and businesses within the City that contend with natural hazards who were invited to participate in the development of this plan. These entities were contacted, either in person, by email, or by phone with an underlying effort to collect information on the hazards and to help determine how their programs could best support the City's mitigation program. In addition to neighboring communities, businesses, and non-profit agencies, additional organizations/agencies were also contacted in an effort to coordinate during the planning process. Those partners, and how they contributed to the plan, are listed in Table 2-4 below.

Table 2-4 Other Coordinating Agencies/Partners

Organization/Agency	Role	Personnel	Title
Integrus Hospital/EMS	Invited	Corey Reeves	Director
Wal-Mart	Invited	Stoney Hayes	Manager
American Red Cross	Provided information about VOAD capabilities	Samuel Rauh	Disaster Program Manager
Grand Gateway EDA	Provided information on electric utilities in the planning area	Ed Crone	CEO
The Salvation Army	Invited		Director
Ottawa Co. EM	Invited	Chad Holcomb	Director
Craig County EM	Invited	M.D. Bluejacket	Director
Mayes County EM	Invited	John Janzen	Director
NOAA/NWS	Provided information for weather related hazards and mitigation action items	Steve Piltz	Meteorologist in Charge
US Army Corps of Engineers (USACE)	Provided information during flood planning efforts	William Smiley	Manager
Grand River Dam Authority (GRDA)	Provided information on electric utilities in the planning area	Robert Scudder	Safety Coordinator
Oklahoma Water Resources Board (OWRB)	NFIP Data & support from floodplain specialists	Aaron Milligan	State NFIP Coordinator
Oklahoma Department of Emergency Management & Homeland Security (ODEMHS)	Mitigation planners provided plan update guidance; provided review and comment on the draft plan documents	Matt Rollins Kim Jensen	State Hazard Mitigation Officer
Oklahoma Forestry Services (OFS)	Provided support and ideas for wildfire mitigation strategies	Steve Mattax	FireWise Coordinator

2.4 Step Four: Assess the Hazard – Plans, Studies, Reports & Technical Information Reviewed

In this section an effort was made to identify and describe past and possible natural hazard occurrences that have affected or may affect the City of Grove planning area. Chapter 3 gives an in-depth look at the various City of Grove planning mechanisms that were reviewed and how information gained from those documents was incorporated into this plan update. Hazards selected in the 2023 Update are based upon information and resources pulled from the City of Grove's 2012 Hazard Mitigation Plan, the State of Oklahoma Hazard Mitigation Plan, as well as through hours of deliberation between the planning team and stakeholder groups. Chapter 4 describes the hazard selection process and assesses each hazard's risks to the planning area. Data from several sources are used to assess the hazards. The Simple Planning Tool for Oklahoma Climate Hazards helped identify modern and comprehensive information surrounding natural hazards and what their future conditions may be in the planning area. Other sources included the federal databases from the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, and the National Weather Service which each helped identify and narrate natural hazards as they impact the City of Grove. State resources included the Oklahoma Forestry Service and the Oklahoma Water Resources Board, where information surrounding wildfire risks were obtained as well as data pertaining to water districts and their sources. Chapter 4 relies heavily on these sources. Planners were sent the City's Emergency Operations Plan as well as the City's Comprehensive Plan and Economic Development Strategy which helped identify critical resources, available assets and City capabilities needed during the assessment provided in Chapter 3. Using these sources, hazards were assessed, prioritized, and verified with key members during the stakeholders at meetings mentioned in Table 2-3.

2.5 Step Five: Assess the Problem

Hazard data was analyzed in the fifth step, with consideration given to each hazard's impact on public safety, health, buildings, transportation, infrastructure, critical facilities, the natural environment, endangered species, and the economy. Historic events pertaining to each hazard was compiled along with the location and extent in which they may impact the City. Specific vulnerabilities were also considered as they pertain to Grove, and through multiple meetings, were discussed with stakeholders and other Planning Committee members. Through collaborative efforts from these parties, a thorough analysis was developed for each of the 11 hazard events.

Building footprints were used to estimate potential losses from flood and wildfire hazard areas identified in Chapter 4 and from a standalone web viewer developed by Meshek & Associates, LLC was built using the latest Esri GIS software and information resources. Building polygons within The City of Grove were selected from computer-generated database that depicts building footprints across all 50 US states, and by utilizing this dataset, it was possible to identify where buildings intersected spatially with both flood and wildfire hazard areas were identified. Through such methods, estimates were derived to find the number of buildings at risk from those hazards, and specific problem statements, or observations, were developed for each in Chapter 4.

2.6 Step Six: Set Goals

As mentioned in Chapter 1, the overall goal of the City's 2023 Hazard Mitigation Plan update is to create a disaster-resistant community and improve the safety and well-being of Grove citizens. In addition to this overarching goal, the Planning Committee also created additional goals related to hazard mitigation efforts and tailored them for the City of Grove. These goals are listed in Chapter 5, the Mitigation Strategy and are incorporated into the plans list of mitigation actions.

2.7 Step Seven: Review Possible Activities

Information presented in previous plans for the City, observations from the capabilities, and risk assessments and input from key members from The City of Grove were all applied to draft the mitigation activities in this update. Action items from the 2012 Hazard Mitigation Plan were revisited to determine their status (completed, ongoing, not started) or whether the previous action items were still relevant. Those whose intent aligned with one another were combined into a more general form of the action. New recommendations and/or mitigation opportunities were spotlighted by the Planning Committee, and Chapter 5 combines these newer items which appear at the end of Chapters 3 and 4. New action items were drafted based on community assessments, hazard observations and input from the planning committee.⁹

In addition to identifying and prioritizing actions deemed most important to the City of Grove, the planning team also identified internal and external revenue streams, existing plans, and partnerships in which key officials in the city could leverage to execute these action items. A more detailed description of these items can be found in Chapter 5.

2.8 Step Eight: Draft an Action Plan

The planning team reviewed observations from the risk assessment and capability assessment in the 2012 Plan, and this review enabled planners and stakeholders to consider and develop new action items to be included in the 2023 Update. Following this review, the planning team assessed the risk of hazards that have affected the city since the last update. From these analyses, the planning team evaluated and prioritized the most critical mitigation actions for the City of Grove and those which can/should be implemented first. Chapter 5: Mitigation Strategy includes mitigation actions to reduce the impacts of hazards identified in the risk assessment.

The plan will be reviewed/revised on an annual basis, or as needed based on disaster events. The City of Grove will ensure that regular review and update of the Hazard Mitigation Plan occurs. Grove's Emergency Management Director will work alongside the City mayor and local government, to monitor and evaluate the progress of the mitigation strategies in the Plan. Through coordination with local and County officials, the City's EM Director will facilitate this process to ensure that plans and goals are monitored. Furthermore, the EM Director will also help monitor any significant changes in any of the hazards as they affect the city. Through planned execution, the City OEM will monitor mitigation objectives and help maintain the safety and well-being of Grove citizens.

2.9 Step Nine: Adopt the Plan

The 2023 City of Grove Hazard Mitigation Plan was submitted to ODEMHS and then to FEMA for approval. Following final approval, the plan was adopted by the City. The signed letter of adoption can be found at the beginning of this document and serves as confirmation that the city has agreed to formally adopt the plan.

2.10 Step Ten: Implement, Evaluate, and Revise

Adoption of the 2023 City of Grove Hazard Mitigation Plan is only the beginning of this effort. Community offices, other agencies, and private partners will proceed with implementation. The Committee will continue to meet regularly to monitor progress, evaluate the activities, and periodically recommend revisions to the plan and Mitigation Action Items. As a part of plan implementation, and in the spirit of the plan being a living document, the plan will be reviewed and updated to reflect the status of mitigation action items as they become addressed, and after they have been completed. The plan will be updated at least every five years, as required by FEMA. Chapters 5 and 6 outline the details of this process and how it will be maintained.

⁹ https://www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf
<http://mitigationguide.org/task-6/mitigation-actions/>

Chapter 3 Capability Assessment

Various strategies to prevent or mitigate the impacts of natural disasters can be implemented by a community. This chapter assesses the existing regulations, plans, and infrastructure throughout the planning area that give officials the capability to mitigate the impacts of the hazards identified in the Risk Assessment section of this plan. This assessment is based on Task 4 of FEMA's Local Mitigation Planning Handbook, which examines each jurisdiction's existing authorities, policies, programs, and resources available to accomplish mitigation.

The planning team reviewed existing capabilities in the planning area and identified capabilities that currently reduced disaster losses or could be used to reduce losses in the future. Also reviewed were relevant community studies, plans, reports, and technical documents in the inventory, evaluation, and planning phases of the Hazard Mitigation Plan's development. Information from public officials, utility operators, emergency operations plans, and economic development partners helped to further identify areas of future growth and development so hazardous areas could be identified, evaluated, planned for, and appropriate mitigation measures taken.

The planning team's mitigation capability review is organized into four sections:

1. Planning and Regulatory
2. Administrative and Technical
3. Financial
4. Education and Outreach

Each of these sections contains two parts, an Overview Assessment as well as a Qualitative Assessment. A high-level summary of the capabilities held by the City is listed in the Overview Assessment. The Qualitative Assessment provides a description of these capabilities, focusing on strengths and deficiencies, along with any information or suggestions for their future utility.

Observations and Recommendations

The planning team included a "Summary of Observations and Recommendations" section at the end of this chapter, and the observations highlight capability gaps that potentially increase the City's vulnerability and risk to hazards. Capability gaps are also detailed in the qualitative assessment sections. The final observations and suggested recommendations directly inform the mitigation actions detailed in Chapter 5.

Key Takeaways

Each community has a unique set of capabilities, including authorities, policies, programs, staff, and funding, and other resources available to accomplish mitigation and reduce long-term vulnerability. Grove is no different. The City's capabilities are fairly robust, though the planning team has noted a few areas where improvement via mitigation activities may enhance the City's resiliency. The overall assessment for the planning area's capabilities will be discussed in this section, focusing on City assets as well as mitigation opportunities.

Grove has implemented many capabilities which allow for mitigating against and responding to natural hazards, such as several planning capabilities, building codes and zoning, emergency management, warning systems, GIS capabilities, and outreach opportunities. Each is discussed in more detail throughout this chapter.

The planning team also noted several areas of improvement, or areas where the amount of knowledge on these items was limited. The first area is the administrative capabilities for fire prevention. Grove is not a FireWise community, nor has a Community Fire Protection Plan been developed. The city does have an ISO FSRs rating of 3, which is on the higher end of the scale, but the planning team recommends the city pursue reaching a rating of 1, which is the highest rating available.

Other areas of improvement noted by the planning team include: enhanced utilization of GIS capabilities by developing a map of special needs populations, meet the requirements to become a CRS community, develop and document a Master Drainage Plan and/or Stormwater Management Plan, develop and document a Capital Improvements Plan, establish a city-wide broadband Wi-Fi network, and develop an education/outreach program, perhaps in conjunction with the retirement facilities in the city, to train and educate elderly residents on using the internet effectively and helpful resources available to them online.. These items have been included in the observations and recommendations section and used as a foundation to develop mitigation action items.

3.1 Planning and Regulatory

Planning and regulatory capabilities refer to ordinances, policies, plans, and other programs that City of Grove uses to guide physical development and growth. There are many kinds of mitigation capabilities that are expressed through plans, processes, and programs, such as operations plans, capital improvements plans, building codes, ordinances, hazard-specific plans, and natural resource preservation programs. Planning and regulatory elements of the City of Grove's floodplain and stormwater management are included in this section.

3.1.1 Overview Assessment

Key	
Addressed directly and is current	●
Addressed somewhat, room for improvement, or meets state standards	◐
No capabilities to very limited capabilities	○

Plans	
Hazard Mitigation Plan	●
Comprehensive Plan	●
Emergency Operations Plan	●
Continuity of Operations Plan	◐
Capital Improvements Plan	◐
National Flood Insurance Program	●
Floodplain Ordinance Permitting	●
Master Drainage Plan (Stormwater Master Plan)	○
Other Floodplain and Stormwater Management	◐
Building Codes	●
Community Wildfire Protection Plan	○

Plans	
Zoning, Subdivision, and Landscape	●
Fire Suppression Rating Schedule	◐
Economic Development Strategy	●
Transportation Plan	◐
Debris Management Plan	○

3.1.2 Qualitative Assessment

Hazard Mitigation Plan (HMP)

This plan signals the intent to resume efforts toward conducting regularly recurring, formal hazard mitigation planning by the city of Grove, culminating with the implementation of mitigation actions. Prior to the adoption of the 2023 Hazard Mitigation Plan Update, the City of Grove's plans were expired. The last hazard mitigation plan found for this planning area was completed in formalized in 2012. Meshek reviewed this plan with the City Emergency Management Director and discussed the mitigation measures in the old plan and any content that needed to be included in the 2023 update or removed. Information that was verified valid or correct was incorporated into the new plan where applicable.

Comprehensive Plan

The City of Grove's Comprehensive Plan lays the groundwork for the City's development policies through the year 2040. The plan sets forth the framework necessary for the orderly growth and development reflecting the community's values today, while anticipating the needs, wants and desires of future residents. It has been organized into six Key Performance Areas (Land Use, Community Character, Livability, Connectivity, Conservation, and Vitality) to facilitate quick reference. Among topics discussed in these key performance areas are references to floodplain development & regulations, stormwater management, enhancement of natural habitat for quality of life and its commitment to several mitigation action items. The information found in the City's Comprehensive Plan was helpful in developing and prioritizing mitigation action items because the Comprehensive Plan provided insight into the City's vision and priorities regarding floodplain development, and quality of life for residents. Meshek was able to incorporate this information into action items to ensure they are beneficial for Grove City officials and Citizens alike.

Emergency Operations Plan (EOP)

Grove's Emergency Operations Plan was last revised in 2021. The Plan provides a comprehensive overview of the City's emergency response efforts, including information in the following categories: Situations and Assumptions, Concept of Operations, Task Organization and Responsibilities, Direction and Control, Continuity of Government, Administration and Logistics, Plan Development and Maintenance, and Authorities and References. This plan was reviewed by Meshek but no aspects of it were carried over to the HMP update.

Continuity of Operations Plan (COOP)

No Continuity of Operations Plan has been developed for Grove, but as indicated in the previous paragraph, a framework for continuity has been integrated into the Emergency Operations Plan.

Capital Improvements Plan (CIP)

Grove officials noted that there was a CIP developed a few years ago but this plan was not provided to Meshek for review prior to this 2023 HMP update therefore no elements of the CIP were used for planning or

incorporated into the plan. Depending on its age, the CIP may need to be updated so that the City can build financial resources that can be used towards mitigation, such as capital improvement funds or tax bonds. Grove can continue to support the efforts of local citizen groups that are willing to assist in emergency management efforts in addition to this.

National Flood Insurance Program (NFIP)

Grove has participated in the National Flood Insurance Program since 1981, and all city residents are eligible to purchase federal flood insurance. The city continues to maintain full compliance with the NFIP. Grove adopted new FEMA floodplains in 2010 and adopted the latest effective Flood Insurance Rate Map (FIRM) September 13, 2019. At the time of this writing, Grove had 23 NFIP flood insurance policies in force.

Substantial Damage/Improvement Provision Implementation

A determination of “substantial damage” applies to a severely damaged home or other structure in a Special Flood Hazard Area, regardless of the cause of damage, where the community participates in the National Flood Insurance Program (NFIP). If the cost to repair the structure is 50% or more of the structure’s market value, then it is considered to be substantially damaged. This damage determination is done by a local building official or floodplain manager.

All NFIP participating communities are required to adopt floodplain regulations, as outlined in 44 CFR, Section 60.3, to include provisions for substantial damage/improvement. [Title 82 OK Stat § 1608 \(2022\)](#) also outlines this requirement for NFIP communities to adopt floodplain ordinance.

In 2019, the City of Grove adopted a floodplain ordinance which addresses the floodplain manager’s duties and responsibilities, to include provisions for substantial damage/improvement. those related to substantial damage determinations:

12-512: FLOODPLAIN ADMINISTRATOR:

- A. *Designation: The city council of the city of Grove designates the building inspector as floodplain administrator to administer and implement the provisions of this chapter and other appropriate sections of national flood insurance program regulations in title 44 CFR pertaining to floodplain management. In the absence of the building inspector, the public works director will serve as the floodplain administrator.*
- B. *Duties And Responsibilities: Duties and responsibilities of the floodplain administrator shall include, but not be limited to, the following:*
 1. *Become accredited by the OWRB in accordance with 82 Oklahoma Statutes sections 1601-1618, as amended.*
 2. *Review permit applications to determine whether the proposed building sites, including the placement of manufactured homes, will be reasonably safe from flooding.*
 3. *Review, approve or deny all applications for development permits required by this chapter.*
 4. *Review proposed development to assure that all necessary permits have been obtained from those federal, state or local governmental agencies from which prior approval are required.*
 5. *Make the necessary interpretation where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions).*
 6. *Notify, in riverine situations, adjacent communities and the OWRB prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the FEMA.*
 7. *Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.*

8. *In the absence of FEMA BFE, The City of Grove shall require the applicant or developer to provide the base flood elevation and other elevation data on the FEMA Elevation Certificate in order to administer the provisions of Sections [12-515](#) through [12-518](#) of this chapter.*
9. *When a floodway has not been designated, the floodplain administrator must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within zone AE as delineated on the Delaware County FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot (1') at any point within the city of Grove.*
10. *After a disaster or other type of damage occurrence to structures in the city of Grove, determine if the residential and nonresidential structures and manufactured homes have been substantially damaged, and enforce the substantial improvement requirement.*
11. *Maintain a record of all actions involving an appeal from a decision of the city council.*
12. *Maintain and hold open for public inspection all records pertaining to the provisions of this chapter. (Ord. 599, 6-1-2010; amd. Ord. 774, 8-6-2019)*

After an event that results in substantial damage, the City of Grove Floodplain Manager will comply with all required ordinances, to include the substantial damage/improvement provisions of their floodplain management regulations. Substantial Improvement and/or Substantial Damage Determinations fall in the hands of Grove's designated Flood Plain Administrator (FPA), and upon the planning team's request, the City FPA issued the following statement:

"Any work or changes to the flood plain within the Grove City Limits must be permitted before changes can be made. The City has a permit process that gives the property owner a chance to make changes within the flood plain area ONLY after a permit has been granted. A [topographical] map layout on a site plan is required for commercial property and subdivision (residential) to assure where the runoff water would go or be held back."

Grove will continue to maintain compliance with the NFIP by enforcing the adopted ordinances which regulate development in flood prone areas, review ordinances annually or as needed when risks change and continued education of floodplain management officials. Details of Grove's local ordinances are detailed at great length in the Floodplain Administration section below.

Additional flood resiliency work in the City can be achieved through the certification in FEMA's [Community Rating System](#) (CRS), which is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements set forth by the [NFIP](#).

Repetitive Losses

A repetitive loss (RL) property is defined by FEMA as "a property for which two or more National Flood Insurance Program losses of at least \$1,000 each have been paid within any 10-year period." In Grove, there are four RL properties inside the City limits, and all RL properties are residential structures located along Spring Branch Creek (see Section 4.2.2 for figures and description). A summary of the City of Grove's flood insurance policies, according to NFIP is included in Table 3-1 below.

Table 3-1 Grove Flood Insurance Policies (Current to 2022)

Flood Insurance	Amounts
Flood Insurance Policies in Force	23
Premiums in Force	\$22,669
Total Losses	16
Flood Losses Paid	\$233,403

Participation in the NFIP requires that Grove adopt a baseline set of ordinances to reduce the effects of flooding, which they meet. Grove will continue to meet NFIP requirements by enforcing local Regulatory Floodplain Ordinances. During and after a flooding event, local officials implement floodplain

ordinance guidelines into the damage assessment and disaster recovery process. Buildings damaged by floodwaters are recorded as first time or repetitive loss structures, and those buildings that are repaired or rebuilt are recorded as substantially improved in accordance with the Grove floodplain ordinances. These damages and improvements are tracked separately from standard damage assessment losses for NFIP purposes. Any structure that was located in a Zone AE and damaged in a flooding event will require special permitting to be build back if permitted at all. Those properties on the repetitive loss list or areas particularly troublesome during flood events may be targeted for mitigation action measures by the City.

Insurers require NFIP floodplain maps to be based on existing watershed development. But unless plans and regulations are based on future watershed urbanization, development permitted today may well flood tomorrow as uphill urbanization increases runoff.¹⁰ Information regarding the City of Grove's participation in the NFIP, claims and repetitive losses was used to assist in creating mitigation action items that will reduce flooding impacts and repetitive losses within the City of Grove, such as acquisition programs.

Floodplain Ordinance Permitting

Floodplain ordinances protect people and assets from flooding by incorporating design, storage, and other standards, which have proven flood mitigation outcomes, into enforceable regulation. Ordinances and permitting for properties located within a floodplain are integrated into the City of Grove's zoning ordinances, which can be found on the City's website or in the National Flood Insurance Program (NFIP) section above.

Master Drainage Plan and Stormwater Master Plan

The planning team was notified that the City's Stormwater Master Plan had been completed a "very" long time ago, but efforts to locate this plan were unsuccessful. It has been made aware that the Public Works Department manages stormwater systems and maintains them. For this reason, the planning team strongly recommends that the city consider this topic and develop a plan based on those considerations. No information is available for review or incorporation into the HMP update.

Building Codes and Permitting

The City of Grove has it written into their city ordinances to automatically adopt the latest ICC building code incorporated by the State of Oklahoma. Thus, the current codes that the city enforces are the ICC 2018 codes. The same can be said for the International Residential Code, International Existing Building Code, and International Energy Conservation Code. The city also has it written in their ordinances that the latest edition of the International Property Maintenance Code is automatically adopted. Grove has a permitting process that impacts all new construction and significant improvements or repairs to existing structures. Information learned while reviewing current building codes provided insight for viable mitigation action measures to be incorporated into the 2023 HMP update. As of this writing, Grove has adopted the following:

Structural Codes

Grove currently follows the State of Oklahoma's building code commission guidance, which includes the 2018 International Building Code, the 2018 International Plumbing Code, and the 2018 International Mechanical Code. Grove currently adheres to the 2020 National Electrical Code. These codes, in combination, provide a helpful mitigation tool against the hazards identified in the risk assessment. Grove can improve its resiliency, however, by taking one step further and automatically adopting the latest codes issued by ICC. These codes include the best mitigation practices beyond this assessment's scope. They enhance the city's potential to meet the criteria for some competitive federal grant programs, like BRIC.

¹⁰ Runoff often becomes deeper and faster, and floods can become more frequent as watersheds develop. Water that once lingered in hollows, meandered around oxbows, and soaked into the ground now speeds downhill, shoots through pipes, and sheets off rooftops and paving.

Fire-related Codes

The City currently follows the 2021 NFPA Life Safety Code 101 and the 2018 International Fire Code. The NFPA Life Safety Code focuses more on mitigating the human health effects caused by fire by focusing on building design, construction, operation, and maintenance. The 2018 Fire Code takes a broader approach to fire mitigation efforts, by also focusing on administration and some other prevention measures.

Vulnerable Residential Structures

Mobile homes are more at risk of tornado/high wind events due to their construction than other types of residential structures because they are often constructed with materials that cannot withstand high wind events or are often not anchored securely to the ground. In addition, manufactured homes and modular homes can be more at risk, depending on their requirements for construction. There are multiple mobile home communities and RV Parks across Grove, most of which do not suffer from flooding issues. Eagles Landing Mobile Home Park northwest of the City was recently annexed by Grove, and this particular location has flooding issues with their structures. Manufactured homes must meet HUD construction standards and be elevated to mitigate against flood events and to be tied down and reinforced to mitigate against high wind events.

Zoning, Subdivision, and Landscape

The city's zoning code regulates the types of uses or densities that are allowed. The Comprehensive Plan complements these codes by discussing how its cascading structure occasionally allows incompatible land uses to occur adjacent to one another. The code divides the city into different districts and subdivisions. In addition, Grove also has a chapter devoted to development criteria for mobile home communities. Locations of mobile home communities are subject to those locations designated within the city's zoning regulations. This information was not utilized for the purposes of the 2023 HMP update.

Fire Suppression Rating Schedule

In addition to the City's mitigation capacity through fire codes, ISO offers a Fire Suppression Rating Schedule (FSRS) for fire companies throughout the Nation¹¹. The FSRS is evaluated on four weighted performance characteristics:

- Emergency Communications
- Fire Department
- Water Supply
- Community Risk Reduction

To receive a certain rating, a community must meet minimum criteria for that rating. Once the community satisfies the requirements for those criteria, a rating is given to the community on a point scale which ranges from 1 to 10, with 10 being the worst and 1 being the best. The City of Grove has achieved a class 3 rating from ISO based on the most current schedule released in 2013. The planning team recommends that the city upgrade its class rating, since doing so would allow Grove to be better prepared to respond to fire. This information was incorporated into Chapter 5; Mitigation Goals where mitigation action items were built to assist the fire department in increasing their ISO rating.

Economic Development Strategy

The City of Grove's Economic Development Strategy provides direction on economic development in the city and is incorporated into the city's Comprehensive Plan. The development strategy is focused on action items which fall into one of three categories: short-term (within 12 months), mid-term (1-5 years), and long-term (6-10 years). The plan analyzes cluster development for business sectors across the city, then proceeds to outline priorities and action items which are designed to address any issues and capitalize on any opportunities identified in the process of developing this strategy. This information was not used for the purposes of the 2023 HMP update.

¹¹ [Fire Suppression Rating Schedule \(FSRS\) Overview | Verisk's Community Hazard Mitigation Services \(isomitigation.com\)](https://www.isomitigation.com/)

Transportation Plan

No Transportation Plan for the City of Grove has been identified by the planning team; however, the city's Public Works Department does have a Pavement Management Plan which outlines the city's plan for repairing, maintaining, and improving its thoroughfares. More information is needed on what components of a plan for the city's transportation needs exist for further understanding.

Debris Management Plan

No Debris Management Plan for the City of Grove has been identified by the planning team, but officials said that a plan would take shape once the 2023 HMP Update was in place. Development of a Debris Management Plan will provide direction and clarity on where storm/disaster debris is taken during recovery efforts. These plans are mostly disaster-driven, so debris related to flooding, tornadoes/high wind, and extreme winter storms are all something that would be incorporated into Grove's future Debris Management Plan. In lieu of this plan, there is a city code of ordinances that addresses debris collection, and the city holds volunteer annual clean-up days which usually take place on a weekend during the spring. This information was utilized to create a hazard mitigation action item for this plan update.

3.2 Administrative and Technical Capabilities

Other administrative and technical capability refers to the community's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions, except for flood and stormwater activities. It also refers to the ability to access and coordinate these resources effectively.

3.2.1 Overview Assessment

Key	
Dedicated Resources/Personnel	●
Addressed somewhat/Includes the Capability	◐
Not included at all	○

Personnel and Technology	
Mitigation Planning Committee	○
Emergency Management	●
General Planning Committee	●
Floodplain Administration	●
Utilities/Streets Departments	●
Engineering	◐
Building Inspector/Building Code Enforcer	●

Personnel and Technology	
Mutual Aid Agreements	●
Warning Systems/Services	●
Virtual Connectivity	◐
GIS Capabilities	◐
Backup Generation	◐

3.2.2 Qualitative Assessment

Mitigation Planning Committee

The planning team has not been made aware of a mitigation planning committee that has been established for the city of Grove, aside from the LEPC and external stakeholders which contributed to the development of this plan. It is recommended that the planning area develop a permanent mitigation planning committee to implement this plan, promote the plan as a living document, and perform and maintain the plan every five years to ensure that the community can continue to receive mitigation funding from state and federal sources.

Emergency Management

Grove has a full-time emergency management director. The emergency management office helps develop and execute plans related to emergency management and hazard mitigation, including the City's Emergency Operations Plan and Hazard Mitigation Plan. They assist with maintaining their StormReady certification from NOAA, public warnings, sheltering when required, and educational outreach about hazards. In addition, the emergency management office helps coordinate emergency preparedness exercises for the city and with city partners.

General Planning

Grove has a 5-voting-member planning commission, which is composed of the city's residents who are appointed to serve 3-year terms in a staggered manner. The planning commission addresses topics related to hazard mitigation, including development, city planning, and related activities. Most specifically, the planning committee also serves as the zoning commission for the city. The commission regularly holds meetings on a monthly basis.

Floodplain Administration

Grove's Flood Plain Administrator (FPA) is a certified Floodplain Administrator with the Oklahoma Water Resource Board (OWRB) and with FEMA, and in addition to the substantial damage ordinance in place at the state level, additional ordinances are in place in Grove. Complete details surrounding the FPA in Grove can be found in National Flood Insurance Program (NFIP) section above.

Utilities/Streets Departments

Grove Municipal Services Authority, which manages the city's utilities, and the Street Department both fall under the umbrella of the city's Public Works Department. The Public Works Department is responsible for streets, alleys, city drives and parking lots. It maintains all of the stormwater systems and maintains stormwater quality. This department is also responsible for maintenance and repairs to utilities including water, wastewater and natural gas.

Response Network/Mutual Aid Agreements

Grove benefits from a network of partnerships internal to and external to the city. This summary provides an overview of Grove's response network and mutual aid agreements and should not be seen as a comprehensive list. Grove has established several external agreements to support its residents and the residents of Delaware County:

- **Public Health:** The city of Grove is a destination where many elderly residents choose to retire. As such, there are a considerable number of retirement facilities within the planning area. Two of these facilities have participated in this plan as stakeholders. They, as well as others, work with Grove officials to ensure the safety and wellbeing of their residents and staff.
- **Tribes:** The city of Grove hosts the headquarters of the Seneca-Cayuga Nation and is also surrounded by lands of the Cherokee Nation.

The city also relies on partnerships within the planning area. All city response departments, including the emergency management office, police, fire, and other agencies collaborate frequently and effectively.

Warning Systems/Services

Electronic Communication Systems

Grove utilizes the Code Red mobile alert application developed by OnSolve, which allows Emergency Management to deliver geo-targeted, time-sensitive information to residents who have downloaded the app onto their mobile device and have registered to receive alerts. Notifications can be delivered via email, SMS, voice, push, and IPAWS as officials and end users see fit. The application is available to users of both Apple and Android products.

Sirens

The Emergency Management Department operates 15 outdoor emergency sirens throughout Grove. These federal signal storm sirens have an audible reach across the entire planning area. These sirens can be activated using a radio signal or remote control by the Emergency Management Director when an imminent hazardous threat is detected within an 8-mile radius of the center of town. Locations of storm sirens can be found on the interactive HMP Viewer App which is housed on the [Grove Hazard Mitigation HUB](#).

Building Inspection/Building Code Enforcement

Grove's Code Enforcement Department is responsible for the administration and enforcement of all city ordinances. The city has one full-time person, designated by the City Manager, who is responsible for building inspections and code enforcement. All codes and laws pertaining to inspection policies and building code enforcement can be found on the [Grove, OK Codes/Laws](#) webpage.

Grant Writing

No grant writer is on staff for the City of Grove to the best knowledge of the planning team. Having a grant writer on city staff is an asset that is very beneficial, since this person is responsible for pursuing grant funding for projects that can help the community increase its resilience and mitigate against hazards. Examples of several state and national grant programs from which funds can be granted include:

- Certified Local Government Grant (CLG)
- Community Development Block Grant Small Cities Set-Aside (CDBG)
- FEMA Hazard Mitigation grants, including the Hazard Mitigation Plan Update grant and Flood-prone Property Acquisition grant.
- Transportation Alternative Program (TAP)
- Assistance to Firefighters grant (AFG)

The grant administration department also oversees the CDBG programs, the homebuyer assistance program, the comprehensive demolition program, and the interim assistance/special services program.

Engineering Personnel

The Engineering department consists of one City Engineer, who works in tandem with the Building Inspector. The city's Code of Ordinances references this position, but the planning team lacks further details needed to develop further understanding of this position and its duties and responsibilities.

Virtual Connectivity

With internet resources becoming more and more important in receiving and delivering information, this data provides an idea for how valuable an internet presence or mobile applications can play in reaching a large proportion of the population before, during, or after a disaster. In addition, relationships between emergency management and social programs that reach access and needs populations (experiencing homelessness, elderly, etc.) can help to better identify needs and prepare those populations to withstand and recover from events.

Grove participates in the FCC Affordable Connectivity Program, which provides a discount on internet services to families and households who may struggle to afford access to this vital community lifeline. Also included in this program is a one-time discount of up to \$100 for a computer or tablet.

Given the importance of internet connectivity in today's age and moving forward, ensuring all residents have access to internet classified as broadband or better can mean the difference between life and death, particularly in a hazardous weather situation where residents may need to rely on a Code Red alert, or an alert through another mobile service. Some communities in Oklahoma have developed free, city-wide Wi-Fi services for their residents. The benefits of such a program would be profound and numerous, particularly for a community like Grove, where the poverty rate is higher than the state's average. The planning team recommends developing city-wide Wi-Fi services for its residents, or at least researching what it would involve doing so.

Additionally, given the age distribution in the planning area, with a much higher than average elderly population, education, and outreach on how to use and take advantage of internet resources are another opportunity that the planning team recommends Grove utilizes in order to equip residents with the knowledge of how to use personal resources in the event of an emergency or disaster.

Geographic Information Systems (GIS)

Personnel

Grove has a GIS Coordinator on its city staff. Further information is needed to develop a further understanding of the scope of this department and its responsibilities.

Technical Capabilities/ Data Collection

Concurrent with this plan update, Grove is developing a hazard viewer that will allow the planning team and other members of the city government access to historical hazard locations, probable hazard locations, vulnerable structures and populations, and other relevant information.

The planning area would benefit from additional information that would be helpful for hazard mitigation and emergency response. The planning team identified additional needs in three key areas:

- Identify and model critical components of the built environment.
- Provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms.
- Develop the ability to distribute information on risks through web-based and mobile technology (for more information see the Warning Systems/Services Section)

In the future, the planning area should consider incorporating weather updates into its GIS applications. GIS capabilities allow personnel to develop platforms that integrate detection systems, like weather, into mapping,

which helps local officials and emergency management personnel identify threats more clearly in real-time. In addition, the planning area would benefit from an improved understanding of the needs of their populations and the best forms of outreach.

Backup Generators

A power outage can cause critical facilities like hospitals, emergency response, and government facilities to be unable to provide basic services. A way to safeguard against a power outage is to have a backup generator, which could maintain core functions of these critical facilities. Officials report that all city facilities have backup generation capabilities, except for City Hall, which will allow for critical services to be provided uninterrupted throughout emergencies and disasters. The city should ensure that all new critical facilities have backup generation. In addition, it's recommended that officials in Grove should test their current generators to ensure that they meet the standards needed to function seamlessly when needed. The planning team identified several factors that would make these power sources more prone to failure. These factors include:

- Age of the unit (exceeded the unit's product lifetime)
- Storage location of the unit (not elevated off ground; exposed to weather)
- Lack insulation of the unit (from extreme heat and cold)
- Time that the unit is activated (Overheating during periods of extended use)
- Time when the unit is activated (delays to activate in extreme heat or cold)
- Failure to conduct regular tests of the unit.
- Lack of available gasoline/diesel to power generator

3.3 Financial Capabilities

This section includes the financial leverage the planning area has accessed, can access, and could access. For specific plans that authorize or enable access to these financial capabilities, see the planning and regulatory section.

3.3.1 Overview Assessment

The planning team grouped Grove's past, present, and future access to financial resources into internal and external capabilities. Internal financial capabilities refer to financial resources generated by the city. External financial capabilities refer to all funding opportunities that are not generated internally. For external funding sources, the planning team focused on state and federal funding, along with local and regional partnerships with other entities since these avenues seemed to be most important to accomplish the planning area's mitigation goals.

3.3.2 Qualitative Assessment

Internal Financial Capabilities

This section provides an overview of internal funding sources that Grove could use to fund hazard mitigation projects. Internal funding sources can be broken into two categories: revenue from taxes and funds raised through financing. Some of these funding streams are allocated for specific activities (see planning and regulatory and administration and technical sections for some examples).¹²

¹² Some other sources of internal funding are generated through utility fees, landfill use, and property taxes.

Taxation

Sales Tax: Grove has a 9.3% aggregated state, county, and local tax.¹³ Grove is also one of 36 jurisdictions in Oklahoma which levies an additional 5% city lodging tax on top of this aggregated rate for those staying in travel accommodations in the city. These taxes are commonly used to fund mitigation projects and others which serve the community and serve toward a match on other projects.

Grove's sales tax revenue benefits from the city's influx of tourists. Tourism is a substantial source of revenue from sales taxes and provides jobs for residents. Tourism brings a substantial amount of revenue to the city each year, with Grand Lake attracting large numbers of visitors, primarily during the warmer months when outdoor and water recreation activities are at their peak.

Utility Tax: Along with sales taxes, Grove's utility tax constitutes a significant tax-based revenue stream that the city can use for mitigation activities. Grove's utility tax is set at a 2% rate and is applied to the gross receipts from residential and commercial sales of power, light, or electricity. Exemptions are provided for any person, firm, association, or corporation operating under a valid franchise from the city.

Telephone Exchange Fee: This fee is an annual inspection fee and service charge levied upon every person, firm and corporation operating a telephone exchange in the city. It is set at 2% of the gross revenues for each current year for exchange telephone transmission service rendered wholly within city limits. This is a fee which is generally levied on telephone service providers, and passed along to consumers, and can be found as a specific line item on a user's bill.

Excise Tax: Excise tax for the City of Grove is set at 3% and is a duty on certain manufactured goods that is generally levied on sellers of these goods.

Emergency Telephone Service Tax: In some jurisdictions, this tax is known as a 911 Tax. This is levied as a service tax levied to provide emergency 911 services to the community. The tax is set to be at 5% or lower and is billed to the user of a telephone service, in addition to the Telephone Exchange Fee described above.

Hotel Tax: This tax is briefly discussed in the overview for this section. The Hotel Tax for the City of Grove is set at 5.0% for occupancy of a room in a hotel within the city limits of Grove.

Financing

Most of Grove's financing for hazard mitigation-related activities arise from tax revenue. The city could use other financing mechanisms in extreme cases, although it has not done so historically.

Bonds: Departments within Grove can issue bonds for longer term mitigation projects, including projects in the city's capital improvements plan.

Rainy Day Fund: A rainy day fund can be used to fund budget shortfalls. In addition, the city council must vote on its use. If the city were to fund an emergency response or mitigation project in an extreme situation, they could do so much more quickly and effectively than the other financial options in this assessment. The scope could be used for any action, mitigation, response, recovery. Additionally, there is not a cap per project.

External Financial Capabilities

State and Federal Programs

Funding from federal, state, and other governmental sources are options pursued by many municipalities. Most of these programs are governed by specific use and eligibility requirements and include a local cost share. Below are some external funding sources that these jurisdictions can access:

¹³ The 9.3% sales tax rate in Grove consists of 4.5% State of Oklahoma Tax Rate, 1.40% Delaware County tax and 3.40% Grove city tax.

Table 3-2 External Funding Sources

Possible Funding Source	Uses
Capital Improvement Program	CIP funding is used for various infrastructure projects throughout the county and participating communities.
Incur debt through General Obligation or special tax bonds	Bonds are used to fund specifically identified projects.
Community Development Block Grant	CDBG are typically used to enhance functional needs populations.
Hazard Mitigation Assistance	Federal HMA grants are used for mitigation projects whenever possible.
Federal Highway Administration Funding	FHWA funding is used for eligible transportation projects.
County Improvement Roads and Bridges	This is an important source of resources for improving transportation infrastructure.
Oklahoma Water Resource Board	OWRB loans are used for water and sewer projects and can also be used for stormwater drainage projects. The potential exists to use these funds as a match.
Emergency Management Performance Grant	This is a federal grant program that funds various emergency management program needs.

Partnerships

Jurisdictions benefit from robust partnerships with entities inside and outside Grove's boundaries. These capabilities extend to partners who can provide financial resources for mitigation activities or who can serve as financial contributors toward a mitigation project. Large stakeholders, especially utility companies, could serve as partners for projects that include upgrades to utilities or their delivery infrastructure.

Some of the largest potential partners in the planning area are the Seneca-Cayuga and Cherokee Nations, the former of which includes Grove, while the latter has lands that surround this area. Tribal Nations often receive federal funding for a multitude of projects but do not always have the amount of personnel needed to complete the projects. Partnerships between the city and tribes can assure timely execution of much needed projects for the two parties.

Delaware County is another entity with whom to partner to develop and improve projects in and around the city. Grove receives tangential benefit from the maintenance of roadways that connect the city to the rest of Oklahoma and rural fire departments, which fall under the jurisdiction of Delaware County. The county maintains these roadways and receives appropriations from the state to maintain them. Most of this tax revenue and funding has been used to fund two mitigation-related activities: roadway improvement projects (combination of revenue streams) and vehicles and equipment for rural fire departments (sales taxes). For larger partnerships regarding fighting wildfire rural firefighter volunteer teams and Delaware County could assist with preventing damage to surrounding area.

Finally, it would be a remission if the importance of Grand Lake were discounted, or even ignored, when it comes to vital partnerships. A continued relationship with the Grand River Dam Authority (GRDA) can allow the city to continue to attract visitors and tourists, which then generates revenue for the municipal area. Additionally, electricity generated by Pensacola Dam, which is managed by GRDA, powers the city, and allows it to realize its capabilities in generating revenue and otherwise.

3.4 Educational and Outreach Activities

This section refers to preventative educational activities—i.e., activities that occur before a disaster—except for activities needed to fulfill the CRS requirement (see NFIP section). For outreach capabilities during a disaster, see mutual aid agreements. For outreach capabilities during a disaster, see mutual aid agreements.

3.4.1 Overview Assessment

Key	
Has a Program	●
Addressed somewhat, but no program in place	◐
Does not have a Program	○

Programs	
FireWise	○
Home Fire Campaign	◐
StormReady	○
Fairs, Festivals, and Similar Activities	●

3.4.2 Qualitative Assessment

FireWise

The National Fire Protection Agency (NFPA) provides a fantastic resource and tool to communities known as FireWise, and the underlying theme is to help residents reduce their wildfire risk. While Grove does not participate in the FireWise Communities program, it certainly presents a great opportunity to educate and inform the citizens about their risk. Grove has implemented a burning permit requirement, which has greatly reduced the number of fires in the city limits, however, joining FireWise would help bridge the gap across City limit boundaries.

American Red Cross Home Fire Campaign

The American Red Cross sponsors the Home Fire Campaign program, which is an educational outreach program launched in 2014¹⁴ to help save lives by installing free smoke alarms in homes that don't have them, and by educating people about home fire safety. If citizens cannot afford to purchase smoke alarms or are physically unable to install a smoke alarm, the Red Cross is able to assist with funds.

StormReady

StormReady is a national program sponsored by the U.S. National Weather Service that encourages grassroots efforts in communities to establish resilient storm communication and awareness systems. “The NWS StormReady Program helps arm America's communities with the communication and safety skills needed to save

¹⁴ [Annual Results of Red Cross Home Fire Campaign](#)

lives and property—before, during and after the event. StormReady helps community leaders and emergency managers strengthen local safety programs.” To participate in the StormReady program, communities must have:

- Establish a 24-hour warning point and emergency operations center.
- Have more than one way to receive severe weather warnings and forecasts and to alert the public.
- Create a system that monitors weather conditions locally.
- Promote the importance of public readiness through community seminars.
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.¹⁵

At the time of this writing, the City of Grove is not listed as a participant, but future involvement would greatly enhance the City’s ability to prepare for, respond to, and recover from future disaster.

Fairs, Festivals, and Similar Activities

Grove offers public events, which are a critical avenue to spread information to the public. Often, these events are the only time that the public will interact with officials involved in hazard mitigation and response for the community in which they live. The city has several events they utilize to connect with residents, including Camp Bandage (held annually in the spring), classes held on Patricia Island, and at the annual Home & Garden Show. All entities should continue to prioritize and publicize these activities.

3.5 Summary of Observations and Recommendations

This section outlines an overview of observations and recommendations from the capabilities assessment. It is intended to provide the reader with a summary of capability gaps across hazards and recommendations to mitigate against these potential vulnerabilities. This approach aligns with an assets-based approach to hazard mitigation (see Chapter 1). To maintain this section as an overview and keep it concise, this section does not seek to provide specific details of the observations. Details of each observation can be found in the qualitative sections of this assessment.

Table 3-3 Summary of Observations & Recommendations for the Capabilities Assessment

Observation	Recommendation	Hazard(s)	Action(s)
While Grove follows state guidance on International Building Code adoption, the City could begin planning for or adopting a resolution to incorporate 2021 codes when applicable.	Adopt and enforce 2021 international building codes for new construction, and when appropriate, for retrofit projects	All	22
Despite achieving fire suppression rating of 3 from ISO, there are several administrative opportunities that create vulnerabilities in the city’s fire prevention efforts.	Implement Fire Protection and Mitigation Plans to improve resiliency against future wildfire hazards	Wildfire	3
Although ongoing efforts are in place to coordinate with utility companies to identify vulnerable populations, the City’s GIS team lacks adequate maps depicting where these populations are clustered	Coordinate with utility companies to identify and communicate vulnerable populations in Grove so that the City’s GIS team can produce and maintain maps for emergency purposes	All	9

¹⁵ <https://www.weather.gov/StormReady>

Observation	Recommendation	Hazard(s)	Action(s)
Flooding in Grove is a problem around Spring Branch Creek, where multiple repetitive loss structures and critical facilities are located. Streambed revitalization efforts and buyouts would help alleviate future flooding issues	Pursue streambed revitalization projects and property buyout opportunities along Spring Branch Creek to reduce flooding impacts in the City.	Flooding	6
It is unknown how old/outdated the City's stormwater master drainage plan is, and new projects are needed to alleviate flooding problem areas in the City.	Update stormwater master drainage plan and implement findings in the plan, including structural projects	Flooding	7
While no debris management plan exists for the City, current hopes are that work will begin on developing one after Grove's HMP is approved.	Develop and Coordinate a Debris Management Plan for the City to address post-disaster debris removal.	Flooding, Hail, Tornado/High Winds, Severe Winter Storms	8
Without a Grant Writer on city staff, there are numerous missed opportunities for Grove to pursue funding for hazard mitigation projects	Hire a Grant Writer position for the city to help identify and pursue funding opportunities for hazard mitigation projects	All	2
Grove has a significantly higher rate of elderly residents and long-term care facilities, many of which lack adequate tools and resources that help mitigate the effects from disasters. Improvements are needed to enhance communication and response plans during emergency events	Coordinate with utility companies to identify and communicate risks to vulnerable populations in Grove, with the coordinated efforts culminating in an accurate and usable database in which City GIS personnel can use to map vulnerable populations	All	5
Grove does not participate in the NWS StormReady Program nor are they a FireWise Community. Joining both programs would serve as important public outreach campaigns.	Develop and fund hazard preparedness, education, information, and awareness programs	All	1

Chapter 4 Risk Assessment

The risk assessment helps communicate vulnerabilities, develop priorities, and inform decision-making for the hazard mitigation plan and for other emergency management efforts. This plan was completed with hours of input from stakeholders in the city and across Oklahoma. The 2023 risk assessment provides the factual basis for developing a mitigation strategy for the City of Grove.

This assessment integrates an assets-based approach with an analysis of individual hazards to provide a deeper understanding of specific hazards and their impact on the planning area. An assets-based approach, which aligns with the most current FEMA guidance, allows communities to identify assets that are critical to their stability and that are most exposed to hazards. For hazard mitigation planning, this approach allows communities to drive mitigation actions more effectively. Beyond the scope of this mitigation plan, results from the risk assessment should be integrated into future emergency management planning, recovery planning, and development efforts.¹⁶

The risk assessment was updated and enhanced to provide the most current and robust data and information for quantifying the cost-effectiveness of potential hazard mitigation projects. A GIS analysis was conducted to include any new/modified/updated information (including hazard, land use, and development trends), findings, research, and risk data. New, readily available, credible technical data was incorporated into the analysis as appropriate.

4.1 Introduction to the 2023 Risk Assessment

This introductory section is divided into five parts, the first two of which relate to a high-level assessment of hazards throughout the planning area, one that highlights some key vulnerabilities in the planning area broadly. The classification part combines development from the previous three parts, along with FEMA guidance, to implement an assessment tool that informs the risk assessment. The final part of this assessment highlights observations about the planning area's vulnerability to the hazards profiled in this risk assessment and proposes recommendations to mitigate against these vulnerabilities. The five parts of this introduction are listed below.

1. Hazard Identification
2. Disaster Declaration History
3. Critical Lifelines and Facilities
4. Hazard Risk Classifications
5. Observations and Recommendations Overview

4.1.1 Hazard Identification

For several months, the planning team and officials from the City of Grove have reviewed and analyzed a full range of hazards that have a reasonable likelihood of affecting the community and surrounding areas. While conducting this analysis, the planning team reviewed previous occurrences and examined the losses, frequency, and magnitude of each event to determine the vulnerability and risk to the community. Furthermore, each hazard poses and the likelihood of those hazards affecting Grove in the future.

The Grove Hazard Mitigation Technical and Citizens' Advisory Committees prioritized the mitigation measures and developed an Action Plan for the highest priority measures. This chapter identifies specific high priority actions to achieve the City's mitigation goals, the lead agency responsible for implementation of each action item, an anticipated time schedule, estimated cost opinion, and identification of possible funding sources. It also lists the Prioritized Mitigation Measures for each hazard in the Public Information and Education, Preventive Measures, Structural Projects, Property Protection, Emergency Services, and Natural Resource Protection categories.

¹⁶ A web-based version of the risk assessment is hosted on the [Grove Hazard Mitigation HUB](#).

For this update, certain changes were made to the hazard types profiled in the 2023 HMP Update. Table 4-1 below compares those profiled in the 2012 HMP and those in the 2023 HMP Update.

Table 4-1 Changes/Updates in the 2023 Hazard Risk Assessment

2012 Hazards	2023 Hazards
Floods	Flooding
Tornadoes	Tornado and High Wind
High Winds	Lightning
Lightning	Hail
Hailstorm	Severe Winter Storm
Winter Storms	Extreme Heat
Extreme Heat	Drought
Drought	Wildfire
Expansive Soils	Earthquake
Urban (Structure) Fires	Hazardous Materials
Wildfires	
Earthquakes	
Hazardous Materials, Fixed Site Incidents	
Dam Failures	
Transportation Incidents	

While most hazards remained the same, the planning team and City officials decided to make certain changes. Grove's 2012 HMP profiled **Expansive Soils** after water main breaks were reported across Grove in the wake of the 2005-2006 drought. It also cited the unusually hot, dry summer of 1998 as resulting in soil shrinkage which led to water main and sewer pipe breaks "in many Oklahoma cities," however, after further examination, the 2023 City of Grove Hazard Mitigation Plan Update does not profile Expansive Soils as a distinct hazard, because mapping of Expansive Soils, both in the OK State Plan and from the US Geological Survey, show a low presence of Expansive Soils across the Planning Area. Another hazard which was not carried over from the 2012 Plan to 2023 is that of **Dam Failures**. No high-hazard dams threaten Grove, and while Pensacola Dam plays a vital role in the City's operation the [QWRB Dam Inventory of Oklahoma](#) lists this dam hazard as being "Significant". Other high-hazard dams in the vicinity do not have inundation areas that impact the City, and planning members agreed that Dam Failures can be omitted for

the 2023 Update. **Transportation Incidents** is not a natural hazard and the threat from transportation-related incidents has been incorporated into the 2023 Hazardous Materials hazard section (see Section 4.7). Although these hazards fall outside the classification of "natural hazard," provided by the Department of Homeland Security as of this writing, the planning team felt that they posed a large enough threat to be analyzed in the risk assessment.¹⁷

In addition to previous hazards being omitted, the 2023 also combines the 2012 hazards, **Tornadoes** and **High Winds**, since these two types of hazard threats produce similar kinds of impacts in Grove. Also combined were the **Urban (Structure) Fires** and **Wildfire** hazards. Several natural hazards can potentially create structure fires when power lines are knocked down, but Urban (Structure) Fires was not a standalone hazard threat officials felt needed to be profiled in 2023. In all, this chapter of the 2023 City of Grove Hazard Mitigation Plan will focus around ten hazards.

To better communicate the 2023 Hazards listed in Table 4-1, the planning team developed a Geographic Information Systems (GIS) viewer hub that will map the City's infrastructure, critical facilities, and land uses. Data from this study will be valuable in the future to determine which hazards present the greatest risk to the city. Access to the online HMP Viewer is linked here: [Grove Hazard Mitigation HUB](#).

¹⁷ FEMA and the larger Department of Homeland Security (DHS) community generally organize threats and hazards into three categories: Natural (tornado, hail, etc.), Technological/accidental (dam incident, hazardous material incident, etc.), Human-induced/intentional (terrorism, cyber-attack, active shooter, etc.). For example, see DHS, Threat and Hazard Identification and Risk Assessment (THIRA) and *Stakeholder Preparedness Review (SPR) Guide: Comprehensive Preparedness Guide (CPG) 201*, 3rd edition (2018), 12.

4.1.2 Disaster History

Of the 211 federal disasters declared in the State of Oklahoma from 1955 to June 2021, Delaware County received 31 total declarations, of which 24 were major disaster declarations (DR) and 7 were emergency management declarations (EM). There are no fire management assistance (FM) declarations in the database. Table 4-2 outlines all FEMA declarations in Grove (Delaware County) since 1973. It should be noted that declarations prior to 1964 do not contain county data, as it is not available (FEMA 2021).

Table 4-2 Grove (Delaware County) FEMA Disaster Declaration

Year of Declaration	Declaration Title	Disaster Number
1973	SEVERE STORMS, FLOODING & TORNADOES	DR-392-OK
1974	SEVERE STORMS & FLOODING	DR-441-OK
1986	SEVERE STORMS & FLOODING	DR-778-OK
1990	SEVERE STORMS, TORNADOES & FLOODING	DR-886-OK
2001	SEVERE WINTER ICE STORM	DR-1355-OK
2003	SEVERE STORMS & TORNADOES	DR-1465-OK
2005	HURRICANE KATRINA EVACUATION	EM-3219-OK
2006	EXTREME WILDFIRE THREAT	DR-1623-OK
2006	SEVERE STORMS & TORNADOES	DR-1637-OK
2007	SEVERE STORMS, FLOODING & TORNADOES	DR-1712-OK
2007	SEVERE WINTER STORM	DR-1678-OK
2007	SEVERE WINTER STORM	DR-1735-OK
2007	SEVERE WINTER STORM	EM-3280-OK
2007	SEVERE WINTER STORM & FLOODING	EM-3272-OK
2008	SEVERE STORMS, TORNADOES & FLOODING	DR-1754-OK
2009	SEVERE WINTER STORM	DR-1823-OK
2010	SEVERE WINTER STORM	DR-1876-OK
2010	SEVERE WINTER STORM	DR-1883-OK
2010	SEVERE WINTER STORM	EM-3308-OK
2011	SEVERE STORMS & FLOODING	DR-1988-OK
2011	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS & FLOODING	DR-1989-OK
2011	SEVERE WINTER STORMS	EM-3316-OK
2015	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS & FLOODING	DR-4222-OK
2016	SEVERE WINTER STORM & FLOODING	DR-4256-OK
2017	SEVERE STORMS, TORNADOES & FLOODING	DR-4315-OK
2017	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS & FLOODING	DR-4324-OK
2019	SEVERE STORMS, STRAIGHT-LINE WINDS, TORNADOES & FLOODING	4438-DR-OK
2020	COVID-19	EM-3462-OK
2020	COVID-19 PANDEMIC	4530-DR-OK
2021	SEVERE WINTER STORM	3555-EM-OK
2021	SEVERE WINTER STORM	4587-DR-OK

4.1.3 Critical Facilities and Lifelines

This section describes critical facilities and FEMA lifelines, given their importance to maintain the continuity of basic and life-sustaining services in the planning area. The planning team has identified critical facilities that are exposed to increased flooding risk, which is the baseline standard for FEMA. The study was expanded to identify critical facilities at risk for any identified hazards across the entire planning area, when possible. A map of critical facilities can be found in Figure 4-1 below, on the [Grove Hazard Mitigation HUB](#) page online, or in Appendix B.

Critical facilities can impact one or more community lifelines. Lifelines, however, provide officials and residents with a system-wide approach to mitigation.¹⁸ FEMA's community lifelines are *systems* that are essential to a community's basic functioning by supporting key government, business, and other essential functions. Lifelines can be composed of chains of critical facilities and other assets.

Critical facilities and Lifelines are found in the vulnerability sections of each profiled hazard. Within this section, the planning team included a commentary on critical facilities in the built environment section, under critical facilities. Commentary on lifelines throughout the planning area are included throughout the vulnerability parts of each hazard but are concentrated in the infrastructure subsection within the built environment section. FEMA's seven lifelines are provided again in Table 4-3 below.

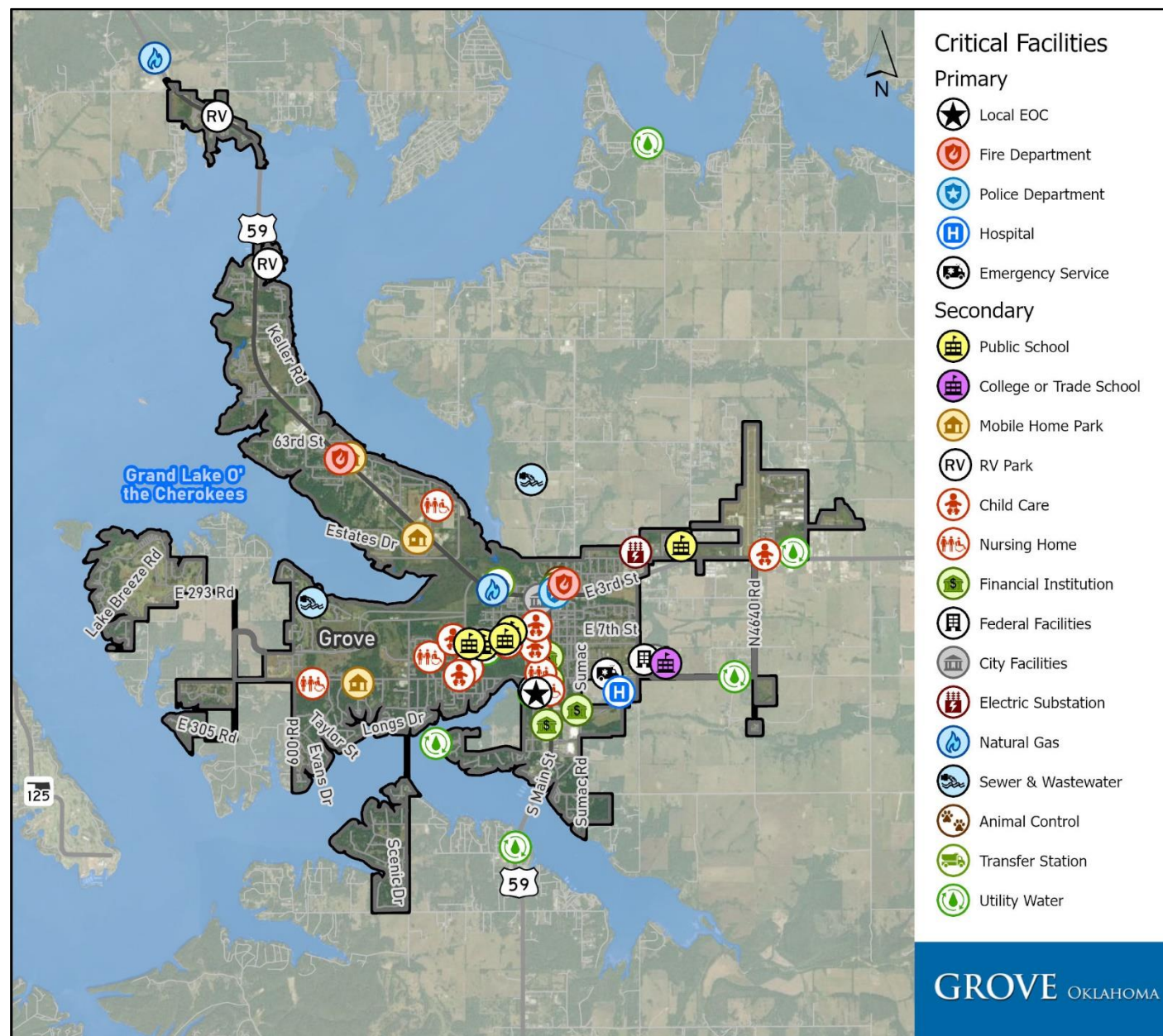
Table 4-3 FEMA Community Lifeline List

	Safety and Security - Law Enforcement/Security, Fire Service, Search and Rescue, Government Service, Community Safety
	Food, Water, Shelter - Food, Water, Shelter, Agriculture
	Health and Medical - Medical Care, Public Health, Patient Movement, Medical Supply Chain, Fatality Management
	Energy - Power Grid, Fuel
	Communications - Infrastructure, Responder Communications, Alerts Warnings and Messages, Finance, 911 and Dispatch
	Transportation - Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Maritime
	Hazardous Material - Facilities, HAZMAT, Pollutants, Contaminants

The planning team included a map of critical facilities to highlight their distribution across the planning area. Vulnerabilities to critical facilities will be highlighted in the individual hazard sections. In addition, the planning team included a map of major components of the Energy Lifeline given its outsized impact on the delivery of basic services in the planning area and its role as a major economic driver for the City.

¹⁸ <https://www.fema.gov/emergency-managers/practitioners/lifelines>

Figure 4-1 Critical Facilities in the Planning Area



Systems and Infrastructure

Critical components of the systems and infrastructure that deliver electricity, water/wastewater, and natural gas to Grove, as well as the transportation network across the planning area, are important considerations to consider when assessing risk. Grove Municipal Services Authority (GMSA) is operated by the City of Grove and provides water/wastewater and natural gas services to residents. Electrical delivery is primarily provided by American Electric Power (AEP), though Northeast Oklahoma Electric Cooperative (NOEC) also provides electrical service to portions of the planning area¹⁹.

Transportation across the planning area is overwhelmingly defined by the network of surface roads. Grove Municipal Airport is northeast of the primary incorporated section of the city and serves as a base for life flight

¹⁹ [WHO WE ARE – Northeast Oklahoma Electric COOP \(noec.coop\)](http://WHO WE ARE – Northeast Oklahoma Electric COOP (noec.coop))

services for medical care stakeholders in the community, such as INTEGRIS Health Grove. Further details on the transportation network have been discussed in Chapter 1.

4.1.4 Hazard Classifications

The classifications for probability, and overall significance, as defined on Worksheet 5.1 in the FEMA Local Mitigation Planning Handbook, met Ponca City's needs and methods, and were used in the 2022 risk assessment.

Probability of Future Events

For this plan, the planning team used the following four metrics to assess probability of future events: "Unlikely," "Occasional," "Likely," and "Highly Likely." These metrics have been used for this plan because they aligned more closely with standard practices in the State of Oklahoma and FEMA Region VI. This should assist readers in comparing and integrating the 2023 Plan with surrounding communities and enhance potential mitigation planning and response actions.

Table 4-4 Classifications used in Future Hazard Probability Statements

Future Probability of Hazard Occurrences	Annual Probability (%)	Recurrence Interval
Highly Likely	>90%	<1 year
Likely	>10% - 90%	1 - 10 years
Occasional	>1% - 10%	11 - 100 years
Unlikely	0% - 1%	>100 years

Overall Significance

The 2017 HMP did not include an overall significance statement, but prioritized risk numerically and organized each hazard accordingly. For the 2023 Update, the overall significance of each hazard was assessed in terms of how each event may impact the community. Overall significance was organized into three categories: Low, Medium, or High based on this assessment, and Table 4-6 below summarizes hazard probabilities and their significance.

Table 4-5 Metrics Used to Describe Hazard Impacts to Grove, OK

Significance	Description
Low	Minimal impact on the planning area
Medium	Impact on the planning area is noticeable but not devastating
High	The event's criteria consistently fall in the high classifications and the event is typically likely/highly likely to occur with severe strength over a significant portion of the Planning Area

Table 4-6 Summary of Hazard Probability and Overall Significance for Grove, OK

Hazard Type	Probability	Overall Significance
Flooding	Likely	High
Severe Winter Storm	Highly Likely	High
Tornado/High Wind	Highly Likely	High
Hail	Likely	High

Hazard Type	Probability	Overall Significance
Wildfire	Highly Likely	Medium
Hazardous Materials	Likely	Low
Extreme Heat	Likely	High
Lightning	Highly Likely	Medium
Drought	Likely	Medium
Earthquake	Unlikely	Low

4.1.5 Observations and Recommendations Overview

An observations and suggested recommendations section at the end of this chapter has been developed and included by the planning team. The observations in this section highlight locations, problem areas, that increase the affected areas' general vulnerability and risk to hazards. Observations are detailed in the hazard profile sections below. These observations are compiled at the end of the chapter to drive recommendations for mitigation, which, along with the suggested actions in Chapter 3, directly inform the mitigation actions in Chapter 5.

4.2 Flooding

4.2.1 Hazard Description

A flood is the partial or complete inundation of water over normally dry land. Common impacts of flooding include damage to personal property, buildings, and infrastructure; bridge and road closures; service disruptions; and injuries or even fatalities. There are three common types of flooding in Ponca City: riverine flooding, flash flooding, and urban flooding.

Riverine flooding occurs from excessive rainfall in upstream areas that forces rivers and streams to rise and overflow their banks, inundating the adjacent floodplains. Riverine flooding is usually a gradual process, with several hours to several days of warning time for downstream communities. This type of event usually remains in flood for a longer period than flash or urban flooding, and often causes more damage due to the length of time structures are inundated, the velocity and depth of water, and floating debris.

Flash flooding is associated with large convective thunderstorms that frequent the region and can drop between 1 and 5 inches of rain in an hour. When the soil is already saturated, rainfall from such storms can converge in creeks and streams suddenly, with little warning. Flash floods can reach peak flows within a few minutes. Waters from flash floods move with great force and velocity and can tear out trees, carry away houses and outbuildings, and destroy roads and bridges. These walls of water often carry large amounts of debris, sewage, and pollutants. Although potentially hazardous to life and destructive of property, flash flooding usually lasts only a matter of hours.

Urban flooding occurs when heavy rainfall runs off structures, parking lots and streets and converges in culverts and drainage ways clogged with debris. This causes streets to flood and storm sewers to back up.

4.2.2 Location

Floods are the most common and widespread of all natural hazards in the United States, with exception of wildfires, and can have different causes. Most flood dangers and deaths are the result of flash floods. Flash floods usually result from weather systems which produce intense rainfall and rainfall rates, which result in substantial amounts of rain within a brief period. The two key elements are rainfall intensity and duration, but topography, soil conditions and ground cover play important roles.

Flash floods occur with little or no warning and can reach peak flow within a few minutes. Water from flash floods moves with great force and velocity and can roll boulders, tear out trees, destroy buildings, and sweep away bridges. Water within flash floods can reach depths of 10 to 30 feet and generally carry large amounts of debris.

Grove is generally between 760 to 850 ft elevation on land surrounded by Grand Lake O' the Cherokees. The lake is dammed 12 miles downstream, to the southwest, at Langley by Pensacola Dam. Flooding in and around Grove's lakefront properties is largely determined by the lake's level. The lake is normally regulated at about 744 feet but has risen as high as 755 feet during flooding events. The US Army Corps of Engineers has defined a flood easement to the 760-ft elevation contour around the lake. It is conceivable that the lake could rise as high as Pensacola Dam itself, which is 757 feet. As no permanent structures in Grove are allowed below the 760-ft contour, the community is generally not subject to riverine or lake flooding. Lakeside facilities such as marinas, piers and floating docks can be damaged or put temporarily out of business by excessively high water or low water. Occasional overland flooding does occur from storm drainage system backup, and roadways and low-water crossings in and around Grove have occasionally been under water.

The planning team used a combination of FEMA mapping and local studies to identify locations of flooding risk. As a part of its regulatory function, the National Flood Insurance Program (NFIP) has established zones used in Flood Insurance Rate Maps (FIRM)s. FEMA uses them to map floodplains. Flood location in Grove is characterized by the Zone A FEMA floodplain zone, in particular (all zones are described in more detail in the extent section).

This mapped zone is Zone A/AE, or 1% Annual Chance (100-year) flood zones. These zones are also called special flood hazard areas (SFHA)s. For the sake of clarity, this plan will refer to these zones as 1% (100-year) flood zones. There are six A zones. FEMA maps for the planning area outline two of them: the approximate A zone (A) and the A zone (AE). The difference between the two lies in Base Floodplain Elevation (BFE), which is the elevation of surface water resulting from a flood that has a 1% probability of equaling or exceeding that level in any given year. Zone AE floodplains are those where BFE is provided, while for Zone A, they are not.

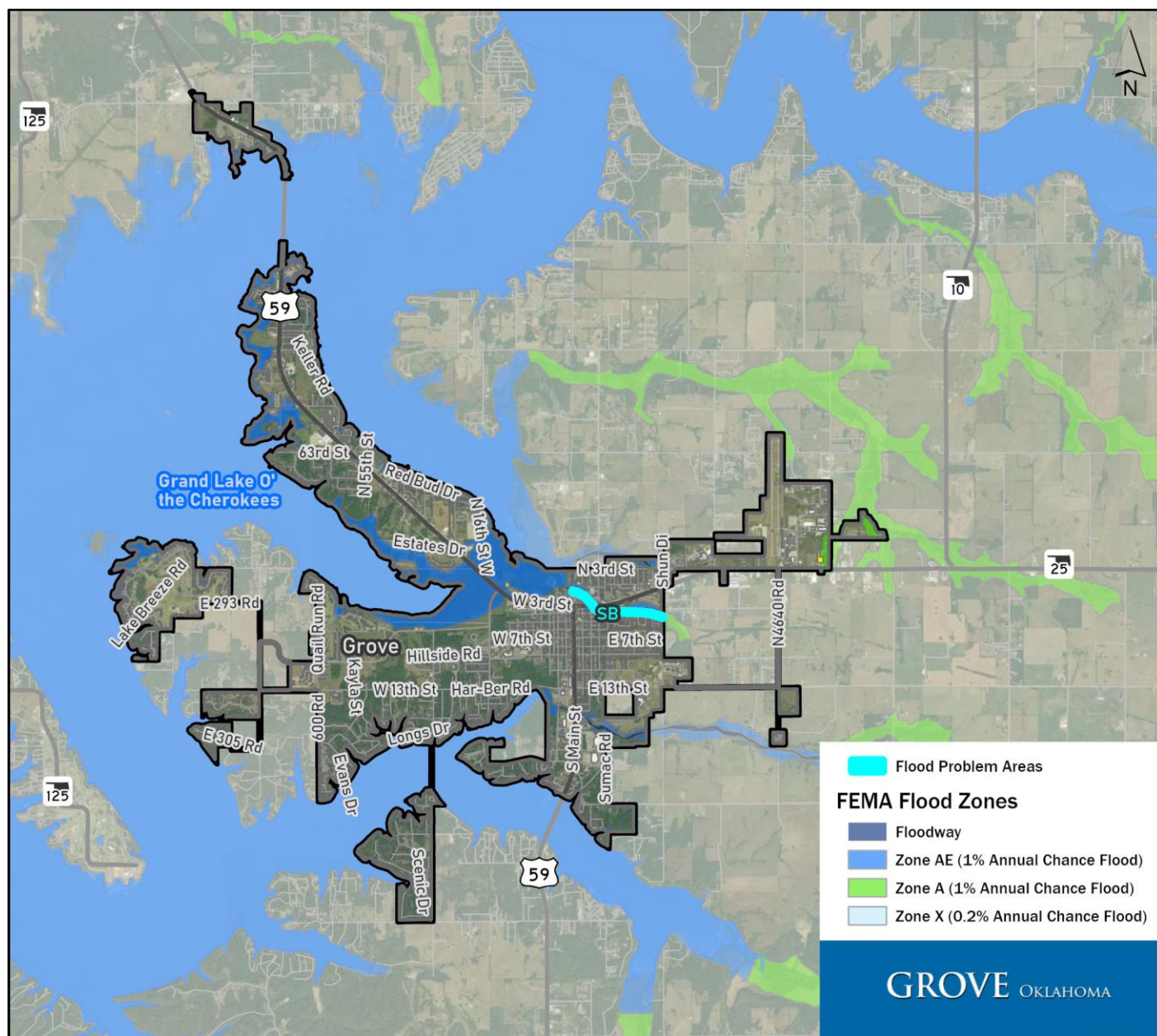
Table 4-7 FEMA Flood Insurance Rate Map (FIRM) Zones

FIRM Zones		
Zone A	The 1% Annual Chance (100-year) or Base Floodplain. There are six types of A zones:	
	A	The base floodplain mapped by approximate methods, i.e., BFEs, are not determined. This is often called an unnumbered A zone or an approximate A zone.
	A1-30	These are known as numbered A zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
	AE	The base floodplain where base flood elevations are provided. AE zones are now used on new format FIRMs instead of A1-30 zones.
	AO	The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided.
	AH	Shallow flooding base floodplain. BFE's are provided.
	A99	Area to be protected from base flood by levees or Federal flood protection systems under construction. BFEs are not determined.
Zone V and VE	AR	The base floodplain results from the de-certification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection.
	V	The coastal area subject to velocity hazard (wave action) where BFEs are not determined on the FIRM.
	VE	The coastal area subject to velocity hazard (wave action) where BFEs are provided on the FIRM.
Zone B and Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and the 500-year floods. B zones are also used to designate base floodplains or lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than one square mile.	
Zone C and Zone X (unshaded)	Area of minimal flood hazard, usually depict FIRMs as exceeding the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood.	
Zone D	Area of undetermined but possible flood hazards.	

As discussed in the flood location section, FEMA develops maps based on several floodplain zones. Flood extent in Grove is characterized by two floodplain zones: Zone A/AE and Zone X. Table 4-7 lists the FIRM zones identified for use in regulating construction in the floodplain and for determining insurance rates for properties located in the floodplain.

Figure 4-2 includes the FEMA floodplain mapping within the city boundaries and several figures on subsequent pages includes the areas mapped for the school district boundaries. It is important to note that although FEMA digital flood data is recognized as the best available data for planning purposes, it does not always reflect the most accurate and up-to-date flood risk.²⁰ Flooding and flood related losses can, and often do, occur outside of mapped flood zones.

Figure 4-2 Flooding Problem Areas & FEMA Flood Zones in Grove, OK



Given these considerations and the in the attempt to present the areas of heightened risk, the planning team has identified several flooding “problem areas,” due to their recurrence interval or expected depth of flooding (see

²⁰ One of the current shortcomings of much of the available detailed floodplain data (Zone AE) is that it was prepared many years ago with much cruder topography and rainfall depths that are smaller than current standards. Any detailed modeling should be updated in areas where the City of Grove is considering development.

extent for depth of flooding) and further detail can be seen by referring to the [Grove Hazard Mitigation HUB](#) online. The planning team found it important to focus on mitigating flood risk in recurring problem areas. These problem areas are the result of riverine flooding associated with runoff into Spring Branch which causes it to exceed its flow rate, as well as urban and flash flooding caused by inadequate infrastructure.

The planning team used FEMA floodplain data to identify these problem areas. These intervals are not mapped but are included in the planning team's analysis of the problem areas.

While not located within a floodplain, an examination of the FEMA floodplain maps reveals that the Grove Police Department building is in the same city block as Bank of Oklahoma, which is in Shaded Zone X. The proximity of this critical facility to an identified floodplain poses a risk to the continuation of city services during an emergency event and is something that is discussed further in Section 4.2.6.

4.2.3 Extent

Regarding flooding, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat:

- **Minor Flooding** - minimal or no property damage, but possibly some public threat or inconvenience.
- **Moderate Flooding** - some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- **Major Flooding** - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations (NWS, 2008).

The historical flooding events information presented in Table 4-9 indicates that the extent of flooding in the City of Grove ranges between minor and moderate flooding. Furthermore, it is estimated that the average structure in the SFHA will experience up to 2 feet of flooding, which will result in 25% damage to the structure and 25% damage to contents.

Table 4-8 Flooding Problem Areas in the City of Grove²¹

Area	Location	Description
SB	Along & north of O' Daniel Parkway, between Grand St. & Mill St	Approximately 20 structures have been identified within FEMA Floodplain Zone AE in this area, including the Grove Fire Department station and Grove Animal Shelter on east O' Daniel Parkway. BFE elevations within this stretch range from 757 feet on the northwestern extent to 765 feet on the southeast. There also appears to be a city maintenance facility within this area located near the intersection of Main Street and Davis Street/East 1 st Street that has a chemical storage tank located in their entryway that would present a potential hazardous materials risk during flooding events.
SB	Along East 3 rd St. from South Hazel St. to South Delaware St.	14 structures have been identified within this stretch within FEMA Floodplain Zone AE and Zone X. BFE elevations within this area range from 765 feet on the western extent to 785 feet on the east. Ridgerunner Car Wash is one structure in this area that presents a potential hazard materials risk during flooding.

²¹ L = flooding associated with Grand Lake

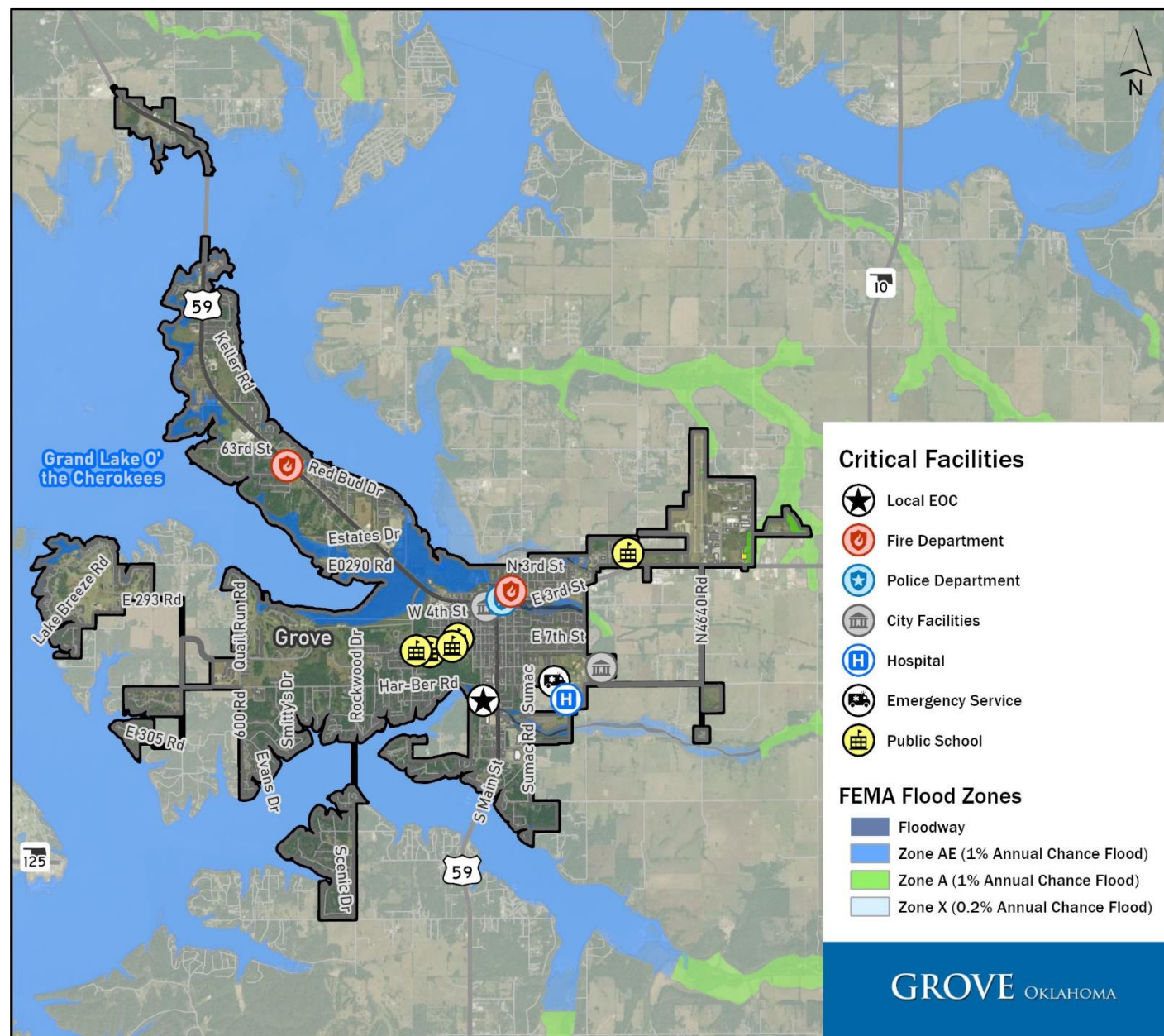
SB = flooding associated with Spring Branch

EC = flooding associated with Elm Creek

Area	Location	Description
SB	Along East 4 th Place from South Osage Street to Chopper Court	33 residential structures have been identified within FEMA Floodplain Zones AE and X. BFE elevations within this area range from 770 feet on the western extent to 775 feet on the eastern extent.
L	On the extreme northwestern portions of Grove near Sailboat Bridge	Approximately 25 structures have been identified within FEMA Floodplain Zone AE along the shores of Grand Lake within this area. BFE elevations within this area range from between 745 feet closer to the lake shore to 765 feet closer to U.S. 59. There is one potential hazardous materials risk during flooding events located at Royal Bay Marina.
L	Within central northwestern Grove from 98 th St. to 63 rd St.	22 structures have been identified on both sides of U.S. 59, mostly within FEMA Floodplain Zone AE along and near the shores of Grand Lake. BFE elevations within this area range from between 745 feet to 765 feet.
L	Along the lake shore in extreme western Grove, west of Patricia Island Golf Club	8 residential structures have been identified along the lake shore in extreme western Grove. While some of the structures may not lie within FEMA Floodplain Zone AE, some of them are partially within the floodplain, and the lakeside portions of these properties are. BFE elevations within this area range from between 745 feet to 765 feet.
EC	Along South Main St. between Elm Creek to East 18 th St.	Five structures have been identified within FEMA Floodplain Zone X in this area, with elevations between 760 feet to 770 feet.

Any detailed modeling should be updated in areas where Grove is considering future development. Extent for the problem areas in Grove is discussed in the Flooding Location section above), while Figure 4-3 below displays where FEMA floodplain zones intersect the City's critical facilities.

Figure 4-3 Critical Facilities and FEMA Floodplain Zones in Grove, OK



4.2.4 Previous Occurrences

In Grove, floods occur semi-regularly, particularly in low-lying areas and locations adjacent to creeks and Grand Lake. In the 10-year period between January 2012 – December 2021, Grove experienced 6 separate flood events were recorded. Despite being one of the most comprehensive resources for climatological data that is available to the public, not all flooding events that have occurred within the planning area have made their way into the National Center for Environmental Information (NCEI) database. For this reason, the planning team has supplemented information found in the NCEI database reports and records with other reliable sources. Descriptions of these events are included in the table below.

Table 4-9 Noteworthy Flood Events in the Planning Area

Date	Event Narrative
May 7-20, 1943	The largest flood in the recorded history of Grand River to this point occurred as a result of an onslaught of heavy rain which fell across much of eastern Oklahoma. The flow rate of the river was 300,000 cubic feet per second, with every gate at Pensacola Dam open. Even so, water reached a height of 7 feet at the powerhouse. 26 deaths resulted from this flooding event.
June 10, 1974	Flooding led to the declaration of DR-441-OK on June 10, 1974.
September 26 – October 15, 1986	From late September through early October, a storm system extending across the U.S. Central Plains region caused flooding of unprecedented proportions in northeastern Oklahoma and southeastern Kansas. This flooding resulted in the declaration of DR-778-OK on October 14, 1986.
November 6, 1996	Thunderstorms developed ahead of a vigorous cold front, producing heavy rains that led to localized flooding over much of the eastern one-third of the state.
October 5, 1998	What started out as Oklahoma's worst-ever October tornado outbreak turned into a widespread and serious flash flood event when a steady train of supercell thunderstorms moving across northeast Oklahoma on the evening of October 4 congealed into a slow-moving line of thunderstorms early on the morning of October 5. This line of thunderstorms remained nearly stationary roughly along I-44 through the overnight and pre-dawn hours of October 5, dumping widespread rainfall amounts of 5 to 7 inches along the I-44 corridor. Some of the heaviest rain fell in the Tulsa metro area. After sunrise, the line of thunderstorms started a slow southeastward drift, causing lesser, but still heavy, rain amounts of 3 to 5 inches across east-central and southeast Oklahoma. By the time the line of thunderstorms reached the southeast corner of the state on the evening of the 5th, rainfall rates were not as intense. Thus, the only county in eastern Oklahoma to not see flash flooding was Choctaw County, where rainfall amounts were generally 2.5 inches or less. High water washed across many roads across Delaware County. There was a significant amount of street flooding, especially near Grove. Cherokee Street had to be closed when a tributary of Wolf Creek overflowed. Grove City Park also flooded. OK-25 near Grove was under one foot of water. Street flooding was also reported in West Siloam Springs. Five school buses were stranded in high water when school let out early, around Noon CDT, in the Jay school district.
May 4, 1999	Following a week-long blocking pattern in the upper-levels of the atmosphere, a strong upper-level trough finally moved out of the southwestern U.S. Interactions with a dryline in western Oklahoma and a slow-moving cold front brought the largest tornado outbreak in Oklahoma history, beginning on the 3 rd and continuing into the 4 th . Following a very wet April that saturated soil around the area, another slow-moving weather system made flash flooding an additional severe problem with which to deal, as most rainfall ran off quickly into creeks, streams and mainstem rivers. One flash flood in Vinita caused millions of dollars in damage following the flooding of dozens of homes. Low-water crossings were also flooded near Grove.
May 9, 2000	May 2000 was a wet month for northeastern Oklahoma, due in part to a rainy start to the month, with several rounds of thunderstorms and heavy rain. The 9 th fell toward the end of this wet period, with thunderstorms producing heavy rain on this date. Heavy rains from this event caused OK-10 to be under water to the south of Grove.
June 3, 2001	Heavy rains from thunderstorms caused flooding in the Buffalo Creek and Elk River areas. Seventeen people were evacuated from a campground and one person was rescued from a vehicle.

Date	Event Narrative
July 24, 2001	Heavy rains from thunderstorms caused numerous roads to be flooded across Delaware County.
August 7, 2001	Street flooding resulted from 3.5 inches of rain, which fell from thunderstorms in the Grove area.
April 9, 2008 – April 28, 2008	Severe thunderstorms produced heavy rain and flooding, prompting the declaration of DR-1754-OK on May 9, 2008.
March 20, 2012	Strong to severe thunderstorms developed along a cold front that pushed into the region during the midday hours of the 19 th . The thunderstorms evolved into a line as they pushed eastward and produced damaging wind, large hail, and a brief tornado over eastern Oklahoma. The slow-moving nature of the complex also resulted in widespread flash flooding across the region. Delaware County District 2 reported 16 roads were closed due to high water between Grove and Jay.
June 23, 2019	Multiple rounds of thunderstorms moved across eastern Oklahoma from the afternoon of the 22 nd through the early morning hours of the 24 th , as a cold front approached the area from the west. The strongest storms produced damaging wind and large hail up to quarter size. In addition, widespread 2-4 inch rain amounts were observed across the area, with some areas receiving as much as 5-7 inches of rain during this period. Flash flooding resulted from this excessive rainfall. The widespread, heavy nature of the rainfall also resulted in moderate flooding of the Neosho River near Commerce, the Spring River near Quapaw, the Illinois River near Watts, Chewey and Tahlequah, the Arkansas River near Muskogee, and the Poteau River near Poteau and Panama. In Grove, several roads west of the city were flooded and closed.

4.2.5 Probability of Future Events

Based on the six flooding events that have occurred between 2012 through 2021, the planning team has determined that it is **likely** that the city of Grove will experience a flooding event, including urban and flash flooding, to occur approximately every 2 years. This yields an approximate probability of 50% per year, based on the record of events. SCIPP's Simple Planning Tool indicates that future trends show the probability of an increase in frequency and intensity of heavy rainfall events across Oklahoma²², which includes Grove, and would therefore lead to a potential increase in the likelihood of flooding events.

The overall significance of flooding events in Grove is **high**, particularly because the noted problem areas in town are areas where multiple critical facilities are impacted as well as primary transportation routes. The known repetitive loss areas are also located in this region as well.

4.2.6 Vulnerability and Risk Assessment

This section summarizes information about Grove's vulnerability to flooding, including the impact on people, structures and buildings, critical facilities, and infrastructure, recent GIS datasets, and federal floodplain maps were combined with noted flooding events of the past to produce a detailed vulnerability assessment.

According to a GIS overlay query by census block, Grove has 298 "residential structures" located in or adjacent to its regulatory floodplains. In a citywide 100-year flood, more than 298 households, including approximately 503 individuals, could be displaced, or affected by flooding within or near the inundation area. Those at greatest risk are individuals residing in structures located in repetitive flood areas. Additionally, those traveling by automobile or foot in flooded areas during heavy rains are also at high risk during these events. For Grove, particular concerns are noted in Figure 4-3 where a few critical facilities in downtown Grove coincide with floodplain areas.

²² [SIMPLE PLANNING TOOL \(southernclimate.org\)](https://southernclimate.org/)

The City's Fire Department and Animal Control buildings are in Zones AE while the Police Department site is just outside of this area to the west. The [Grove Hazard Mitigation HUB](#) will provide more highly detailed maps of these zones and structures. It is important to note that while these structures are vulnerable to flooding from Spring Branch creek, roadways that bisect the City from east-to-west may become unpassable or unusable during flooding events, and this severely limits the safety and operation of first responders who may need to travel east/west across the flooded creek.

In many instances, motorists continue to ignore barricades and warnings about driving into flooded roads, becoming stranded in their vehicles. Vehicles can be swept away in as little as 18-24 inches of moving water. Too often the rate of the water's rise is not appreciated, and people become trapped in the vehicle. Residents being directed to evacuate their homes due to the threat of rising water without appropriate transportation could be at greater risk and require emergency rescues. Likewise, those directed to evacuate but not willing to leave their homes may resist such instruction, which places them at risk too. A heightened emphasis for an education and outreach program to educate residents of the dangers associated with flooding, including participation in the "Turn Around Don't Drown" campaign, and encouraging them to create and implement emergency plans for these events would be beneficial to the planning area, and the planning team recommends that officials adopt these measures.

Additionally, Grove has 129 parcels with improved values of varying types which are located in the 100-year floodplain²³. Details on these vulnerable structures are identified according to their structure type in

Table 4-10 below. Structural values used in this assessment were from the Delaware County Assessor's Office. Based on the classifications in Table 4-6, and the considerations in FEMA Worksheet 5.1, the overall significance of a flooding event in Grove is **high**.

Future Conditions

Climatologically speaking, future conditions across the City of Grove will likely include warmer conditions which are expected to promote more intense flooding events. Seasonally, climate experts project that rainfall is expected to increase over the winter and spring while decreasing in summer months by the late 21st century. The Southern Climate Impacts Planning Program (SCIPP) planning tool guide shows there is strong confidence that the frequency and intensity of heavy rainfall events in the 21st century will increase, which also means flooding events will likely follow suit. Residents and low-lying areas currently in floodplains can expect more frequent flooding events and future flooding impacts should these climate projections verify.

People

Flooding is one of the most dangerous natural hazards to human life profiled in this plan. Driving through flooded areas accounts for most flood-related deaths, though residents trapped in their homes may be at risk of rising waters as well. In addition, busy roadways can become locations for accidents or drownings.

Certain groups of people are also more vulnerable to flooding. Among these groups are socioeconomically vulnerable populations including elderly people, young people, and lower-income people. Elderly people and younger people are more vulnerable to flooding for overlapping reasons, among them difficulties with using transportation independently and some difficulties/disinclination to use communication networks during emergency events. Another group significantly impacted by flooding is lower-income residents, since they are more likely to reside in areas with a higher frequency and/or extent of flooding, where costs of living are lower.

²³ Floodway, FIRM Zones A and AE

Public Health

There are also public health concerns due to flooding. According to the planning team's analysis, approximately 1,700 residents live in a SFHA floodplain.²⁴ These people are exposed to heightened public health risks to flooding. Flood waters can be contaminated with e-coli and fecal coliforms from sanitary sewer overflows and animal waste as well as hazardous chemicals which can cause immediate health problems. Contaminated flood waters can result in long term health and environmental impacts, and buildings inundated by flood waters may develop mold. There is long-term health risk from mold remaining in flooded structures. Flooding also can lead to evacuations, which carries their own physical and psychological risk to the people being evacuated.

Education and Outreach

There are no flood warning devices in Grove, giving people in the planning area less time to respond and react to an impending flood event. This can exacerbate the conditions listed in this section. Officials also expressed interest in having an emergency management application to reach all residents to warn them about a flood. The emergency application could be expanded to provide educational materials as well, especially flood insurance, dangers building in a floodplain, health risks from flooding (e.g., mold), and other materials.

Economy

Flooding causes significant economic losses. Disruption to transportation networks causes business interruption. Flooding also can damage businesses, vehicles, and it can also halt certain business operations. Flooding of roads, and key transportation routes can have significant impacts on the economy, largely because it prevents goods/services from reaching their customers and citizen employees commuting to work may see increased travel times. Prolonged disruption of supply chains in the planning area could cause a long-term economic downturn in the affected sectors.

Damage to large structures or structures with valuables can cause significant economic losses in building repairs. In addition, damage or closure to business that is revenue driver can lead to economic losses in terms of lost revenue. In Grove, some utilities are at risk of flooding, but no major employer is uniquely at risk of flooding in the City.

Built Environment

Existing Structures

All structures in Grove are at risk of flooding. To assess flood risk, a GIS-based analysis was used to estimate exposure to flood events using local tax assessor records in combination with building footprint data. The determination of assessed value at-risk (exposure) was calculated using GIS analysis by summing the improved values for parcels and structures that were confirmed to be located within an identified floodplain.

Table 4-10 highlights several types of structures in Grove that are potentially at-risk of flooding due to their location to Special Flood Hazard Areas (SFHA). Those impacted by flooding are encouraged to participate in the National Flood Insurance Program (NFIP), and Table 4-11 provides a detailed overview of NFIP statistics as they pertain to Grove. For additional information surrounding the City's built environment, please see Chapter 1, Section 3.

Table 4-10 Structures Touched by the Special Flood Hazard Area (SFHA)

Improvement Type	Number	Land Value	Improvement Value	MH* Value	Total Value
Residential	59	\$2,603,964	\$7,685,895	\$6,360	\$10,296,219
Commercial	59	\$5,184,158	\$8,559,057	\$4,981	\$13,748,196

²⁴ Estimate reached by multiplying the number of residential structures in the SFHA (Table 4-10) by 2021 ACS estimates for average household size (2.38 persons per household). [Grove city, Oklahoma household - Census Bureau Tables](#)

Improvement Type	Number	Land Value	Improvement Value	MH* Value	Total Value
Other	11	\$457,960	\$957,143	\$0	\$1,415,103
Total	129	\$8,246,082	\$17,202,095	\$11,341	\$25,459,518

MH=Mobile Home

The planning team has identified over 120 structures in the Planning Area that are exposed to mapped flood risk (the floodway, the 1% floodplain, the 1% approximate floodplain, and the 0.2% floodplain). The estimated value of parcels in the SFHA (Zone A floodplains) exceeds \$25 million. According to NFIP data, there have been approximately \$233,403 flood claim properties across the planning area, with eight of these claimants being repetitive loss properties.

As of this writing, four repetitive loss (RL) properties remain unmitigated. A repetitive loss property is defined as a property that has received at least two NFIP claims exceeding \$1,000 within any ten-year period since 1978. A Repetitive Loss Area (RLA) is an area with at least one repetitive loss property that has not yet been mitigated.

Table 4-11 City of Grove Floodplain and NFIP Data Information

FEMA Floodplain	No. of Buildings	RL Properties*	RL Claims	NFIP Total \$ RL Paid	NFIP Claim Locations	NFIP Total \$ Claims Paid
Floodway	10	1	2	\$22,144	4	\$45,833
1% Floodplain	115	3	6	\$75,175	9	\$79,812
1% (Approximate) Floodplain	4	--	--	--	--	--
0.2% Floodplain	28	--	--	--	--	--
Not in FEMA Floodplain	3,433	--	--	--	3	\$107,758
TOTAL	3,590	4	8	\$97,319	16	\$233,403

*unmitigated as of this writing

Location-specific flooding issues are also vulnerable to additional flood risk, which was identified in the location section of this assessment for the city. This section was not included in this section out of consideration for redundancy.

Infrastructure

The planning team analyzed infrastructure based on four utility sectors: electric, gas, water/wastewater, and transportation. These four elements were selected for further analysis based on different ways the hazards interact with these elements, in this case flooding. Most importantly, when these utilities are damaged or impacted by flooding their disruptions can cause significant economic, cultural, and social impacts (see FEMA Lifelines). All hazards analyzed in this risk assessment include a commentary on some or all these infrastructure segments. The gas segment is not at specific or unique risk of flooding.

Electric: Flooding can cause power outages in the Planning Area. The most common causes and accentuations of power outages due to flooding include damage to electrical generation or distribution networks and flooding

to roadways/properties that prevent repair crews from reaching offline areas. Power outages can exacerbate the conditions outlined in the People section above.

Water/Wastewater: Water/wastewater facilities and water/wastewater distribution systems can be adversely affected by floodwater. Flooding can inundate facilities, which can halt operations. If prolonged, a cessation of operations can result in a crisis to provide potable water to citizens or cause a backup of wastewater, which can cause a sanitation and/or environmental crisis. Floodwater seepage into water lines and other distribution systems, although unlikely, could cause contamination and public health issues (see Public Health for more information). Information provided by the Grove Municipal Services Authority (GMSA) shows the Quail Run Lift station being in FEMA Flood Zone AE and the East Booster Station on E 290 Rd. as being in FEMA Zone A. See the Grove HMP Viewer Web App hosted on the [Grove Hazard Mitigation HUB](#) for more detailed maps of these structures.

Transportation: Road blockages and congestion can cut off access to homes and businesses. Closed bridges and roads can cause traffic accidents and other backups that can extend the flood impact well beyond the flooded area. In Grove, this is particularly true for Highway 59N that crosses through Zone AE from about N 16th St to Leisure Rd. Highway 59N is a crucial roadway for traffic entering/exiting the City on the northwest side and broad flooding threat is possible which may render this arterial road impassable. Flooded roadways such as these or those immediately surrounding Spring Branch & Elm Creeks can result in citizens missing work, extra transportation costs/commute times, not to mention logistical issues for first responders. Flooding can result in hazardous driving conditions, which could cause loss of life, when vehicles are driven or swept into floodwaters.

As little as 12 inches of standing water over roadways can stall vehicles, and depths as shallow as 18 inches of flowing water can sweep many vehicles off roadways. Other transportation sectors impacted by flooding are railroads, waterways, and airports. In Grove, no railway or waterway is at risk, however portions of Grove Municipal Airport's taxiways are in FEMA Floodplain Zone A. Fortunately, this airfield serves general aviation interests, and no significant disruption is expected during flooding events.

Cultural Resources

All cultural institutions in Grove are at risk of flooding events. While not in Zone A/AE or X, the risk of flooding for Corey House is like that for Grove Police Department, as both are similar distances from those floodplains. A similar risk to flooding also exists for Splitlog Church, northeast of the incorporated area of Grove, and Bassett Grove Ceremonial Grounds. The risk to the ceremonial grounds, which contain many graves, poses a risk for damage to those graves, with the possibility of coffins being brought to the surface in floodwaters.

Critical Facilities

Several critical facilities and structures are touched by or located proximal to floodplains. Facilities identified below are critical facilities or infrastructure sites identified by City and GMSA officials. For a more detailed map of these problem areas, please refer to the Grove HMP Viewer Web App hosted on the [Grove Hazard Mitigation HUB](#)

- Bank of Grove
- Grove Police Department
- Bank of Oklahoma
- Grove Fire Department
- Grove Animal Control
- Grove EOC
- Hospital Lift Station
- Grove Water Treatment Facility
- Quail Run Lift Station
- East Booster Station

The effects of flooding at the city facilities listed can disrupt continuity of municipal services. Additionally, a blockage of key transportation routes (see location section) can disrupt emergency response times for police, fire, and other responders in the planning area.

Future Development

All future development in the planning area is vulnerable to flooding. Building in floodplains should be avoided at all costs when possible. In addition, any retrofit work to buildings in a mapped or known flooding area should integrate flood mitigation efforts. Studies of future weather patterns indicate that the planning area may experience higher amounts of rainfall in the years to come. It is still unclear how increased rainfall will change flooding areas in the City.²⁵ Currently, the City is not planning any development with major flood risk.

²⁵ <http://www.southernclimate.org/documents/SPTOK.pdf>

4.3 Severe Winter Storm

4.3.1 Hazard Description

A winter storm is a winter weather event that produces significant and impactful accumulations of freezing rain/ice, sleet and/or snow. Winter storms usually occur in the planning area between November and March and are usually created by large low-pressure systems moving rapidly across the country. Ice storms are often a greater threat than blizzards. Moisture from the Gulf of Mexico moving over shallow cold air near the earth's surface can produce ice accumulations of two inches or greater.

Winter storms may include heavy snowfall, blowing and drifting snow, high winds, extreme cold or ice storms. Of the most extreme instances is a blizzard, which is defined as winds greater than 35 mph, visibility less than $\frac{1}{4}$ mile, and a duration of at least three hours. New snowfall is not necessary for a blizzard, since blowing snow can obscure visibility. Another more extreme winter storm event that the planning area can expect is an ice storm, which is characterized by unusually low temperatures, freezing rain, and winds. Most significantly, ice storms can result in the rapid accumulation of ice on the built and natural environments. Winter storms are measured by snowfall accumulation or ice thickness.

4.3.2 Location

The City of Grove is affected by severe winter storms and due to the scale of winter storms, and their nature, winter storms encompass the entire planning area.

4.3.3 Extent

The extent of a storm is determined by its duration and severity. Severity reflects the general combination of a storm's temperature, wind speed, and precipitation levels (precipitation type is determined, in part, by temperature). Wind Chills in Grove can reach as low as -20°F (see Figure 4-4), with winter storms in Grove typically depositing 1-3 inches of snow, sleet, and/or freezing rain. A severe winter storm is one that drops 4 or more inches of snow during a 12-hour period, or 6 or more inches during a 24-hour span. Ice accumulations of only $\frac{1}{2}$ inch can immobilize the town and cause critical damage to infrastructure. As little as 2 inches of snow combined with strong winds can cause blizzard conditions.

Ice

While winter storms can bring several different hazards, one specific hazard that commonly affects Grove is the accumulation of ice. This happens when snow within clouds melts as it falls, then refreezes prior to contacting the surface (sleet, or ice pellets), or freezes after contacting the surface (freezing rain). The Sperry-Piltz Ice Accumulation (SPIA) Index, shown in Table 4-12 can be used to predict the types of damage that may occur before the onset of a winter storm. The SPIA Index is used to predict the location, timing, and severity of ice storm impacts days in advance. This index uses National Weather Service forecast parameters to predict the spatial coverage, total ice accumulation, and potential damage from ice storms. The tool allows schools, power cooperatives, and other entities to better prepare for severe ice events. Where ice accumulations are concerned, the planning area generally sees anywhere between $\frac{1}{4}$ to 1 inch on elevated surfaces and a ratings of 0-2 on the SPIA index. In far less frequent (but more severe) conditions, the planning area could see anywhere between 1 and 3 inches of ice accumulations and ratings up to 5 on the SPIA Index.

Table 4-12 Sperry-Piltz Ice Accumulation (SPIA) Index

SPIA Index	Damage and Impact Descriptions
0	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages
1	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous
2	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation
3	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 - 5 days.
4	Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 - 10 days
5	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.

Snow/blizzards

Another hazard brought by winter storms that commonly affects Grove is that of snow. Lighter accumulations of 3 inches or less during an event still present a hazard, particularly if there are ice accumulations that are present underneath the snow layer but are manageable through pretreatment techniques and utilizing snow clearing equipment and ice melting techniques to limit the extent of the hazard. The severity of the hazard increases more dramatically, however, when snowfall accumulations exceed 4 inches, or snowfall rates become particularly heavy, such as during blizzards.

While the NCEI Storm Events Database shows no records of blizzards affecting Grove going back to 2012, a blizzard in February 2011 produced 12-18 inches of snow across Delaware County, and docks on Grand Lake were destroyed by the weight of the snow, which caused secondary damage and destruction to boats anchored to those docks. Thus, while blizzards are not an event that occurs with great frequency, it is an event that has the potential and likelihood to occur in the planning area and have significant impacts.

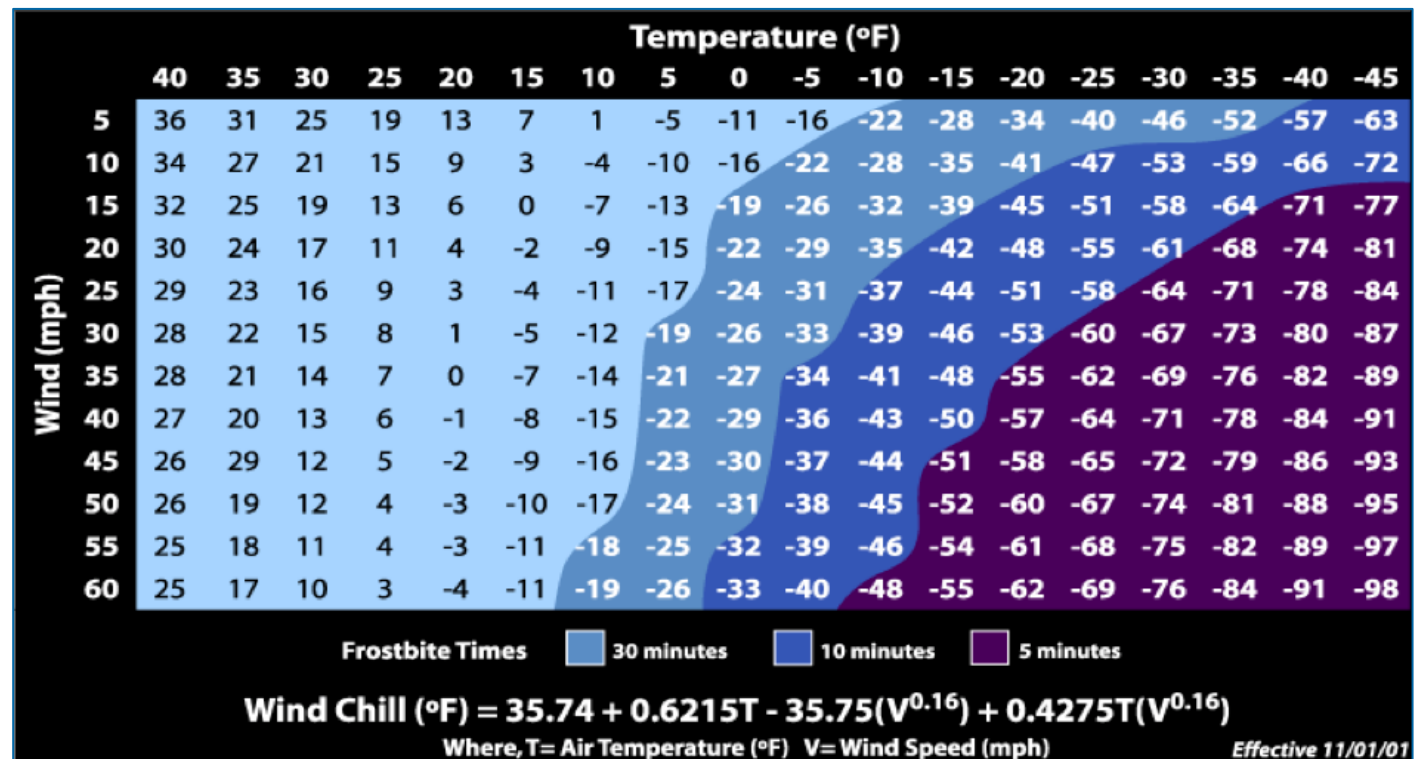
Extreme Temperature/Wind Chill

In addition to ice and snow, wind chill has a significant impact on a winter storm's extent. According to the National Weather Service, wind chill is a term used to describe what the air temperature feels like to the human skin due to the combination of cold temperatures and winds blowing on exposed skin. In simple terms, the colder the air temperature and the higher the wind speeds, the colder it will feel on skin for someone who is outside.

The National Weather Service and the National Oceanic and Atmospheric Association created one of the most used windchill charts in the United States (Figure 4-4). This chart's primary use is to indicate immediate threat to human safety by listing approximate time periods for exposed skin to develop frostbite.

Rapid onset times for frostbite, although rare, are possible. Several days during the February 2021 event, one in which extremely cold air affected the planning area, the windchill factor approached the 30-minutes-to-frostbite zone. The planning area can expect the windchill temperatures that range between 36F and -30F.

Figure 4-4 NOAA/NWS Windchill Index



4.3.4 Previous Occurrences

Despite the climate being classified as humid subtropical, winter storms are no stranger to Grove. Though not always accompanied by precipitation, cold fronts often spread Polar and Arctic air southward across the planning area. When juxtaposed with the correct timing of moisture, this cold air can combine with that moisture to produce wintry precipitation. Therefore, the entire jurisdiction of the City of Grove is considered vulnerable to the effects of a severe winter ice/snow event.

Severe winter storm events are catalogued in the NCEI Storm Events Database, which includes regional reports. As discussed in the extent section, severe winter storms are, by nature, not isolated events – therefore it could be stated that winter weather events affecting Delaware County also had a degree of impact on the City of Grove. The NCEI database reported 13 winter weather events in Delaware County between January 1, 2013, and December 31, 2022, which were observed in Delaware County, all of which were included in Presidential Disaster Declarations.

Table 4-13 Noteworthy Winter Storm Events in the Planning Area

Date	Event Narrative
December 9-10, 2007	Arctic air spread into the region ahead of a strong storm system over the desert southwest. Several disturbances translated from the low-pressure area across the Southern Plains, resulting in several periods of precipitation, including thunderstorms. Freezing rain was the dominant precipitation type during the event; the thunderstorms resulted in an increased rate of ice accumulation. One to two inches of ice accumulated on trees and power lines within a 40-mile-wide band along a Bristow-Tulsa-Vinita-Miami line and one to one and a half inches of ice accumulated on exposed surfaces along a Welty-Coweta-Jay line. Nearly one million people were estimated to be without power in eastern Oklahoma after this event, some of which remained without power for up to two weeks. Early estimates indicate that this storm, which affected a large portion of the state, could be the costliest weather-related

Date	Event Narrative
	disaster in Oklahoma history. Several indirect related injuries and fatalities were attributed to this storm in eastern Oklahoma, including seven fatalities in automobile accidents on treacherous roads; one carbon monoxide fatality due to improper use of a heat source indoors; and six fatalities due to house fires that were started by temporary heat or light sources during the power outages. There were also three direct fatalities, including one in which a male was killed in Tulsa when a utility pole fell on his vehicle due to ice weighting; and two hypothermia deaths, one in Tulsa on the 15th and one in Skiatook on the 18th. One half inch to one inch of ice accumulated on trees, power lines and other exposed surfaces, causing \$35 million in property damage across Delaware County, triggering three disaster declarations (DR-1678, DR-1735 and EM-3280)
January 26-27, 2009	Upper-level disturbances passing through the Southern Plains resulted in precipitation development north of a stationary arctic front in North Texas. Freezing rain began across the area during the late morning hours of the 26th and became more widespread and heavier during the afternoon and evening hours. Freezing rain changed to sleet north of an Okemah-Wagoner-Colcord line during the morning of the 27th with heavy freezing rain continuing south of that line. The heaviest icing and most widespread power outages and tree damage occurred across portions of Cherokee, Sequoyah, Muskogee, and Adair Counties where one to one and a half inches of ice accumulated. Over 100,000 electric customers were without power during the storm's height in eastern Oklahoma, and some customers in remote rural areas were without power for over two weeks. A 40- to 50-mile-wide swath of heavy sleet occurred just to the west of the most significant ice with two to three inches accumulating along and near an Okemah-Wagoner-Grove line. Elsewhere up to an inch of sleet fell on top of the heavy ice. One direct injury occurred from the storm in eastern Oklahoma. A man was injured by ice coated tree limbs that fell on him in Cherokee County. Disaster declaration DR-1823 resulted from this event.
December 24-25, 2009	A strong upper-level low pressure system moved from the Southern Rockies across the Southern Plains on the 24th. Widespread precipitation developed as this system approached. Arctic air gradually spread into the region behind a strong cold front changing the rain to sleet over much of northeastern Oklahoma during the morning hours and then to snow during the afternoon. Many locations received between one half and one and a half inches of sleet over the northeastern portion of the state. Periods of heavy snow followed resulting in at least four inches of snow along and north of I-40. Heavier bands of snow between eight and twelve inches fell along the Pawnee to Pawhuska line and along an Okmulgee to Vinita line. Many roads were snow covered and closed across the region, including interstate highways and turnpikes. Numerous automobile accidents occurred during this storm as roads became treacherous. These accidents resulted in three (indirect) fatalities and numerous injuries. Tulsa International Airport was also closed during the storm with numerous flights into and out of the airport cancelled. Very strong winds with frequent gusts above 35 mph caused extremely low visibility in blowing snow and near blizzard conditions. Snow drifts of several feet occurred across portions of northeastern Oklahoma. A major disaster declaration (DR-1876) was approved for 29 counties in Oklahoma to help with the \$18 million spent in response and recovery efforts because of this storm, including Delaware County.
January 28-29, 2010	A strong upper-level low pressure system moved from Baja California into the Southern Rockies on the 28th and into the Southern Plains on the 29th. Rain changed to freezing rain and sleet during the morning and early afternoon of the 28th. The freezing rain resulted in 1/4 to 3/4 of an inch of glaze across much of northeast Oklahoma. Sleet amounts were up to an inch across

Date	Event Narrative
	portions of northeast Oklahoma. An estimated 5000 electric customers in northeastern Oklahoma were without power during the height of the storm. As the upper low neared the region on the 29th, the precipitation changed to snow with over 4 inches falling north of a McAlester to Fort Smith line. Up to 8 inches of snow fell across portions of northeast Oklahoma by the evening of the 29th. Many automobile accidents occurred across the area due to the icy conditions, resulting in many indirect injuries. One to three quarters of an inch of glaze occurred across the county along with five to seven inches of snow, as this event resulted in two disaster declarations (EM-3308 and DR-1883).
February 1-5, 2011	Two systems within a short span of time affected northeastern Oklahoma in early February. First, a strong storm system moved across the Southern Rockies into the Southern Plains on the 31st of January and 1st of February. Cold air had surged into the region ahead of this system on the 30th and 31st. Precipitation developed into eastern Oklahoma during the evening of the 31st, beginning as freezing rain and sleet. Most places transitioned to snow quickly, although some in northeastern Oklahoma and east-central Oklahoma received between one quarter and one half inch of sleet before the transition. Other locations received about one quarter of an inch of ice before changing over to snow. Heavy snow fell during most of the day resulting in more than four-inch accumulations north of a Sallisaw to McAlester line. A large portion of northeastern Oklahoma received over ten inches of snow and a swath of 20-inch snow was measured across Osage, northern Tulsa, Rogers, and Ottawa Counties. Strong winds frequently gusting to more than 35 mph resulted in near zero visibilities and snow drifts up to about five feet across northeastern Oklahoma. The storm had a crippling impact on the region with interstate highways impassable and closed, the Tulsa International Airport closed, and many businesses shut down for a couple days during and following the storm. A couple of schools experienced collapsed roofs from the weight of the snow, as did a casino in the Tulsa area. Boat docks on Grand Lake were destroyed by the weight of the snow, damaging or destroying several boats. Damage estimates for that area alone were \$30 million. This event resulted in a disaster declaration, EM-3316-OK.
February 14-17, 2021	Two systems combined to produce a protracted winter event across the planning area. First, a strong storm system translated into the Southern Plains from the Southern Rockies on the 14th and 15th. Heavy snow began across the area with the main storm system approaching early morning of the 14th. Several rounds of widespread heavy snow produced four to eight inches of accumulation, as the snow continued into the early afternoon hours of the 15th in some areas as the storm system moved away from the region. The heaviest snow fell in a swath along and south of I-44, and north of I-40, including across Delaware County. In addition to the heavy snow, much of eastern Oklahoma experienced excessively cold wind chill from the 14th through the 16th. Temperatures fell below zero across the area on the 15th and 16th, and wind chill values were as low as -20 to -30 degrees. The second system translated along a similar path to the winter storm that impacted the area on the 14th and 15th. It moved into the Southern Plains from the Southern Rockies on the 16th. Precipitation developed across portions of eastern Oklahoma during the early evening of the 16th and became widespread across the region during the evening and overnight. Due to the deep arctic air that remained entrenched across the region, the precipitation fell as snow. A general three-to-five-inch snowfall occurred across much of eastern Oklahoma as a band of snow persisted across northeastern Oklahoma into the morning hours of the 17th. Two disaster declarations were triggered by these systems (DR 4587 and EM-3555).
February 23, 2022	Arctic air spread into the Southern Plains on the 22nd, ahead of a strong storm system translating into the southwestern United States. The first disturbance moved into the Southern

Date	Event Narrative
	Plains on the 23rd, resulting in a large area of precipitation to develop across eastern Oklahoma. A layer of air several thousand feet above the ground remained above freezing, with very cold air below this layer extending to the ground. This scenario resulted in sleet, which was mixed with snow in northern areas, and mixed with freezing rain in southern areas. Thunderstorms were embedded in this area of precipitation, resulting in heavy accumulation rates. Much of eastern Oklahoma received between one half and two inches of sleet by the late afternoon of the 23rd. Some light snow was mixed with sleet north of I-44, and light freezing rain produced a glaze of ice across far southeastern Oklahoma. Up to an inch of snow fell in a swath downwind of Lake Oologah on top of the layer of sleet across western Rogers, eastern Tulsa, and western Wagoner Counties. Very light snow and freezing drizzle occurred intermittently throughout the early morning hours of the 24th across much of the region. A second disturbance approached the area during the morning of the 24th, resulting in another round of sleet and freezing rain. Thunderstorms were once again embedded in the precipitation. Additional accumulations of sleet and ice occurred across much of eastern Oklahoma on the 24th, with the precipitation ending from west to east during the late morning and early afternoon.

**bolded dates are those which resulted in a major disaster declaration*

4.3.5 Probability of Future Events

NCEI reports 13 winter weather events impacted the planning area between January 1, 2013 and December 31, 2022, making the probability of this hazard affecting the planning area annual basis as **highly likely**.

4.3.6 Vulnerability and Risk Assessment

City of Grove is affected periodically by heavy snow and ice that cause damage. Trees and power lines can fall due to the weight of ice and snow, damaging their surroundings and blocking streets and roads. Icy roads cause vehicular accident rates to increase and impair the ability for emergency vehicles to respond which can result in more injuries and sometimes deaths.

Winter storms can range from accumulating snow and/or ice over just a few hours to blizzard conditions with blinding, wind-driven snow that can have effects which last several days. The aftermath from a damaging winter storm can continue to impact a region for weeks and even months. Economic losses can occur to livestock producers and any business in the affected areas. Water systems being shut down or frozen can disrupt social services, schools, homes, and businesses. Carbon monoxide poisoning is always a possibility as homeowners and businesses use alternative heat sources to keep warm. Personal health can be affected in a variety of ways including mental and physical stress, frostbite or related injuries and inability to travel for care.

In the event of a severe ice storm, Grove residents could have to wait days or weeks before power company crews can repair power lines servicing their homes. Utility companies have developed extensive right-of-way vegetation maintenance programs to remove trees that pose a threat to nearby power lines. Ice storm contingency plans have also been developed by utility companies; these plans identify priority facilities such as hospitals that need power service restored as quickly as possible. The plan also lists mutual aid agreements with utility companies in neighboring areas that, if able, can send service crews to the area to help restore power.

Because of the costs associated with the placement and maintenance of underground lines, and the immediate need to restore power to a disaster area, the burial of electrical lines during a disaster are usually not cost effective, despite being a measure that can enhance resiliency of the electrical grid. However, as new lines are considered and/or replacement lines are needed, the providers should thoroughly investigate replacing these lines with underground lines to enhance resiliency, at least in incorporated areas. The planning team also

recommends establishing Citizen Emergency Response Teams to complement the implementation of a debris removal plan.

Based on the classifications in Table 4-6 the overall significance of a severe winter storm event is **high**. Communities and individuals exposed to severe winter storms are at risk of extended loss of utilities. Combined with dangerous travel conditions and structure damage, winter storms can put Grove residents at elevated risk.

Future Conditions

Climatological changes this century are expected to bring less frequent and less intense extreme cold events in Oklahoma, with generally warmer winter seasons. Climate models have a much more difficult time predicting what trends will be like for winter storm events that produce ice, sleet and/or snow, mostly because these types of winter weather events are themselves highly complex.

Changes in the severity of these hazards may increase the threats already posed to residents and vulnerable populations in the City. Until proper actions can be funded and communities across Grove are capable of withstanding more intense winter weather events, populations will remain at risk. While population trends may be hard to forecast, vulnerable populations in the planning area (see Figures 1-1 through 1-7) will be especially hard hit until mitigation measures can be taken, and community resiliency improves.

People

The entire population is exposed to severe winter storm events. The NCEI database did not indicate any fatalities or injuries due to this hazard Grove during the reporting period, however, winter storms have resulted in severe car crashes and dangerous conditions for residents. Transportation accidents and cold-related injuries and fatalities present the largest concern to public safety. Ice accumulation on roadways immediately creates hazardous driving conditions. Roads on gradient and slick road surfaces increase the frequency and impact of traffic accidents for the general population, which can result in personal injuries and fatalities. Smaller, less maintained roads may be additionally damaged by ice or become more difficult to navigate.

Public Health and Safety

Hypothermia is the most prominent cold-induced threat to human life. Extreme cold can cause animals and people, especially outdoor workers exposed to winter elements, to suffer from frostbite and hypothermia – and when severe enough, death. Children and the elderly are at increased physiological risk.

Socioeconomically disadvantaged people are particularly vulnerable to the cold. They may not have access to housing, or their housing may have poor insulation or poor heating. Also, some of this population may not have electrical service due to possessing lesser means to afford it. Some people may resort to alternate methods of heat such as space heaters or using the oven as a heat source, which can lead to carbon monoxide poisoning or produce other harmful side effects. This risk has been observed commonly during periods of colder than normal weather. With Grove having a considerable number of retirees who call the city home, some of whom are on fixed incomes, this is a concern (see Chapter 1 for more details).

Grove City Hall serves as a warming center during periods of extreme cold. Officials report that school buses can be utilized to transport residents in need of transportation to provide them warmth and safety. Warming centers are particularly important in an area such as Grove, with high numbers of vulnerable people due to income level and age (see vulnerability indicators in Chapter 1).

Education and Outreach

Grove Emergency Management utilizes the CodeRED mobile app to alert citizens and communicate hazard risk to them. Education on proper warming techniques, locations of warming centers, proper ways to conserve water and prevent pipes bursting, insulations best practices, and other information can be improved and provided for residents, developers, builders, and realtors. Outreach methods can include social media platforms and producing and distributing family emergency preparedness information about severe winter weather.

Economy

Extended power outages can pose a risk to Grove's economy by preventing businesses from operating, some of which provide critical or much-needed goods and services. The overwhelming majority of Grove's economy is seasonal however, with revenues for many businesses peaking during the spring and summer months, as many people visit the city and the lake for recreational purposes. Even so, the effects of a winter storm inhibiting businesses from being able to generate revenue can have a profound impact on the local economy.

Winter storms also affect the economy by disrupting transportation networks throughout the city, most prominently roads. Prolonged road closures can cause interruptions to the supply chain, which can prevent gasoline and much needed goods and supplies from being able to be transported to Grove.

Built Environment

Existing Structures

Threats to structures from winter weather include ice buildup on roads and bridges, and weighting from ice/snow on flat or low-grade roofing surfaces. This is especially true of older structures not constructed to building standards, which considered this. Commercial structures face similar impacts from winter weather as residential properties.

Indirect threats to structures include power outages causing interruption to heat and refrigeration (loss of supplies, food, sensitive equipment), frozen water pipes (excessive flooding causing damage to interior and sensitive electronic equipment if pipes burst), and fires (caused by power lines being torn away from structure or power surges as lost power is restored).

Infrastructure

Electric: One of the most severe consequences of a winter storm on infrastructure is damage to power lines caused by the added weight and surface area of ice accumulation, combined with the additional stress of wind. This can result in economic effects if service interruptions are prolonged across large portions of the planning area (see economy section). In addition, Grove has a sizable portion of the population who are elderly retirees, some of whom rely on electrical-powered machines. These residents are immediately at risk during a power outage. Some of the biggest threats stemming from a prolonged loss of electrical power include stoppage of operations at water/wastewater utilities, as well as medical care facilities who may not have backup generators. Current efforts are underway at the City Office of Emergency Management to coordinate with AEP/PSO to help identify vulnerable populations, and how to inform when power is lost at these locations. A unified communication process would ensure that emergency personnel would be notified promptly when/if vulnerable residents lose power/heating during severe winter storms.

Officials in Grove report that AEP and NOEC provide routine tree trimming and vegetation management on a "per-hazard basis" to ensure power lines are protected. These actions prevent power outages from occurring due to power lines downed by tree limbs or other vegetation producing undue stress on them. Despite these measures, officials noted that the timing and nature of a winter weather event can influence power outages. A winter weather event that occurs unseasonably early, in October for instance, has the potential for more damage to lines, along with roofs and cars. Since vegetation will not have yet gone into winter dormancy phase, additional surface area of ice on leaves that have not fallen can add to the weighting from trees on electrical power lines.

Gas: When Winter weather impacts the region GMSA, who supplies natural gas service to the City, can experience a variety of challenges in delivering natural gas to their customers. These challenges can include, but are not limited to, damage to gas meters from ice accumulation, falling power lines or tree debris, inaccessibility to underground gas meters from falling debris, danger to field employees related to road conditions, downed power lines, and exposure to extreme temperatures. Loss of gas services could lead to a

sharp reduction in residents' abilities to heat their homes properly (see people section), use personal vehicles, or power backup generators. These effects can pose a risk to the livelihoods of residents in Grove.

Water/Wastewater: The primary threat of severe winter storms to the operation of Grove's wastewater treatment plant revolves around power outages. Fortunately, the city plant does have access to a backup generator should power ever be interrupted.

Extreme cold can also cause water and wastewater delivery lines to burst. A system failure due to a significant water line break or a facility going offline could lead to significantly adverse consequences. Citizens could lose access to potable water for a long time. Wastewater from the planning area treated at the wastewater treatment plant could become backed up, potentially leading to additional sanitation issues.

Transportation: All manners of transportation would be at risk during a winter event in the planning area. Road closures due to ice/snow accumulation can result in loss of retail trade, wages, and tax revenue. There are three bridges within the City limits, each of which is vulnerable to icing. According to the National Bridge Inventory (NBI) database, which provides daily vehicular traffic over bridges, estimates that the Veldo M. Goins Memorial Bridge averages 5,200 vehicles per day, the Honey Creek Bridge averages 7,300 vehicles per day, while the E 3rd Street bridge over Spring Branch Creek handles over 11,000.²⁶ Icing can render these structures unusable, which would prevent thousands of vehicles from crossing.

The challenges to transportation posed by ice and snow to first responders during and after a winter event can also contribute to increased risk to the population if it emergency routes, access to other medical care, or access to safe shelter are blocked or impassable.

Food insecurity is also a concern. Those who are without transportation or blocked by degraded road conditions due to ice or snowpack will be vulnerable to food shortages. This highlights the need for support systems to be in place, particularly for the elderly and other socioeconomically disadvantaged residents.

Critical Facilities

All critical facilities in Grove are susceptible to the potential impacts of a winter storm event. Among other adverse effects, power outages can interrupt vital services, and snow/ice accumulation or debris from damaged trees result in inaccessibility due to road closures or blockages. Stakeholders in Grove have noted that not all critical facilities are supported by backup generators for a continued supply of electricity. Representatives from Betty Ann Nursing Center report that they do not have a backup generator and have also experienced a pipe burst incident in their facility due to extreme cold. Officials report that all city facilities, except for City Hall, have backup generation.

To ensure proper operation and reliability, it is recommended that city officials and those at private facilities which are critical should conduct regular tests and maintenance on these generators. Backup generators can still fail, despite efforts toward proper maintenance, for several reasons including:

- Age of the unit (exceeded the unit's product lifetime)
- Storage location of the unit (not elevated off ground; exposed to weather)
- Lack insulation of the unit (from extreme heat and cold)
- Time that the unit is activated (overheating during periods of extended use)
- Time when the unit is activated (delays to activate in extreme heat or cold)
- Failure to conduct regular tests of the unit
- Lack of available gasoline/diesel to power generator due transportation issues or supply shortage

²⁶ Bureau of Transportation Statistics (BTS; Federal Highway Administration (FHWA))

Cultural Resources

Both Grove's cultural structures are exposed to and at risk from hazards associated with winter weather. The associated hazards with the highest probability of risk to these cultural resources would be structural damages caused by heavy snow loads or downed trees due to weighting by ice accumulation. More studies are needed, however, to improve the understanding of the effects of severe winter weather on these assets.

Future Development

All future development is at risk of hazards posed by winter storm events. It is recommended that electrical power lines in areas of future development should be buried to avoid power loss where practicable. Generators should be installed at all critical facilities across the planning area. Adoption of the 2018 International Building Codes, the standard for Oklahoma, automatically takes place for Grove, as written in their code of ordinances. Buildings constructed before the adoption of the 2018 IBC codes, however, will continue to remain more vulnerable unless they are retrofitted or updated with most current standards.

Natural Environment

The environment, especially large flora, is at risk of snow and ice accumulation. As little as ¼-to-½-inches of ice accumulations can break small branches and weak limbs, while ½-to-1-inch ice accumulations can cause larger branches to break.

4.4 Tornado and High Wind

4.4.1 Hazard Description

Tornadoes and high winds form differently, but can have similar features (e.g. high windspeeds), depending on their severity. According to the National Weather Service, a tornado is a violently rotating column of air, usually pendant to a cumulonimbus, with circulation reaching the ground.²⁷ Tornadoes form from severe thunderstorms. Thunderstorms may result in conditions favorable to the formation of numerous or tornadoes with longer durations. Supercell thunderstorms are often associated with increased tornado risk. Tornadoes may also develop along squall lines or in bands of storms associated with hurricanes. Tornadoes require moist air, instability (warm air rising), a source of lift such as a front, dryline, or heating, and wind shear (change in wind direction and speed with height).

High wind is the motion of air relative to the earth's surface. Extreme windstorm events are associated with cyclones, severe thunderstorms, and accompanying phenomena such as tornadoes and downbursts. High winds can result from thunderstorms, strong cold front passages, or gradient winds between high and low pressure. Damaging winds are often called "straight-line" winds to differentiate the damage caused by tornadoes. Downdraft winds are a small-scale column of air that rapidly sinks toward the ground, usually accompanied by precipitation. A downburst is the result of a strong, thunderstorm associated downdraft that causes damaging winds near the ground.

4.4.2 Location

Tornado and high wind events present a risk for the City of Grove. High wind events are likely to impact a large proportion of the jurisdiction during a single event. Although tornado events are usually localized, any specific location in the planning area could be impacted by a tornado.

4.4.3 Extent

The planning team used Enhanced Fujita (EF) scale to classify the extent of tornadoes in Grove. In terms of extent, it is often difficult to separate windstorms and tornado damage when winds get above 73 mph, which happens frequently in association with tornadoes and in thunderstorms that produce high winds. The EF Scale was revised from the original Fujita Scale to better reflect the relationship between damage surveys and observed wind speeds. Tornadoes are classified according to the Enhanced Fujita (EF) scale, which became operational on February 1, 2007.

While any tornado can cause damage or injury, tornadoes of EF-3 or greater are most important in terms of their extent.²⁸ FEMA and NOAA estimate that 85% of all fatalities resulted from tornadoes of EF-3 or greater.²⁹ Table 4-14 provides a description of typical damage to one- and two-family dwellings at certain windspeeds, which can apply to tornadoes and high winds. It is important to note, however, that these descriptions should be seen as a general estimate of damages, not a baseline estimate. As discussed in further detail in the vulnerability sections, structures like mobile and prefabricated homes are likely to experience higher damage volumes than fixed residential structures.

²⁷ <https://www.weather.gov/safety/tornado>

²⁸ FEMA P361, 4th edition, B3-16; https://www.fema.gov/sites/default/files/documents/fema_safe-rooms-for-tornadoes-and-hurricanes_p-361.pdf

²⁹ Ibid., A2-2; https://www.fema.gov/sites/default/files/documents/fema_safe-rooms-for-tornadoes-and-hurricanes_p-361.pdf

Table 4-14 Enhanced Fujita Tornado Scale & Levels of Damages Associated with Each (NWS)

EF Rating	Wind Speeds	Damage	Damage Description
EF-0	65-85 mph	Minor	Shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.
EF-1	86-110 mph	Moderate	More significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.
EF-2	111-135 mph	Considerable	Roofs torn off well-constructed homes, homes shifted off their foundation, mobile homes destroyed, large trees snapped or uprooted, cars tossed.
EF-3	136-165 mph	Severe	Entire stories of well-constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark
EF-4	166-200 mph	Extreme	Well-constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.
EF-5	> 200 mph	Massive / Incredible	Well-constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches, and snapped.

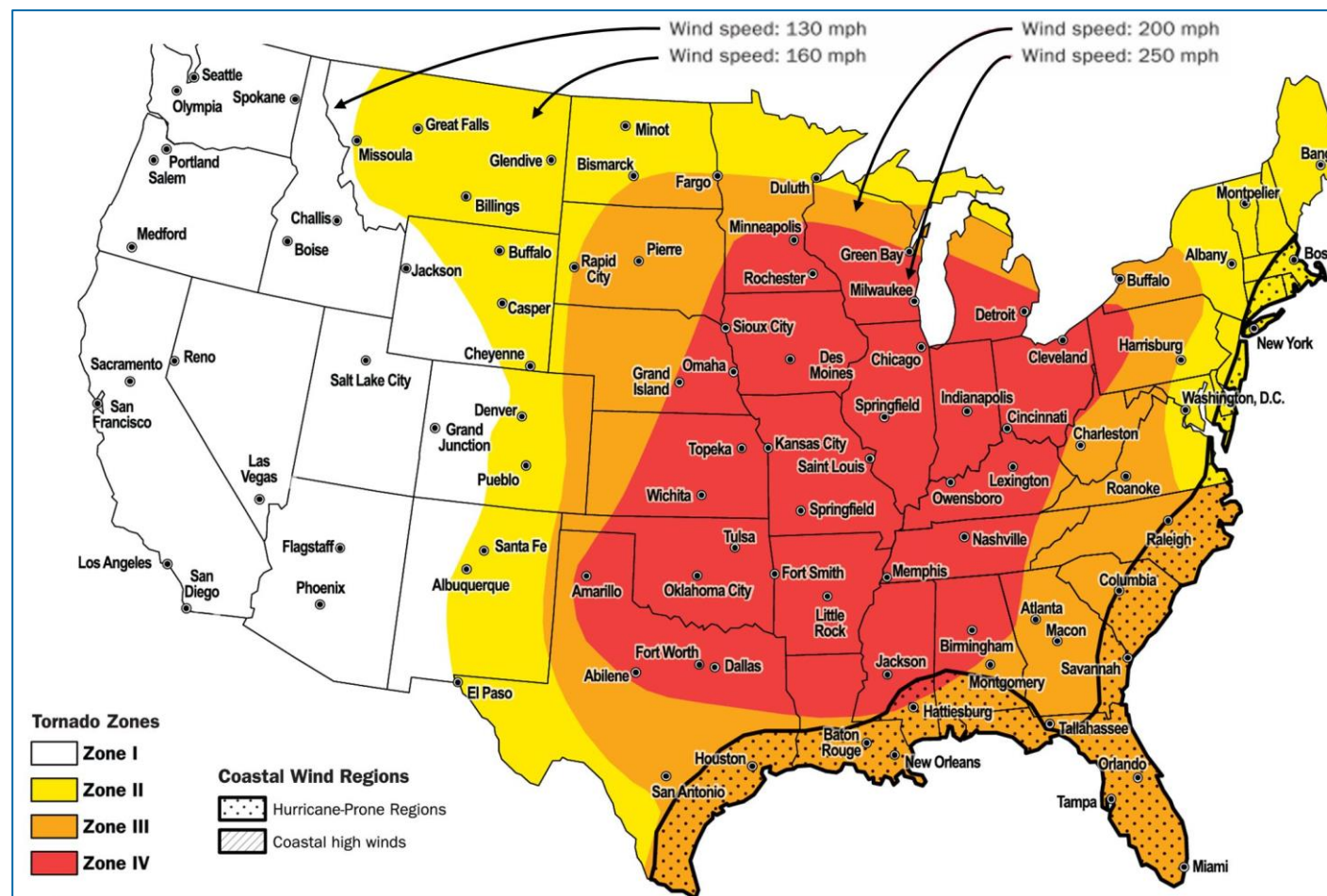
Together, the International Code Council (ICC) and National Storm Shelter Association (NSSA) publish standards for the design and construction of storm shelters, and in 2020 the latest edition was published. Abbreviated as ICC 500 – 2020, these standards are formed based on the maximum possible wind speeds an area may experience due to tornado/high wind events. The 2018 and 2021 editions of the International Building Codes (IBC) require that new buildings with certain uses or occupancies and geographic locations include a storm shelter constructed in accordance with ICC 500. Those structures include:

- 911 call stations
- Emergency Operations Centers
- Fire, Rescue, and Ambulance stations
- Police Stations
- K-12 school buildings with an occupant load of 50+

Furthermore, these 2018 and 2021 International Existing Building Code (IEBC) provide storm shelter requirements for additions to existing buildings that parallel the storm shelter requirements for new buildings.³⁰ Figure 4-5 shows that Grove and the entire surrounding region are at risk of experiencing high wind events that are speeds ranging between 65mph and 250mph, or an EF0-EF5 tornado.

³⁰ https://www.fema.gov/sites/default/files/documents/fema_ICC-500-2020-highlights_publication_082021.pdf

Figure 4-5 Design Wind Speeds for Tornado Storm Shelters (ICC 500 – 2020)



4.4.4 Previous Occurrences

Delaware County has reported 58 tornadoes between 1950 and 2021, according to NCEI data, causing an estimated \$16.47 million in damage combined. Grove has been directly impacted by at least three of these as seen in Figure 4-6. Similarly, high wind events have also been observed across Grove. NCEI database shows 33 high wind events occurring in the City between January 2012 and December 2021.

The planning team used tornadic events in Delaware County as a proxy for Grove, since the NCEI Storm Events Database lists events by County first, then by municipality. The municipality listed in the Storm Events Database table is not necessarily representative of all municipalities affected, as those municipalities listed serve as a reference point for the closest town or city where the event began or was reported.

From 2012 through 2021, the planning team recorded 14 events of EF1 or greater for Delaware County, with the most impactful event being an EF-2 tornado in April 2013 which caused \$400,000 in assessed damages over areas south and southeast of incorporated areas of Grove. No damage from tornadoes was recorded within the incorporated areas of Grove during this timeframe. The more significant tornado/high wind events that impacted the planning area are described in Table 4-15 below.

Figure 4-6 Historic Tornado Paths Impacting the City of Grove (NWS)

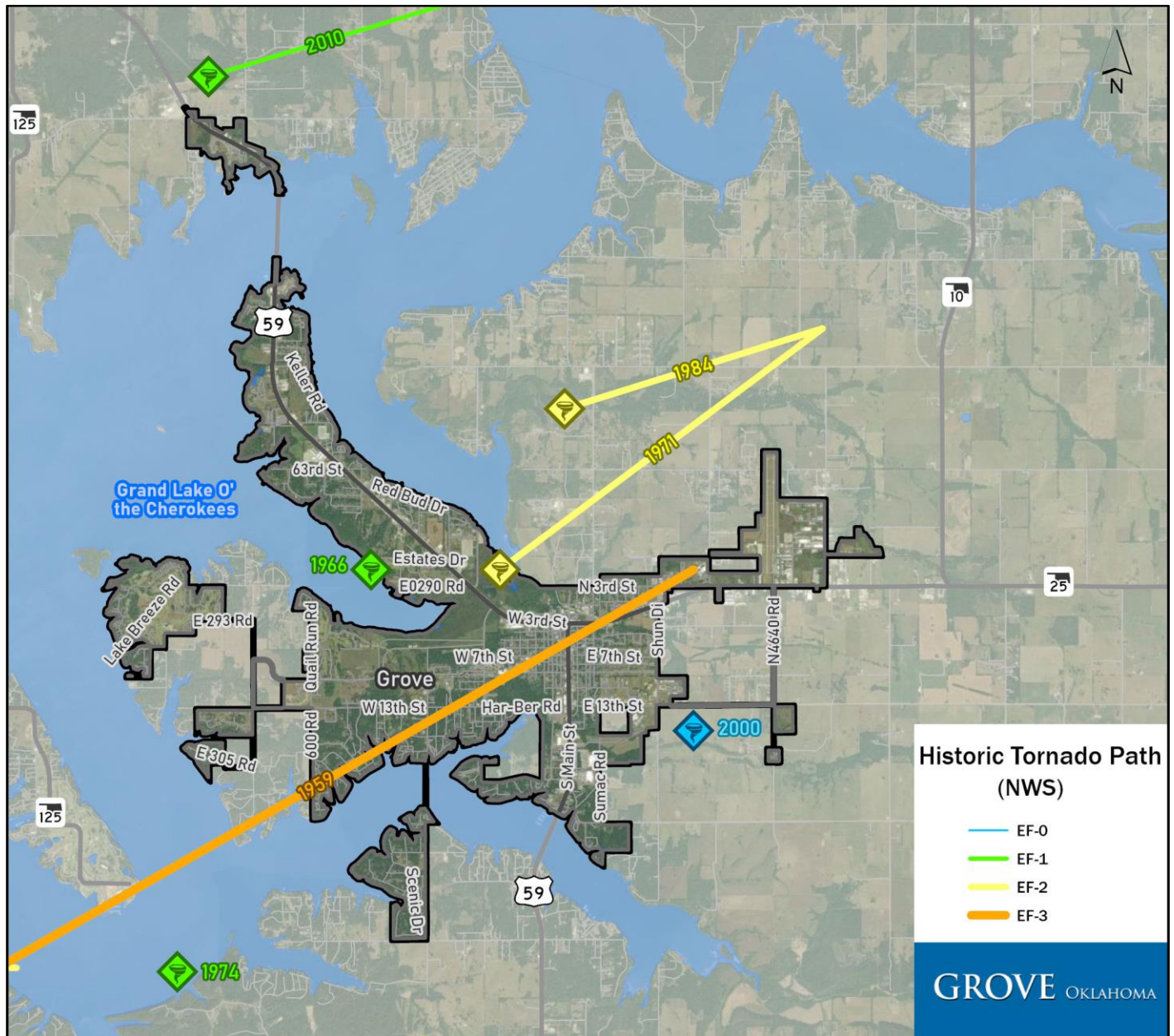


Figure 4-7 Historic High Wind Events Impacting the City of Grove

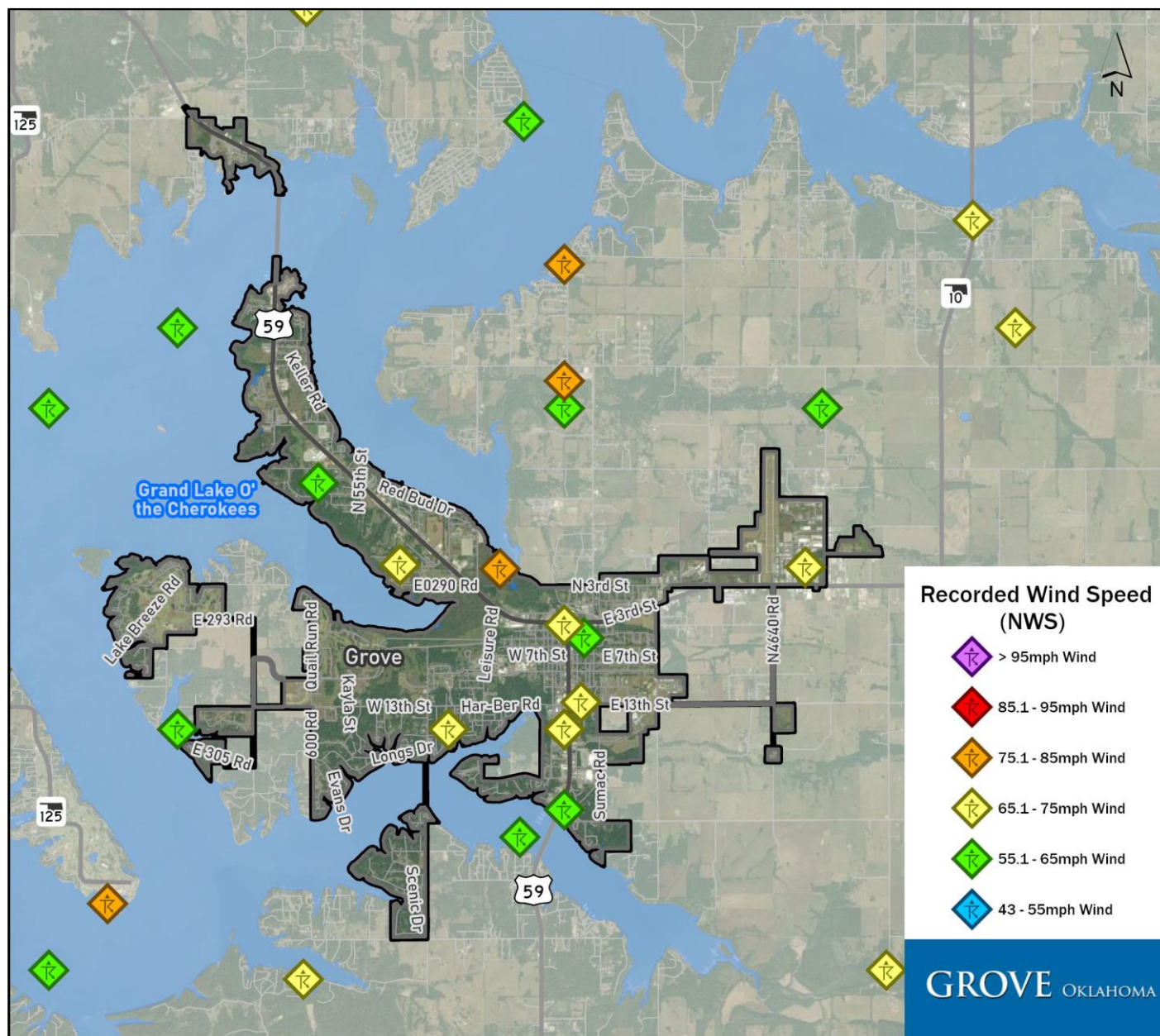


Table 4-15 Noteworthy Tornado/High Wind Event Events Impacting Grove and the Surrounding Areas

Date	Event Narrative
May 9, 1959	A tornado was reported 4 miles southeast of Grove at 6:00 pm. The F-3 rated tornado was 880 yards wide, with a path length of $\frac{3}{4}$ mile, oriented in a southwest-to-northeast manner. Several farmsteads were destroyed. Witnesses indicated the possibility of 2 funnels coming together before the tornado touched down. Farm machinery was scattered, and animals were killed, as \$25,000 in property damage was assessed. Most people reached safety in storm cellars as several escaped injury.

Date	Event Narrative
May 22, 1971	At least one tornado caused extensive property damage to trees and utility lines, in addition to several homes and businesses. Five planes were damaged at the airport. Several people reported hearing a loud roar. The F-2 rated tornado was reported to have been 100 yards wide, with a path length of 3.8 miles. \$250,000 in resultant damages were assessed.
May 23, 1974	A small tornado, approximately 50 yards wide, briefly touched down north of Grove at about 11:30 am with a path length of about 1 mile. The tornado uprooted several trees and caused \$25,000 in damage to boat docks and mobile homes near Grand Lake.
April 27, 1984	A 20-yard wide, F-2 rated tornado touched down south of Grove and traveled about 2 miles before dissipating east of town, causing \$2.5 million in assessed damages, \$500,000 of which occurred at Iron Horse Lodge. This tornado, and its associated thunderstorm, were part of a broader tornado outbreak which triggered the declaration of DR-704-OK .
June 29, 1997	Severe thunderstorms moved across northeast Oklahoma during the evening hours and produced damaging winds. Strong thunderstorm winds downed 9 large trees and damaged 2 vehicles at Bears Den Resort, 5 miles northwest of Grove. Additionally, 3 boats were damaged, and 2 others were unmoored from the dock there. Total damage was assessed at \$25,000.
July 3, 1997	\$10,100 in damage was assessed north of Grove due to thunderstorms which produced strong winds during the evening hours.
June 30, 1998	A complex of thunderstorms associated with a slowly, southward-moving cold front moved out of southeast Kansas and across far northern Oklahoma during the morning hours. Several thunderstorms produced severe wind reports, as well as hail as large as nickel-size. Winds tore loose a floating café on Grand Lake. One boat went missing after the storm. \$10,000 in total damages was assessed.
July 9, 2003	Thunderstorm winds estimated at 70 mph damaged the roof of an airport hangar. Numerous large trees and limbs were also downed, and power outages were also reported across half of the city. \$25,000 in total damages was assessed.
May 22, 2011	A very moist and very unstable air mass developed across eastern Oklahoma on the afternoon and evening of the 22 nd as a dry line moved into the area from the west. Severe thunderstorms, including supercells, developed ahead of the dryline, and moved across the area producing tornadoes, large hail up to softball size, and damaging wind gusts. This event produced two tornadoes within 2 hours of one another that affected areas near Grove. The first touched down south of Cleora and moved in an easterly direction across Grand Lake and Dennis. It dissipated before coming ashore a second time near Grove. The most destructive damage from this tornado was rated at EF-2. The second touched down about 2.5 miles west-southwest of Zena, moved east-northeast across Grand Lake, passed south of the incorporated areas of Grove, and continued into McDonald County, Missouri, where it dissipated shortly thereafter. EF-3 damage was observed southeast of Grove, over areas east of US-59, where several permanent homes were severely damaged, two double-wide mobile homes were destroyed, and many large trees were snapped or uprooted. Maximum winds from this tornado were estimated at 140 mph. These storms were part of an outbreak which continued through May 25 and prompted the declaration of DR-1989-OK on June 6.

Date	Event Narrative
May 28, 2012	Thunderstorms developed across northeast Oklahoma along and ahead of a cold front late in the day and continued into the early hours of the 29 th . Damaging winds and large hail were observed with the stronger storms. Winds up to 80 mph felled trees, damaged boat docks and shingles of several homes near Holdens Cove, about 3 miles north of Grove, producing \$10,000 in damage.
August 4, 2012	A slow-moving cold front pushed into the region during the late afternoon and evening hours. Thunderstorms developed along and ahead of this front in a warm, humid air mass. Damaging wind and hail occurred in the stronger storms. 80 mph winds snapped large tree limbs, felled trees, damaged roofs of mobile homes and permanent homes, and blew down power lines, producing total assessed damages of \$25,000.
May 20, 2019	A strong upper-level storm system moved into the Southern Plains from the Rockies on the 20 th and 21 st . The attendant warm front moved from northern Texas northward into northeastern Oklahoma during the day on the 20 th , then the subsequent cold front associated with this system moved through eastern Oklahoma during the late evening of the 20 th and early morning hours of the 21 st . Warm, moist, and very unstable air was in place across eastern Oklahoma ahead of the cold front. This pattern resulted in multiple rounds of severe thunderstorms across eastern Oklahoma beginning during the early afternoon of the 20 th and continuing into the late morning the next day. Very strong wind shear in combination with strong instability resulted in supercell thunderstorms that produced large hail up to the size of golf balls and multiple tornadoes on the 20 th . A squall line developed along the cold front that moved into the area during the morning of the 21 st which had tornadoes that developed along its leading edge. Locally heavy rainfall and subsequent flash flooding occurred across northeastern Oklahoma as multiple rounds of thunderstorms affected the same general areas. Winds up to 70 mph produced by these thunderstorms damaged boat docks on Grand Lake near Highway 59, producing \$50,000 in damage. This system was part of a series of systems between May 7 and June 9 which resulted in the declaration of 4438-DR-OK .
August 26, 2019	Thunderstorms developed across portions of eastern Oklahoma during the evening hours as a cold front approached the region. The strongest storms produced damaging wind and large hail up to the size of ping pong balls. Winds up to 70 mph blew down a power pole, snapped large tree limbs and rolled a camper trailer, all in and around Grove. \$12,000 in total damages was assessed.

**bolded dates are those resulting in a federally declared disaster*

4.4.5 Probability of Future Events

Based on previous occurrences, the planning team has assessed it is **highly likely** Grove will experience tornado/high wind events on a regularly recurring interval. One of the tools used to arrive at this assessment is the Tornado Risk Assessment tool³¹ hosted by the Storm Prediction Center. This product shows that there have been 25 tornadoes within 15 km of the center of Grove in a 70-year period between 1950 and 2019. This produces an average of 0.3 tornado days per year for the planning area. The month with the greatest frequency of tornadoes is May, with 18 occurrences. For reference, the month with the second highest frequency is April, with 5. March and December are both on record with 1 tornado each.

³¹ [Tornado Risk Assessment - SPC \(noaa.gov\)](https://www.spc.noaa.gov/products/tornado/risk-assessment/)

4.4.6 Vulnerability and Risk Assessment

Tornadoes have inflicted their share of damage in the City of Grove. Every structure in the planning area is vulnerable to tornadoes. Utility service outages can affect large segments of the population for extended periods of time with no electric, gas, or water service. Economic losses from homeowners and businesses alike can be devastating. Food spoilage from lack of refrigeration, gas pumps not operating, and daily life activities can all come to a halt when electrical power outages occur. People displaced from homes that are damaged and destroyed also create a new set of challenges with the basics of food, shelter, and clothing.

Based on the classifications in Table 4-6 the overall significance of a high wind or damaging tornado event is **high**. Tornadoes and high winds threaten lives and can cause injury. These events also can cause significant economic loss, especially through damage to the built environment.

On the lower end, damage from an EF-0 tornado with winds between 65-85 mph can result in destruction of road signs, tall structures, trees, and possible damage to shingled roofs. On the spectrum's upper end, an EF-5 tornado contains winds greater than 200 mph. Massive damage will occur in the path of these tornadoes, which have been observed to be greater than 1 mile wide in some instances. Homes, automobiles, appliances, outbuildings, and anything outdoors can be picked up and thrown long distances as large projectiles.

Effects resulting from tornadoes and high winds can be profound. Utility infrastructure such as power lines, substations, water towers, and water wells are vulnerable and can be severely damaged or destroyed due to these hazards. Downed power lines and debris across roadways can limit or prevent first responders from being able to access affected areas. Livestock and wildlife are also vulnerable during these events, and often become injured or die since there is little protection for animals on the open range.

Using storm spotters and the reports they provide which allow city officials to activate early warning systems, Grove residents can take appropriate precautions during these events. Education on and the use of better building techniques, tie-down systems, and the availability of storm shelters and safe rooms are things that officials can do to help mitigate losses in the planning area. Delaware County and the City of Grove have previously utilized HMGP funds to install residential safe rooms in the city and countywide. The planning team recommends continuing these efforts to promote an ongoing effort to protect people and enhance the city's resilience.

Future Conditions

Climatological changes in the nature of severe weather events are expected to produce more extreme, and damaging tornado events in the future. It is currently difficult to account for tornadoes in climate models because they occur on a very small scale. Therefore, more research is needed to understand how climate change is influencing tornadoes (Walsh et al. 2014). Climate models project an increase in the frequency and intensity of severe thunderstorms, which can include tornadoes, most commonly during the months of March, April, and May. However, confidence in the details of this projected increase remains low (Kossin et al. 2017). Known impacts from previous tornado/high wind events should be taken into consideration when planning and developing future lands across Delaware County and the City of Grove.

People

All people in the planning area are vulnerable to tornadoes. People without access to safe rooms or other secure shelter options are at direct risk of injury or death, even from weaker tornadoes or high wind events. One concern regarding safe rooms is the need for an education campaign to inform the public that not all safe rooms are created equal. Lack of adequate safe room design can cause the unit to fail. Grove should consider applying for residential safe room funding through FEMA's Hazard Mitigation Assistance Programs and implementing a safe room education program.

Citizens of the planning area are encouraged to apply for safe rooms for their residences, since most tornado casualties are caused by bodily injury or blunt force trauma. Casualties are frequently the result of structural collapse and exposure to projectiles. People in vehicles are also at heightened risk while in transit.

Public Health

Grove's medical system could be strained or compromised by a tornado that results in a mass casualty incident, especially if the incident also damages key infrastructure or critical facilities. Delivery of other key services, such as potable water and food could be disrupted by similar effects (see built environment for more information).

Education and Outreach

Adequate warning systems are essential to public safety during high wind and tornado events. Currently, tornado sirens are the primary means for communicating with people about an impending tornado event. Although mostly effective, these sirens are intended for people who may be outdoors. Emergency Management in Grove also utilizes the CodeRED mobile alert app, which is a wider-reaching messaging system, to complement sirens as an effective way to alert residents to imminent threats from hazards. City officials should consider a service like Reverse 911 as a redundancy measure for alerting residents, in addition to also ensuring that the messaging can be translated into other languages, if needed.

In addition, officials could strengthen current outreach and education efforts on tornado and high wind hazards for developers, builders, realtors, and residents. Going forward, it will also benefit the city if design professionals are trained to include wind mitigation during building design. Officials could provide training and education on building to Insurance Institute for Business and Home Safety's (IBHS) standards (for more information, see Chapter 3) and other prevention techniques, like anchoring, especially for mobile homes.

Economy

While forecasting and early warning have decreased the number of fatalities associated with wind events, less has been done, in general, to address economic losses. Direct tornado damage is one of several factors contributing to economic loss after a tornado. Tornadoes and high winds in the planning area can cause extended and widespread loss of business services through direct damage and damage to infrastructure. (Please see infrastructure section for more information on utility disruptions).

Built Environment

Existing Structures

All structures in the planning area are at risk of being affected by a tornado or high wind event. The residential building stock in Grove is diverse in the type of construction, age, and size of the building. Nonetheless, mobile homes, homes with crawlspaces buildings with large spans, such as airplane hangars, gymnasiums, and factories are more vulnerable to high wind and tornadic events due to their construction. Mobile homes or manufactured homes are the most vulnerable of housing units in Grove. The federal government established standards in 2007, which were updated in 2013, requiring all new manufactured homes to meet the requirement for installation and anchoring in accordance with its structural design and windstorm standards³². Even anchored mobile homes can be severely damaged when winds gust over 58 mph. Houses with crawl spaces are more susceptible to lifting.

In addition to structure type, older homes are especially vulnerable to tornado events. This is primarily due to lack of, or lower standard, building codes and lower quality building materials which may not be as resilient as those available now. More on the city's capabilities and the standard of building codes which have been adopted can be found in Chapter 3. Older homes in the planning area are more vulnerable to tornado damage than more recently built homes constructed to higher standards.

³² [Federal Register :: Model Manufactured Home Installation Standards: Ground Anchor Installations](#)

Infrastructure

Electric: Loss of power and communication lines will require alternate methods of communication until cellular service, radio frequency, or landline communications can be restored. Prolonged outages can lead to the disruption of vital services including energy for life-sustaining devices, business operations, heat, light, and other basic functions, and communications. Although many critical facilities have backup generation, which will increase the likelihood that they remain operative during a disaster, many private residential and commercial facilities do not, which will necessitate their reliance on government facilities which do have backup generation capabilities. This is particularly true for the portions of the population who are reliant upon a continued source of reliable electricity to sustain health and life.

Water/Wastewater: Destruction of or damage to water/wastewater processing or distribution infrastructure could strain water systems in the planning area and place the populations affected by the disruption at risk to degradations of water quantity and quality. Grove should ensure it has sufficient redundancies in backup water sources and an emergency plan for wastewater to account for severe damage to or destruction of its water systems.

Transportation: Debris along roads can delay or inhibit recovery and response operations. In an extreme event, loss of power and communication lines will require alternate methods of communication until cellular service or landlines can be restored.

Critical Facilities

All critical facilities in Grove are exposed to this hazard, especially buildings that do not meet 2018 codes, which have been adopted by the Oklahoma Uniform Building Code Commission. Some critical facilities owned by the city have adequate backup generation while others do not. Loss of functioning to a critical facility—either from damage sustained to the structure or a power failure—could lead to the disruption in key emergency, government, and basic services. Private critical facilities should also maintain these standards. It is recommended that the City pursues backup generation capabilities for any/all critical facilities that currently are without.

Local officials noted that several of their public buildings lack a saferoom that meets the guidelines of FEMA 361 and ICC 500. Employees at these buildings are much more vulnerable to effects outlined in the people section of this assessment since the structural protection is not adequate.

Cultural Resources

Loss of structures listed on the National Historic Register would be devastating. All are vulnerable to high wind and tornadoes. Structural mitigation or retrofitting measures should maintain the historical integrity of National Register eligible or listed properties. For example, impact resistant glass systems in windows and doors could match the period and style of a historic structure.

Future Development

All future development is vulnerable to tornado and high wind events. Powerlines in areas of future development should be buried to avoid power loss, and any new critical facilities should have generators installed with them. These measures along with the adherence to the latest building codes will ensure future development is better prepared for high wind and tornado events.

As of this writing, Grove follows suit with the building codes adopted at the State level – the 2018 International Building Codes (IBC).³³ Buildings constructed before the adoption of these codes, however, remain more vulnerable unless they are retrofitted or updated with more current standards. In 2018, insurance companies began offering discounts on homes built or retrofitted to certain tornado-resilient standards since a law went into effect April 1 requiring them. These improvements can be shared through a robust public outreach program.

³³ https://codelibrary.amlegal.com/codes/groveok/latest/grove_ok/0-0-0-1031
https://www.ok.gov/oubcc/Codes_&Rules/Adopted_Building_Codes/

Grove should work with the Oklahoma Insurance Department to educate the public, building professionals, and insurance agents about these benefits. Additionally, Grove should consider a program to train building officials as IBHS Home Evaluators. There is a shortage of these trained officials in Grove. Many homes have yet to be evaluated and once they are, homeowners may be eligible to receive insurance discounts. Going forward, it will also benefit the city if design professionals are educated to include wind mitigation during building design.

Natural Environment

The effects of damaging wind from high wind events or tornadoes on the natural environment are not always obvious or immediately apparent. Debris from damaged or destroyed homes can result in asbestos being deposited. Additionally, tornadoes and high wind commonly damage or destroy trees and other flora, while animals are susceptible to projectiles and becoming caught up in high winds and being involuntarily transported.

4.5 Hail

4.5.1 Hazard Description

A hailstorm often results from severe thunderstorm or similar atmospheric event. Hail, in the form of irregularly shaped lumps of ice, falls with rain. Extreme temperature changes from the ground into the jet stream produce strong updraft winds that cause hail formation. Hail is typically a by-product of thunderstorms, tornadoes, or other atmospheric events, making the entire planning area susceptible to this hazard.

4.5.2 Location

The entire planning area is affected by this hazard.

4.5.3 Extent

Extent is determined by the frequency of hail events that receive a classification of severe or higher. As shown in the Combined NOAA/TORRO Hailstorm Intensity Scale, and as defined by the U.S. National Weather Service, hail is considered to be severe when it measures an inch in diameter or larger.³⁴ Hail of this severity tends to be accompanied by winds greater than 58 miles per hour. The two combine to define the standard for a severe thunderstorm in the United States. In the past, hailstone sizes recorded in the planning area since 1953 have ranged between H0 and H7 on the NOAA/TORRO Scale. Severe thunderstorms across the southern U.S. Great Plains (including the Grove planning area) can occasionally generate even larger hailstone sizes in supercell thunderstorms. While rare, the planning area may potentially see hailstone sizes that range between H0 and H10 on the NOAA/TORRO scale.

Table 4-16 NOAA/TORRO Intensity Scale

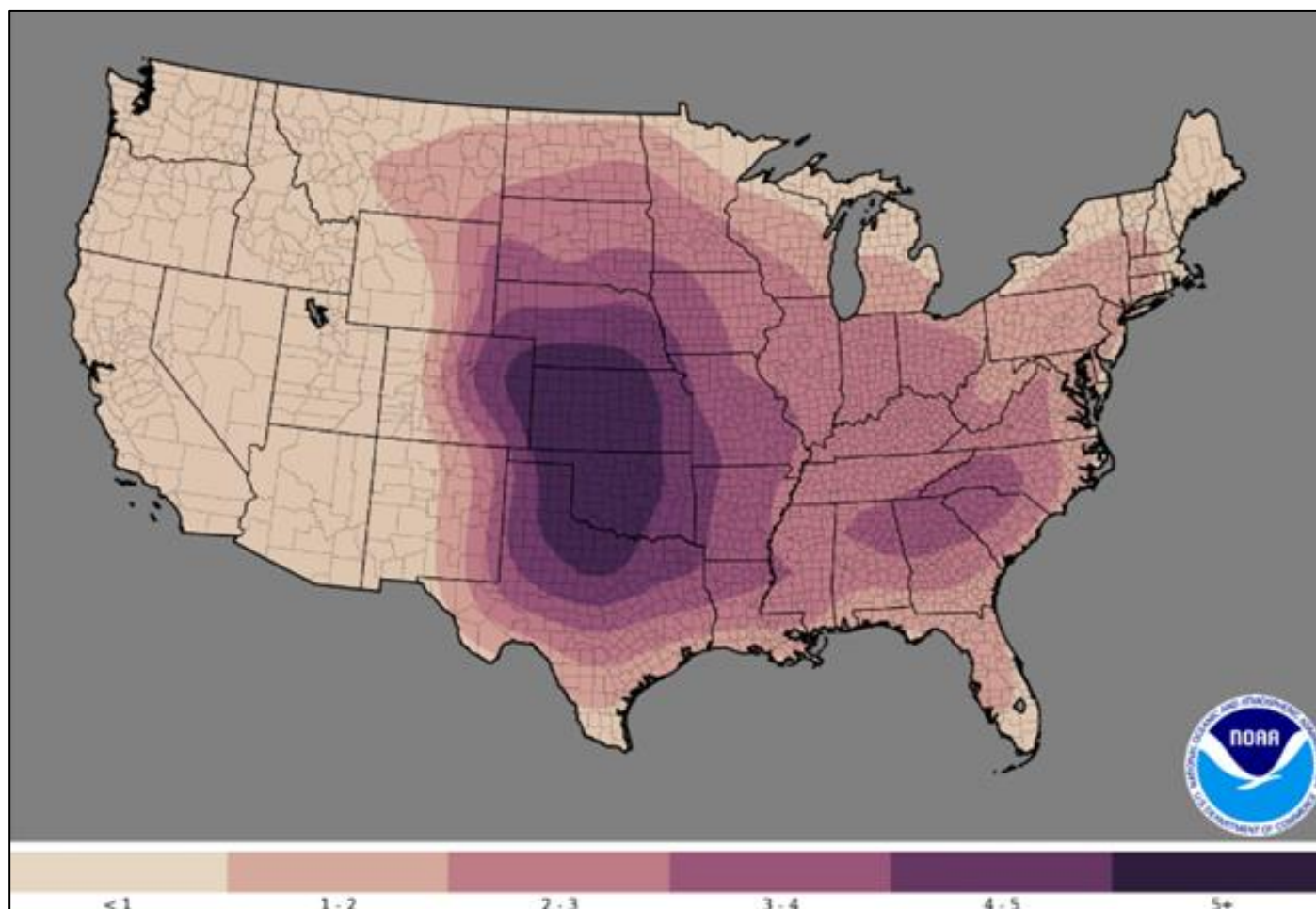
Size Code	Intensity Category	Typical Hail Diameter (inches)	Approximate Size	Typical Damage Impacts
H0	Hard Hail	< 0.33	Pea	No damage
H1	Potentially Damaging	0.33 – 0.60	Marble or Mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60 – 0.80	Dime or grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80 – 1.20	Nickel to Quarter	Severe damage to fruit & crops, damage to glass & plastic structures, paint & wood scored
H4	Severe	1.20 – 1.60	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.60 – 2.00	Silver dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.00 – 2.40	Lime or Egg	Aircraft bodywork dented; brick walls pitted

³⁴ [NOAA's National Weather Service - Glossary](#)

Size Code	Intensity Category	Typical Hail Diameter (inches)	Approximate Size	Typical Damage Impacts
H7	Very Destructive	2.40 – 3.00	Tennis ball	Severe roof damage, risk of serious injuries
H8	Very Destructive	3.0-3.5	Baseball to Orange	Severe damage to aircraft bodywork
H9	Super Hailstorms	3.5-4.0	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	4+	Softball & up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

The figure below represents NOAA data related to the number of days with hail exceeding 1 inch in diameter.³⁵ The NOAA data estimates the planning area will experience 5+ events with hail 1 inch or larger hail each year.

Figure 4-8 NOAA Events with Hail Exceeding 1.00"



³⁵ http://climate.ok.gov/index.php/climate/map/1.00_inch_hail_days_1986_2015/tornadoes_severe_storms

4.5.4 Previous Occurrences

According to the NCEI database, from 2012-2021 the City of Grove experienced 9 events with hail greater than 1.00 inch in diameter. The largest hailstone reported by the NCEI was in 1961 when 3.00" hailstones fell just north of the Honey Creek State Park. Other more significant hail events occurred more recently and are represented in yellow in Figure 4-9 below. NCEI databases show that hail events have been reported every month, with the highest frequency occurring from mid-April to mid-May. Some of the more impactful hail events are summarized in Table 4-17 below.

Figure 4-9 Historic Hail Events Occurring within/near the City of Grove

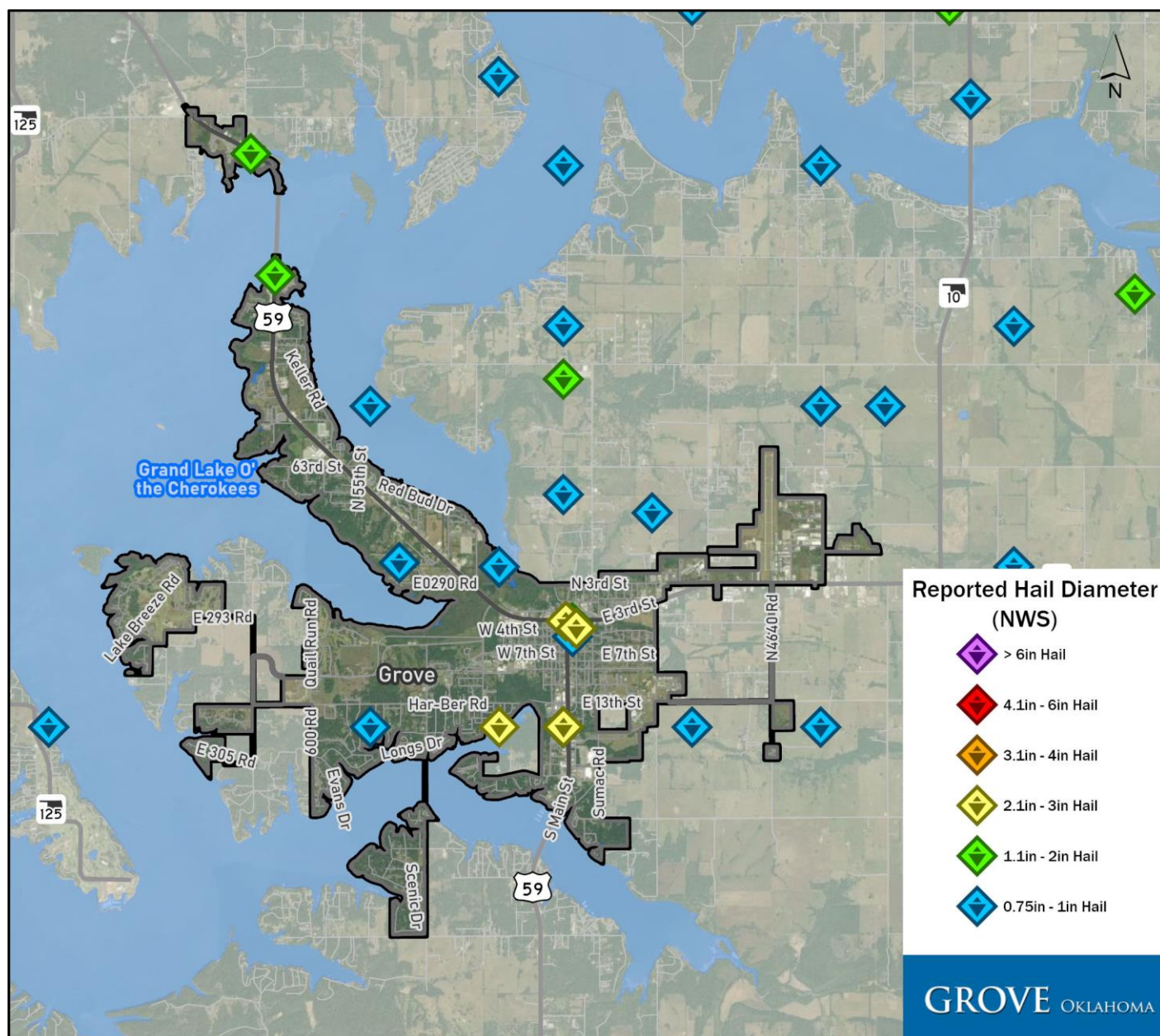


Table 4-17 Noteworthy Hail Events in the Planning Area

Date	Event Narrative
May 8, 1961	Hail up to 3.00 inches in diameter was reported in Grove in association with a thunderstorm during the late evening hours.
April 22, 1999	A cold front moved southeast out of Kansas into northeast Oklahoma during the afternoon. A broken line of thunderstorms formed along the front and quickly became severe as the front continued a steady southeastward push. This boundary slowed as it neared I-40, causing a training effect with the motion of the thunderstorms, which then caused minor flash flooding. These thunderstorms produced the full spectrum of severe weather, from golf ball size hail, to damaging winds, to touchdowns of several weak tornadoes. Hail stones up to 1.75 inches were reported at the Delaware/Ottawa County line, 3 miles west of the Missouri state line, or about 8 miles northeast of Grove.
March 27, 2008	Severe thunderstorms developed across a large portion of eastern Oklahoma during the evening hours, producing hail up to 1.25 inches in diameter 5 miles SSE of Grove.
May 29, 2012	Numerous thunderstorms developed along a cold front moving through eastern Oklahoma, producing damaging winds and large hail. 1.00-inch hail was reported 2 miles N of Grove.
September 26, 2012	Scattered thunderstorms developed along an outflow boundary over east-central Oklahoma during the early afternoon hours. These storms drifted south and east throughout the afternoon. Several of the storms became super cellular, producing large hail, damaging winds and some flash flooding. 2" hail was reported in Grove, causing \$10,000 in assessed damages.
March 9, 2017	Strong to severe thunderstorms developed across northeastern Oklahoma and southwestern Missouri during the evening hours along and ahead of a cold front that pushed southward across the region. A moderately unstable air mass ahead of the front, coupled with strong deep layer wind shear, supported the development of supercell thunderstorms. This activity moved southeastward across northeastern Oklahoma, then evolved into a line of thunderstorms across east-central Oklahoma. The strongest of this activity produced hail up to the size of tennis balls and damaging winds. 2.50-inch diameter hail which produced \$25,000 in assessed damages was reported near Grove.
March 11, 2017	A slow-moving upper-level storm system moved from the Southern Rockies into the Southern Plains during the 10 th and 11 th . Warm, moist, and unstable air was in place across eastern Oklahoma ahead of this system. Several disturbances translated across the Southern Plains ahead of the main system, resulting in multiple rounds of severe thunderstorm development along the associated frontal boundary that slowly progressed eastward and southward across the region. These storms produced several tornadoes, hail up to the size of golf balls, damaging wind and locally heavy rainfall. 1.00-inch hail was reported in Grove.
May 27, 2017	Strong to severe thunderstorms developed during the late afternoon hours along and ahead of a cold front that moved into eastern Oklahoma. Very unstable air over the area, combined with strong, deep-layer wind shear, resulted in widespread severe weather. Several tornadoes, hail up to the size of softballs & damaging wind gusts occurred in association with the strongest storms. \$5,000 in damages was assessed in Grove due to the 1.25" diameter hail.

Date	Event Narrative
March 27, 2020	Strong to severe thunderstorms developed over central Oklahoma during the early afternoon hours to the north of a boundary at the surface, as a weak upper-level disturbance approached the area from the southwest. This activity developed into eastern Oklahoma throughout the afternoon. Despite these storms being elevated in nature, strong deep layer wind shear combined with moderately strong instability allowed some of these storms to mature into supercells. Hail as large as 3.00 inches in diameter resulted in some locales over northeastern Oklahoma. Hail with a diameter of 2.50 inches was reported in Grove, causing \$250,000 in assessed damages.
July 11, 2020	Severe thunderstorms developed across southeastern Kansas and northeastern Oklahoma during the late afternoon hours, as a cold front pushed southward into the area. The atmosphere became extremely unstable ahead of the storms. This, combined with a strong low-level jet which enhanced deep layer wind shear and extreme instability resulted in organized severe thunderstorm activity that developed and continued through the evening, producing widespread damaging winds and large hail. Some heavy rainfall rates were also reported and produced localized flash flooding. Hail up to the size of golf balls fell in Grove, producing \$50,000 in damages to vehicles, homes, and businesses.

4.5.5 Probability of Future Events

Based on the frequency of previous occurrences over the past 30 years, the planning team has determined that it is **likely** that Grove will experience one or more thunderstorms with hail 1.00 inch in diameter or larger per year. The map in Figure 4-8 provided by the NOAA/National Weather Service Storm Prediction Center supports this assessment, as it estimates that severe hail events occur 4 to 5 days per year, on average, in the planning area.

4.5.6 Vulnerability and Risk Assessment

Previous storms which have produced damaging hail in Grove have had profound effects on residents and businesses. Some have shown damages to vehicles can range from several hundred dollars to total loss of the vehicle. At times when large parking lots or dealerships get hit, losses can be in the millions of dollars. Based on the classifications in Table 4-6, the overall significance of a damaging hail event in Grove is **high**. The greatest vulnerabilities to hail result from vehicle and roof damage.

Future Conditions

Future climatological changes suggest thunderstorms (and associated hail events) will increase over the coming years. As air temperatures are expected to warm, thunderstorms will become severe more easily, and an uptick in severe storms will promote more frequent hail events. Additionally, warmer air can hold more moisture content, and an increase in moisture will help hail-producing thunderstorms to have a higher propensity for larger hail stones to form. Any future development that takes place across the City of Grove should consider installing protective measures (both on residential structures as well as commercial) so hail impacts of the future are minimized as much as possible.

People

All people in the planning area are at risk of hail. While structural or property damages are most common, personal injury or even death, in extreme cases, is certainly a threat. People engaging in outdoor activities may find themselves in a situation where adequate shelter is unavailable. Baseball-sized hail, observed in the region including Grove, can cause brain bleeds and brain damage and broken bones if people do not take proper shelter. The planning team did not identify any additional public health and safety concerns from hail events.

Education and Outreach

Like most hazard-education capabilities identified in this plan, the planning area could benefit from consistent outreach about hail events, which can include:

- Becoming acquainted with communication and warnings about upcoming hail events
- Private and public sheltering (humans and animals)
- Storing outdoor items and other private property, such as vehicles and boats
- Preparing for electrical outages that can result from hailstorms
- Securing windows properly and effectively
- Best practices for construction

Economy

The economic impacts associated with this hazard could include agriculture, like crops such as corn or soybeans, or livestock, which can be damaged/injured to the point of total loss, but in Grove, hail impacts the local economy mostly in property damages. The urban setting and lake tourism may see a setback from outages or damage produced by hailstorms. Vehicles are particularly at risk to hail, including government and first responder vehicles that remain unsheltered. Ensuring government assets are properly covered against the damaging hail stones is something the planning team recommends.

Built Environment

Existing Structures

All structures are exposed to hail events, and northern Delaware County will likely experience some form of hail damage each year, causing losses to structures and vehicles. Hail can cause bruises, punctures, and leaks on roofing systems. The amount of damage depends on the size of the hail, and the age, material, and surface temperature at the time of the event. Substantial hail damage may destroy a roof to the point of necessitating replacement. Large hail can break through windows, doors, and skylights that are not impact resistant, allowing wind-driven rain to enter buildings. When building a new home or replacing the roof, homeowners should consider using building materials that are resilient to hail and other hazards. Older buildings in Grove and buildings built prior to the adoption of the current code are more at risk of hail events due to the possibility of use of lower grade materials.

A notable hail vulnerability for Grove is the socioeconomic status of some of its citizens and their inability to upgrade or repair damaged roofing due to a Hail event. According to data shown in Table 1-4 in Chapter 1, Grove has more residents that live below the poverty line, compared to the state of Oklahoma poverty rate. Grove also has a considerably lower median income rate, due to the higher number of retirees living in this community. This could result in delays in needed repairs and/or the usage of lower-quality roofing materials that are more easily damaged by hail. Officials in Grove could collect data on roof quality from private citizens while conducting outreach on the importance of safeguarding against a hail event.

Infrastructure

Disruption of gas service, water/wastewater systems, or transportation networks is not anticipated from hail events.

Electric: Although unlikely, a large hail event could disable or destroy some electrical delivery systems (e.g. poles, lines, substations), which could cause a temporary loss in power transmission. This could threaten business operations, life/health (for people who rely on electricity to sustain their health and survival), food refrigeration, and other essential daily activities. Although some public buildings have backup generation, many private residential and commercial buildings do not, making them more vulnerable to power outages.

Critical Facilities

The primary vulnerability of critical facilities to hail within the planning area would be nursing homes and long-term care facilities experiencing window breakage. No critical facility in the planning area reported a roof or other structural vulnerability that would make the entire building and its occupants uniquely vulnerable to hail. Window breakages resulting from hail could expose residents and staff at those facilities to hazards for a period until those windows can be boarded up or replaced.

While Fire, Emergency Management and EMS vehicles have access to shelter, City and Police vehicles do not. City vehicles and assets which are exposed to the elements during a hail event would all face the same risk of damage, most likely to windows and windshields. Serious damage any of these services could disrupt response operations throughout the city. All critical facilities should also ensure that their backup generation is up-to-date and secured as best as possible from the effects of a hail event.

Cultural Resources

Large hail could cause significant impacts on older and historic properties without proper roof protection and could damage historic architecture, statues, and buildings in Grove. Windows at Splitlog Church and Corey House are also at risk of hail events. City officials should ensure that Splitlog Church and Corey House continue to monitor the quality of their roofs and windows and upgrade to the most resilient standards and materials available to mitigate against hail damage to these cultural assets.

Future Development

Grove has a system of building codes, but it is uncertain which standards have been adopted as of this writing.

Grove should continue to work with the Oklahoma Uniform Building Code Commission and the Oklahoma Insurance Department to educate both insurance agents and consumers of the discounts offered for building to higher standards. In addition, Grove should ensure that all windows and roofs on current and future public buildings have adequate protection from a severe hailstorm. Grove also should ensure that its debris management plan is updated to manage debris from a large hail event.

Natural Environment

Hail damage to the planning area can have a variety of different looks. From damage to trees, recreational areas on Grand Lake, or to animals and wildlife, there are a variety of risks presented by hail across the city.

Limbs and branches on trees can be downed by hail. Boats, docks, and marinas on Grand Lake can be damaged or destroyed by hail, which affects recreation on this body of water. Any animals and wildlife exposed to hail can become injured or harmed to the point of death. Any land areas manicured and landscaped are also at risk of damage or destruction.

4.6 Wildfire

4.6.1 Hazard Description

A wildfire is any outdoor fire that is not controlled, supervised, or arranged. Wildfire probability depends on local weather conditions; outdoor activities such as camping, debris burning, and construction; and the degree of public cooperation with fire prevention measures. Wildfires can result in widespread damage to property and loss of life. Structure fires are those that burn a home, business, or other type of improved structure. Fire creates a black, impenetrable smoke that blocks vision and stings the eyes, making it often impossible to navigate through or evacuate a building on fire.

4.6.2 Location

Within the Grove jurisdiction, development in more remote and wooded areas, also called the Wildland Urban Interface (WUI), continues. Residential and business structures developed close to grassy and woody fuels will be natural risks for this event. In addition, wildland/grassland fires are a strong threat to agricultural areas such as farms and/or ranches, especially during the high-risk fire season.

Fire can occur anywhere in the planning area, though several factors increase the likelihood that fire will occur in a specific location. These factors include age of structures, type of construction, building materials, and their location relative to vegetation (wooded areas, especially red cedars, and open grasslands) can influence the location of wildfires. The planning team used mapping from WUI areas and reports from local officials to determine wildfire location.

WUI can be defined as the zone of transition between unoccupied land and human development. It is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. To determine the WUI, structures per acre and population per square mile are used. The WUI in the area is divided into two categories: intermix and interface. Intermix areas have more than one house per 40 acres and have more than 50-percent vegetation. Interface areas have more than one house per 40 acres, have less than 50% vegetation, and are within 1.5 miles of an area over 1,235 acres that is more than 75% vegetated. WUI for the planning area was obtained through the Southern Group of State Foresters Wildfire Risk Assessment Portal. Based on the best available data and analyses, the WUI can be used to determine areas of fire hazard location within Grove, as shown in the extent section.³⁶

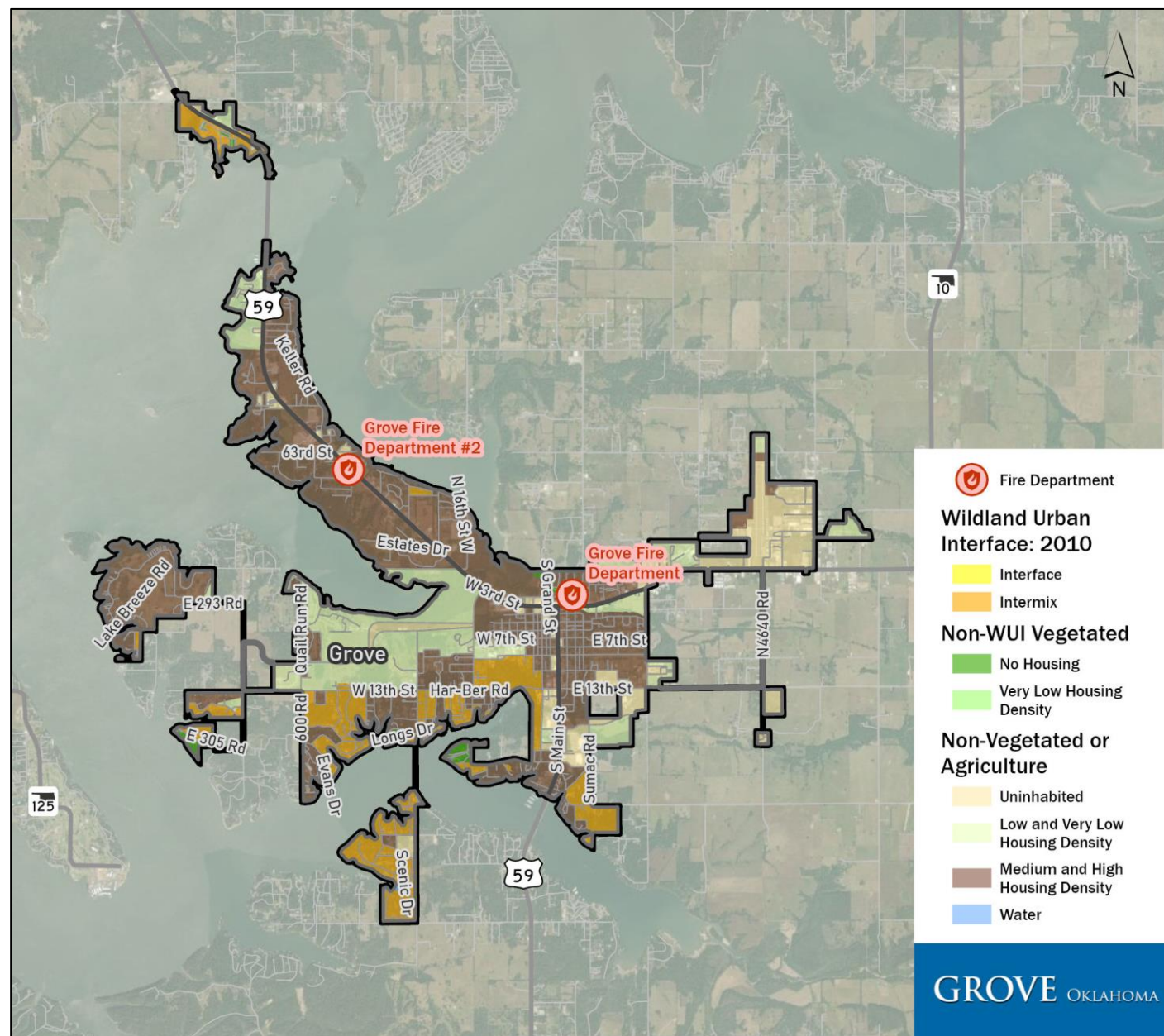
There are two primary areas of the WUI that convey potential risk – the Interface and Intermix regions. While the City of Grove is mostly urbanized and developed, there are still areas within the City Limits that are at a greater risk of fire. Those regions can be seen in Figure 4-10 below or on the Grove HMP Viewer Web App, found online through the [Grove Hazard Mitigation HUB](#) page.

4.6.3 Extent

To determine the extent of wildfires in Grove, the Wildland Urban Interface is used alongside other scales/indices, such as the Keetch-Byram Drought Index (KDBI), Fire Danger Rating System, and the Burning Index.

³⁶ [SGSF WRAP - Home \(southernwildfirerisk.com\)](https://southernwildfirerisk.com/)

Figure 4-10 Wildland Urban Interface (WUI) for the City of Grove



Wildfire extent is also measured by the expected severity a fire can reach within the City. Wildfire danger is measured using indices that relate longer-term soil and vegetation conditions to shorter-term weather patterns. The most explosive conditions occur when dry, gusty winds blow across dry vegetation. Indices used by the planning team with WUI maps were the Keetch-Byram Drought Index (KBDI), Fire Danger Rating System, and the Burning Index. The planning team combined these indices in Table 4-19 to determine extent in Grove.

The Keetch-Byram Drought Index is a drought measurement designed specifically to measure an area's potential for fire. The index measures factors like precipitation, the amount of moisture that is present in soil and vegetation, and evapotranspiration to estimate the "flammability of organic material in the ground." This index measures this estimate on a scale which ranges from 0-800 and is depicted in the table below.³⁷ It is possible that the planning area could experience a wildfire extent in the 600-800 point range.

³⁷ [TWC | Keetch-Byram Drought Index \(KBDI\) \(tamu.edu\)](#)

Table 4-18 Keetch-Byram Drought Index

Points	Description
0 - 200	Soil moisture and large class fuel moistures are high and do not contribute much to fire intensity. Typical in spring dormant season following winter precipitation.
200 - 400	Typical in late spring, early growing season. Lower litter and duff layers are drying and beginning to contribute to fire intensity.
400 - 600	Typical in late summer and early fall. Lower litter and duff layers actively contribute to fire intensity and will burn actively.
600 - 800	Often associated with more severe drought with increased wildfire occurrence. Intense, deep burning fires with significant downwind spotting can be expected. Live fuels can also be expected to burn actively at these levels.

Utilized by officials at the Oklahoma Mesonet to assess the level of wildfire risk, the Oklahoma Fire Danger Model (OFDM)³⁸ outputs the four fire danger indices that make up the National Fire Danger Rating System: Burning Index (BI), Spread Component (SC), Energy Release Component (ERC), and Ignition Component (IC). Definitions for each component follow in the subsequent discussion.

- **Burning Index** is one component of the OFDM, relates temperature, relative humidity, wind speed, and solar radiation to the “relative greenness” of vegetation (taken from satellite measurements) and fuel models for native vegetation (assigned on a 1-kilometer grid across the State).³⁹ The higher the Burning Index number, the higher the potential severity of the fire.
- **Spread Component (SC)** and **Energy Release Component (ERC)** are indices that are laid out in Deeming, 1977⁴⁰. SC is a rating of the forward rate of spread of the head of a fire.⁴¹ It combines the effects of wind, slope of terrain, fuel bed, and fuel particle properties. This is a quantity which is highly variable on a day-to-day basis due to changes in wind, moisture content of the fire fuels, and dead fuel time lag classes. Energy Release Component is a measure of potential available energy for a fire to burn at the head of a fire, within the flaming zone, measured in BTU per square foot. This quantity is related to SC and is dependent upon the same fuel characteristics: loading, compaction, particle size (fineness), heat of combustion, and mineral content. ERC is calculated as a result of predictions made of the rate of heat release per unit area during flaming combustion and the duration of flaming. Like SC, it is also variable on a day-to-day basis.
- **Ignition Component (IC)** is a rating of the probability that a firebrand will cause a fair requiring suppression action and is expressed as a probability. An IC of zero expresses an indication that no firebrand would cause a fire which would require suppression action. Meanwhile, an IC of 100 expresses an indication that any firebrand would cause a fire which would cause suppression action, given contact with a receptive fuel.

Factors which are fed into the OFDM include observed Mesonet data and 84-hour weather forecasts output by the North American Mesoscale (NAM) forecast model, as well as daily 500-m resolution relative greenness data, a 500-m resolution Oklahoma NFDRS fuel model map, current and forecast dead fuel moisture content from a calibrated version of the Nelson dead fuel moisture model, live fuel moisture calculated from the relative

³⁸ [Oklahoma Fire Danger Model.pdf \(mesonet.org\)](https://www.mesonet.org/index.php/agriculture/map/range_forest/fire_danger/burning_index1)

³⁹ https://www.mesonet.org/index.php/agriculture/map/range_forest/fire_danger/burning_index1

⁴⁰ [The National Fire-Danger Rating System - 1978 \(usda.gov\)](https://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/nureg-1150/nureg-1150-vol-1.pdf)

⁴¹ [NFDRS System Inputs and Outputs | NWCCG](https://www.nwccg.org/nfdrs-system-inputs-and-outputs)

greenness data, and daily updated Keetch-Byrum Drought Index values. Resultant output from the OFDM is displayed on the OK-FIRE website, maintained by the Oklahoma Mesonet.⁴²

Table 4-19 Correlation Between the Fire Danger Rating and Burning Index Indices

Fire Danger Rating	Burning Index	Flame Length	Description
Low	< 20	< 2 ft	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.
Moderate	20-40	2–4 ft	Fires can start from most accidental causes, but except lightning fires in some areas, the number of starts is low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy
High	40-80	4-8 ft	All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High	80-110	8-11 ft	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme	> 100	> 11 ft	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash (trunks, branches, and treetops) or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes, or the fuel supply lessens

4.6.4 Previous Occurrences

Historic wildfire runs were determined using the Oklahoma Fire Marshal annual reports – not NCEI narratives like in other hazard types. NCEI compiles wildfire information only for “significant” fires, which are those that cause

⁴² [Mesonet | OK-FIRE](#)

fatalities, injuries, and/or substantial property damages. To obtain a more realistic perspective on wildfire runs in Grove, OFM data was used.

Table 4-20 Grove Fire Department Reporting from the Oklahoma Fire Marshal⁴³

Year	Number of Wildfire Runs	Acres Burned	Annual Losses (\$)
2012	4	127	\$0
2013	0	0	\$0
2014	26	11.61	\$0
2015	17	37.76	\$0
2016	26	34.99	\$0
2017	18	55.29	\$0
2018	27	28.21	\$3,100
2019	8	12.03	\$0
2020	0	0	\$0
2021	9	Unavailable	Unavailable
2022	3	Unavailable	Unavailable
Total	138	310.89	\$3,100
Annual Average	>12	>34.5	>\$344

*Acres Burned and Losses are for 2012-2020 only. OK Fire Marshall did not provide this info for 2021 or 2022

Table 4-21 Noteworthy Fire Events (Other Fire Event Narratives)

Date	Event Narrative
2012	Reports from the NFIRS show that the Grove Fire Department responded to 1 building fire, 1 forest/wildland fire, 1 brush fire, and 2 grass fires.
2014	Reports from the NFIRS show that Grove Fire Department responded to 1 building fire (totaling \$37,000 in damages), 3 natural vegetation fires, 2 forest fires, 3 brush fires, 17 grass fires, and 1 cultivated tree/nursery stock fire.
2015	NFIRS records indicate Grove responded to 5 brush fires, 11 grass fires, and 1 cultivated trees/bursary stock fire
11/11/2015	Strong westerly winds gusting up to 55 mph behind a Pacific cold front, combined with unseasonably warm conditions and low relative humidity, promoted the rapid spread of wildfire across northeastern Oklahoma during the afternoon and evening hours of November 11 th . Large wildfires burned portions of Osage, Washington, Delaware and Nowata Counties. The fire in Delaware County burned over 300 acres, producing \$50,000 in damages.
2016	Grove Fire Departments responded to 1 natural vegetation fire, 2 forest/wildland fires, 4 brush fires, and 19 grass fires, not producing any financial damages as reported by the NFIRS
2017	The NFIRS reported that Grove Fire Departments responded to 1 forest/wildland fire, 4 brush fires, and 13 grass fires. In total, no financial damages were estimated.
03/03/2017 – 03/06/2017	Unseasonably warm temperatures, very low relative humidity and gusty winds combined with drought-stricken, dormant vegetation to promote the rapid spread of several wildfires across eastern Oklahoma. About 300 acres were burned in Delaware County.

⁴³ Some of these data are rounded for readability.

Date	Event Narrative
03/20/2017 – 03/22 2017	Unseasonably warm temperatures, very low relative humidity and gusty winds combined with drought-stricken, dormant vegetation to promote the rapid spread of wildfires across eastern Oklahoma for the second time in March. 600 acres were burned in Delaware County.
2018	Grove Fire Departments responded to 1 forest/wildland fire, 6 brush fires, and 20 grass fires, with the 21.15 acres burned by the grass fires producing an estimated loss of \$3,100.
2019	NFIRS reported that in 2019, Grove Fire Department had 8 fire runs for grass/brush/wildland fires that burned a combined total of 12.03 acres.
03/04/2020 – 03/04/2020	Unseasonably warm temperatures, very low relative humidity and gusty winds combined with drought-stricken, dormant vegetation to promote the rapid spread of several wildfires across eastern Oklahoma. 600 acres were burned in Delaware County, none of which impacted Grove.
03/07/2021 – 03/11/2021	Unseasonably warm temperatures and strong, gusty winds combined with very low humidity and dormant, dry fine fuels combined to promote conditions that supported the rapid spread of wildfire across eastern Oklahoma. Numerous wildfires occurred across the region during this period, but the largest fires affected Delaware Co., where over 4,000 acres were burned.

4.6.5 Probability of Future Events

Between January 1, 2012 through December 31, 2022, Grove Fire Department responded to a total of 138 wildfire runs. Over the 11-year period, these numbers average to more than 12 wildfire runs per year, making this probability of future wildfire events on any given year **highly likely**, or recurrence probability of 90 to 100 percent in the next year.

4.6.6 Vulnerability and Risk Assessment

Unless explicitly noted in the vulnerabilities described below, the risks associated with this hazard apply to the entire planning area. Based on the classifications in Table 4-6, the overall significance of a wildfire or structural fire event is **medium**. Fire can result in fatalities, structural damage, and crop damage. Some of the most significant economic vulnerabilities are economic results from structure and infrastructure damage along with costs due to business closures.

Future Conditions

Observed trends in weather events across the planning area may heighten the frequency and severity of wildfires across the region due to more frequent occurrences of drought in Oklahoma. Fire code enforcement personnel ensure that public and private buildings meet or exceed current nationally recognized and legal fire codes. Fire code enforcement efforts are a critical element in the success of fire prevention programs. Almost every aspect of a thorough fire prevention program is affected by code enforcement in some way. It plays a major role in fire and life safety inspections, plans review, hazardous materials, code adoption, environmental investigations, and the issuance of fire prevention code permits.

Wildfires in Oklahoma are dependent upon current weather conditions, seasonal climate patterns, vegetation conditions, and an available source for ignition (such as a spark, flame, or intentional). Given this complex relationship, the future trend for wildfire is also complex. However, projected increases in temperatures that can dry fine fuels such as grasses and enhanced wet/dry cycles that promote vegetation growth and drying or dormancy, coupled with population growth along the wildland-urban interface, suggests the risks of wildfires is likely to continue to increase.⁴⁴

⁴⁴ [SPTOK.pdf](#)

People

Structural fires and wildfires can put people in life-threatening danger from smoke inhalation and burn wounds. Residential structural fires can occur at night, putting sleeping people at a very high risk of injury or death. Wildfires moving into residential areas or along roadways can threaten individuals who are traveling or seeking escape from the fire. Firefighters are at risk while responding to both types of fires. A wildfire or structural fire could result in evacuation of school or another large gathering facility.

Public Health and Safety

Fires could degrade air quality for part of, or the entire, planning area. This depends, in part, on the duration of the fires, the size of the fires, the location of the fires, and the types of matter being burned. Populations with pre-existing conditions or other vulnerability factors (e.g., age) are especially at risk. At the extreme, air quality issues can cause increased hospitalizations and, when combined with other conditions, could even cause death. In addition, fires near densely populated areas also can lead to evacuations or mass casualty incidents, which can further strain Grove's resources, especially its healthcare system.

Education and Outreach

Increased fire awareness can decrease the planning area's vulnerability to wildfires. Local fire response units could conduct educational programs in schools, informing the public about proper evacuation and other lifesaving procedures, running fire drills on a regular basis, and proper burning techniques for waste. Grove can provide fire safety materials for residents, insurance companies, utility providers and other stakeholders. This education can include removing dead or dry leaves, needles, twigs, and combustible materials around property, along with installing and maintaining smoke detectors and fire extinguishers on each floor of homes or other buildings. Many of these activities can be completed through the FireWise program. These outreach and education activities can also be enhanced by a mobile electronic application, such as Code Red, as well as the city's website and social media pages.

Economy

Economic impacts of wildfires can include acreage burned and employment opportunities lost, along with goods and services, especially for industries like agriculture and recreation. The City of Grove also depends heavily on tourism from visitors to the lake, and wildfires can threaten the welfare of the economy should fires prevent tourists from visiting the City.

Built Environment

Existing Structures

Modern buildings are designed to minimize the probability of catastrophic fires. Nonetheless, all structures in Grove are vulnerable to fires, but residential areas along the southern and northwestern fringes of the City are particularly vulnerable as shown in Figure 4-10. These areas reside in the Interface region of the Wildland Urban Interface and these areas are ones where abiding by building codes and adhering to local fire mitigation measures remain most critical. Fire vulnerabilities also depend on a structure's location to sources of flammable material, including vegetation and other structures, and fire retardants, including ditches and fire-resistant surfaces.

Infrastructure

Electric: Poles or lines could be damaged by a fire, resulting in power outages. This would affect business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activities. Although all public buildings except City Hall have backup generation, many private residential and commercial buildings do not, making them more vulnerable to a power outage and the secondary effects of an outage.

Gas: Gas supply lines threaten to exacerbate the effects of a fire due to their flammability. A fire could lead to burn and inhalation problems, which are outlined in the people and public health sections.

Water/Wastewater: Depending on damage levels to infrastructure or the demands from a fire, water and wastewater plants may not meet daily intake levels due to water shortages. This could cause a water crisis for certain populations, if redundancies to supply drinking water are not established. Although a severe fire could strain the City's water infrastructure, the availability of water from Grand Lake would likely mitigate most of this vulnerability. An additional complicating factor for water is water levels depending on severity of drought conditions, which have been discussed further in Section 4.10.

Transportation: Smoke from fires can obscure visibilities, which can create hazardous conditions for driving, both for residents as well as responders fighting the fire and transporting patients from affected areas to facilities where medical care can be administered. In more severe cases, fire can block transportation routes, further complicating transportation issues.

Critical Facilities

All critical facilities are at risk of fire; however, critical facilities that were more at risk include the Hospital Liftstation water treatment plant on S Broadway St., the GMSA Water Intake structure located on the western shoreline of Honey Creek Recreational Area, as well as Wanda's Day Care and Kids R First childcare facilities. Each of these four facilities were located within the Intermix WUI regions. Impacts to either the Intake Structure or Hospital Liftstation could have substantial impacts to water supply (and fire suppression abilities) in the City.

The structural loss of a critical facility can result in a disruption of basic services (see infrastructure section), emergency response and medical services, or governmental services, all of which could have immediate and long-term consequences on the capabilities of the city to provide critical services and the health of the people residing in the city. All publicly owned critical facilities, excluding City Hall, have adequate backup generation if a fire results in a loss of power. All critical facilities should ensure that their backup generation is up-to-date and secured as best as possible from the effects of a hail event.

Cultural Resources

All cultural resources are at risk of fire, particularly Bassett Grove Ceremonial Grounds and Splitlog Church, which are both located in more rural areas, surrounded by vegetation which could become fuel if dried out sufficiently.

Future Development

As weather conditions change in the future, the frequency and severity of wildfires in Grove are expected to increase. Code enforcement personnel should ensure that public and private buildings meet or exceed current nationally recognized and legal fire codes. Fire code enforcement efforts are a critical element in the success of fire prevention programs. Almost every aspect of a thorough fire prevention program is affected by code enforcement in some way. It plays a major role in fire and life safety inspections, plans review, hazardous materials, code adoption, environmental investigations, and the issuance of fire prevention code permits. It is strongly recommended that the city continue to enforce the codes conforming to ICC 2018.

Natural Environment

Wildfires, especially those that result in structure fires, could release pollutants into the natural environment. These could include household chemicals or industrial scale releases. Fire also can cause soil erosion, due to the loss of ground cover, such as leaves and needles. Fires can also destroy habitat for wildlife, causing them to flee in search of new areas more suitable for them. Nonetheless, wildfires are a part of natural cycles and can be beneficial. Controlled burns should be conducted to reap these benefits and minimize the buildup of fuel materials which could result in more dangerous fires. In addition, wildfires can have renewing functions for soil.⁴⁵ Structural fires could release pollutants into the natural environment. These could include household chemicals or industrial scale releases. Wildfires are a part of natural cycles and can be beneficial.

⁴⁵ <https://blog.suny.edu/2013/08/ask-an-expert-why-are-wildfires-good/>

4.7 Hazardous Materials

4.7.1 Hazard Description

Hazardous substances include materials and wastes that are considered severely harmful to human health and the environment, as defined by the United States Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (commonly known as Superfund). Many hazardous materials are commonly used substances, which are harmless in their normal uses, but are quite dangerous if released in concentration. The EPA designates more than 1,300 substances as hazardous, making them subject to the reporting requirements under the Emergency Planning and Community Right-to-Know Act (EPCRA), CERCLA, and/or Clean Air Act (CAA). This does not include all hazardous chemicals for which material safety data sheets are required.⁴⁶ Because relevant legislation uses the term “hazardous substance”, but the emergency management and response community typically use the term “hazardous materials,” for this hazard profile, “hazardous materials” and “hazardous substances” are used interchangeably. Hazardous materials sites, for regulatory purposes, are divided into two general categories, fixed sites, and transportation facilities:

Fixed-site hazardous substances (materials and waste) incidents are the uncontrolled release of materials from a fixed-site capable of posing a risk to health, safety, and property as determined by the Resource Conservation and Recovery Act (RCRA). It is possible to identify and prepare for a fixed-site incident because federal and state laws require those facilities to notify state and local authorities about what is being used or produced at the site. The EPA regulates hazardous materials at fixed sites. Hazardous substances, as listed, are generally materials that tend to persist for long periods and pose long-term health hazards for living organisms if released into the environment. Extremely hazardous substances, while also generally toxic materials, represent acute health hazards that are immediately dangerous to the lives of humans and animals and can cause serious damage to the environment if released. When facilities have these materials in quantities at or above the threshold planning quantity (TPQ), they must submit Tier II information to appropriate state and/or local agencies to facilitate emergency planning.

Transportation of hazardous materials incidents are any events resulting in the uncontrolled release of materials during transport that can pose a risk to health, safety, and property as defined by the U.S. Department of Transportation (U.S. DOT) Materials Transport regulations. The U.S. DOT regulates hazardous materials in transit. Transportation of hazardous waste is regulated by the Oklahoma Dept of Transportation. The U.S. DOT regulations define a hazardous material as a substance or material that the Secretary of Transportation has determined could pose an unreasonable risk to health, safety, and property.

4.7.2 Location

Although the hazard could affect any location in the planning area, the hazard’s location generally is concentrated in the areas immediately proximate to Tier II facilities and transportation networks. While roadways can be conduits for volatile and toxic chemical products, there are no hazardous material restricted highways listed in the jurisdiction or the county. An analysis of tier II reporting indicates that there are ten locations where toxic substances are in and near Grove.⁴⁷ Although any of these facilities could present a danger to the planning area, none presented a uniquely heightened risk. Additional analysis, which is outside the scope of this project, is required to confirm or refute this conclusion.

To facilitate community planning for hazardous material events, the Emergency Planning and Community Right-to-Know Act (EPCRA) requires Tier II reporting on the storage, use, and release of hazardous substances. Facilities that use or store chemicals over EPA thresholds must submit Tier II reports to ODEQ on an annual basis;

⁴⁶ <https://www.epa.gov/epcra/consolidated-list-lists-under-epcracerclacaa-ss112r-august-2020-version>

⁴⁷ [Chemicals In Your Community \(arcgis.com\)](#)

these facilities can be known as Tier II facilities. The LEPC and fire departments use this information to create response plans.

In addition to Tier II facilities, transportation networks are also key locations of transmission for hazardous materials. The occurrence of a transportation incident involving hazardous materials is also a concern. The complexity of this hazard has much to do with the location of an event and materials involved.

Roadways account for many hazardous material releases. The major thoroughfares within and around the planning area on which most hazardous materials are transported are along U.S. 59, OK-10, and OK-25. Local roadways may also be used to move materials through populated areas.

Accidents involving aircraft can range from human error to meteorological causes and can be a cause of hazardous materials incidents. Fog, ice, thunderstorms, and wind shear are conditions that can lead to difficulties in properly controlling aircraft. Weather delays are common in air transportation and are respected to help prevent accidents. Airport runway pavement is also a concern. When deteriorated, runway pavement can cause damage to aircraft turbines, propellers, and landing gear and may result in runway or airport closure. Grove has 1 public municipal airport located northeast of the center of town.

Several previous occurrences have involved the discharge of gasoline at marinas on Grand Lake, as noted in Section 1.8.4. Marine incidents can be more difficult to control or clean up and can affect the natural environment in profound ways.

4.7.3 Extent

Given the multitude of hazardous materials and their various effects, it is difficult to determine an extent for hazardous materials. With a hazardous substance release, whether accidental or intentional, several potentially exacerbating or mitigating circumstances will affect its severity of the impact, however. Characteristics that can enhance or magnify the effects of a hazardous substance release, include:

- Weather conditions, which affect how the hazard occurs and develops (such as wind speed and direction)
- Micro-meteorological effects of buildings and terrain, which alters the dispersion of hazardous substances in compliance with applicable codes (such as building or fire codes)
- Mechanical failures (such as fire protection and containment features), which can substantially increase the damage to the facility itself and to surrounding buildings
- Land use, population and building density will be factors contributing to the extent of exposure and impacts incurred.

The severity of a hazardous material incident is dependent not only upon the circumstances described above, but also with the type of substance released, distance from the release, and the related response time for emergency response teams to stabilize and contain the release. Generally, areas closest to a release are at the greatest risk, due to their exposure to higher concentrations of the substance and the limited warning time before being impacted. Nonetheless, depending on the substance/material, a release can rapidly travel great distances or remain present in the environment for long periods of time (e.g., centuries to millennia), allowing for greater dispersal and increasing the spatial extent of the impact.

4.7.4 Previous Occurrences

The U.S. Coast Guard National Response Center (NRC) maintains a database of reports for the release of pollution for both fixed site and transportation events. This is the primary source which has been used to collect data included in Table 4-22. It should be noted that the database contains information from initial reports that have not been validated by state or other federal agencies.⁴⁸

⁴⁸ <https://nrc.uscg.mil/Default.aspx>

Regulations in 49 CFR 171.15 and 171.16 govern situations where hazardous materials are released, along with required notifications and reporting measures. Unless hazardous materials are properly reported, it is difficult to identify and track past hazardous materials releases that occur in transit.

The planning team identified 6 reported hazardous material incidents between January 2000 – December 2021, as reported in the National Response Center database. Details on these incidents are listed below in Table 4-22.

Table 4-22 Noteworthy Hazardous Material Events

Date	Event Narrative
May 24, 2000	Material stored and spilled on lot at 8416 Highway 59 North
January 25, 2002	While working on a fuel pump, an o-ring busted and released material at Honey Creek Landing Marina.
April 27, 2003	250 gallons of gasoline entered Grand Lake due to a breakaway valve failing at a fueling area at Honey Creek Landing Marina.
July 13, 2007	Due to flooding, raw sewage and unknown chemicals have gone into Grand Lake at 25231 South 603 Road.
June 23, 2008	Discharge of non-PCB material oil from a transformer on Ballerina Drive due to pole failure. Release went into Grand Lake.
January 5, 2011	A chlorine leak at Grove Water Treatment Plant sent one worker to the hospital. The plant was evacuated, and streets were closed at the intersections of 18 th and Broadway and 13 th and Main Street.
March 5, 2012	A release of approximately 30 gallons of sulfuric acid occurred at 2021 E Highway 10, with 5 gallons going onto the soil and the rest landed on a pad, caused by a hole punctured into a carboy.
June 3, 2013	Material on six pallets used for plating spilled from one gallon paint cans outside on the south side of a building located at 2900 E Highway 10.
June 12, 2018	Approximately 800 gallons of gasoline was released from the marina's fuel tanks at 25090 South 630 Road due to a mechanical failure.
February 7, 2019	An unknown white substance floating in an unnamed creek due to an unknown cause was reported at 63248 East 290 Road
April 12, 2021	A spill of 100 gallons of diesel from a partially sunken pleasure craft which was tied to a dock occurred at Elk River Landing, 65400 East 250 Road.
August 16, 2021	Discharge of about 20 gallons of gasoline to the water from piping that leads to a fuel pump occurred at U.S. Highway 59 at Royal Bay Marina due to mechanical failure.

4.7.5 Probability of Future Events

Due to the incidental nature of past hazardous materials events, along with a consideration for the human element in such a technological hazard, determining a “hard and fast” probability for a hazardous materials event is not as straightforward as it is with the natural hazards assessed in this plan. With that said, based on the number of recorded events between 2012-2021, the planning team has determined that it is **likely** that a hazardous materials incident will occur on an annual basis, with a probability greater than 10 percent, but less than 90 percent.

4.7.6 Vulnerability and Risk Assessment

The hazard has a minimal impact on the planning area and has a **low** overall significance based on classifications in Section 4.1.4. The hazard's impacts on the planning area are noticeable but not devastating to Grove's

property and citizens, especially given the City's the ability to partner with local fire jurisdictions and other response units.

People

People working and living in areas near hazardous materials facilities and transportation routes are at the greatest risk of a hazardous materials incident. Given the difference in hazardous materials and their physiological effects, hazardous materials can have limited health impacts, on one extreme, or cause death, on the other.

People at heightened risk include those with mobility or severe health issues that would limit their ability to evacuate quickly and people who speak a language other than English, limiting their ability to receive warning messages. Construction and maintenance workers are at increased risk of personal injury when working on or near hazardous materials sites.

Public Health and Safety

Most hazardous material spills recorded in the planning area recently were related to petroleum products and chemicals used in industry (see previous occurrences). Some hazardous materials, however, can cause long-term effects on peoples' health and strain the public health system, which can last for years. These long-term consequences can be prolonged by the secondary effects from hazardous materials. Hazardous materials can be introduced in the human body through secondary effects, such as eating or drinking contaminated food and water, touching or handling contaminated items, and bathing with contaminated water.

Developing a timely approach in responding to and remediating an extreme hazardous materials event can be crucial for public health. This approach requires coordination across private and public response units, along with healthcare workers across the planning area. Grove also should maintain and exercise capabilities to contain and remediate hazardous materials in line with current best practices.

Education and Outreach

People in the planning area would benefit from additional outreach and education on hazardous materials. This outreach could include information on properly storing and registering hazardous materials with local and state authorities. In addition, residents should be knowledgeable about evacuation procedures or sheltering options during an extreme hazardous materials event. These outreach and education activities can be enhanced by a mobile electronic application.

Economy

A large spill could impact recreational activities, close a facility, or harm agricultural activities, which could have severe economic impacts if the entity affected is a revenue generator or economic driver. Most events would not have broad implications for the economy. The costs of hazardous materials events can be expensive. Costs can include the cost of lost materials, property damage, cessation of business activities, response cost, and remediation/cleanup costs.

Built Environment

Existing Structures

An explosion at any Tier II facility may create off-site collateral damage (for more information on Tier II sites, see the extent section). Adjacent structures and properties are most vulnerable. Hazardous material releases can damage and destroy public, commercial, and private property. Proximity, intensity, and the structural integrity of the building itself are all factors in the subsequent vulnerability and expected damage.

Infrastructure

The planning team did not find any specific vulnerabilities to electric infrastructure from a hazardous materials incident.

Gas: A gas line rupture presents a primary danger if large quantities of gas are leaked and cause secondary fire hazard (see fire section). A fire would put people at direct risk of injury or death.

Water/Wastewater: Water and wastewater plants use chemicals to purify water and treat wastewater, among other hazardous materials. A large spill could cause the water or wastewater plants serving Grove to stop their activity, which could create a water or sewage crisis if not addressed quickly and effectively. An excess of chemicals in drinking water could cause hospitalization and death. As noted in Table 4-22, a chlorine leak at Grove Water Treatment Plant in January 2011 sent one worker to the hospital. The plant was evacuated, and streets were closed at the intersections of 18th and Broadway and 13th and Main Street.

Transportation: A traffic incident involving hazardous materials would cause significant traffic delays, including delays for emergency response vehicles or evacuation routes. Damages to transportation infrastructure and their closure are not uncommon following a hazardous materials release.

Transportation infrastructure can also be affected by cascading impacts, as described in the January 2011 incident at the Grove Water Treatment Plant, where the plant experienced the primary effects and transportation corridors were closed as an effect.

Critical Facilities

All critical facilities face the same vulnerabilities as existing structures. In addition, some critical facilities contain or use hazardous materials, such as industrial plants and hospitals. These critical facilities are designated as Tier II sites. Due to the risk that hazardous materials events can present to all critical facilities in the planning area, officials should ensure that all critical facilities are protected against hazardous materials events as much as is feasible.

Cultural Resources

Cultural resources face the same vulnerabilities as existing structures. No specific vulnerabilities were identified.

Future Development

All designated Tier II facilities should follow the current best practices on hazardous materials maintenance. All new developments should follow best practices about maintaining a safe distance from Tier II facilities or other hazardous materials sites, particularly facilities with elderly and young children.

Natural Environment

A hazardous substance release, whether at a fixed site or in transit, can negatively impact the natural environment. Depending on the nature and amount of the substance, the release may contaminate the air, water, or soil potentially causing concern for direct human and animal exposure, recreational usage, and fish and wildlife consumption. Water contamination, whether surface water or groundwater, is an immediate concern from a hazardous material release potentially impacting potable water supplies, wildlife, and recreational activities.

Hazardous material releases could also significantly impact soils, harming ecosystems. Depending on the characteristic of the hazardous material and/or the volume of product involved, the affected area can be as small as several square feet or as large as many square miles that require soil remediation. Such environmental damage can linger for decades and result in extensive remediation costs.

4.8 Extreme Heat

4.8.1 Hazard Description

Heat is the leading weather-related cause of death in America.⁴⁹ Extreme heat is defined as unusual hot weather (maximum, minimum, daily average) over a region persisting at least two consecutive days based on local climatological conditions, with thermal conditions recorded above given thresholds (WMO 2015). Note: There is no universally recognized metric for what constitutes extreme heat. The World Meteorological Organization recommends characterizing a heat wave by its magnitude, duration, severity, and extent. This definition also aligns with the definition used in the State of Oklahoma's 2018 Hazard Mitigation Plan.

4.8.2 Location

Extreme heat is a hazard that affects the entire planning area. The entirety of northeastern Oklahoma, including Grove, is known for its hot, humid summers, as large areas of high pressure become established over the southern U.S. during these months for varying lengths of time. When high pressure affects a region for an extended period of time, there is a higher probability that it will be accompanied, at least for part of that period, by extreme heat at the surface. While the effects of heat are more noticeable outside of shady or in places where a breeze can reach, heat is a hazard which has a large areal extent, which will be discussed further in the following section.

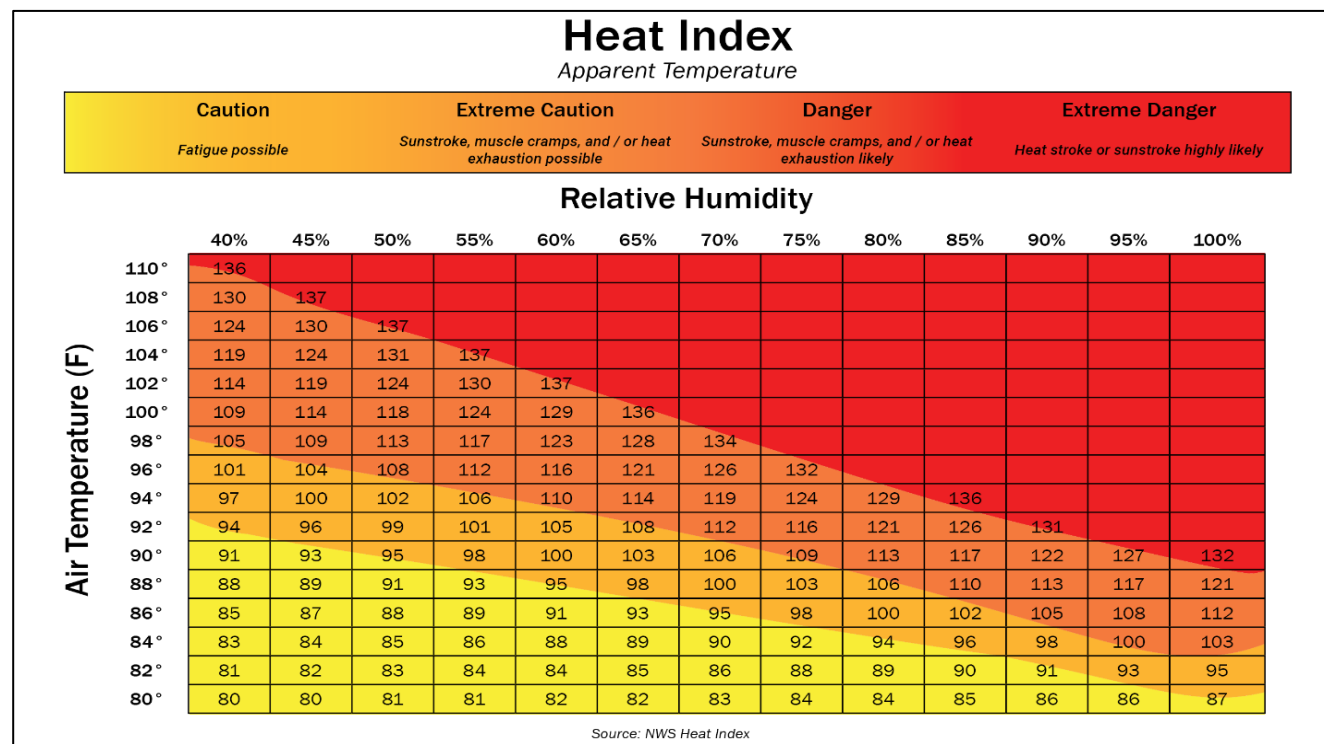
4.8.3 Extent

In terms of hazard extent, temperatures can often reach above 100°F for extended periods, with heat indices significantly exceeding 100°F. Figure 4-11 shows how relative humidity and high temperatures combine to produce apparent temperatures, often referred to as the Heat Index, that cause heat disorders in humans. A description of these impacts are shown in the various colors in the figure.⁵⁰ The table suggests varying degrees of caution depending on the relative humidity combined with the temperature. The shaded zones on the chart indicate varying symptoms or disorders that could occur depending on the magnitude or intensity of the event. "Caution" is the first level of intensity where fatigue due to heat exposure is possible. "Extreme Caution" indicates that sunstroke, muscle cramps or heat exhaustion are a possibility, whereas a "Danger" level means that these symptoms are likely. "Extreme Danger" indicates that heat stroke or sunstroke is highly likely. The City of Grove can expect to experience heat indices that range between 87 degrees and 130 degrees.

⁴⁹ <https://www.weather.gov/phi/heatcond>

⁵⁰ <https://www.weather.gov/safety/heat-index>

Figure 4-11 Heat Indices and Related Heat Disorders



Even in circumstances where the ambient temperature or heat index is below 100°F, Wet Bulb Globe Temperature can show indications of danger to people if they are outdoors for extended periods of time. Some weather experts also use Wet Bulb Globe Temperature (WBGT) as the primary index for heat. This transition is driven by research indicating that WBGT is much more positively correlated with health effects (for examples of these affects, see the people subsection of the vulnerability and risk assessment).⁵¹

Table 4-23 Differences Between WBGT & Heat Index⁵²

Parameters	Wet Bulb Globe Index	Heat Index
Measured in the sun	✓	✗
Measured in the shade	✗	✓
Uses Temperature	✓	✓
Uses Humidity	✓	✓
Uses Windspeed	✓	✗
Uses Sun Angle	✓	✗
Uses Cloud Cover	✓	✗

In addition to the heat index, the National Weather Service has created a series of tables related to WBGT temperature levels and their effects on human health. The table below highlights general guidelines for people working or exercising in Wet Bulb conditions. Other guidelines exist for different at-risk groups (e.g. youth) and activities (e.g. sports and military training). People who are at risk of extreme heat should take precautions in addition to the ones listed below (see the vulnerabilities section for people who may be at-risk).

⁵¹ Kevin Kloesel, University of Oklahoma; National Weather Service

⁵² NWS Atlanta

Table 4-24 NWS Composite Guidelines for Working or Exercising in Full Sun⁵³

Risk	WBGT	Heat Index
Low	80°F – 85°F	Body stressed After 45 minutes
Moderate	85°F – 88°F	Body stressed after 30 minutes. Heat cramps likely (painful contraction of muscles, weakness)
High	88°F – 90°F	Body stressed after 20 minutes. Heat exhaustion likely (dizziness, nausea, vomiting, headache, fainting, disorientation, weakness)
Extreme	Above 90°F	Body stressed after 15 minutes. Heat stroke likely (extremely high body temperature, confusion, convulsions, unconsciousness, death)

According to the Oklahoma Climatological Survey, the all-time maximum temperature (all-time record high) reached in Delaware County is 118°F.⁵⁴ Grove should continue to expect to experience temperatures above 100°F and high relative humidity in the future, which could reach danger levels (or even extreme danger levels) on the heat index and will contribute to more severe WBGT days each year.

4.8.4 Previous Occurrences

July is statistically the hottest month, on average, for the planning area. The average high temperature for July in Delaware County is 91.3°F, with an average humidity of 71%, putting the area near the “Danger” category on the National Weather Service (NWS) Heat Index scale (see extent section). When temperature and humidity rise higher, as they often do in July and August, conditions can reach the “Extreme Danger” category.

Four extreme heat events have been recorded in the NCEI database from January 2012 – December 2021. While this is a lower frequency than the number of heat events recorded in the preceding 6-year period, it is not necessarily representative of a change in the longer-term climatic trends for the area. There are several factors that can affect weather patterns which cause extreme heat conditions to develop, and those conditions can come together more frequently over a period of several years, then become absent in following years, in a somewhat cyclical pattern.

Table 4-25 Noteworthy Extreme Heat Events Impacting Grove

Date	Event Narrative
July 17-21, 2006	A strong upper-level ridge of high pressure that was anchored over the Southern Plains in combination with a humid air mass over the region combined to produce excessive heat conditions over much of eastern Oklahoma, with daytime heat indices as high as 115°F, with low temperatures in the mid 70s to lower 80s. The persistent heat resulted in several heat-related fatalities
July 29, 2006 – August 3, 2006	A strong upper-level ridge redeveloped and persisted over the Southern Plains in late July and continued into early August. This system, combined with a humid air mass over the region, resulted in persistent excessive heat conditions over much of eastern Oklahoma with daytime heat indices near 105°F & morning low temperatures in the mid 70s to lower 80s.
August 9-10, 2006	A strong, upper-level ridge redeveloped, once again, over the Southern Plains and combined with a humid air mass to produce another period of excessive heat over eastern Oklahoma. Afternoon heat indices ranged from 105°F to 111°F, and low temperatures were in the upper 70s to mid 80s.

⁵³ <https://www.weather.gov/arx/wbgt>

⁵⁴ [Delaware_draft \(ok.gov\)](#)

Date	Event Narrative
August 6-12, 2007	A strong ridge of high pressure developed over the south-central U.S. Few clouds under this ridge resulted in abundant sunshine and hot temperatures. Spring rains that continued well into the summer contributed to high humidity levels, which exacerbated the apparent heat values. Heat indices between 105°F to 113°F were experienced across much of eastern Oklahoma. Overnight temps remained above 75°F, which prevented relief from the heat.
July 11-15, 2009	A prolonged period of excessive heat occurred across eastern Oklahoma in mid-July. Daytime heat indices peaked at between 105°F to 115°F, with overnight low temperatures only falling to around 80°F for several consecutive days.
June 19-21, 2010	Temperatures in the mid to upper 90s, combined with high relative humidity, resulted in a period of excessive heat across eastern Oklahoma. Heat indices each afternoon reached 105°F to 110°F, and morning low temperatures only fell into the mid to upper 70s.
July 13-23, 2010	A strong subtropical ridge developed and remained over the south-central U.S. for a prolonged period during the middle of July. This resulted in an extended period of exceptionally hot weather. Temperatures were above normal with daytime reading reaching the mid 90s to near 100°F, and overnight temperatures remaining at or above the mid 70s. Very humid conditions, as a result of the excessive rainfall that occurred earlier in the month, and subsequent highly saturated soils and vegetation, resulted in afternoon heat index values as high as 105°F to 115°F.
June 30, 2011	A strong high-pressure ridge in the middle and upper atmosphere developed across the south-central U.S., resulting in strong subsidence over the region. High temperatures climbed to between the mid 90s and 103°F under mostly clear skies. This heat, combined with high relative humidity, resulted in afternoon heat index values in the 105°F to 110°F range. Very little relief was realized overnight as temperatures only fell into the mid to upper 70s. This period of excessive heat continued into July.
July 14 – August 8, 2011	A strong high-pressure ridge in the middle an upper atmosphere redeveloped across the south-central U.S., in mid-July, resulting in strong subsidence across the region. High temperatures in excess of 100°F were recorded on all but two days during the remainder of July at Tulsa International Airport. July 2011 was observed to have been the second warmest July on record in Tulsa since recordkeeping began in 1905. Numerous record high temperatures were recorded across eastern Oklahoma. The heat combined with high relative humidity resulted in heat indices reaching the 105°F to 115°F range, with overnight lows in the upper 70s to mid 80s offering little relief. The excessive heat continued into early August, with records at Tulsa International Airport indicating that August 2011 was the 5th warmest August on record. During this period, afternoon temperatures exceeded 100°F, and the all-time record maximum temperature in Tulsa was 2°F of being broken on the 3rd when the observed high temperature was measured to be 113°F. High humidity factored in resulted in afternoon heat indices in the 105°F to 115°F range, with overnight low temperatures near 80°F.
July 30 – August 4, 2012	Hot temperatures, combined with very high humidity, resulted in excessive heat across much of eastern Oklahoma. Temperatures climbed into the mid 90s to near 100°F, with heat index values between 105°F to 115°F. Overnight low temperatures in the upper 70s to mid-80s offered little relief.
June 26 - 27, 2013	Unseasonably hot temperatures, combined with high humidity, resulted in excessive heat across much of eastern Oklahoma. Temperatures were observed in the mid 90s to near 100°F, with heat index values between 105°F to 110°F. Overnight lows in the mid 70s to near 80°F offered little relief overnight.

Date	Event Narrative
June 17 – 18, 2016	A strong ridge of high pressure aloft was anchored over the south-central U.S., producing temperatures in the mid 90s to near 100°F across much of eastern Oklahoma. This heat, combined with high humidity, resulted in heat indices between 105°F to 110°F both afternoons. A heat-related fatality occurred in Delaware County as a woman with no air conditioning in her home died.
July 19 – 20, 2018	An upper-level ridge over the south-central U.S. resulted in a period of unseasonably hot weather over the area. Temperatures each afternoon reached the 100°F to 105°F range across much of eastern Oklahoma. This heat, combined with high humidity, resulted in heat index values between 105°F to 112°F.

4.8.5 Probability of Future Events

Based on the number of excessive heat events over the past decade, and the number over the past 30 years, the planning team has determined that excessive heat events will be **likely** to occur on an annual basis, with a probability greater than 10 percent, but less than 90 percent.

An additional consideration is research from the Oklahoma Climatological Survey and from SCIPP predicts an increase in more extreme heat events across the planning area as the result of climate change.⁵⁵ The planning area could experience an increase of another 3-9 degrees Fahrenheit by the end of the century.

4.8.6 Vulnerability and Risk Assessment

Extreme heat events can pose a serious threat to elderly citizens as well as those outside, and Grove is home to both populations. The City's high number of assisted living/long-term care facilities reiterates the fact that many residents may be impacted (see Section 1.3.1 People), particularly those where no backup power generation is in place. Extreme heat events produce higher-than-normal demands on the City's electrical grid, and when demand exceeds capacity, rolling brownouts are sometimes required to maintain the grid's integrity. Should power outages occur due to these brownouts, elderly residents are extremely vulnerable when their living facility is unable to (or has no capability to) keep the A/C running. City officials and members from long-term care facilities confirmed that there are evacuation procedures/policies in place should elderly residents require transportation to a cooling center. Grove public schools will bring buses to the affected facilities and transport individuals to identified cooling centers, and during emergencies, hospitals will provide ambulances. While emergency plans/policies may be in place at Grove's long-term care facilities, the biggest issue for these vulnerable citizens is the lack of/need for backup power generators. Grove's hospital and Grand Lake Villa Assisted Living Center were identified as having generators in place, but others, like the Betty Ann Nursing Center on S. Main Street do not.

Grove also attracts many tourists year-round, particularly during the summer months when boating and lake-side activities are at their peak. As extreme heat events occur, these people are also at an increased risk of being impacted by extreme heat events. And as is the case with many urbanized areas, cities like Grove can exacerbate extreme heat events due to the building materials and land coverage within the city. Daytime temperatures and heat related illnesses are more frequently found in urbanized regions during extreme heat events since hot temperatures radiate upwards from the ground. For these reasons, the overall significance of extreme heat events to the planning area is **high**.

⁵⁵ https://forestry.ok.gov/sites/g/files/gmc801/f/documents/2020/ok_climatological_survey_climate_statement.pdf

Future Conditions

Climatological changes and future conditions suggest that increased temperatures will make extreme heat events more common in the planning area. Urban areas, like the City of Grove, will expect to see an increase in the number of extreme heat events because of the combined effects that urban building materials have on the near-surface temperatures near the ground. These vulnerabilities underscore the importance of implementing the use of green spaces in the planning area, because concrete and other imperious materials commonly used in urban settings can intensify the effects of extreme heat.

People

Heat impacts the entire population of Grove and can be expected every summer. The population at most risk of extreme heat is the 29.2% of the Grove population aged 65 and above, the 16.9% of the population below the poverty line, and that segment of the population that works outdoors.

Despite being a regularly occurring weather phenomenon, heat poses a risk for people in Grove, particularly when it reaches the extreme categorization, which happens less frequently. Extreme heat can take its toll on all people in Grove and participating jurisdictions; even physically fit individuals can succumb to heat effects. Minor temperature differences can be associated with increased illness and death, more notably for vulnerable populations. These effects are also dependent on other natural effects, such as duration, wind speed, and, especially, humidity. Wildfire conditions are exacerbated by extreme heat and response during these events puts responders and residents at even greater risk.

Certain segments of the population are at higher risk.⁵⁶ Of particular concern are those living in the long-term care facilities or who are over the age of 65. Also, those living below the poverty line are at increased because of their limited access to affordable air condition. Heat-induced health conditions can rapidly lead to hospitalization and death. In addition, this segment of the population is mostly retired and have a small, fixed income, which could hinder their ability to pay for air conditioning if prices for electricity were to rise during an extreme heat event.

Generally, public schools are not in session during the peak of the extreme heat season; however, athletic and band practices typically begin in early August and run through September, during a time of the year when heat is still prevalent. All students and staff of participating schools are vulnerable to heat illnesses.

To mitigate some of these effects, some public buildings in Grove can serve as cooling stations, if needed. Many of these cooling stations are supported by backup generators (See Chapter 3 on sheltering; also see education and outreach section).

Public Health and Safety

People in the planning area also can be exposed to physiological and psychological effects from extreme heat. Extreme heat can also exacerbate cardiovascular, respiratory, and other chronic physiological conditions. Extreme heat also can alter population psychology and negative psychological behaviors, such as increased crime rates.⁵⁷

Education and Outreach

Extreme temperatures can have adverse impacts on public health, which can be lessened if citizens know how to prepare and protect themselves. Educating Grove's citizens regarding the dangers of extreme heat and best practices for extreme heat events can protect them from illness and death in the future. Understanding the location and movement of vulnerable populations and how they obtain their news sources is key and all possible

⁵⁶ Individuals 65 years and older, children under five years old (especially infants), socially isolated individuals, mentally & mobility challenged individuals, obese individuals, individuals under the influence of alcohol or medication, individuals and families living below the poverty line, outdoor workers.

⁵⁷ [Violent crime increases during warmer weather, no matter the season, study finds \(phys.org\)](#)

media and outlets should be utilized. These outreach and education activities can be enhanced by a mobile application.

Economy

Heat waves can have adverse effects on the economy of Grove by slowing worker productivity, affecting structures and infrastructure, and damaging crops. Worker productivity can also decrease during heat waves. Businesses that can allow employees to work remotely should develop a plan to implement broadband services if power to business is cut and workers can perform more effectively elsewhere. The slowdown is particularly acute in outdoor industries, such as construction. During periods of extreme heat, the electrical demand increases greatly, including costs for electricity. Most electrical motors and controls are designed to operate with ambient air temperatures of 104 °F or less. The increased heat from the increased electrical demand by electrical equipment with ambient air temperatures above 104 °F will result in electrical power outages. Those electrical power outages will reduce the available cooling capacity and could also reduce the treatment and distribution of the domestic water supply. Since the last update, there haven't been any reported disruptions or major casualties from extreme heat events. In addition, buildings can be vulnerable to extreme heat, but these vulnerabilities tend to be limited.

One effect on the economy from the heat that is positive is that presented by Grand Lake, and its resource as a recreation area that attracts people seeking relief from the heat by indulging in water-related activities. The warmest months of the year are correlated with an increase in visitors and activity on the Lake.

Built Environment

Existing Structures

Although the direct effects of extreme heat on structures are minimal, extreme heat threatens the built environment, particularly infrastructure. Extreme heat also can have related effects associated with drier weather, which typically accompanies extreme heat, by heightening the incidence of soil destabilization, due to cracking and erosion, and that of wildfires. Homes that have poor thermal insulation, however, can exacerbate the hazard's effect on people. Older homes tend to be more poorly insulated.

Infrastructure

Only electric and transportation infrastructure have noted and specific vulnerabilities to extreme heat events.

Electric: Prolonged extreme heat events can result in rolling blackouts or other forms of power outages. These outages can exacerbate conditions outlined in the people and public health section in Grove. The City should ensure that communication about cooling stations is consistent and is delivered over the media and the languages (especially Spanish; see Chapter 1) to maximize reach. Grove officials confirmed that public buildings that could be used as cooling stations have backup generation. Officials should also coordinate with electrical utility providers to communicate planned blackouts. Prolonged blackouts can exacerbate the conditions listed in the people section of the assessment.

Transportation: Extreme heat can further degrade roads and some paving systems or limit the ability of crews to repair damage in Grove. When heat causes roads to buckle, it can disrupt emergency service and business delivery, which could lead to reduced medical and business efficiency.

Critical Facilities and Cultural Resources

No critical facility or cultural resource in Grove reported any specific vulnerability to extreme heat other than general structural vulnerabilities.

Future Development

Grove should continue with building inspections to make sure that buildings are up to at least the 2018 international codes. This could prevent the development and continuation of structures that are not properly

insulated from extreme heat events. In addition, the city should ensure that all new critical facilities and public buildings are equipped with backup generation.

Natural Environment

Extreme heat causes crop loss. High temperatures and dry air can lead to heat stress in trees and other flora. If prolonged, high heat conditions also could cause animals to leave their natural habitats to search for cooler places or places with more water.

4.9 Lightning

4.9.1 Hazard Description

Lightning is a discharge of electrical energy that results from the buildup of positive and negative charges in a thunderstorm, generating a “bolt” when the buildup of charges reaches a certain level. Lightning can occur between a cloud and the ground (cloud-to-ground lightning), between two clouds (Intercloud Lightning), or within the same cloud (Intracloud Lightning). Lightning can strike 10 miles outside the rain column.

4.9.2 Location

Lightning is typically a by-product of thunderstorms, making the location of lightning uniform over the entire planning area. Other causes of lightning are extremely rare and will not be considered for this discussion.

4.9.3 Extent

Extent is determined by a metric designed by NOAA and the U.S. Wildfire Service, called the Lightning Activity Level (LAL), and this scale describes lightning activity in six different categories, shown in Table 4-26 below. Using this scale, the extent of lightning activity across the City of Grove can range from LAL 1 to LAL 6.

Table 4-26 Lightning Activity Level (LAL)

LAL Value	Description
LAL 1	No thunderstorms
LAL 2	Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground strikes in a five-minute period.
LAL 3	Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud-to-ground strikes in a 5-minute period.
LAL 4	Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud-to-ground strikes in a 5-minute period.
LAL 5	Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud-to-ground strikes in a 5-minute period.
LAL 6	Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag Warning.

4.9.4 Previous Occurrences

The planning area experiences Lightning on multiple occasions annually. Not all lightning strikes cause damage, however. 5 damaging occurrences of lightning in Delaware County were recorded between 1995 and 2017 that resulted in over \$100,000 in damages and 1 death. The City of Grove reported 2 lightning strike events during that period with \$100,000 in damage, although it is highly likely that, due to the number of thunderstorms that affect the county, and the previously referenced lightning flash data, that there were many more unreported incidents producing unreported damage. Although the entire community of Grove is at risk from lightning, the damage produced from a lightning strike depends upon factors such as: the type of structure that is hit, the age, condition and density of structures in the strike area, the community's fire response capability and the presence or absence of lightning warning and protection systems. Oklahoma has one of the highest average lightning densities in the United States. Grove, like most of northeastern Oklahoma, has higher-than-average lightning strike densities compared to the rest of the state and nation. The National Lightning Detection Network estimates that Delaware County (including the City of Grove) experiences 6-8 flashes per square kilometer annually, based on 2019 data (see Figure 4-12 below).

Figure 4-12 Vaisala's Cloud-to-Ground Flash Density 2015-2020 (per county)

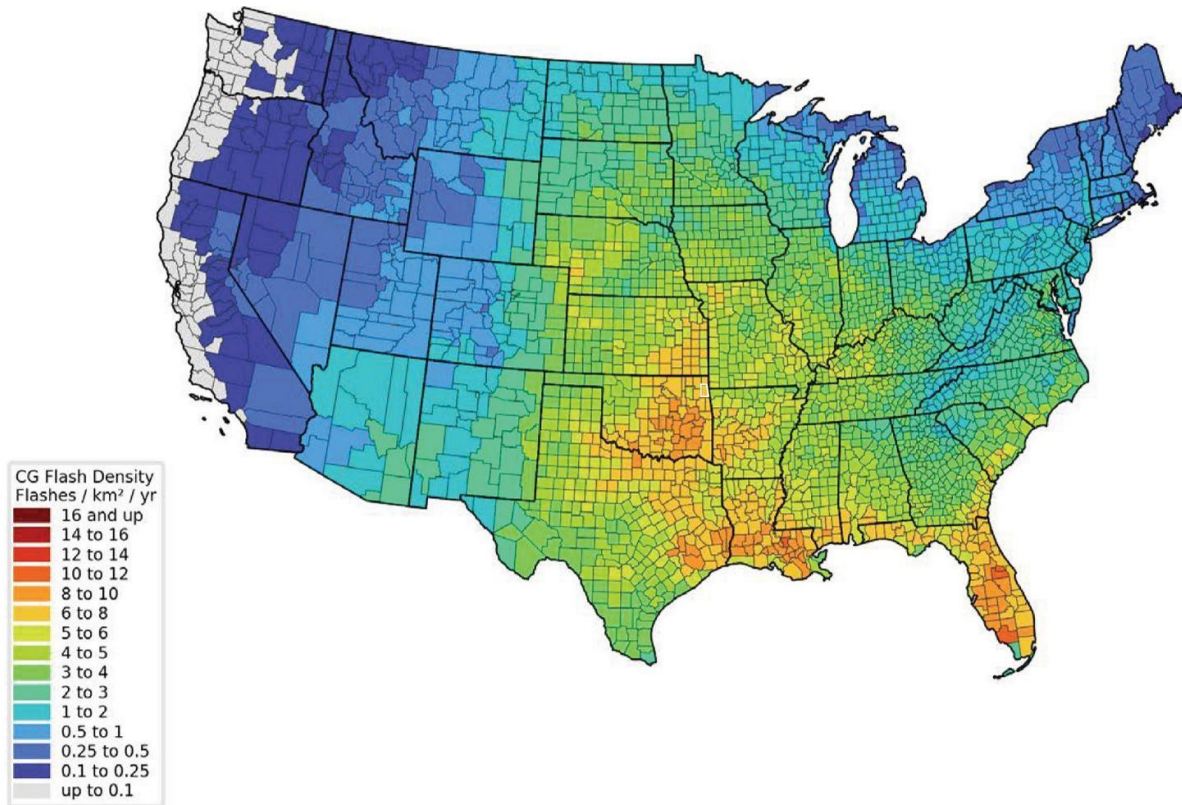
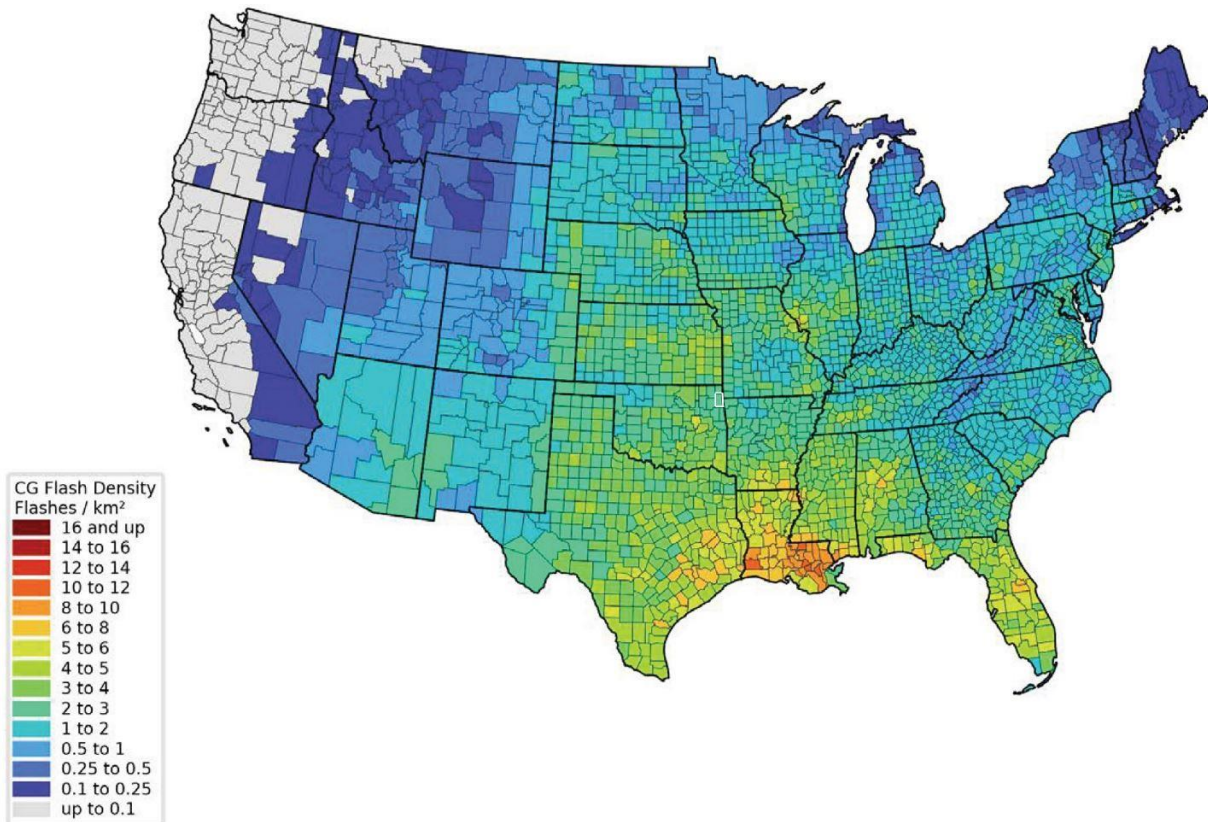


Figure 4-13 Vaisala Cloud-to-Ground Flash Density 2021 per County



The Vaisala 2020 Lightning Report similarly indicated that Delaware County experienced 4 to 8 cloud-to-ground strikes per square kilometer.⁵⁸

The low number of reported incidents does not necessarily imply a low incidence of lightning, however. In fact, the probability of lightning strikes across the planning area is highly likely. This determination was based on location, and previous occurrences across the planning area. The planning area should expect future lightning events to fall in line with The National Lightning Detection Network (NLDN) data from previous years, with a high probability of lightning occurring on an annual basis. The NLDN estimates that Grove experiences about 147-197 flashes annually, based on their 2020 report.⁵⁹

Table 4-27 Noteworthy Lightning Events Impacting the Grove Planning Area

Date	Event Narrative
August 7, 2001	Lightning struck a house in Grove, causing a fire which destroyed the house. \$50,000 in damage was assessed.
October 6, 2002	Lightning struck the police station and a nearby house. The police station sustained \$10,000 in damage. The lightning ignited a fire in the house and destroyed it, with \$40,000 in damage assessed. Between the two, damages totaled \$50,000.

4.9.5 Probability of Future Events

While not every lightning strike produces tangible harm or damage, the potential exists with each occurrence for such an effect. Based on the infographic in Figure 4-13 It is **highly likely** that Grove will experience a lightning occurrence annually, or a 90 percent or greater probability of occurrence in the next year.

4.9.6 Vulnerability and Risk Assessment

While several risks are associated with lightning, perhaps the greatest vulnerability within the planning area exists in the potential loss of human life. Property damage can also occur to structures, electrical equipment, water wells, etc. These risks and vulnerabilities will be discussed in detail in this section, and the overall significance of lightning events remains **medium**.

Future Conditions

Climatological changes in Delaware County and the City of Grove may mean more frequent thunderstorms (and hence more frequent lightning events) in the future. While thunderstorms are expected to increase in frequency, so will the threat for any lightning-related incidents to those caught outdoors or in unsafe locations – like on Grand Lake. As recreational activity on Grand Lake increases, so will risks for those who remain outdoors.

People

All people in the planning area are at risk of lightning. Fatalities and injuries can be caused directly (being struck by lightning) or indirectly (through a conductor). Common conductors for indirect lightning strikes can include tree, pole, or other tall object, along with household conductors that include electrical or metallic components. Lightning could also cause an explosion, which may lead to secondary hazard effects that can include hazardous materials releases (see hazardous materials section for more information on the potential effects of hazardous materials).

The planning area's recreational areas also can be dangerous during lightning events, especially at a popular recreation destination like Grand Lake or at outdoor gatherings or events, such as athletic events or concerts.

⁵⁸ <https://www.vaisala.com/sites/default/files/documents/WEA-MET-Annual-Lightning-Report-2020-B212260EN-A.pdf>

⁵⁹ The NLDN report suggests that the area surrounding Grove experiences 6-8 flashes per square kilometer per year. Grove has a surface area of 24.63 square kilometers. Thus, $24.63 \times (6 \leq 8) = 147 \leq 197$ (approximate).

Anyone outdoors during a thunderstorm is exposed and at risk of injury from lightning. People who do not have access to lightning warnings are at higher risk of being exposed to lightning. People, buildings, trees, electrical systems and components are all vulnerable to lightning. The impacts stemming from a strike include injury or death, structural damages including fire, fallen trees or limbs, fallen electrical lines, and damaged electrical substations that experience a direct strike.

While no school districts are participating in this plan, a critical concern arising from this hazard is the safety of spectators and participants in outdoor activities, school-related or otherwise. In general school officials will call a game if lightning becomes a concern. A lightning strike would cause loss of life and injury if it occurred when patrons were outdoors at a sporting event. The planning team recommends upgrading detection capabilities and developing a method or procedure to alert officials responsible for making decisions at these events of imminent lightning threats.

Education and Outreach

A general assessment of outreach and education on lightning within Grove by the planning team finds an overall lack of consistent outreach and education on a lightning event for developers, builders, realtors, and residents. This can include best practices on how to shelter from lightning while outdoors and indoors, as lightning can be conducted indoors through commonly used appliances.⁶⁰ People also should receive education on the importance of lightning mitigation measures, such as lightning rods or surge protection. Officials in Grove report that some area swimming pools, and water parks are installing early warning devices to alert patrons of the danger of imminent lightning strikes. The planning team recommends either customizing the already utilized Code Red mobile alert application to include lightning alerts or utilize and implement another effective method to disseminate lightning alerts.

Economy

Economic impacts from lightning are primarily related to loss of power and business interruption. The amount of impact on the economy depends on the affected entity(ies) and the length of time until service restoration (see built environment section for more information).

Built Environment

Existing Structures

All structures in Grove are at risk of lightning. Older buildings and densely concentrated businesses and residences that were built prior to the City's adoption of 2018 codes can be more vulnerable to lightning strikes. These buildings often have fewer protective measures to mitigate against the effects of a lightning strike or the cascading impacts stemming from a lightning strike, such as fire. In addition, structures without lightning mitigation measures, such as lightning rods or enhanced surge protection, may be more at risk.

Infrastructure

The planning team did not identify any gas or transportation infrastructure as being particularly vulnerable to lightning.

Electric: Electrical is the infrastructure segment that is most vulnerable to lightning. A lightning event could damage electrical generation or transmission (including substations), reducing or cutting off power to critical facilities and other buildings. This would affect business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activities. Although nearly all public buildings have backup generation (officials note that City Hall does not), many private residential and commercial buildings do not, making them more vulnerable to a power outage and the secondary effects of an outage. It is important to note that many of the basic needs listed could be disrupted with a power outage to residential structures.

⁶⁰ <https://www.cdc.gov/disasters/lightning/safetytips.html>

Water/Wastewater: Instances where water and wastewater plants have been disabled or damaged by lightning have been noted throughout the region (due to electrical issues outlined above) in the past. A prolonged water or wastewater outage could lead to a crisis of a lack of drinking water or significant sanitation issues with wastewater. Plant operators should ensure that they have the redundancies to continue to deliver water or treat wastewater (see critical facilities section for some examples) and a way to effectively communicate with their customers in the event of a disabling lightning strike.

Critical Facilities

All critical facilities are at risk of lightning, especially to a power surge or power outage resulting from a lightning strike. For this reason, power generation and distribution networks and capabilities are especially important. Critical facilities with high a quantity or quality of electronics are similarly vulnerable since a power outage or surge led to the disabling of key electronic functions and destruction of expensive electronic equipment.

Grove should equip all critical facilities with lightning mitigation measures, such as lightning rods and surge protection. Additionally, all city buildings and other critical facilities, such as nursing homes, should all be equipped with properly maintained and functioning backup generators sufficient to meet their power needs.

Cultural Resources

Due to lack of current knowledge incorporated into building codes at the time they were constructed, some historic buildings are composed of more flammable materials than more modern buildings, which heightens the risk of a fire resulting from a lightning strike. Retrofitting these structures with materials that meet IBC 2018 requirements is recommended to protect these resources.

Future Development

All future development is at risk to lightning. Grove has adopted the IBC 2018 standards, matching those adopted by the state. Additionally, Grove has two code enforcers and building inspectors on staff responsible for ensuring that public and private buildings meet or exceed current nationally recognized and legal standards. All buildings would also benefit from the installation of lightning mitigation measures, such as lightning rods and enhanced surge protection. The National Fire Protection Association document NFPA 780, *Standard for the Installation of Lightning Protection Systems*, for instance, describes lightning protection system installation requirements. NFPA 780.⁶¹

Natural Environment

Fires sparked by lightning often damage vegetation, flora, and crops, along with contributing to air pollution, depending on the size and duration of the fire. These fires can have the cascading effect of limiting food sources for animal wildlife, forcing them to relocate to a habitat with more suitable food sources. Lightning strikes on bodies of water also have the potential to kill aquatic life and damage the ecosystem in ponds, lakes, and rivers.

⁶¹ [List of NFPA Codes and Standards](#)

4.10 Drought

4.10.1 Hazard Description

A drought is a period of unusually persistent dry weather that persists long enough to cause deficiencies in the water supply (surface or underground). Droughts are slow-onset hazards that can severely affect crops, municipal water supplies, recreational resources, and wildlife. If drought conditions persist over many months or years, the direct and indirect economic impacts can be devastating. High temperatures, high winds, and low humidity can worsen drought conditions and make areas more susceptible to wildfire. In addition, human actions and demands for water resources can accelerate drought-related impacts. A publication in late 2021 by the Cybersecurity & Infrastructure Security Agency (CISA) discussed this issue in the [Drought and Infrastructure - A Planning Guide](#), where four primary types of drought are defined. Further discussion on the direct and secondary hazards produced by droughts is provided below in the Vulnerability and Risk Assessment section. Table 4-28 provides definitions and distinctions between the four types of droughts.

Table 4-28 Primary Drought Types that Present Direct or Secondary Hazards (CISA)⁶²

Drought Types	Definitions
Meteorological	Occurs when dry weather patterns dominate an area and can begin and end rapidly
Hydrological	Occurs when low water supply becomes evident, especially in streams, reservoirs, and groundwater levels, usually after many months of meteorological drought and takes time to develop then recover.
Agricultural	Occurs when soil moisture is insufficient and results in the lack of crop growth and production, which is primarily concerned with short-term drought situations
Socioeconomic	Occurs when the demand for an economic good exceeds supply as a result of a weather-related deficit in water supply.

4.10.2 Location

The location of droughts is uniform across the entire planning area, as drought affects an area on a scale much larger than one municipality.

4.10.3 Extent

The extent of droughts was calculated by determining a drought's severity, using the Palmer Drought Severity Index (PDSI), and its duration. The extent of droughts in northeastern Oklahoma (including the planning area) are not expected to be severe or extreme on a regular basis. The PDSI depicts prolonged (months, years) periods of

Palmer Drought Severity Index	
Extreme Drought	-4.0 or less
Severe Drought	-3.0 to -3.9
Moderate Drought	-2.0 to -2.9
Near Normal	-1.9 to 1.9
Unusual Moist Spell	+2.0 to +2.9
Very Moist Spell	+3.0 to +3.9
Extremely Moist	+4.0 and above

anomalous dry or wet periods. Based on historical averages of the Palmer Drought Index since 2005, drought conditions in northeast Oklahoma typically range from -4.0 to +6.0.⁶³ A drought in the planning area can range from “near normal” to “extreme” on the PDSI index.

Table 4-29 Palmer Drought Severity Index

⁶² https://www.cisa.gov/sites/default/files/publications/Drought_and_Infrastructure_A_Planning_Guide_508c.pdf

⁶³ <https://www.drought.gov/drought/data-maps-tools/current-conditions> <https://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/>

4.10.4 Previous Occurrences

Drought is a hazard which can occur in all climates, though what is considered dry weather for one area may not be the same standard for another. Grove, and northeastern Oklahoma, experiences drought every few years, on average. A drought during the early 1950s was the worst drought since the Dust Bowl and the construction of Pensacola Dam in 1940. It should be noted that NOAA began tracking drought events in 1980.

While Grove experiences drought frequently, and drought occurrences have increased since 1980, the frequency and intensity of drought across northeastern Oklahoma are lower than that in western parts of the state. Over the 10-year period from January 2012 through December 2021, the planning area has experienced 13 months of drought, with 2 discreet events, according to NCEI data. Based on this average, the planning area statistically has an approximately 11% probability of experiencing drought in a given month. No damage or injuries attributed to droughts were recorded in the NCEI database or noted by local officials between January 2010 and December 2021.

Table 4-30 Noteworthy Drought Events Impacting the Planning Area

Date	Event Narrative
November 2005 – May 2006	A rainfall deficit began and continued to grow throughout the month of October 2005 in Delaware County, and moderate drought conditions set in by the end of the month. The prolonged absence of significant rainfall through December resulted in the onset of severe drought conditions (D2) across most of eastern Oklahoma, including Delaware County and Grove. During the month, some portions of northeastern Oklahoma received about $\frac{3}{4}$ inch of precipitation, while other areas received generally less than $\frac{1}{2}$ inch. Northeastern Oklahoma received about 27% of its average precipitation for that 90-day period. Streamflow was well below normal for tributaries of the Arkansas River Basin. All major reservoirs across eastern Oklahoma were below 70% of their normal pools. A burn ban was instituted and remained in place across the entire state through December. Extreme drought (D3) began to set in during January 2006 as the rainfall deficit continued to deepen. Reservoirs in eastern Oklahoma remained below 70% of their normal pools as the burn ban continued. Exceptional drought (D4) conditions briefly set in over northern Delaware County during mid-March, but the gradual ebbing of the severity of drought conditions began during the back half of the month. Extreme drought (D3) continued to persist until the beginning of May, when additional rainfall allowed for continued improvement. This rainfall continued and allowed the area to experience the end of the drought by mid-May.
August – December 2006	A rainfall deficit began in June across northern Delaware County, as moderate drought conditions (D1) set in during the first week of August, quickly deepening into severe drought (D2) territory by the middle of the month. Improvement to D1 conditions were experienced by the end of the month and continued through November. After a 1-week reprieve from drought conditions, as a result of beneficial rains, D1 conditions set back in by mid-month and continued through the remainder of the month, with drought removal once the new year arrived.
July – November 2011	After a wet period in April and May, an exceptionally dry period suddenly set in during June, as the area received less than 20% of its normal rainfall for the month. A strong subtropical ridge developed earlier than normal during the summer, was persistent through much of autumn, and acted to suppress the development of precipitation. There were a few days on which isolated to widely scattered thunderstorms occurred when the ridge weakened enough to allow for this activity, but this activity was too few and far between to have much of an effect. Much of eastern Oklahoma experienced well below average precipitation during this event, with some locations only receiving a few hundredths of an inch during an entire month. As a result, severe to extreme drought conditions had redeveloped across much of the region by the end of June.

Date	Event Narrative
	Severe drought conditions set in during the first part of August, though some relief came toward the end of the month across the planning area, as several precipitation events produced near to slightly above normal rainfall amounts for the month. Since August is typically one of the driest months of the year, however, the effects of the long-term drought were only subtle, with a modest upgrade to D1 conditions experienced. The ridge intensified once again during September, which allowed the return of D2 conditions to the Grove area. This persisted throughout most of October, as the area only received about 30% of its average monthly precipitation. The end of October saw the beginning of the end of the drought, as several precipitation events allowed drought conditions to finally subside by the 22nd, when Grove finally experienced the end of a particularly intense 4-month drought.
July 2012 – April 2013	Dry conditions set in across northern Delaware County during the month of May, leading to moderate drought (D1) conditions setting in by the start of July. Very hot temperatures, combined with a lack of appreciable rainfall, resulted in significantly worsening drought conditions across all of eastern Oklahoma during the month of July. Much of northeastern Oklahoma received less than 25% of its average precipitation for the month. By the end of July, much of eastern Oklahoma experienced extreme drought (D3) conditions. The USDA declared all counties in eastern Oklahoma disaster areas due to the drought. This dry pattern continued throughout the remainder of the year, with only sporadic precipitation and monthly rainfall. Precipitation events and amounts increased throughout the January to March timeframe, but by the time all was said and done, the peak of the drought event saw exceptional drought (D4) conditions in Grove from mid-August until mid-September, with D3 conditions continuing for a month beyond that, into mid-October. The drought finally lifted in mid to late April 2013, one year after the onset of drier than normal conditions.
November 2017 – February 2018	A drier than normal period beginning in November 2017 persisted through the first half of February 2018. As a result, moderate drought (D1) conditions set in by the end of November. There was a brief respite between late December and mid-January before D1 conditions returned. Severe drought (D2) conditions then set in during the first 2/3 of February before an active weather pattern began to take shape across the area on February 16th and continued for over a week, resulting in multiple significant rain events across the region. Due to these late-month rains, total monthly rainfall between 6 to 10 inches occurred across eastern Oklahoma, generally along and south of I-44. The excessive rains that fell across much of the area during the latter part of the month resulted in much improved drought conditions, with drought removal across northern Delaware County by the end of the month.

4.10.5 Probability of Future Events

Two discrete drought events have been noted over the examined 10-year period, and five discrete drought events in the NCEI database over a 17-year period 2005-2021, both of which produce a **likely** probability of a drought occurring in any given year.

4.10.6 Vulnerability and Risk Assessment

The effects of drought on Grove are characterized primarily by low lake levels, crop damage, and wildfire. Based on the Palmer Drought Severity Index, conditions observed can range from -4 to 6. The value for this area, and all areas across the United States, is assessed and monitored weekly by the U.S. Drought Monitor, which is a partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration.

Economic damage due to crop loss and wildfire resulting from drought also threatens the community. NCEI estimates that drought has produced a cumulative cost between \$2 billion to \$5 billion in Oklahoma since 2012.⁶⁴

Mitigation measures can be effective in reducing the impacts of drought by the implementation of early warning and notification systems, backup sources of water supply, cooperative agreements with neighboring jurisdictions, and local ordinances for rationing water use. Wildfire impacts can be reduced by applying proper vegetation management and defensible space techniques in the urban/rural interface and participating in the national FireWise program. Adverse consequences of drought occur because of deficiencies in the following:

- Public and rural water supplies for human and livestock consumption
- Natural soil water or irrigation water for agriculture
- Water for hydroelectric power, forests, recreation, and navigation

Grove's municipal water supply is sourced from Grand Lake, and drought conditions can lower lake levels to a point that would impact the City's water pumps and supply. Drought conditions not only help evaporate water from lakes, but they also affect upstream creeks and the Neosho River which all feed Grand Lake. Drought conditions could cause interruptions to this vital service to the planning area. Water rationing and other drought response measures have had to be implemented in the past.

While economic impacts from drought can be substantial, another significant impact resulting from drought is socioeconomic effects. Drought affects water flows into Grand Lake that are vital to recreation, tourism, and individual consumption. Water levels in the lake have a direct impact on Grove's revenues and water distribution. Grove residents and businesses rely on the city water distribution system to provide potable water for everyday use and the local economy is heavily dependent upon the amenities the lake provides. A catastrophic long-term drought, such as ones that occurred in the late 1930s or early 1950s, could result in a drinking water shortage and have a serious impact on Grove's municipal revenues from tourism and recreation, business profitability, property values, and electric power generation.

Grand Lake also provides a source of electricity through Pensacola Dam. When water levels drop, as they do during drought events, the Grand River Dam Authority (GRDA) cannot produce enough inexpensive hydroelectric power to meet demand. GRDA is forced to buy electricity from other providers, usually more costly sources or those that generate adverse effects on the environment, such as coal-fired generating plants or the spot market. In doing so, this increases the cost of electricity to end users. In addition, water shortages can affect fire-fighting capabilities through reduced water flows and pressures, which can compound wildfire dangers.

The vulnerabilities and impacts described above give drought events a **medium** overall significance to the planning area, based on the criteria listed in Table 4-6.

Future Conditions

With climatological expectations suggesting that warmer temperatures are likely to continue, drought conditions may also increase, not only in intensity but also duration. Furthermore, growing population numbers in the City of Grove will lead to an increase in water demand. Therefore, it would behoove City planners to consider developing secondary or even tertiary water supplies/connections in the event that water shortages become a problem.

People

All residents in Grove are at risk of drought. Drought rarely impacts people's health directly. One of the most significant vulnerabilities to drought is a lack of access to drinking water. Grove's municipal drinking water is drawn from Grand Lake, and the population served by the Grove Municipal Services Authority serves a population

⁶⁴ [Disaster and Risk Mapping | Billion-Dollar Weather and Climate Disasters | National Centers for Environmental Information \(NCEI\) \(noaa.gov\)](#)

of 7,311 residential customers as well as 436 wholesale customers.⁶⁵ A map of the various GMSA critical facilities can be found on the City's HMP Viewer.⁶⁶ At the time of this plan update, the water supply is adequate to meet the current needs in Grove, however, officials expressed some concern that periods of extreme drought conditions could lead to reductions in potable water.

Drought conditions can cause prices for food to increase because of a drop in supply for people living in Grove. If people are not able to afford increasing prices during drought conditions, it is possible for them to suffer health problems because of the lack of healthy food. This is especially true in areas identified as having a high vulnerability in Grove based on their socio-economic status.

Public Health and Safety

Drought can also present significant implications to long-term public health, including a shortage of drinking water and degraded clean water, as discussed previously, as well as degraded air quality. A reduction in water volume can stagnate water. Stagnant water can degrade the quality of clean water by increasing the likelihood of infectious disease and harmful bacteria.

Dusty conditions caused by winds picking up dry dirt and topsoil as a result of drought, along with smoke from an uptick in drought-induced wildfires, can degrade air quality. Drought conditions can increase the number of particulates in the air, which can irritate people with lung, nasal, or eye problems, especially those with preexisting conditions. Similarly, toxic blooms from stagnant waters (e.g., cyanobacteria) can cause decreases in air quality.

Education and Outreach

Any lack of consistent education and outreach related to drought for developers, builders, realtors, and residents can present vulnerabilities in the built environment. This can include best practices on water conservation and mitigating against soil destabilization and erosion, as well as other building materials and considerations. Printed education and outreach materials could be supplemented by the development of an electronic mobile application to assist with disseminating educational materials or adding a section to this end to the Code Red mobile application, which is utilized by Grove to disseminate hazardous weather alerts, and/or the City of Grove website.

Economy

Adverse economic effects of a drought on Grove are well noted by officials. In addition to a decrease in available water supply, drought also affects agricultural communities surrounding the city, which can increase wind erosion, insect infestations, and crop diseases. More notably, droughts commonly have the effect of lowering water levels on Grand Lake, which can have adverse effects on recreation and tourism, which are primary drivers of the city's economy during the warmer months.

The Oklahoma Drought Management Plan outlines several additional economic impacts that could apply to Grove during a drought:

- Increases in consumer prices for food,
- Reduction in tourism and recreational activities. The lakes and golf courses were noted as being particularly impactful,
- Increases in unemployment,
- Reduction tax revenues due to reduced expenditures. The lakes and golf courses were noted as being particularly impactful,

⁶⁵ http://sdwis.deq.state.ok.us/DWW/JSP/WaterSystemDetail.jsp?tinwsys_is_number=716124&tinwsys_st_code=OK&wsnu mber=OK1021614

⁶⁶ [Grove Hazard Mitigation HUB](#)

- Foreclosures on bank loans to farmers and businesses⁶⁷

To avoid these effects, Grove should review water conservation plans and programs and adjust as needed, including rate structures and implementation. Additionally, maintaining a good working relationship with Grand River Dam Authority to manage lake levels is another important action that can reduce the effects of drought.

Built Environment

Drought types defined in Table 4-28 can threaten to disrupt the goods and services produced by critical infrastructure sectors in Grove, and CISA's [Drought and Infrastructure - A Planning Guide](#) provides a detailed examination of the various direct and indirect hazards droughts can produce on critical infrastructure systems across Grove. Table 4-31 differentiates the two threats.

Table 4-31 Direct and Secondary Hazard Threats on Critical Infrastructure due to Drought

Direct Hazards Caused by Droughts	
Raw Water Availability	Decreased supply, increased demand, and competition between water dependent sectors and community needs
Raw Water Quality Degradation	Increased concentration levels of contaminants, pollutants, sediments, and solid waste as raw water volumes diminish
Secondary Hazards Produced by Droughts	
Land Subsidence Exacerbation	Shrink-and-swell periods, less moisture, and reduced stability of soil, contributing to soil erosion – this can result in increased risk of damage to infrastructure assets and structures due to shifts in soil/foundations.
Wildfires	Reduced moisture in vegetation, air, and ground; Vegetation becomes less resilient to combustion, thus enabling fire to spread more quickly – this can increase the risk of fire damage to exposed critical infrastructure
Flooding	Reduced moisture in vegetation and ground, hardened topsoil and soil erosion, and increased volume of rain during drought periods, when rain does occur – this can increase the risk of flooding
Dust Storms	Reduced moisture in air and soil, longer periods between precipitation periods – this can result in increased coating of dust and other contaminants, mainly impacting electrical transmission lines.

Existing Structures

The secondary effects of a drought event can affect the built environment; namely, soil destabilization and erosion and increased threats for wildfire activity (see Table 4-31). All structures in Grove are at risk of these hazards. As moisture levels drop and soil surfaces destabilize, structural foundations can be at risk of shifting which can be a substantial cost when repairs are needed. This secondary hazard produced by droughts is especially true for structures with poor masonry and foundations.

Infrastructure

Effects on gas lines, water and wastewater treatment, electrical and transportation infrastructure are all possible as a result of drought. The effects on each component are discussed below:

Gas: City gas lines could fracture or break due to soil destabilization and/or erosion, causing natural gas to leak. This could cause toxic seepage into the ground or groundwater, which could affect the natural

⁶⁷ https://www.owrb.ok.gov/supply/drought/reports/drought_plan.pdf, 6

environment and human health. This may also cause a disruption in gas services to homes, which would make people more vulnerable to temperature fluctuations, especially during extreme heat or extreme cold events (see extreme heat or severe winter storm sections for more information).

Water/Wastewater: Water lines and structures in Grove are similarly vulnerable to damages from soil destabilization and/or erosion. Depending on water levels on Grand Lake, water and wastewater plants may not meet the required daily intake levels needed for water treatment service. This could cause a water crisis for certain populations if redundancies to supply drinking water are not established. Grove should ensure that it has developed enough redundancies to meet all its residents' water needs. The planning team recommends officials secure a backup or secondary source of water to ensure that the city can continue to meet the needs of the city and all who require access to GMSA's water system.

Electric: It has been discussed previously that drought can have the effect of lowering lake levels on Grand Lake, and in order to maintain adequate water levels of the Lake, the turbines at Pensacola Dam may be forced to be idle, like they did during the drought of 2005-2006. If this were to happen, it would reduce power generation capabilities at Pensacola Dam, one source of electrical power upon which the planning area relies.

Transportation: Roadways and streets in the City can be weakened or damaged as soil destabilization and/or erosion below threatens the roadways structural integrity. When droughts persist for long enough, the weight of vehicular traffic can cause roadway surfaces to crack, buckle, or cave in. Additionally, drier air during periods of drought can lead to greater diurnal temperature swings, which can present an additional stressor that may compromise the integrity of asphalt, concrete or other paving materials. This may disrupt traffic, including emergency services, or may weaken transportation infrastructure, making it more vulnerable to other hazards. The planning team did not identify any roadways that are uniquely at risk to this hazard, however. The planning team recommends that the city continue consistent maintenance on roadways and that officials incorporate design standards that account for higher heat fluctuations.

Critical Facilities

Officials noted no specific direct vulnerability to any of Grove's critical facilities other than the indirect hazards to structures discussed above in the Built Environment section. Soil destabilization and/or erosion can compromise or damage Grove's infrastructure and/or utility systems which can then prevent Grove residents from receiving key services, such as electricity, gas, water/wastewater, and more. All FEMA lifelines listed in Table 4-3 are at risk to drought, especially the food, water, and shelter lifeline.

Cultural Resources

Drought conditions can threaten cultural resources such as historic sites and/or cemeteries due to soil destabilization and/or erosion. Destruction of cultural resources would constitute a loss of property and, possibly, irreplaceable historic value.

Future Development

The city should continue with building inspections to make sure that buildings are up to the 2018 International Building Codes at a minimum, and the same goes for any future development in the City. Any new development should likewise adhere to these building codes so that there is a minimal impact from drought hazards, like soil destabilization and/or erosion.

Natural Environment

Drought has many negative effects on the natural environment. The general effects of drought on the natural environment are similar to extreme heat, although there may be increased vulnerabilities from the lack of water, such as soil erosion. Drought can lead to crop loss and can stress flora and fauna. Drought conditions could cause animals to leave their natural habitats to search for cooler places during times of extreme heat, or warmer places during times of extreme cold, or places with a more suitable water supply. Aquatic life is especially at risk. Of particular concern is Grand Lake, which itself is a local habitat for many wildlife species.

4.11 Earthquake

4.11.1 Hazard Description

An earthquake is a sudden release of energy that generates a seismic shift in the earth's crust. This section is not concerned with seismic tremors that do not cause any damage and are not a threat to human or natural life, which Federal agencies define as below a 3.0 Magnitude on Richter Scale (see extent section). Only seismic movements that exceed 3.0 on the Richter scale will be defined as earthquakes. Most severe earthquakes take place at tectonic fault lines. They can also occur along any of the multitudes of fault and fracture lines within the plates themselves.

4.11.2 Location

Given an earthquake's possible geographic reach, the risk of this hazard encompasses the entire planning area. Grove and Delaware County are in the stable Ozark Uplift physiographic region, where there have only been 7 earthquakes reported between 1995 and 2016, all of them were too weak to be felt, and below a magnitude of 3.2.

4.11.3 Extent

Should one occur, it is probable that an earthquake would impact the entire planning area. In fact, an earthquake with an epicenter in an entirely different County or state also could affect the entire planning area. Due to the oil and gas activity in the State of Oklahoma and Delaware County's proximity to the New Madrid and Meers fault lines, it is possible that the planning area could be affected by an earthquake or subsequent aftershock measuring between a magnitude 2.0 and 5.0 on the Richter Scale at any given time.

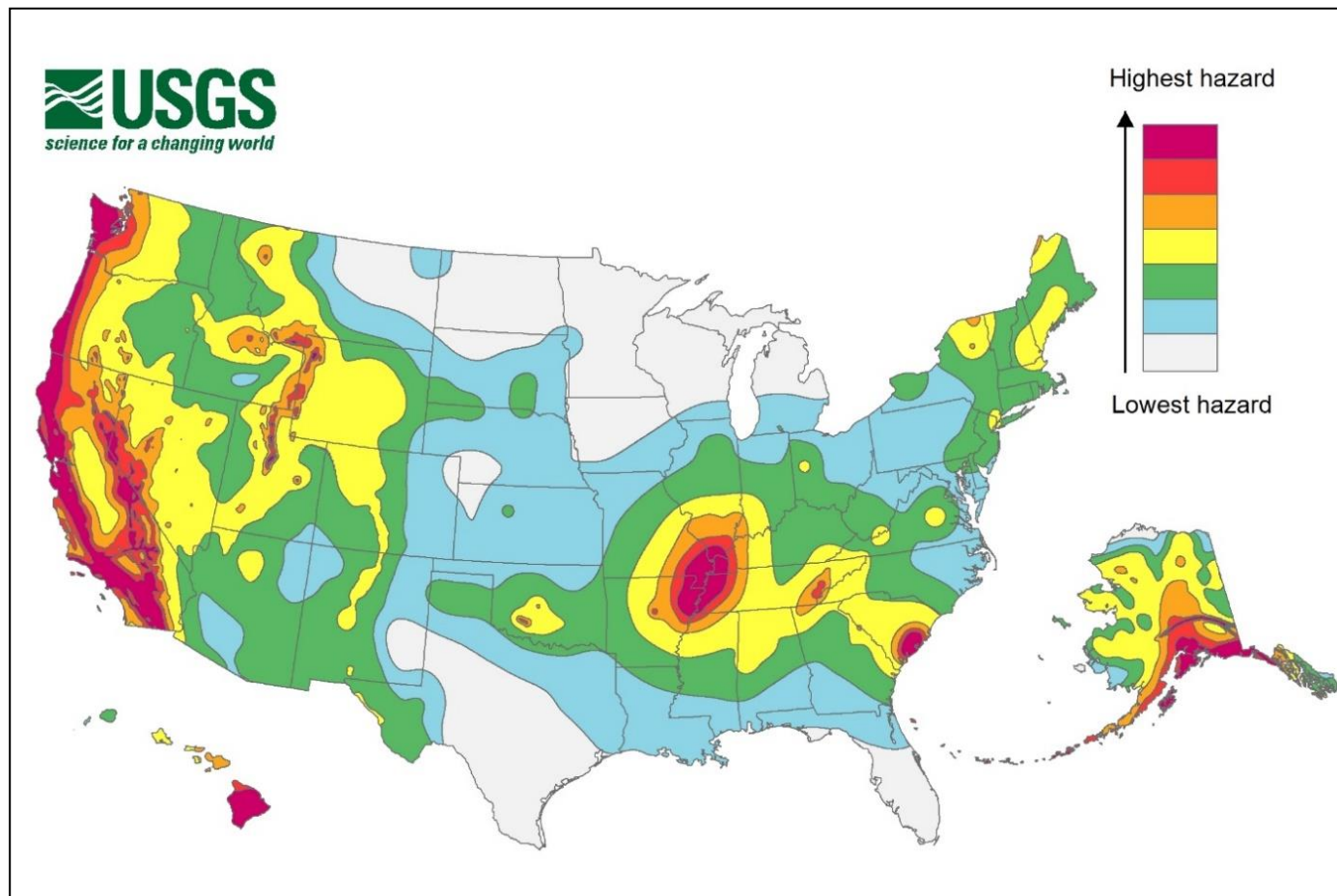
Table 4-32 Richter Scale & Associated Damages

Class	Magnitude	Information
Great	≥ 9.0	Complete (or near-complete) destruction with permanent ground changes
Great	8.0 – 8.9	Felt in extremely large regions with very severe damage
Major	7.0 – 7.9	Felt across great distances with severe damage
Strong	6.0 – 6.9	Felt in wider areas with moderate to severe damage
Moderate	5.0 – 5.9	Felt by everyone with damage to weak buildings
Light	4.0 – 4.9	Felt by people near the epicenter with zero or minimal damage
Minor	3.0 – 3.9	Often felt but very rarely causes damage
Minor	2.0 – 2.9	Slightly felt by some people
Micro	1.0 – 1.9	Not felt or rarely felt

Two standard measures are used to classify an earthquake's extent: magnitude and intensity. In the past, these measures were sometimes referred to as the Richter Scale (magnitude) and the Modified Mercalli (intensity). As more seismograph stations were installed around the world, it became apparent that the method developed by Richter was strictly valid only for certain frequency and distance ranges. Because of the limitations of all three magnitudes a new, more uniformly applicable extension of the magnitude scale, known as moment magnitude, was developed. For very large earthquakes, the moment magnitude gives the most reliable estimate of earthquake size. Earthquakes are classified in categories ranging from minor to great, depending on their magnitude.

From these and other measures, USGS has charted the probability of peak ground accelerations that have only a 2% probability of being exceeded in 50 years. The map below reflects the upper limits of earthquake severity compared to the rest of the country. According to USGS, Grove is at a moderate risk for earthquakes compared to the rest of Oklahoma and lower risk compared to the other areas in the United States.⁶⁸

Figure 4-14 Earthquake Hazard Areas per USGS



4.11.4 Previous Occurrences

Between January 2012 and December 2022, there were no earthquakes reported to have occurred in the City of Grove (or in Delaware County for that matter). USGS reports the only earthquake since 1900 to have been centered in Delaware County was that which occurred in 1986. This event is detailed in Table 4-33 below along with some other noteworthy earthquake events that occurred either near Delaware County or were felt within the County boundaries.

⁶⁸ <https://www.usgs.gov/media/images/2018-long-term-national-seismic-hazard-map>

Table 4-33 Earthquake Events Felt in Delaware County

Date	Event Narrative
10/22/1882	The Cherokee Advocate reported that at Fort Gibson, “the trembling and vibrating were so severe as to cause door and window shutters to open and shut, hogs in pens to fall and squeal, poultry to run and hide, the tops of weeds to dip, and cattle to Iowa.” ⁶⁹ The magnitude and epicenter were unable to be determined since much of Oklahoma was still considered Indian Territory at this time.
04/09/1952	An earthquake registering a magnitude of 5.7 on the Richter Scale (VII intensity on the Mercalli Scale) was centered near El Reno, caused by slippage along the Nemaha Fault. This earthquake is tied for the 2 nd strongest earthquake on record in Oklahoma history. Damage included toppled chimneys and smokestacks, cracked exteriors on buildings and broken windows and dishes. Shaking was felt as far away as Austin, TX and Des Moines, IA.
05/25/1986	An earthquake 2.2 in magnitude on the Richter Scale was centered in southern Delaware County, 1.5 miles north of the intersection of the Cherokee Turnpike and U.S. Highway 412, between the towns of Leach and Kansas.
04/28/1998	A 4.2 magnitude quake on the Richter Scale was centered near Lawton, at Richard’s Spur. This event caused a 14-foot crack in the 2 nd floor of the Comanche County Courthouse building.
08/15/2001	An earthquake measuring 1.9 magnitude on the Richter Scale was centered 2 miles east of Disney, or about $\frac{3}{4}$ miles south of OK-28.
11/06/2011	An earthquake centered 5 miles northwest of Prague registered a magnitude of 5.7 on the Richter Scale, tying it with the 1952 El Reno quake for the 2 nd strongest in state history. U.S. Highway 62 was reported to have buckled in 3 locations west of Prague ⁷⁰ . NWS radar in Norman also detected birds and bats which took flight in response to the shaking. This event is the first significant quake in a swarm that started in 2009 that is thought to be related to fracturing and drilling practices by companies in the oil and gas industry across the region. A couple in Prague who sustained physical injuries and damage to their home reached an out-of-court settlement with Spess Oil and Old Dominion, LLC after filing a suit. A foreshock on the 5 th and an aftershock on the 8 th , both near Sparks in Lincoln County, both registered 4.8 magnitude on the Richter Scale. The USGS Shakemap estimates that shaking equivalent to an intensity of IV occurred in and around Grove during this event.
02/13/2016	A 5.1 magnitude earthquake was centered in Major County, 17 miles north of Fairview, or 11 miles southeast of Waynoka. This event comes in as the 4 th strongest earthquake in state history. Shaking was felt as far away as Oklahoma City and Wichita, KS.
09/03/2016	The strongest earthquake on record saw a 5.8 magnitude event centered 8 miles northwest of Pawnee. Moderate to severe damage was observed around Pawnee, with shaking and damage associated with this event occurring as far away as Kansas City, KS, 225 miles away, where the Wyandotte County Courthouse experienced a crack which developed from the roof to the ground as a result of this event. ⁷¹ One injury was reported in Pawnee, as a man was injured by a toppled chimney. No deaths were reported. The USGS Shakemap estimates that shaking equivalent to an intensity of IV occurred in and around Grove during this event. Aftershocks up to 5.0 magnitude continued for 2 months following this event.

⁶⁹ [Earthquakes | The Encyclopedia of Oklahoma History and Culture \(okhistory.org\)](https://www.okhistory.org/publications/enc/onlinepublications/earthquakes.htm)

⁷⁰ <https://www.latimes.com/archives/blogs/nation-now/story/2011-11-05/oklahoma-quake-buckles-highway-damages-several-homes>

⁷¹ <https://www.kshb.com/news/local-news/oklahoma-earthquake-causes-damage-to-wyandotte-courthouse>

4.11.5 Probability of Future Events

With no earthquakes occurring in the planning area between 2012 and 2022, it is statistically **unlikely** that Grove and the surrounding areas will experience an earthquake event.

Any significant earthquake risk for Grove would most likely arise from its proximity to the New Madrid and Meers faults. According to Dr. James Lawson, chief geophysicist of the Oklahoma Geological Survey's Seismic Observatory at Leonard, the risk of an earthquake in the New Madrid Fault Zone cannot be over emphasized. He believes a major seismic event there would have no greater impact on Grove than a locally generated earthquake. An 8-magnitude event in New Madrid would likely produce tremors with an intensity of VI in Oklahoma (Trees and bushes shake. Damage is slight in poorly built buildings. No widespread structural damage) and would not be expected to be as intense as the Ft. Gibson quake of 1882.

4.11.6 Vulnerability and Risk Assessment

The hazard has a minimal impact on the planning area and has a **low** overall significance based on classifications outlined in Section 4.1.4. The planning team arrived at this assessment due to the proximity of the New Madrid and Meers fault systems, as well as the heightened seismic activity resulting from wastewater well injection.

Future Conditions

Climatological changes in the future remain independent of any changes expected in earthquake occurrences. As the City continues to grow, it will be important to continue current practices of abiding by the latest IBC adoptions. Grove has adopted the ICC International Building Code 2018 and has two code enforcers on staff. All future development going forward should continue to enforce all 2018 ICC codes going forward to better prevent earthquake damage.

People

A severe earthquake, although unlikely, would threaten people across the entire planning area. Although these events are rare, earthquakes can be dangerous. Most earthquake injuries and fatalities occur within buildings from structural collapse and its associated effects, such as glass and the movement of other objects. Contents in a home can be equally, if not more, dangerous than the structure itself. Any unsecured objects that can move, break, or fall during an earthquake event are potential safety hazards and can cause potential property losses. The city should educate all residents within Grove on best practices to take during an earthquake event. Populations considered most vulnerable are people located in structures with unreinforced or weakened masonry construction (see built environment).

Public Health and Safety

All people in Grove can be affected by degradation in air quality as well as an accidental release of hazardous materials due to an earthquake event (see the built environment for additional discussion on its effects). Populations at heightened risk of inhalation include young children and the elderly, low-income people, and people with pre-existing respiratory conditions. 3% of residents within the planning area are under the age of 5, which is below the county and state average, with 29% of residents over 65, which is well above the state average. Lower income people are also at risk, as they may live in housing that is less ventilated and as they may not be able to afford personal respiratory protection. 17% of Grove residents live below the poverty line, which is higher than the state average, but below the county average. In addition, people with pre-existing respiratory conditions would also be at risk (the planning team was not able to collect data on this indicator).

Education and Outreach

Grove and its citizens would benefit from consistent earthquake education and outreach, as well as earthquake drill scenarios to mitigate and reduce confusion. Benefits that officials would receive from earthquake drill scenarios include: these activities would serve to provide an estimate of potential losses related to loss/injuries, types of potential damage, and to confirm existing roles and priorities.

Grove should plan for many traditional communication channels to be inoperable for some time. Clear, concise, unified messaging provided by trusted leaders before, during, and after an incident can help residents be better informed to take protective action measures and make important health-related decisions to help ensure their safety. Messages should be accessible in multiple formats.

During and after earthquakes, instances where families and friends are separated often occur. Reuniting them should be a priority for healthcare facilities, health officials, and emergency managers by establishing a coordinated approach for accessing search and rescue data. This can include social media, community hotlines and assistance centers, shelter rosters, and healthcare facility information, which can be improved by the development of a mobile electronic emergency management application, or an expansion of the utilization of the Code Red app already in use by city officials.

Economy

Earthquakes have the potential to affect the economy in the planning area. Small business owners should take actions to make their businesses safer to be in during earthquakes and more resistant to earthquake damage by assessing its structure and contents and retrofitting any weaknesses, as structural damage could limit or prohibit business activity (see the build environment for more information).

Built Environment

Existing Structures

All buildings in Grove are vulnerable to earthquakes. Depending on when and how it was designed and built, a structure may have weaknesses that make it more vulnerable to earthquakes. Common examples include structures that are not anchored to foundations, or unreinforced/unbraced masonry walls or foundations. In addition, structures with a higher potential for structural weaknesses, such as mobile or prefabricated homes, may wish to be examined.

Infrastructure

It is not likely Grove's infrastructure will be impacted by an earthquake since the city is in an area of low seismicity. An earthquake with high magnitude could disrupt vital infrastructure services, which are explained below.

Electric: An extreme earthquake could damage electrical generation or transmission (including substations) anywhere in Grove, reducing or cutting off power to critical facilities and other buildings. This would affect business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activities. All critical facilities should ensure that their backup generation is up-to-date and secured as best as possible from the effects of an earthquake event. Many private residences and businesses lack adequate backup generation, making them vulnerable to these effects.

Gas: An extreme event could cause major gas leaks or leaks in other hazardous materials in the City. Leaks from hazardous material in storage facilities can affect human health and the environment, or it could increase the risk of fires (see the fire section). Depending on rainfall or other conditions, this can occur miles from the initial earthquake zone.

Water/Wastewater: An extreme seismic event could damage water lines and water treatment facilities, causing a disruption in services. This could cause a water crisis for certain populations, if redundancies to supply drinking water are not established. The city should ensure that its system has sufficient redundancies, including producing or procuring alternative forms of water delivery, such as water buffaloes.

Transportation: In the event of an extreme earthquake, roads across Grove may be damaged or destroyed, which could delay emergency response times or disrupt evacuation routes, further straining public health systems and threatening personal health.

Critical Facilities

Critical facilities face the same potential impacts to earthquakes as other structures/buildings in Grove. Of particular concern are critical facilities, such as hospitals and transportation facilities, electrical power and communication facilities, and water supply and sewage treatment facilities and lines. Although nearly all public buildings have backup generation, damage to emergency response facilities, including EOC, police, and fire would hinder the city's response efforts.

Cultural Resources

Earthquakes could cause minor structural damage to historical structures. A more significant concern is the contents of structures, such as museum collections and cultural items with historic and story-telling value.

Natural Environment

Earthquakes can cause land subsidence, either directly related to an earthquake or as the result of shaking.

4.12 Hazards: Summary of Observations and Recommendations

This section outlines an overview of observations and recommendations from the risk assessment. It is intended to provide the reader with a summary of vulnerabilities across hazards and recommendations to mitigate against these vulnerabilities. This approach aligns with an assets-based approach to hazard mitigation (see Chapter 1), since actions are described in light of their impact to mitigating a class of hazards, rather than by hazard. In order to maintain this section as an overview, this section does not seek to provide hazard-specific details of the observations. For example, flooding can cause a much different failure to transportation infrastructure than extreme heat. This level of analysis is provided in the hazard profiles themselves—mainly in the vulnerability sections.

Table 4-34 Summary of Observations and Recommendations for Hazard Risk Assessment

Observation	Recommendation	Hazards	Action
People in the planning area would benefit from addition outreach and education all hazards (see individual vulnerability sections and Chapter 3 for more information).	Develop and fund hazard preparedness, education, information, and awareness programs.	All	1
Residents would benefit from a warning system that integrates data across hazards (see people sections in the hazard profiles for more information).	Develop automated hazard warning systems which integrate existing weather stations, storm sirens, the capabilities within the Code Red mobile application already in use and the reverse-911 system.	Flooding, Tornado/High Wind, Lightning, Hail, Extreme Heat, Severe Winter Storms, Hazardous Materials Incidents	10
There appears to be a wealth of volunteer organizations in the planning area that can be mobilized to assist in disaster response.	Establish or sponsor a Citizen Emergency Response Team to educate volunteers about disaster preparedness. Also, develop relationships with religious and other volunteer organizations in and near the county who have volunteer groups that would be able to provide assistance in times of disaster response.	All	11
Loss of power for public and critical facilities has the potential to pose a significant hazard to human health and life.	Obtain backup electrical generators and conduct regular tests and maintenance on generators already in place to ensure proper operation	Earthquake, Extreme Heat, Wildfire, Lightning, Severe Winter Storms, Tornado/High Wind	12
Roofs, windows, and lack of sufficient insulation are common vulnerabilities that can incur replacement costs when natural hazards occur	Fortify roofs, windows, and insulation in and on city and critical facilities against threats posed by hail, high winds, extreme temperatures	Extreme Heat, Hail, Severe Winter Storms, Tornado/High Wind	13
Some city and first responder vehicles are vulnerable to hazards by virtue of unsheltered parking	Construct protected parking for city and first responder vehicles	Hail, Severe Winter Storm, Tornado/High Wind	14

Observation	Recommendation	Hazards	Action
Development in areas within the WUI are vulnerable to damage or destruction as a result of wildfire	Provide and maintain defensible space around structures vulnerable to wildfires in peripheral areas of the city and those bordering undeveloped areas.	Wildfire	15
Electrical infrastructure can be damaged during Severe Winter Storm, Tornado/ High Wind, Fire, Lightning, Hail, Earthquake events, cutting power to the planning area.	Harden, strengthen, or bury electrical infrastructure when cost-effective.	Severe Winter Storm, Tornado/High Wind, Wildfire, Lightning, Hail, Earthquake	16
Damage to roadways can inhibit a quick, efficient response by first responders.	Improve the maintenance, quality, and design of roadways to mitigate against the effects of future events and account for greater temperature and precipitation fluctuations.	Flooding, Severe Winter Storm, Drought, Earthquake	17
All people in the planning area are vulnerable to a lack of water from extreme drought situations.	Secure a secondary or backup source(s) of water in the event that lake levels drop below the necessary threshold during periods of extreme drought.	Drought	18
Safe Rooms can prevent loss of life from tornado and high wind events.	Evaluate and install shelters/safe rooms that meet ICC 500 and FEMA 361 requirements at public critical facilities that do not have shelters that meet ICC 500 and FEMA 361 requirements.	Tornado/High Wind	19
Residential and commercial properties have been subjected to flooding, sometimes over the course of multiple flooding events	Acquire properties in the FEMA Floodplain and in Repetitive Loss properties	Flooding	4
Development may lead to increased stream use or development in floodplains, which may threaten the natural environment. In addition, pollutants and biohazards like e-coli can threaten the health of waterways throughout the planning area.	Incorporate nature-based solutions into mitigation projects, when appropriate.	All	20
Critical facilities lack lightning mitigation measures and lightning detection systems.	Construct lightning rods or air terminals for protection of critical facilities.	Lightning	21

Chapter 5 Mitigation Strategy

This chapter includes the hazard mitigation strategy, created by the planning team, officials, and stakeholders in the City of Grove. The mitigation strategy is made up of three components: mitigation goals, mitigation actions, and a plan for implementation. There is some overlap across these three components, but each generally represents a different aspect of the strategy. The goals section addresses the *why*, the actions section addresses the *what*, and the implementation section addresses the *how*. Presented at the end of this chapter, this comprehensive mitigation strategy is shown through a series of tables, each color coded according to which parts correlate with which of the three components. The result is a mitigation strategy that will enable the City of Grove to best identify, prioritize, and implement actions in order to reduce risks across its planning area. For an itemized list of mitigation actions in the strategy, see Section 5.4 of this chapter.

5.1 Mitigation Goals

Goals from the City's previous Hazard Mitigation Plan were reviewed and evaluated by the stakeholders and planning team members to identify the status of previous action items to understand both their progress as well as any actions that have been taken over the previous five years. Goals that were deemed to be effective and pertinent to the current plan were retained and incorporated into the City of Grove's 2023 Hazard Mitigation Plan Update.

5.1.1 Mission Statement

To create a disaster-resistant community and improve the safety and well-being of the City of Grove by reducing deaths, injuries, property damage, environmental and other losses from natural and technological hazards in a manner that advances community goals, quality of life, and results in a more livable, viable, and sustainable community.

5.1.2 Mitigation Goal

To identify community policies, actions, and tools for long-term implementation to reduce risk and future losses stemming from natural and technological hazards that are likely to impact the community. 2023 goals adhere to the same goals outlined in the previously approved HMP as well as with those set forth in the State's 2018 Hazard Mitigation Plan.

5.1.3 Goals for All Hazards

- Minimize loss of life and property from natural hazard events
- Protect public health and safety
- Increase public awareness of risks from natural hazards
- Reduce risk and effects of natural hazards
- Identify hazards and assess risk for local area
- Ascertain historical incidence and frequency of occurrence
- Determine increased risk from specific hazards due to location and other factors
- Improve disaster prevention
- Improve forecasting of natural hazard events
- Limit building in high-risk areas
- Improve building construction to reduce the dangers of natural hazards
- Improve government and public response to natural hazard disasters

5.2 Recommended Mitigation Activities

A mitigation action is a policy, project, activity, or process taken to reduce or eliminate long-term risk to people, property, and the environment from hazards. Based on the goals section and FEMA CRS guidance, the types of mitigation actions reviewed to reduce long-term vulnerability include:

- Preventative Activities
- Floodplain Management Regulatory/Current and Future Conditions
- Property Protection Activities
- Natural Resource Protection Activities
- Emergency Services Activities
- Structural Projects
- Public Information Activity

Specific observations and problem statements, resulting in the actions listed below, are included at the end of each hazard section in Chapter 4, the Risk Assessment. Stakeholders reviewed actions to mitigate the observations identified in the risk assessment as well as those from the 2012 HMP. Previous items were labeled one of three ways based on their completion status. Actions were either “completed,” “ongoing,” or “not started.” Actions were evaluated with the intent of carrying over “ongoing” and “not started” actions that also remain relevant to the planning area. Actions with the same intent were combined into a general action item to allow more opportunity for FEMA funding. These actions were reviewed and prioritized in the prioritization section for the 2023 Plan update.

The second part discusses how these previous actions and newly proposed actions were prioritized. The benefits and costs of an action, which included qualitative and quantitative measures, were measured together to generate a Benefit-Cost Review (BCR) which the planning team used to prioritize actions based on the BCR.

5.2.1 Actions from the 2012 Hazard Mitigation Plan

Of the 40 action items listed in the 2012 plan, one was listed as being completed, sixteen items had not been started, and the remaining 23 were “Ongoing”. Appendix A contains notes as to what changes, which items were removed, and which were edited for the 2023 Update. Based on these notes, any items that officials noted as still being relevant were carried over into Section 5.4 below.

Completed:

- Action Number 15. *Develop an Individual Saferoom Program for vulnerable populations that will withstand hazards.* One round of this program has been completed; however, the action item was rolled over into 2023 actions as officials noted a desire to continue this action.

Not Started:

- Lightning, Number 9. *Provide lightning warning systems for public outdoor sports arenas, pools, golf courses, and parks.* No progress has been made. The intent of this action has been incorporated into the 2023 list of action items.
- Lightning, Number 10. *Provide surge and lightning protection for computer-reliant critical facilities.* No progress has been made toward this goal. The intent of this action has been incorporated into the 2023 list of action items.

- Lightning, Number 11. *Educate the public and encourage utility companies to provide information to clients on house surge and lightning protection.* AEP handles this, and the intent from this action item can be removed from the 2023 list.
- Tornado/High Wind, Number 16. *Adopt an ordinance requiring registration of saferooms and create GIS database to locate saferooms in the event of a disaster.* No progress has been made as officials have requested that this item be changed to public outreach. The intent of this action has been changed and included in 2023 list.
- Tornado/High Wind, Number 17. *Provide technical assistance in obtaining grants for storm shelters/saferooms in mobile home parks.* No action has been taken on this item as it falls under the ongoing action This specific action was to be removed from the 2023 list and combined with Action Number 15 – *Develop an Individual Saferoom Program for vulnerable populations.*
- Tornado/High Wind, Number 18. *Adopt ordinance requiring new mobile home parks to provide storm shelters/saferooms for their residents.* No action has been taken as officials requested that this item be removed from the 2023 list of mitigation action items.
- Number 23. *Implement and enforce an administrative procedure/ordinance to require permits for foundation repair.* Action had no prioritization and was requested that it be removed from the 2023 list.
- Expansive Soils, Number 24. *Establish an administrative procedure or change in City codes that require builders to check for expansive soils when applying for construction permits.* Expansive soils is not identified as a natural hazard and as such this previous action item was incorporated into general building codes action item for the 2023 list of mitigation actions.
- Number 29. *Adopt an ordinance requiring generator pad and wiring/transfer switches at Elder Care Facilities and Nursing Homes.* The intent of this action was incorporated into the current list of action items.
- Number 30. *Identify/encourage key private sector facilities to have wiring transfer switches and back-up generators installed.* No action was taken on this item and the intent of this action was incorporated into the current list of action items.
- Hail, Number 32. *Provide covered shelters for City First Responders/government vehicles to protect against hail damage.* No action was taken on this item, and the intent of this action item was incorporated into the list of 2023 items shown below.
- Number 36. *Develop, review, and update the Grove Debris Management Plan.* Officials noted that this item needed to be removed from the 2023 list and incorporated into the City's Emergency Operations Plan.
- Number 37. *Provide routine trimming of trees to reduce power outages during storms.* Officials noted that this item needed to be removed from the 2023 list and incorporated into the City's Emergency Operations Plan.
- Wildfire, Number 38. *Develop a contingency plan for evacuating population endangered by wildfire.* Officials noted that this item needed to be removed from the 2023 list and incorporated into the City's Emergency Operations Plan.
- Extreme Heat, Number 39. *Develop a Heat Emergency Action Plan/Heat Emergency Annex to the EOP for the jurisdiction.* Officials noted that this item needed to be removed from the 2023 list and incorporated into the City's Emergency Operations Plan.
- Number 40. *Develop a secondary source of water in the case of a dam failure.* The item received low prioritization from officials. Changes to this action item were made and then incorporated into the 2023 list of action items.

5.2.2 Prioritization

In addition to the previous mitigation actions, stakeholders considered a broad array of different actions to mitigate against the observations. Potential mitigation actions were evaluated using the criteria recommended on Worksheet 6.1 in the *FEMA Local Mitigation Planning Handbook* and developed, an Action Plan for the actions determined to be highly effective and feasible. A summary of criteria considered can be found in Table 5-1. Certain mitigation measures are recommended for multiple hazards. To prioritize all hazard mitigation action items, a benefit/cost review was employed. This informal analysis reflects FEMA's BCA and prioritizes projects on how they accomplish the plan's mission and their estimated cost. The planning team discussed prioritization of action items in depth and found no need to change priorities on existing action items since the last update.

Table 5-1 Evaluation Criteria for Mitigation Actions

Criterion	Question
Life Safety	How effective will the action be at protecting lives and preventing injuries?
Property Protection	How significant will the action be at eliminating or reducing damage to structures and infrastructure?
Technical	Is the mitigation action technically feasible? Is it a long-term solution? Eliminate actions that, from a technical standpoint, will not meet the goals.
Political	Is there overall public support for the mitigation action? Is there the political will to support it?
Legal	Does the community have the authority to implement the action?
Environmental	What are the potential environmental impacts of the action? Will it comply with environmental regulations?
Social	Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?
Administrative	Does the community have the personnel and administrative capabilities to implement the action and maintain it or will outside help be necessary
Local Champion	Is there a strong advocate for the action or project among local departments and agencies that will support the action's implementation?
Other Community Objectives	Does the action advance other community objectives, such as capital improvements, economic development, environmental quality, or open space preservation? Does it support the policies of the comprehensive plan?

The benefits of each measure are scored as High, Medium, or Low based on how well it moves the City towards the stated mission statement "To create a disaster-resistant community and improve the safety and well-being of Grove residents by reducing deaths, injuries, property damage, environmental and other losses from natural and technological hazards in a manner that advances community goals, quality of life, and results in a more livable, viable, and sustainable community." The Costs are also measured as High, Medium, or Low. Costs estimate the resources needed to implement the measure. While monetary cost is the primary resources, staffing and other resources should also be considered. The ratio of Benefits/Costs then determines whether an action item is considered High, Medium, or Low. Table 5-2 explains the process.

Table 5-2 How Scores are Assigned for the Benefit and Cost of Mitigation Action Items

Benefits		Costs	
<i>Classification Scale</i>	<i>Description</i>	<i>Classification Scale</i>	<i>Description</i>
High	The action meets many priority benefit criteria and/or meets these criteria to a significant degree	Low	The action does not strain community resources and minimal external assistance is required
Medium	The action meets some priority benefit criteria and/or meets criteria to moderate degree	Medium	The action could strain community resources, making external assistance a significant component of the action
Low	The action meets almost no priority benefit criteria and/or meets criteria to a minimal degree	High	The action strains community resources significantly; external assistance will be crucial and is not guaranteed

From these metrics, the planning team developed a benefit-cost review. The higher the BCR assigned to an action, the higher that action was prioritized. The prioritized actions can be found in Section 4 below.

5.3 Implementation

Considering implementation as a separate component in the mitigation strategy allows jurisdictions to understand more clearly the resources needed to execute mitigation actions. This section identifies external funding sources, partnerships, and integration with other plans as crucial components in an action's implementation.

The external funding subsection provides guidance on which funding options can best meet the planning area's priority actions. The partnerships subsection highlights key stakeholders in the community and suggests the formation of new partnerships with other stakeholders to strengthen mitigation actions.

5.3.1 Internal Funding

The City of Grove has a variety of avenues in which mitigation actions can be funded internally, and those funding opportunities are detailed in length in Chapter 3 of this document. While implementation of mitigation actions can be achieved solely through internal sources, there are other opportunities that originate outside the City's purview and those are detailed below. Through a combination of internal and external sources, the City can work towards implementing some of the items listed in Section 4 of this chapter.

5.3.2 External Funding & External Programs

This section compliments and aggregates the previous section by identifying external funding programs that would allow the participating jurisdictions to pursue funding sources to meeting their highest-priority mitigation goals. This section provides a general overview of major funding programs, highlights their differences, and identifies which programs would best meet the highest-priority mitigation actions in this plan. State agencies in Oklahoma play an important role in the administration and funding of these grants, but these programs are considered federal programs due to the federal government's role in developing the criteria for selection and participation in the selection process. Chapter 3 includes more details on the universe of possible external funding sources and the federal grants that Grove has been awarded in the last several years.

FEMA Funding Opportunities

FEMA administers programs that provide funding for eligible mitigation planning and projects that reduce disaster losses and protect life and property from future disaster damages. The three largest and most accessible programs are the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) Program, and the Building Resilient Infrastructure and Communities Program (BRIC).

- HMGP assists in implementing long-term hazard mitigation planning and projects following a Presidential disaster declaration.
- BRIC provides funds for large scale, resilient infrastructure projects on an annual basis.
- FMA provides funds for planning and projects to reduce or eliminate the risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis.

HMGP funding is generally 15% of the total amount of Federal assistance provided to a State, Territory, or federally recognized tribe following a major disaster declaration. FMA funding depends on the amount Congress appropriates each year the program. FEMA can set aside up to 6% of total estimated disaster expenditures associated with each presidential disaster declaration to fund BRIC. Individual homeowners and business owners may not apply directly to FEMA. Eligible local governments, like Grove, may apply on their behalf.

5.4 Mitigation Action Items for 2023

The mitigation strategy combines the previous three sections into a cogent and comprehensive approach to mitigating risk in the City of Grove. Each action includes components from the goals, actions, and implementations sections to provide planners with a clear *why, what, how* template that can drive actions.

Table 5-3 Mitigation Action Items for the 2023 City of Grove HMP Update

Action 1: Develop and fund hazard preparedness, education, information, and awareness programs	
Principle(s)	Minimize loss of life and property from natural hazard events, Protect public health and safety, Identify hazards and assess risk for local area, Determine increased risk from specific hazards due to location and other factors, Limit building in high-risk areas
Action Type	Floodplain Management Regulatory/Current and Future Conditions
Priority	High
Hazard(s) Addressed	All
Lead Agency (Partners)	City of Grove Emergency Management, City of Grove
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA HMA
Timeframe	2023 - 2028

Action 2: Hire a grant writer position for the City to help identify and pursue funding opportunities for hazard mitigation projects

Principle(s)	Protect public health and safety, Improve governmental and public response to natural hazards
Action Type	Preventative Activities
Priority	Medium
Hazard(s) Addressed	All
Lead Agency (Partners)	City of Grove Emergency Management
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, State and Federal HMGP funding
Timeframe	2023 - 2028

Action 3: Implement Fire Protection and Mitigation Plans to improve resiliency against future wildfire hazards.

Principle(s)	Protect public health and safety, Improve governmental and public response to natural hazards
Action Type	Preventative Activities
Priority	Low
Hazard(s) Addressed	Wildfire
Lead Agency (Partners)	City of Grove Emergency Management, Grove Fire Department
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, State and Federal HMGP funding
Timeframe	2023 - 2028

Action 4: Acquire properties in the FEMA Floodplain and in Repetitive Loss properties

Principle(s)	Protect public health and safety, Minimize loss of life and property from natural hazard events, Limit building in high-risk areas
Action Type	Preventative Activities
Priority	High
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	City of Grove Emergency Management, City of Grove Floodplain Management
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, HMGP, HMA
Timeframe	2023 - 2028

Action 5: Work with City GIS personnel to identify and map vulnerable populations in Grove, to develop an accurate and usable database in which City personnel can use to communicate risks and ensure needs are met during a disaster event.

Principle(s)	Protect public health and safety
Action Type	Emergency Services Activities
Priority	High
Hazard(s) Addressed	All
Lead Agency (Partners)	City of Grove Emergency Management, Local & City Utility Providers, Grove GIS
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources
Timeframe	2023 - 2028

Action 6: Pursue streambed revitalization projects and property buyout opportunities along Spring Branch Creek to reduce flooding impacts in the City.

Principle(s)	Minimize loss of life and property from natural hazard events, Protect public health and safety, Identify hazards and assess risk for local area, Determine increased risk from specific hazards due to location and other factors, Limit building in high-risk areas
Action Type	Floodplain Management Regulatory/Current and Future Conditions
Priority	High
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	City of Grove Emergency Management
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA HMA
Timeframe	2023 - 2028

Action 7: Update stormwater master drainage plan and implement findings in the plan, including structural projects

Principle(s)	Improve disaster prevention
Action Type	Floodplain Management / Regulatory Activity
Priority	High
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	City of Grove Emergency Management
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources
Timeframe	2023 - 2028

Action 8: Develop and Coordinate a Debris Management Plan for the City to address post-disaster debris removal.

Principle(s)	Improve government and public response to natural hazard disasters
Action Type	Preventative Activities
Priority	Low
Hazard(s) Addressed	Flooding, Hail, Tornado/High Wind, Severe Winter Storm
Lead Agency (Partners)	City of Grove Emergency Management
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources
Timeframe	2023 - 2028

Action 9: Coordinate with & establish emergency response plans with each long-term care facility in Grove, and pursue mitigation efforts that would enhance the preparedness levels of this vulnerable population

Principle(s)	Improve government and emergency response to natural hazard disasters
Action Type	Preventative Activities
Priority	High
Hazard(s) Addressed	All
Lead Agency (Partners)	City of Grove Emergency Management, Grove Long-Term Care Facilities, Integris
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources
Timeframe	2023 - 2028

Action 10: Develop automated hazard warning systems which integrate existing weather stations, storm sirens, the capabilities within the Code Red mobile application already in use and the reverse-911 system.

Principle(s)	Protect public health and safety
Action Type	Emergency Services Activities
Priority	Medium
Hazard(s) Addressed	Flooding, Tornado/High Wind, Lightning, Hail, Extreme Heat, Wildfire, Severe Winter Storms, Hazardous Materials Incidents
Lead Agency (Partners)	City of Grove
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA HMA
Timeframe	2023 - 2028

Action 11: Establish or sponsor a Citizen Emergency Response Team to educate volunteers about disaster preparedness. Also, develop relationships with religious and other volunteer organizations in and near the county who have volunteer groups that would be able to provide assistance in times of disaster response.

Principle(s)	Increase public awareness of risk from natural hazards, Improve government and public response to natural hazard disasters
Action Type	Emergency Services Activities, Public Information Activity
Priority	Medium
Hazard(s) Addressed	All
Lead Agency (Partners)	City of Grove
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA HMGP/BRIC, Volunteer services
Timeframe	2023 - 2028

Action 12: Obtain backup electrical generators and conduct regular tests and maintenance on generators already in place to ensure proper operation

Principle(s)	Reduce risk and effects of natural hazards, Protect public health and safety
Action Type	Preventative Activity
Priority	High
Hazard(s) Addressed	All
Lead Agency (Partners)	City of Grove, Stakeholders
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA HMGP/BRIC, State Funding
Timeframe	2023 - 2028

Action 13: Fortify roofs, windows, and insulation in and on city and critical facilities against threats posed by hail, high winds, extreme temperatures

Principle(s)	Improve building construction to reduce the dangers of natural hazards
Action Type	Structural Projects, Property Protection Activities
Priority	Low
Hazard(s) Addressed	Extreme Heat, Hail, Severe Winter Storms, Tornado/High Wind
Lead Agency (Partners)	City of Grove Emergency Management
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA BRIC
Timeframe	2023 - 2028

Action 14: Construct protected parking for city and first responder vehicles

Principle(s)	Improve government and public response to natural hazard disasters, Minimize loss of life and property from natural hazard events
Action Type	Preventative Activities
Priority	High
Hazard(s) Addressed	Hail, Severe Winter Storm, Tornado/ High Wind
Lead Agency (Partners)	City of Grove Emergency Management, Grove Police Department, Grove Fire Department
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources
Timeframe	2023 - 2028

Action 15: Provide and maintain defensible space around structures vulnerable to wildfires in peripheral areas of the city and those bordering undeveloped areas.

Principle(s)	Improve disaster prevention, Reduce risk and effects of natural hazards
Action Type	Preventative Activities, Property Protection Activities
Priority	Low
Hazard(s) Addressed	Wildfire
Lead Agency (Partners)	City of Grove Emergency Management, Grove Fire Department
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA HMA, State Funding
Timeframe	2023 - 2028

Action 16: Harden, strengthen, or bury electrical infrastructure when cost-effective.

Principle(s)	Reduce risk and effects of natural hazards, Protect public health and safety
Action Type	Preventative Activities
Priority	Medium
Hazard(s) Addressed	Severe Winter Storm, Tornado/ High Wind, Wildfire, Lightning, Hail, Earthquake
Lead Agency (Partners)	City of Grove
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA HMA
Timeframe	2023 - 2028

Action 17: Improve the maintenance, quality, and design of roadways to mitigate against the effects of future events and account for greater temperature and precipitation fluctuations.

Principle(s)	Protect public health and safety, Improve building construction to reduce the dangers of natural hazards
Action Type	Structural Projects
Priority	Medium
Hazard(s) Addressed	Flooding, Severe Winter Storm, Drought, Earthquake
Lead Agency (Partners)	City of Grove Emergency Management
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA HMA
Timeframe	2023 - 2028

Action 18: Conduct a study to determine the best source or course of action to obtain backup source(s) of water in the event that lake levels drop below the necessary threshold during periods of extreme drought.

Principle(s)	Protect public health and safety, Reduce risk and effects of natural hazards
Action Type	Preventative Activities
Priority	Low
Hazard(s) Addressed	Drought
Lead Agency (Partners)	City of Grove Emergency Management, Grove Municipal Services Authority
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA BRIC
Timeframe	2023 - 2028

Action 19: Evaluate and install shelters/safe rooms that meet ICC 500 and FEMA P361 requirements at public critical facilities that do not have shelters that meet ICC 500 and FEMA 361 requirements.

Principle(s)	Protect public health and safety
Action Type	Structural projects
Priority	High
Hazard(s) Addressed	Tornado/High Wind
Lead Agency (Partners)	City of Grove Emergency Management
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA BRIC
Timeframe	2023 - 2028

Action 20: Incorporate nature-based solutions into mitigation projects, when appropriate.

Principle(s)	Reduce risk and effects of natural hazards, Identify hazards and assess risk for local area, Determine increased risk from specific hazards due to location and other factors, Improve disaster prevention
Action Type	Natural Resource Protection Activities
Priority	Medium
Hazard(s) Addressed	All
Lead Agency (Partners)	City of Grove Emergency Management
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA HMA
Timeframe	2023 - 2028

Action 21: Construct lightning rods or air terminals for protection of critical facilities

Principle(s)	Minimize loss of life and property from natural hazard events, Reduce risk and effects of natural hazards
Action Type	Property Protection Activities
Priority	Medium
Hazard(s) Addressed	Lightning
Lead Agency (Partners)	City of Grove Emergency Management, City Planners
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA HMA
Timeframe	2023 - 2028

Action 22: Adopt and enforce 2021 international building codes for new construction, and when appropriate, for retrofit projects

Principle(s)	Improve building construction to reduce the dangers of natural hazards
Action Type	Property Protection Activity
Priority	Medium
Hazard(s) Addressed	All
Lead Agency (Partners)	City of Grove Emergency Management, Grove City Council, Grove Economic Development
Jurisdiction(s) Affected	City of Grove
Funding Sources	Local sources, FEMA FMA
Timeframe	2023 - 2028

Chapter 6 Plan Maintenance and Adoption

This chapter includes a discussion of the plan maintenance process and documentation of the adoption of the plan by the City of Grove. The Core Planning Group will continue to meet to evaluate progress and recommend changes to the plan on an annual basis. The City of Grove's Emergency Management Department will oversee the process to ensure that an annual review and update of the Multi-Hazard Mitigation Plan occurs. The Plan will be updated and resubmitted to the State and FEMA for approval prior to the 5-year approval period expiration, per FEMA requirements.

6.1 Monitoring the Plan

Monitoring of the 2023 Plan will involve city officials tracking the mitigation actions and plan integration. An annual meeting, open to the public, will allow the planning team to report on progress and discuss future mitigation steps.

Monitoring of the Plan, the Action Plan, and Mitigation Measures is the primarily the responsibility of the City of Grove Emergency Management Director. Other private and public officials will assist when necessary. Those responsible for implementation of the Action Plan and the Mitigation Measures will create or update Progress Reports on an annual basis, and report to the core planning team as a whole on progress and/or impediments of the mitigation measures. A worksheet, similar to Worksheet 7.1 of Appendix A of the *FEMA Local Mitigation Handbook 2013*, will be used to summarize mitigation action progress as the Progress Report. Individual action items will be noted as "Not Started," "Underway," "Ongoing," or "Complete." Any additional planning mechanisms or processes that integrate the mitigation plan will be tracked.

The City of Grove Emergency Management Director will host an annual meeting for public and private officials participating community representatives and general public to report and comment on plan implementation success and continued challenges. At minimum, this meeting will address recent hazard events, evaluate current the plan's goals and priorities, prioritize mitigation action items for the upcoming year, summarize plan implementation and integration, and discuss plan updates. A draft monitoring meeting schedule is outlined in Table 6-1. These annual meetings should provide an opportunity to summarize the beforementioned progress reports and collaborate on upcoming projects, opportunities, grants, or similar matters.

Table 6-1 Plan Maintenance Schedule

Meeting Year	Topic
2023	Monitor Plan Progress and Hazard Activity
2025	Monitor Plan Progress, Hazard Activity, and Begin Plan Update
2026	2027 HMP Update Planning Process
2027	Adopt Plan Update and Begin Monitoring Process

6.2 Evaluating the Plan

The 2023 City of Grove Multi-Hazard Mitigation Plan will be annually evaluated by the City of Grove Emergency Management Director, and a report will be made to the Core Planning Committee. This evaluation will assess:

- Adequacy of adopted Goals and Strategy in addressing current and future expected conditions.
- Whether the nature and magnitude of the risks have changed.

- Appropriateness of current resources allocated for implementation of the Plan.
- To what extent the outcomes of the Mitigation Measures occurred as expected.
- Whether agencies, departments and other partners participated as originally anticipated.
- Whether Mitigation Measures have been incorporated into new planning processes.

These programs will continue to be evaluated and updated on an annual basis. The annual monitoring meeting and reports from Planning Team members will provide the information necessary for the Emergency Management Director to evaluate the plan.

6.3 Updating the Plan

The City of Grove Hazard Mitigation Plan will be updated according to the following schedule:

Revise and Update

The Core planning team, led by the Emergency Management Director, will review the plan annually and incorporate any necessary revisions to the plan identified during the annual review meetings. Updates may be necessary due to completed or started action items, changing priorities, or changes in planning group information. The formal 5-year update process will begin no later than 18 months prior to the plan's expiration date with 24 months prior to expiration being preferred. The City of Grove found no change in priorities since the approval of the prior Hazard Mitigation Plan.

Submit for Review

The revised plan will be submitted to ODEMHS and FEMA through the State Hazard Mitigation Officer for review and approval, and to FEMA no later than six (6) months prior to the plan expiration date.

Final Revision and Adoption

If necessary, the plan will be revised per ODEMHS and FEMA remarks, adopted by the participating jurisdictions, and the updated plan sent to FEMA prior to the expiration of the 5-year approval period.

6.4 Public Involvement

The public will always play a vital role in the mitigation planning process in the City of Grove, and this includes during the update process after the 2023 HMP is formally approved by FEMA. Every attempt will be made to ensure the public will be able to directly comment on and provide feedback about the Plan. Public Meeting agendas will be posted at city hall as well as through sharing via social media platforms such as Facebook. Meetings will be publicized and open to the public for comment and they will be a space where Grove residents can express their concerns, opinions, or ideas about the Plan. Meeting notices will be posted in accordance with the policies for the Oklahoma Open Meeting Law and meetings at City Hall, which is located at 104 W. 3rd Street Grove, OK.

A copy of the approved plan will be available at Grove City Hall and is also available to any citizen upon request. Additionally, the City's Emergency Management Director also maintains a digital copy of the file which can also be shared upon written request. Local newspapers and the city website will also be utilized to notify the public and additional stakeholders of the opportunity to comment as well as serving as a tool they can utilize to submit comments for review. Upon completion of the update process, the plan will be resubmitted to the State and FEMA for approval.

6.5 Incorporating the Multi-Hazard Mitigation Plan

The City of Grove *Multi-Hazard Mitigation Plan* will be approved and adopted by City Council as a guide to City mitigation actions and the city intends to incorporate mitigation planning as an integral component of daily government operations.

As discussed in Section 6.1, the City of Grove's Emergency Management Director is responsible for overseeing the implementation and integration of the Hazard Mitigation Plan at the City level. Planning team members are responsible for integrating the Plan into their departments and capital improvement efforts.

As individual city planning commissions review and update their respective plans, it is the responsibility of their planning team to integrate this mitigation plan into those planning efforts.

Implementing the mitigation action items will include:

- Mitigation measures will be assigned to the appropriate departments for planning and implementation
- The responsible department managers will report to the Planning Committee on the progress made on each measure, identifying successes and obstacles to their implementation.

The City recognizes that the information contained in this plan can be invaluable in making decisions under other planning programs, such as capital improvement and emergency operations plans. Table 6-2 below includes existing processes and programs through which the mitigation plan should be implemented.

Table 6-2 Existing Processes and Programs for Mitigation Plan Implementation

Process	Action	Implementation of Plan
Administrative	Departmental or organizational work plans, policies, and procedural changes	• Planning Department • Public Works Department • Dept. of Emergency Management • Engineering • Economic Development • Social Services
	Other Organizations' Plans	Include reference to this plan in: • Comprehensive Emergency Management Plans • Comprehensive/Master Plans • Drought Management Plans • Other County and local plans as necessary
Budgetary	Capital and operational budgets	• Continue to include mitigation related projects in annual Capital Improvement Program. • Leverage mitigation grant funding to support local funding for such mitigation projects.
Regulatory	Executive Orders, ordinances, policies and other directives	• Comprehensive Planning - Institutionalize hazard mitigation for new construction and land use • Zoning and Ordinances • Building Codes-enforcement of codes or higher standard in hazard areas • Capital Improvements Plan - Ensure that the person responsible for projects under this plan evaluates if the new construction is in a high hazard area, floodplain, etc. so the construction is designed to mitigate the risk. • National Flood Insurance Program (NFIP) – Continue participation in this program. • Prior to formal changes (amendments) to comprehensive plans, zoning, ordinances, capital improvement plans, or

Process	Action	Implementation of Plan
		other mechanisms that control development, review to ensure they are consistent with the hazard mitigation plan
Funding	Secure traditional sources of financing	Apply for grants from federal (including FEMA Hazard Mitigation Assistance (HMA) and HMGP funding programs), state government, nonprofit organizations, foundations, and private sources. U.S. Department of Housing and Urban Development's Community Development Block Grant (CDBG) Other potential federal, state and regional funding sources include: • Stafford Act, Section 406 – Public Assistance Program Mitigation Grants • Federal Highway Administration • United States Fire Administration – Assistance to Firefighter Grants • United States Small Business Administration Pre and Post Disaster Mitigation Loans • United States Department of Economic Development Administration Grants • United States Army Corps of Engineers • Other sources yet to be defined
Partnerships	Existing Committees and Councils	Local Government Committees: • Planning & Zoning Boards • Chambers of Commerce • Property Owners Associations
	Working with other federal, state, and local agencies	• Army Corps of Engineers (USACE) • American Red Cross • Oklahoma Department of Emergency Management & Homeland Security (ODEMHS) • Federal Emergency Management Agency (FEMA) • National Oceanic and Atmospheric Administration (NOAA) • National Weather Service (NWS) • National Fire Protection Association (NFPA) • Oklahoma Department of Transportation (ODOT) • United States Geological Survey (USGS) • Other Non-Profit and NGO Partners

As other planning processes are initiated, appropriate Planning Committee members will serve as advocates for integrating appropriate mitigation goals into that planning effort. These planning processes could include comprehensive plans, building code updates, zoning/subdivision codes updates, or similar items.

Implementation since 2017

Chapter 3 provides a detailed description of which existing plans were reviewed and utilized in the writing of this update as well as how portions of previous plan (2017) were implemented into the other planning mechanisms utilized by the City of Grove. Examples of how that plan was implemented into other planning mechanisms include:

- Regular review and updating of land use strategies, including zoning, subdivision, and other regulatory codes, to enhance the community's resilience and fulfill elements of the Comprehensive Plan
- Also mentioned in the Comprehensive Plan was investment in upgrading communications infrastructure in the community, which will allow city officials to communicate threats before, during and after hazard events.
- Several elements from Grove's Emergency Operations Plan tie-in with their Hazard Mitigation Plan, including establishing procedures for activating warning sirens and evacuation procedures.
- Grove's participation in the NFIP allow them to fulfill a critical resilience metric against flooding, which is a hazard profiled in the previous mitigation plan.
- Similarly, the Comprehensive Plan contains an action item targeting the acquisition of repetitive loss properties in Grove, which not only is an NFIP requirement but it's also mirrored in the City's HMP.

Other references to incorporation and implementation, or lack thereof, into planning mechanisms can be found in Section 3.1.2.

6.5.1 Incorporating Action Items into Planning Mechanisms

Quarterly LEPC meetings will include:

- Assessment of structural mitigation measures, such as improved building codes, safe rooms, etc.
- Development of recommended plans and studies, particularly those with impacts felt city-wide
- Elected personnel or a representative will attend the LEPC meeting once a year to update the County Emergency Management Director on the status of how mitigation measures are being incorporated into planning mechanisms

Other meetings will include the following assessments:

- Structural mitigation measures, such as improved building codes, safe rooms, etc. will be assessed at scheduled trustees' or council meetings
- Redundancies, such as backup generators, will also be assessed at these meetings
- The development of recommended plans and studies, in addition to any other business which may need to be addressed, will be considered at these meetings annually

As any new planning strategies or other capabilities are developed and adopted by the City, it will be the responsibility of their planning team representatives to integrate appropriate elements from this mitigation plan into those planning efforts.

Incorporating elements of the Hazard Mitigation Plan into other planning mechanisms allows communities to follow through on the investments made in writing these plans, and following through on action items created, which further allows communities to achieve accountability to their citizens. Implementing the action items will include:

- Mitigation measures will be assigned to the appropriate departments for planning and implementation
- The responsible department managers will report to the Planning Committee on the progress made on each measure, identifying successes and impediments to their implementation.
- Mitigation actions that require adoption will go through the appropriate boards, councils, or commissions for formal adoption.

As other planning processes are initiated, appropriate Planning Committee members will serve as advocates for integrating appropriate mitigation goals into that planning effort. These planning processes could include comprehensive plans, building code updates, zoning/subdivision code updates, or similar items. Chapter 3 provides a detailed description of existing plans that would integrate with this hazard mitigation update. Chapter 5, Sections 3 and 4 also provide overviews of similar information. As individual jurisdictions update or adopt new planning mechanisms, it will be the responsibility of their planning team representatives to facilitate integrating the Mitigation Plan into those planning efforts.

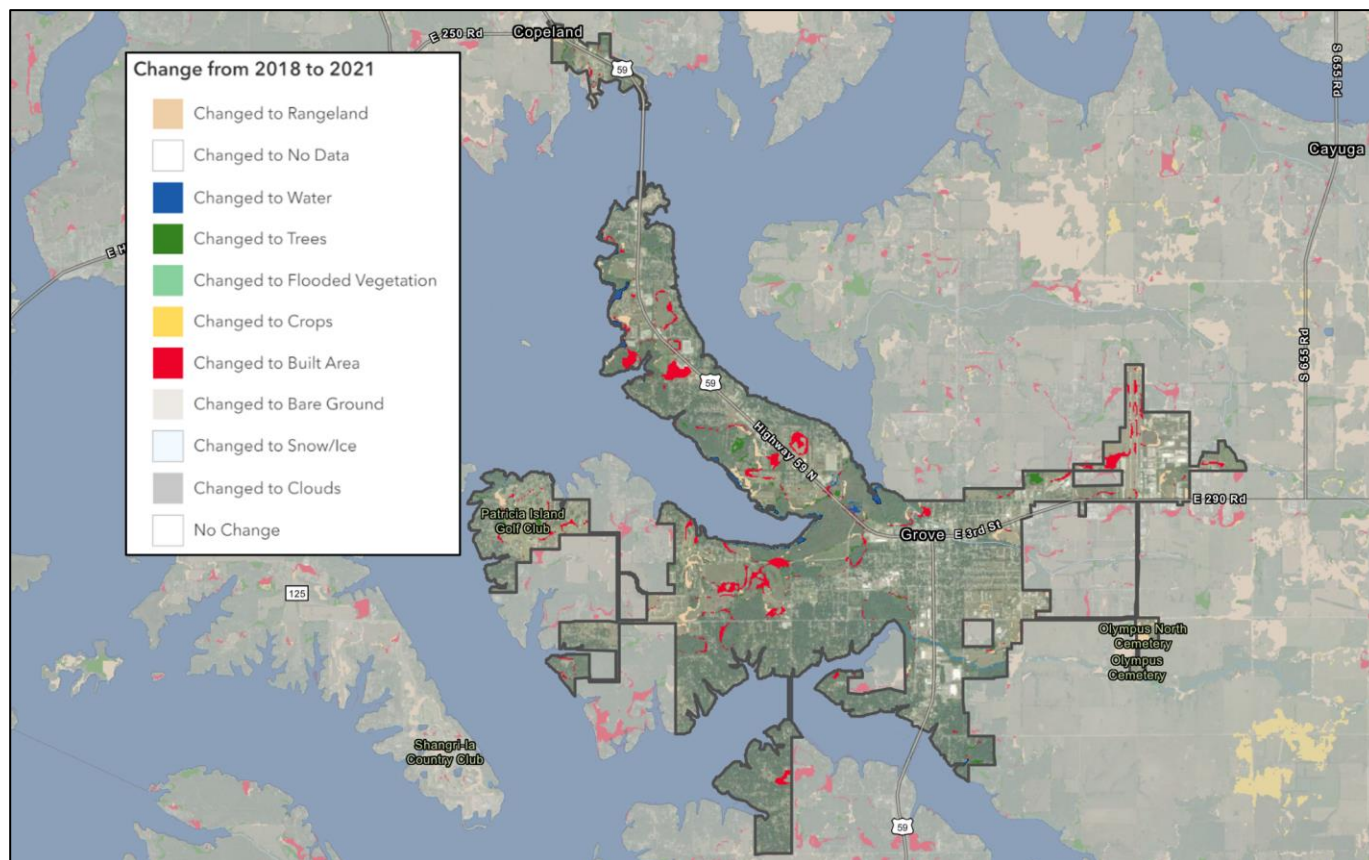
6.5.2 Changes in Priorities

Priorities for the 2023 Update remained in-line, for the most part, with those held in the 2017 plan. City officials noted that the high concentration of long-term care facilities and elderly care facilities were something they wanted to highlight in the 2023 plan. Aside from this, no specific changes in priorities were noted by City officials.

6.5.3 Changes in Development

Using Sentinel-2 10m satellite data from Esri, land use changes can be observed across Delaware County as well as the City of Grove. The dataset currently available notes land use changes between the years 2018 and 2021. Changes noted in Figure 6-1 only account for a fraction of changes that have occurred since the 2017 plan, but one significant change was the recent annexation of the land near Copeland, OK. Overall, changes in the City include new urban/built environments, with a few areas of added green space. A comprehensive report into the changes in development following recent disasters was not provided, nor did City officials note any specific changes. It was, however, strongly advised against any future development in areas that are prone to flooding, and the City looks forward to utilizing the latest maps and information presented in the 2023 Update to future protect future development across the planning area.

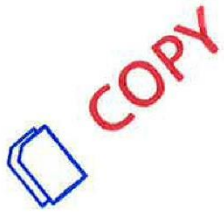
Figure 6-1 Land Use Change/Development from 2018 to 2021 (Sentinel-2)



6.6 Signed Adoption Resolution Letter

Grove's adoption resolution letter can be found in Figure 6-2 below. Once FEMA formally approves the plan and sends their Letter of Approval, this document will appear at the beginning of this document. Together, these letters signify the official recognition and adoption of the 2023 Hazard Mitigation Plan for the City of Grove and provide evidence that the participating jurisdiction (the City of Grove) has formally adopted the plan.

Figure 6-2 City of Grove Signed Adoption Resolution Letter

 **RESOLUTION NO. 23-002**

**City of Grove
City Council**

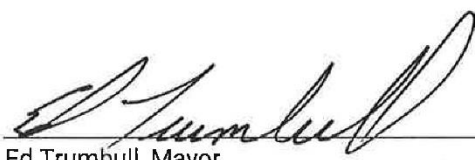
WHEREAS, the 2023 City of Grove Hazard Mitigation Plan has been prepared in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS, the City of Grove Mayor and Council is a local unit of government that has afforded the citizens an opportunity to comment and provide input in the Plan and the actions in the Plan; and

WHEREAS, the City Council has reviewed the Plan and affirms that the Plan will be updated no less than every five years;

NOW THEREFORE, BE IT RESOLVED by the Mayor and Council that the City of Grove adopts this Plan as this jurisdiction's FEMA Natural Hazard Mitigation Plan.

APPROVED AND ADOPTED BY THE CITY OF GROVE MAYOR AND COUNCIL ON THE 17th day of January 2023.

 
Ed Trumbull, Mayor


Ivonne Buzzard, City Clerk

Appendix A: Previous Action Items

Mitigation action items from the 2012 *City of Grove Hazard Mitigation Plan* were assessed to determine their status. Items determined to still be operable in reducing the planning area's exposure to hazards were incorporated into the 2023 mitigation strategy in Chapter 5. Notes from City officials and Core Group planning members have been added in the right-hand column that explain the City's position on how previous action items will change in the 2023 HMP Update.

Table A-1 Status Updates on the 2012 City of Grove HMP Action Items

Action #	Action Description	Current Status	Notes
1	Develop an All-Hazard Public Information, Education, and Awareness Program	Ongoing	Combine Actions 1-4
2	Educate the Public on the Importance of a Family Disaster Plan and Supply Kit	Ongoing	
3	Develop and Distribute a Family Emergency Preparedness Guide to all families.	Ongoing	
4	Develop distribution centers in local libraries, government facilities, and other public buildings where information and safety guidance on natural and man-made hazards can be provided to citizens.	Ongoing	
5	Develop an inventory, registry and database of Special Needs Population (elderly, poor, deaf, blind, etc.) that may require special assistance, that tie in with 9-1-1, GIS Systems, etc., so that vulnerable populations within the community can be checked on, notified, or educated effectively in the event of disasters.	Ongoing	
6	Develop a public information program designed to communicate the potential severity of a drought, and the appropriate responses by the local population, including voluntary water conservation measures the public can take.	Ongoing	
7	Evaluate, upgrade, and maintain community-wide outdoor omnidirectional voice/siren warning systems.	Ongoing	
8	Acquire and distribute NOAA Weather Radios to all Critical Facilities and the public.	Ongoing	
9	Provide lightning warning systems for City of Grove public outdoor sports areas, pools, golf courses, and parks.	Not Started	
10	Provide surge and lightning protection for computer-reliant critical facilities (e.g., City Hall, 911 Center, EOC, Police and Fire Stations, water/wastewater treatment plant and public works buildings)	Not Started	
11	Educate the Public and encourage the Utility Companies to provide information to their clients on Whole House Surge and Lightning Protection.	Not Started	Remove – AEP/REC utilities handle this
12	When replaced, install Break/Shatter Resistant Glass in Government Offices, and critical facilities.	Ongoing	Keep

Action #	Action Description	Current Status	Notes
13	Provide employee shelters/saferooms at critical facilities, such as 911 Center, fire stations, and police stations to protect first responders.	Ongoing	Keep – Police Dept is making jail cell saferooms
14	Provide new/retrofit facilities for the 911 Center and the EOC	Ongoing	Keep – wanting to harden the new PSC
15	Develop an Individual Saferoom Program for vulnerable populations that will withstand hazards, including homeowners, special needs populations, elderly, mobile home residents, etc.	Ongoing	Keep – one round has been completed
16	Adopt an ordinance requiring registration of saferooms, and create a database and GIS (Lat/Lon) map to locate saferooms in the event of a disaster.	Not Started	Change to public outreach/register saferoom
17	Provide technical assistance in obtaining grants for storm shelters/saferooms in mobile home parks.	Not Started	Remove – falls under
18	Adopt an ordinance requiring new mobile home parks to provide storm shelters/saferooms for their residents.	Not Started	Remove
19	Educate residents, building professionals and saferoom vendors of the International Codes Council/National Storm Shelter Association’s “Standard for the Design and Construction of Storm Shelters” and consider incorporating this standard into current regulatory ordinances.	Ongoing	Combine 19-22 & Change to FEMA standards; add “adopt higher building codes”
20	Train/Educate builders, developers, architects, and engineers in techniques of disaster-resistant homebuilding, such as Fortified Home standards developed by the Institute for Business & Home Safety (IBHS), the Blueprint for Safety guidelines developed by Federal Alliance for Safe Homes (FLASH)	Ongoing	
21	Identify and develop public information and education programs and provide materials and mitigation measures that protect a building’s roof, all outside openings, and the building envelope. Also, research ways to improve quality of construction as it pertains to wind resistance. Top priority should be given to protection of the roof systems, typically the most vulnerable and most expensive component to replace.	Ongoing	
22	Educate builders on appropriate foundation types for soils with different degrees of shrink-swell potential. For example, using “post-tensioned slab-on-grade” or “drilled pier” vs. standard “slab on grade” or “wall-on-grade” foundations.	Ongoing	
23	Implement and enforce an administrative procedure/ ordinance to require permits for foundation repair.	Not Started	
24	Establish an administrative procedure or change in City codes that require builders to check for expansive soils when applying for new residential construction permits, and to consider the use of foundations that mitigate expansive soil damages when in a moderate to high-risk area.	Not Started	Remove
25	Develop an emergency back-up generator hazard mitigation plan annex to the Grove Multi-Hazard Mitigation Plan for the community, assessing and prioritizing generator needs for critical facilities, both public and private. Assessment should	Ongoing	Combine 25-27 and roll into one

Action #	Action Description	Current Status	Notes
	include emergency generator needs, costs of installation for pads/transfer panels only, or for complete generator assembly installation.		
26	Based on the results of the Emergency Back-up Generator HMP Annex, provide wiring and transfer switches to accommodate emergency generators during disaster power outages for critical facilities including EOC, City Hall, Dispatch, Police, Fire, Community Centers used for emergency housing during disasters, critical facilities, lift stations, water treatment plants, and community medical facilities.	Ongoing	
27	Obtain emergency generators for continuity of government/use during disaster power outages for critical facilities including EOC, City Hall, Dispatch, Police, Fire, Community Centers used for emergency housing during disasters, critical facilities, lift stations, water treatment plants, and community medical facilities, as identified in the Emergency Back-up Generator HMP Annex.	Ongoing	
28	Identify and encourage Private Critical Facilities (Financial Institutions, Elder Care Facilities, Designated/Potential Community Emergency Shelters, etc.) to have generator pad, wiring/transfer switches and Emergency Back-Up Generators, or Reliable Contracts to provide Back-Up Generators.	Ongoing	Keep
29	Adopt an Ordinance requiring generator pad and wiring/transfer switches for Elder Care Facilities and Nursing Homes, to accommodate Emergency Back-Up Generators in the event of prolonged power outages.	Not Started	Remove
30	Identify and/or encourage key important private service facilities (gas stations, convenience stores, etc.) to have wiring/transfer switches and emergency back-up generators installed, or reliable contracts for the provision of back-up generators, in the event of disasters or power outages.	Not Started	Remove
31	Develop Memorandums of Understanding (MOUs) with private sector gasoline service facilities to provide priority fuel to emergency/critical vehicles (government, Police, Fire, ambulance, etc.) in times of emergency or power outage.	Ongoing	Remove – include in EOP
32	Provide covered shelters for City First Response/government vehicles to protect against hail damage.	Not Started	Change – everyone but PD has covered parking. Schools don't either
33	Continue Compliance with, and Participation in the National Flood Insurance Program (NFIP) and the Community Rating System (CRS)	Ongoing	
34	Prepare a comprehensive basin-wide Flood and Drainage Annex to the Multi-Hazard Mitigation Plan for all watersheds within the jurisdiction. The Annex should identify all flooding problems within the jurisdiction and recommend the most cost-effective and politically acceptable solutions.	Ongoing	Look for projects in updated plan, write those in

Action #	Action Description	Current Status	Notes
35	Continue to acquire and remove floodplain and (future) repetitive loss properties where the community's Repetitive Loss and Flood and Drainage Annex to the Multi-Hazard Mitigation Plans identify acquisition as the most cost-effective and desirable mitigation measure.	Ongoing	Keep – 7 potential structures
36	Develop / Review / Update the Grove Debris Management Plan.	Not Started	Remove – include in EOP
37	Provide routine trimming of trees to reduce power outages during storms.	Not Started	Remove – AEP/REC utilities handle this
38	Develop a contingency plan for evacuating population endangered by a wildfire	Not Started	Remove – include in EOP
39	Develop a Heat Emergency Action Plan/Heat Emergency Annex to the Emergency Operations Plan for the jurisdiction.	Not Started	Remove – include in EOP
40	Develop a secondary source of water in the case of a dam failure	Not Started	Change to back-up connection

Appendix B: Critical Facilities

This appendix provides a detailed overview of all structures and facilities deemed to be critical to both the City of Grove as well as to the City's infrastructure. Figure B-1 not only maps the location of each but it also shows which facilities are "primary" vs "secondary". Federal HiFLD data was combined with those provided to the planning team by City officials as well as those from the Grove Municipal Services Authority (GMSA). An interactive map is available online through the [Grove Hazard Mitigation HUB](#) webpage. Click on the "Grove HMP Web Viewer App" tab at the top of the page.

Figure B-1 Critical Facilities or Infrastructure Located in the City of Grove

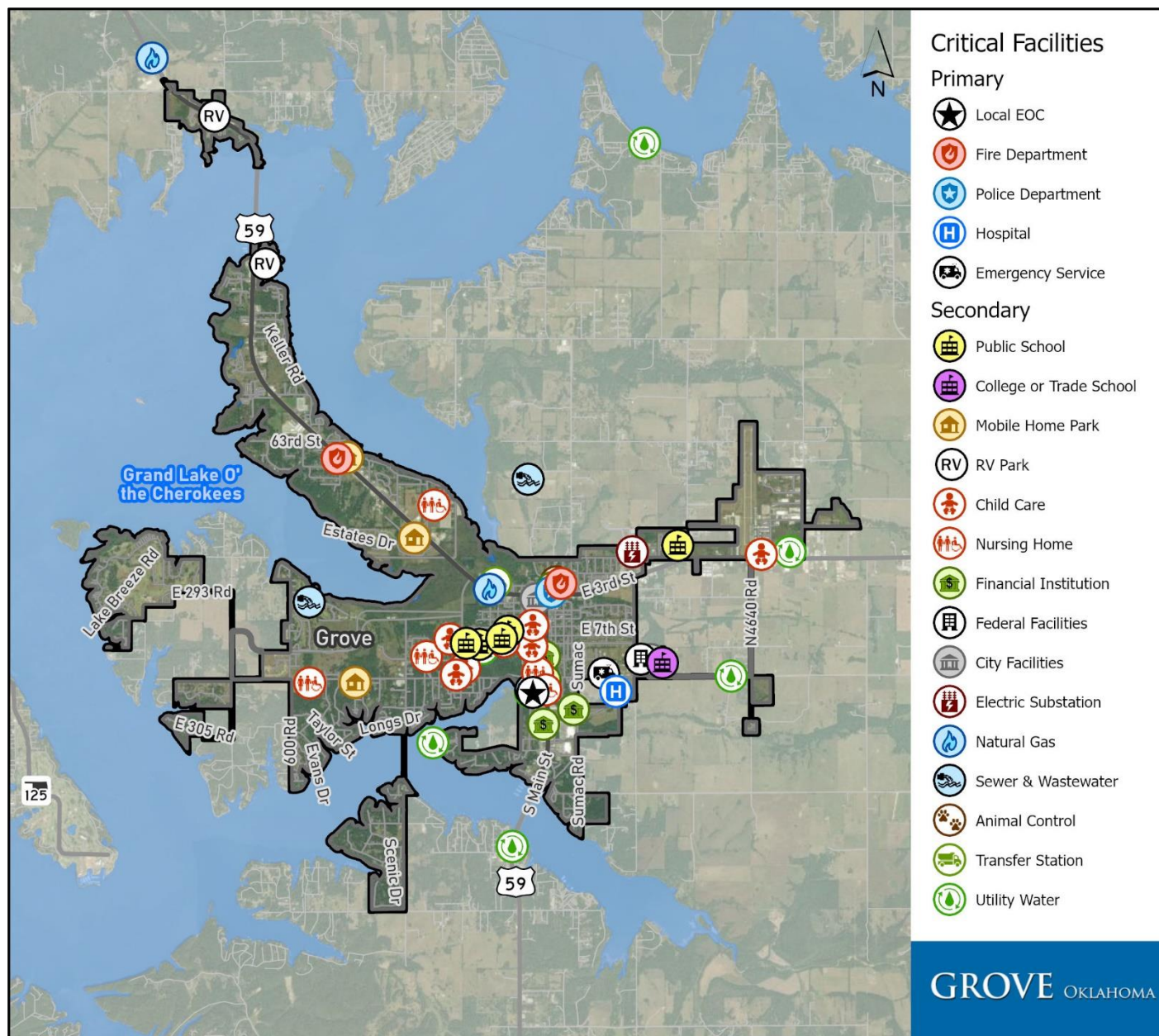


Table B-1 Critical Facilities & Infrastructure Locations in Grove, OK

Facility Type	Name	Address
City Facilities	Grove City Hall	104 West 3 rd Street
	Grove Animal Shelter	131 East O Daniel Parkway
	Grove Street Department	104 West 3 rd Street
	Grove Municipal Warehouse	104 West 3 rd Street
	Grove Vehicle Maintenance	104 West 3 rd Street
	Grove Public Library	1140 NEO Loop
Local EOC Police Department	Grove Emergency Operations	1411 South Broadway
	Grove Police Department	13 East 3 rd Street
Fire Department	Grove Fire Department	141 East O Daniel Parkway
	Grove Fire Department #2	North 55 th Street
Federal Facilities Hospital	US Post Office	1200 South Shundi
	INTEGRIS Grove Hospital	1001 East 18 th Street
Emergency Services	Grove EMS	701 East 13 th Street
RV Park	The Regatta on Grand	1567 124 th Street NW
	Eagles Landing Resort	25301 Highway 59 North
Mobile Home Park	Palmer & Pryor Resort	926 Palmer Drive
	Grandview Estates Mobile Home Park	1100 Firebird Road
	Woodland Hills Resort	1521 James Street
Financial Institution	Bank of Grove	201 East 18 th Street
	Grand Savings Bank	1022 South Main Street
	Bank Of Oklahoma	210 South Main Street
	Arvest Bank	1818 South Main Street
	Banc First	32 West 13 th Street
Nursing Home	Grove Nursing Center	1503 West Har-Ber Road
	Betty Ann Nursing Center	1400 South Main Street
	Grand Lake Villa	103 West Har-Ber Road
	Baptist Village Honey Creek	2226 Har-Ber Road
Assisted Care Facility	Grandwood Assisted Living	2001 Sunrise Blvd
Public School	Grove High School	300 Ford Road
	Grove Middle School	500 West 7 th Street
	Grove Upper Elementary	700 West 7 th Street
	Grove Lower Elementary	801 East 10 th Street
	Grove Early Childhood Center	901 West 10 th Street
College or Trade School	NEO A&M Grove Campus	1201 NEO Loop
Child Care Center	Wee Little Lambs	1001 South Broadway
	Kids Company Child Care Center	119 West 7 th Street

Facility Type	Name	Address
	Wanda's Day Care	1221 Leisure Road
	Heritage Childcare	1005 Leisure Road
	Lil Ridgely's Childcare & Learning Center	1911 East Hwy 10
	Kids R First	1010 West 13 th Street
Electrical Utility Sub-Station		S 626 Road & N 3 rd Street
Sewer & Wastewater	Quail Run Liftstation	1461 Bayshore Drive
	Hospital Liftstation	1413 South Broadway Street
	Sewer Plant	61501 East 284 Road
Natural Gas Utility Water	Tomcat Reg Station	24949 US Highway 59A
	Grove City Gate Reg Station	573 West 3 rd Street
	East Booster Station	65616 East 290 Road
	Olympus Booster Station	63826 East 300 Road
	South Booster Station	31502 South 620 Road
	Water Plant	1320 South Broadway Street
	Intake Structure	945 State Park Road
	Transfer Station	601 West O Daniel Parkway
	School Water Towers	806 West 10 th Street
	Blue Bluff Water Tower	25121 South 630 Road
	Airport Water Tower	2919 East 290 Road

Appendix C: Sign-In Sheets & Meeting Agendas

This appendix provides an overview of the personnel (name and position) who participated in the three meetings hosted by Meshek & Associates throughout the planning process. In addition to sign-in sheets, meeting agendas are also included. Any participants who chose to attend a meeting virtually were added in to the sign-in sheet for accountability. Additional information on Stakeholders and Core Group Planning members can be found in Chapter 2.

1.1 STAKEHOLDER WORKSHOP #1 (SEPTEMBER 26, 2022)

Figure C-1 City of Grove Stakeholder Workshop #1 Sign-in Sheet

City of Grove Stakeholder Workshop #1 2022 Hazard Mitigation Plan Update September 26 th , 2022, 9am-12pm Grove EOC, 1411 S. Broadway St. Grove OK			
Name	Title/Organization	Phone	Email
Allison Whitsett	Meshek	918-728-5207	awhitsett@meshekengr.com
Mark Morris	Grove Police Dept	918-786-6121	mjormorris@grovepolice.com
Thomas Coleman	THE GROVE NURSING	918-786-3223	Treder@gmail.com
Kriston Johnson	City of Grove	918-964-1409	KJohnson@msa@outlook.com
Lisa Slayton	Betty Ann Nursing Center LWH	918-937-2930	lisa.slayton@bettyannnursinghc.us
Frank Close	City of Grove EM	918-787-4357	fclose@cityofgroveok.gov
Mark Stalcup	Project Manager / Meshek	713-391-7324	mstalcup@meshekengr.com
Ivan Devitt	Grove Vice Mayor	(918) 791-8328	in.devitt@att.net
Peggy Kief	Grove P&Z	918-858-4723	peggykief@gmail.com

Figure C-2 Stakeholder Workshop #1 Meeting Agenda



Stakeholder Workshop #1
2022 Hazard Mitigation Plan Update
September 26th, 2022, 9am-12pm
Grove EOC, 1411 S. Broadway St, Grove OK

1. Welcome & Introductions
2. Hazard Mitigation Planning Process
 - a. Benefits
 - b. Potential Funding Sources
 - c. Phases & Timeline
3. New Guidance Updates
4. Group Activities
 - a. Capabilities Overview & Discussion
 - b. Hazards Overview & Discussion
5. Open Discussion
6. Closing Comments
7. Adjourn

1.2 STAKEHOLDER WORKSHOP #2 (NOVEMBER 17, 2022)

Figure C-3 Stakeholder Workshop #2 Sign-in Sheet¹


City of Grove Stakeholder Workshop #2
 2022 Hazard Mitigation Plan Update
 November 17th, 2022 ~ 9:00am to 12:00pm
 Grove EOC 1411 S. Broadway St, Grove, OK

Name	Title/Organization	Phone	Email
Oliver Whitsett	Meshek	918-728-5117	OliverWhitsett@meshekengr.com
Derek Douthett	POD Grove	918-555-0531	ddouthett@cityofgroveok.gov
Kaston Johnson	GIS Coordinator	918-964-1409	KJohnson@mesa@outlook.com
John Kostered	Betty Ann nursing center	918-257-0720	Kostered@msjk.org
Mark Morones	Grove Police Dept	918-786-6121	mmorones@grovetpolice.com

Figure C-4 Stakeholder Workshop #2 Meeting Agenda

Stakeholder Workshop #2
 2023 Hazard Mitigation Plan Update
 November 17th, 2022, 9am-12pm
 Grove EOC, 1411 S. Broadway St, Grove, OK

1. Welcome
2. Capabilities Worksheet
3. Previous Action Items
4. New Action Items
5. MOU's & Long-Term Care Facilities
6. GIS Demonstration
7. Adoption Process
8. Next Steps
9. Adjourn

¹ Not shown on the sign-in sheet are Meshek GIS team member David Webb and Meshek Planner Archie Losey

1.3 PUBLIC MEETING (JANUARY 11, 2023)

Figure C-5 Public Meeting Sign-in Sheet



City of Grove Public Meeting Sign-in Sheet

2023 Hazard Mitigation Plan Update

January 11th, 2023 – 1:00pm to 2:00pm

Grove EOC 1411 S. Broadway St, Grove, OK



Name	Title/Organization	Phone	Email
Pierce Taylor	DPS - Red Cross	(918) 509-0345	pierce.taylor@redcross.org
Samuel Rauch	DPM - Red Cross	580-614-1533	Samuel.Rauch@Redcross.org
JEFF REEVES	Delco EM	918-541-7666	DELAWARE County EM@yahoo.com
Brenda Bryant	ODEMHS	405-312-6370	brenda.bryant@oem.ok.gov
Frank Close	City of Grove EM	918-964-9709	fclose@cityofgroveok.gov
Elena Barnwell	Meshek & Associates		gharnwell@meshekengr.com
Mark Stalcup	Meshek	713-391-7324	mstalcup@meshekengr.com
Allison Whitsitt	Meshek & Associates	918-728-5617	awhitt@meshekengr.com

Figure C-6 Public Meeting Agenda

City of Grove Public Meeting Agenda
2023 Hazard Mitigation Plan Update
January 11th, 2022, 1pm-2pm
Grove EOC, 1411 S. Broadway St, Grove, OK

1. Welcome
2. HMP Process Overview
3. Digital Presentation of the 2023 City of Grove HMP Update
4. Feedback and Open Discussion/Input
5. Demonstration of the Grove Public HMP Viewer Webpage
6. Review of the HMP Approval Process
7. Review of the HMP Adoption Process
8. Example Adoption Resolution Letter
9. Next Steps
10. Adjourn

Appendix D: Participation Log

Information contained below shows a detailed description of who attended what meeting during the Meshek-sponsored planning process. This information is meant to supplement the narrative found in Chapter 2.

Figure D-1 Participation Log

First Name	Last Name	Title	Organization	Phone	Email	Meetings Attended ¹
Allison	Whitsitt	Planning Dept. Manager	Meshek & Associates, LLC.	918-728-5617	awhitt@meshekengr.com	S1, S2, P1
Archie	Losey	Planner	Meshek & Associates, LLC.		alosey@meshekengr.com	S2*
Brenda	Bryant		ODEMHS	405-312-6370	brenda.bryant@oem.ok.gov	P1
David	Webb	GIS	Meshek & Associates, LLC.		dwebb@meshekengr.com	S2*
Deric	Douthit	Public Works Department	City of Grove	918-533-0531	ddouthit@cityofgroveok.gov	S2
Frank	Close	Director	City of Grove EM	918-787-4357	fclose@cityofgroveok.gov	S1, S2, P1
Gena	Barnwell	GIS	Meshek & Associates, LLC	918-392-5620	gbarnwell@meshekengr.com	P1
Ivan	Devitt	Economic Development Authority / Vice Mayor	City of Grove	918-791-8328	in.devitt@att.net idevitt@cityofgroveok.gov	S1
Jeff	Reeves	Director	Delaware County EM	918-541-7666	delawarecountiem@yahoo.com	P1
John	Kosted		Betty Ann Nursing Center, Grand Lake Villa	918-257-0720	kostedfarmsjk@gmail.com	S2
Kaston	Johnson	Grove Municipal Services / GIS Mapping	City of Grove	918-964-1409	kjohnsongmsa@outlook.com	S1, S2
Lisa	Slayton	Administrator	Betty Ann Nursing Center LNHA	918-937-2930	lisa.slayton@bettyannnursinghc.us	S1
Mark	Stalcup	Project Manager	Meshek & Associates, LLC.	713-391-7324	mstalcup@meshekengr.com	S1, P1
Mark	Morris	Police Chief	City of Grove – PD	918-786-6121	majormorris@grovepolice.com	S1, S2
Peggy	Keifer-Steed	Planning & Zoning	City of Grove	918-858-4723 925-858-4723	peggykief@gmail.com	S1
Pierce	Taylor	DPS	American Red Cross	918-509-0345	pierce.taylor@redcross.org	P1
Samuel	Rauh	DPM	American Red Cross	580-614-1533	samuel.rauh@redcross.org	P1
Thomas	Coleman		Grove Nursing Homes	918-786-3223	trcoleman@gmail.com	S1

¹ S1/S2 = Stakeholder Workshop #1/#2 P1 = Public Meeting #1 * = virtual

City of Ponca City Ponca City School District No. 71 2022 Hazard Mitigation Plan Update





FEMA

July 7, 2022

Matthew Rollins, State Hazard Mitigation Officer
Oklahoma Department of Emergency Management
P.O. Box 53365
Oklahoma City, OK 73152-3365

RE: Approvable Pending Adoption of the Ponca City, Oklahoma Multi-Jurisdiction
Hazard Mitigation Plan
Funding Source: HMGP; FEMA-4438-DR-OK; 0011

Dear Mr. Rollins:

This office has concluded its review of the referenced plan, in conformance with the Final Rule on Mitigation Planning (44 CFR § 201.6). Formal approval of this plan is contingent upon the adoption by the participants on Enclosure A, as well as the receipt of the final draft of the plan containing all plan components.

Adopting resolutions must be submitted to this agency for review and approval no later than one year from the date of this letter. Failure to submit these resolutions in a timely manner could lead to a required update of the plan prior to FEMA approval.

Once this final requirement has been met, a letter of official approval will be generated. The Local Hazard Mitigation Planning Tool, with the reviewer's comments has been enclosed to further assist the jurisdictions in complying with planning requirements.

Sincerely,

A handwritten signature in black ink, appearing to read "Ronald C. Wanhanen".

Ronald C. Wanhanen
Chief, Risk Analysis Branch

Enclosure

cc: Shona Gibson, R6-MT-HM

Enclosure A

Attached is the list of participating local governments included in the July 7, 2022 review of the referenced Hazard Mitigation plan.

Community Name

- | |
|------------------------------|
| 1) Ponca City city |
| 2) Ponca City Public Schools |

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Chapter 1 Introduction

1.1 Introduction

This document is the Multi-Hazard Mitigation Plan 2022 Update for the City of Ponca City and Ponca City Public School District. This plan update is developed in accordance with, and fulfills the requirements for, the Building Resilient Infrastructure and Communities Program (BRIC) and Hazard Mitigation Grant Program (HMGP). It also fulfills the requirements for the Flood Mitigation Assistance Program (FMA) and the Community Rating System Plan (CRS) from FEMA. The City of Ponca City and the Ponca City School District are the two jurisdictions that participated in this Plan. This Plan addresses natural and manmade hazards that can affect people and property in Ponca City and Ponca City Public School District.



1.1.1 Purpose and Scope

Mitigation is most effective when it is based on a comprehensive, long-term plan that is developed before a disaster occurs. The purpose of mitigation planning is to identify local policies and actions that can be implemented over the long term to reduce risk and future losses from hazards. The objective of this plan is to guide mitigation activities for the next five years. It will ensure that Ponca City implements hazard mitigation activities that are most effective and appropriate for the hazards that threaten the community. Given geographic jurisdiction of the two participating jurisdictions, the scope of the 2022 City of Ponca City's Multi-Hazard Mitigation Plan Update is citywide and includes the Ponca City Public School District. The plan addresses both short-term and long-term hazard mitigation opportunities beyond existing federal, state, and local funding programs. This plan also fulfills the requirement of the CRS floodplain management plan for the City of Ponca City.

1.1.2 Goal

The overall goal of the Ponca City and Ponca City Public School's Hazard Mitigation plan is to create a disaster-resistant community and improve the safety and well-being of Ponca City by reducing deaths, injuries, property damage, environmental and other losses from natural and technological hazards in a manner that advances community goals, quality of life, and results in a more livable, viable, and sustainable community. The planning team solicited input from stakeholders and the public in order to develop this goal (see Chapter 2). In addition, goals from other planning documents, such as the City's comprehensive plan, were considered during the development of this goal. Specific goals and the process by which they were developed are included in Chapter 5 of this plan.

1.1.3 The Planning Process

Planning for the City of Ponca City Multi-Hazard Mitigation Plan Update followed a ten-step process, based on guidance and requirements of FEMA and the Community Rating System (CRS) to fulfil the requirements for FEMA hazard mitigation plan and a Floodplain Management Plan (CRS activity 510).¹ The City of Ponca City is an active participant in CRS. The organization of this plan is outlined in more detail in Chapter 2:

1. Organize to prepare the plan	6. Set goals
2. Involve the public	7. Review possible activities
3. Coordinate with other agencies and organizations	8. Draft the action plan
4. Assess the hazard	9. Adopt the plan
5. Assess the problem	10. Implement, evaluate, and revise

¹ <https://www.fema.gov/hazard-mitigation-planning-process>

1.1.4 Plan Organization

The plan and planning process build from the community and hazard assessments to create a specific and actionable mitigation strategy. The surveys, assessments, research, and analysis are organized into the following 6 chapters:

Chapter 1: Introduction

Chapter 2: The Planning Process

Chapter 3: Capability Assessment

Chapter 4: Hazard Identification and Risk Assessment

Chapter 5: Mitigation Strategy and Action Plan

Chapter 6: Implementation and Maintenance

The City of Ponca City and Ponca City Public School District is primarily located in Kay County, 109 miles north of Oklahoma City, at the intersection of U.S. Highway 60 and U.S. Highway 77. According to the United States Census Bureau, the City of Ponca City has a total area of 19.3 square miles (~50.0 km²) of which approximately 18.4 square miles (~47.7 km²) is land. The city had a 2020 Census population estimate of 24,424.2

Although the Ponca City School District serves people in outlying communities, all Ponca City School District facilities are located within Ponca City limits. The Administration Center, located at 613 East Grand, serves as the main office for the district's activities. The Ponca City Public School District is comprised of seven elementary schools (grades K - 5), west middle school (grades 6 - 7), east middle school (grade 8), a Senior High School (grades 9 - 12), and several supporting schools. Serving a population of over 2400 students, Ponca City Schools has an operating budget that exceeds \$30 million dollars as of this writing. Ponca City Schools is whole heartedly supported by the community it serves by forming business partnerships and participating in volunteering and/or mentoring programs (for more information, see the School District subsection in the community assets section of this Chapter).

1.2 Community Description

1.2.1 Governance

All legislative powers of the City of Ponca City, except for the rights of initiative and referendum reserved to the people of the City of Ponca City by the Constitution of Oklahoma, are exercised by a Commission composed of five at-large Commissioners, who serve 3-year terms. One of these commissioners is elected to serve as Mayor, who serves a 3-year term. The Commission acts as the executive and administrative body for the City of Ponca City.

1.2.2 Geography

The City of Ponca City is situated in Kay County, just 21 miles south of the Kansas-Oklahoma border. The City is bordered by the Ponca Nation to the south, by the Osage nation to the east. Tribes nearby the planning area include the Tonkawa (west), the Otoe-Missouria (south), the Pawnee (southeast), and the Kaw (northeast).³ The city is near the Arkansas River, the Salt Fork of the Arkansas River, Kaw Lake, and Lake Ponca which all provide numerous recreational opportunities.

1.2.3 Climate

The climate of Kay County is continental, as is all the Great Plains. Summers are typically hot and last from June to September. Ponca City has a yearly average temperature of 70°F and an average rainfall of 38 inches.

² <https://www.census.gov/quickfacts/fact/table/poncacitycityoklahoma/LND110210#LND110210>

³ https://www.ok.gov/health2/documents/map_tribal_jurisdictions.pdf

Weather patterns vary by season with occasional extremes in temperature and rainfall. Temperatures of 100° F or higher are often observed from July to early September, usually accompanied by high humidity brought in by southerly winds. The autumn season is usually short, consisting of pleasant, sunny days followed by cool nights. Winter temperatures, while generally mild at 45° F, can experience extremes below 0° F, while annual snowfall averages about 8.5 inches. Winters are shorter and warmer than those of the more northern Plains States.

Annual average relative humidity is approximately 70%.⁴ Average annual lake evaporation varies from 48 inches in the extreme east to 65 inches in the southwest, numbers that far exceed the average yearly rainfall in those areas. Evaporation and percolation preclude use of about 80 percent of Oklahoma's precipitation. Prevailing winds are southerly to southeasterly throughout most of the State during the spring through autumn months. March and April are the windiest months, while July, August and September are the calmest.

1.2.4 History

Ponca City was founded after the Cherokee Outlet was opened for settlement in the Cherokee Strip land run, the largest land run in United States history. Ponca City was founded in 1893 as New Ponca after the Cherokee Outlet was opened for settlement in the Cherokee Strip land run. The site for Ponca City was selected because of its proximity to the Arkansas River and a fresh-water spring near the river. The city was founded by Burton Barnes who drew up the first survey of the city and sold lottery tickets for the lots he had surveyed. After the drawing for lots in the city was completed, Barnes was elected the city's first mayor. Another city, Cross, vied with Ponca City to become the leading city in the area. The Atchison, Topeka and Santa Fe Railway had originally opened a station in Cross and refused to open one in Ponca City saying the two cities were too close to warrant another station. Citizens of Ponca City jacked up the train depot in Cross and moved it to Ponca City in the dead of night making Ponca City the railroad connection. Cross was later incorporated into Ponca City.

Ponca City's history has been shaped for the most part by the ebb and flow of the petroleum industry. The Marland Oil Company, which once controlled approximately 10 percent of the world's oil reserves, was founded by E. W. Marland, who later became a Governor of Oklahoma and a U.S. Congressman. Marland's luck and tenacity would fuel growth and wealth that were previously unimaginable on the Oklahoma prairie, and his company virtually built the city from the ground up. This led to the so-called "Roaring 20s" in Ponca City, which would come to an end for the City shortly before the Great Depression. Marland Oil Co. eventually merged with Continental Oil Co. (Conoco) in the late 1920s and would be known as Conoco for more than 70 years. The company maintained its headquarters in Ponca City during this time and continued to grow into a global corporation. During the oil boom years of the 1980s, Conoco was owned by the DuPont Corp., which took control of the company in 1981. After nearly two decades of ownership and an oil bust that crippled Oklahoma's economy in the late 1980s, DuPont eventually sold off its Conoco assets in 1998.

By 2002, Conoco had merged with Phillips Petroleum (interestingly, another major petroleum player with roots in northern Oklahoma) to become ConocoPhillips. ConocoPhillips is now one of the five largest oil companies in the world and maintains a significant presence in its historic home state. Based in Houston, Texas, ConocoPhillips continues to operate one of the United States' largest refineries in Ponca City, as well as offices at the former Phillips Petroleum corporate headquarters in Bartlesville, Oklahoma. The company's presence is much smaller than it once was, and Ponca City's population has declined steadily since the early 1990s as a result. In February 2009, ConocoPhillips announced that all of its remaining non-refinery operations in Ponca City (representing 750 jobs) would be moved out of the city. However, recent efforts to grow the city's economy beyond the petroleum industry have landed a number of technology, manufacturing and service jobs.

In 2005, ConocoPhillips announced plans to build a \$5 million dollar museum across from its Ponca City refinery. Opened to the public in May, 2007, the Conoco Museum features artifacts, photographs and other historical

⁴ https://climate.ok.gov/county_climate/Products/County_Climatologies/county_climate_kay.pdf

items related to the petroleum industry and its culture in northern Oklahoma. Threads of Ponca City's Native American heritage and oil boom days are still visible in the city's historic fabric.

1.3 Community Assets

Community assets are defined broadly to include anything that is important to the character and function of a community and can be organized very generally into the following four categories: People, Economy, Built Environment, Natural Environment.

Although all assets may be affected by hazards, some assets are more vulnerable because of their physical characteristics or socioeconomic uses. This section describes assets in the Planning Area. School Districts have additional assessments in their subsections.

1.3.1 People

Population Growth

Ponca City's population declined slightly since the last plan update in 2017 (~1% per annum). This mild decline is driven by a lack of people moving to the City relative to deaths and departures from the City. The City's comprehensive plan addresses ways to attract young professionals and families to the planning area (see Chapter 3).

Vulnerable Population Indicators

People are the most important asset for all jurisdictions in the planning community. Every person who lives in the planning area can experience some level of exposure to the hazards assessed in this plan. It is important to understand the demographic characteristics that make some residents in the planning area more vulnerable to hazards. This will inform the vulnerability assessments (Chapter 4) and allow for targeted mitigation actions (Chapter 5) that will increase the resiliency of the participating communities. Seven of these vulnerable population indicators were identified by the planning team.

1. Children under the age of 5

Young children have vulnerabilities to some hazards due to their physiological makeup, such as extreme temperatures or hazardous materials. In addition, they rely on caretakers to fulfill all their needs. Young children's higher levels of need, compounded by a lack of awareness to hazards, increase a family or community's vulnerability to hazards. The percentage of residents in the County who are younger than 5 is nearly the same as the county and state averages.

2. Elderly over the age of 65

People over age 65 are also vulnerable to hazards. They are more directly susceptible to extreme temperatures and may be less able to evacuate during or after extreme events. They are also more likely to be retired and on a fixed income, which could limit their ability to recover financially from home, vehicle, or other property damages. The percentage of people over 65 throughout Ponca City is less than the county average but slightly more than the state average.

3. People who speak a language other than English

These residents may need outreach in another language to understand a hazard warning and how to respond. Additional study is needed to confirm which languages would be best for targeted outreach to these communities. According to American Community Survey (ACS) data, the second language spoken most frequently throughout Ponca City is Spanish (5.5%).

4. People who did not graduate from high school

This population may have less income potential and more likely to be near or under the federal poverty line. As a result, their housing may be more at risk of hazard damages. This population also may be less able to use

education or outreach materials. Ponca City's high school graduation rate is close to the county average and slightly above the state average.

Table 1-1 Ponca City Vulnerable Population Indicators (ACS data) 1-4

Location	Residents Under 5 Years Old	Residents Over 65 Years Old	First Language other than English	Did not graduate high school
Oklahoma	6.3%	16.1%	10.9%	11.6%
Kay County	6.7%	18.9%	6.3%	13.2%
Ponca City	6.7%	18.0%	6.9%	13.3%

5. Racial Demographics: Marginalized Populations

Race can also play a role in vulnerability, especially for historically marginalized groups. Race is correlated with other indicators profiled by the planning team, including poverty and education. Historical marginalization can also negatively affect a racial group's access to resources and capabilities. These groups also can be suspicious of authorities, making mitigation and recovery more difficult. Some non-white minority groups may have access to additional or extra-community resources, such as Native American Tribal citizens, which may decrease their vulnerability.

Table 1-2 Ponca City Vulnerable Population Indicators (ACS data) 5

Location	Caucasian	Black/ African American	Native American	Asian	Other	Two or more races
Oklahoma	72.4%	7.3%	8.0%	2.3%	2.4%	7.6%
Kay County	77.9%	2.1%	9.1%	0.4%	3.1%	7.4%
Ponca City	75.5%	3.5%	8.7%	0.5%	0.0%	8.1%

The Planning Area has a large Native American population, which also makes up most of the demographic "two or more races." Kaw Nation and Ponca Tribe of Indians have a long history in the area. Members of these nations are important members of the City of Ponca City. The Tribal governments can be important partners to local governments and fire departments; these partnerships are key to increasing the planning area's resiliency.

6. People Living with a Reported Disability

American Community Census (ACS), estimates the percentage of the population living with a disability through self-reported surveys. Individuals with different disabilities may need secondary methods of receiving warnings, assistance during isolation, a constant flow of electricity to power life-sustaining apparatus, or help evacuating. ACS's definition of disability includes hearing, vision, ambulatory, cognitive, self-care, and independent living difficulties.⁵

Table 1-3 Ponca City Vulnerable Population Indicators (ACS data) 6

Location	Hearing Difficulty	Vision Difficulty	Cognitive Difficulty	Ambulatory Difficulty	Self-Care Difficulty	Independent Living Difficulty
Oklahoma	5.2%	3.5%	6.1%	8.9%	2.9%	6.9%

⁵ American Community Survey and Puerto Rico Community Survey 2019 Subject Definitions (census.gov), pg 61.

Location	Hearing Difficulty	Vision Difficulty	Cognitive Difficulty	Ambulatory Difficulty	Self-Care Difficulty	Independent Living Difficulty
Kay County	6.6%	4.5%	8.3%	10.7%	3.8%	8.6%
Ponca City	5.4%	4.3%	9.5%	10.4%	3.9%	8.6%

Ponca City's disability total is about 20.4%, compared to Kay County and the state of Oklahoma which is 33.5%.

7. People who live below the poverty line

The planning area also has a slightly higher percentage of people living below the poverty line than the Oklahoma average. Low-income populations may be susceptible to damages from hazards, due to factors like poorer structural construction of their shelters, lack of access to resources, and shelter location. Lower-income populations also may take longer to recover financially from the impact of a hazard (more discussion in Chapter 3).

Table 1-4 Ponca City Vulnerable Population Indicators (ACS data) 7

Location	Below 100 percent of the poverty level	Total Households	Household Median Income	Household Mean Income
Oklahoma	15.2%	1,749,520	\$54,449	\$75,537
Kay County	17.3%	21,515	\$46,809	\$63,840
Ponca City	17.8%	10,836	\$44,043	\$40,918

Figure 1-1 Percent of the Population Under the Age of 5 in the Planning Area

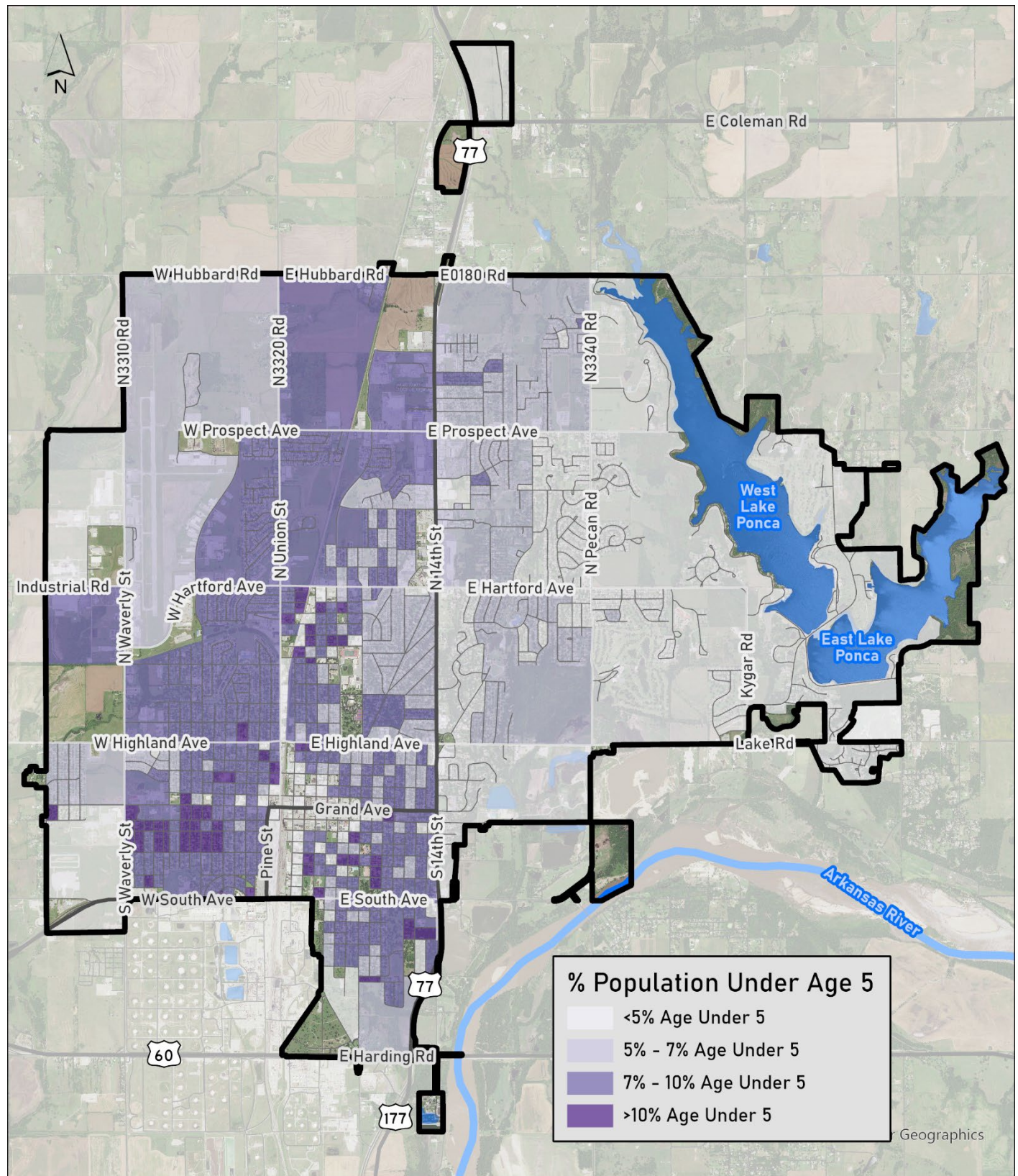


Figure 1-2 Percent of the Population Over the Age of 65 in the Planning Area

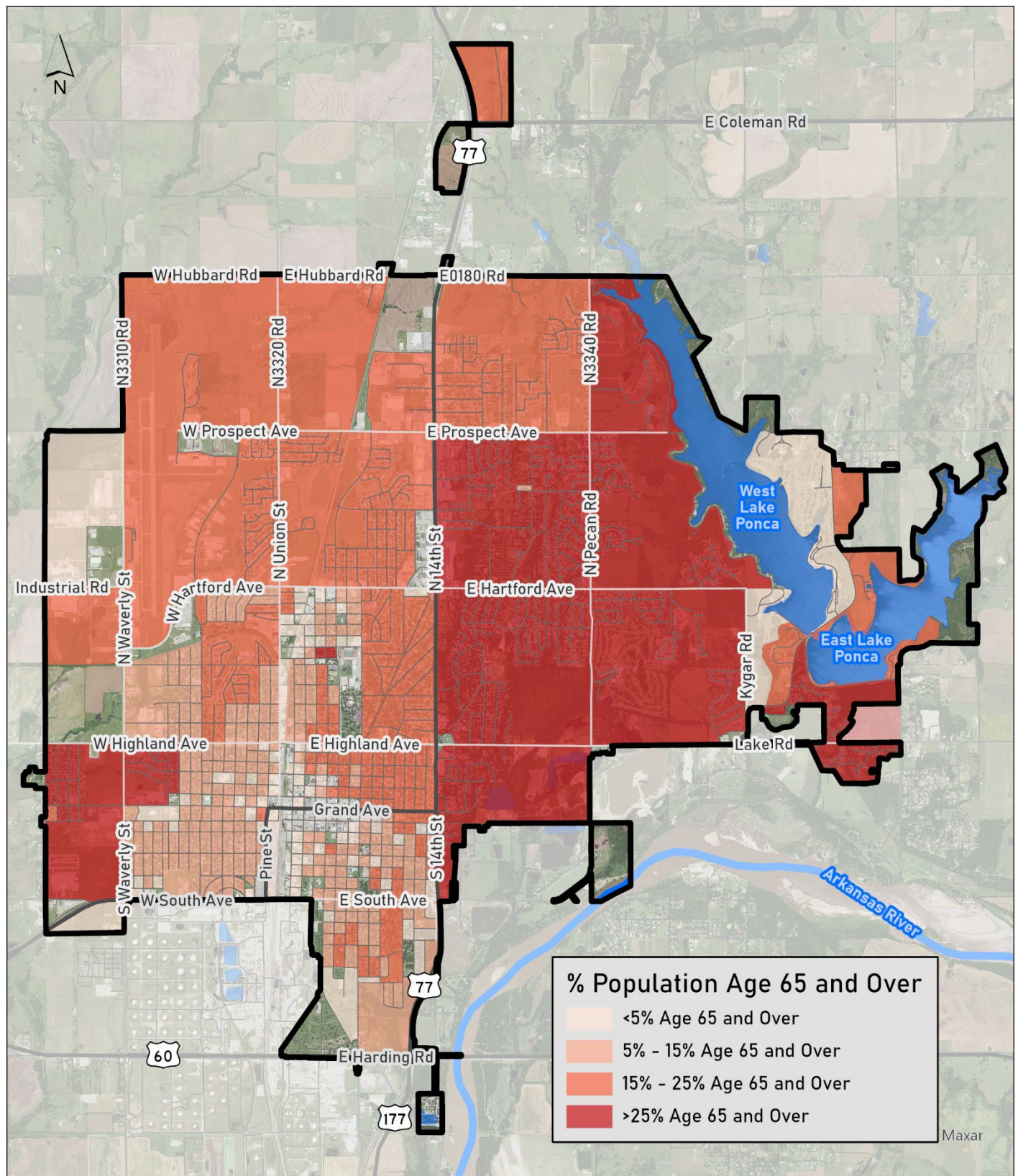


Figure 1-3 Percent of the Population Who Speak a Language Other Than English at Home

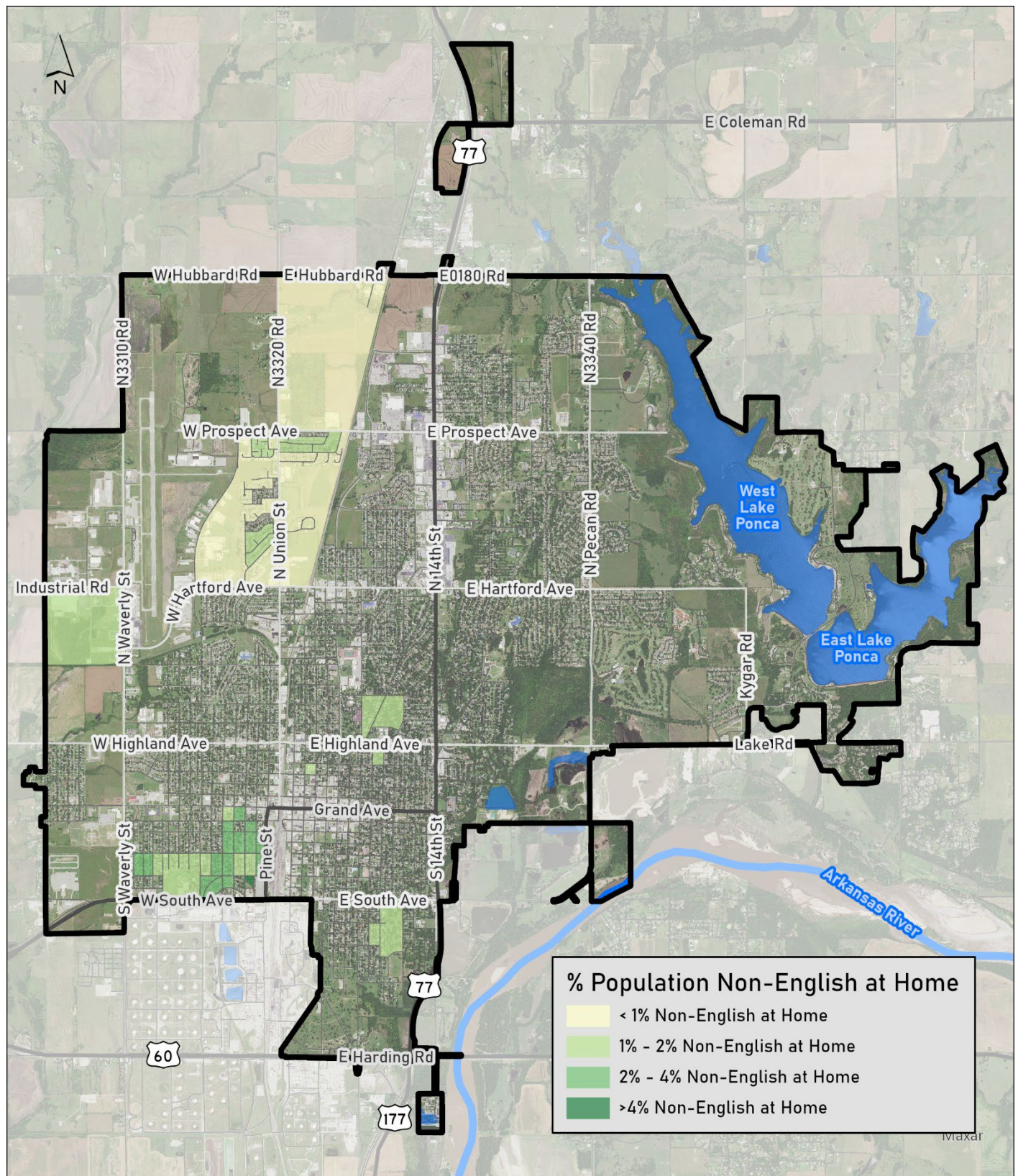


Figure 1-4 Percent of the Population Who Did Not Graduate High School

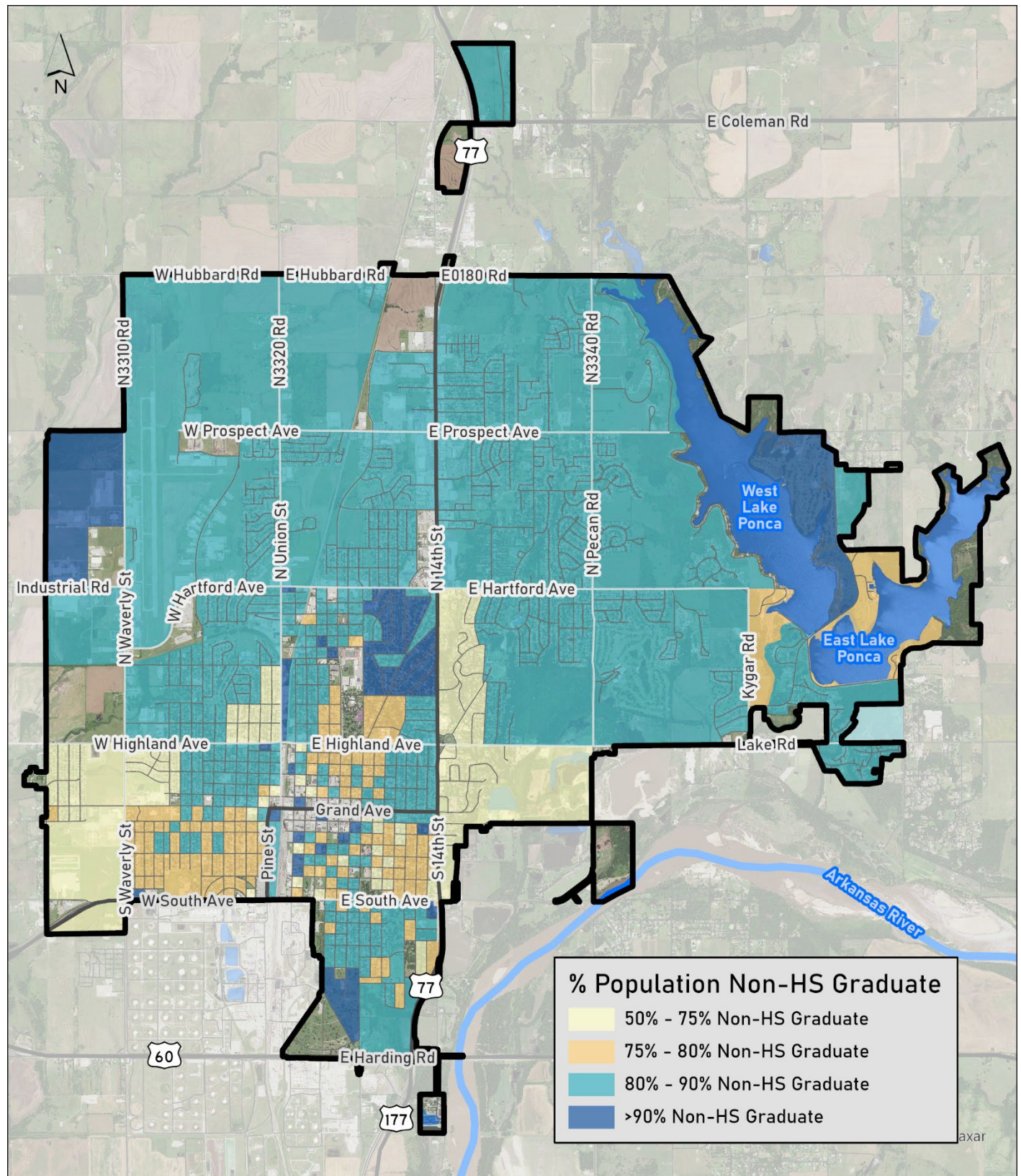


Figure 1-5 Percentage (%) of Non-White Population

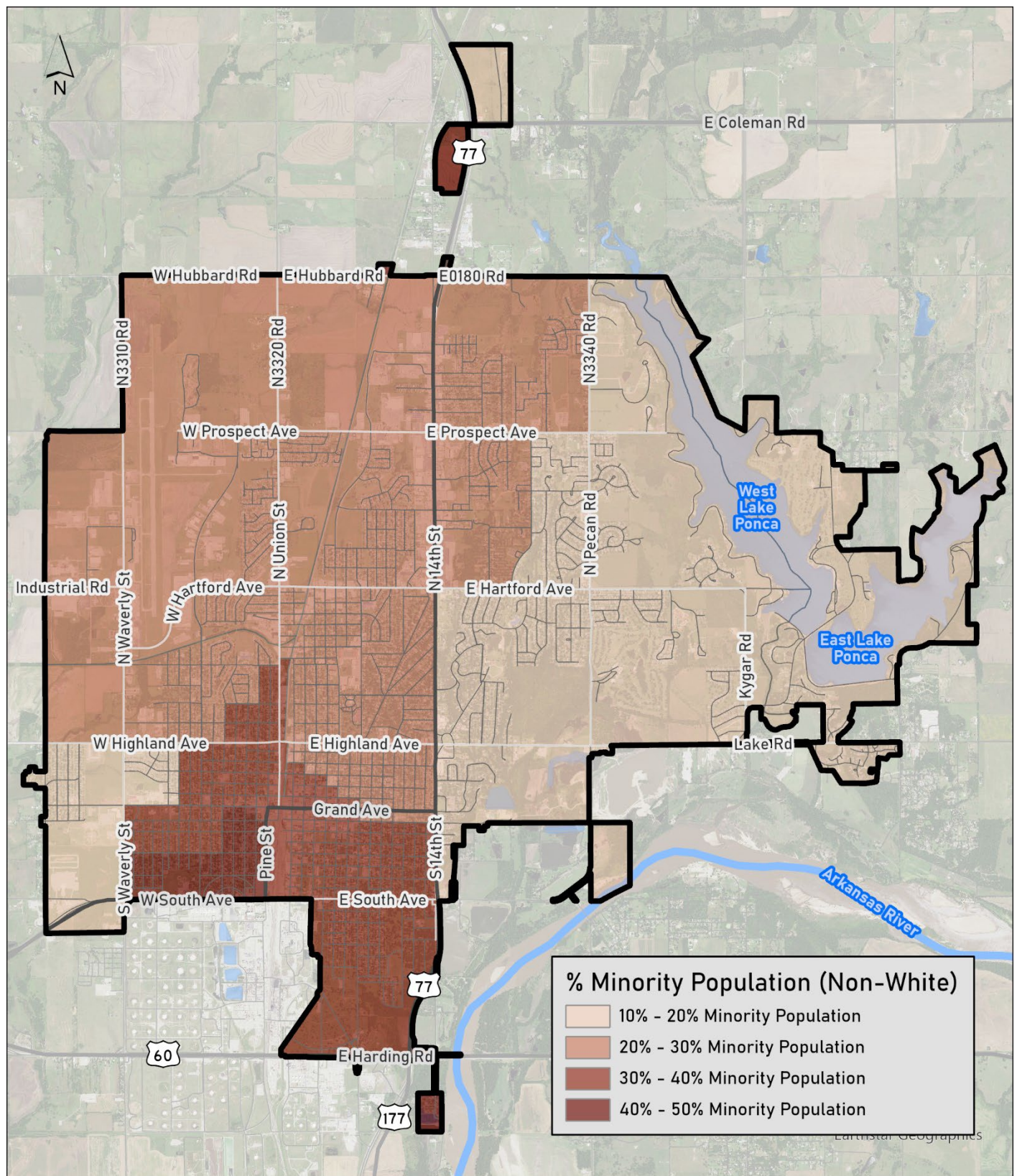


Figure 1-6 Percent of the Population with at least One Reported Disability

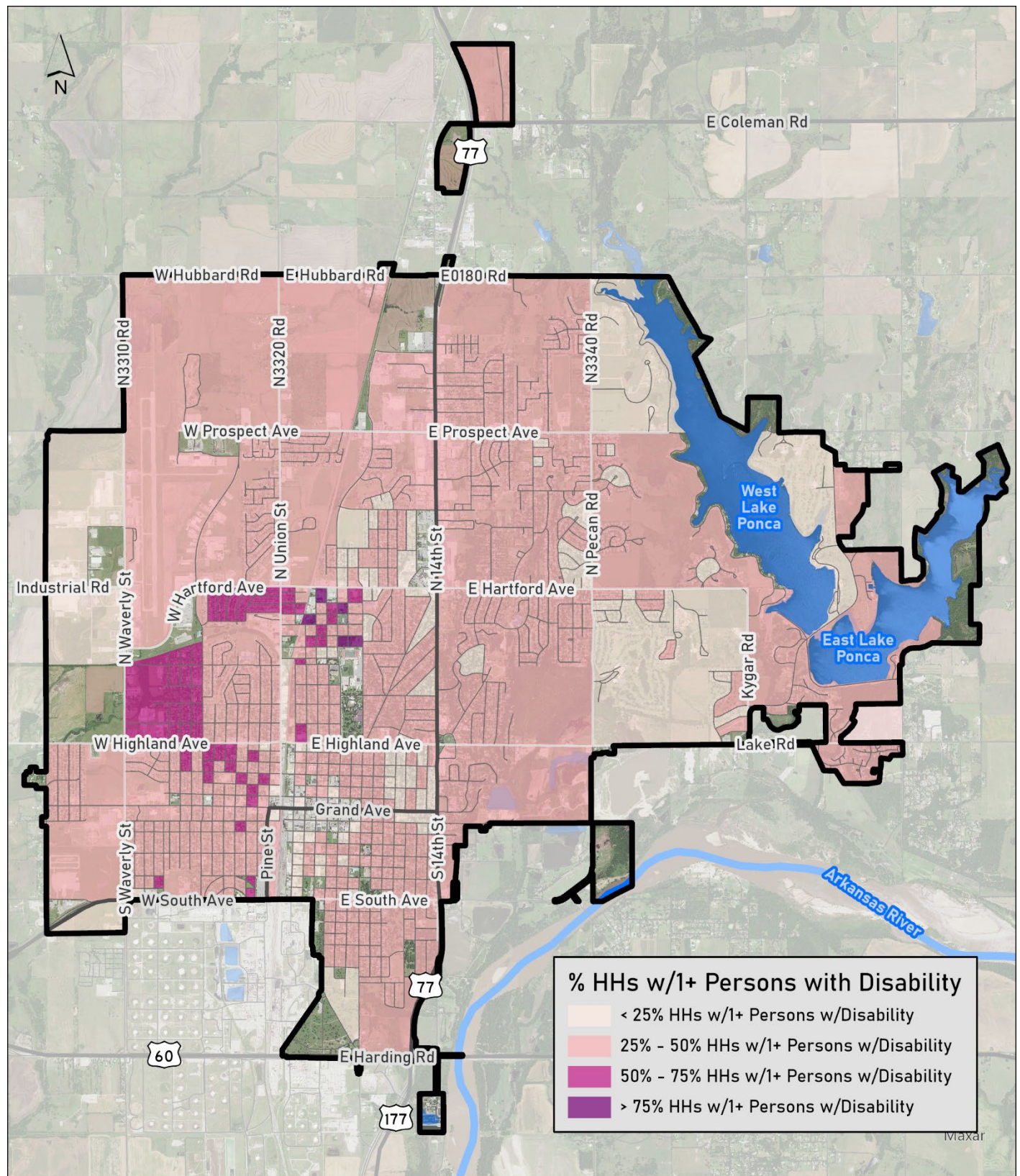
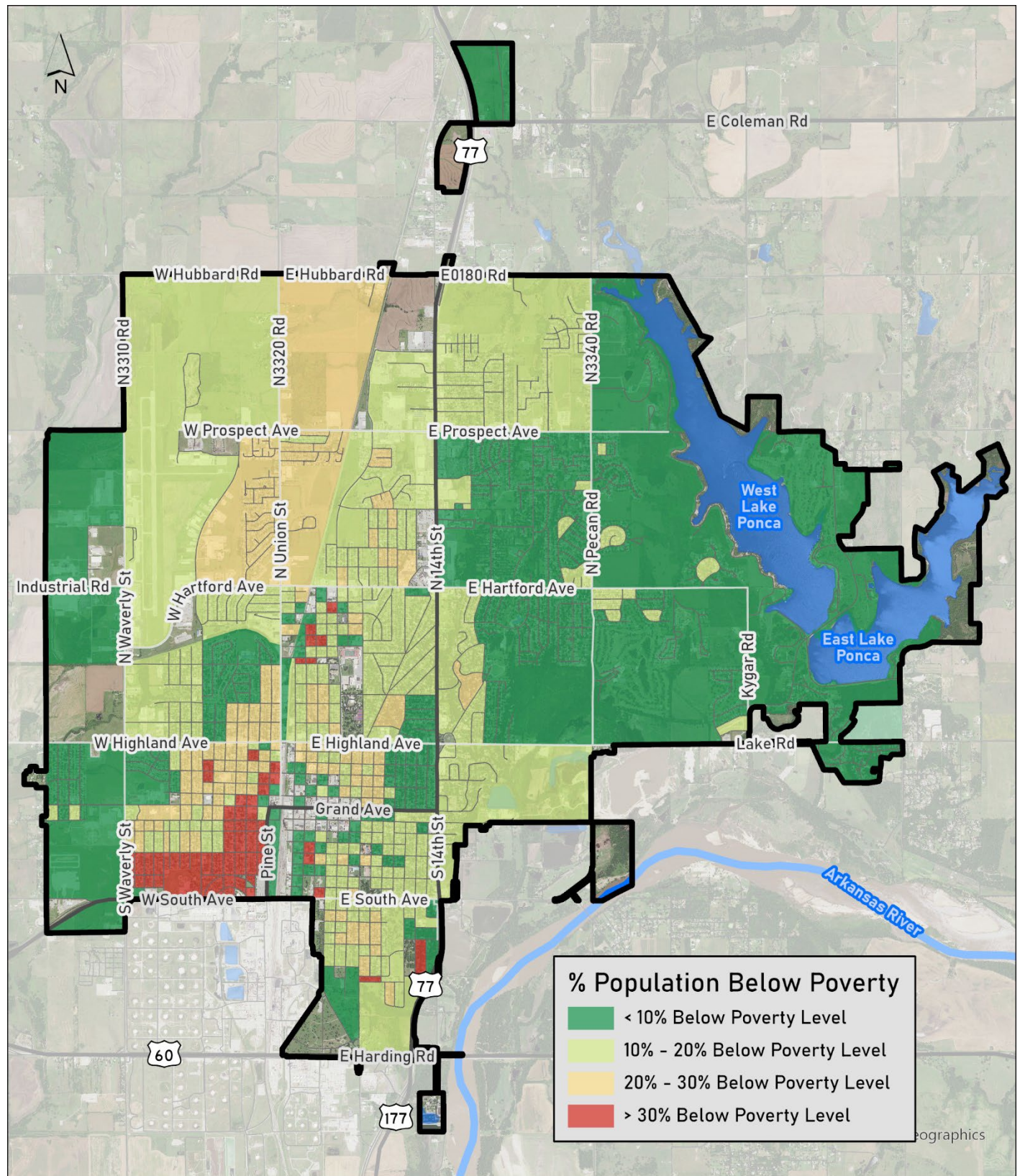


Figure 1-7 Percent of the Population Below the Poverty Line



1.3.2 Economy

After a disaster, economic resiliency drives recovery. Ponca City has specific economic drivers that are important to understand when planning to reduce the impacts of hazards and disasters to the local economy. Ponca City's major industries are mining, healthcare, oil and gas extraction, petroleum, technology, and manufacturing. In recent years, oil, gasoline, and especially crude petroleum sectors have declined in value; however, coal, machinery and electronics have had a large annual growth increase in production and consumption in Ponca City.⁶

1.3.3 Built Environment

The built environment includes existing structures, infrastructure systems, and cultural resources within the planning area. Given the importance of understanding their direct and varied risks, critical facilities and lifelines are discussed in Chapter 4.

Existing Structures

Table 1-5 City of Ponca City Built Environment Breakdown

Structure Type	Number	Est. Market Value
Residential	9,510	\$713,163,000
Residential - Multi	128	\$21,115,000
Commercial	773	\$254,215,000
Government	58	\$81,369,000
Education	21	\$40,508,000
Tribal	101	\$7,957,000
Rural Ag and Rural Residential	21	\$2,732,000
Church and Other Exempt	160	\$65,319,000
Total	10,772	\$1,186,378,000

All structures are exposed to risk. The total number of structures by type and estimated market value are included in Table 1-5. Nonetheless, certain buildings or concentrations of buildings may be more vulnerable because of their location, age, construction type, condition, or use (see Chapters 3 and 4 for more information).

Infrastructure

Infrastructure systems are critical for life safety and economic viability and include transportation, power, communication, and water and wastewater systems. Many critical facilities depend on infrastructure to function. For example, hospitals need electricity, water, and sewer to continue helping patients. The continued operations of infrastructure systems during and following a disaster are key factors in the severity of impacts and the speed of recovery. Hospitals and medical facilities are included on the list of critical facilities in Appendix A.

Utilities

Oklahoma Natural Gas and Public Service Company of Oklahoma (PSO) provide gas and electric service to Ponca City. The Ponca City region receives hydro-electrically generated service from the Kaw Reservoir, a United States Army Corps of Engineers project. The facility, located seven miles east of Ponca City, dams the Arkansas River. The electric utility is managed by the Oklahoma Municipal Power Authority of Edmond, Oklahoma. Water, sanitary sewer, stormwater, trash, and EMSAcare are services provided by the city, and paid for by citizens.

⁶ Comprehensive Plan | Ponca City, OK (poncacityok.gov)

Transportation

Roadways provide the primary means of transportation throughout the Planning Area. Highway 60 (east-west) and 77 (north-south) are the primary access routes to and from the City. Ponca City has a grid of local roads to connect residents to each other, businesses, employment, and recreational activities. A network of county roads provides local access to homes and businesses from Ponca City to Kay County. In addition to roadways, the Burlington Northern and Santa Fe (BNSF) railway—the largest freight network in the United States as of this writing—passes through the City, bringing in products from around the United States.

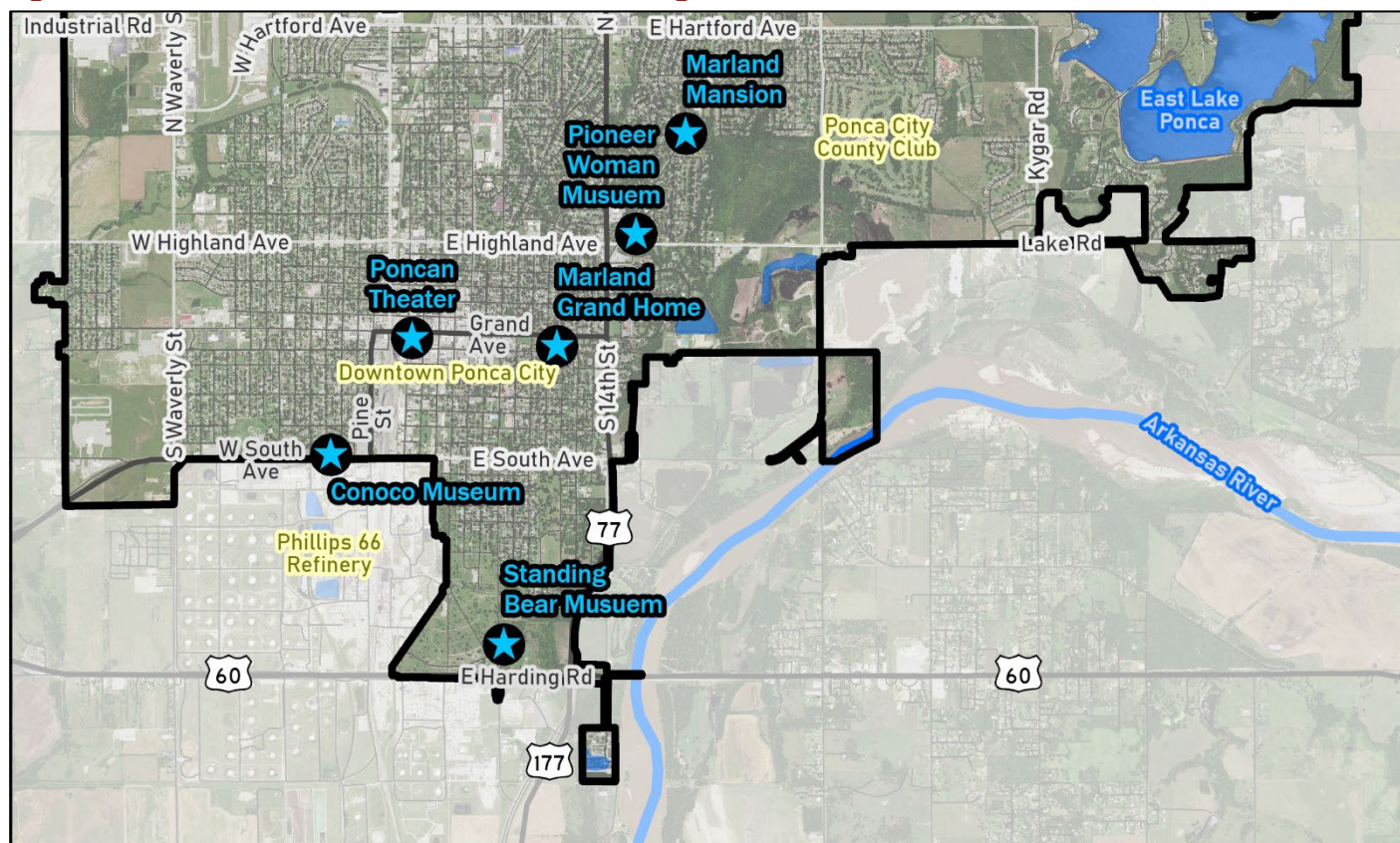
Cultural Resources

Ponca City is home to many cultural and historic assets that are unique or irreplaceable. Any asset that is important to the community can be considered a cultural resource. Ponca City has an amazing variety of arts and culture. Ponca City has a rich Native American history and is home to the Marland Oil Company, which once controlled approximately 10 percent of the world's oil reserves. The City maintains buildings from this period, as well as historic museums, which allows visitors of all ages to take in the impressive cultural collections Ponca City has to offer. The Poncan Theater (1927) is also a point of interest with its culturally rich deco style architecture.

A list of the main cultural resources identified by the City are located in the southern part of the planning area and can be found below:

- Marland Mansion
- Marland Grand Home
- Pioneer Woman Museum
- Standing Bear Museum
- Poncan Theater
- Conoco Museum

Figure 1-8 Cultural Resources Identified in the Planning Area



1.3.4 Natural Environment

Environmental assets and natural resources are important to Ponca City's identity and quality of life and support the economy through agriculture, tourism and recreation, and a variety of other ecosystem services, such as clean air and water. The natural environment also provides protective functions that reduce hazard impacts and increase resiliency. For instance, wetlands and riparian areas help absorb flood waters, soils and landscaping contribute to stormwater management, and vegetation provides erosion control and reduces runoff. Conservation of environmental assets may present opportunities to meet mitigation and other community objectives, such as protecting sensitive habitats, developing parks and trails, or contributing to the economy. Ponca City manages several parks, 2 reservoirs, and one creek, which hold multiple recreational activities and thousands of plant and shrub species. The Arkansas River Corridor is an important corridor for bird migration, include the American Bald Eagle and other endangered or threatened species.

1.3.5 Ponca City School District

There are 10 public schools for traditional K-12 learning and several supporting facilities within Ponca City School District #71. The boundary includes Ponca City and extends beyond the city limits into Kay County. There are 7 elementary schools, 2 middle schools and 1 high school in Ponca City School District.

Name ⁷	Enrollment (2021-2022)	Grade Levels Offered
Washington Pre-K Center	262	Pre-K
Garfield Elementary School	198	K-5
Liberty Elementary School	227	K-5
Lincoln Elementary School	334	K-5
Roosevelt Elementary School	272	K-5
Trout Elementary School	253	K-5
Union Elementary School	276	K-5
Woodlands Elementary School	309	K-5
West Middle School	731	6-7
East Middle School	561	8
Ponca City High School	1196	9-12
WCA/Teen PEP	91	9-12
SHARE	37	10-12
Total	2416	-

⁷ Includes students listed as entirely virtual.

1.3.6 Recent and Future Development

Recent Development

Ponca City has not experienced residential development or commercial development that has increased or decreased its vulnerability to any of the hazards profiled in Chapter 4 since the last plan update. The City has completed several public works projects since the last plan update, which have reduced the City's risk to flooding. A description of these projects can be found below:

- The Young Street Detention Pond was completed in 2018. This project was designed to offset storage loss when the City begins opening culverts throughout Tributary E to relieve flooding problems through the Acre Homes neighborhood.
- The Engineering & Acquisition for Joe Street Detention Pond was complete 2021. Construction will commence in 2022 (noted in future development section)
- Lake Ponca Spillway Reconstruction was completed in 2021. This project replaced the aging concrete at the crest of the spillway and also installed dozens of rock anchors, securely fastening the spillway concrete and underlying rock to the surrounding bedrock.
- Completed the engineering study for Redecking Union Street Bridge in 2020. This bridge is used by multiple school buses each day as well as police, fire, and ambulance emergency service vehicles. The construction is supposed to begin soon (noted in future development section)
- The McGraw Drainage project was completed in 2019 to better capture runoff from the street which overflowed the street and threatened several nearby homes. The project will direct stormwater into the ditch that was constructed for that purpose.

Since the last plan update, Ponca City School district has completed a saferoom in Garfield elementary school, which met FEMA standards (see Chapter 3 for more information). This saferoom reduced students' and staff's vulnerability to the tornado and high wind hazard outlined in Chapter 4. No other recent developments were identified as increasing or decreasing the school's vulnerability to the hazards identified in Chapter 4.

Future Development

Ponca City has a central focus on future development to build upon current capabilities and to create new areas of growth. Most recently, Ponca City has instituted a multiphase broadband connectivity project that provides professionally engineered and constructed fiber optic broadband services to the entire city. The estimated total cost for the project is approximately \$20.4 million dollars, which was funded using various funding mechanisms. The broadband service requires no contract and utilizes the already in place utility agreement. Fees for usage are based upon what a resident consumes, and not a flat rate or fee.

Of the 5 phases within the project, 3 phases are complete, with phase 4 and 5 beginning during the completion of this planning process. The completion of this project not only allows for increases connectedness citywide, but also allows the potential opportunity for surrounding communities to tie into the network in the future to address some of their own connectivity disparities and increase public engagement and information sharing. Increasing the ease speed and redundancy of communication will reduce the planning area's vulnerability to all hazards (see Chapter 3 for more information).⁸

In addition to technological development, Ponca City and Ponca City School District has invested in several public infrastructure ventures including building a Ponca City Public Schools' Concert Hall, making improvements to

⁸ Managed by the Ponca City Utility Authority (PCUA), the project ensures increased access to the internet, ensures that revenue gained remains in the city, and with a longstanding reputation of efficient processes by the PCUA, ensures the program will be maintained and effectively managed. Interest in the project was gauged based upon community engagement using a public survey in which 1,555 residents responded.

school athletic facilities, securing entrances at several school locations, and adding updates to windows and HVAC systems at several school facilities. The expected completion of construction for the Joe Street Detention Pond and the Union Street Bridge Redecking will reduce the City's vulnerability to flood hazards.

Updates to windows will reduce Ponca City School district's vulnerability to extreme heat and extreme cold events (the latter during severe winter storm), since these provide better insulation from temperature extremes. In addition, new HVAC system will reduce Ponca City School district's vulnerability to extreme heat and extreme cold events (the latter during severe winter storm) for the facilities receiving the install. A better HVAC system will allow these buildings to provide heat and cooling against weather extremes. These projects are not expected to result in a direct increase or decrease in vulnerability to any other hazard. These projects were completed following a \$37.5 million bond election during October 2015. With additional renovations and expansion being covered under a \$49.7 million dollar bond that was passed in October of 2021, with work to begin soon. The city has also recently acquired additional building space and will be converting the space into a new city animal shelter in addition to building a new Ponca City Safety Center and Jail house.

Chapter 2 The Planning Process

2.1 Hazard Mitigation Planning and the Community Rating System

The planning process for the City of Ponca City followed a ten-step process, based on the guidance and requirements of the FEMA Community Rating System (CRS). The ten steps are described on the following pages. The Local Mitigation Plan Review Guide, Local Mitigation Planning Handbook, and the 2017 CRS Coordinators Manual, Activity 510, were used to ensure Local Mitigation Planning requirements and CRS Floodplain Management requirements were met in this process.

2.1.1 Step One: Organize to Prepare the Plan

As outlined in Chapter 1, there are two participating jurisdictions in this plan: the City of Ponca City and Ponca City Public School District. Jesse Beck served as the representative for the City of Ponca City. As of this writing, Beck is the assistant City Engineer at the City of Ponca City. Adam Leaming served as the representative for Ponca City School District. As of this writing, Leaming is Executive Director of Operations at the School District. Participants from both jurisdictions were involved in core planning meetings, stakeholder workshops, and other meetings throughout the duration of this process (see sections 2.1.2 and 2.1.4). In addition, representatives from these participating jurisdictions reviewed and provided feedback on drafts during this process.

Ponca City secured funding for this update through the Hazard Mitigation Grant Program (HMPG). The planning process was formally created by a resolution of the City Council of Ponca City on May 26, 2021 (the official planning process began in July with the first core group meeting). The resolution elected the stakeholder working group to oversee the planning effort (see Section, Coordinate with Other Agencies). A core planning team led the Stakeholder working group.

The Core Planning Team, which led planning activities and planning committees throughout this process, was composed of members of Ponca City government and other key stakeholders. The core group, in combination with the stakeholder group (below), was composed of 50% public members, per CRS requirements. Membership for the core planning team was selected, in part, based on the membership needed to form a Program for Public Information (PPI) Committee following the adoption of this plan (for more information on the PPI, see Chapter 3). The Core Planning Team is also referred to as “the planning team” throughout this Plan. The core planning team was assisted by Meshek and Associates, and was composed of the following members:

Core Planning Team

<i>First Name</i>	<i>Last Name</i>	<i>Position</i>	<i>Occupational Affiliation</i>
Jesse	Beck	Assistant City Engineer	Ponca City, Engineering*
Paula	Cain	Director	Ponca City, Emergency Management
Rob	Dick	Assistant Director	Ponca City, Public Works
Russ	Didlake	Real Estate Agent	KW Select Realtor
Jim	Fairbanks	City Engineer	Ponca City, Engineering*
Kacey	Flanery	Coordinator	Ponca City, Grants
Chris	Henderson	Development Services Director	Ponca City, Development Services*
Adam	Leaming	Executive Director of Operations	PC School District
Tana	McKinley	Assistant City Manager	Ponca City, Public Administration
Mary Beth	Moore	Real Estate Agent	Coldwell Bank Realtor
Eric	Newell	Director	Ponca City, Parks and Recreation
Rhonda	Skrapke	Administrator	Ponca City, Grants

Brett Smith	Principal	PC School District
Todd Smith	Manager	Ponca City, Environmental Science
Nga Wells	Insurance Agent	State Farm

**Serves on the stormwater/floodplain management team at Ponca City responsible for permitting, acquisitions, etc.*

The first core group meeting on July 7 began the planning process for this hazard mitigation update. During the first stages of the planning process, the planning team met weekly and monthly at City Hall in Ponca City to review preventative measures, property protection, natural resource protection, emergency services, structural flood control projects and public information. This review led to the development of the plan and the recommendation of goals, objectives, mitigation measures, and priorities for mitigation actions. During the planning process, the committee reviewed progress, identified issues, received task assignments, and advised the consultants. Meeting dates and locations were posted by the Ponca City Assistant Engineer. The meeting dates of the 5 planning team meetings can be seen in Table 2-1.

Table 2-1 Core Planning Team Meetings

Meeting	Date	Purpose
Core Meeting 1	July 7, 2021	Planning process kickoff meeting with the core group to discuss the process and goals, deliverables, plan organizational structure, and phases of the process.
Core Meeting 2	August 4, 2021	Discussion of identified hazards, adding additional hazards to the plan, capability assessment information gathering, and creating and promoting of a public hazard survey.
Core Meeting 3	August 18, 2021	Discussion of repetitive loss properties and overview and risk assessment discussion.
Core Meeting 4	September 1, 2021	Additional capability assessment information collection, and hazard mitigation GIS tool review.
Core Meeting 5	September 15, 2021	Other hazards discussion (cyber security), CRS discussion, CRS and Dams discussion, and public survey results overview for presentation at stakeholder meetings.

In addition to these meetings, the Core Planning team also attended all stakeholder meetings, since the core planning team also served as part of the stakeholder planning group. Between the core group meetings and the stakeholder meetings, the planning team addressed the following Floodplain Management Plan steps in at least one meeting:

- Assess the hazard
- Assess the problem
- Set goals
- Review possible activities
- Draft an action plan

2.1.2 Step Two: Involve the Public

Public involvement was sought and encouraged during every step of the planning process and involved a two-pronged effort: meetings and an online survey. All Stakeholder Committee Meetings were open to the public and posted on the Ponca City social media outlets (see next section). The planning team also held a public meeting within 2 months of commencing the planning process.

The public also was given the opportunity to comment generally on hazards, capabilities, or other aspects of the planning process through a survey and through two meetings specifically designed for the public. Draft action items and the draft plan also were made available for review and comment

prior to submittal to the Oklahoma Department of Emergency Management and Homeland Security (ODEMHS) for review. In addition, the public was invited to a joint stakeholder meeting in February 2022 to discuss the draft plan. Feedback from the public was incorporated into the capability and risk assessments (Chapters 3 and 4), along with the mitigation action items (Chapter 5).

Table 2-2 Public Meetings

Meeting	Date	Purpose
Public Event	August 18, 2021	Collect Public comments on natural hazards, possible mitigation solutions, and related issues. Also allowed the public to interact with hazard experts and learn how to take steps now in reducing risk.
Public Survey	August 18, 2021	Further gathered public comments on natural hazards, capabilities, possible mitigation solutions, and related issues.
Joint public event with the stakeholder group	February 6, 2022	See stakeholder meetings

In addition to formal public meetings, an online survey was made available to the public via social media posts and remains live on the Ponca City Website to solicit feedback from citizens of the City. This became an opportunity for the Ponca City Emergency Manager and Ponca City Mayor to share information about hazards faced and actions taken to reduce risk. The survey generated nearly 100 responses and was considered by the committee for incorporation into the final action plan. The survey also was used to determine continuing needs for educating the public on various hazard information.

The City held a joint stakeholder meeting with the public and stakeholders following February, 2022, prior to the Plan's submittal to the City for final adoption. This meeting served to meet some of the requirements of the Floodplain Management Plan (CRS 510), including a public meeting on the draft plan.

2.1.3 Step Three: Coordinate with Other Agencies and Organizations

The Planning Committee contacted 45 entities, including neighboring communities, tribes, local, state and federal agencies, businesses and other private and non-profit organizations, hereafter referred to as "stakeholders," by email, letter, or phone. Stakeholders were personally interviewed to review their existing studies, reports and technical information, and their needs, goals and plans for the area.

Five workshops were held throughout the planning process. At the first three workshops, attending Stakeholders reviewed the existing Ponca City Hazard Mitigation Plan and determined what was still relevant, assessed the identified hazards and resulting problems associated with each hazard, determined/developed appropriate mitigation measures and drafted an action plan. At the fourth workshop, attending Stakeholders reviewed the draft Hazard Mitigation Plan and provided final comments and recommendations prior to adoption of the 2022 Ponca City Hazard Mitigation Plan. 29 representatives of these Stakeholders attended one or more of these workshops, which included core planning team members. Core planning team members shared dual roles and were members of

the Stakeholder Committee and attended meetings accordingly. Other representatives provided input through emails.

Stakeholders List

<i>First</i>	<i>Last</i>	<i>Position</i>	<i>Occupational Affiliation</i>
Core planning group			
Bill	Smiley	Emergency Management Chief	USACE
Burl	Herring	Fire Chief	PCFD
Dakota	Allison	Assistant Lake Manager	Kaw Lake
Darwin	Haney	Water Distribution & W/water Collection Super.	PC Water Distribution/Collection
Dave	Klanica	Health, Safety, and Environmental Manager	Phillips 66
David	Baur*	Board Member	PC Planning Commission
Dereck	Cassady	Fire Marshall	PCFD
Kevin	Kloesel	Professor and Meteorologist	University of Oklahoma
Kathy	Mack	Client Director	Microsoft
Don	Bohon	Police Chief	PCPD
Hong	Fu	Environmental Services Director	PC Environmental Services
Kim	Jensen	Lead Planner	ODEMHS Hazard Mitigation
Laurence	Beliel	Director of Business Retention & Expansion	Ponca City Development Authority
Matt	Rollins	State Hazard Mitigation Officer	ODEMHS Hazard Mitigation
Phillip	Johnston	Director	PC Energy
William	Coomer	Director, Facilities Management	Alliance Health Ponca City

*Although Baur is a member for a City Commission, he serves as a public representative in this capacity

A list of stakeholders contacted, along with workshop invitations and workshop sign-in sheets are included in Appendix D. Public and stakeholder meetings provided critical information on the vulnerability of the city to each hazard, which assisted creating the risk assessment. Input also facilitated creating and prioritizing mitigation strategies into the Action Plan. Stakeholders were given the opportunity to review the hazard mitigation plan draft prior to its submission. At the 5th workshop, stakeholders also were given the opportunity to comment on the hazard mitigation plan draft prior to its approval. Public meetings are summarized in Table 2-1.

Table 2-3 Stakeholder Meetings

Meeting	Date	Purpose
Stakeholder Workshop 1	July 27, 2021	Introduction to plan process and organization. Collect information on Ponca City's existing mitigation practices and capabilities.
Stakeholder Workshop 2	September 1, 2021	Conduct a risk assessment for the city and school district for each natural hazard and rank the perception of each hazard's importance for Ponca City.
Stakeholder Workshop 3	September 29, 2021	Discuss ways to add increased public involvement and information sharing by creating a Program for Public Information (PPI) Committee, review and discussion of hazards presented at stakeholder meeting #2, and discussion of warning and response mechanisms for each hazard.

Stakeholder Workshop 4	October 22, 2021	Future condition of the planning area, touching on each hazard and their potential effects. Public engagement survey regarding hazards results and analysis. Cyber security overview.
Stakeholder Workshop 5	November 3 rd , 2021	Joint public and stakeholder meeting. Goal setting for the City regarding hazards and development of a mitigation strategy and action plan. Community members and stakeholders at this meeting were given the opportunity to discuss the hazard mitigation draft plan.

Following the plan's approval and prior to adoption, the planning team shared the Hazard Mitigation Plan with the following entities for feedback and buy in:

- Kay County Health Dept
- Catholic Charities of Oklahoma
- Ponca City Libraries
- United Way
- Opportunity Center
- Dearing House
- Pioneer Woman Museum
- Marland Grand Home
- Cononco Museum
- Standing Bear Museum
- Ponca Tribe
- Chilocco Benefit Association
- Housing and Redevelopment Services
- Kaw Lake Association
- Nothern Oklahoma Youth Services and Shelter Inc
- Osage Cove Firefighters, INC
- Ponca City Police Foundation Trust
- Ponca City Meals on Wheels

2.1.4 Step Four: Assess the Hazard

The Stakeholder Committee collected data on the hazards from available sources, the 2017 Ponca City Hazard Mitigation Plan, and the 2018 State of Oklahoma Hazard Mitigation Plan. The Hazard Identification and Risk Assessment, Chapter 4, includes a description of the type, location, and extent of natural hazards that can affect Ponca City. The Plan includes information on previous occurrences of hazard events and the probability of future events. Chapter 4 describes the hazard selection process and assesses each hazard's risks to the Planning Area. Data from several sources was used to assess the hazards, including the Simple Planning Tool for Oklahoma Climate Hazards, the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, the National Weather Service, among other federal and state sources (e.g. FEMA Coordinators' Manual and Addendum, Oklahoma Mesonet, Oklahoma Climatological Survey). These sources were used throughout Chapter 4.⁹ The planning team also reviewed documents developed by Ponca City or for Ponca City, including floodplain ordinances, CRS review sheets, master drainage plans, capital improvements plans, comprehensive plans, and emergency operations plans. In addition to these sources, hazards were assessed, prioritized, and verified with key stakeholders at meetings 2 and 3 (see step 3, above; see the next section for more information).

2.1.5 Step Five: Assess the Problem

The hazard data was analyzed considering its impact on public safety, health, buildings, transportation, infrastructure, critical facilities, the natural environment, endangered species, and

⁹ The simple planning tool for hazards is produced by the Southern Climate Impacts Planning Program, one of 11 NOAA Regional Integrated Sciences Assessments Teams.

the economy. Each hazard's previous occurrences, location, and extent were considered in the assessment. The community's specific vulnerabilities were also considered. Hazard risks were discussed at a public meeting, where members of the Planning Committee contributed to the analysis. Overall, this review included an analysis of community needs and goals, past flood studies, disaster damage reports, natural areas plans, and other documents that will provide information for the planning process

Outreach to subject-matter experts, stakeholders, and the public ensured the appropriate elements of each hazard were included and that the best-available data was used for the risk assessment. Surveys were also used to collect data for the risk and capabilities assessments (Chapters 3 and 4), which can be seen in section 2.2.

Building footprints and problem areas were used to estimate potential losses from flood and wildfire hazard areas identified in Chapter 4, and a standalone web viewer developed by Meshek & Associates, LLC. Building footprint polygons within the planning area were selected from computer-generated building footprints covering all 50 US states.¹⁰ Additional GIS data from previous studies, such as the master drainage plan, and other collected information was used in this analysis. Property damage estimates were not calculated for the general area hazards. Building footprint polygons that intersected spatially with flood and wildfire hazard areas were identified. This was used to estimate the number of buildings at risk to those hazards. Specific problem statements, or observations, are included for each hazard in Chapter 4.

In addition, demographic data that indicated a heightened vulnerability to natural hazards were collected through a GIS analysis and included in Chapter 1 and referenced in Chapter 4. The Capability assessment (Chapter 3) included a review of documents from the City's Emergency Operations Plan, Capital Improvements Plan, Comprehensive Plan, master drainage, plan, debris management plan, along with other ordinances and codes. In addition, the planning team examined other documents, like the Community Rating System Coordinator's manual and addendum to the Coordinators' Manual, Build Code Regulations, and the Fire Suppression Rating Schedule.

The Risk Assessment (Chapter 4) includes analysis of the previous plan, along with the state of Oklahoma's hazard mitigation plan. In addition, some of the documents used in chapter three were included into the vulnerability assessments, such as building code assessments. Other plans, such as the State of Oklahoma Drought Plan, were included in the assessment.

2.1.6 Step Six: Set Goals

Project and community hazard mitigation goals and objectives for Ponca City were developed by the Core Working Group to guide the development of the plan. The hazard mitigation goals are listed in Chapter 5.

2.1.7 Step Seven: Review Possible Activities

There were 50 mitigation actions identified in the 2017 mitigation plan. An annual report is prepared by Engineering Services under the direction of the Planning Committee on the status of existing Hazard Mitigation Plan mitigation actions and presented to the governing body of the City of Ponca City. This report includes the status of each mitigation action, whether the action is achieving expectations, and if not, if it should be modified. A review of the 2017 mitigation actions along with the latest annual report was completed by the planning team. Actions were evaluated with the intent

¹⁰ Microsoft 2018 data

of carrying over any not started, or continuous for the next five years. Actions with the same intent were combined into a general action item. Specific observations and problem statements, resulting in the actions listed in Chapter 5, are included at the end of each hazard section in Hazards, Chapter 4. Wide varieties of measures that can affect hazards or the damage from hazards were examined. A more detailed description of each category is located in *Chapter 5: Mitigation Strategy*.

2.1.8 Step Eight: Draft an Action Plan

The planning team reviewed observations from the risk assessment and results of the capability assessment when considering different actions. The planning team evaluated and prioritized the most suitable mitigation actions for Ponca City to implement. The mitigation strategy analyzes actions and projects considered to reduce the impacts of hazards identified in the risk assessment and identifies the actions and/or projects that Ponca City intends to implement.

2.1.9 Step Nine: Adopt the Plan

The Draft City of Ponca City Multi-Hazard Mitigation Plan Update 2022 was submitted to the Oklahoma Department of Emergency Management and Homeland Security (ODEMHS) and then to FEMA Region VI for review and approval. The plan was approved and adopted by the Ponca City Council and the Ponca Public School District School Board.

2.1.10 Step Ten: Implement, Evaluate, and Revise

Adoption of this *Multi-Hazard Mitigation Plan* is only the beginning of this effort. Community offices, other agencies, and private partners will proceed with implementation. The planning team and other stakeholder continue to meet on a regular basis to monitor progress, evaluate the activities, and periodically recommend revisions to the Plan and Mitigation Action Items. These findings and recommendations will be included in the annual report. The plan will be formally updated a minimum of every five years, as required by FEMA.

Chapter 3 Capability Assessment

Communities can take a variety of actions to mitigate the impacts of natural disasters. This chapter assesses the regulations, plans, and infrastructure throughout the planning area that have the potential to mitigate the impacts of the hazards identified in the risk assessment (Chapter 4). This assessment is based on Task 4 of FEMA's *Local Mitigation Planning Handbook*, which examines each jurisdiction's existing authorities, policies, programs, and resources available to accomplish mitigation.¹¹

The planning team reviewed existing capabilities in the planning area and identified capabilities that currently reduce disaster losses or could be used to reduce losses in the future. The planning team reviewed the information provided in the 2017 Ponca City Hazard Mitigation plan. Documents like Ponca City's Comprehensive Plan, Emergency Operations Plan, the 5-year Capital Plan, and the Debris Management Plan provided information on the community's goals and future development strategies. Other information from ISO review documents, Ponca City School District, and other partners helped to identify areas of anticipated risk so that hazardous areas could be identified, evaluated, and mitigated. Core planning members and stakeholders validated these studies and provided other information related to the planning area's capabilities (see Chapter 2 for a list of core planning members and stakeholders).

The planning team's mitigation capability review is grouped into 5 sections, with the first 4 sections covering Ponca City and last section covering Ponca City School District. Stormwater management capabilities were profiled specifically and in detail throughout this assessment since this Plan update also seeks to meet the Community Rating System's 512 requirements. Although Public School Districts share many overlapping categories of capabilities as the city, they offer distinct services and have enough unique capabilities that are better profiled separately.

Assessment Sections

The City of Ponca City

1. Planning and Regulatory
2. Administrative and Technical
3. Financial
4. Education and Outreach

Ponca City Public Schools

5. Comprehensive Assessment

Section Parts

All sections are organized into two parts:

Overview Assessment

The Overview Assessment provides a high-level summary of the capabilities that these jurisdictions have at their disposal.

Qualitative Assessment

Qualitative Assessment describes the capabilities listed in the overview assessment, focuses on their strengths or deficiencies, and includes any information or suggestions for their future utility.

¹¹ Worksheet 4.1 from the *Local Mitigation Planning Handbook*.

Observations and Recommendations

The planning team included an observations and suggested recommendations part at the end of this chapter. The observations in this part highlight capability gaps that increase the affected areas' vulnerability and risk to hazards. The capability gaps are detailed in the qualitative assessment sections. This section suggests recommendations to mitigate or close these capability gaps, which, along with the suggested actions in Chapter 4, directly inform the mitigation actions in Chapter 5.

3.1 Planning and Regulatory

Planning and regulatory capabilities refer to the ordinances, policies, plans, and other programs that Ponca City uses to guide physical development and growth. There are many kinds of mitigation capabilities that are expressed through plans, processes, and programs, such as operations plans, capital improvements plans, building codes, ordinances, hazard-specific plans, and natural resource preservation programs. Planning and regulatory elements of Ponca City's floodplain and stormwater management are included in this section.

3.1.1 Overview Assessment

Key

Addressed directly and is current, with minor room for improvement, or exceeds state standard	●
Addressed somewhat, room for improvement, or meets state standards	◐
No capabilities to very limited capabilities	○

Plans

Hazard Mitigation Plan	●
Comprehensive Plan	●
Emergency Operations Plan	●
Continuity of Operations Plan	◐
Capital Improvements Plan	●
National Flood Insurance Program	●
Community Rating System Overview	●
Floodplain Ordinance Permitting	◐
Master Drainage Plan (Stormwater Master Plan)	◐
Other Floodplain and Stormwater Management	◐
Building Codes	◐
Zoning, Subdivision, and Landscape	●
Structural Assessment and Enhancement Programs	◐
Fire Suppression Rating Schedule	●
Economic Development Plan	●
Transportation Plan	●
Debris Management Plan	●

3.1.2 Qualitative Assessment

Hazard Mitigation Plan

This plan marks the planning area's continued efforts to conduct recurring, formal hazard mitigation planning, culminating with mitigation actions. Prior to the adoption of this plan, both the City of Ponca City and Ponca City School District plans were nearly expired.

Comprehensive Plan

Ponca City's Comprehensive Plan lays the groundwork for the City's development policies for the next several decades. The plan outlines the City's strengths and weaknesses across several key areas: future land use and character, growth capacity, transportation, housing and neighborhoods, and economic development (the economic and transportation sections are addressed later in this chapter). Several chapters include considerations and priorities to mitigate hazards, especially flooding and stormwater, dam inundation, and fire. The plan also includes an implementation strategy and schedule for the execution of these actions.

Chapter 2 of the comprehensive plan, which focuses on land use, does not address development in the floodplain explicitly. The City has established rules and regulations on future construction with flooding in mind (see floodplain ordinance permitting and other floodplain and stormwater management). In addition, several chapters note the importance of providing and enhancing the natural habitat, as well as the built environment, in the plan. The Comprehensive plan does not address natural uses for floodplain functions explicitly, however, which is a point for future action. The City as continued to expand its commitment to natural in this plan through several mitigation action items (see Chapter 5).

Emergency Operations Plan (EOP)

The last date of a major revision of Ponca City's Operations Plan was 2017. The Plan provides a comprehensive overview of the City's emergency response efforts, including:

Direction, Control, and Task Organization

The EOP outlines and assigns emergency responsibilities to key government officials, utilities, and some volunteer organizations (Red Cross, Salvation Army, VOAD), and other city groups. These people are organized into three groups: the policy group, which makes critical leadership decisions; the coordination group, which coordinate the highest priority tasks set by the policy group; and operations staff, which perform the tactical execution of tasks. These plans also establish a chain of command by location (e.g. the chain of command in the EOC and in the shelters). The EOP highlights a succession of leadership, both for these operations and for government leadership. The EOP also outlines materials, personnel, and staging areas needed to execute emergency operations.

The EOP establishes a primary EOC, which is located outside the floodplain, and alternate EOCs. In addition, Ponca City has a specific document that outlines how its Emergency Operations Center (EOC) will be activated.

Communications, Warning, and Public Information

The EOP describes the process regarding how the key personnel will be notified in the event of an emergency. Following activation, the plan describes the processes of internal coordination to an emergency event, along with the personnel assigned to execute the City's communication and coordination. In addition, the plan contains redundancies in communications elements, in the event the primary elements failed.

The City's EOP also contains a priority to communicate with the public, with an explicit focus to craft and disseminate messages to curb rumors and panic.

Evacuation and Human Resources

The EOP contains processes and procedures regarding evacuation in the event of a dam breach, flooding, fire, hazardous materials event, or another hazard that would require evacuation. This includes vehicles, transportation routes, public communication, and the personnel required to execute an evacuation of such scale. During and following an event, the EOP contains stipulations for the City to coordinate with local organizations and other entities provide sheltering options, human services, medical services, and other recovery services.

Maintenance and Execution

The EOP outlines the schedule for annual maintenance and upkeep of the plan, along with the parties responsible for their upkeep. Maintenance and exercises of this plan are performed on an as needed basis and often times annually in compliance with other programs the city participates in.

Water Plan

The City has budgeted funding to develop a separate water emergency response plan in the next several years. This response plan is mandated by Public Law 115-270 (America's Water Infrastructure Act of 2018) for water systems that serve more than 3,300 customers. Pursuant to this plan, the City must conduct a risk assessment of their water system, similar to the processes of a hazard mitigation risk assessment. In addition, the plan must collaborate with local emergency partners (LEPC, emergency responders, etc.) and identify resources (materials, personnel, etc.) that would be necessary to meet the demands of an emergency.

Continuity of Operations Plan (COOP)

A section of the basic plan outlines a basic plan for continuity of government, including leadership succession. In addition, the EOP contains several sections that include emergency response efforts for public works, which could have a secondary effect to improve the probability that these departments could continue to deliver utility services. The EOP does not explain how these government departments or stakeholders will continue to operate in the event of a disaster, however. In addition to the information listed in the EOP, stakeholders like utility or other critical facility operators, may have their own COOPs. The planning team was not able to access any of these stakeholder EOPs or COOPs, which may be cause for further study. The planning team recommends that the City develop a COOP that integrates existing COOPs, if any, to strengthen a system-wide continuity of operations across critical service providers. During the completion of this planning process, the development of the COOP plan was beginning.

Capital Improvements Plan (CIP)

Ponca City has a Capital Improvements Plan, called the Five-Year Capital Plan. The current Plan is operational from FY 2021-2025. The plan is a working document, which allows the City to address new needs or shift priorities. Currently, the plan addresses several projects that will improve emergency response and hazard mitigation capabilities, either directly or tangentially. These projects include:

Emergency response

- Vehicles for Police, Fire, Ambulance, and Emergency Management Departments
- Improvements in technology software for enhanced communications, including emergency communications
- Enhanced virtual capabilities (see virtual capabilities section)

Hazard Mitigation

- Stormwater detention pond in the Joe Street Area
- Other stormwater drainage projects listed in the MDP.
- Water and wastewater line redundancies
- Replacing existing power supplies in critical facilities to ensure continuity of operations during moderate power outage events
- Roof installation for Ponca City RecPlex (potential for mitigation capabilities)

- Street improvements (potential for additional mitigation capabilities)
- Repairs to Police Station (potential for additional mitigation capabilities)

In addition, the City Manager retains a set-aside of at least \$125,000 per-year to address “unforeseen capital needs,” and several other non-mitigation related activities. For a broader understanding of the City’s financial portfolio and its potential to leverage for mitigation projects, see the financial section in this chapter.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) allows homeowners, business owners, and other entities to purchase federally backed flood insurance policies. Communities must participate in the NFIP to allow these entities to purchase insurance, however. Participation in the NFIP requires that communities maintain baseline standards of mapping, permitting, regulating, and related activities. Communities can reduce the premiums available to some of their residents by participating the Community Rating System (CRS; see the section below for more information).

Ponca City joined the NFIP in 1980. All residents of Ponca City are eligible to purchase federal flood insurance through the NFIP, as the City Remains in good standing in the NFIP. As outlined in Table 3-1, all rates are based on a structure’s location on FEMA’s Flood Insurance Rate Maps (FIRM) New Digital Maps (DFIRMS) became effective in December 2013. In addition to the City’s DFIRMS, the City completed a Master Drainage Plan that updated the floodplains in the Arkansas River, Bois D’Arc Creek, and Ponca Lake Tributaries in 2009 (see floodplain and stormwater management for additional suggestions related to mapping). These floodplains were submitted to FEMA and are displayed on the current DFIRM. Flood mitigation projects, which are included in the City’s Capital Improvement Plan. This plan serves as the framework for floodplain management planning and programs (see other planning are regulatory section in this chapter for additional information).

A summary of City of Ponca City flood insurance policies, according to NFIP, as of May 31, 2018, is included in Table 3-1. Ponca City has 8 active Repetitive Loss properties. Information about Repetitive Loss properties is included in Chapter 4.

Table 3-1 City of Ponca City Flood Insurance Policies (Current to 2018)

Flood Insurance	Amounts
Flood Insurance Policies in Force	84
Premiums in Force	\$67,311
Total Losses	123
Flood Losses Paid	\$722,270

Participation in the NFIP requires that Ponca adopt ordinances to reduce the effects of flooding. Ponca exceeds some of these baseline ordinances, which is outlined in the following sections. Ponca City will continue to meet minimum NFIP requirements and exceed those requirements by enforcing local

Regulatory Floodplain Ordinances and by participating in CRS.

Insurance purposes require the NFIP floodplain maps to be based on existing watershed development. But unless plans and regulations are based on future watershed urbanization, development permitted today may well flood tomorrow as uphill urbanization increases runoff.¹² For this reason, Ponca City enforces higher standards to the NFIP in addition to NFIP standards (see sections below).

Community Rating System (CRS)

The Community Rating System (CRS) is a part of the NFIP and helps coordinate all flood-related activities of the City. Ponca City has participated CRS since 2010. The CRS is a voluntary program that seeks to reduce flood

¹² Runoff often becomes deeper and faster, and floods can become more frequent as watersheds develop. Water that once lingered in hollows, meandered around oxbows, and soaked into the ground now speeds downhill, shoots through pipes, and sheets off rooftops and paving.

losses, facilitate accurate insurance rating, and promote awareness of flood insurance by creating incentives for a community to go beyond minimum floodplain management requirements. Ponca City advanced from a Class 6 to a Class 5 community on October 1, 2014.¹³ The Class 5 rating allows Ponca City's SFHA residents a twenty-five percent reduction in their flood insurance premium rates, ranking the City in the 91% percentile of 1725 communities that participate in the CRS.

An outline of some of the City's policies and ordinances that capture CRS points, along with suggestions for improving these elements, can be found in almost every component of this section on Flood and Stormwater Management. For an overview of the City's public outreach and education activities that meet CRS requirements, see the section on CRS Outreach Activities.

Repetitive Loss Area Analysis

As of this writing, the City is completing a repetitive loss area analysis to better highlight flood risks to repetitive loss plans and to develop a strategy to mitigate properties within these areas. An overview assessment of these plans is expected for the subsequent hazard mitigation plan.

Floodplain Ordinance Permitting

Floodplain ordinances protect people and assets from flooding by incorporating design, storage, and other standards, which have proven flood mitigation outcomes, into enforceable regulation. The City of Ponca City has a higher standard of ordinance than the national or state minimum-standard ordinance. Ponca City's Drainage Design Criteria is in Title 12 Subdivision Regulation Chapter 8 Drainage design Standards. The Drainage Design Standards include criteria that meet some of the CRS credit criteria for Activity 430 (Higher Regulatory Standards). Some of these regulations are encapsulated in the City's Flood Damage Prevention Ordinance (Title 10 Building Regulations, Chapter 10 Flood Damage Prevention). The ordinance requires a permitting process to make sure that any work affecting the floodplain is approached properly. Permits address the following elements:

- **Pre-construction Elevation Certificate:** An elevation will be determined for a building that will protect it from expected flooding. This is also often required by banks if you are receiving a loan to construct.
- **Freeboard:** The City exceeds NFIP requirements for freeboard, allowing it to capture CRS points (432.b), by establishing the Base Flood Elevation (BFE; 1% annual chance or 100-year event) plus 1.0 vertical foot for all structures that are not critical facilities.¹⁴ For structures that are critical facilities or serve a critical facility, the freeboard is established at a 0.2% annual chance (500-year) event plus 1.0 vertical foot (432.f).
- **Compensatory Storage:** The City exceeds NFIP requirements for compensatory storage, which allows it to capture additional CRS points (CRS 432.a). Any fill material that reduces floodplain storage capacity must be compensated in a 1:1 ratio on the same property and under similar hydraulic and hydrologic conditions. Volumes and hydrology must be determined by a Civil Engineer licensed to work in the State of Oklahoma. All such excavations shall drain freely to the watercourse. No area below the water line of a pond or other body of water can be credited as compensatory storage.
- **Floodplain Development Permit:** This will ensure that all work done in the floodplain will adhere to the City's regulations.
- **Post-construction Elevation Certificate:** This is the final Elevation Certificate, which the City approves and keeps on file, and will be used to determine the risk (which translates into dollars) of flooding that for each new building.

¹³ The CRS has 19 activities, each with from 1 to 13 elements, that provide credit points. Participating communities are separated into classes from 1-10. Class ratings are segmented into 500-point increments. Class 1 requires the most credit points (4500+) and offers the largest premium reduction. Discounts are commensurate with classes, with Class 1 receiving a 45% discount to class 9 receiving a 5% discount. Class 10 does not reduce premiums.

¹⁴ Base Flood Elevation (BFE) is the 1% annual chance (100-year) event.

Although Ponca City floodplain ordinances collect these data, local officials and the planning team noted that Ponca City has not conducted a complete inventory of its finished floor elevations, which would be extremely beneficial in FEMA grant competitions. Finished floor elevations are not generally obtained because of the expense of collecting them.

Master Drainage Plan (Stormwater Master Plan)

In 2009, the City completed a Master Drainage Plan, named the Stormwater Master Plan, to address current flood and drainage problems and to recommend flood mitigation actions. To date, the City has completed some of the recommendations and intends to continue making stormwater improvements as funding allows. The planning team identified several components of the plan that should be updated. Some of these components are outlined below:

- The City's Stormwater Master Plan was developed before the updated Atlas 14 rainfall data were available. The current floodplains are based on rainfall that is 8.8% higher for the 1% storm (9.05" v 8.32).
- The Stormwater Master Plan hydrology model was limited to a minimum of 40 acres.
- New and additional flooding problem areas have been identified since the completion of the plan (see Chapter 4, flood section).

Other Floodplain and Stormwater Management

In addition to the floodplain permitting process, the City has other floodplain and stormwater management policies and design standards, along with mapping levels, which increase resilience. Most of these policies can be found in Title 12 Subdivision Regulation Chapter 8 Drainage design Standards. Some of these policies also increase the City's CRS point total. This is not a comprehensive analysis, but rather highlights important components and provides suggestions to enhance some of these components.

Policies and Design Standards

- **Zone A/AE Without Floodway:** Ponca requires the following higher standard floodplain management policies, which also increase the City's CRS point totals. When a regulatory floodway has not been designated, the floodplain administrator must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within zones A1-30 and AE on the community's FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood at any point within the community.
- **Substantial Damage:** Currently, Ponca requires that repairs to substantially damaged buildings or substantially improved buildings (repair or improvements that exceed 50% of the current value of the structure) be brought into compliance with the City's floodplain management regulations. The City should consider developing a Substantial Damage Management Plan (SDP) in accordance with the 2021 CRS addendum's directives (512.d). Completing an SDP could bring 140 CRS points to the City and strengthen the City's approach to mitigating substantially damaged properties.
- **Stormwater management regulations (SMR) and Design storms used in regulations (DS):** The City controls release rates from developments for the 2-, 5-, 10-, 25-, 50- and 100-year storms so that post-development runoff does not exceed pre-development runoff (12-8-20.A.3). This enables Ponca City to capture CRS points (Activity 452.a.). Although the City's higher standards regulate the size of development to 10 acres for the use of the modified rational method for stormwater detention (12-8-15.A.4), the 2021 CRS addendum limits the use of the modified rational formula from 10 acres to 1 acre. If the City continues the 10-acre limit for the

use of the modified rational method, then the City would lose 75 points because of this adjustment (50 points fewer if the impact adjustment stays the same).¹⁵

- **Rainfall calculations:** Currently, Ponca uses the Rainfall Intensity formulae taken from the 1988 ODOT “Drainage Design Manual” (12-8-4.F). The City should update their ordinance to reflect formulae from the 2014 ODOT Roadway Drainage Manual.¹⁶ The City also should update the rainfall used in the 24-hour storm from TP40/Hydro35, which is now superseded by NOAA Atlas 14 Rainfall.¹⁷
- **Time of Concentration Calculations:** Ponca should update their ordinance (12-8-15.B.4) to use the May 2010 NRCS Part 630 Hydrology, National Engineering Handbook, Chapter 15 methods for estimating time of concentration Section (b) Velocity Method.¹⁸ This would eliminate an arbitrary length that can cause an overestimate of the travel time and subsequent underestimate of the flow rate to be used for design.
- **Stormwater Detention:** Stormwater detention basins can help reduce downstream flooding. However, the pattern and volume of flood runoff can change with new development. For this reason, Ponca City should consider requiring all stormwater detention facility dams to be constructed using criteria for high hazard dams. Many communities find that development of properties or roadways downstream for these lower hazard dams cause them to be revised to be high hazard dams by the OWRB, requiring spillway modifications.
- **Erosion Protection:** Erosion and sedimentation can move valuable topsoil, dam lowlands, clog streams, and pollute rivers. For this reason, the City mandates a land disturbance permit, which requires an erosion/sedimentation control plan.

Mapping

To enhance the City’s mapping capabilities that were outlined in the NFIP section, the planning team recommends that Ponca City consider mapping and regulating based on fully developed watersheds. This can provide a factor of safety from changes brought about by increased development or new, larger rainfall requirements, as statistical rainfall estimates are updated. In addition, Ponca should consider mapping fully urbanized floodplains and regulating based on those maps. This would provide the City with additional CRS points (up to 110 points per study) under Activity 412.d. Higher study standards (HSS) when the master drainage plan is updated. Insurance purposes require the NFIP floodplain maps to be based on existing watershed development. But unless plans and regulations are based on future watershed urbanization, development permitted today may well flood tomorrow as uphill urbanization increases runoff.

Substantial Damage Plan

This plan serves as a tool to assess structures in the planning area that have received flood damages exceeding 50% of the structure’s value. Completing this plan will allow Ponca City to have a better understanding about how to prioritize funds to reduce flood risk and to capture additional CRS points. Currently, Ponca City has not developed a substantial damage plan.

¹⁵ “The regulations must require pre- and post-development hydrology calculations and post-development runoff must be limited to pre-development levels at the site boundary (credit criterion (5)). The standard used may be peak flow, volume, or a combination of the two. If the volume of runoff is controlled by retaining the runoff on site, infiltrating the runoff, or ensuring that the volume of runoff during all storms greater than half of the 2-year event remains constant, the credit is increased by 50%. If the modified rational method is used to design detention facilities for areas larger than one acre, the total credit for DS is reduced by 50%.” 2021 Addendum to the 2017 CRS Coordinator’s Manual for Activity 452.a

¹⁶ <https://oklahoma.gov/content/dam/ok/en/odot/documents/chapter-10-stormwater-drainage.pdf>

¹⁷ https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=pa

¹⁸ Time of Concentration method described in Section 630.1502. This method uses a formula for calculating overland flow that is based on an overland flow “n” value found in Table 15-1 of that reference.

<https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=27002.wba>

Building Codes and Permitting

Ponca City has a permitting process that impacts all new construction and significant improvements or repairs to existing structures. As of this writing, Ponca has adopted:

Structural Codes

Ponca City currently follows the State of Oklahoma's building code commission guidance, which includes the 2015 International Building Code, the 2015 International Plumbing Code, and the 2015 International Mechanical Code. Ponca City follows the 2007 Electrical code. These codes, in combination, provide a helpful mitigation tool against the hazards identified in the risk assessment, to some degree or another. Ponca City can improve its resiliency, however, by pursuing the 2021 International Building codes, which are the most updated codes as of this writing. These codes include best practices for mitigation that is beyond the scope of this assessment. They enhance the City's potential to meet the criteria for some competitive federal grant programs, like BRIC.

Fire-related Codes

The City currently follows the 2021 NFPA Life Safety Code 101 and the 2015 International Fire Code. The NFPA Life Safety Code focuses more on mitigating the human health effects caused by fire by focusing on building design, construction, operation, and maintenance. The 2015 Fire Code takes a broader approach to fire mitigation efforts, by also focusing on administration and some other prevention measures. Ponca City can improve its resiliency, however, by pursuing the 2016 International Fire code, which is the most updated fire code as of this writing (for some reasons, see Structural Codes section above).

Vulnerable Residential Structures

Mobile homes are more at risk to high wind and earthquake events due to their construction than other residential homes. Compared to other homes in the City, mobile homes are often constructed with materials that cannot withstand high wind events and are often not anchored securely to the ground. In addition, manufactured homes and modular homes can be more at risk, depending on their requirements for construction. There are three main mobile home parks in Ponca City: Meadowbrook, Kay County, and Big Country. Manufactured homes must meet HUD construction standards and be elevated to mitigate against flood events and to be tied down and reinforced to mitigate against high wind events.

Zoning, Subdivision, and Landscape

The City's zoning code regulates the types of uses or densities that are allowed. The Comprehensive Plan discusses how its cascading structure occasionally allows incompatible land uses to occur adjacent to one another. The code uses several different districts, Residential (R1, R2, R2-M, R3, and PUD), Commercial (C1, C2, CBD), along with Light Industrial, Moderate Industrial, and Heavy Industrial (L1, L2, L3). In addition, Ponca City also has development criteria for mobile home parks and mobile home subdivisions (RMHP, RMHS).¹⁹ RMHP are the only areas where mobile home building is allowed, while RMHP and RMHS are the only places that permit manufactured homes. Other than these restrictions, the City code does not seem to have any other stipulations on mobile or manufactured homes building areas. The zoning code also includes some regulations related to setbacks, lot size, and parking.

The City outlines development design criteria for development of residential, public, and infrastructure projects, which can minimize the risk of flooding and fire, along with limiting pollution and biohazards, like e coli (for more information on flooding, see section on flood and stormwater management). Fire hazards are limited by specifying building materials and minimum distances.²⁰ In addition to these fire regulations, Ponca City mandates that citizens who wish to burn within city limits complete a burn permit and submit it to the City.

¹⁹ Title 11

²⁰ Title 12

In addition to Zoning and Subdivision regulations, Ponca City's landscape regulations require that owners maintain their properties to protect electrical lines. The tree trimming services Ponca City provides also assist with maintenance, especially for the more vulnerable populations who may be physically incapable of upkeep. In addition, owners are required to maintain and trim vegetation, which has the secondary effect of reducing fire hazards and reducing erosion, in some cases.

Structural Assessment and Enhancement Programs

BCEGS

Insurance services office (ISO) is an independent body that rates the effectiveness of certain community capabilities, including fire capabilities and building codes. It provides an assessment of a community's building codes, called the Building Code Effectiveness Grading Schedule (BCEGS) rating. This rating focuses on a codes' mitigation capabilities and vulnerabilities to hazard events, which can give communities deeper insight into their mitigation strengths and weaknesses. Like ISO's other rating systems, BCEGS is rated from 1 to 10, with 1 being the best rating and 10 as not meeting ISO's standards. In addition to increased resilience, communities are assigned credit ratings based on ranges of BCEGS classifications (1-3, 4-7, 8-9, and 10). During Ponca City's most recent verification process in 2019, Ponca City received a 4 for residential and 4 for commercial rating, placing the City in the ~22% for residential and ~33% for commercial in the state of Oklahoma.²¹

IBHS

In addition, future development throughout the planning area could be less vulnerable to high wind events if higher building standards are implemented. In 2018, insurance companies began offering discounts on insurance premiums for homes constructed to the Insurance Institute for Business and Home Safety's (IBHS) fortified home standards. Homes constructed to this structural capacity can withstand winds up to 130 mph, which includes 95% of tornadoes. Although building to IBHS can reduce structural vulnerability to many hazards, they seem most impactful at reducing vulnerability to Tornado/ High Wind, Hail, Fire, and Earthquake events.

Ponca City makes information available on their website about improving structural resistance to wind, but these recommendations are not explicitly IBHS. For more information on educational materials that Ponca offers as of this writing, see the Tornado/High Wind section.

Fire Suppression Rating Schedule

In addition to the City's mitigation capacity through fire building codes, ISO offers a Fire Suppression Rating Schedule (FSRS) for fire companies throughout the Nation. The FSRS is evaluated on four weighted performance characteristics:

- Emergency Communications
- Fire Department
- Water Supply
- Community Risk Reduction

There are 9 classes of fire rating, as of this writing. Ponca City achieved a class 3 from ISO in 2013. The planning team recommends that the City reverify with ISO to determine its class rating, since ISO has added the community risk reduction component since the 2013 reverification.

Economic Development Plan

The City of Ponca City's Comprehensive Plan provides a discussion on economic development in Chapter 6. The development plan chapter focuses on partnerships and enhancing local businesses, especially key employers like ConcoPhilips (for a list of key employers, see Chapter 1). The chapter highlights Ponca City resources,

²¹ <https://www.isomitigation.com/bcegs/facts-and-figures/>

including its Chamber of Commerce and the Ponca City Development Authority. The development strategy aims to attract talent to join its workforce, especially young and professional workers. The influx of increased workers can bolster the City's tax base, providing the City with additional financial capabilities for mitigation projects. Although this economic development strategy may apply to Ponca's current conditions, the City may want to reconfirm that the economic conditions that drove the strategy still apply to the City.

Transportation Plan

Ponca City's transportation plan is included as chapter 4 in the City's Comprehensive Plan. The plan prioritizes mobility, connectivity, and thoroughfare. The plan also integrates with the Capital Improvements Plan to execute on these goals. One of the priorities for the transportation plan is to improve emergency response. These emergency response capabilities should include evacuation considerations, which are not explicitly mentioned in the plan.

Debris Management Plan

The Debris management plan helps the City manage and properly dispose of debris following Flooding, Severe Winter Storm, Tornado/High Winds, Hail, or Earthquake. This enables the City to safeguard human health, minimize disposal footprint, limit environmental impacts, and comply with existing regulations. The City's Debris Management Plan also outlines fees and estimates on debris types.

The Plan was last updated in 2015. The City should ensure that the site selection and priority removal locations continue to match their priorities, especially in the light of recent and future development.

Brownfields Remediation

To the planning team's knowledge, the City has not identified any brownfields projects.

3.2 Administrative and Technical Capabilities

Other administrative and technical capability refers to the community's staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions, except for flood and stormwater activities. It also refers to the ability to access and coordinate these resources effectively. Administrative and technical elements of Ponca City's floodplain and stormwater management are included in this section.

3.2.1 Overview Assessment

Key

Dedicated Resources/Personnel	●
Addresses/Includes the Capability	◐
Not included at all	○

Personnel and Technology

Mitigation Planning Committee	●
Emergency Management	●
General Planning Committee	●
Floodplain Administration	●
Utilities/Streets Departments	●
Engineering	●
Building Inspector/Building Code Enforcer	●
Mutual Aid Agreements	◐
Warning Systems/Services	◐
Virtual Connectivity	●
GIS Capabilities	◐
Backup Generation	●

3.2.2 Qualitative Assessment

Mitigation Planning Committee

Ponca City established a mitigation planning committee to complete this hazard mitigation plan, which it has done to complete previous hazard mitigation plans. This committee is composed of people from City Engineering, the emergency management department, utilities departments, and other relevant departments. The planning committee also benefited from the guidance of external stakeholders within and outside Ponca City. Following

the adoption of the plan, however, the Ponca City plans to use this committee as the basis for the City's program for public information, which will be a standing hazard mitigation committee (see PPI, Chapter 2, and Chapter 6).

Emergency Management

Ponca City has a full-time emergency management director, which has served the city for more than two decades. All other members of the department are volunteers. There are approximately 6 to 7 volunteers at any given time. The emergency management office helps develop and execute plans related to emergency management and hazard mitigation, including the City's Emergency Operations Plan and Hazard Mitigation Plan. They assist with maintaining their StormReady certification from NOAA, public warnings, sheltering when required, and educational outreach about hazards. In addition, the emergency management office helps coordinate emergency preparedness exercises for the city and with city partners, including USACE, the National Weather Service, Phillips66 and Alliance Health.

General Planning

Ponca City has a planning 9-member voting planning committee, which is composed of government officials and citizens. Committee members are elected to 3-year terms. The planning commission addresses topics relate to hazard mitigation, including development, city planning, and related activities. Most specifically, the planning committee also serves as the zoning commission for the city. The Committee's regular meeting cycle is monthly (for stormwater/floodplain management see Flood and Stormwater Management Section).

Floodplain Administration

The City has three Certified Floodplain Managers (CFMs) who can assist citizens with planning and implementing a flood-safe project in accordance with the City's floodplain development policies. All of the CFMs also have other roles and responsibilities for the City. As discussed in the permitting section, floodplain managers coordinate with other entities, such as the permitting officer, to determine if a floodplain development permit is required. Currently, CFMs also oversee Ponca City's NFIP and CRS programs. The City's CFMs also have assisted in the procurement and execution of funds for stormwater reduction programs, including a flood buyout of substantially damaged structures in the City.

Based on a preliminary analysis, the floodplain managers are capable to carry out their duties, both in terms of knowledge and staffing power. That being said, Ponca City could enhance its CRS outreach activities, which are addressed below. Any other recommendations are outside the scope of this assessment. For activities related to CRS, see the Education and Outreach section below.

Utilities/Streets Departments

Ponca City relies on two departments to cover utilities and streets in the city. The Public Works department covers streets and drainage, stormwater, and other activities for the city. These activities under Public Works are headed by a full-time Assistant Public Works Director, and a fleet superintendent. In addition, the City collects a stormwater fee (see financial section) that helps protect the environment by transferring runoff containing debris, chemicals, dirt and other pollutants to ditches, culverts and catch basins and storm sewers.

Response Network/Mutual Aid Agreements

Ponca City benefits from a network of partnerships from internal to and external to the City. This summary provides an overview of Ponca City's response network and mutual aid agreements and should not be seen as a comprehensive list. Ponca City has established several external agreements to support its residents and the residents of Kay County:

- **Public Health:** Ponca City assists the rest of the incorporated and unincorporated areas in Kay County by providing public health assistance (via their public health department location in Ponca City), support the

funding for volunteer organizations and provides emergency and non-emergency medical transport throughout Kay County.

- **Tribes:** As of this writing, Ponca City is pursuing opportunities to strengthen its relationships with some of the neighboring Tribes. Tribes from the surrounding jurisdictions were invited to participate in the planning process.
- **Volunteer Organizations:** Ponca City partners with the American Red Cross, New Emergency Resource Agency (NERA), VOAD, United Way and Peachtree Landing Inc.

The city also relies on partnerships within the planning area. All city response departments, including the emergency management office, police, fire, and other agencies collaborate frequently and effectively. In addition to interagency cooperation, the Conoco Philips facility has their own fire and hazmat units who assist Ponca City on some emergency calls when needed. In particular, the ConocoPhillips unit is the unit that leads the response to hazardous materials incidents, given their experience, education, and training with hazardous materials (for financial partnerships, see the financial section).

Warning Systems/Services

Electronic Communication Systems

Ponca City was the first city in the state to be equipped with the enhanced 911 service. The city utilizes their website for the most current updates and if there is a hazard or threat to the community sirens, text notifications and robotic calls are made to warn citizens and notify them if evacuation is necessary. For more information and more frequent alerts, Ponca City is looking into obtaining their own app that citizens can opt in or out of such as CivicReady, which can send notifications if a disaster strikes or if there is a warning. The app should have multilingual capabilities and could manage Ponca City's internal team as well during a crisis.

Sirens

The Emergency Management Department operates outdoor emergency sirens throughout Ponca City. These federal signal storm sirens cover the entire planning area, including the school district. Kay County has also installed sirens near and around the planning area. All sirens can function and can be activated remotely, which can shorten residents' and emergency responders' warning times. The sirens are tested every Thursday of the month each month. Although these sirens have been used for tornadoes/ high winds primarily, they also could be equipped to warn residents during dam incidents, lightning events, hail, fire, and hazardous materials events. Ponca City learned from other counties and cities in Oklahoma to not use their sirens in cases of extreme flooding because residents can be seriously injured or killed if they try to evacuate and get trapped in deep waters.

Building Inspection/Building Code Enforcement

Ponca City has a building services division, part of neighborhood services. They department is responsible for permitting and inspecting new construction projects to determine compliance with the 2015 ICC building codes and the 2014 NEC code as adopted by the Oklahoma Uniform Building Code Commission. Ponca City intends to improve these codes to meet the 2018 International building standards, which is concurrent with the State of Oklahoma's adoption of these codes. Ponca City would benefit from enforcing more recent codes, which offer addition protections from hazard events, including high winds and extreme heat and cold.

Grant Writing

Ponca City has a full-time grant administrator who writes and oversees grants, and assists City employees from other offices who have successfully obtained grants, from several state and national grant programs, including:

- Certified Local Government Grant (CLG)
- Community Development Block Grant Small Cities Set-Aside (CDBG)

- FEMA Hazard Mitigation grants, including the Hazard Mitigation Plan Update grant and Flood-prone Property Acquisition grant
- Transportation Alternative Program (TAP) – Lake Ponca Trails
- Assistance to Firefighters grant (AFG)

The grant administration department also oversees the CDBG programs, the homebuyer assistance program, the comprehensive demolition program, and the interim assistance/special services program.

Engineering Personnel

The Engineering department consists of the primary city engineer and the assistant city engineer. The city engineering division of the development services department maintains infrastructure records of the city and provides support services to all city departments. These services include construction inspection, engineering design, geographic information services, land survey, planning, project management, and public resource information.

Virtual Connectivity

With internet resources becoming more and more important in receiving and delivering information, this data provides an idea for how valuable an internet presence or mobile applications can play in reaching a large proportion of the population before, during, or after a disaster. In addition, relationships between emergency management and social programs that reach access and needs populations (experiencing homelessness, elderly, etc.) can help to better identify needs and prepare those populations to withstand and recover from events.

Ponca City offers city-wide free Wi-Fi provided through their technology services department. For a fee (paid to the utility billing office), Ponca city offers fiber optic broadband to businesses and citizens within the boundaries of Ponca City and the majority of Ponca City School District. As of the writing of this Plan, Ponca City is rolling out a \$12 million broadband service, which will be installed in phases throughout Ponca City over the next several years. This is the fastest internet access available and is 100% fiber optic, requiring a service plan with varying Mbps/Gbps. Construction is in phase 4 and 5, which is estimated to begin in December 2021 with a planned completion date of December 2022.

Geographic Information Systems (GIS)

Personnel

Ponca City's GIS manager oversees the city's GIS data system and is assisting with creating a website for public access. The City's GIS manager works full time and works independently without additional staff. The GIS team is imbedded within the City's engineering department.

Technical Capabilities/ Data Collection

Concurrent with this plan update, Ponca City is developing a hazard viewer that will allow the planning team and other members of the City government access to historical hazard locations, probable hazard locations, vulnerable structures and populations, and other relevant information. In addition to this viewer, the City also has collected information related to related programs, including hazardous waste and cyber security.

The planning area would benefit from additional information that would be helpful for hazard mitigation and emergency response. The planning team identified additional needs in three key areas:

- Identify and model critical components of the built environment
- Provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms
- Develop the ability to distribute information on risks through web-based and mobile technology (for more information see the Warning Systems/Services Section)

In the future, the planning area should consider incorporating weather updates into its GIS applications. GIS capabilities allow personnel to develop platforms that integrate detection systems, like weather, into mapping, which helps local officials and emergency management personnel identify threats more clearly in real-time. In addition, the planning area would benefit from an improved understanding of the needs of their populations and the best forms of outreach. Outreach methods preferred by the residents of Ponca City were identified during a public survey distributed during the planning process.

Backup Generators

A power outage can cause critical facilities like hospitals, emergency response, and government facilities to be unable to provide basic services including:

- **Water and Wastewater** – Residents unable to access water likely would not be able to meet basic needs, such as drinking, washing, bathing, and cooking. A partial, or complete loss of water/wastewater plant also can impact businesses and the economy in the planning area. Although all critical facilities are hindered by a lack of clean water and wastewater, some critical facilities in the planning area may be unable to perform basic services without access to potable water and a wastewater distribution system. These facilities include hospitals and other medical facilities, Emergency Response Units (includes fire departments and police departments who fulfill this function), and community centers and shelters
- **Emergency Response Units (Safety and Security Lifeline; Health and Medical Lifeline)** – A prolonged power outage, however, could disrupt these units' ability to charge their mobile communications systems (radios, hand-held devices, etc.), which could lead to a communication breakdown.
- **Health and Medical Facilities (Health and Medical Lifeline)** – A power failure at these critical facilities could disrupt all core functions at these facilities, from routine appointments to invasive emergency surgeries. In the event of a power failure, emergency patients would have to be rerouted to other medical centers, which would increase the time until they received a medical intervention (in terms of travel time and waiting times from overloaded centers). Increasing the time until medical intervention can increase these patients' risk of complications and can decrease their likelihood of survival. During a prolonged power outage, patients with routine appointments often are pushed into a backlog of later appointments, which has the overall effect of limiting preventative medicine immediately after the outage and during the recovery period.
- **Government Operations (Safety and Security Lifeline)** – A power outage in a government building is likely disrupt communications and decision-making, since both components rely on tools that use electrical power. According to reports from the participating jurisdictions, most government buildings in the planning area do not have adequate backup generation.

These outages can be caused by any of the hazards listed in the risk assessment (Chapter 4). A way to safeguard against a power outage is to have a back up generator, which could maintain core functions of these critical facilities. Ponca City officials reported that all current government owned facilities currently have backup generation in the event of a power outage. The City should ensure that all new critical facilities have backup generation. In addition, Ponca City officials should test to ensure that their current generators meet the standards across these categories: The planning team identified several factors that would make these power sources more prone to failure. These factors include:

- Age of the unit (exceeded the unit's product lifetime)
- Storage location of the unit (not elevated off ground; exposed to weather)
- Lack insulation of the unit (from extreme heat and cold)
- Time that the unit is activated (Overheating during periods of extended use)
- Time when the unit is activated (delays to activate in extreme heat or cold)
- Failure to conduct regular tests of the unit
- Lack of available gasoline/diesel to power generator

3.3 Financial Capabilities

This section includes the financial leverage the planning area has accessed, can access, and could access. For specific plans that authorize or enable access to these financial capabilities, see the planning and regulatory section.

3.3.1 Overview Assessment

The planning team grouped Ponca City's past, present, and future access to financial resources into internal and external capabilities. Internal financial capabilities refer to financial resources generated by the city. External financial capabilities refer to all funding opportunities that are not generated internally. For external funding sources, the planning team focused on state and federal funding, along with local and regional partnerships with other entities since these avenues seemed to be most important to accomplish the planning area's mitigation goals.

3.3.2 Qualitative Assessment

Internal Financial Capabilities

This section provides an overview of internal funding sources that Ponca City could use to fund hazard mitigation projects. Internal funding sources can be broken into two categories: revenue from taxes and fund raised through financing. Some of these funding streams are allocated for specific activities (see planning and regulatory and administration and technical sections for some examples).²² Overall, the City collects several million dollars from funding streams and more than 10 million from market funds. For example, revenue from aggregate taxes (relevant to mitigation) for the 2020-2021 year exceeded \$7 million, while funding from financing exceeded \$10 million.

Taxation

Sales Tax: Ponca City has one of the highest sales tax rates in Oklahoma, at 9.25% for an aggregated state, county, and local tax. After state and county taxes, Ponca City's sales taxes. Ponca City does not have an applicable special tax for sales taxes.²³ These taxes have been used in the past to fund mitigation projects and serve as a match on other projects.

Ponca City's sales tax revenue benefits from the City's influx of tourists. Although tourism is not an explicit revenue stream, it increases the City's revenue from sales taxes and provides jobs for residents. Ponca city tourism brings thousands of dollars of revenue each year to the City. The history behind the city can be seen through the lens of the Marland Mansion, and the Standing Bear Museum, arts and culture is enjoyed through the Ponca theater, the city's architecture, Ponca City Library and Attucks community center. In addition to arts and cultural attractions, Ponca city also offers outdoor recreation activities, with an emphasis on water recreation in Lake Ponca.

General Utility Tax: Along with sales taxes, Ponca City's utility tax constitutes the largest tax-based revenue stream that the City can use for mitigation activities. Ponca City's utility tax applies to water, electric, sewer, solid waste, and storm drainage. Some of the taxes must be allocated to specific activities, including:

- The general fund (see capital improvements plan in the Planning and Regulatory section)
- Streets and street maintenance (see utilities/streets departments in the Administrative and Technical section)

²² Some other sources of internal funding are generated through tree line trimming, electric, garbage or refuse charges, automatic water fill station in town, landfill use, and property taxes.

²³ The 9.25% sales tax rate in Ponca City consists of 4.5% Oklahoma state sales tax, 0.917% Kay County sales tax and 3.833% Ponca City tax.

- Sewer systems and maintenance (see below)
- Stormwater systems and maintenance (see below)

This utility tax is composed of several subcomponents that fund various activities. The planning team has highlighted one of the specific utility fees below.

Sewer taxes exist primarily to fund the maintenance of these systems in the City. Well-maintained systems reduce communities' vulnerability to hazards since these systems are better equipped to handle the impacts of hazard events. In addition to general maintenance activities, the City can exercise some discretion regarding how to use these funds.

Stormwater Fee: Ponca City also charges residents a stormwater fee for the express purpose of maintaining and funding stormwater projects. Similar to a sewer system, well-maintained stormwater systems reduce communities' vulnerability to flooding since these systems are better equipped and designed to handle the impacts of high volumes of water.

E911 Tax: In addition to utility taxes, the City levies a nominal Emergency 911 fee on residents in the planning area every month. The tax funds the E911 service in the planning area.

Financing

Most of Ponca City's financing for hazard mitigation-related activities arises from bonds (fixed-income). The City could use other financing mechanisms in extreme cases, although it has not done so historically.

Bonds: Departments within Ponca City can issue bonds for longer term mitigation projects, including projects in the City's capital improvements plan. In recent years, Ponca City Utility Authority has issued bond notes amounting to millions of dollars for projects including the broadband for the City, along with new water and electric meters, new street lighting, and some HVAC projects.

Rainy Day Fund: It is important to note that this fund currently is not used for projects. Instead, it is used to fund budget shortfalls. In addition, the City Council must vote on its use. This being said, if the City were to fund an emergency response or mitigation project in an extreme situation, the City could do so much more quickly and effectively than the other financial options in this assessment. The scope could be used for any action, mitigation, response, recovery. Additionally, there is not a cap per project. Given the City's historical record of use of this fund, it is unlikely to be used as a funding mechanism for hazard mitigation unless its general use changes or an extreme scenario demands immediate and rapid funding, which cannot be acquired from other sources.

External

State and Federal Programs

Jurisdictions in the planning area indicated that they pursue funding from federal, state, and other governmental sources, as appropriate. Most of these programs are governed by specific use and eligibility requirements and include a local cost share. Below are some external funding sources that these jurisdictions can access:

Table 3-2 External Funding Sources

Possible Funding Source	Uses
Capital Improvement Program	CIP funding is used for various infrastructure projects throughout the county and participating communities.
Incur debt through General Obligation or special tax bonds	Bonds are used to fund specifically identified projects.
Community Development Block Grant	CDBG are typically used to enhance functional needs populations.

Possible Funding Source	Uses
Hazard Mitigation Assistance	Federal HMA grants are used for mitigation projects whenever possible.
Federal Highway Administration Funding	FHWA funding is used for eligible transportation projects.
County Improvement Roads and Bridges	This is an important source of resources for improving transportation infrastructure.
Oklahoma Water Resource Board	OWRB loans are used for water and sewer projects and can also be used for stormwater drainage projects. The potential exists to use these funds as a match.
Emergency Management Performance Grant	This is a federal grant program that funds various emergency management program needs.

Partnerships

Jurisdictions in the planning area benefit from robust partnerships from entities inside and outside Ponca City's borders. These partnership capabilities extend to partners who can provide financial resources for mitigation activities or who can serve as financial partners on a mitigation project. Large stakeholders, especially utilities could serve as partners for projects that include upgrades to utilities or their delivery infrastructure.

Some of the largest potential partners in the planning area are Kaw and Ponca tribes as well as Osage Nation which is on the outskirts of the city and already partakes in business partnerships with the city. Tribal Nations often receive federal funding for a multitude of projects but do not always have the amount of personnel needed to complete the projects. Partnerships between the city and tribes can assure timely execution of much needed projects for the two parties.

Kay County is another partner to continue a partnership to develop and improve projects in and around the City. Ponca City receives tangential benefit from the maintenance of roadways that connect the City to the rest of Oklahoma and rural fire departments, which fall under the jurisdiction of Kay County. Kay County, which maintains these roadways, receives appropriations from the State to maintain County roadways. Most of this tax revenue and funding has been used to fund two mitigation-related activities: roadway improvement projects (combination of revenue streams) and vehicles and equipment for rural fire departments (sales taxes).

For larger partnerships regarding fighting wildfire rural firefighter volunteer teams and Kay County could assist with preventing damage to surrounding area. Ponca City is hoping to establish a water line from Kaw Dam, which has the potential to be mutually beneficial for both the county and city through a new taxation law where funds are provided to the county and the city would sustain adequate drinking water for periods of drought.

3.4 Educational and Outreach Activities

This section refers to preventative educational activities—i.e. activities that occur before a disaster—with the exception of activities needed to fulfill the CRS requirement (see floodplain and stormwater management section). Educational and outreach elements of Ponca City’s floodplain and stormwater management are included in this section. For outreach capabilities during a disaster, see mutual aid agreements. For outreach capabilities during a disaster, see mutual aid agreements.

3.4.1 Overview Assessment

Key

Has a Program	●
Does not have a Program	○

Programs

PPI	○
Other CRS Outreach	●
FireWise	○
Home Fire Campaign	●
StormReady	●
Fairs, Festivals, and Similar Activities	○

3.4.2 Qualitative Assessment

Program for Public Information (PPI)

The Program for Public Information Committee is a committee composed of specific stakeholders and dedicated to outreach for flood hazards under FEMA’s Community Rating System (CRS; see planning and regulatory section). Not only is the PPI committee useful to capture CRS points, lowering a community’s insurance rate, but it also enhances a community’s flood, stormwater, and dam outreach through a series of specific, designed activities. The 2017 CRS Coordinators’ Manual, along with the 2021 Addendum to the Coordinators’ Manual, highlight the need for certain personnel to participate in the PPI process, and incentivize communities who include these personnel.

Currently, Ponca City’s CRS activities are overseen by the CFMs and supported by other staff and personnel. The planning team recommends that Ponca City form a PPI committee. To this end, the planning team has established the stakeholder group to include personnel needed to enhance the City’s floodplain outreach and education and to maximize CRS points for nearly all the activities in the CRS outreach section outlined below.

Other CRS Outreach Activities

Ponca City completes the activities necessary to allow it to maintain a Class 5 CRS rating. This section provides an overview on City of Ponca's CRS educational and outreach activities, along with suggestions to improve outreach activities. According to ISO's most recent report, Ponca City maintains these general activities:

- **Outreach Projects:** Ponca City completed targeted and general outreach projects on flood hazards in the City. The City maintains general flood brochures in City Hall and sends targeted messages to residents in the Special Flood Hazard Area (activity 330). The City could enhance this program and increase these points by developing a PPI Committee as the dissemination arm for all outreach projects (see below).
- **Flood Hazard Disclosure:** The City requires disclosure of flood hazard upon the sale of a property (activity 340). The City could enhance this program and increase these points by developing a PPI Committee as the dissemination arm for all outreach projects (see below).
- **Flood Protection Information:** The City maintains relevant flood documents in the public library and maintains a website with flood information (activity 350). The City could increase points for the web application by developing a PPI Committee as the dissemination arm for all outreach projects (see below).
- **Flood Protection Assistance:** The City meets nearly all the CRS activities for flood protection assistance through a similar dissemination method as the Outreach Projects (activity 360). The City could enhance this program and increase these points by developing a PPI Committee as the dissemination arm for all outreach projects (see below).
- **Flood Insurance Promotion:** The City meets nearly all the CRS activities for flood insurance coverage assessment but could capture additional points for their coverage improvement plan, or its implementation (activity 370). The City could enhance these programs and increase these points by developing a PPI Committee as the dissemination arm for all outreach projects (see below).
- **Floodplain Management Planning:** This Plan also will serve as the City's floodplain management plan (activity 510). The public was involved in a way to maximize the Plan's efficiency and the possible CRS point totals. A repetitive loss area analysis will be conducted as a separate study.
- **Stream Dumping:** Ponca City could enhance its CRS credit by disseminating its ordinance on Stream Dumping through a medium approved by the CRS (activity 540).
- **Flood Warning and Response:** The City did not report on any flood warning and response activities (activity 610). Concurrent with the update of this Plan, the City is engaged to develop and report some flood warning and response activities.
- **Dams:** The City completed activities to meet the dam safety program but could enhance this program by developing and reporting activities pursuant to the CRS requirements for dam failure warning, response operations, and critical facilities planning (activity 630). Concurrent with the update of this Plan, the City is engaged to develop and report these activities.

FireWise

FireWise is a voluntary program for communities that meet a set of criteria. FireWise provides education and collaboration resources for residents and community members to enable them to lower the threat of wildfire to homes. Ponca City is not a FireWise community as of this writing.

Home Fire Campaign

The American Red Cross sponsors the Home Fire Campaign program, which is an educational outreach program developed to help save lives by installing free smoke alarms in homes that don't have them, and by educating people about home fire safety. If citizens cannot afford to purchase smoke alarms or are physically unable to install a smoke alarm, the Red Cross is able to assist with funds.

StormReady

StormReady is a national program that encourages grassroots efforts in communities to establish resilient storm communication and awareness systems. Ponca City is a StormReady community. To participate in the StormReady program, communities must have:

- Establish a 24-hour warning point and emergency operations center
- Have more than one way to receive severe weather warnings and forecasts and to alert the public
- Create a system that monitors weather conditions locally
- Promote the importance of public readiness through community seminars
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.²⁴

Fairs, Festivals, and Similar Activities

Ponca City offers some public events, which are a critical avenue to spread information to the public. Oftentimes, these events are the only time that the public will interact with the people involved in hazard mitigation and response for the City. County Emergency Management and Fire Companies hold several events at local stores and schools annually to spread awareness. All entities should continue to prioritize and publicize these activities.

²⁴ <https://www.weather.gov/StormReady>

3.5 Ponca City School District Capabilities

Public school districts are vital to Ponca City's and the surrounding communities' livelihood, daily functioning, and support system during and after disasters. Schools not only provide more educational services, but also can be a key resource for safety to students, families, and their surrounding communities.

It is important to note that the observations in this section reflect the planning team's assessment of the school district's capabilities based on responses from school officials and desktop research. Additional studies to fill gaps in responses, along with expert analysis, are outside the scope of this section, but nevertheless would benefit this analysis.

3.5.1 Overview Assessment

The planning team divided school district capabilities into two categories: district-wide capabilities and school specific capabilities. District-wide capabilities refer to capabilities that are uniform across the school facilities in the district. For this reason, all schools within the district are assessed as a single unit. School-specific capabilities refer to capabilities that differ by school facility. In this instance, schools within the district are addressed separately. School-specific capabilities are denoted by an asterisk following the name of the capability.

Key

Exceeds the state of Oklahoma's guidance or standards	●
Meets the state of Oklahoma's guidance or standards	◐
No capabilities, almost no capabilities	○

District-Wide Capabilities

Emergency Operations Plan	●
Technology/Virtual Capabilities	●
Hazard Mitigation Personnel	●
Personnel Training	◐
Drills	◐
Educational Partnerships	●
Communication	●
Building Codes	◐
Funding	◐
Areas of refuge*	●

District-Wide Capabilities

Shelters*



School-Specific capability

3.5.2 Qualitative Assessment

Emergency Operations Plan (Safety Action Plan)

All public schools in Oklahoma must meet state standards for student safety. These include lifesaving activity, developing a school safety and emergency plan, sheltering procedures, and other activities. Most of these activities involve checklists, contacts, and locations for lifesaving activity. Although extremely important, these lifesaving and response standards are focused on incidents that occur on school grounds and do not address many pre-disaster mitigation activities.

To meet these guidelines, Ponca City School District has an established safety action, which governs all school facilities within the district. Administrators of each school facility have access to the safety action plan. The plan outlines the roles and responsibilities for staff members during emergency events (e.g. active shooter) and natural hazard incidents (e.g. flooding). The plan also includes a safety committee and a crisis team (see personnel section).

This plan, along with other plans in the district, has a routine maintenance schedule. Ponca City School district reviews the hazard components of these plans at the beginning and end of the academic year.

Technology/Virtual Capabilities

Technology capability refers to the devices that students and staff can access within and outside school property. Ponca City students and staff have hot-spot capabilities for devices (Chromebooks and iPads) provided to each student, and for the teachers teaching remotely. Each student has a chrome book as well, this allows students to learn remotely during a public health emergency or during inclement weather.

Virtual capability is an assessment of the broadband capabilities inside and, especially, outside of school grounds. All students and staff in Ponca City School District can access broadband on and off school grounds. All schools within the District reported offering portable hotspots to students during the coronavirus pandemic. Each school also offers take-home chrome books that connect to the hotspots for virtual learning.

Hazard Mitigation Personnel

Ponca City school district has several roles that overlap with some hazard mitigation and (mostly) response activities. The school district should ensure that personnel in these roles have sufficient time and resources to consider hazard mitigation and response activities. In particular, the school district should include these personnel in discussions about structural and planning activities that overlap with hazard mitigation activities.

Safety Committee and Crisis Team

Per the school action plan, each school within the action plan is mandated to maintain a safety committee and a crisis team. The safety committee must consist of the principal, two teachers, two parents and two students at minimum. The crisis team is made up of the principal, teachers, custodians, counselors, and/or others. More information is needed to determine which mitigation activities include these teams, if any.

Operations Officer

All 11 schools within Ponca City School District have a dedicated operations director. The operations director is the point person during a natural hazard event. The operations director's responsibilities overlap with many of

the response requirements needed in the aftermath of a hazard event, such as sheltering of staff and students, operations and transportation coordination, and related activities. The operations director is also involved in emergency planning activities.

Personnel Training

This section refers to hazard mitigation and response trainings that staff at the school district receive. highly trained School Resource Officers, and the Ponca City Public Schools (PCPS) safety board help maintain high levels of safety and preparedness across the district. Employing a workforce of over 279 teachers and hundreds of support employees, Ponca City has opportunities for teachers of all disciplines and support staff to participate in personnel training related to emergency response and hazard mitigation.

The school district follows the state of Oklahoma's guidance for disaster drills (see below), which include personnel. Most of the training for the school district includes hazardous materials training. The School District trains school personnel in hazard communications and hazardous chemical training and awareness.²⁵ Asbestos hazard emergency response act training is conducted for two hours annually for all maintenance and custodial staff. Fire extinguisher training, bloodborne pathogen training, shelter-in-place for terrorist attacks, and hazmat incidents training is provided to all staff.²⁶

This training, although useful, does not address mitigation or response efforts directly. These types of trainings can include proper sheltering techniques during high wind and tornado events, parts of built environment at higher risk of collapsing, and others.

Drills

This section refers to school-wide activities that require staff and students' participation. Each school facility abides by state and federal law by performing fire drills four times per year, twice each semester for elementary schools and six times per year twice each trimester for the secondary schools. The fire marshal also drills and inspects each school every year. Tornado drills are practiced in September and March of each school year. Annual drills also include security drills such as unwanted intruder, lockdown, and active shooter. In total Ponca City School District conducts 12 different types of drills throughout the school year.

Educational Partnerships

The following education and outreach programs and methods are already in place and could be used to implement mitigation activities and communicate hazard-related information.

American Red Cross: The American Red Cross participates in a wide variety of preparedness and response activities. They also provide a significant amount of education and public outreach material related to safety. They are a strong resource during mass-care events and partner with the schools to assist in emergency situations. These events are often held at Ponca City high school.

Ponca City School District also offers the following Ongoing Public Education or Information Program and Certifications:

- Local firefighters set up a blow-up version of mobile safehouses for educating students
- StormReady Certification (see outreach and education section)*

²⁵ Safety data sheets are made available to all personnel and outside contractors who work in the buildings.

²⁶ Specific training such as location of all main cutoffs for gas, water and electric, lockout/tag-out training is provided to maintenance staff whereas medication administration and ladder safety, CPR etc. is provided to site secretaries.

* In conjunction with Ponca City

- Firewise Community Certification (see outreach and education section)*
- Home Fire Campaign (see outreach and education section)*
- Bomb threat training and drills
- Earthquake drills, including a “Midwestern Shakeout”
- Safe House FireLife Safety Council

Communication

Ponca City School District continually informs students and parents about dangers of natural, chemical, and man-made hazards that threatens their students, along with best practices to protect themselves. The schools provide hand-outs and numbers to call in case of questions. The school continually updates parents/guardians of their children’s safety, whereabouts and emergency plans via the internet, TV and radio broadcasts and interviews, text messages and automated calls. There are designated individuals with specific responsibilities for every scenario within the schools Safety Action Plan along with necessary numbers to call in case of emergency or assistance.

When students are unable to be transported home or picked up from school due an emergency, schools shelter students at locations near to their facilities, such as recreational centers, churches and other safe areas. Students can remain in these locations until the schools communicate with the parents and guardians to pick up their children.

Building codes

Ponca City public schools enforces the ICC 2015 building codes for their facilities and are looking to further improve the safety of their students and staff by updating the buildings to 2018 standards, which is concurrent with the state of Oklahoma. 2021 codes are the most current codes available at the time of this writing.

Funding

Ponca City School District has secured funding for projects from a combination of internal financing (mostly bonds) and external sources from state and federal agencies. In the last several years, Ponca City has secured FEMA funding to construct a saferoom at Garfield elementary school. More recently, the School District was awarded grant money from the State of Oklahoma to assist with Covid-19 relief. More information is needed to determine the scope of the school district’s funding capabilities. The planning team recommends that the school district hire personnel with background in hazard mitigation funding opportunities to increase the district’s abilities to access mitigation funds for its projects.

Areas of Refuge

Areas of Refuge: Ponca City Schools open their facilities to the public in case of extreme hazardous events, such as flooding, winter weather or extreme heat and others. The capacity—in terms of for each facility varies. Examining the differences between these facilities is outside the scope of this assessment.

Ponca City does not recommend citizens to go to their nearest school facility unless necessary, this is due to overcrowding and risks of waiting outside before entering in cases of dangerous weather conditions. In coordination with Ponca City Emergency Management, the school districts also offers their buses to the public for transportation to safer locations in cases of severe weather.

Mass Care: Mass care differs from areas of refuge in that mass care areas serve as areas designated for the medical treatment, aid, or other medical interventions. As of this writing, Ponca City High School is the only facility

* In conjunction with Ponca City

* In conjunction with Ponca City

at the school district utilized for mass care events, which the City used to test and vaccinate people against Covid-19.

Saferooms

Saferoom in this instance refers to a designated area designed to protect people from wind (and earthquake) hazards as they occur. This section is based on reports from local officials and a detailed 2013 report from Professional Engineering Consultants (PEC). According to the report, none of the school buildings had an area that met all International Code Council (ICC) 500 or FEMA 361 requirements, which are often seen as the gold standard for structural wind protection related to saferooms. Evaluation criteria included:

- Continuous Load path
- Accessibility and Safety
- Ventilation
- Lighting
- Communications
- Signage
- Windows and Doors
- Organization
- Emergency Power
- Restrooms

Based on this conclusion, PEC determined that none of the school facilities should be considered a “saferoom” to acceptable standards, but rather an area of refuge (for more information, see the PEC assessment). Since the development of this plan, the saferoom at Garfield public school was built with FEMA funding and approved to ICC 500 standards. Based on the analysis from PEC and the feedback from officials, the planning team divided the quality of saferooms in the school district into three different levels.

Table 3-3 Saferoom Grade Overview for Ponca City School District Schools

Saferoom Grade	School(s) ²⁷
Best/Meet FEMA 361 or ICC 500 Standards	Garfield Elementary
Average according to FEMA scoresheets	Ponca City High School (Anderson), Lincoln Elementary, Roosevelt Elementary, Trout Elementary, Woodlands Elementary
Below Average according to FEMA scoresheets	Ponca City High School (Howell), Liberty Elementary, Washington Elementary school, West Middle School

Areas with saferooms graded as “average” or “below” average are much more susceptible to the vulnerabilities highlighted in the people section in Chapter 4.

²⁷ East Middle School was not profiled in the engineering assessment.

3.6 Summary of Observations and Recommendations

This section outlines an overview of observations and recommendations from the capabilities assessment. It is intended to provide the reader with a summary of capability gaps across hazards and recommendations to mitigate against these potential vulnerabilities. This approach aligns with an assets-based approach to hazard mitigation (see Chapter 1). In order to maintain this section as an overview and keep it concise, this section does not seek to provide specific details of the observations. Details of each observation can be found in the qualitative sections of this assessment.

Observation	Recommendation	Hazards	Action(s)
Ponca City should develop hazard mitigation trainings for fairs festivals, and similar activities. Ponca City School District should invest in hazard mitigation and response training that exceeds the state's requirements.	Develop and fund hazard preparedness, education, information, and awareness programs	All	1
Although Ponca City has established outreach programs that reduce floodplain risk and capture CRS points in the 300 - 600 series, the City could improve its floodplain reduction and CRS point capture in these categories.	Develop and maintain a Program for Public Information (PPI) Committee. Update ordinances to follow the guidance in the 2021 CRS addendum, in addition to the 2017 CRS coordinators' manual, and the most current state guidance. Improve National Flood Insurance Program (NFIP) compliance and exceed NFIP standard requirements.	Flooding, Dam	2, 6, 27
Ponca City does not map and regulate based on fully developed watersheds, which can provide safety from changes brought about by increased development or new, larger rainfall requirements, as statistical rainfall estimates are updated. The same issues were noted in the stormwater master plan (see floodplain sections for more details).	Update stormwater master plan and implement findings in the plan. Conduct mapping and regulating based on fully developed watersheds.	Flooding, Dam	3, 17
The Emergency Operations Plan (EOP) does not explain how these government departments or stakeholders will continue to operate in the event of a disaster. In addition, local officials and water utility operators noted a disconnect in the continuity of operations following past hazard events. In addition, the planning area has not developed a continuity of operations plan, which could resolve these issues.	Develop a continuity of operations plan that address these, and other, issues.	All	7
Ponca City has not conducted a complete inventory of its finished floor elevations, which would be extremely beneficial in FEMA grant competitions. Finished floor elevations are not generally obtained because of the expense of collecting them.	Complete Finished Floor Elevations and other data collection for benefit-cost analyses (BCA)s on potential projects to assist in identifying grant funding.	Flooding and Dam Incident	9

Observation	Recommendation	Hazards	Action(s)
Many communities find that development of properties or roadways downstream for lower-hazard stormwater retention dams cause them to be revised to be high hazard dams by the OWRB, requiring spillway modifications.	Update EAPs for Cremer's Park and Lake Ponca high hazard dams and revise to better fit CRS 600 requirements.	Dam	10
If Ponca City continues the 10-acre limit for the use of the modified rational method Stormwater management regulations (SMR), design storms used in regulations (DS), the City would lose 75 points under the new 2021 CRS addendum. Ponca City does not use the most current standards for rainfall calculations or time of concentration calculations.	Update floodplain and CRS ordinances and regulations to follow the guidance in the 2021 CRS addendum, in addition to the 2017 CRS coordinators' manual, and the most current state and FEMA guidance (see other floodplain and stormwater management section).	Flooding	12
A mobile electronic application would allow response agencies, local officials, and school officials to better communicate with people in Ponca City.	Develop or purchase a voluntary emergency management app to send notifications about various hazards throughout the planning area.	All	13
The planning area's communication/distribution of information, hazard detection, vulnerable population analysis, and built environment analysis would be enhanced by developing GIS capabilities in three key areas (see GIS section in Administrative and Technical Capabilities).	Personnel should maintain and continue to develop GIS and other web-based and mobile capabilities in these three key areas.	All	18
Ponca City and Ponca City School District would benefit from updating building codes to the most recent codes.	Adopt 2021 international building codes and zoning ordinances, including fire codes. Ponca City should improve its BCEGS rating, when applicable.	All, except extreme heat and hazardous materials	19, 34
Ponca City does not participate in FireWise, as of this writing.	Ponca City should participate in the FireWise Program.	Fire	25
Safe Rooms can prevent loss of life from tornado and high wind events.	Evaluate and install shelters/safe rooms that meet ICC 500 and FEMA 361 requirements at public critical facilities and schools that do not have shelters that meet ICC 500 and FEMA 361 requirements.	Tornado/High Wind	26
A substantial damage management plan would enhance Ponca City's administration and approach to its substantially damaged properties.	Develop a substantial damage management plan based on CRS guidelines.	Flooding	29

Observation	Recommendation	Hazards	Action(s)
The City should ensure that all new critical facilities have backup generation. In addition, Ponca City officials should test to ensure that their current generators meet the standards across these categories (see generators section).	Install backup generators on all critical facilities and conduct routine testing to ensure that current backup generators are adequate.	All	30

Chapter 4 Risk Assessment

The risk assessment helps communicate vulnerabilities, develop priorities, and inform decision-making for the hazard mitigation plan and for other emergency management efforts. This plan was completed with hours of input from stakeholders in the city and across Oklahoma. The 2022 risk assessment provides the factual basis for developing a mitigation strategy for the city of Ponca City, including Ponca City School District, which is a participating jurisdiction in this plan (Chapter 1).

The 2017 risk assessment included assessments of the City and Ponca City School District. For the 2022 update, the city found it unnecessary to profile the school district individually, and the risk assessment was consolidated into one city-wide assessment to eliminate redundancy. The risk assessment was updated and enhanced to provide the most current and robust data and information for quantifying the cost-effectiveness of potential hazard mitigation projects. A GIS Analysis was conducted to include any new/modified/updated information (including hazard, land use, and development trends), findings, research, and risk data. New, readily available, credible technical data was incorporated into the analysis as appropriate.

This assessment integrates an assets-based approach with an analysis of individual hazards to provide a deeper understanding of specific hazards and their impact on the planning area. An assets-based approach, which aligns with the most current FEMA guidance, allows communities to identify assets that are critical to their stability and that are most exposed to hazards. For hazard mitigation planning, this approach allows communities to drive mitigation actions more effectively. Beyond the scope of this mitigation plan, results from the risk assessment should be integrated into future emergency management planning, recovery planning, and development efforts.²⁸

The risk assessment was updated and enhanced to provide the most current and robust data and information for quantifying the cost-effectiveness of potential hazard mitigation projects. A GIS analysis was conducted to include any new/modified/updated information (including hazard, land use, and development trends), findings, research, and risk data. New, readily available, credible technical data was incorporated into the analysis as appropriate.

4.1 Introduction to the 2022 Risk Assessment

This introductory section is divided into 5 parts, the first 2 of which relate to a high-level assessment of hazards throughout the planning area, 1 that highlights some key vulnerabilities in the planning area broadly, and the classification part, which combines development from the previous 3 parts, along with FEMA guidance, to implement an assessment tool that informs the risk assessment. The final part of this assessment highlights observations about the planning area's vulnerability to the hazards profiled in this risk assessment and proposes recommendations to mitigate against these vulnerabilities. The 5 parts of this introduction are listed below:

1. Hazard Identification
2. Disaster Declaration History
3. Critical Lifelines and Facilities
4. Hazard Risk Classifications
5. Observations and Recommendations Overview

4.1.1 Hazard Identification

Ponca City considered a full range of hazards that could affect the city for the 2022 HMP Update. The process included a review of the 2017 HMP, a review of the state hazard mitigation plan, a review of previous events and

²⁸ A web-based version of the risk assessment may be found online at [Ponca City Hazard Mitigation Plan \(arcgis.com\)](https://arcgis.com).

losses, as well as information on the frequency, magnitude and costs associated with hazards that have struck Ponca City or could do so. Extensive outreach was conducted to subject-matter experts to ensure the appropriate elements of each hazard were included and best-available data was used for the risk assessment. Decisions regarding hazard identification were discussed and confirmed with the core planning team and stakeholders at core planning meetings and stakeholder workshops.

For this update, the planning team decided that all hazards remained valid, but some should be combined to reduce redundancy. “High wind” and “tornado” events were combined in this plan due to their similar impacts. Similarly, “thunderstorms” were not assessed individually in this plan, but their affects (hail, high winds, lightning, and flooding from precipitation) were addressed. “Dam failure” was reclassified as “dam incident” to account for a more comprehensive range of risk posed by dams. “Wildfire” was changed to “fire” to include commentary on the planning area’s risk to structure fire in addition to wildfire.

Expansive soils were not included in the previous hazard mitigation plan. The planning team included as part of the drought hazard assessment in this plan update. The planning team made this determination on expansive soils for two main reasons. First, expansive soils almost exclusively result from prolonged periods of heat and drought. Representing expansive soils as an effect of drought can more accurately represents conditions that cause expansive soils. Second, expansive soils present risks to the planning area, but the historical and expected risk of the hazard was not significant enough to merit its own vulnerability assessment. Including expansive soils as part of drought hazard allows community members to understand the threat of expansive soils as part of several risks that can arise during drought events.

In addition to these changes, the planning team added,” hazardous materials incident,” and “public health emergency” as new hazards to be profiled. Although these hazards fall outside the classification of “natural hazard,” provided by the Department of Homeland Security as of this writing, the planning team felt that they posed a large enough threat to be analyzed in the risk assessment.²⁹ The 11 hazards of concern evaluated in the 2022 HMP update are presented below in alphabetical order:

- Dam Incident
- Drought
- Earthquake
- Extreme Heat
- Fire
- Flooding
- Hail
- Hazardous Materials Incident
- Lightning
- Tornado/High Wind
- Severe Winter Storm

In addition to the hazards analyzed in this risk assessment, Ponca City officials noted the need for mentioning public health, cybersecurity, electric magnetic pulse (EMP) into the hazard mitigation plan. Ultimately, the planning team did not include these threats as separate hazards, since both are far outside FEMA’s working definitions of natural hazards, as outlined by the DHS.³⁰ Nonetheless, considering the threat that these two events could pose, the planning team has included a paragraph addressing each below.

Public Health Emergency was considered as a hazard and discussed by the planning team, given the impact of the Covid-19 pandemic, and the threat of other public health emergencies, especially those with a biological or ecological basis. Public health emergencies are best mitigated holistically, especially to protect vulnerable populations. Public health emergency response should be continuous and include a range of medical,

²⁹ FEMA and the larger Department of Homeland Security (DHS) community generally organize threats and hazards into three categories: Natural (tornado, hail, etc.), Technological/accidental (dam incident, hazardous material incident, etc.), Human-induced/intentional (terrorism, cyber-attack, active shooter, etc.). For example, see DHS, Threat and Hazard Identification and Risk Assessment (THIRA) and *Stakeholder Preparedness Review (SPR) Guide: Comprehensive Preparedness Guide (CPG) 201*, 3rd edition (2018), 12.

³⁰ Ibid.

infrastructural, and communication components to ensure that mitigation and response remain holistic.³¹ For these reasons, a public health subsection was included in the vulnerability section for nearly every hazard.

Citizens' daily life, economic strength, and security depend on a stable, safe, and resilient cyberspace, which comes from protective technological bulwarks to prevent cyber-attacks or cyber-terrorism. According to the U.S. Department of Commerce, cybersecurity is the prevention of damage to, protection of, and restoration of electronic devices and systems to ensure integrity and continued functioning.³² Officials in the planning area noted that their concern was due to the past occurrences of cyberattack, such as the attack on Ponca City School District. A cyberattack can affect the population's safety, security, and wellbeing, as well as all FEMA lifelines. The planning team determined that cybersecurity was outside the scope of a hazard analysis. Nonetheless, the planning team should consider enhancing their plan, budgeting appropriately for additional cybersecurity security, engaging business with trusted third-party vendors and identify, and assessing cybersecurity vulnerabilities through anti-virus tools.

Electromagnetic pulses (EMPs) are caused by solar events or man-made devices which cause intense pulses of electromagnetic energy. These pulses can be extremely detrimental to FEMA lifelines; they can damage significant portions of the Nation's critical infrastructure, including the utilities systems, communications equipment, and transportation routes.³³ The Nation's security and a large part of the economy relies on the electric grid, if a human-made or naturally occurring EMP could affect large geographic areas, including Ponca City.³⁴ If the EMP is from a nuclear explosion, the City may also need to shield citizens from severe gamma radiation that could adversely affect their health. Each family, classroom, and the city should have a plan in place in case this disaster causes the technological grid to become inaccessible for long periods of time. Learning what it is and how to protect their citizens, educating the public, identifying which facilities require an emergency action plan are suggested actions for the City.

4.1.2 Disaster History

Of the 211 federal disasters declared in the State of Oklahoma from 1955 to June 2021, Kay County received 33 total declarations, of which 25 were major disaster declarations (DR), 7 were emergency management declarations (EM), and 1 was a management assistance declaration (FM). Table 4-1 outlines all FEMA declarations in Ponca City (Kay County) since 1973. It should be noted that declarations prior to 1964 do not contain county data, as it is not available (FEMA 2021).

Table 4-1 Pona City (Kay County) FEMA Disaster Declarations

Year of Declaration	Declaration Title	Disaster Number
1973	SEVERE STORMS & FLOODING	DR-404-OK
1973	SEVERE STORMS & FLOODING	DR-409-OK

³¹ These efforts can, and should, include: environmental hazard identification, epidemiological services, health and medical needs assessment, identification of affected individuals, contamination control, health surveillance, laboratory specimen collection and analysis, infectious disease control, quarantine/isolation, public health information, risk communication, responder safety and health, medical equipment safety and availability, health-related volunteer and donation coordination, in-hospital care and evacuation measures.

³² These systems can include computers, electronic communications systems, electronic communications services, wire communication, and electronic communication, including information contained therein. In: NRST, <https://csrc.nist.gov/glossary/term/cybersecurity>

³³ Homeland Security, <https://www.dhs.gov/publication/protecting-and-preparing-homeland-against-threats-electromagnetic-pulse-and-geomagnetic>

³⁴ https://www.cisa.gov/sites/default/files/publications/emp-program-status-report_508.pdf#:~:text=Related%20to%20this%20effort%2C%20FEMA%20manages%20the%20Emergency,threats%20like%20EMP%20and%20radio%20frequency%20weapons%20attacks.

Year of Declaration	Declaration Title	Disaster Number
1974	HEAVY RAINS & FLOODING	DR-419-OK
1986	SEVERE STORMS & FLOODING	DR-778-OK
1987	SEVERE STORMS & FLOODING	DR-794-OK
1993	SEVERE STORMS, TORNADOES & FLOODING	DR-991-OK
1995	SEVERE STORMS AND FLOODING	DR-1066-OK
2001	SEVERE WINTER ICE STORM	DR-1355-OK
2002	SEVERE WINTER ICE STORM	DR-1401-OK
2003	SEVERE STORMS AND TORNADOES	DR-1465-OK
2005	HURRICANE KATRINA EVACUATION	EM-3219-OK
2006	EXTREME WILDFIRE THREAT	DR-1623-OK
2006	PONCA CITY FIRE	FM-2633-OK
2007	SEVERE WINTER STORMS	DR-1678-OK
2007	SEVERE STORMS, TORNADOES, AND FLOODING	DR-1707-OK
2007	SEVERE STORMS, FLOODING, AND TONADOES	DR-1712-OK
2007	SEVERE WINTER STORMS AND FLOODING	EM-3272-OK
2007	SEVERE WINTER STORMS	EM-3280-OK
2008	SEVERE STORMS AND FLOODING	DR-1775-OK
2008	SEVERE STORMS, TORNADOES, AND FLOODING	DR-1803-OK
2010	SEVERE WINTER STORM	DR-1876-OK
2010	SEVERE WINTER STORM	EM-3308-OK
2011	SEVERE WINTER STORM	EM-3316-OK
2012	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	DR-4064-OK
2013	SEVERE WINTER STORM AND SNOWSTORM	DR-4109-OK
2015	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	DR-4222-OK
2016	SEVERE WINTER STORMS AND FLOODING	DR-4256-OK
2019	FLOODING	EM-3411-OK
2019	SEVERE STORMS, STRAIGHT-LINE WINDS, TORNADOES, AND FLOODING	DR-4438-OK
2019	SEVERE STORMS, STRAIGHT-LINE WINDS, TORNADOES, AND FLOODING	DR-4453-OK
2020	COVID-19 PANDEMIC	DR-4530-OK
2020	COVID-19	EM-3462-OK
2021	SEVERE WINTER STORMS	DR-4587-OK

4.1.3 Critical Facilities and Lifelines

This section describes critical facilities and FEMA lifelines, given their importance to maintain the continuity of basic and life-sustaining services in the planning area. The planning team has identified critical facilities that are exposed to increased flooding risk, which is the baseline standard for FEMA. The planning team expanded their

study to identify critical facilities that are at risk for any of the identified hazards across the entire planning area, when possible. A map of critical facilities can be found on Figure 1-1.

Critical facilities can impact one or more community lifelines. Lifelines, however, provide officials and residents a system-wide approach to mitigation.³⁵ FEMA's community lifelines are *systems* that are essential a community's basic functioning by supporting key government, business, and other essential functions. Lifelines can be composed of chains of critical facilities and other assets.

Critical facilities and Lifelines are found in the vulnerability sections of each profiled hazard. Within this section, the planning team included a commentary on critical facilities in the built environment section, under critical facilities. Commentary on lifelines throughout the planning area are included throughout the vulnerability parts of each hazard but are concentrated in the infrastructure subsection within the built environment section. FEMA's seven lifelines are listed below:

FEMA Community Lifeline List



Safety and Security - Law Enforcement/Security, Fire Service, Search and Rescue, Government Service, Community Safety



Food, Water, Shelter - Food, Water, Shelter, Agriculture



Health and Medical - Medical Care, Public Health, Patient Movement, Medical Supply Chain, Fatality Management



Energy - Power Grid, Fuel



Communications - Infrastructure, Responder Communications, Alerts Warnings and Messages, Finance, 911 and Dispatch



Transportation - Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Maritime



Hazardous Material - Facilities, HAZMAT, Pollutants, Contaminants

The planning team included a map of critical facilities to highlight their distribution across the planning area. Vulnerabilities to critical facilities will be highlighted in the individual hazard sections. In addition, the planning team included a map of major components of the Energy Lifeline given its outsized impact on the delivery of basic services in the planning area and its role as a major economic driver for the City.

³⁵ <https://www.fema.gov/emergency-managers/practitioners/lifelines>

Figure 4-1 Critical Facilities in the Planning Area

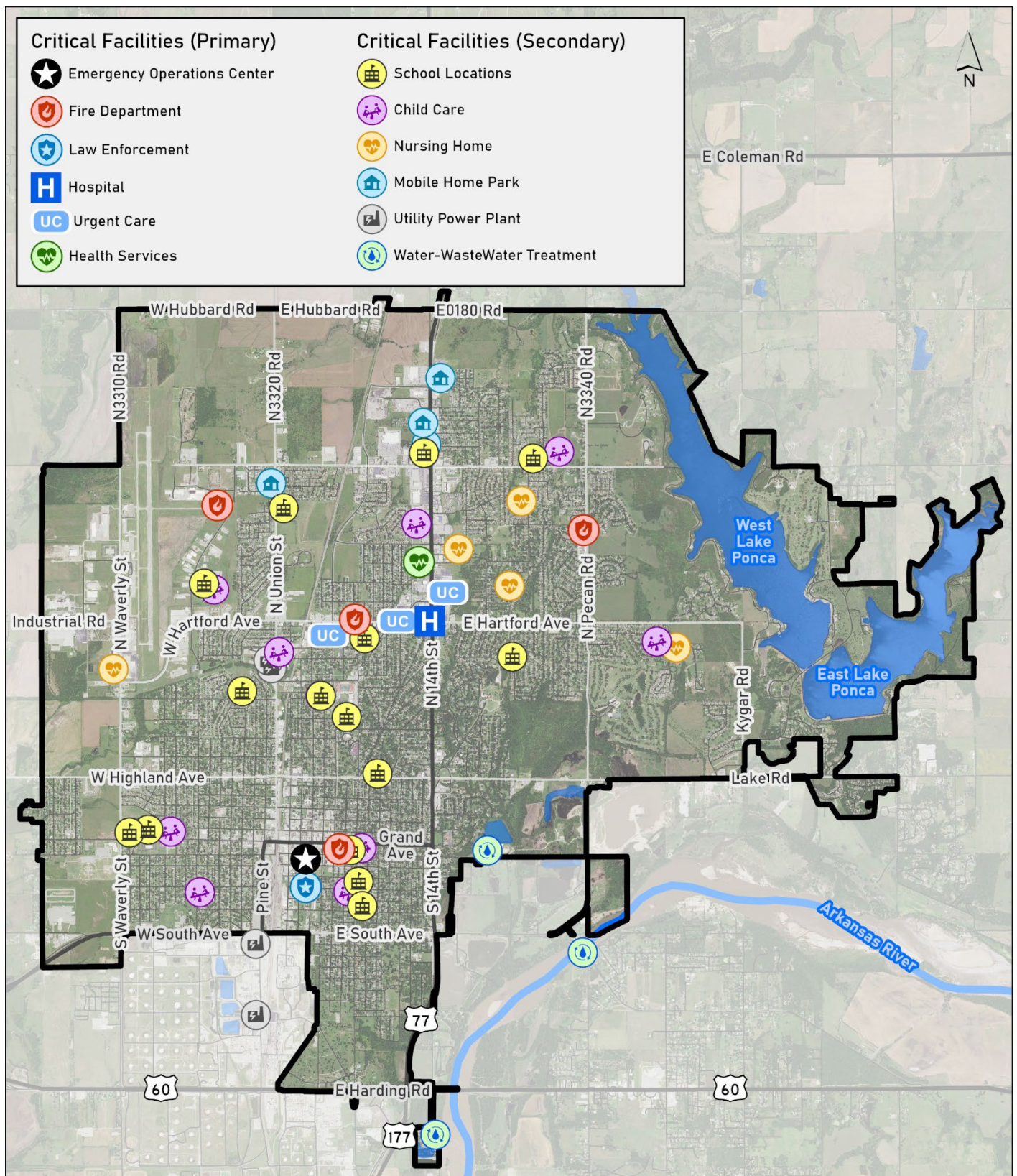
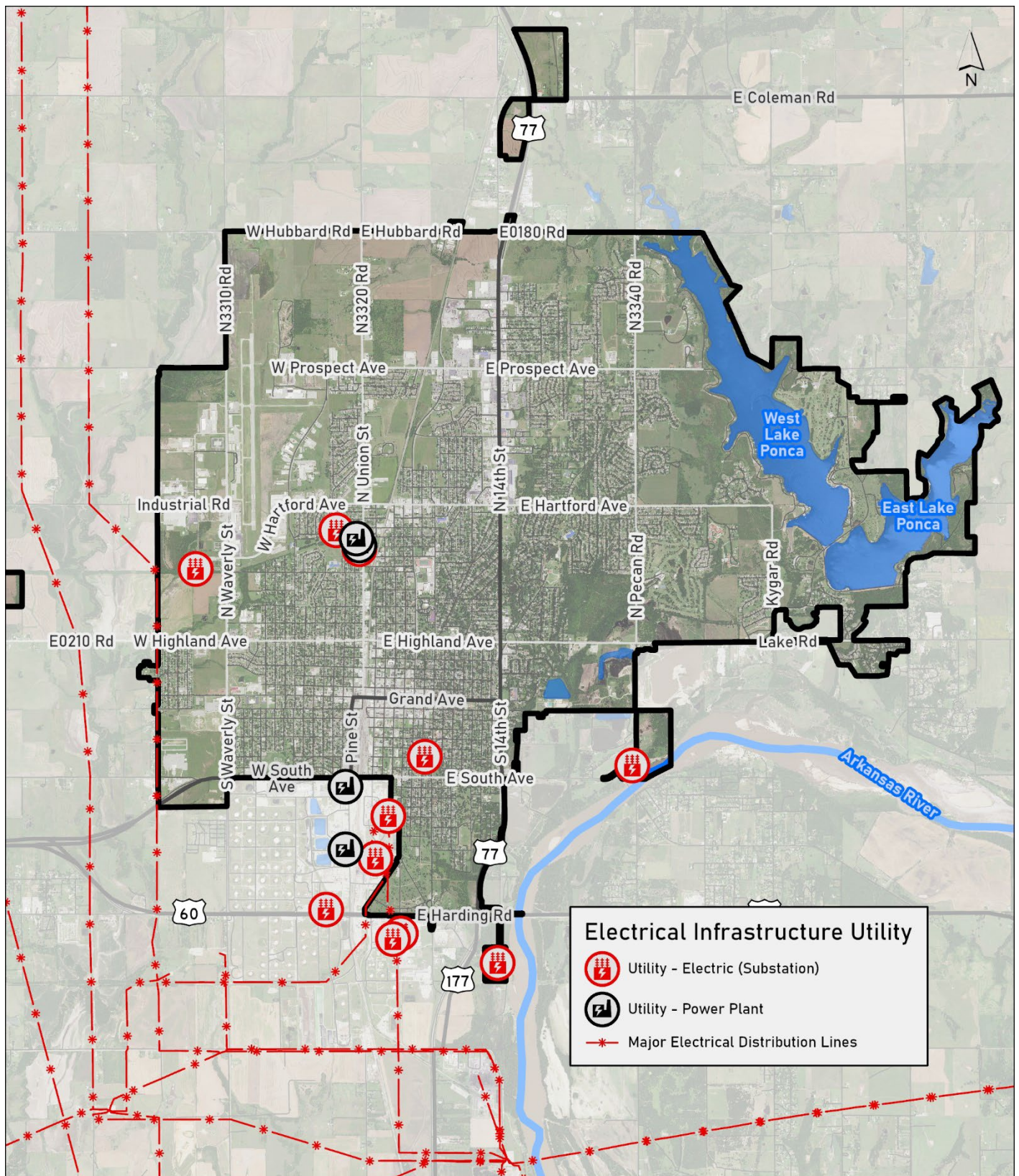


Figure 4-2 Major Components of the Energy Lifeline



4.1.4 Hazard Classifications

The classifications for probability, and overall significance, as defined on Worksheet 5.1 in the FEMA Local Mitigation Planning Handbook, met Ponca City's needs and methods, and were used in the 2022 risk assessment.

Probability of Future Events

The planning team used different probability metrics for the 2022 Plan compared to the 2017 Plan. The 2017 plan used the similar metrics—"Unlikely," "Possible," "Likely," and "Highly Likely"—as this assessment but assigned these metrics different probability values.³⁶ The planning team decided to use different metrics in the 2022 Plan because they aligned more closely with standard practices in the State of Oklahoma and FEMA Region VI. This should assist readers in comparing and integrating the 2022 Plan with surrounding communities, enhancing potential mitigation planning and response actions.

Unlikely: Less than 1 percent probability of occurrence in the next year or a recurrence interval of greater than every 100 years.

Occasional: 1 to 10 percent probability of occurrence in the next year or a recurrence interval of 11 to 100 years.

Likely: 10 to 90 percent probability of occurrence in the next year or a recurrence interval of 1 to 10 years.

Highly Likely: 90 to 100 percent probability of occurrence in the next year or a recurrence interval of less than 1 year.

Overall Significance

The 2017 HMP did not include an overall significance statement, but prioritized risk numerically by organized the hazards by risk priority.

Low: The event has a minimal impact on the planning area.

Medium: The event's impacts on the planning area are noticeable but not devastating.

High: The criteria consistently fall in the high classifications and the event is typically likely/highly likely to occur with severe strength over a significant to extensive portion of the planning area.

Table 4-2: Summary of Hazard Probability and Overall Significance

Hazard	Probability	Overall Significance
Flooding	Likely	High
Severe Winter Storm	Highly Likely	High
High Wind	Highly Likely (High Wind)	High
Tornado	Unlikely (Tornado)	High
Dam Incident	Unlikely	High
Hail	Highly Likely	Medium
Fire	Highly Likely	Medium
Hazardous Materials	Highly Likely	Medium

³⁶ "Highly likely" was classified by a 100% < probability of occurrence in the next year (event has a one in one years' chance of occurring). "Likely" was classified by a 33% < 100% probability of occurrence in the next year (event has a one in three years' chance of occurring). "Occasional" referred to 20% < 33% probability of occurrence in the next year (event has a one in five years' chance of occurring). "Unlikely" referred to < 10% probability of occurrence in the next year (event has a one in ten years' chance of occurring).

Hazard	Probability	Overall Significance
Extreme Heat	Occasional	Low
Lightning	Highly Likely	Low
Drought	Highly Likely	Low
Earthquake	Highly Likely	Low

4.1.5 Observations and Recommendations Overview

The planning team included an observations and suggested recommendations part at the end of this chapter. The observations in this part highlight locations, problem areas, that increase the affected areas' general vulnerability and risk to hazards. Observations are detailed in the hazard profile sections below. These observations are compiled at the end of the chapter to drive recommendations for mitigation, which, along with the suggested actions in Chapter 3, directly inform the mitigation actions in Chapter 5.

4.2 Flooding

4.2.1 Hazard Description

A flood is the partial or complete inundation of water over normally dry land. Common impacts of flooding include damage to personal property, buildings, and infrastructure; bridge and road closures; service disruptions; and injuries or even fatalities. There are three common types of flooding in Ponca City: riverine flooding, flash flooding, and urban flooding.

Riverine flooding occurs from excessive rainfall in upstream areas that forces rivers and streams to rise and overflow their banks, inundating the adjacent floodplains. Riverine flooding is usually a gradual process, with several hours to several days of warning time for downstream communities. This type of event usually remains in flood for a longer period than flash or urban flooding, and often causes more damage due to the length of time structures are inundated, the velocity and depth of water, and floating debris.

Flash flooding is associated with large convective thunderstorms that frequent the region and can drop between 1 and 5 inches of rain in an hour. When the soil is already saturated, rainfall from such storms can converge in creeks and streams suddenly, with little warning. Flash floods can reach peak flows within a few minutes. Waters from flash floods move with great force and velocity and can tear out trees, carry away houses and outbuildings, and destroy roads and bridges. These walls of water often carry large amounts of debris, sewage and pollutants. Although potentially hazardous to life and destructive of property, flash flooding usually lasts only a matter of hours.

Urban flooding occurs when heavy rainfall runs off of structures, parking lots and streets and converges in culverts and drainage ways often clogged with debris. This causes streets to flood and storm sewers to back up.

4.2.2 Location

Flooding problems in Ponca City are widely dispersed. For this reason, the planning team divided these flooding problems into several categories:

- Riverine floods along major waterways with very large drainage basins, most prominently, the Arkansas River and Bois D' Arc Creek
- Flash floods along the tributary creeks that ultimately drain into major waterways (listed above)
- Floods that impact streets and county transportation systems
- Localized drainage problems from inadequate infrastructure

The planning team used a combination of FEMA mapping and local studies to identify locations of flooding risk. As a part of its regulatory function, the National Flood Insurance Program (NFIP) has established zones that are used in Flood Insurance Rate Maps (FIRM)s. FEMA uses these zones to map floodplains. Flood location in Ponca City is characterized by two types of FEMA floodplain zones, in particular (all zones are described in more detail in the extent section). These mapped zones are:

- Zone A, or 1% Annual Chance (100-year) flood zones. These zones are also called special flood hazard areas (SFHA)s. For the sake of clarity, this plan will refer to these zones as 1% (100-year) flood zones. There are six A zones. FEMA maps for the planning area outline two of them; the approximate A zone (A) and the A zone (AE).
- Zone C, 0.2% (500-year) flood zones. These flood zones are determined to have a 0.2% chance of flooding annually. For the sake of clarity, this plan will refer to these zones as 0.2% (500-year) flood zones.

Figure 1-3 includes the FEMA floodplain mapping within the city boundaries and several figures on subsequent pages includes the areas mapped for the school district boundaries. It is important to note that although FEMA

digital flood data is recognized as best available data for planning purposes, it does not always reflect the most accurate and up-to-date flood risk.³⁷ Flooding and flood related losses can, and often do, occur outside of mapped flood zones.

Given these considerations and the in the attempt to present the areas of heightened risk, the planning team has identified several flooding “problem areas,” due to their recurrence interval or expected depth of flooding (see extent for depth of flooding). The planning team found it important to focus on mitigating flood risk in recurring problem areas. These problem areas are the result of riverine flooding from major waterways, especially the Arkansas River and Bois D’Arc Creek, flash flooding and riverine along tributary creeks, and urban and flash flooding caused by inadequate infrastructure.

For clarity, the planning team has divided flooding problem areas in the planning area into 4 categories, which can be seen in Table 4-6. The first three categories relate to problem areas Ponca City and are mapped accordingly. The last category relates to Ponca City School District, which is also mapped accordingly.

The planning team used local studies identify with higher recurrence intervals than FEMA Zone A for many of these problem areas, meaning that flooding in these areas is expected to occur at a greater frequency than 1% Annual Chance (100-year) flood zones. These recurrence intervals include the 2% Annual Chance (50-year) storms, 5% Annual Chance (20-year) storms, 10% Annual Chance (10-year) storms, 100% Annual Chance (annual) storms. These intervals are not mapped but are included in the planning team’s analysis of the problem areas.

Table 4-3 Flooding Problem Areas

Flooding Area Key	Name	Number of Flooding Areas	Main Source
Ponca City (Mapped)			
ARK	Flooding from Arkansas River or tributaries to Arkansas River (excluding Bois D’Ark Creek)	9	2009 Master Drainage Plan (MDP)
BD	Bois D’ Ark Creek and immediate tributaries	10	2009 Master Drainage Plan
L	Localized flooding issues from built environment	9	Local Officials
Ponca City School District (Mapped)			
S	School District flooding areas (structures and main transportation routes)	7 ³⁸	School Officials, 2009 MDP

³⁷ One of the current shortcomings of much of the available detailed floodplain data (Zone AE) is that it was prepared many years ago with much cruder topography and rainfall depths that are smaller than current standards. Any detailed modeling should be updated in areas where Ponca City is considering development. Ponca City follows flood resistant provisions that align with the 2015 IBC and IRC requirements for residential and commercial buildings and is considering updating the codes to 2021 standards. Flood insurance definitions are more thoroughly detailed in Appendix B where it specifies county ordinances.

³⁸ Some of the flooding areas for Ponca City School District overlaps with the localized flood areas in Ponca City.

Figure 4-3 Flooding Problem Areas for Ponca City

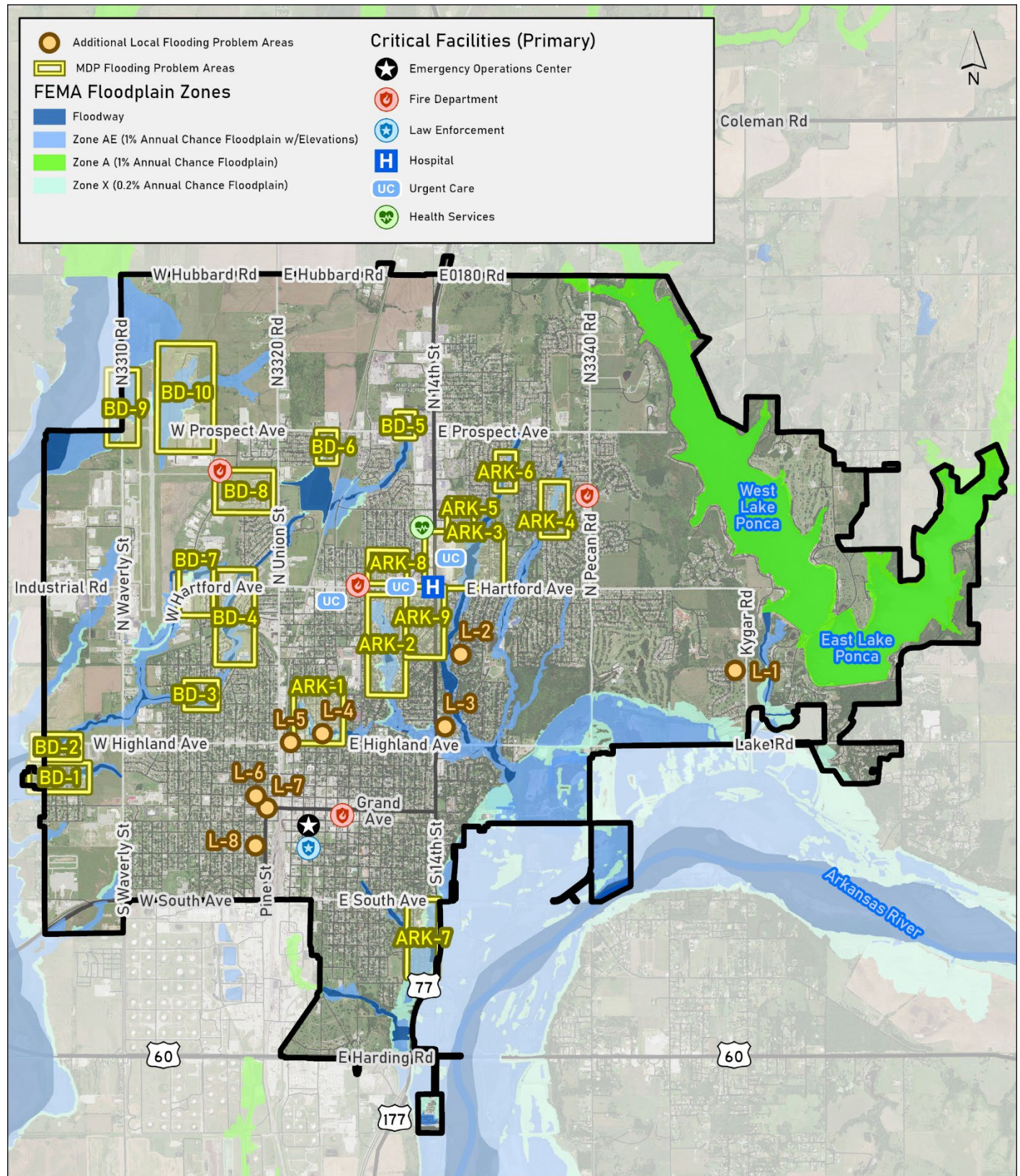


Table 4-4 Flooding Problem Areas in the City of Ponca City (ARK, BD, and L)

Area	Flooding Source	Location	Description
ARK-1	Trib. G	From Roosevelt Avenue to 5th Street upstream from War Memorial Park.	This area is on the upper reach of the mapped portion of Tributary G. Out of the 39 properties that are touched by the 1% storm floodplain, three appear to have an estimated finished floor below the 1% storm water surface elevation. The bridges and culverts through this reach are inadequate and are overtopped by storms more frequent the 10% storm. In terms of flood depth at a 10% storm: 7 th St. overtops by more than a foot, 4 th St overtops by almost 2.5 feet, 3 rd St. overtops by 0.6 feet, and Summit St. overtops during the 10% storm by 1.4 feet.
ARK-2	Trib. E	North of Overbrook Avenue up through the existing residential developments to the school at 7th Street and Little Lane.	There are approximately 80 properties that are inundated by the 1% storm floodplain. Thirty-one of those buildings appear to have a finished floor elevation lower than the calculated 1% storm water surface elevation. Some of the houses near Donahoe Dr. and McGraw Dr. flood by as much as 3 feet, while some between Gray Ave. and Albany Ave. flood by as much as 2 feet during a 1% storm. Most of the bridges/culverts begin overtopping at the 20% storm, such as Overbrook (0.7 feet 10% storm and 1.7 feet 1% storm), Liberty Ave (1.5 feet 20% storm, 1.75 feet 1% storm) and Donahoe Dr (2.2 feet 10% storm and 3.6 feet 1% storm).
ARK-3	Trib. D	Hartford Ave. east of 14th St. and south.	Hartford Avenue is overtopped annually by 0.3 feet, and the 10% storm by 1.6 feet. This is a route to the hospital west of 14 th St. There are 14 properties that are touched by the 1% floodplain, none of which has a finished floor elevation lower than the 1% water surface elevation.
ARK-4	Trib. C	Upstream from Willow Ave. and El Camino Street.	The El Camino St. culvert is overtopped 10% storm by 0.74 feet and the 1% storm by 1.1 feet. Six properties are touched by the 1% floodplain. None of the structures on these properties appear the have a finished floor elevation lower than the 1% elevation.
ARK-5	Trib D-R1	From north of the East Terrace Apartments located north of Bradley Avenue and to the south through the Timbers North Apartments.	Several of the buildings are touched by the 1% water surface elevation. In addition, the roadway crossings in this reach are inadequate and are overtopped annually by more than 1 foot.
ARK-6	Trib D	From upstream of Kingston Road on Tributary D downstream to where the tributary exits the Northgate subdivision south of Yale Avenue	At the time that the MDP was being developed, there were 4 buildings inundated during a 1% frequency storm, 2 of which were repetitive loss properties. These 2 properties have been mitigated by the City. Kingston Road is overtopped by the 50% storm (0.14 feet), by the 10% storm by 1.14 feet, and by the 1% storm by 2.5 feet.

Area	Flooding Source	Location	Description
ARK-7	Tribs H & H-L1	Upstream of Highway 177 and west to 11th Street and north to South Avenue	There are 33 structures that are touched by the 1% floodplain and approximately 15 of those appear to have a finished floor elevation lower than the water surface elevation at the 1% floodplain. Most of the bridges/culverts in this area are undersized. All the bridges/culverts on Tributary H-L1 are overtopped by the 100% frequency storm and by the 10% storm by more than 1 foot. The roadway structures on Tributary H at 12th Street and Scott Avenue are overtopped by the 20% storm by approximately 1 foot. The other structures in this area can pass a 10% or greater storm.
ARK-8	Trib. E	Upstream of Clarke St. and Hartford Ave. between 7th Street and Joe Street to Young Ave.	There are a few businesses along Joe Street that are impacted by flood waters and are impassable during relatively small storms. East of Joe Street on Young Avenue, approximately 40 acres of drainage area converges on Young Avenue at the intersection of Young and Garden Street. There are no storm sewers in this area, leading the water to be conveyed between the two homes immediately south of Garden Street. This causes frequent flooding of at least several inches deep annually. The storm sewer under Joe St. cannot carry the 100% (annual) storm.
ARK-9	Unnamed tributary to Trib D	Acre Homes Addition west of 14th St. South of Hartford Ave.	This area drains poorly and is situated above the limits of the floodplain mapping that prepared for the MDP. There is a small, undersized storm sewer draining southerly through this addition. The overflow from the surface water that cannot flow through the storm sewer system makes its way through and/or between several buildings before it enters the 14th Street storm sewer system, which is also undersized. This flooding occurs between houses several inches deep at least annually.
BD-1	Trib. L	Along Broadway Avenue between Flormable Street and Olympia Street.	It appears that there is only one building, located east of Irving Street and north of Broadway Avenue that would experience flooding in a 1% storm. All of the bridges/culverts are inadequate, however, and are overtopped by flow rates from storm frequencies smaller than the 20% storm, with inundation depths ranging from 1 to 2 feet.
BD-2	Trib. M	The area south of Highland Avenue to west of Flormable Street on the lower end of Tributary M	There are seven buildings that experience flooding in a 1% storm event and two of those buildings would be flooded by a 50% storm event. The bridges/culverts through this reach are also overtopped by as much as 2 to 4 feet during a 10% storm.
BD-3	Trib. M	From north of Overbrook Avenue from upstream of Ash Street to the Pedestrian Bridge downstream of Birch Street.	These crossings only convey up to the 50% event without overtopping. During a 10% storm, Birch St. overtops by 1 foot, Ash St. by 1.7 feet, and Liberty Ave. by 0.8 feet. There are also several buildings that are touched by the 1% storm event with one of those touched by the 10% storm.

Area	Flooding Source	Location	Description
BD-4	Trib. M	From upstream of Hartford Avenue and continues south between Hudson Drive and Osage Street across the railroad embankment to Liberty Ave.	Many of the buildings on the west bank north of Emporia Ave. are touched by the 1% storm floodplain. There are 2 repetitive losses south of Emporia Ave., one of which has been mitigated by the City. The stream then opens into a park area before continuing under the existing railroad. The railroad embankment is not overtopped and creates a significant backwater effect up through Emporia Avenue. The stream then runs between a subdivision on the west and a school on the east where water depths outside of the channel are up to 1.5 feet deep from a 1% storm. The east bank contains a significant amount of open space whereas the west bank is encroached upon by the subdivision; where several of the buildings are touched by the 1% event.
BD-5	Trib. M	On Prospect Ave. between N. 5th St. and N. 14th St.	The upper end of Tributary M above Prospect Avenue has two culverts that are overtopped by the 50% storm event. During a 10% storm the roadway will overtop by 0.76 feet. There is one building (Lockes Supply) that could experience flooding during a 1% storm event.
BD-6 ³⁹	Trib. N	Lansbrook Rd. culvert	This area on Tributary N is located just upstream of the Cremer Park stormwater detention facility. The Lansbrook culvert was inadequate and there were several buildings upstream that were flooded by the 1% storm event. This culvert and downstream channel were constructed as an HMGP project and have mitigated this flooding.
BD-7	Trib. O	Just north of the Ash Street and Hartford intersection	There is a culvert that is undersized and a building on the south side of the tributary is flooded by almost 0.5 feet during the 1% storm. Ash St. overtops to the south of the culvert by 1.3 feet during the 10% storm.
BD-8	Trib. O	South of Oriole St. and Martha Ave.	This addition is located at the upper end of Tributary O. There don't appear to be any buildings that are impacted by the 100-year. All of the houses along Lonnie Avenue drain to the street and then into Oriole Street. The water eventually exits the southwest side of the cul-de-sac into Tributary O. The conveyance of the local runoff causes deep street flooding at the cul-de-sac of approximately 1-2 feet during a 1% (annual) storm.
BD-9	Trib. Q.	Northwest of the Airport west of Waverly St.	This area is west of the airport on Tributary Q and is a very flat area that does not drain well. It starts at the outlet of the box under the runway and continues through Waverly. There are no buildings that are impacted, just nuisance water that may attract waterfowl, creating a dangerous situation for aircraft using the airport.
BD-10	Trib. Q.	Northeast of the airport	This area is just east of the airport and north of Prospect Avenue on Tributary Q. There are not any buildings that are impacted by flooding but only portions of the BMX track itself.

³⁹ This culvert and downstream channel were constructed as a Hazard Mitigation Grant Program project, which has mitigated this flooding.

Area	Flooding Source	Location	Description
L-1	Local Area	Ranchwood Manor just west of Lake Ponca	There is a ditch along the north side of this subdivision that collects as much as 25 to 30 acres of drainage from the north and conveys it west along the north boundary and south along the west boundary of the subdivision. Twice in the past 35 years the ditch has been overtopped and the water conveyed through lots to the street. In 2019 it flooded 10 houses in the subdivision. This has a probability of occurrence of 5% or once in 20 years.
L-2	Local Area	Pioneer Rd. and Quail Ln.	The neighborhood north and east of this intersection receives runoff from approximately 14 acres with no public system to drain it west to Trib. D, causing flooding of houses and backyards. One resident has flooded 4 times in 5 years.
L-3	Local Area	Pioneer Apartments north of Monument Rd.	Water collects from several large, paved lots, flooding at least one home on Monument Rd. in the past 5 years.
L-4	Local Area	3rd, 4 th , and 5th St Culverts on Trib G.	Flash flooding occurs frequently that enters nearby houses. This is a chronic problem and encompasses a part of Problem Area Ark-1 on Trib. G. Water gets as much as 4 feet deep in the overbanks in a 1% storm.
L-5	Local Area	Highland Ave. Underpass west of 1st St.	Rains can flood underpass and adjoining intersection 10 feet deep before relieving itself overland and floods at least annually. It can stay flooded for multiple hours due to the inadequate storm sewer system draining this area.
L-6	Local Area	Cleveland Ave. and Oak St.	Street flooding occurs that can jump over to Pine if it's backed up at Grand. This area receives approximately 25 acres of runoff with an inadequate storm sewer system. This happens annually at depths of up to 3 feet in the street.
L-7	Local Area	Grand Ave. and Pine St.	Street Flooding that can enter nearby businesses, especially with waves from traffic. This area receives approximately 25 acres of runoff with an inadequate storm sewer system. This happens very frequently with depths water in the street 3 feet deep.
L-8	Local Area	Sump location on Oak St. between Oklahoma Ave and Ponca Ave.	Severe flash flooding as water backs up to enter the inadequate storm sewer system. This area receives approximately 90 acres of runoff. Flooding happens annually. Water gets 2 to 3 feet deep before breaking over between buildings towards Elm St.
L-9	Local Area	Sump location on Queens Aves between 14th St and Meadow Ln.	The sump location on Queen's Ave. between 14th St and Meadow Lane receives approximately 26 acres of stormwater runoff. The sump location indicates a single grate drop inlet with 2 hoods on both sides of the intersection over a 30-inch pipe in the street, changing to a 36-inch pipe downstream. The large overflows (1 to 2 feet deep) flow north and east to a small creek in the alley between Dean Ave. and Meadow Lane. At least one house experiences flooding above the finished floor. This occurs in approximately a 10% storm.

Figure 4-4 Washington Pre-K Flooding Areas (S-1)

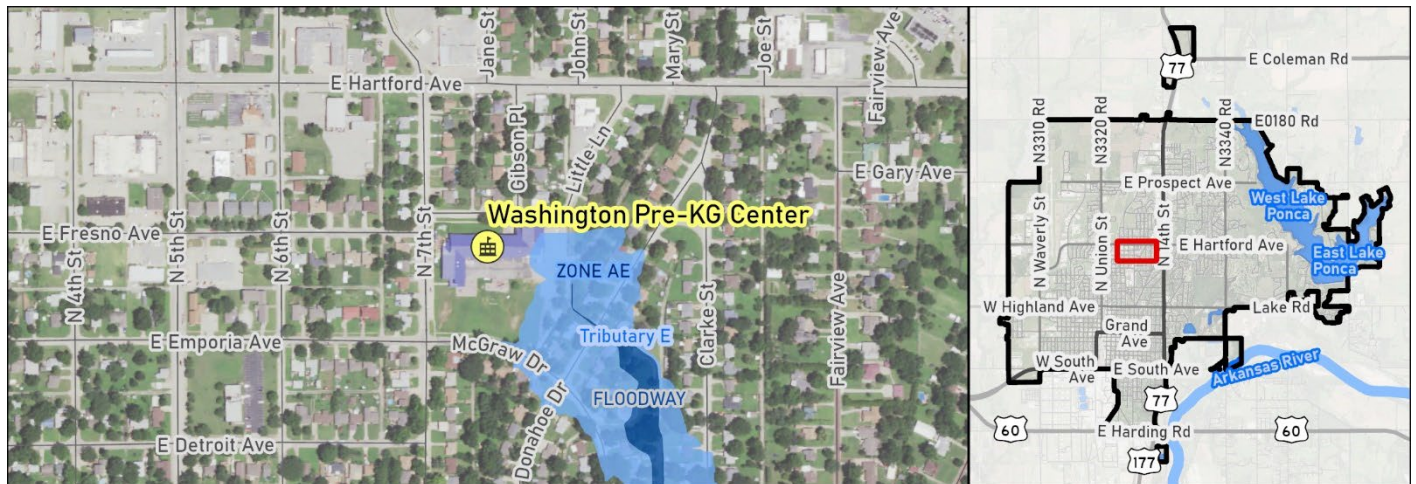


Figure 4-5 Liberty Elementary Flooding Areas (S-2)



The first two problem areas (S-1 and S-2) highlight flooding areas near school structures and are mapped above. No other structures were identified with a heightened flood risk. The remaining areas relate to school transportation routes and are not mapped above.

Table 4-5 Ponca City School District Flooding Problem Areas (Structure and Transportation)

Flooding Area	Location	Flooding Source	Description
S-1 (Structure)	Little Lane and N. 7 th St.	Tributary E	Washington Pre-K Center appears to be touched by the SFHA with a flooded parking lot to the east of the school during a 1% storm.
S-2 (Structure)	Northeast of W. Liberty Lane and N. Osage St.	Tributary M	The land owned by Independent School District 71 north and west of Liberty Elementary School is in the SFHA but does not affect the school building.

S-3 (Transportation)	N. 5 th St. north of E. Highland Ave.	Tributary G	This is part of School Bus Route #43. The culvert is overtopped by 1.2 feet during a 20% storm and by 3.2 feet during a 1% storm.
S-4 (Transportation)	Windsor Rd. north of Brentwood Drive	Tributary M	This is part of School Bus Route #42. The culvert is slightly overtopped during a 10% storm and by 1.1 feet during a 1% storm.
S-5 (Transportation)	Prospect Ave. west of N. 14 th St.	Tributary M	This is part of School Bus Route #42. The culvert is overtopped by 0.15 feet during a 50% storm and by 0.65 feet during a 1% storm.
S-6 (Transportation)	Grand Avenue (see areas L-5 and L-7 from Table 4-5).	Localized flooding	Grand Ave. is also School Bus Route #42
S-7 (Transportation)	N. Waverly St. just south of W. Chestnut Ave.	Tributary L	This is part of School Bus Route #43. The culvert is overtopped by 0.8 feet by an annual storm and by 1.1 feet by a 1% storm.

4.2.3 Extent

As discussed in the flood location section, FEMA develops maps based on several floodplain zones. Flood extent in Ponca City is characterized by two floodplain zones in particular, which affects the extent of flooding in these areas. They are:

- Zone A, or 1% Annual Chance (100-year) flood zones.
- Zone C, 0.2% (500-year) flood zones.

Table 4-6 lists the FIRM zones identified for use in regulating construction in the floodplain and for determining insurance rates for properties located in the floodplain. It is estimated that the average structure in the SFHA will experience 2 feet of flooding, which will result in 25% damage to the structure and 25% damage to contents.

Table 4-6 FEMA Flood Insurance Rate Map (FIRM) Zones

FIRM Zones		
Zone A	The 1% Annual Chance (100-year) or Base Floodplain. There are six types of A zones:	
	A	The base floodplain mapped by approximate methods, i.e., BFEs, are not determined. This is often called an unnumbered A zone or an approximate A zone.
	A1-30	These are known as numbered A zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
	AE	The base floodplain where base flood elevations are provided. AE zones are now used on new format FIRMs instead of A1-30 zones.
	AO	The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided.
	AH	Shallow flooding base floodplain. BFE's are provided.
	A99	Area to be protected from base flood by levees or Federal flood protection systems under construction. BFEs are not determined.
	AR	The base floodplain that results from the de-certification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection.

Zone V and VE	V	The coastal area subject to velocity hazard (wave action) where BFEs are not determined on the FIRM.
	VE	The coastal area subject to velocity hazard (wave action) where BFEs are provided on the FIRM.
Zone B and Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and the 500-year floods. B zones are also used to designate base floodplains or lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than one square mile.	
Zone C and Zone X (unshaded)	Area of minimal flood hazard, usually depiction FIRMs as exceeding the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood.	
Zone D	Area of undetermined but possible flood hazards.	

Any detailed modeling should be updated in areas where Ponca City is considering development. Extent for the problem areas in Ponca City and Ponca City School District are discussed in Table 4-4 and Table 4-5, respectively (see location section).

4.2.4 Previous Occurrences

In Ponca City, floods have accounted for many of the most frequent and most costly weather disasters. From January 2010 – June 2021 Ponca City experienced 7 separate flood events. The National Center for Environmental Information (NCEI) is one of the most comprehensive databases for most natural hazards in the United States, which includes Ponca City. For this reason, the planning team will use NCEI information frequently throughout this risk assessment to determine previous hazard events and consequences. According to NCEI data, the planning area has recorded \$35,000 in flood damages. No injuries or deaths were reported during this team, although emergency responders had to perform several rescues of people from their vehicles. Descriptions of these events are included in the table below.

Table 4-6: Flood Event Narratives

Date	Event Narrative
April 29, 2012	Widespread street flooding occurred from Tonkawa to Ponca City. Several inches of water forced the closure of several city streets and county roads and caused some automobiles to stall. I-35 was inundated with 6- 8 inches of water. Water entered residences on the west side of Ponca City.
July 28, 2016	Afternoon diurnal convection formed on the 28th across northern Oklahoma in a moist and unstable environment. Despite a lack of shear, some of these storms became severe. The underpass flooded at South Ave. and 1st Street.
October 6, 2016	An area of storms formed overnight on the 5th into the morning hours of the 6th in the vicinity of a retreating front across northern Oklahoma. Ponca city emergency manger reported upwards of 2 to 3 feet of water covering several residential streets. Hubbard road was closed between W and Waverly streets.
May 11, 2017	Widespread heavy rainfall across Ponca City and severe thunderstorms across western Oklahoma combined to cause severe flash flooding. This caused several vehicles to stall in flood waters and rescue teams were sent to help. According to NCEI, \$5,000 was reported in damages.
May 20-21, 2019	An extremely unstable environment led to widespread severe weather across Texas and Oklahoma on the 20th into the morning of the 21st. Water entered buildings. Five to 7 inches of rainfall fell across Kay County. Parts of State Hwy-11, US-60, US-177, and SH-156 closed due to flooding. \$5000 in damage was reported. Kay County was included in the Disaster Declaration DR-4438.

Date	Event Narrative
May 24, 2019	Scattered supercells merged and caused severe street flooding, leaving cars stranded and several city streets to close. There were numerous water rescues conducted and water in a few structures around Ponca City and Ponca City Airport. According to NCEI there was \$20,000 in property damages.
September 12, 2019	Flooding occurred around underpasses and roads. Building damages from the event were reported to be \$5,000.

4.2.5 Probability of Future Events

Based on the 7 flood events that occurred from 2010 through 2021, it is **likely** that the city of Ponca City will experience a flood each year. Ponca City should expect an average of two or three minor flood events every several years and major flood events on a less frequent basis. In recent years, Ponca City has experienced more short duration high intensity thunderstorms where rainfall intensity has exceeded the 1% storm intensities for brief time periods. This has resulted in more street and localized flooding.

4.2.6 Vulnerability and Risk Assessment

Based on the classifications in Table 4-2, the overall significance of a flooding event is **high**.

People

Flooding is one of the most dangerous natural hazards to human life profiled in this plan. Driving through flooded areas accounts for most flood-related deaths, though residents trapped in their homes may be at risk of rising waters as well. In addition, busy roadways can become locations for accidents or drownings.

Certain groups of people are also more vulnerable to flooding. Among these groups are elderly people, young people, and lower-income people. Elderly people and younger people are more vulnerable to flooding for overlapping reasons. Among them can difficulties with using transportation independently and some difficulties/disinclination to use communication networks during emergency events. Among the groups most impacted by flooding are lower-income residents, since lower income people are more likely to reside in areas with a higher frequency and/or extent of flooding.

Public Health

There are also public health concerns due to flooding. According to the planning team's analysis, approximately 690 residents live in a SFHA floodplain.⁴⁰ These people are exposed to heightened public health risks to flooding. Flood waters can be contaminated with e-coli and fecal coliforms from sanitary sewer overflows and animal waste as well as hazardous chemicals which can cause immediate health problems. Contaminated flood waters can result in long term health and environmental impacts, and buildings inundated by flood waters may develop mold. There is long-term health risk from mold remaining in flooded structures. Flooding also can lead to evacuations, which carry their own physical and psychological risk to the people being evacuated.

Education and Outreach

Officials also noted the lack of consistent education and outreach on flooding hazards for developers, builders, realtors, and residents. This includes driving during a flood, health affects due from mold, and the proper techniques to make compromised water potable.

There are no flood warning devices in Ponca City, giving people in the planning area less time to respond and react to an impending flood event. This can exacerbate the conditions listed in this section. Officials also

⁴⁰ Estimate reached by multiplying the number of residential structures in the SFHA (Table 4-7) by 2019 ACS estimates for average household size.

<https://data.census.gov/cedsci/table?q=Ponca%20City%20city,%20Oklahoma%20household&tid=ACSST5Y2019.S1101>

expressed interest in having an emergency management application to reach all residents to warn them about a flood. The emergency application could be expanded to provide educational materials as well, especially flood insurance, dangers building in a floodplain, health risks from flooding (e.g. mold), and other materials.

Economy

Flooding causes significant economic losses. Disruption to transportation networks causes business interruption. Flooding also can damage to business contents, vehicles, and business inputs (for example wood in lumber mills). Flooding of roads, and key transportation routes can have significant impacts on the economy. Prolonged disruption of supply chains in the planning area could cause an economic downturn in the sectors affected for months or even years.

Damage to large structures or structures with valuables can cause significant economic losses in building repairs. In addition, damage or closure to business that is revenue driver can lead to economic losses in terms of lost revenue. Some utilities are at risk of flooding in Ponca City, but no major employer is uniquely at risk to flooding in the City.

Built Environment

Existing Structures

All structures in Ponca City are at risk of flooding. Not all structures share a uniform risk to flooding, however. To assess flood risk, a GIS-based analysis was used to estimate exposure to flood events using local tax assessor records in combination with building footprint data. The determination of assessed value at-risk (exposure) was calculated using GIS analysis by summing the improved values for parcels and structures that were confirmed to be located within an identified floodplain. Table 4-7 and Table 4-8 highlights some potential at-risk structures based on their relationship to mapped floodplains.

Table 4-7 Structures Touched by the SFHA

Improvement Type	Number	Est. Market Value
Residential Single-Family	274	\$18,377,000
Residential Multi-Family	4	\$1,454,000
Commercial	15	\$2,774,000
Other	1	\$980,000
Total	294	\$23,585,000

The planning team has identified over 380 structures in the Planning Area that are exposed to mapped flood risk (the floodway, the 1% floodplain, the 1% approximate floodplain, and the 0.2% floodplain). The estimated value of parcels in the SFHA (Zone A floodplains) exceeds \$23,500,000 alone. According to NFIP data, there have been approximately \$480,000 flood claim properties across the planning area, with 18 of these claimants being repetitive loss properties.

As of this writing, 8 repetitive loss properties remain unmitigated. A repetitive loss property is defined as a property that has received at least two NFIP claims exceeding \$1,000 within any ten-year period since 1978. A Repetitive Loss Area (RLA) is an area with at least one repetitive loss property that has not yet been mitigated. These 8 unmitigated properties are all residential properties and are concentrated across 7 RLAs. Ponca City has conducted a separate RLA Analysis concurrent to the development of this plan that meets FEMA CRS requirements.

Table 4-8 Ponca City NFIP Data (current to 2018)

Floodplain	Number of Buildings	Repetitive Loss Properties*	Repetitive Loss Claims	NFIP Total \$ RL Paid	NFIP Claim Locations	NFIP Total \$ Claims Paid
Floodway	28	3	11	\$165,300	31	\$224,600
1% FEMA Floodplain	281	0	17	\$220,900	56	\$347,800
1% FEMA (Approximate) Floodplain	12	0	0	\$0	0	\$0
0.2% FEMA Floodplain	63	0	2	\$7,500	5	\$14,400
Not in FEMA Floodplain	11375	5	15	\$86,500	31	\$135,500
Total	-	8	45	\$480,200	123	\$722,300

*unmitigated as of this writing

Location-specific flooding issues are also vulnerable to additional flood risk, which was identified in the location section of this assessment for the city (Table 4-4) and the public-school districts (Table 4-5). These sections were not included in this section for redundancy issues.

Infrastructure

The planning team conducted an analysis of infrastructure based on 4 segments: electrical, gas, water/wastewater, and transportation. The planning team selected these 4 elements for further analysis based on the different ways that the hazards interact with these elements, in this case flooding. Most importantly, these 4 elements were selected because damage and disruptions to these elements can cause significant disruptions in the economic, cultural, and the basic people affected (see FEMA Lifelines in the introduction of this chapter). All hazards analyzed in this risk assessment include a commentary on some or all these infrastructure segments. The gas segment is not at specific or unique risk to flooding.

Electric: Flooding can cause and has caused power outages in the planning area. The most common causes and accentuations of power outages due to flooding include:

- Damage to electrical generation or distribution due to flooding
- Floodwaters can make it impossible for repair crews to reach points of generation or distribution to maintain or fix their operation (see transportation section)

Power outages can exacerbate conditions outlined the people and culture section.

Water/wastewater: Water/wastewater facilities and water/wastewater distribution systems can be affected by floodwaters. Flooding can inundate facilities, which can halt operations. If prolonged, a cessation of operations can result in a crisis to provide potable water to citizens or cause a backup of wastewater, which can cause a sanitation and/or environmental crisis. Floodwater seepage into water lines and other distribution systems, although unlikely, could cause contamination and public health issues (see public health for more information).

Transportation: Road blockages and congestion can cut off access to homes and businesses. Closed bridges and roads can cause traffic accidents and other backups that can extend the flood impact well beyond the flooded area. These concerns result in missed work, extra transportation costs and reduced commerce. Flooding can result in hazardous driving conditions, which could cause loss of life, when vehicles are driven or swept into floodwaters. As little as 12 inches of standing water over roadways can stall many vehicles. Only 18 inches of flowing water can sweep most vehicles off roadways.

Significant flooding can cause disruptions to railroad, waterway, and air distribution and travel networks. Major disruptions can lead to an economic downturn in the sectors affected (recreation, business sectors, etc.) and, in extreme cases, failure or difficulty to bring vital goods and services to people in the planning area.

Cultural Resources

All cultural institutions in Ponca City are exposed to flooding events. This being said, only the Pioneer Woman Museum was identified as higher risk to flooding, given its proximity to Ponca City's Zone A floodplains.

Critical Facilities

Several critical facilities are touched by or located to the floodplains and some critical facilities are in a floodplain. These facilities are as follows:

- The Water Treatment Plant (Zone A)
- The Wastewater Treatment Plant (Zone A)

The effects of a partial or complete failure at either of these facilities is outlined in the water/wastewater section above. In addition, blockage of key transportation routes (see location section) can disruption emergency response times for police, fire, and other responders in the planning area.

During this assessment, Ponca City officials noted that its Emergency Operations Center floods. According to their analysis, this flooding is due mostly to structural issues with the building where the EOC is located, as the EOC is located in a basement. Loss of a working EOC could easily disrupt or hinder the deployment and coordination of response efforts, the development or implementation of operations plans, and other activities. This could result in direct harm to people affected due to delays in response times or inadequate or ineffective response efforts.

In sum, Critical facilities at a higher risk to flooding include:

- The Water Treatment Plant
- The Wastewater Treatment Plant
- The City's EOC

Future Development

All future development in the planning area is vulnerable to flooding. This being said, Ponca City is not expected to build in existing floodplains given its focus on reducing flooding hazards. Building in the floodplain should be avoided, if all possible. In addition, any retrofit work to buildings in a mapped or known flooding area should integrate flood mitigation efforts. Climate change reports indicate that the planning area may experience higher amounts of rainfall in the future. It is still unclear how increased rainfall will change flooding areas in the City.⁴¹ Currently, the City is not planning any development with major flood risk. As of this writing, Ponca City plans to adopt the 2018 international building codes.⁴²

⁴¹ <http://www.southernclimate.org/documents/SPTOK.pdf>

⁴² Includes the international residential code, the international building code, the international existing building code, the international fire code, the international fuel gas code, the international mechanical code, the international plumbing code, the international energy conservation code, and the 2020 international electrical code.

4.3 Severe Winter Storm

4.3.1 Hazard Description

A **winter storm** is a winter weather event that produces significant and impactful accumulations of freezing rain/ice, sleet and/or snow. Winter storms usually occur in the planning area between November and March and are usually created by large low-pressure systems moving rapidly across the country. Ice storms are often a greater threat than blizzards. Moisture from the Gulf of Mexico moving over shallow cold air near the earth's surface can produce ice accumulations of two inches or greater.

Winter storms may include heavy snowfall, blowing and drifting snow, high winds, extreme cold or ice storms. Of the most extreme instances is a blizzard, which is defined as winds greater than 35 mph, visibility less than $\frac{1}{4}$ mile, and a duration of at least 3 hours. New snowfall is not necessary for a blizzard, since blowing snow can obscure visibility. Another more extreme winter storm event that the planning area can expect is an **ice storm**, which is characterized by unusually low temperatures, freezing rain, and winds. Most significantly, ice storms can result in the rapid accumulation of ice on the built and natural environments. Winter storms are measured by snowfall accumulation or ice thickness.

4.3.2 Location

The risk of this hazard is uniform over the entire City of Ponca City, including Ponca City School District. Given the size of fronts that produce storms in northcentral Oklahoma, a winter storm can encompass most or all of the planning area.

4.3.3 Extent

The extent of a storm is determined by its duration and severity. Severity reflects the general combination of a storm's temperature, wind speed, and precipitation levels (precipitation type is determined, in part, by temperature). During the winter months, Ponca City occasionally experiences snowfall combined with high winds, freezing rain, or ice storms. The snowfall season usually lasts from November to April. Total seasonal snowfall averages around 9.0 inches. The record low temperature recorded in Ponca City was -27 degrees Fahrenheit.⁴³

The planning area has experienced ice accumulation during winter storms. The Sperry-Piltz Ice Accumulation (SPIA) Index, shown in Table 4-9, can be used to predict the types of damages that may occur before the onset of a winter storm. The SPIA Index is used to predict the location, timing, and severity of ice storm impacts days in advance. The tool allows schools, power cooperatives, and other entities to better prepare for severe ice events. The planning area may experience an ice storm with greater than 3 inches of ice accumulation and a rating of 5 on the SPIA.

Table 4-9 SPIA Index

Ice Damage Index	Damage and Impact Descriptions
0	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.

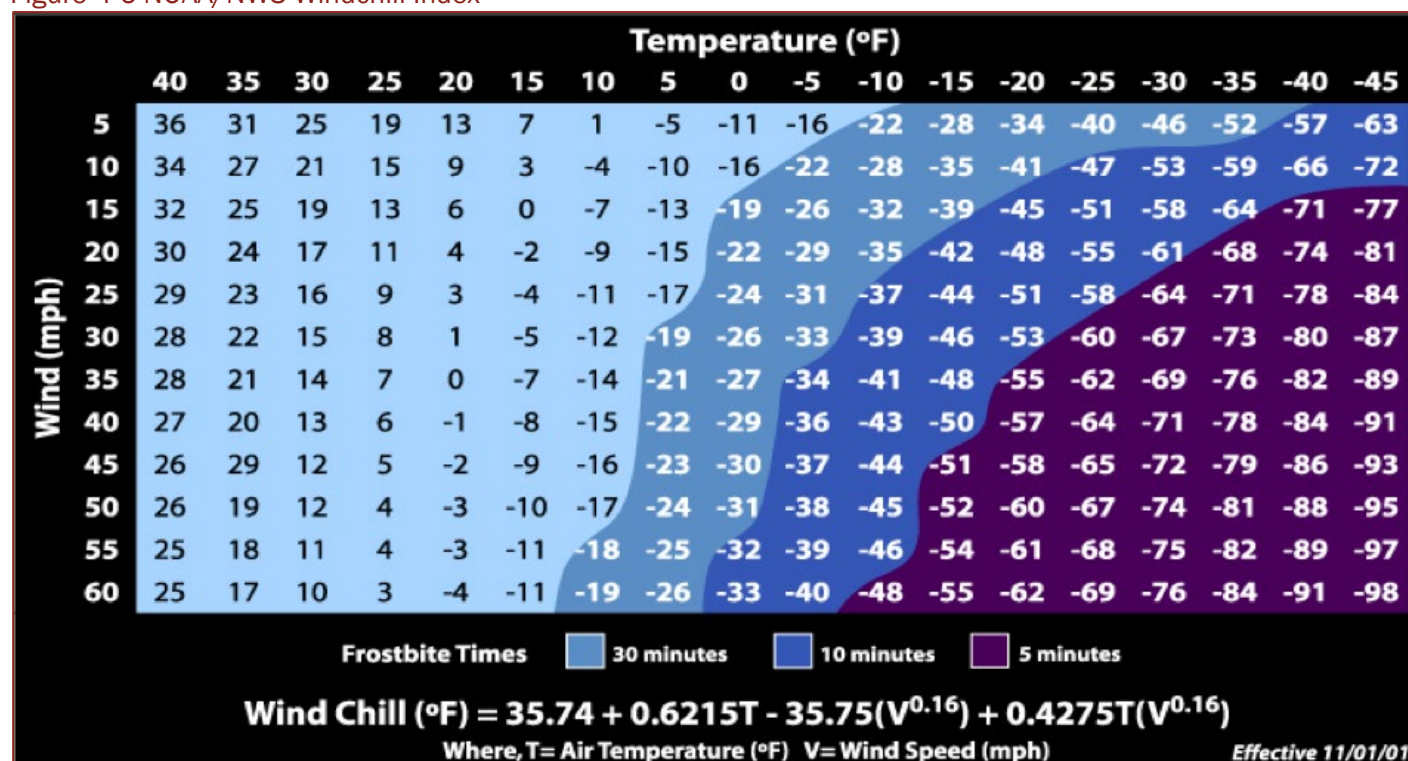
⁴³ http://climate.ok.gov/county_climate/Products/County_Climatologies/county_climate_kay.pdf

Ice Damage Index	Damage and Impact Descriptions
2	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
3	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 - 5 days.
4	Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 - 10 days.
5	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.

In addition to ice, windchill (wind and temperature) has a significant impact on a winter storm's extent. The National Weather Service and the National Oceanic and Atmospheric Association created one of the most used windchill charts in the United States (Figure 4-6). This chart's primary use is to indicate immediate threat to human safety by listing approximate time periods for exposed skin to develop frostbite.

Rapid onset times for frostbite, although rare, are possible. Several days during the February 2021 event, for instance, the windchill factor approached the 30-minutes-to-frostbite zone. The planning area can expect the windchill factor to approach the 30-minutes-to-frostbite zone for extreme cold events.

Figure 4-6 NOAA/NWS Windchill Index



4.3.4 Previous Occurrences

The NCEI Storm Events Database includes reports of severe winter storm events on a regional basis. As discussed in the extent section, severe winter storms are, by nature, not isolated events – therefore it could be stated that winter weather events affecting Kay County also had some impact on the City of Ponca City. The NCEI database reported 26 winter weather events between 2001 to 2021. Severe winter weather resulted in four

Presidential Disaster Declarations in Ponca City. The most significant ice storm in Oklahoma took a devastating toll on Ponca City in 2007, and in 2011 record snowfall shut down the Ponca City.

Table 4-10 Historic Winter Storm Events

Date	Event Narrative
January 31-February 5, 2011	A swath of heavy snow occurred across much of central and southern Oklahoma with 4-8 inches occurring across the state and effecting power lines in Ponca City (EM-3316-OK).
February 24-26, 2013	Very heavy snowfall occurred over several days. Up to 18 inches were reported for Kay County and gusty winds up to 40 mph accompanied the snow which added 7 inches of snow to Ponca City (DR-4109-OK).
November 27, 2015	Light freezing rain and sleet fell across portions of Kay County, affecting Ponca City and leaving 0.25inch of ice. Roads were ice-covered; ice knocked out power for 132 customers. The utility company claimed over \$9.8 million in damages.
December 26, 2015-January 5th, 2016	Up to an inch of ice accumulation was reported. Two men out duck hunting were killed when their boat capsized on Kaw Lake during the storm. Power outages occurred and the damage estimates from the power company were about \$38.4 million. Property damages in Kay County were \$195,000 (DR-4256-OK).
October 26, 2020	An arctic cold front moved through eastern Oklahoma causing Kay County, and subsequently Ponca City to have an ice storm. Ice accreted 0.30-0.75 across the county. Partial estimates reached \$285,000. The ice-covered roads led to dangerous driving conditions.
February 8-16, 2021	A severe winter storm occurred throughout much of Oklahoma. Lake effect snow produced up to 1.5-inch accumulations in some areas, a rare occurrence for the region. There was excessively cold wind chill as well as heavy snow from the 14 th through the 16 th . Temperatures fell below zero across the area and wind chill values were as low as -20 to -30 degrees. This event received a disaster declaration (DR-4587-OK).

4.3.5 Probability of Future Events

Based on previous occurrences in the past decade, the likelihood of severe winter storms impacting the planning area is **highly likely**.

4.3.6 Vulnerability and Risk Assessment

Based on the classifications in Table 4-2 the overall significance of a severe winter storm event is **high**.

Communities and individuals exposed to severe winter storms are at risk of extended loss of utilities. Combined with dangerous travel conditions and possible structure damage, winter storms can put Ponca City residents at high risk.

People

The entire population is exposed to severe winter storm events. The NCEI database did not report any fatalities or injuries within Ponca City during the reporting period, however, winter storms have resulted in severe car crashes and dangerous conditions for residents. Transportation accidents and cold-related injuries and fatalities present the largest concern to public safety. Ice accumulation on roadways immediately creates hazardous driving conditions. Roads on gradient and slick road surfaces increase the frequency and impact of traffic accidents for the general population, which can result in personal injuries and fatalities. Smaller, less maintained roads may be additionally damaged by ice or become more difficult to navigate.

Public Health and Safety

Hypothermia is the most prominent cold-induced threat to human life. Extreme cold can cause animals and people, especially outdoor workers exposed to winter elements, to suffer from frostbite and hypothermia – and when severe enough, death. Children and the elderly are at increased physiological risk. Since 44% of the population of Ponca City is under 18 or over 65, the likelihood of someone succumbing to winter weather is high.⁴⁴

The homeless and lower-income populations also are vulnerable to the cold. They may not have access to housing, or their housing may have poor insulation or poor heating. Historically, Ponca City has had problems with a lack of information for this population, who resort to alternate methods of heat such as space heaters or using the oven as a heat source, which can lead to carbon monoxide poisoning or produce other harmful side effects. Nearly 18% of Ponca City residents live below the poverty line, which is higher than the state average. This population is concentrated in the southwest of the planning area, which also overlaps with the people that are racial minorities (see Chapter 1 for more details).

There are several warming shelters throughout the City, which are offered by local nonprofit organizations. Warming shelters are particularly important in areas with high numbers of vulnerable people due to their income level an age, who are concentrated in the southwest and northwest parts of the City (see vulnerability indicators in Chapter 1).

Education and Outreach

A mobile app/call line citizens can use to request for assistance should be installed and education on this should be shared on all media platforms before the next winter storm hits. Officials noted the lack of consistent outreach and education on severe winter storm for developers, builders, realtors, and residents. This can include information on proper warming techniques, location of shelters for warming, proper ways to conserve water, insulation best practices, and other information.

It is also important to inform the public about severe winter weather, and how to best protect themselves and their family from the impacts. This can include information on proper warming techniques, location of shelters for warming, proper ways to conserve water, insulation best practices, and other information. Officials also noted the lack of consistent outreach and education on severe winter storm for developers, builders, realtors, and residents. Outreach methods can include social media platforms and producing and distributing family emergency preparedness information about severe winter weather.⁴⁵ In addition, a mobile app/call line citizens can use to request for assistance should be installed and education on this should be shared on all media platforms before the next winter storm hits.

Economy

Extended power outages can put residents at economic risks by prevent businesses from opening or working remotely in Ponca City. Refineries and other heavy industry, such as ConocoPhillips, reported difficulties operating due to extreme cold like the 2021 winter event.

Winter storms also affect the economy by disrupting transportation networks throughout the City, most prominently roads, but also rail roads and air travel. Prolonged closures can cause thousands of dollars in lost income, which can affect revenue and tax base in the long run. Although Ponca City benefits from having employers across a range of sectors, prolonged or permanent closure of a significant employer in the planning area due to a winter storm also will likely affect the tax base.

⁴⁴ The planning area has about 7% residents who are young (under 5), which is the county and state average, and 18% residents over 65, which is slightly above the state average.

⁴⁵ When the Power Goes Out | Natural Disasters and Severe Weather | CDC

Built Environment

Existing Structures

A direct threat to structures from a severe winter event is excessive snow/ice accumulation onto flat or low-grade sloped roofing surfaces. This is especially true of older structures that were not constructed to withstand this type of stress. Approximately half of all Ponca City residential structures were built before 1960. Commercial structures face the same impacts of winter weather as residential properties. More indirect threats to structures would be from power outages causing interruption to heating and refrigeration (loss of supplies, food, sensitive equipment), frozen water pipes (excessive flooding causing damage to interior and sensitive electronic equipment if pipes break), and fires (caused by power lines being torn away from structure or power surges as lost power is restored).

Infrastructure

Electric: The most severe consequence of a winter storm on infrastructure is damage to power lines caused by the added weight and surface area of ice accumulation, combined with the additional stress of wind. This can result in economic effects, if prolonged in the planning area (see economy section). In addition, residents living in Ponca City who use electrical-powered machines are immediately at risk (people section). Some of the biggest threats to a prolonged loss of power include water/wastewater utilities and the hospital. These facilities, however, were reported to have adequate backup generation, which would minimize the impact of power loss.

Ponca City maintains routine tree trimming to ensure power line are protected and buildings and roads are clear. This has helped reduce power outages from downed power lines. Despite these measures, officials noted that the timing of the winter storm event can affect power outages. An event earlier in the fall, like October, has the potential for more damages to lines, along with roofs and cars, because of the tree limbs that fall on lines.

Gas: During winter events, Oklahoma Natural Gas (ONG) can experience a variety of challenges in meeting the needs of Ponca city residents, including damage to gas meters from ice accumulation, falling power lines or tree debris, inaccessibility to underground gas meters from falling debris, danger to field employees related to road conditions, downed power lines, and extreme temperatures. City officials reported these that these failures occurring in the planning area during the last decade. Loss of gas services could lead to a sharp reduction in residents' abilities to heat their homes properly (see people section), use personal vehicles, or power backup generators.

Water/Wastewater: A threat to the operation of Ponca City's wastewater treatment plant during a winter storm would be power outages. Although this may present a threat to the City, these facilities also have access to adequate backup generation. Historically, residential water line breaks have been more common in the City.

A system failure due to a significant water line break or a facility could lead to significant consequences. Citizens could lose access to potable water for extended amount of time. The 3.5 million gallons of wastewater produced daily by the wastewater treatment plant in Ponca City could be backed up, potentially leading to additional sanitation issues.

Transportation: All manner of transportation would be at risk during a winter event in the planning area. Road closures due to ice/snow accumulation can result in loss of retail trade, wages, and tax revenue. The inability of public transportation (to function after a winter event can also contribute to increased risk to the population if it blocks normal emergency routes, access to other medical care, or access to safe shelter. Food insecurity is also a concern. Those who are without transportation or blocked by road conditions will be vulnerable to food shortages and need support systems in place.

Severe winter weather could result in the interruption of normal operations of the railway and Ponca City airport. Significant ice or snow accumulations can impact runway safety and result in cancellation or major delays in regular flight schedules. This occurred during the 2021 winter weather event.

Ponca City is responsible for clearing snow and ice from within their borders of the Ponca City including all arterial (main) streets. The City relies on the county for ice trucks and snowplows. Kay County Oklahoma Department of Transportation is responsible for clearing expressway segments on the outskirts of Ponca City and within Ponca City School District.

Critical Facilities

All critical facilities in Ponca City are susceptible to the potential impacts of a winter storm event. Among other things, power outages interrupt vital services, and snow/ice accumulation or debris from damaged trees result in inaccessibility due to road closures or blockages. Ponca City officials note that all public critical facilities are supported by backup generators. The City also has portable backup generators as a reserve for these facilities. Ponca City should ensure to test and maintain these generators on a regular basis. This being said, backup generators could fail for several reasons, including:

- Age of the unit (exceeded the unit's product lifetime)
- Storage location of the unit (not elevated off ground; exposed to weather)
- Lack insulation of the unit (from extreme heat and cold)
- Time that the unit is activated (overheating during periods of extended use)
- Time when the unit is activated (delays to activate in extreme heat or cold)
- Failure to conduct regular tests of the unit
- Lack of available gasoline/diesel to power generator due transportation issues or supply shortage

More research is needed to determine the specifics of generators in Ponca City. In addition, all private critical facilities should acquire and maintain adequate backup generation.

Cultural Resources

All cultural institutions in Ponca City are exposed to winter weather. The most likely effect of this hazard on cultural resources would be structural damages caused by heavy snow loads. The historic theater and some of the older architecture around the City are at risk from the elements, due to its construction. More studies are needed, however, to determine the severity of this exposure.

Future Development

All future development is exposed to winter storm events. Powerlines in areas of future development should be buried to avoid power loss. Generators should be installed at all new critical facilities. As of this writing, Ponca City is adopting the 2018 building codes. Buildings constructed before the adoption of these codes, however, remain more vulnerable unless they are retrofitted or updated with more current standards.

Ponca City School District

Although Ponca City School District is vulnerable to power outages caused by winter storms, all schools have back up generation in the event of a power outage, which reduces its likelihood of an outage. In the event of an outage, the district would need to postpone school or move it online. Food and other perishables may also spoil.

In addition, some of the HVAC systems at Ponca City Public School facilities are exposed to snow, ice, and extreme temperatures. Failure across these systems could prevent the building from being heated, making the school potentially temporarily uninhabitable for students and staff due to cooling of the building to unreasonable levels. In addition, cooling of the building may increase the likelihood of pipes bursting or other structural damages.

All eleven schools within Ponca City School District have an emergency action plan to mitigate against a short-term or long-term power outage from winter storms, which reduces the schools' vulnerability to winter storms. In addition, all schools have a long-term sheltering plan for students, along with citizens who request sheltering services, during a prolonged outage caused winter storm event (see Chapter 3 for more details). During the

December 2007 ice storm, for instance, schools kept students for extended periods of time within school buildings before it was safe for busses to take them home or parents to pick them up.

All buildings reported to have adequate insulation for pipes and valves. Better insulation practices does not eliminate pipes from bursting. Bursting pipes could cause millions of dollars in damages and close school or suspend at-school operations. Although heavy snow loads could damage roofs, none of the school districts reported concerns or historical issues with snow load damage. Ponca City School District did not report any other structural vulnerability to severe winter storm. Ponca City bus routes can be impacted by severe winter storms (see Transportation section), including bus routes that extend outside the City's boundaries.

Natural Environment

The environment, especially large flora, is at risk of snow and ice accumulation. As little as $\frac{1}{4}$ -to- $\frac{1}{2}$ -inches of ice accumulations can break small branches and weak limbs, while $\frac{1}{2}$ -to-1-inch ice accumulations can cause larger branches to break.

4.4 Tornado and High Wind

4.4.1 Hazard Description

Tornadoes and high winds form differently, but can have similar features (e.g. high windspeeds), depending on their severity. According to the National Weather Service, a **tornado** is a violently rotating column of air, usually pendant to a cumulonimbus, with circulation reaching the ground.⁴⁶ Tornadoes generally form from severe thunderstorms. Thunderstorms may result in conditions favorable to the formation of numerous or tornadoes with longer durations. Supercell thunderstorms are often associated with increased tornado risk. Tornadoes may also develop along squall lines or in bands of storms associated with hurricanes. Tornadoes require moist air, instability (warm air rising), a source of lift such as a front, dryline, or heating, and wind shear (change in wind direction and speed with height).

High wind is the motion of air relative to the earth's surface. Extreme windstorm events are associated with cyclones, severe thunderstorms, and accompanying phenomena such as tornadoes and downbursts. High winds can result from thunderstorms, strong cold front passages, or gradient winds between high and low pressure. Damaging winds are often called "straight-line" winds to differentiate the damage caused by tornadoes. Downdraft winds are a small-scale column of air that rapidly sinks toward the ground, usually accompanied by precipitation. A downburst is the result of a strong, thunderstorm associated downdraft that causes damaging winds near the ground.

4.4.2 Location

In terms of location, wind and tornado events can occur anywhere in Ponca City or Ponca City School District. High wind events could impact a large proportion of the jurisdiction during a single event. Although tornado events are usually localized, the likelihood that they impact any specific location is uniform throughout the planning area.

4.4.3 Extent

The planning team used Enhanced Fujita (EF) scale to classify the extent of tornadoes in Ponca City and Ponca City School District. In terms of extent, it is often difficult to separate windstorms and tornado damage when winds get above 73 mph. The EF Scale was revised from the original Fujita Scale to better reflect the relationship between damage surveys and observed wind speeds. Tornadoes are classified according to the Enhanced Fujita (EF) scale, which became operational on February 1, 2007.

Table 4-11 EF Rating Scale

Rating	Wind Speed (3-Second Gust)
EF-0	65-85 MPH
EF-1	86-110 MPH
EF-2	111-135 MPH
EF-3	136-165 MPH
EF-4	166-200 MPH
EF-5	>200 MPH

The EF scale is used to classify tornadoes based on estimated wind speeds. As of this writing, the EF Scale, as shown on Table 4-11 is used by FEMA in its most recent guidance on saferooms for tornadoes.⁴⁷ Although all ratings on the EF scale can cause damage or injury, tornadoes of EF-3 and greater are

⁴⁶ <https://www.weather.gov/safety/tornado>

⁴⁷ FEMA P361, 4th edition, B3-16; https://www.fema.gov/sites/default/files/documents/fema_safe-rooms-for-tornadoes-and-hurricanes_p-361.pdf

most important in terms of their extent. FEMA and NOAA estimate that 85% of all fatalities resulted from tornadoes of EF-3 and greater.⁴⁸

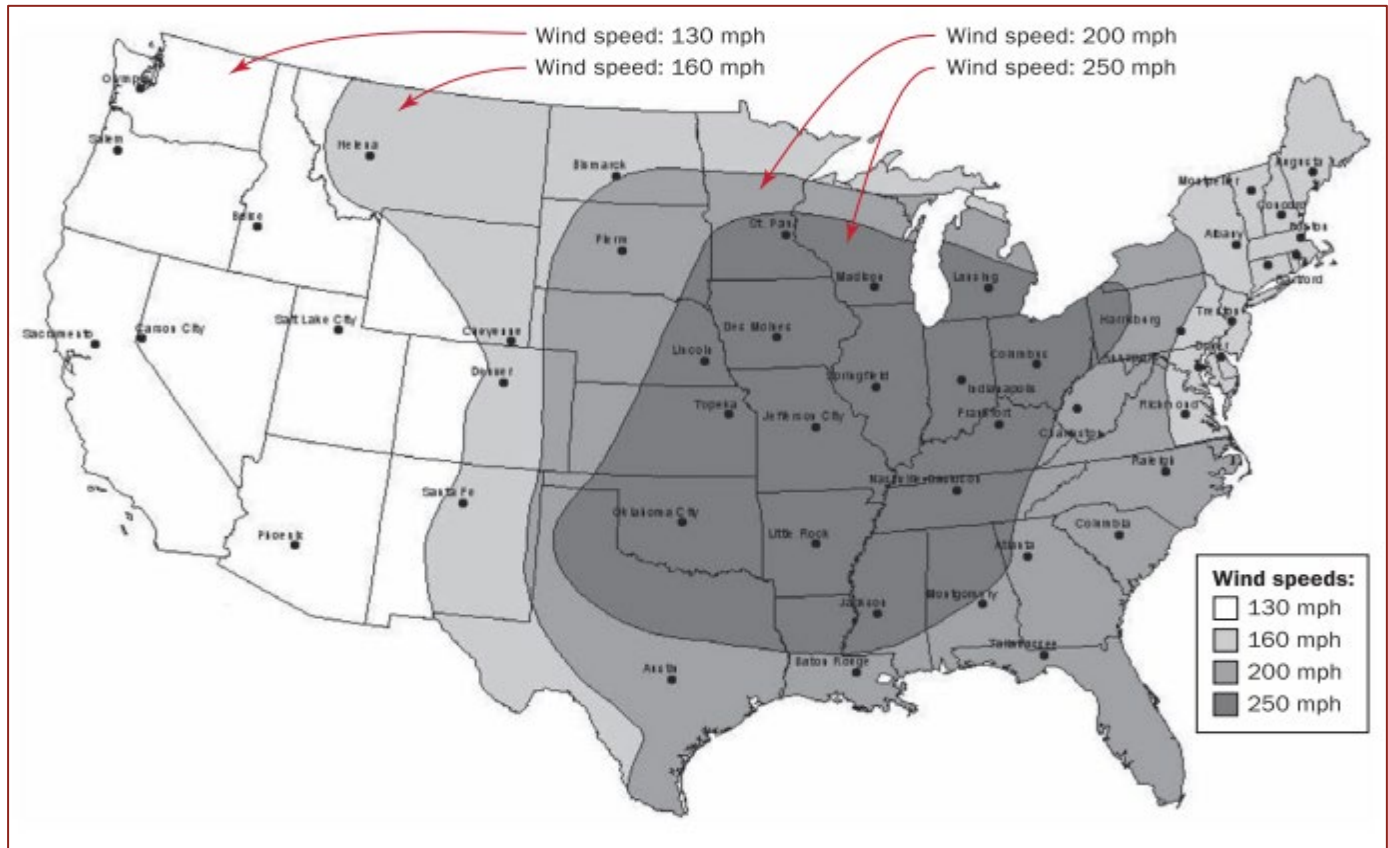
Table 4-12 provides a description of typical damage to one- and two-family dwellings at certain windspeeds, which can apply to tornadoes and high winds. It is important to note, however, that these descriptions should be seen as a general estimate of damages, not a baseline estimate. As discussed in further detail in the vulnerability sections, structures like mobile and prefabricated home are likely to experience higher damage volumes than fixed residential structures.

Table 4-12 Residential Tornado Damage Descriptions

Wind Speed Ranges	General Description
63 – 97 MPH	Loss of roof covering material (<20%), gutters and/or awnings; loss of vinyl or metal siding.
79 – 116 MPH	Broken glass in doors and windows; uplift of roof deck and significant loss of roof covering (>20%); collapse of chimneys and garage doors.
103 – 142 MPH	Entire house shifts off foundation, and/or large sections of roof structure removed; most walls remain standing.
127 – 178 MPH	Most walls collapse except for small interior rooms.
142 – 198 MPH	All walls collapse.
165 – 220 MPH	Complete destruction of engineered and/or well-constructed residence. Foundation swept clean of structure.

⁴⁸ Ibid., A2-2; https://www.fema.gov/sites/default/files/documents/fema_safe-rooms-for-tornadoes-and-hurricanes_p-361.pdf

Figure 4-7 ICC 500-2020 Wind Speed Zone Map

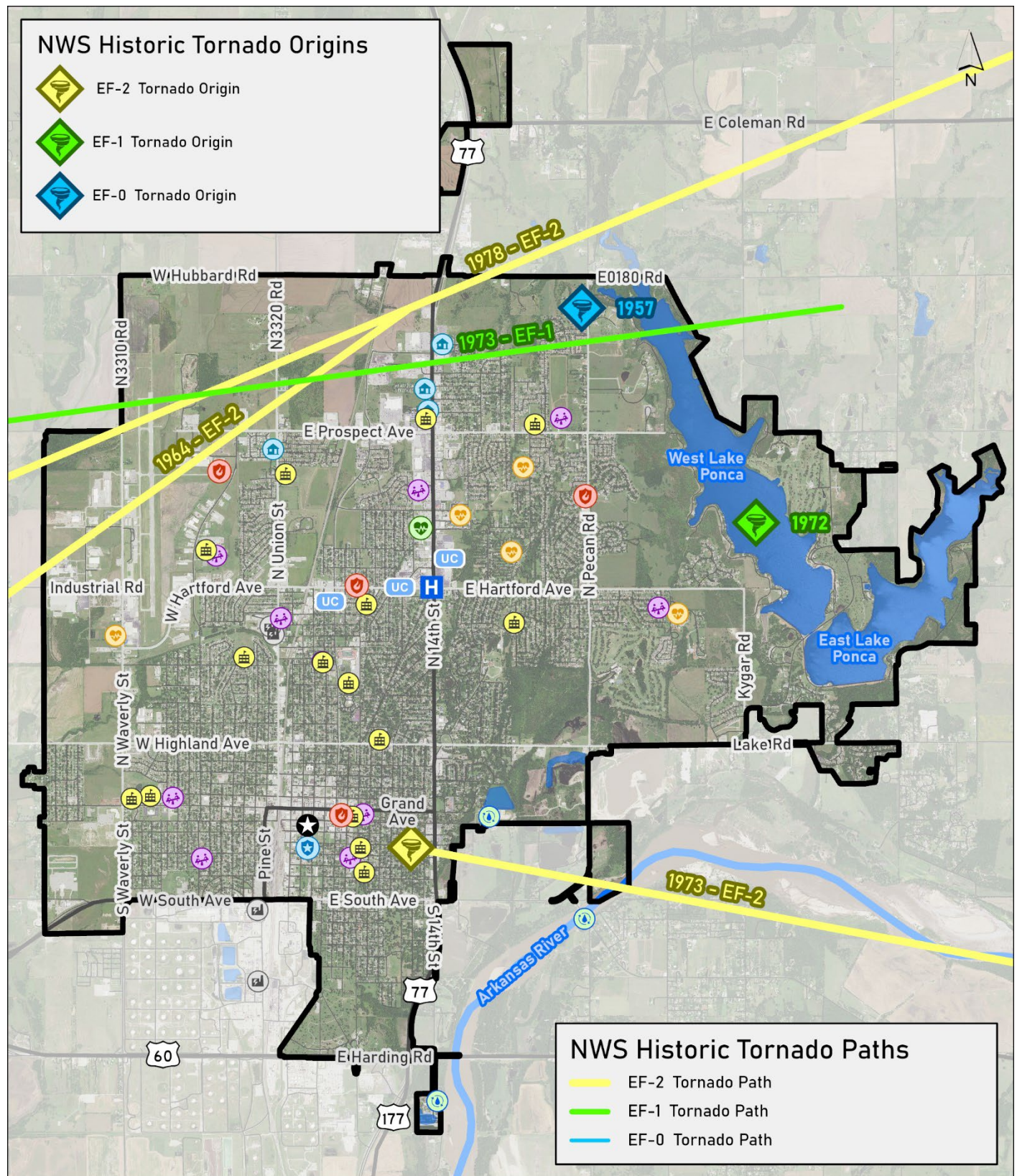


The planning team used the ICC 500-2020 Map to determine extent of high winds and tornadoes in the planning area, given that both measures use wind speeds as a gauge. This map was used to measure extent because of recent guidance from FEMA.⁴⁹ Oklahoma and many surrounding states have the highest wind zones in the United States. According to ICC analysis, which can be seen in the Figure above, the entire planning area shares a uniform risk to winds up to 250 mph, or an EF5 tornado.⁵⁰

⁴⁹ Ibid.

⁵⁰ https://www.fema.gov/media-library-data/20130726-1630-20490-8357/9_taking_shelter.pdf

Figure 4-8 Historic Tornado Paths in the Planning Area



4.4.4 Previous Occurrences

High Wind events have occurred in the city of Ponca City (including Ponca City Airport), according to the NCEI Storm Events Database. From January 2010 through May 2021, Ponca City experienced 30 high wind events over 24 days. The database recorded 2 property damages events, which estimated about \$3,000 in damages and one indirect injury. The planning team used tornadic events in Kay County as a proxy for Ponca City, since Ponca City's area is not large enough to render an accurate analysis. From 2010 through 2021, the planning team recorded 7 events of EF1 or greater for Kay County, with the most impactful event being an EF-3 tornado in May 2010. No damages from tornadoes were recorded in Ponca City. The most impactful events from this time period in terms of wind speed, human injury, and damages are recorded below.

Table 4-13 Historic Tornado/High Wind Events

Date	Event Narrative
March 10, 2010	Wind speeds of approximately 60 mph damaged a shed in South Ponca City. Debris from this shed injured one person. Kay County experienced an EF-3 tornado near Ponca City, which ultimately did not effect the planning area.
June 10, 2011	Strong bursts of wind and large hail was produced from a severe thunderstorm. No one in Ponca City was injured from 60 mph winds.
August 8, 2011	Severe thunderstorms caused four large hail bales to roll across the street. Power poles were knocked down by the strong winds in Ponca City. NCEI estimated that monetary damages were \$1,000.
June 24, 2016	A severe thunderstorm produced winds of approximately 70 mph, which snapped power poles and caused dangerous road conditions.
October 6, 2016	Strong thunderstorm winds caused a large tree to be uprooted. Minor damages occurred throughout the city, as well as power outages from the 70 mph winds.
August 12, 2019	Scattered thunderstorms produced severe wind gusts across northern Oklahoma. Multiple reports were filed of large tree limbs being knocked down, blocking some roads in Ponca City.

4.4.5 Probability of Future Events

It is **highly likely** that the planning area will experience a high wind event in the next year, or a recurrence interval of 1 or less, based on previous occurrences. The probability of a tornado occurring within Ponca City was derived using the Tornado Risk Assessment Tool from the Storm Prediction Center. A historical analysis was run for Kay County to determine the annual probability of a tornado event in Ponca City. Based on this analysis of Kay County, it is **likely** that a tornado will strike Ponca City. The most likely month the city of Ponca City should expect to experience a tornado is the month of June.

4.4.6 Vulnerability and Risk Assessment

Based on the classifications in Table 4-2 the overall significance of a high wind or damaging tornado event is **high**. Tornadoes and high winds threat people's lives and can cause injury. These events also can cause significant economic loss, especially through damages to the built environment.

People

All people in the planning area are vulnerable to tornadoes. People without access to safe rooms or other secure shelter options are at direct risk of injury or death, even from small tornadoes or high wind events.⁵¹ Ponca City does not offer community shelters. This makes individual shelters the exclusive option for people who are not school students or staff). Information on individual shelters was not available to the planning team at the time of this assessment. Ponca City School District offers saferooms at some of its schools. According to school officials, some of these saferooms were constructed to meet FEMA requirements, however, most do not meet FEMA requirements.

Citizens are encouraged to apply for saferooms for their personal homes. More than 90% of tornado casualties are bodily injuries. Casualties are most frequently the result of structural collapse and flying objects. People are also at heightened risk while in transit. A compilation of tornado-related fatalities nationwide from 1985 through 1997 revealed that 38% of all fatalities occurred in mobile homes, 27% in permanent houses, and 11% in automobiles (see built environment for a commentary on vulnerable structures).

Public Health

Ponca City's medical system could be strained or compromised by a tornado that results in a mass casualty incident, especially if the incident also damages key infrastructure or critical facilities. Delivery of other key services, such as a potable water and food could be disrupted by similar effects (see built environment for more information).

Education and Outreach

Adequate warning systems are essential to public safety during high wind and tornado events. Currently, tornado sirens are the primary means for communicating with people about an impending tornado event. Although effective, these sirens are intended for people outdoors. City officials should ensure that the messaging can be translated into other languages, if needed. The entire planning area should have access to an emergency notification app that would enable officials to send a message to people who have opted into the service. This program provides a direct text link with residents to maximize their warning time. Officials would like to integrate the siren capabilities in communities with a messenger application, which would improve the planning area's immediate response to tornadoes and high winds.

In addition, officials could strengthen current outreach and education efforts on tornado and high wind hazards for developers, builders, realtors, and residents. Going forward, it will also benefit the city if design professionals are educated to include wind mitigation during building design. Officials could provide training and education on building to Insurance Institute for Business and Home Safety's (IBHS) standards (for more information, see Chapter 3) and other prevention techniques, like anchoring, especially for mobile homes. To this end, Ponca City would benefit from an emergency mobile application, which could assist outreach and education efforts during response scenarios and blue skies.

Economy

While forecasting and early warning have decreased the number of fatalities associated with wind events, less has been done to address economic losses. Direct tornado damage is one of several factors contributing to economic loss after a tornado. Tornadoes and high winds in the planning area can cause extended and widespread losses of business services. Business service interruption can be due to either property destruction or disruption of utility services (see infrastructure section for more information on utility disruptions).

⁵¹ One ongoing problem with Safe Rooms is the need for the public to understand not all safe rooms are created equal. Lack of adequate safe room design can cause the unit to fail. Communities in the planning area should consider applying for residential safe room funding through FEMA's Hazard Mitigation Assistance Programs.

Built Environment

Existing Structures

All structures in the planning area can be affected by a tornado or high wind event. The residential building stock in Ponca City is diverse in the type of construction, age, and size of the building. Nonetheless, mobile homes, homes with crawlspaces buildings with large spans, such as airplane hangars, gymnasiums, and factories are more vulnerable to high wind and tornadic events due to their construction. Mobile homes or manufactured homes are the most vulnerable of housing units in Ponca City. The federal government established standards in 2007 requiring all new manufactured homes to meet the requirement for installation and anchoring in accordance with its structural design and windstorm standards. Even anchored mobile homes can be severely damaged when winds gust over 80 mph. Houses with crawl spaces are more susceptible to lift. Ponca City also has several large buildings, but most of these are not privately owned and operated (for school vulnerabilities, see Ponca City School District, for industrial and airport vulnerabilities see critical facilities).

In addition to structure type, older homes especially vulnerable to tornado events. These older homes in the planning area are generally more vulnerable to tornado damage than more recently built homes constructed to higher standards. All homes that were built, retrofitted, or not examined since the City's adoption of 2015 building codes are similarly at risk to tornadoes and high winds.

Infrastructure

Electric: Loss of power and communication lines will require alternate methods of communication until cellular service or landlines can be restored. Prolonged outages can lead to the disruption of vital services including energy for life-sustaining devices, business operations, heat, light, and other basic functions, and communications. Disruptions in communication can outreach to people in the planning area. Although many critical facilities have backup generation, which will increase the likelihood that they remain operative during a disaster, many private residential and commercial facilities do not.

Water/wastewater: Destruction of water/wastewater processing or distribution infrastructure could strain water systems in the planning area and place the populations affected by the disruption at risk to degradations of water quantity and quality. Ponca City should ensure that it has sufficient redundancies to account for significant damage to its water systems.

Transportation: Debris along roads can delay recovery and response operations. In an extreme event, loss of power and communication lines will require alternate methods of communication until cellular service or landlines can be restored.

Critical Facilities

All critical facilities in Ponca City are exposed to this hazard, especially buildings that do not meet 2015 codes. All critical facilities owned by the City and by the school district reported having adequate backup generation in the event of a power outage. The City and the School Districts should maintain and test these forms of backup generation regularly. Loss of functioning to a critical facility—either from damages sustained to the structure or a power failure—could lead to the disruption in key emergency, government, and basic services. Private critical facilities should also maintain these standards.

Local officials noted that several of their public buildings lack a saferoom that meets the guidelines of FEMA 361 and ICC 500. Employees at these buildings are much more vulnerable to effects outlined in the people section of this assessment since the structural protection is not as adequate.

Cultural Resources

Loss of structures listed on the National Historic Register, or of one of Ponca City's many museums, would be devastating. All are vulnerable to high wind and tornados. Structural mitigation measures should maintain the historical integrity of National Register eligible or listed properties. For example, impact resistant glass systems in windows and doors could match the period and style of a historic structure.

Future Development

All future development is vulnerable to tornado and high wind events. Powerlines in areas of future development should be buried to avoid power loss. Generators should be installed at all new critical facilities. The City of Ponca City adopted the ICC International Building Code, 2015, and the ICC International Residential Code for One and Two-Family Dwellings, 2015 Edition. Ponca City should be prepared to focus beyond the apparent clean-up and repair/rebuild post-event.

As of this writing, Ponca City is adopting the 2018 building codes. Buildings constructed before the adoption of these codes, however, remain more vulnerable unless they are retrofitted or updated with more current standards. In 2018, insurance companies began offering discounts on homes built or retrofitted to certain tornado-resilient standards since a law went into effect April 1 requiring them. These improvements can be shared through a robust public outreach program.

Ponca City should work with the Oklahoma Insurance Department to educate the public, building professionals, and insurance agents about these benefits. Additionally, Ponca City should consider a program to train building officials as IBHS Home Evaluators. There is a shortage of evaluators in Ponca City, and a need so homes may be evaluated, and homeowners may receive insurance discounts if their company offers them. Going forward, it will also benefit the city if design professionals are educated to include wind mitigation during building design.

Ponca City School District

Some Ponca City's school buildings are more vulnerable structurally to tornado and high wind events, including Howell, Liberty, Washington, and West. In addition, school buildings could use enhanced reinforcement for doors and windows, especially for designated-shelter areas. Almost all school buildings in the district do not have a saferoom that meets the guidelines of FEMA 361 and ICC 500 (see Chapter 3). Students and staff at these buildings are much more vulnerable to effects outlined in the people section of this assessment since the structural protection is not as adequate.

In addition, tornado and high wind events can cause structural damage (residential and commercial) outside the planning area and could disrupt critical services outside the planning area in similar ways as outlined above for the City of Ponca City (see above sections on the built environment). These effects, along with transportation disruptions could cause students to be unable to attend school or extracurricular activities and may place other burdens on families with school-age children.

Natural Environment

The effects of damaging wind from high wind events or tornadoes on the natural environment are not always obvious or immediately apparent. Debris from damaged or destroyed homes can result in asbestos being deposited. Hazardous household waste, such as cleaning and automotive products, becomes an issue to animals and plants in the area, and can also contaminate water and soil. During severe thunderstorm events in Ponca City, flash flooding is a common occurrence. Household and industrial waste can spread into animal habitats, stormwater, rivers, and lakes. Ponca City should address these issues with the Department of Environmental Quality during the recovery period, and plan for proper disposal of debris in advance of wind or tornado events.

4.5 Dam Incidents

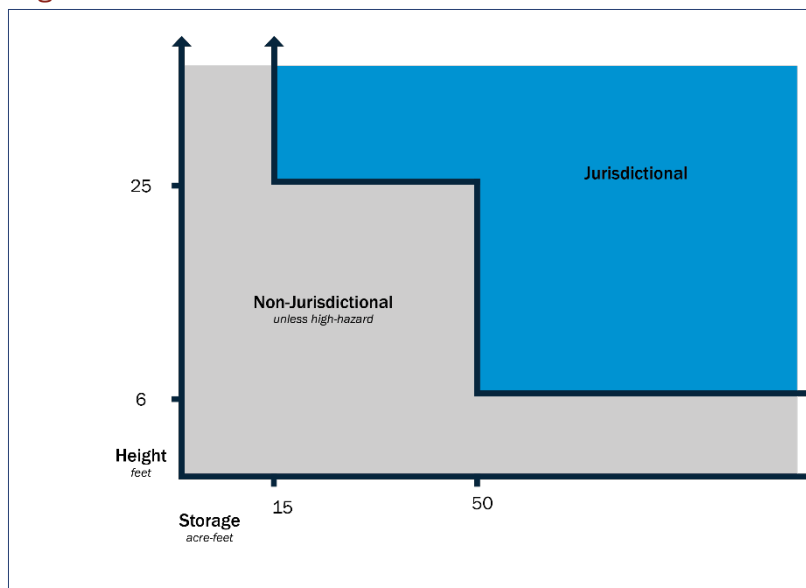
4.5.1 Hazard Description

The Federal Emergency Management Agency (FEMA) defines a **dam** as “a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water.” Dams typically are constructed of earth, rock, concrete, or tailings (chaff) from mining operations. A dam incident is the release, collapse, breach, or other failure resulting in downstream flooding. The amount of water impounded in the reservoir behind a dam is measured in acre-feet. An acre-foot is the volume of water that covers an acre of land to a depth of one foot, or approximately 325,000 gallons. As a function of upstream topography, even a very small dam may impound or detain many acre-feet or millions of gallons of water.

A break in a dam produces an extremely dangerous flood situation because of the high velocities and large volumes of water released. In the event of a dam incident, the potential energy of the water stored behind even a small dam can cause substantial property damage, as well as loss of life if there are people in the inundation area. The extent of this inundation may be minimal to uninhabited farmland or catastrophic in an urban environment.

Flooding can occur downstream from a dam without the structure being breached. Sometimes, to prevent overtopping and catastrophic failure, dams are forced to make emergency releases of large amounts of water, which can cause downstream flooding incidents.

Figure 4-9 OWRB Jurisdictional Sizes of Dams



Dam failures are primarily caused by hydrologic or structural deficiencies. A hydrologic deficiency is inadequate spillway capacity caused by excessive runoff from heavy precipitation. Structural deficiencies include seepage, erosion, cracking, sliding, and overturning, mainly caused by the age of a dam and lack of maintenance. The operation of a reservoir can also influence the safety of the structure.

There can be varying levels of dam failure. Partial dam failures include inadequate spillway capacity that causes excess flow to overtop the dam or internal erosion through the dam or foundation. Complete failure occurs if internal erosion or overtopping results in a total structural breach, releasing a high-velocity wall of debris-laden water rushing downstream, damaging or destroying everything in its path.

Any dam that has a height of 25 feet or more from the natural streambed and/or 50 acre-feet or more of storage capacity, is under the jurisdiction of the Oklahoma Water Resources Board (OWRB) as shown in Figure 1-9. OWRB also classifies dams as high-hazard, significant-hazard, and low-hazard, depending on the downstream populations and infrastructure. The hazards are based on first, potential for loss of life from a breach and secondly from the level of economic damage that will occur downstream from a breach. Table 4-14 identifies the risk and required inspection frequency for these dams.⁵²

⁵² Oklahoma Water Resources Board, Dam Safety, <http://www.owrb.ok.gov/damsafety/index.php>

Table 4-14 OWRB Dam Classifications

Hazard-Potential Classification	Risk Involved with Dam Failure	Inspection Frequency
High	Probable loss of human life	Annually, by a registered professional engineer
Significant	No probable loss of human life but can cause economic loss or disruption of lifeline facilities	Every three years by a registered professional engineer
Low	No probable loss of human life and low economic loss	Every five years

Levees were not profiled in this assessment, as there are no levees in Ponca City, according to the National Levee Database.⁵³

4.5.2 Location

According to OWRB, there are three high hazard dams inside the city limits of Ponca City. There are no federal high hazard dam locations in Ponca City. However, a Kaw Lake dambreach would affect the City. Table 4-15 summarizes the high hazard dams within the planning area.⁵⁴ Although Ponca Lake East and West Dams could be considered separate dams, the planning team followed the National Inventory of Dams, which does not differentiate between East and West Dams. Instead, the East and West Dams are a single entity.

Table 4-15 Ponca City High Hazard Dams (OWRB)

Nat Id	Dam Name	Owner	River	Year Built	Dam Length	Dam Height	Max. Discharge
OK20509	Kaw Dam ⁵⁵	USACE	Arkansas River	1976	9466	125	653,000
OK11017	Ponca Lake West	City of Ponca City	Turkey Creek Trib. W	1935	5000	67	29,000
OK11017	Ponca Lake East	City of Ponca City	Turkey Creek	1935	5000	67	29,000
OK83011	Cremer Park Stormwater Detention Facility	City of Ponca City	Bois D'Arc Creek Tributary M	1987	2600	17	10,283

This section is divided into two parts. The first part highlights general information related to the location and important physical characteristics of these dams. Some of the information (especially results of failure) contained in this section also can be related to extent and vulnerability sections, which will be referenced in those sections. The second part maps the inundation areas in the event of a dambreach.

Location Information Overview

Table 4-16 High Hazard Dams Impacting Ponca City

Kaw Lake Dam (NID No. OK 20509)

⁵³ <https://levees.sec.usace.army.mil/#/>

⁵⁴ <https://www.owrb.ok.gov/damsafety/index.php>

⁵⁵ <https://www.swt.usace.army.mil/Locations/Tulsa-District-Lakes/Oklahoma/Kaw-Lake/Pertinent-Data/>

Location	36° 41' 56.04" N, 96° 55' 30.57" W, approximately 8 miles east of N. 14 th St. along Lake Rd.
Source	Arkansas River
Owner/operator	USACE
Year built	1976
Length/ Height	9466/125
Surface area	17,000 acres
Construction material	Earthfill dam, concrete spillway with eight tainter gates
Use of Dam	Flood risk management, water supply, water quality control, hydropower, recreation, and fish, and wildlife.
Capacity	362,511 acre-feet at normal pool.
Results of failure	The main areas impacted by a flood and failure at maximum pool are Ponca City, Cleveland, Sand Springs, Tulsa, Jenks, and Bixby, OK. extending out to the east and west approximately one to two miles.
Emer Action Plan (EAP)	Yes
Ponca Lake East and West Dams (combined in the National Inventory of Dams (NID) as No. OK 11017	
Location East Dam	36° 42' 52.9" N, 97° 01' 07.1" W, approximately one mile north of Lake Rd. west of N. Prentice Rd.
Location West Dam	36° 43' 14.7" N, 97° 37.1" W, approximately one mile north of Lake Rd. between L.A. Cann Dr. and Kygar Rd.
Source	Turkey Creek and Tributary W
Owner/operator	City of Ponca City
Year built	1935
Length/ Height	5000/67 (combined for both dams)
Surface area	1159 acres
Construction material	Earthfill
Use of Dam	Water Supply
Capacity	23,700 acre-feet
Results of failure	A major flood cause by a sudden breach of the dam is estimated to inundate 180 homes, 36 commercial buildings and 58 uninhabited structures (barns).
Emer Action Plan (EAP)	Yes
Cremers Park Regional Stormwater Detention Dam NID No. 83011	
Location	36° 43' 59" N, 97° 04' 51" W between N. Union St. and the Burlington Northern Railroad, south of Westbury Rd.
Source	Tributary M, Bois D' Arc Creek
Owner/operator	City of Ponca City
Year built	1987
Length/ Height	2600/16
Surface area (acres)	36.3
Construction material	Earthfill with grass-lined auxiliary spillway
Use of Dam	Flood control
Capacity	305 acre-feet
Results of failure	In the High Risk Area requiring evacuation during a breach, there are one business/group home (Opportunity Center, Inc), one apartment complex (Paladin Apartments), and 90 houses adjacent to Tributary M. on N. Union Street, W. Hartford Avenue, N. Osage Street, Hudson Drive and W. Emporia Ave. These structures are considered at the greatest risk for

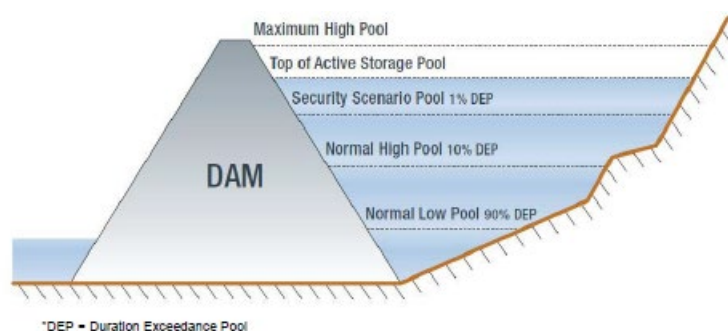
Emergency Action Plan (EAP)

inundation. The total number of properties that can be potentially impacted is 196, including moderate and low risk properties.

Yes

Dam Inundation Mapping

Kaw Lake dam is a USACE dam. USACE dams display a normal-high and maximum high failure for dams in the planning area. The USACE determines dam failure scenarios based on those two conditions as shown in the Figure below. The Maximum High Pool includes the total storage space in the reservoir below the design water elevation. It includes surcharge, flood, conservation, inactive and dead storage. It is determined based on an elevation excluding any allowance for freeboard or wedge storage due to a sloping water surface. It establishes the upper limit of reservoir storage capacity, downstream inundation, and potential consequences for the dam. Failure assumed during a maximum high pool assumed to occur due to overtopping.



The Normal High Pool (10% Duration Exceedance) is the maximum reservoir water surface elevation obtained when the reservoir is fully utilized for conservation purposes (e.g. municipal and industrial water supply, irrigation, hydroelectric power generation, navigation, etc.) excluding flood and surcharge storage. In this case failure is assumed to occur because of piping through the dam. While the Maximum High Pool provides the largest footprint and consequence from a dam breach, it is also quite unlikely. The Normal High Pool is seen as the reasonable lower limit to consider for dam breach and is the pool level with a 10% recurrence interval. Since this pool level occurs more frequently, the possibility of failure at this elevation would be more likely. The Normal High dam breach limits are mapped for consideration in the location and extent section.

In addition to complete or partial failure, the planning area also can be impacted by a high release event. A high release is an intentional release of water that exceeds normal release levels. A high release can occur in response to more runoff entering the reservoir than what is being released, causing the water surface to rise to the top of the flood pool while inflow is still occurring. Operating the gated spillway at that level requires that the outflow through the spillway must be equal to the inflow so that the water surface will not overtop the dam.

Ponca Lake East and West Dams and Cremers Park Regional Stormwater Detention Dam are not USACE dams and, as such, have different mapping criteria, based on State guidance. Incidents for these dams are subject to measurements under Probable Maximum Flood (PMF). PMF covers an area of maximum expected flooding that is expected to result from a dam incident. Ponca Lake East and West Dams were constructed prior to 1973 and are subject to meet or exceed minimum dam flows:

- Small size - 25% PMF with one foot of freeboard.
- Intermediate size - 50% PMF with no minimum freeboard.
- Large size - 75% PMF with no minimum freeboard.

For almost all of this assessment, Ponca City East and West dams are considered jointly, since they are treated as one entity in the National Inventory of Dams (NID). These dams are separated in the location and vulnerabilities section to provide the reader more with clarity about the specific inundation area for each dam.

Cremers Park Regional Stormwater Detention Dam was constructed after 1973 and is subject to the small size high hazard guidance, which finds that the small size is 50% PMF with one foot of freeboard. Sunny day breach refers to an incident that is not caused by inflows. This can include structural, mechanical, or another failure. Only Ponca Lake East and West Dams included data for sunny day breach and were mapped accordingly.

Figure 4-10 Kaw Lake Dambreach (Normal Fail and Max Fail)

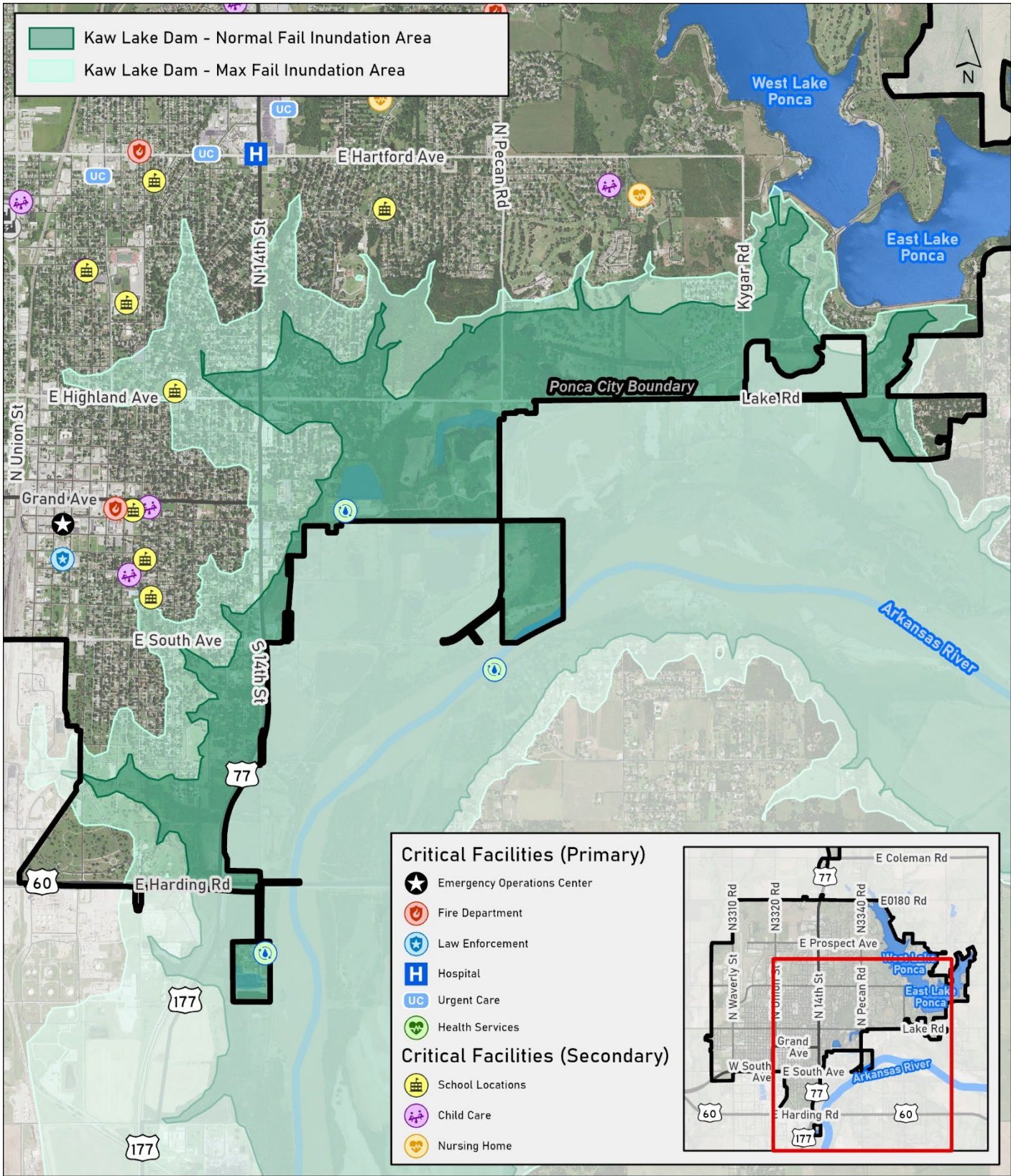


Figure 4-11 Ponca Lake East Dambreach (Sunny Day and 50% PMF)

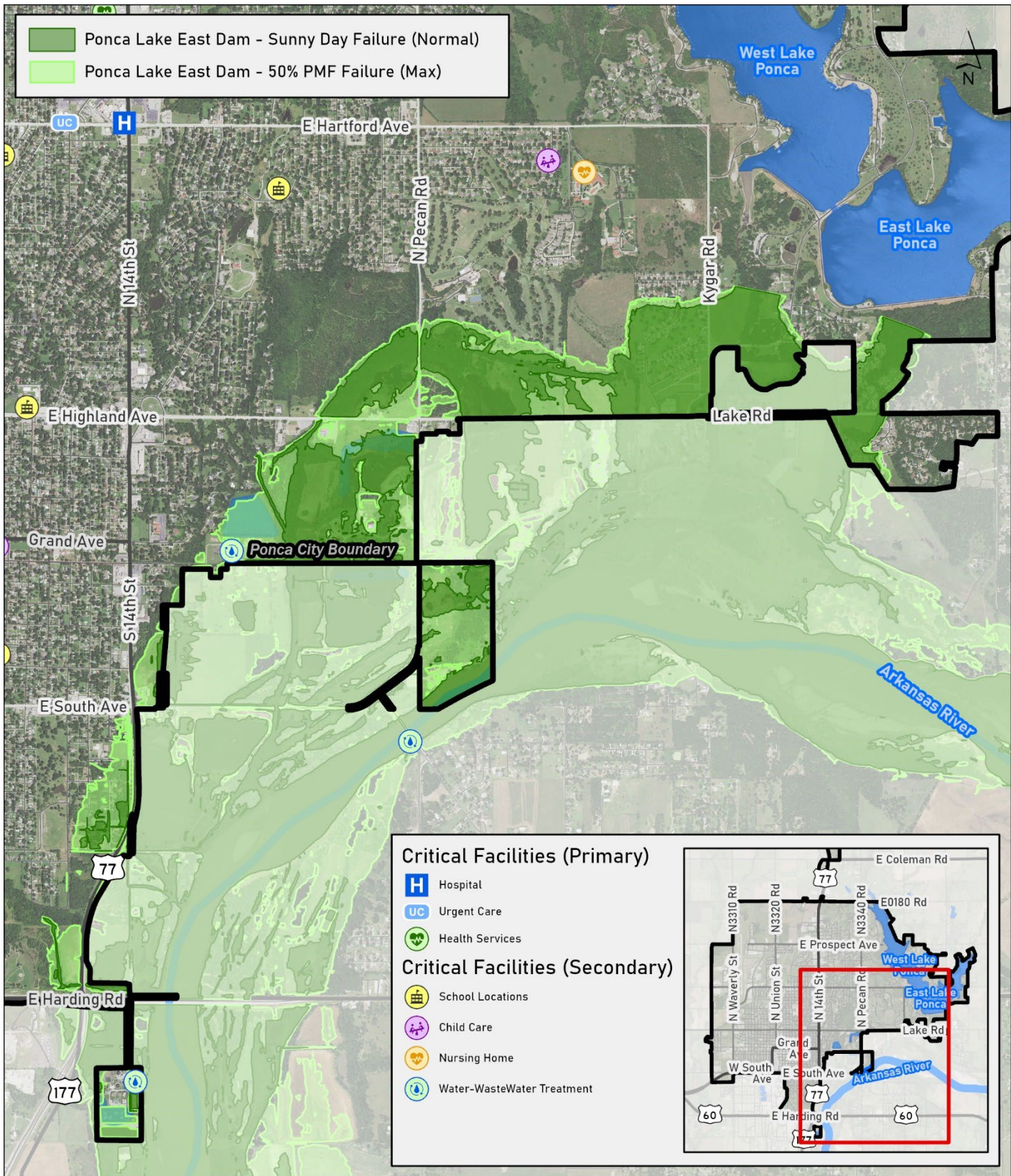


Figure 4-12 Ponca Lake West Dam Breach (Sunny Day and 50% PMF)

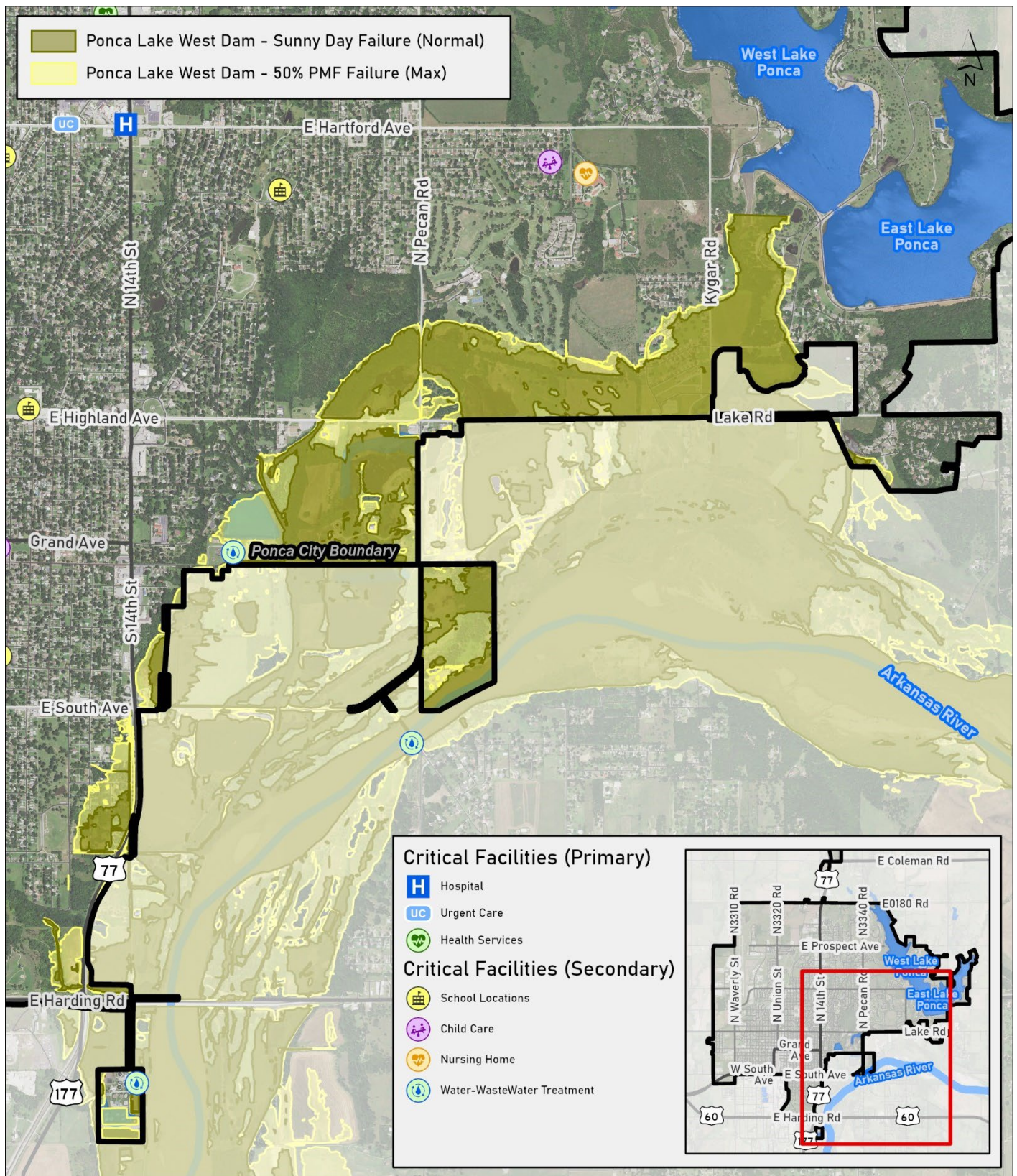
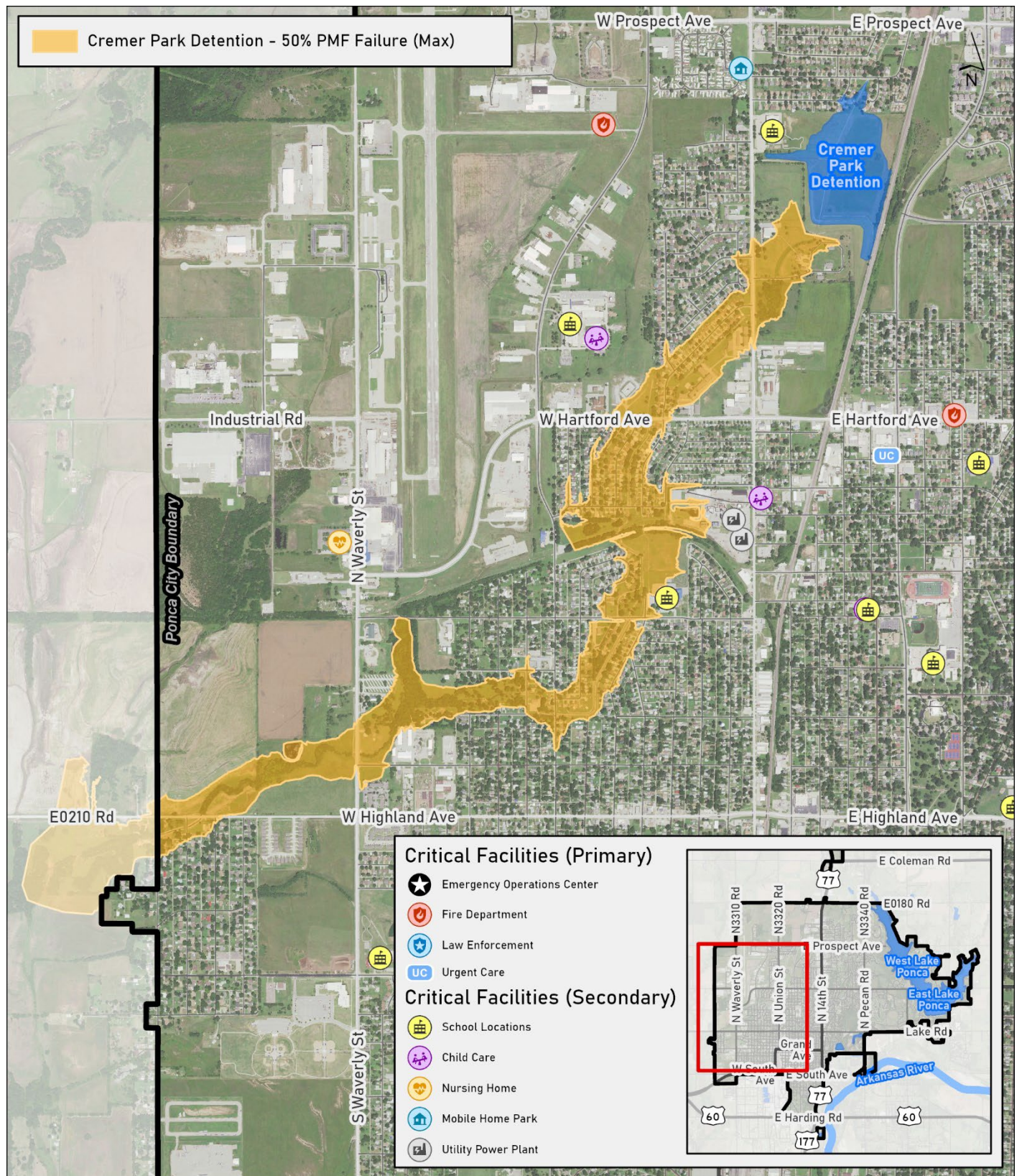


Figure 4-13 Cremers Park Dambreach (50% PMF)



The planning team identified three Ponca City School District facilities that would be affected by dam failure. None of the other facilities would be affected, nor would any of the other dam breach scenarios analyzed affect the schools.

Figure 4-15 Roosevelt Elementary School (Kaw Lake Max Failure)

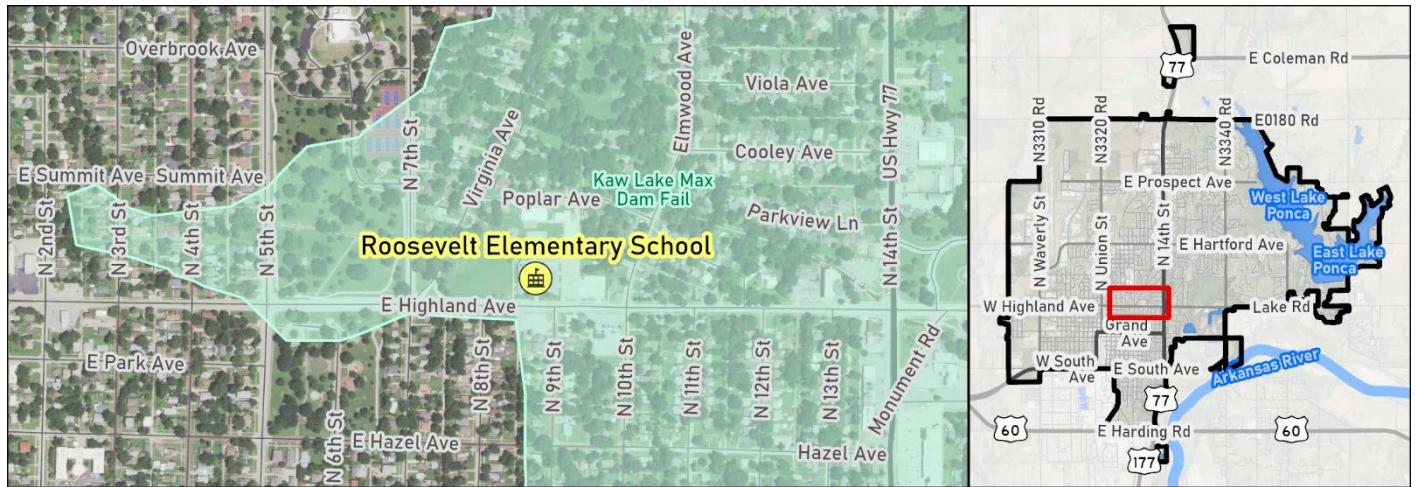
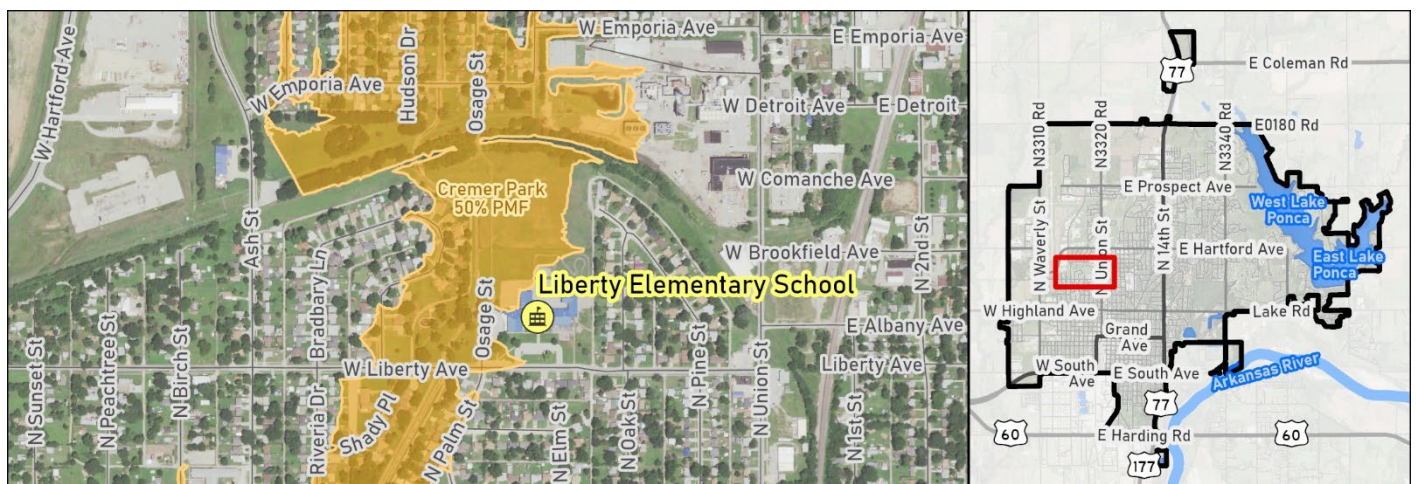


Figure 4-14 Garfield Elementary School (Kaw Lake Max Failure)



Figure 4-16 Liberty Elementary School (Cremers Park 50% PMF)



4.5.3 Extent

The extent section compliments the location section by focusing on the timing and depth of inundation of dambreach events for the three high-hazard dams identified by the planning team.

Kaw Lake

The dambreach analysis prepared by the USACE for Kaw Lake assumed that a breach would take less than one hour to develop. Following a breach, two measurements for time of arrival are listed in the EAP prepared by the USACE at each cross-section downstream. Failure wave arrival time is the time following initial dambreach, until increased flow directly resulting from dambreach arrives at a given location (a two-foot increase in water surface elevation). Cross sections and flood wave arrival time points are based on the dambreach model. The second time measurement is the time for the peak flow to reach that cross-section. Water surface elevations are included for both time measurements within the Kaw Lake EAP at each of the mapped cross-sections.

Table 4-17 Kaw Lake Dambreach Normal High Failure Warning Times and Elevations

Kaw Lake Dambreach	Upstream River Mile	Arrival Time (2' depth increase) (H:MM)	Closest EAP Cross Section (XSEC)	Arrival Time of Peak to Closest XSEC	Peak Elevation from profile	1% flood elevation	Depth above/below the 1% flood
Water Treatment Plant	8	2 hours 15 minutes	C	6 hours 0 minutes	956.9	926.5	30.4 feet above
DS from Wastewater Treatment Plant	10.5	2 hours 48 minutes	D	6 hours 19 minutes	944.9	922.2	22.7 feet above

Table 4-18 Kaw Lake Dambreach Maximum High Failure Warning Times and Elevations

Kaw Lake Dambreach	Upstream River Mile	Arrival Time (2' depth increase) (H:MM)	Closest EAP Cross Section (XSEC)	Arrival Time of Peak to Closest XSEC	Peak Elevation from profile	1% flood elevation	Depth above/below the 1% flood
Water Treatment Plant	8	3 hours 15 minutes	C	8 hours 19 minutes	985.1	926.5	59.6 feet above
DS from Wastewater Treatment Plant	10.5	3 hours 40 minutes	D	8 hours 39 minutes	968.8	922.2	46.6 feet above

Ponca Lake East and West Dam

Although the EAP for both dams mapped the Sunny Day and 50% PMF scenarios, the EAP detailed the “worst-case” scenario only, which is the 50% PMF in this case. For this reason, the planning team only described the 50% PMF scenarios for both dams.

All properties adjacent to Tributary M of Bois d'Arc Creek upstream of Emporia Avenue are considered High Risk for inundation. All those properties adjacent to Tributary M between Waverly Street and Emporia Avenue are considered to be at Moderate Risk of inundation. All properties adjacent to Tributary M downstream of Waverly Street are considered to have a Low Risk of inundation.

Table 4-19 Ponca Lake East and West Dam (50% Probable Maximum Flood)

Ponca Lake	EAP Designation	Location	Distance downstream from dam (ft)	Water depth at ground level (ft) or impacts	Time to peak flow (H:MM)
Ponca Lake East Dam	Witmer Hills Subdivision (32 SF homes)	Between Lake Road and Lake Ponca at the 4600 Block of Lake Road	>500 feet	>10'	< 0:15
Ponca City Lake East and West Dams	Ginger's East Lake Estates and other properties (approx. 20 SF homes)	Between the two dams and west and south of the subdivision (Turkey Creek Road and L.A. Cann Road)	>500 feet	>10'	< 0:15
Ponca City Lake East and West Dams	Ranchwood Manor Subdivision (152 homes and 2 commercial properties)	On the northwest corner of Lake Road and Kygar Road.	>500 feet	>10'	< 0:15
Ponca City Lake East and West Dams	Properties south of Lake Road (14)	On either side of Kygar Road south of Lake Road	Approx. 2000 feet	>10'	< 0:15
Ponca City Lake East and West Dams	Electric Substation	Pecan Road near Lake Rd	Approx 10,000 feet	Inundation up to 2 feet and blocked access	< 0:15
Ponca City Lake East and West Dams	Water Treatment Plant	Central Ave 1800 block	Approx 15,000 feet	Inundation of drying beds and chem tank up to 3 feet	< 0:15
Ponca City Lake East and West Dams	Wastewater Treatment Plant	3300 S. River Street	Not included in EAP	Partial inundation of aeration basins and blocked access	< 0:15
Ponca City Lake East and West Dams	Electric Substation	S. Pecan Road 500 block	Not included in EAP	Inundation up to 5 feet and blocked access	< 0:15
Ponca City Lake East and West Dams	Sewer Pump Station	S. River Street 2500 block	Not included in EAP	Blocked access only	< 0:15

Cremers Park Regional Stormwater Detention Facility Dam

The planning team was not able to get data for the water depths in this failure, which should be gathered in a future study.

Table 4-20 Cremers Park Regional Stormwater Detention Facility Dam (50% Probable Maximum Flood)

Risk (High requires evacuation)	EAP Designation	Location	Distance downstream from dam (ft)	Impacted Facilities	Time to peak flow (H:MM)
High	Opportunity Center	2225 N. Union Street and adjacent secondary buildings. Property is adjacent to the dam	<200'	Commercial facility and screen printing shop, a candy store and several group homes for developmentally disabled adults	<0:15
High	Union Street Road Crossing	Union St. just west of the Opportunity Center	800 feet	Overtopped and Damaged Roadway	<0:15
High	Paladin Apartments & N. Osage Street -	Between Union Street and N. Osage St.	2,800 feet	Several Apartment buildings could be impacted as well the houses along the southeastern side of N. Osage Street.	<0:15
High	Hartford Avenue Road Crossing		3,800 feet	Overtopped and Damaged Roadway	<0:15
High	Hudson Drive & N. Osage Street	Between Hudson Drive and N. Osage Street	From 3,800 feet to 5,100 feet	Houses on the west side N. Osage Street, on the east side of Hudson Street, and along W. Emporia Ave near the stream crossing .	<0:15
High	Emporia Ave		5,100 feet	Overtopped and Damaged Roadway	<0:15

4.5.4 Previous Occurrences

The city of Ponca City and its school district have not been impacted by a dam break or failure. Results were queried based on desktop research and reports from operators from the beginning of each dam's working life, which ranges from the late 1930s to the 1980s (see Table 4-16 for specific dates) until the end of 2021. There are currently no levees in or around the city.

4.5.5 Probability of Future Events

Due to no dam incidents in the past, it is **unlikely** that the planning area will experience any dam breaks or failures in the next year or a recurrence interval of greater than every 100 years (less than 1% probability).

4.5.6 Vulnerability and Risk Assessment

The overall significance of a dam failure hazard is **high**. The event will occasionally occur with severe strength over a significant citizen location area within the planning area.

People

Damage potentials from a high hazard dam incident or failure could people directly in the path of inundation waters. The best available information from EAPs, inundation maps, and public sources was used to assess the vulnerability of Ponca City and Ponca City School District to dam failures. The number of fatalities or injuries resulting from either hazard is strongly influenced by the number of people occupying the inundation area, the amount of warning they are provided, and the amount of pre-event public education and planning. People who might be at risk include those who are living, working, at school or play, or traveling through vulnerable areas. Anyone in the inundation areas identified in the maps displayed earlier in this section are at risk of the impacts described herein.

Public Health and Safety

The public health effects from inundation due to dams are similar to the effects from flooding. Waters from a dam or levee incident can be polluted. This pollution arises from two sources: waters that become polluted while being impounded by a dam or levee and waters that become polluted based on their interaction with the environment upon release. In the planning area, some of the most common pollution sources are from industrial, petroleum and agricultural products and byproducts. Standing water following inundation also can result in a build-up of mold and other toxic substances (see flooding section). Depending on the scale of the incident a dam or levee incident could result in the mass displacement of populations, which could place additional strain on the health care system, the emergency response system, and the affected populations' psychological health.

Education and Outreach

The public living below this dam, and others, are often unaware of their risk. Officials also noted the lack of consistent education and outreach on dam and levee hazards for developers, builders, realtors, and residents. Officials in the Nation expressed interest in having an emergency management application to reach all residents to warn them about a dam or levee incident. The emergency application could be expanded to provide educational materials as well, especially flood insurance, dangers building in a floodplain, health risks from flooding (e.g. mold), and other materials.

Economy

Dam and levees can have a wide range of impacts, which depend on the size of the release and area affected by the release. Although economic impacts of a dam failure could differ, these impacts could include:

- Replacement costs for dam/levee and all assets affected by an incident
- Loss of revenue/utility from dam/levee itself
- Loss of revenue/utility from the areas affected
- Potential economic effects if water shortages result from the incident
- Lost tourism in or nearby the planning area

Some of the direct affects are outlined in the tables in the built environment section.

Built Environment

Structures in the planning area could sustain damages from flooding during a dam breach or failure. A dam failure would fall under a unique and varied risk because if it happens, the line of water would follow the downstream path.

The Kaw Lake Dam Maximum High Failure would impact approximately 1,585 residential and non-residential buildings. The Kaw Lake Normal High Failure would still impact a larger area than the Arkansas River SFHA and would impact approximately 459 residential and non-residential buildings. A major flood caused by a sudden breach of either Lake Ponca dam is estimated to inundate 180 homes, 36 commercial buildings and 58 uninhabited structures (e.g. barns). The Cremers Park Regional Detention Pond Dam could cause damage to residential houses and other structures. For inundation specific to school buildings, see the school building assessment. Another summary of these impacts can be found in the “results of failure” category in the location section.

Table 4-21 - Estimated Structure Count: Inundation from a Dambreach

Dam Incident Name	No. of Structures	Est. Market Value
Kaw Dam - Normal High Failure	349	\$49,596,000
Kaw Dam - Maximum High Failure	1394	\$138,669,000
Ponca Lake East – Sunny day Failure	110	\$16,716,000
Ponca Lake East - 50% PMF Failure	132	\$19,589,000
Ponca Lake West Sunny day Failure	68	\$7,531,000
Ponca Lake West - 50% PMF Failure	79	\$9,892,000
Cremers Park - 50% PMF Failure	283	\$19,287,000
Total Sunny day or Normal High*	527	\$73,843,000
Total 50% PMF or Maximum High	1888	\$187,437,000

**Excludes Cremer Park*

Infrastructure

Electrical: A significant power outage can exacerbate conditions outlined the people section. A 50% PMF at either of Ponca East or West Dams would impact two electrical substations, cutting power to residents, businesses, and critical facilities. The electrical substation on Pecan Road near Lake Road will be inundated approximately 2 feet during the same failure.

Power outages can have a direct impact on people in the planning area. In particular, people who use electrical-powered machines are immediately at risk (people section). Some of the biggest threats to a prolonged loss of power include water/wastewater utilities and the hospital. These facilities, however, were reported to have adequate backup generation.

Gas: Transmission pipelines could be breached both through trees being uprooted, affecting the lines, and ground being washed out, exposing the pipelines to damage.

Water/wastewater: The most significant impact to Ponca City’s water treatment facility and wastewater during a Lake Ponca 50% PMF dam failure would be from loss of access to the facilities with some low-level flooding internally. Loss of the East or West Ponca Lake dams would eliminate the secondary water source that Ponca Lake provides. The 50% PMF breach could damage both the water treatment plant on Central Ave. east of N. 14th St. and the wastewater treatment plant southeast of E. Harding Road and S. 14th St.

During a Kaw Lake Normal High failure, the plant would be flooded approximately 20 feet deep. During a Kaw Lake Maximum High dam failure, the wastewater plant would be flooded 30 to 40 feet deep and during a Kaw Lake Normal High failure the wastewater plant would be flooded 10 to 20 feet deep. The water plant would be flooded approximately 50 feet deep.

Damages of this magnitude from either failure can halt operations, which can result in a crisis to provide potable water to citizens or cause a backup of wastewater, which can cause a sanitation and/or environmental crisis.

Water seepage into water lines and other distribution systems, although unlikely, could cause contamination and public health issues.

Transportation: Road blockages and congestion can cut off access to homes and businesses. Closed bridges and roads can cause traffic accidents and other backups that can extend the impact well beyond the inundated area. These concerns result in missed work, extra transportation costs and reduced commerce. Dam or levee inundation can result in hazardous driving conditions, which could cause loss of life, when vehicles are driven or swept into floodwaters. As little as 12 inches of standing water over roadways can stall many vehicles. Only 18 inches of flowing water can sweep most vehicles off roadways. For some major roadways impacted by a dam incident, see the tables in the extent section.

Critical Facilities

Several critical facilities could be inundated by waters from a dam breach. Depending on the type of incident, a dam breach may severely impact essential services or critical functions provided by these facilities. Most significant are the water and wastewater treatment plant; possible impacts to these facilities are described in the infrastructure section above.

Dam Incident Name	Critical Facilities Impacted
Kaw Dam - Normal High Failure	• Water Treatment Intake • Water Treatment Plant • Wastewater Treatment Plant
Kaw Dam - Maximum High Failure	• Water Treatment Intake • Water Treatment Plant • Wastewater Treatment Plant <i>Two school facilities (see school district sections)</i>
Ponca Lake East - Sunnyday Failure	• Water Treatment Intake • Water Treatment Plant • Wastewater Treatment Plant • Two Electric Substations
Ponca Lake East - 50% PMF Failure	<i>Same as Sunny Day Failure</i>
Ponca Lake West Sunnyday Failure	• Water Treatment Intake • Water Treatment Plant • Wastewater Treatment Plant • Two Electric Substations
Ponca Lake West - 50% PMF Failure	<i>Same as Sunny Day Failure</i>
Cremers Park - 50% PMF Failure	<i>None other than school (see school district sections)</i>
Aggregate Dambreach Numbers for Sunnyday or Normal High (excludes Cremers Pond)	5
Aggregate Dambreach Numbers 50% PMF or Maximum High	8

Fire, Police and Medical Services would all at risk to the indirect effects of a dam breach. Emergency responders would be extremely taxed. With loss of vital utilities such as water and wastewater lines, gas lines and electrical distribution facilities, emergency services would be heavily impacted. As with flooding, a dam incident would create a larger call load for all emergency response agencies, presenting various challenges to the agencies, in addition to the posed hazards to emergency personnel performing these services.

Cultural Resources

The only dam that would affect cultural resources is Kaw Lake Dam. The Pioneer Woman Monument site and visitor's center would be inundated by approximately 30 feet during a Kaw Lake Maximum High Failure and 5 feet during Kaw Lake Normal High Failure. The War Memorial Park grounds northeast of N. 5th St. and E. Highland Ave. would be inundated from 5 to 10 feet deep during the Kaw Lake Maximum High Failure but would not be impacted by the Kaw Lake Normal High Failure.

The Standing Bear Museum could be flooded by as much as 5 feet during a Kaw Lake Maximum High Failure, and the monument itself by 2-5 feet during the same flood, but unaffected by any of the other dambreach scenarios. In addition, the Attucks Community Center near E. Madison Ave. and S. 12th St. would also be flooded by as much as 40 feet during a Kaw Lake Maximum High Failure and by approximately 10 feet during the Kaw Lake Normal High Failure, but unaffected by any of the other dambreach scenarios.

School Districts

The School District buildings that are affected by a Kaw Dam Maximum High Failure dambreach are Roosevelt Elementary School (approximately 5 feet deep) and potentially Garfield Elementary by no more than 2 feet. Transportation routes in the E. Highland Ave. and N. 5th St area may be affected somewhat for that same dambreach scenario. The Cremers Park Regional Detention Pond Dam could cause damage to residential houses and Liberty Elementary located downstream in Ponca City. No other scenarios analyzed would affect school buildings directly.

Natural Environment

If Kaw Dam or the East or West Ponca Lake Dams failed, the resulting release would devastate downstream habitat on the Arkansas River. The Cremer Pond Dam failure would go through developed areas until it reached Nor Birch St. From that street downstream to Bois D'Arc Creek the impact would be worse because there are more natural areas to be damaged. Additional environmental consequences could result if the levee breached and resulted chemicals or industrial products spilling to waterways.

4.6 Hail

4.6.1 Hazard Description

A **hailstorm** often results from severe thunderstorm or similar atmospheric event. Hail, in the form of irregularly shaped lumps of ice, fall with rain. Extreme temperature changes from the ground into the jet stream produce strong updraft winds that cause hail formation. Hail is typically a by-product of thunderstorms, tornadoes, or other atmospheric events, making the location of hail uniform over the planning area.

4.6.2 Location

The risk of this hazard is uniform across the entire planning area.

4.6.3 Extent

Extent is determined by the frequency of hail events that receive a classification of severe or higher. As shown in the Combined NOAA/TORRO Hailstorm Intensity Scale, hail begins to be considered severe when it approaches an inch in diameter or larger.⁵⁶ Hail of this severity tends to be accompanied by winds greater than 58 miles per hour.

Table 4-22 NOAA/TORO Intensity Scale

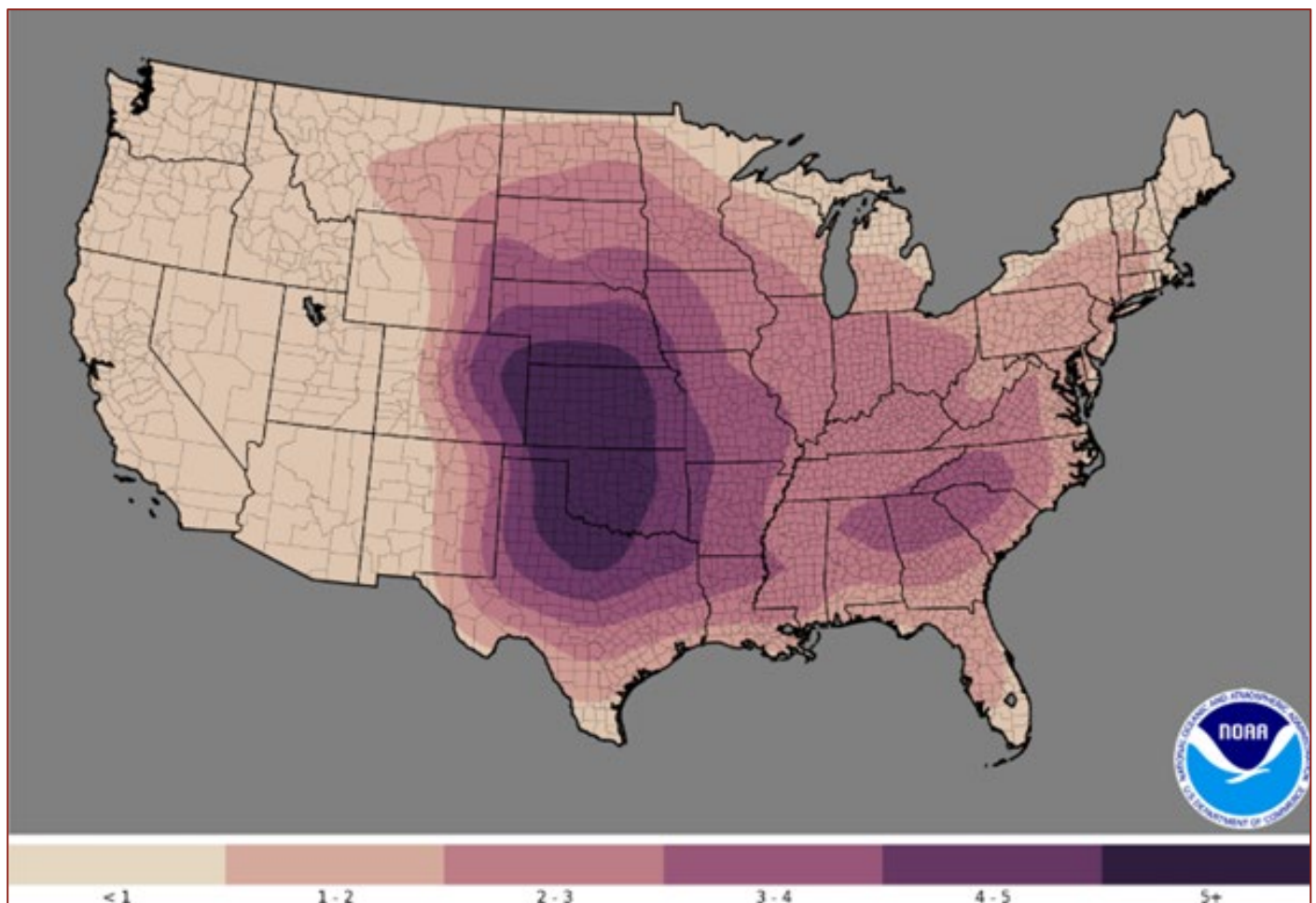
Size Code	Intensity Category	Typical Hail Diameter (inches)	Approximate Size	Typical Damage Impacts
H0	Hard Hail	up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33-0.60	Marble or Mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60-0.80	Dime or grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80-1.20	Nickel to Quarter	Severe damage to fruit & crops, damage to glass & plastic structures, paint & wood scored
H4	Severe	1.2-1.6	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.6-2.0	Silver dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0-2.4	Lime or Egg	Aircraft bodywork dented; brick walls pitted
H7	Very Destructive	2.4-3.0	Tennis ball	Severe roof damage, risk of serious injuries
H8	Very Destructive	3.0-3.5	Baseball to Orange	Severe damage to aircraft bodywork

⁵⁶ <http://www.torro.org.uk/hscale.php>

Size Code	Intensity Category	Typical Hail Diameter (inches)	Approximate Size	Typical Damage Impacts
H9	Super Hailstorms	3.5-4.0	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	4+	Softball & up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

The figure below represents NOAA data related to the number of days with hail exceeding 1 inch in diameter.⁵⁷ The NOAA data estimates the planning area will experience 5+ events with hail 1 inch or larger hail each year.

Figure 4-17 NOAA Events with Hail Exceeding 1"



4.6.4 Previous Occurrences

According to the NCEI database, from 2010-2021 the City of Ponca City experienced 15 events with hail greater than 1.5 inches in diameter. Hail events reported in Ponca City ranged from 0.50 to 1.5 inches in diameter

⁵⁷ http://climate.ok.gov/index.php/climate/map/1.00_inch_hail_days_1986_2015/tornadoes_severe_storms

during this time but caused no reported damages. Some of the most impactful events in terms of hail size and potential damages are summarized below.

Table 4-12 Historic Hail Events

Date	Event Narrative
April 8, 2011	Thunderstorms produced hail of approximately 1.75in hail in Ponca City. The size of this hail, which was accompanied by 90-mile-per-hour winds, caused some damages in Ponca City. Despite damages being reported in the NCEI's quantitative report, no dollar amount was listed for the area. This being said, the Mesonet archive noted that the event left thousands of residents without power and damaged a number of residential structures. ⁵⁸
March 30, 2016	Ponca City reported hail sizes of approximately 1.5in, along with strong winds, but no damages were reported.
May 27-29, 2016	A region wide thunderstorm system produced several hail events throughout Ponca City, including the airport. Hail up to 1.75 inches was reported, but no damages were named.
March 29, 2019	A thunderstorm system produced ping-pong ball sized hail up to 1.50 inches in Ponca City, but no damages were reported.

4.6.5 Probably of Future Events

Based on previous occurrences, It is **highly likely** that the planning area will experience a severe hailstorm within the next year or a recurrence interval of less than 1 year, according to the table in the introduction section. The map in Figure 4-17 provided by the NOAA/National Weather Service Storm Prediction Center supports this assessment, as it estimates the average number of days per year in which severe hail events will in the planning area to be more than 5.

4.6.6 Vulnerability and Risk Assessment

Based on the classifications in Table 4-2, the overall significance of a damaging hail event is **medium**. Hail has not led to a recorded fatality in the planning area. The greatest vulnerabilities to hail result from vehicle and roof damage.

People

All people in the planning area are at risk to hail. Although not as common as structure and vehicle damage, personal injury can be caused by large hail driven by high winds. People engaging in outdoor activities may find themselves in a situation where adequate shelter is unavailable. In extreme cases, hail has also resulted in severe injury and death. Baseball sized hail, which has been overserved in the region that includes Ponca City, can cause brain bleeds and brain damage as well as broken bones if people do not take proper shelter. The planning team did not identify any additional public health and safety concerns from hail events.

Education and Outreach

Like most hazard-education capabilities identified in this plan, the planning area could benefit from consistent outreach about hail events, which can include:

- Becoming acquainted with communication and warnings about upcoming hail events
- Private and public sheltering (humans and animals)
- Storing outdoor items and other private property
- Preparing for electrical outages that can result from hailstorms
- Securing windows properly and effectively

⁵⁸ https://www.mesonet.org/index.php/earthstorm/page/weather_events/weather_facts/4.

- Posting warning signage at large, outdoor locations
- Best practices for construction

Economy

The economic impacts associated with this hazard could include agriculture, as crops such as corn or soybeans, which can be damaged to the point of total loss. Damage to buildings and equipment stored outdoors may cause financial hardship. Vehicles are particularly at risk to hail, including government vehicles. Officials report that most public vehicles could be sheltered during a hail event, however. Vehicle also damage can be mitigated by insurance.

Built Environment

Existing Structures

All structures are exposed to this hazard. Hail damages occur on an annual basis within the planning area, causing losses to structures and vehicles. Hail can cause bruises, punctures, and leaks on roofing systems. The amount of damage depends on the size of the hail, and the age, material, and surface temperature at the time of the event. Substantial hail damage may destroy a roof to the point of replacement. Large hail driven by high winds can break through windows, doors, and skylights that are not impact resistant, allowing rainwater to enter buildings. When building a new home or replacing the roof, homeowners should consider using hail-resistive roofing materials. Older buildings in Ponca City and buildings built prior to the adoption of the current code are more at risk to hail events due to the possible degraded quality of their roofs.

One of the main hail vulnerabilities for Ponca City is the economic vulnerability of some of its citizens and their ability to upgrade or repair damaged roofing due to a Hail event. According to data shown in Table 1-4, Ponca City has a higher average number of residents that live below the poverty line, when compared with Kay County and state of Oklahoma poverty rates. Ponca City also has a lower medium income rate. This could result in delays on needed repairs and/or the usage of lower-quality roofing materials that are more easily damaged by hail. Officials at Ponca City could collect data on roof quality from private citizens while conducting outreach on the importance of safeguarding against a hail event.

Infrastructure

Disruption of gas service water/wastewater systems, or transportation networks is not anticipated from hail events.

Electric: Although unlikely, a large hail event could disable or destroy some electrical delivery systems (e.g. poles or lines), which could cause a temporary loss in power to certain areas. This could threaten business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activity. Although all public buildings have backup generation, private residential and commercial buildings do not, making them more vulnerable to a power outage and the secondary effects of an outage.

Critical Facilities

Although critical facilities in Ponca City are vulnerable to hail, it is unlikely a hailstorm would render a building non-operational. No critical facility in the planning area reported a roof or other structural vulnerability that would make the entire building and its occupants uniquely vulnerable to hail. Although Ponca City reported that all public vehicles could be sheltered, fire, police, and medical services would be at risk to the effects of a hail event. Response vehicles in the open during a hail event would all face the same risk of damage, most likely to windows and windshields. Serious damage any of these services could disrupt response operations throughout the City. All critical facilities should ensure that their backup generation is up-to-date and secured as best as possible from the effects of a hail event.

Cultural Resources

Large hail could cause significant impacts on older and historic properties without proper roof protection and could damage historic architecture, statues, and buildings in Ponca City. The Marland Museum has recently undergone some renovations. No cultural landmark was noted by the planning team as being uniquely at risk to hail. City officials should ensure that the Marland Museum, along with the Marland Grand Home continue to monitor the quality of their roofs to mitigate against hail damage.

Future Development

Ponca City adopted the ICC International Building Code, 2015, and the ICC International Residential Code for One and Two-Family Dwellings, 2015 Edition, but, as of this writing, intends to adopt the 2018 building codes.

Ponca City should continue to work with the Oklahoma Insurance Department to educate both insurance agents and consumers of the discounts offered for building to higher standards. In addition, Ponca City and Ponca City School District should ensure that all windows on current and future public buildings have adequate protection from a severe hailstorm. Ponca City also should ensure that its debris management plan is updated to manage debris from a large hail event.

Ponca City School District

The School District did not report on additional vulnerabilities other than those mentioned in the existing structures section. No school buildings reported any major damages due to hail in the last decade. Despite a lack of historical damages, hail can cause structural damage (residential and commercial) outside the planning area and could disrupt critical services outside the planning area in similar ways as outlined above for the City of Ponca City (see above sections on the built environment). Depending on the time of year, the exposed HVAC systems could be damaged. Damages to enough systems could cause schools to close or to move to online learning if the building becomes unreasonably hot or cold. These damages also could cost the school district tens of thousands of dollars. The school district should consider hail insurance for critical and expensive equipment that is exposed to hail. These effects could cause students to be unable to attend school or extracurricular activities and may place other burdens on families with school-age children.

Natural Environment

Large pieces of hail can damage branches and take down tree limbs. Forests in the county provide recreation and significant environmental benefits. A severe hailstorm could affect the large tree population in the planning area. Landscaped areas also can be damaged.

4.7 Fire

4.7.1 Hazard Description

A **wildfire** is any outdoor fire that is not controlled, supervised, or arranged. Wildfire probability depends on local weather conditions; outdoor activities such as camping, debris burning, and construction; and the degree of public cooperation with fire prevention measures. Wildfires can result in widespread damage to property and loss of life. A **structure fire** is one that burns a home or other improved structure. Fire creates a black, impenetrable smoke that blocks vision and stings the eyes, making it often impossible to navigate through or evacuate a building on fire.

4.7.2 Location

Although fire could occur anywhere in the planning area, several factors increase probability that fire will occur in a specific location. These factors include age of structures, type of construction, and their location relative to vegetation (woods, especially red cedars, and open grasslands) can influence the location of wildfires. The planning team used mapping from wildland-urban interface (WUI) areas and reports from local officials to determine wildfire location

WUI areas note to the zone of transition between unoccupied land and human development. It is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. To determine the WUI, structures per acre and population per square mile are used. The WUI in the area is divided into two categories: intermix and interface. Intermix areas have more than one house per 40 acres and have more than 50-percent vegetation. Interface areas have more than one house per 40 acres, have less than 50% vegetation, and are within 1.5 miles of an area over 1,235 acres that is more than 75% vegetated. WUI was obtained through the Southern Group of State Foresters, Wildfire Risk Assessment Portal. **Based on the best available data and analyses, the Wildland Urban Interface (WUI) can be used to determine areas of fire hazard location within Ponca City, as shown in the extent section.**⁵⁹

In addition to the WUI, local officials noted two areas of increased location (and extent) of fire hazard for Ponca City. They are mapped as problem areas on extent maps.

Table 4-23 Fire Problem Areas

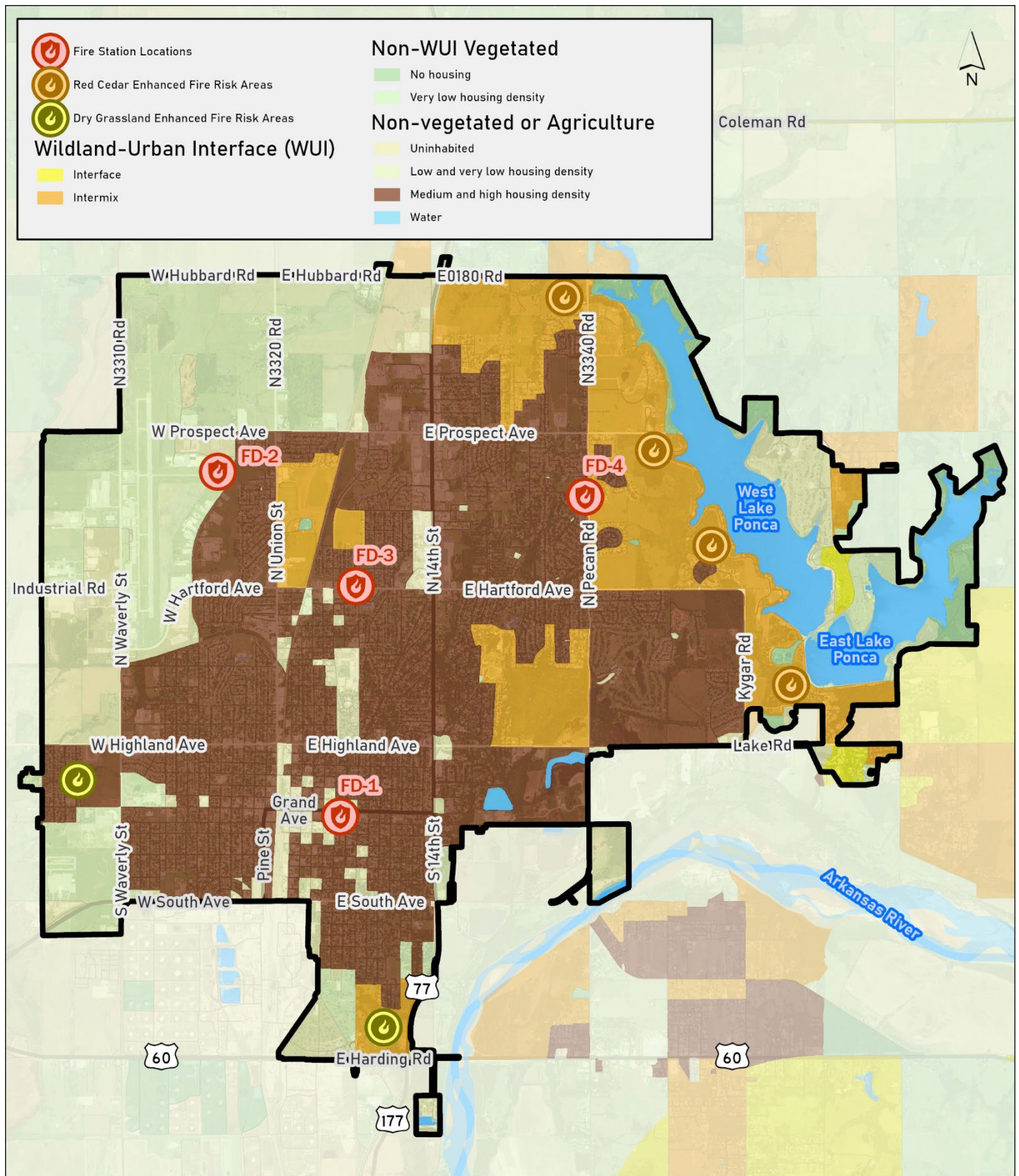
Fire Area	Location	Description
Dry Grassland	Southwest Ponca City (City Border)	This area is characterized by small neighborhoods and dry grasslands, which presents a heightened danger to fires.
Red Cedar	Lake Ponca	Red Cedars around Lake Ponca pose a threat due to their high flammability potential. In addition, the areas around Lake Ponca are private property, making maintenance more difficult.

4.7.3 Extent

The WUI also informs the extent of fire, since the factors contributing to the location of a fire also contribute to the extent (see above). In addition to WUI, the planning team also used the Keetch-Byram Drought Index (KDBI), Fire Danger Rating System, and the Burning Index to determine extent. The WUI maps and problem areas of Ponca City and Ponca City School district are shown on figures Figure 1-18 through Figure 1-21.

⁵⁹ Southern Group of State Foresters. <https://www.southernwildfirerisk.com/>

Figure 4-18 WUI for City of Ponca City



Union Elementary School is the only school that is located in a WUI intermix zone; however, Woodlands elementary and E.M. Trout Elementary School were located sufficiently close to the intermix zone to be concerning to the planning team.

Figure 4-19 WUI for Ponca City School District (Union Elementary)

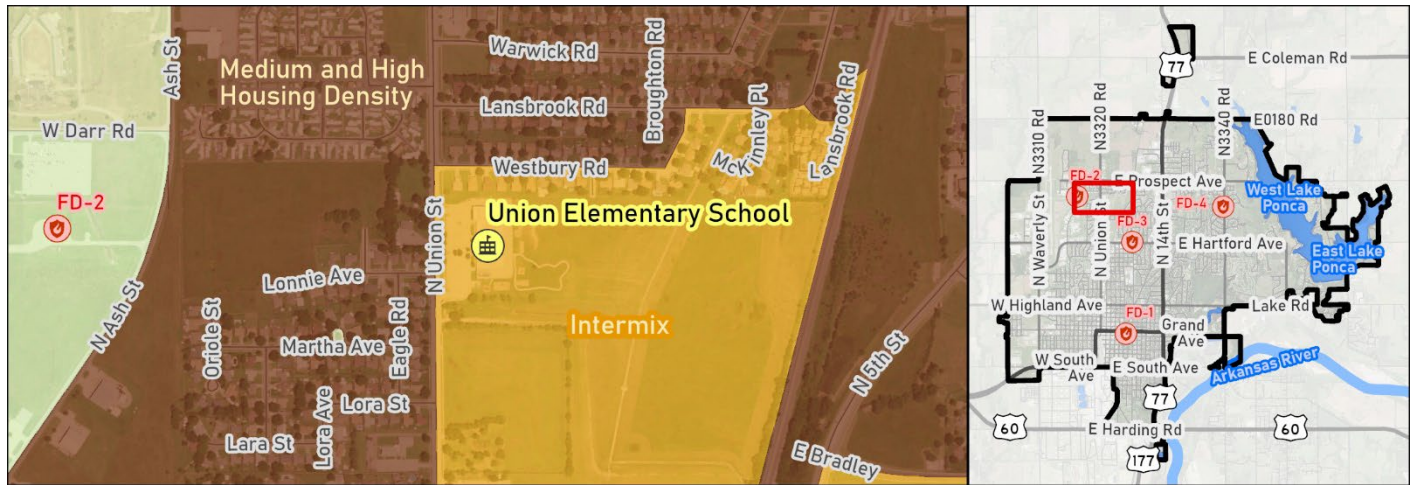


Figure 4-20 WUI for Ponca City School District (Woodlands Elementary)

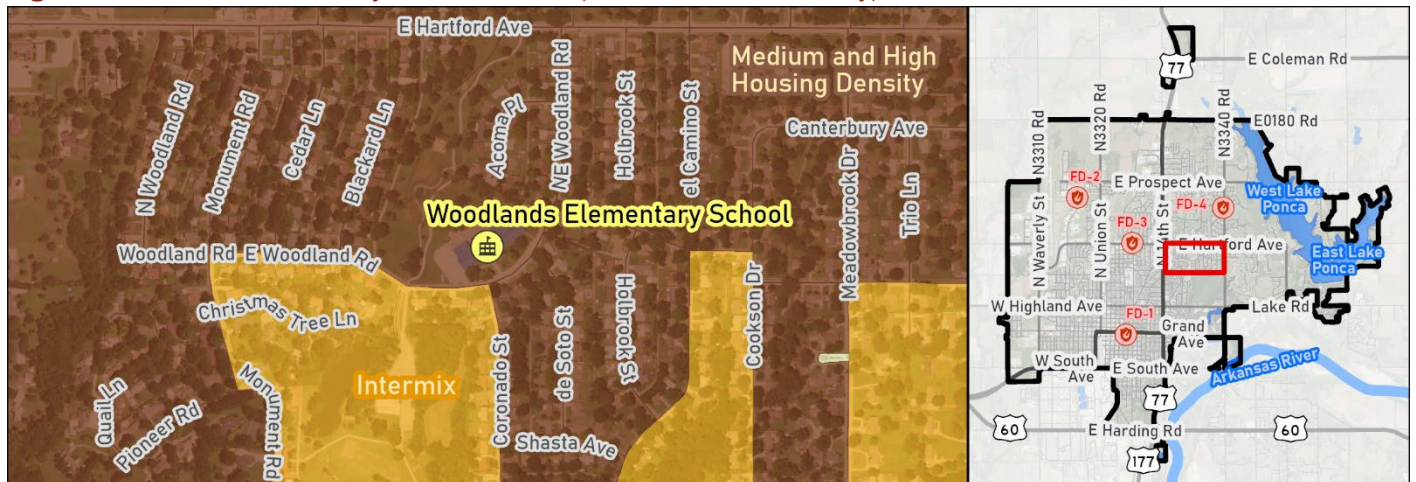
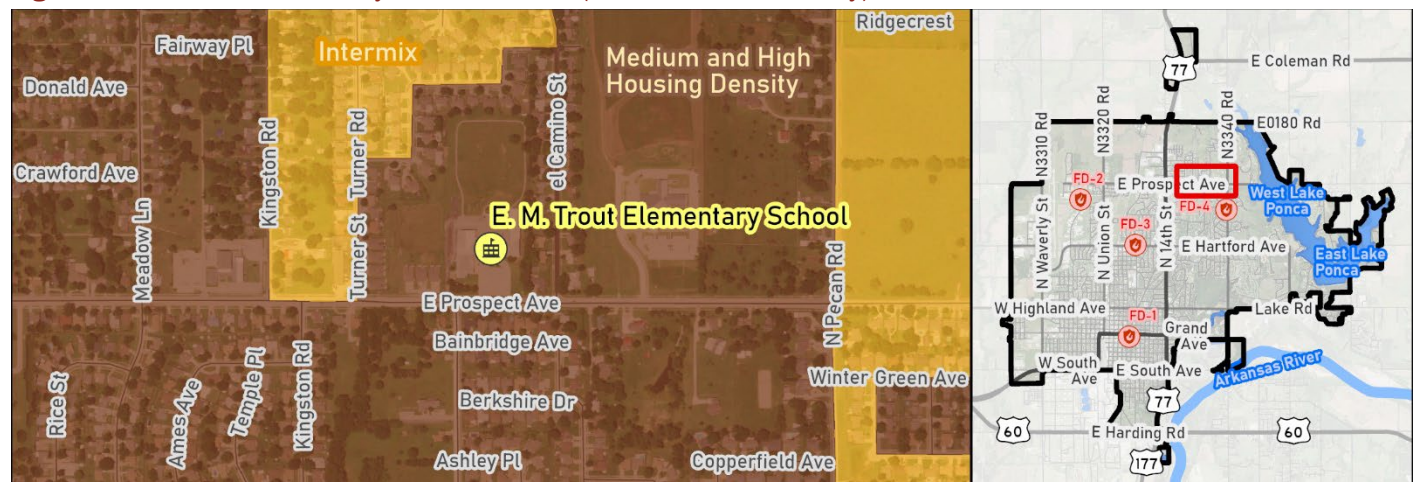


Figure 4-21 WUI for Ponca City School District (E.M. Trout Elementary)



In addition to the WUI, wildfire extent is measured by the expected severity levels of the fire hazards across planning area. Wildfire danger is measured using indices that relate longer-term soil and vegetation conditions to shorter-term weather patterns. The most explosive conditions occur when dry, gusty winds blow across dry vegetation. The planning team combined the Keetch-Byram Drought Index (KDBI), Fire Danger Rating System, and the Burning Index to determine extent in Ponca City.

The Keetch-Byram Index is a drought measurement designed specifically to measure an area's potential for fire. The index measures factors like precipitation, the amount of moisture that is present in soil and vegetation, and evapotranspiration to estimate the "flammability of organic material in the ground." This index measures this estimate in 200-point increments from 0-800, which can be found in the table below.⁶⁰ The planning area could experience a wildfire extent in the 600-800 point range.

Table 4-24 Keetch-Byram Index

Points	Description
0-200	Soil moisture and large class fuel moistures are high and do not contribute much to fire intensity. Typical in spring dormant season following winter precipitation.
200-400	Typical in late spring, early growing season. Lower litter and duff layers are drying and beginning to contribute to fire intensity.
400-600	Typical in late summer and early fall. Lower litter and duff layers actively contribute to fire intensity and will burn actively.
600-800	Often associated with more severe drought with increased wildfire occurrence. Intense, deep burning fires with significant downwind spotting can be expected. Live fuels can also be expected to burn actively at these levels.

The Burning Index relates temperature, relative humidity, wind speed, and solar radiation to the "relative greenness" of vegetation (taken from satellite measurements) and fuel models for native vegetation (assigned on a 1-kilometer grid across the State).⁶¹ These factors are used to derive four indices: Spread Component, Energy Release Component, Ignition Component, and Burning Index. The Burning Index is a synthesis of the Spread and Energy Release components. It is used to predict fire line intensity and flame length. The higher the Burning Index number, the higher the potential severity of the fire. The Fire Danger Rating System combines the combustibility of vegetation and weather conditions.⁶² Table 4-26 shows a combination of the Fire Danger Rating System and Burning Index. The planning area may experience days of extreme fire danger on this combined index.

There is no scientific scale to measure the extent of a structural fire, however, fires that cause a total loss of a structure and contents may occur. The most devastating events are those that cause loss of life. Even small fires may result in expensive damages and/or force an evacuation and relocation until the damaged structures can be repaired.

⁶⁰ <https://www.wfas.net/index.php/keetch-byram-index-moisture--drought-49>

⁶¹ https://www.mesonet.org/index.php/agriculture/map/range_forest/fire_danger/burning_index1

⁶² <https://www.fs.usda.gov/detail/cibola/landmanagement/resourcemanagement/?cid=stelprdb5368839>

Table 4-25 Combined Fire Danger Rating and Burning Index

Fire Danger Rating	Burning Index	Flame Length	Description
Low	<20	<2 feet	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.
Moderate	20-40	2-4 feet	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.
High	40-80	4-8 feet	All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High	80-110	8-11 feet	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme	>100	> 11 feet	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash (trunks, branches, and treetops) or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

4.7.4 Previous Occurrences

It is **highly likely** that the fire hazard will impact the planning area more than once a year. The planning team determined this estimate primarily by relying on Fire Marshal and NCEI data.

Data was collected from 2010 – 2020, from the office of the Oklahoma State Fire Marshall. As of the completion of this plan, the Fire Marshall did not have the data for 2021 collated. The Ponca City Fire Department responded to 439 wildfires, which burned nearly 3,100 acres and resulted in approximately \$118,319 in damages. Annualized over this 11-year period, these numbers average to approximately 40 runs, 281 acres burned, and over \$10,000 in losses. From 2010-2015, Ponca City Fire Department reported higher numbers than from 2016-2020. These data may be incomplete since they are based on voluntary reporting measures from the fire departments. In addition, this data does not factor in which fire events directly threatened Ponca City, as

opposed to which events the City Fire Department assisted due to an agreement with neighboring fire departments, or another reason.

Table 4-26 Historic Fire Events (OK Fire Marshal)⁶³

Year	No. of Wildfire Runs	Acres Burned	Losses
2010	11	161	\$45,000
2011	79	166	\$0
2012	14	42	\$4,260
2013	16	94	\$10,002
2014	61	853	\$38,562
2015	56	229	\$15,384
2016	58	572	\$3,711
2017	34	282	\$0
2018	40	81	\$0
2019	43	447	\$1,400
2020	27	169	<i>Not reported</i>
Total	439	3,096	\$118,319⁶⁴
Average	40	281	\$10,756⁶⁵

In addition to the Fire Marshal's Office, the NCEI database recorded 1 wildfire event in Kay County from January 2010 – May 2021, which occurred in April 2018. Based on reports from local officials, the direct impacts on Ponca City were minimal.

The planning team was not able to locate datasets on the number of structure fires in the city. Nonetheless, personnel at Ponca City Fire Department reported that the Department currently responds to over 3,033 incidents annually. In addition to this input, Local officials reported a fire event in January 2020, which affected Ponca City. This narrative and the NCEI narrative are included in Table 4-28.

Although it outside the scope of the time period queried, one of the most notable fires effecting the city of Ponca City in recent history is the Ponca City fire of 2006. NCEI did not have any reports of this event, however, Ponca City Commissioners Archived report stated that there was a fire at the diesel plant. The reported cost for repairs were estimated to be between \$1.4 million to \$2.75 million dollars, which received disaster number FM-2633-OK.

Table 4-27 Historic Fire Events (Other Fire Event Narratives)

Date	Event Narrative
April 11, 2018	Extremely hot temperatures with dry conditions caused grass fired to burn approximately 800 acres in Kay County.
January 3, 2020	Conoco Phillips 66 had a micro-explosion within the refinery, which caused a dangerous structural fire due to its proximity (2 miles) to a school and Ponca City's major hospital.

⁶³ Some of these data are rounded for readability.

⁶⁴ Assumes that 2020 financial data is \$0.

⁶⁵ Assumes that 2020 financial data is \$0.

4.7.5 Probability of Future Events

Based on datasets of past wildfire events and local input (see previous section), it is **highly likely** that Ponca City will experience a fire (structural and wildfire) in the next year, or a recurrence interval of less than 1 year (90 to 100 percent probability).

4.7.6 Vulnerability and Risk Assessment

Based on the classifications in Table 4-2, the overall significance of a wildfire or structural fire event is **medium**. Fire can result in fatalities, structural damage, and crop damage. Some of the most significant economic vulnerabilities are economic result from structure and infrastructure damage along with costs due to business closures.

People

Structural fires and wildfires can put people in life-threatening danger from smoke inhalation and burn wounds. Residential structural fires can occur at night, putting sleeping people at a very high risk of injury or death. Wildfires moving into residential areas or along roadways can threaten individuals who are traveling or seeking escape from the fire. Firefighters are at risk while responding to both types of fires. A wildfire or structural fire could result in evacuation of school or another large gathering facility. The planning team identified two “problem area” locations for fire, indicating that people living in these locations would be at heightened vulnerability to fire (see Table 4-23 and Figure 4-18).

Public Health and Safety

Fires could degrade air quality for part, or the entire, planning area. This depends, in part, on the duration of the fires, the size of the fires, the location of the fires, and the types of matter being burned. Populations with pre-existing conditions or other vulnerability factors (e.g. age) are especially at risk. At the extreme, air quality issues can cause increased hospitalizations and, when combined with other conditions, could even cause death. In addition, fires near densely populated areas also can lead to evacuations or mass casualty incidents, which can further strain Ponca City’s resources, especially its healthcare system.

Education and Outreach

Increased fire awareness can decrease the planning area’s vulnerability to wildfires. Local fire response units could conduct educational programs in schools, informing the public about proper evacuation and other lifesaving procedures, running fire drills on a regular basis, and proper burning techniques for waste. Ponca City can provide fire safety materials for residents, insurance companies, utility providers and other stakeholders. This education can include removing dead or dry leaves, needles, twigs and combustible materials around property, along with installing and maintaining smoke detectors and fire extinguishers on each floor of homes or other buildings. Much of these activities can be completed through the FireWise program (see Chapter 3 for more information). These outreach and education activities can be enhanced by a mobile electronic application.

Economy

Economic impacts of wildfires can include acreage burned and employment opportunities lost, along with goods and services, especially for industries like agriculture and recreation. Ponca City has several large growing farms on the outskirts of midtown which run the threat of catching fire.

Built Environment

Existing Structures

Modern buildings are designed to minimize the probability of catastrophic fires. Nonetheless, all structures in Ponca City are vulnerable to fires. Due to age and other factors, it’s not safe to assume that every building in Ponca City meets modern fire codes and that every large building has automatic fire sprinklers. Fire vulnerabilities also depend on a structure’s location to sources of flammable material, including vegetation and other structures, and fire retardants, including ditches and fire-resistant surfaces. For areas where local officials

have earmarked as having higher vulnerability to fires in the planning area, see the location section. The planning team concluded that these areas were at greater risk to fire (see Table 4-23 and Figure 4-18).

Infrastructure

Electric: Poles or lines could be damaged by a fire, resulting in power outages. This would affect business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activities. Although all public buildings have backup generation, many private residential and commercial buildings do not, making them more vulnerable to a power outage and the secondary effects of an outage.

Gas: Gas supply lines threaten to exacerbate the effects of a fire due to their flammability. A fire could lead to burn and inhalation problems, which are outlined in the people and public health sections.

Water/Wastewater: Depending on damage levels to infrastructure or the demands from a fire, water and wastewater plants may not meet daily intake levels due to water shortages. This could cause a water crisis for certain populations, if redundancies to supply drinking water are not established. Although a severe fire could strain the City's water infrastructure, the availability of water from Lake Ponca and nearby Kaw Lake would likely mitigate most of this vulnerability.

Transportation: Though unlikely, a fire at Ponca City airport would be particularly devastating, given the value of property and hazardous materials, along with other factors traffic rerouting and the potential size of the blaze. This could disrupt business operations and would place responders at additional risk, given the typical amount of hazardous materials at airports. This observation also can apply to the railroad that runs through the City.

Critical Facilities

All critical facilities are at risk to fire; however, no critical facility was identified as being at a heightened risk to fire. The structural loss of a critical facility can result in a disruption of basic services (see infrastructure section), emergency response and medical services, or governmental services, all of which could have immediate and long-term consequences on the health of the City's economy and the health of the people residing in the City.

All publicly owned critical facilities, including the school district, have adequate backup generation in the event that a fire results in a loss of power. All critical facilities should ensure that their backup generation is up-to-date and secured as best as possible from the effects of a hail event.

Cultural Resources

All cultural resources are at risk to fire. That being said, the Standing Bear Museum is located in a high-risk area of dry grasslands in the southern part of town, making it more uniquely at risk to fire events.

Future Development

Climate change may heighten the frequency and severity of wildfires in Ponca City due to increased warming and drought in Oklahoma. Fire code enforcement personnel ensure that public and private buildings meet or exceed current nationally recognized and legal fire codes. Fire code enforcement efforts are a critical element in the success of fire prevention programs. Almost every aspect of a thorough fire prevention program is affected by code enforcement in some way. It plays a major role in fire and life safety inspections, plans review, hazardous materials, code adoption, environmental investigations, and the issuance of fire prevention code permits. Although the City plans to adopt 2021 building codes, it is suggested that the city adopt the newest building codes ICC 2021.

Ponca City School District

Union Elementary School is the only school that is in a WUI intermix zone. Ponca City School District has two schools that are near intermix grass areas that could pose a threat for wildfires: Union and Trout Elementary Schools. In addition, Lincoln Elementary School, Garfield Elementary School, and Ponca City West Middle Schools are located near the problem area (grasslands) identified by local officials (see Table 4-24).

The other schools are located in town were not identified as being at a heightened risk to fire. Ponca City schools practice routine drills in the event of a fire in or near to a school building, which can help reduce the schools' vulnerabilities to on people (see Chapter 3).

In addition, large fire events can cause structural damage (residential and commercial) within the school district area, outside the City limits, which could disrupt critical services in similar ways as outlined above for the City of Ponca City (see above sections on the built environment). These effects, along with transportation disruptions could cause students to be unable to attend school or extracurricular activities and may place other burdens on families with school-age children.

Natural Environment

Wildfires, especially those that result in structure fires, could release pollutants into the natural environment. These could include household chemicals or industrial scale releases. Fire also can cause soil erosion, due to the loss of ground cover, such as leaves and needles. Nonetheless, wildfires are a part of natural cycles and can be beneficial. Controlled burns should be conducted to reap these benefits and minimize the buildup of fuel materials which could result in more dangerous fires. In addition, wildfires can have renewing functions for soil.⁶⁶ Structural fires could release pollutants into the natural environment. These could include household chemicals or industrial scale releases. Wildfires are a part of natural cycles and can be beneficial. Controlled burns should be conducted to reap these benefits and minimize the buildup of fuel materials which could result in more dangerous fires.

⁶⁶ <https://blog.suny.edu/2013/08/ask-an-expert-why-are-wildfires-good/>

4.8 Hazardous Materials

4.8.1 Hazard Description

Hazardous substances include materials and wastes that are considered severely harmful to human health and the environment, as defined by the United States Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (commonly known as Superfund). Many hazardous materials are commonly used substances, which are harmless in their normal uses, but are quite dangerous if released in concentration. The EPA designates more than 1,300 substances as hazardous, making them subject to the reporting requirements under the Emergency Planning and Community Right-to-Know Act (EPCRA), CERCLA, and/or Clean Air Act (CAA). This does not include all hazardous chemicals for which material safety data sheets are required.⁶⁷ Because relevant legislation uses the term “hazardous substance”, but the emergency management and response community typically use the term “hazardous materials,” for this hazard profile, “hazardous materials” and “hazardous substances” are used interchangeably. Hazardous materials sites, for regulatory purposes, are divided into two general categories, fixed sites, and transportation facilities:

Fixed-site hazardous substances (materials and waste) incidents are the uncontrolled release of materials from a fixed-site capable of posing a risk to health, safety, and property as determined by the Resource Conservation and Recovery Act (RCRA). It is possible to identify and prepare for a fixed-site incident because federal and state laws require those facilities to notify state and local authorities about what is being used or produced at the site. The EPA regulates hazardous materials at fixed sites. Hazardous substances, as listed, are generally materials that tend to persist for long periods and pose long-term health hazards for living organisms if released into the environment. Extremely hazardous substances, while also generally toxic materials, represent acute health hazards that are immediately dangerous to the lives of humans and animals and can cause serious damage to the environment if released. When facilities have these materials in quantities at or above the threshold planning quantity (TPQ), they must submit Tier II information to appropriate state and/or local agencies to facilitate emergency planning.

Transportation of hazardous materials incidents are any events resulting in the uncontrolled release of materials during transport that can pose a risk to health, safety, and property as defined by the U.S. Department of Transportation (U.S. DOT) Materials Transport regulations. The U.S. DOT regulates hazardous materials in transit. Transportation of hazardous waste is regulated by the Oklahoma Dept of Transportation. The U.S. DOT regulations define a hazardous material as a substance or material that the Secretary of Transportation has determined could pose an unreasonable risk to health, safety, and property.

4.8.2 Location

Although the hazard could affect any location in the planning area, the hazard’s location generally is concentrated in the areas immediately proximate to Tier II facilities and transportation networks. Ponca City is a major thoroughway for trucks to pass through and a destination and leaving point depending on the material being transported. The highway, and railroad track can carry volatile and toxic chemical products through the jurisdiction.⁶⁸ An analysis of tier II reporting suggests that there are several toxic substances being transported into, stored, and transported out of Ponca City.

To facilitate community planning for hazardous material events, the Emergency Planning and Community Right-to-Know Act (EPCRA) requires **Tier II** reporting on the storage, use, and release of hazardous substances. Facilities that use or store chemicals over EPA thresholds must submit Tier II reports to ODEQ on an annual basis;

⁶⁷ <https://www.epa.gov/epcra/consolidated-list-lists-under-epcracerclacaa-ss112r-august-2020-version>

⁶⁸ **There** are no hazardous material restricted highways listed in the County.

these facilities can be known as Tier II facilities. The LEPC and fire departments use this information create response plans.

There are more than 50 registered **Tier II facilities** in and around the planning area; most are located in the industrial park just south of the planning area. Although any of these facilities could present a danger to the planning area, none presented a uniquely heightened risk. Additional analysis, which is outside the scope of this project, is required to confirm or refute this conclusion.

In addition to Tier II facilities, transportation networks also key locations of transmission for hazardous materials. The occurrence of a transportation incident involving hazardous materials is also a concern. The complexity of this hazard has much to do with the location of an event and materials involved.

Roadways account for many hazardous material releases. Most of the hazardous material and chemical spills that are reported within and around the border of Ponca City and Ponca City School District are located between and arounds Interstate 35 and Business U.S. 60 in **Ponca City**. U.S. 77 and U.S. 177 join U.S. 60 for 12 miles, and U.S. 60 East/U.S. 77 North/U.S. 177 South. In southeast **Ponca City**, U.S. 77 heads north and U.S. 177 heads south, ending the triplex of three U.S. **highways**, **this is another major hub where trucking incidents occur**. Local roadways may also be used to move materials through populated areas.

Accidents involving **aircraft** can range from human error to meteorological causes. Fog, ice, thunderstorms, and wind shear are conditions that can lead to difficulties in properly controlling aircraft. Weather delays are common in air transportation and are respected to help prevent accidents. Airport runway pavement is also a concern. When deteriorated, runway pavement can cause damage to aircraft turbines, propellers, and landing gear and may result in runway closure. Ponca City has 1 public municipal airport located near Conoco Phillips 66 Refinery.

Over 1.52 million carloads of hazardous material move by **rail** each year. Collisions and derailments are the most common accidents for rail travel. The Burlington Northern and Santa Fe (BNSF) railway—the largest freight network in the United States as of this writing—passes through the City, bringing in cars with hazardous products from around the country.

The **pipeline** network supporting energy transportation in the United States includes approximately 1.9 million miles of natural gas and hazardous liquid pipelines and has more than 3,000 companies operating in all 50 states. Pipelines represent 18.4% of all hazardous material transportation in the U.S. Natural gas distribution, with over 1.8 million miles of pipelines, represents the greatest commodity transported through pipelines. Most pipelines are installed in underground rights-of-way (ROW), which are maintained for access and marked with above ground markers and warning signs. Both gas and liquid pipelines were reported in Ponca City.

4.8.3 Extent

Given the multitude of hazardous materials and their various effects, it is difficult to determine an extent for hazardous materials. With a hazardous substance release, whether accidental or intentional, several potentially exacerbating or mitigating circumstances will affect its severity of the impact, however. Characteristics that can enhance or magnify the effects of a hazardous substance release, include:

- Weather conditions, which affect how the hazard occurs and develops (such as wind speed and direction)
- Micro-meteorological effects of buildings and terrain, which alters the dispersion of hazardous substances in compliance with applicable codes (such as building or fire codes)
- Mechanical failures (such as fire protection and containment features), which can substantially increase the damage to the facility itself and to surrounding buildings
- Land use, population and building density will be factors contributing to the extent of exposure and impacts incurred.

The severity of a hazardous material incident is dependent not only on the circumstances described above, but also with the type of substance released, distance from the release, and the related response time for emergency

response teams to stabilize and contain the release. Generally, areas closest to a release are at the greatest risk, due to their exposure to higher concentrations of the substance and the limited warning time before being impacted. Nonetheless, depending on the substance/material, a release can rapidly travel great distances or remain present in the environment for long periods of time (e.g. centuries to millennia), allowing for greater dispersal and increasing the spatial extent of the impact.

4.8.4 Previous Occurrences

Two sources were used to provide a rough estimate of hazardous material incident occurrences from January 2010 – June 2021. The National Response Center (NRC) maintains a database of reports for the release of pollution for both fixed site and transportation events. The database contains initial information that has not been validated, and therefore it can only be used as a rough guide.⁶⁹ The Pipeline and Hazardous Materials Safety Administration (PHMSA) tracks in-transit hazardous material releases through its nationwide database.⁷⁰ Regulations in 49 CFR 171.15 and 171.16 govern situations where hazardous materials are released, along with required notifications and reporting measures. Unless hazardous materials are properly reported, it is difficult to identify and track past hazardous materials releases that occur in transit.

The planning team identified 68 reported hazardous material releases from January 2010 – June 2021. The National Response Center database included 68 discrete reports of suspected hazardous material spills in and immediately proximate to the planning area (4 of those reports was a repeat or a correction). Most of these calls involved petroleum refining or chemicals used in industry. The PHMSA identified natural gas transmission lines and hazardous liquid pipelines around the City, with a concentration in the southwest corner of the City. The PHMSA did not report any spill information.

Table 4-28 Historic Hazardous Material Events

Date	Event Narrative
June 17, 2010	A major refinery released hydrogen sulfide and benzene caused by the wet gas scrubber system. Water had backed up through the system due to human error. The refinery is 2 miles from the hospital and 4 miles from a local school.
June 12, 2011	Sodium hydroxide was released from the Ponca City Power Plant due to a lightning strike that caused a pump to run and start to overflow the mutualization basin. NaOH is odorless, highly caustic and leads to nasal passage and chronic skin irritation; it can also affect reproduction. It was estimated 700-900 gallons of the material that was released.
July 1, 2013	Phillips 66 Ponca City Refinery reportedly released hydrogen cyanide HCN emissions of over 10 lbs per day, which was found to be the result of human error. HCN is odorless and can result in poisoning and death to humans and animals when inhaled. ⁷¹
March 27, 2019	There was a pipeline explosion at a Ponca City residence. The victim was severely injured and medically evacuated a hospital in OKC. There was a subsequent fire and release of natural gas.
March 11, 2020	A large oil battery spill caused hazardous material to run into the ground, run off into a ditch, and into Turkey Creek and Ponca Lake. Ponca Lake is the drinking water supply source of the town and was impacted.
February 15, 2021	Cascading effects from another hazard (an ice storm) caused a flare at the major refinery in town which actively released hydrogen sulfide into the air. H ₂ S in small

⁶⁹ <https://nrc.uscg.mil/Default.aspx>

⁷⁰ <https://pvnpm.phmsa.dot.gov/PublicViewer/>

⁷¹ The closest exposure is to workers and can be fatal. 100-200 ppm will kill a person breathing the air within 10-60 minutes.

Date	Event Narrative
	amounts causes severe bronchial irritation. The airport and a school are approximately 4 miles away from the refinery.

4.8.5 Probability of Future Events

Past events suggest that Ponca City will experience hazardous material events at least once per-year, making the probability of a hazardous material spill a **highly likely** event, according to Table 4-2.

4.8.6 Vulnerability and Risk Assessment

The hazard has a minimal impact on the planning area and has a **medium** overall significance based on classifications in Table 4-2. The event's impacts on the planning area are noticeable but not devastating to Ponca City's property and citizens, especially given the City's the ability to partner with local fire jurisdictions and other response units.

People

People working and living in the areas near hazardous materials facilities and transportation routes are at the greatest risk of a hazardous materials incident. Given the difference in hazardous materials and their physiological effects, hazardous materials can have limited health impacts, on one extreme, or cause death, on the other.

People at heightened risk include those with mobility or severe health issues that would limit their ability to evacuate quickly and people who speak a language other than English, limiting their ability to receive warning messages. Construction and maintenance workers are at increased risk of personal injury when working on or near hazardous materials sites.

Public Health and Safety

Most hazardous material spills recorded in the planning area recently were related to petroleum products and chemicals used in industry (see previous occurrences). Some hazardous materials, however, can cause long-term effects on peoples' health and strain the public health system, which can last for years. These long-term consequences can be prolonged by the secondary effects from hazardous materials. Hazardous materials can be introduced in the human body through secondary effects, such as eating or drinking contaminated food and water, touching or handling contaminated items, and bathing with contaminated water.

Developing a timely approach to responding and remediating to an extreme hazardous materials event can be crucial for public health. This approach requires coordination across private and public response units, along with healthcare workers across the planning area. To this end, conducting hazardous materials training with ConocoPhillips's response team is encouraged to better the planning area's response to dangerous chemical spill, explosion, or exposure (for more information on ConocoPhillips's response team, see the response network section in Chapter Three). Ponca City also should maintain and exercise capabilities to contain and remediate hazardous materials in line with current best practices.

Education and Outreach

People in the planning area would benefit from addition outreach and education on hazardous materials. This outreach could include information on properly storing and registering hazardous materials with local and state authorities. In addition, residents should be knowledgeable about evacuation procedures or sheltering options during an extreme hazardous materials event. These outreach and education activities can be enhanced by a mobile electronic application.

Economy

A large spill could impact recreational activities, close a facility, or harm agricultural activities, which could have severe economic impacts if the entity affected is a revenue generator or economic driver. Most events would not have broad implications for the economy. The costs of hazardous materials events can be expensive. Costs can include a cost of materials lost, property damage, cessation of business activities, response cost, and remediation/cleanup costs.

Built Environment

Existing Structures

An explosion at any Tier II facility may create off-site collateral damage (for more information on Tier II sites, see the extent section). Adjacent structures and properties are most vulnerable. Hazardous material releases can damage and destroy public, commercial, and private property. Proximity, intensity, and the structural integrity of the building itself are all factors in the subsequent vulnerability and expected damage.

Infrastructure

The planning team did not identify specific vulnerabilities to electric infrastructure from a hazardous materials incident.

Gas: A gas line rupture presents a primary danger if large quantities of gas are leaked and cause secondary fire hazard (see fire section). Officials reported a number of gas leaks throughout the planning area. A fire would put people at direct risk of injury or death.

Water/Wastewater: Water and wastewater plants use chemicals to purify water and treat wastewater, among other hazardous materials. A large spill could cause the water or wastewater plants serving Ponca City to stop their activity, which could create a water or sewage crisis, if not addressed quickly and effectively. An excess of chemicals in drinking water could cause hospitalization and death.

Transportation: A traffic incident involving hazardous materials would cause significant traffic delays, including delays for emergency response vehicles or evacuation routes. Damages to transportation infrastructure and their closure are not uncommon following a hazardous materials release. The BNSF railroad could be a particular concern, given the volume of hazardous materials that travel on large railroad systems (see extent section for more information).

Critical Facilities

All critical facilities face the same vulnerabilities as existing structures. In addition, some critical facilities contain or use hazardous materials, such as industrial plants and hospitals. Many of these critical facilities are designated as Tier II sites (see extent section for more information). Officials noted that some critical facilities have completed upgrades recently, including ConocoPhillips, which reduces vulnerability. Other critical facilities may be located near higher volume of gas lines, due to their location or function. Due to the risk that hazardous materials events can present to all critical facilities in the planning area, officials should ensure that all critical facilities are protected against hazardous materials events as much as is feasible.

Cultural Resources

Cultural resources face the same vulnerabilities as existing structures. No specific vulnerabilities were identified.

Future Development

All designated Tier II facilities should follow the current best practices on hazardous materials maintenance. All new development should follow best practices about maintaining a safe distance from Tier II facilities or other hazardous materials sites. This is especially the case facilities with children.

Ponca City School District

Most of the school facilities are located at least a mile away from a Tier II facility, implying that these buildings would likely be impacted only in an extreme scenario. Union Elementary is the public school located closest to a Tier II facility. No other vulnerabilities were identified.

Natural Environment

A hazardous substance release, whether at a fixed site or in transit, can negatively impact the natural environment. Depending on the nature and amount of the substance, the release may contaminate the air, water, or soil potentially causing concern for direct human and animal exposure, recreational usage, and fish and wildlife consumption. Water contamination, whether surface water or groundwater, is an immediate concern from a hazardous material release potentially impacting potable water supplies, wildlife, and recreational activities.

Hazardous material releases could also significantly impact soils, harming ecosystems. Depending on the characteristic of the hazardous material and/or the volume of product involved, the affected area can be as small as several square feet or as large as many square miles that require soil remediation. Such environmental damage can linger for decades and result in extensive remediation costs.

4.9 Extreme Heat

4.9.1 Hazard Description

Heat is the leading weather-related cause of death in America.⁷² **Extreme heat** is defined as unusual hot weather (maximum, minimum, daily average) over a region persisting at least two consecutive days based on local climatological conditions, with thermal conditions recorded above given thresholds (WMO 2015). Note: There is no universally recognized metric for what constitutes extreme heat. The World Meteorological Organization recommends characterizing a heat wave by its magnitude, duration, severity, and extent. This definition also aligns with the definition used in the State of Oklahoma's 2018 Hazard Mitigation Plan.

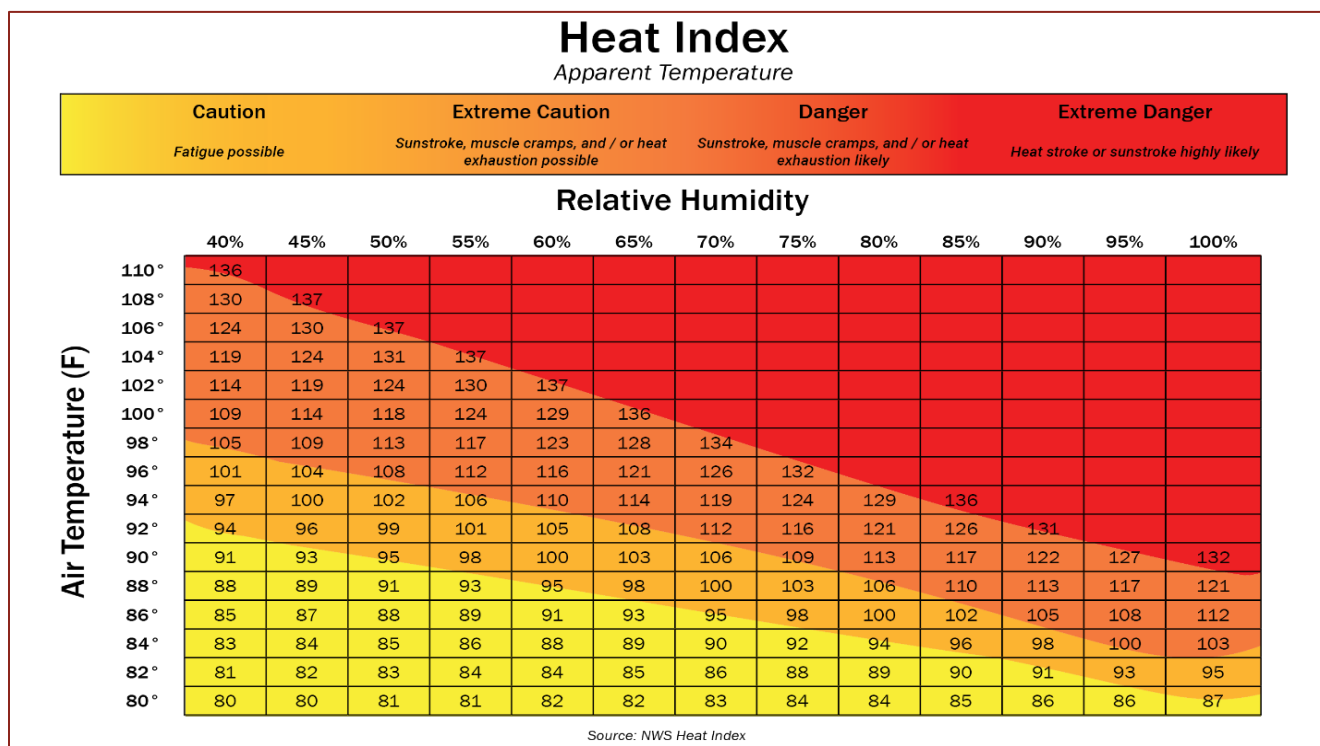
4.9.2 Location

Extreme heat is a hazard that is uniform across the entire planning area. The entire northcentral Oklahoma region, including Ponca City and Ponca City School District, is known for its hot, humid summers.

4.9.3 Extent

In terms of hazard extent, temperatures often reach above 100°F for extended periods, with heat indexes significantly exceeding 100°F. The Heat Index and Heat Disorders table combines temperature and relative humidity into heat index.⁷³ The table suggests varying degrees of caution depending on the relative humidity combined with the temperature. The shaded zones on the chart indicate varying symptoms or disorders that could occur depending on the magnitude or intensity of the event. "Caution" is the first level of intensity where fatigue due to heat exposure is possible. "Extreme Caution" indicates that sunstroke, muscle cramps or heat exhaustion are a possibility, whereas a "Danger" level means that these symptoms are likely. "Extreme Danger" indicates that heat stroke or sunstroke is highly likely.

Figure 4-22 Heat Indexes and Heat Disorders



⁷² <https://www.weather.gov/phi/heatcond>

⁷³ <https://www.weather.gov/safety/heat-index>

Although the heat index captures important elements of extent and risk, some researchers also use Wet Bulb Globe Temperature (WBGT) as the primary index for heat. This transition is driven by research indicating that WBGT is a much more positively correlated with health effects (for examples of these affects, see the people subsection of the vulnerability and risk assessment).⁷⁴

Table 4-29 National Weather Service (NWS) Differences in WBGT and Heat Index⁷⁵

Parameters	Wet Bulb Globe Index	Heat Index
Measured in the Sun	✓	X
Measured in the Shade	X	✓
Uses Temperature	✓	✓
Uses Humidity	✓	✓
Uses Windspeed	✓	X
Uses Sun Angle	✓	X
Uses Cloud Cover	✓	X

In addition to the heat index, the National Weather Service has created a series of tables related to WBGT temperature levels and their effects on human health. The table below highlights general guidelines for people working or exercising in Wet Bulb conditions. Other guidelines exist for different at-risk groups (e.g. youth) and activities (e.g. sports and military training). People who are at risk of extreme heat should take precautions in additions to the ones listed below (see the vulnerabilities section for people who may be at-risk).

Table 4-30 NWS Composite Guidelines for Working or Exercising in Full Sun⁷⁶

Risk	WBGT	Heat Index
Low	80F-85F	Body stressed After 45 minutes
Moderate	85F-88F	Body stressed after 30 minutes. Heat cramps likely (painful contraction of muscles, weakness)
High	88F-90F	Body stressed after 20 minutes. Heat exhaustion likely (dizziness, nausea, vomiting, headache, fainting, disorientation, weakness)
Extreme	90F	Body stressed after 15 minutes. Heat stroke likely (extremely high body temperature, confusion, convulsions, unconsciousness, death)

According to the Oklahoma Climatological Survey, Kay County has a record high of 117.⁷⁷ Ponca City should expect to experience temperatures above 100 degrees and high relative humidity in the future, which could

⁷⁴ Kevin Kloesel, University of Oklahoma; National Weather Service

⁷⁵ NWS Atlanta

⁷⁶ <https://www.weather.gov/arx/wbgt>

⁷⁷ https://climate.ok.gov/county_climate/Products/County_Climatologies/county_climate_kay.pdf

reach danger levels (or even extreme danger levels) on the heat index and will contribute to more severe WBGT days each year.

4.9.4 Previous Occurrences

The average high temperature for July and August in the City of Ponca City is 93.5° F, with an average humidity of 56%, putting the area near the “Extreme Caution” category on the National Weather Service (NWS) Heat Index scale (see extent section). When temperature and humidity rise higher, as they often do in July and August, conditions can reach the “Danger” and even “Extreme Danger” categories.

Despite high temperatures, the NCEI database did not report any extreme heat events from January 2010 – June 2021. 2017 Plan did not report any extreme heat events from 2007-2017. In addition, community leaders and other stakeholders supported these findings by noting that the extreme heat events have either decreased or remained the same since the last plan update. The planning team was able to identify one instance when Kay County reported an extreme heat advisory during this period.

Table 4-8: Historic Extreme Heat Events

Date	Event Narrative
August, 2019	Low temperatures stayed in the upper 70s and low 80s Fahrenheit, providing little relief from daytime heat indexes more than 115° F. Kay County received an excessive heat warning for this event. ⁷⁸

4.9.5 Probability of Future Events

Although the planning area is likely to experience heat events annually, extreme heat events are reported to be **occasional**, or a recurrence interval of 11 to 100 years, based on previous occurrences in the NCEI database and local officials’ reports. This being said, however, research from the Oklahoma Climatological Survey and from SCIPPP predicts an increase in more extreme heat events across the planning area as the result of climate change.⁷⁹ The planning area could experience an increase of another 3-9 degrees Fahrenheit by the end of the century.

4.9.6 Vulnerability and Risk Assessment

The hazard has a minimal impact on the planning area and has a **low** overall significance based on classifications in Table 4-2. Despite the highly likely probability of occurrence and moderate location and extent rating, extreme heat is a relatively normal occurrence for Ponca City. Residents and workers have developed solutions to mitigate most of the severe risks to the hazard. The impact on infrastructure and buildings is very localized, if any.

People

Despite being a comparatively normal occurrence, extreme heat poses a risk for people in Ponca City. Extreme heat can take its toll on all people in Ponca City and participating jurisdictions; even physically fit individuals can succumb to heat effects. Minor temperature differences can be associated with increased illness and death, especially for vulnerable populations. These effects are also dependent on other natural effects, such as duration, windspeed, and, especially, humidity. Wildfire conditions are exacerbated by extreme heat and response during these events puts responders and residents at even greater risk.

⁷⁸ <https://www.poncapost.com/local/extreme-heat-continues-for-tuesday>

⁷⁹ https://forestry.ok.gov/sites/g/files/gmc801/f/documents/2020/ok_climatological_survey_climate_statement.pdf

Certain segments of the population are at higher risk.⁸⁰ Of particular concern are people over the age of 65 who live below the poverty line. These people are some of the highest risk population segments of loss of life due to extreme heat conditions. Heat-induced hospitalization death can occur rapidly, over the course of a day. The planning area has 18% residents over 65, which is slightly above the state average. These populations tend to be at higher risk, since they have more difficulty thermoregulating against the effects of extreme heat. In addition, these populations tend to be retired and have a small fixed income, which could hinder their ability to pay for air conditioning if prices for electricity were to rise during an extreme heat event. Although these vulnerable populations are spread throughout the planning area, many are concentrated in the northeast part of the planning area.

Generally, public schools are not in session during the peak of the extreme heat season; however, athletic and band practices typically begin in early August and run through September. All students and staff of participating schools are vulnerable to heat illnesses.

To mitigate against some of these effects, some public buildings in Ponca City and the school district can serve as cooling stations, if needed. Many of these cooling stations are supported by backup generators (See Chapter 3 on sheltering; also see education and outreach section).

Public Health and Safety

People in the planning area also can be exposed to physiological and psychological effects from extreme heat. Extreme heat can also exacerbate cardiovascular, respiratory, and other physiological chronic conditions. Extreme heat also can alter population psychology and negative psychological behaviors, such as increased crime rates.

Education and Outreach

The impacts of extreme temperatures on public health can be lessened if citizens know how to prepare and protect themselves. Educating Ponca City's citizens regarding the dangers of extreme heat and best practices for extreme heat events can protect them from illness and death in the future. Understanding the location and movement of vulnerable populations and how they obtain their news sources is key and all possible media and outlets should be utilized. These outreach and education activities can be enhanced by a mobile electronic application.

Economy

Heat waves can affect the economy of Ponca City by slowing worker productivity, affecting structures and infrastructure, and damaging crops. Worker productivity decreases during heat waves. Businesses that can allow employees to work remotely should develop a plan to develop broadband services if power to business is cut and workers would perform more effectively elsewhere. The slowdown is particularly acute in outdoor industries, such as construction. During periods of extreme heat, the electrical demand increases greatly, including costs for electricity. Most electrical motors and controls are designed to operate with ambient air temperatures of 104 degrees Fahrenheit or less. The increased heat from the increased electrical demand by electrical equipment with ambient air temperatures above 104F will result in electrical power outages. Those electrical power outages will reduce the available cooling capacity and could also reduce the treatment and distribution of the domestic water supply. Since the last update, there haven't been any reported disruptions or major casualties from extreme heat events. In addition, buildings can be vulnerable to extreme heat, but these vulnerabilities tend to be limited.

⁸⁰ Individuals 65 years and older, children under five years old (especially infants), socially isolated individuals, mentally & mobility challenged individuals, obese individuals, individuals under the influence of alcohol or medication, individuals and families living below the poverty line, outdoor workers.

With this said, however, water recreation activities may experience a greater influx of customers looking to escape the heat. A local official noted that boating, and other water-related activity, increased during some periods of extreme heat, especially on the weekends.

Built Environment

Existing Structures

Although the direct effects of extreme heat on structures are minimal, extreme heat threatens the built environment, especially infrastructure. Extreme heat also can have secondary effects by heightening the incidence of expansive soils and fire (for the effects of expanding soils on the planning area, see the drought section, for fire, see the fire section). Homes that have poor thermal insulation, however, can exacerbate the hazard's affect on people. Older homes tend to be more poorly insulated. Ponca City has high numbers of older homes, which are spread throughout the City. The City should ensure that it is establishing and maintaining communication channels with the public on the best practices for extreme heat events

Infrastructure

Only electric and transportation infrastructure have specific vulnerabilities to extreme heat events.

Electric: Prolonged extreme heat events can result in rolling blackouts or other forms of power outage to avoid straining the electrical grid. Power outages can exacerbate conditions outlined the people and public health section in Ponca City. The City should ensure that communication about cooling stations is consistent, and is delivered over the mediums and the languages (especially Spanish; see Chapter 1) to maximize efficacy. Ponca City officials confirmed that public buildings that could be used as cooling stations have backup generation. Officials should also communicate about planned blackouts. Prolonged blackouts can exacerbate the conditions listed in the people section of the assessment.

Transportation: Extreme heat can further degrade some paving systems or limit the ability of crews to repair damages in Ponca City. Major limitations can disrupt emergency service and business delivery, which could lead to reduced medical and business efficiency.

Critical Facilities and Cultural Resources

No critical facility or cultural resource in Ponca City reported any specific vulnerability to extreme heat other than general structural vulnerabilities.

Future Development

The City should continue with building inspections to make sure that buildings are up to at least the 2018 international codes, which the City plans to adopt as of this writing. This could prevent the development and continuation of structures that are not properly insulated from extreme heat events. In addition, the City should ensure that all new critical facilities and public buildings are equipped with backup generation.

Ponca City School District

Extreme heat events can threaten students and staff similar to the effects outlined in the people section. Ponca City Schools have protocols in place to reduce students' and staff likelihood of exposure to extreme heat. Currently, the school district does not have a standardized plan for actions in the event of prolonged (more than 30min) power failure during an extreme heat event. Failure to act in a timely manner could cause students to experience some of the effects outlined in the people section.

No critical facility or cultural resource, including school district buildings, reported any specific vulnerability to extreme heat other than general structural vulnerabilities. Nonetheless, schools should ensure that all buildings are protected against heat events as much as is feasible. Ponca City Schools can serve as cooling stations for students and are equipped with backup generation to minimize vulnerability due to power outages.

In addition, large extreme heat events can cause structural damage (residential and commercial) within the school district area, outside the City limits, which could disrupt critical services in similar ways as outlined above

for the City of Ponca City (see above sections on the built environment). These effects could cause students to be unable to attend school or extracurricular activities and may place other burdens on families with school-age children.

Natural Environment

Extreme heat causes crop loss. High temperatures and dry air can lead to heat stress in trees and other flora. If prolonged, high heat conditions also could cause animals to leave their natural habitats to search for cooler places or places with more water.

4.10 Lightning

4.10.1 Hazard Description

Lightning is a discharge of electrical energy that results from the buildup of positive and negative charges in a thunderstorm, generating a “bolt” when the buildup of charges reaches a certain level. Lightning can occur between a cloud and the ground (cloud-to-ground lightning), between two clouds (Intercloud Lightning), or within the same cloud (Intracloud Lightning). Lightning can strike 10 miles outside the rain column.

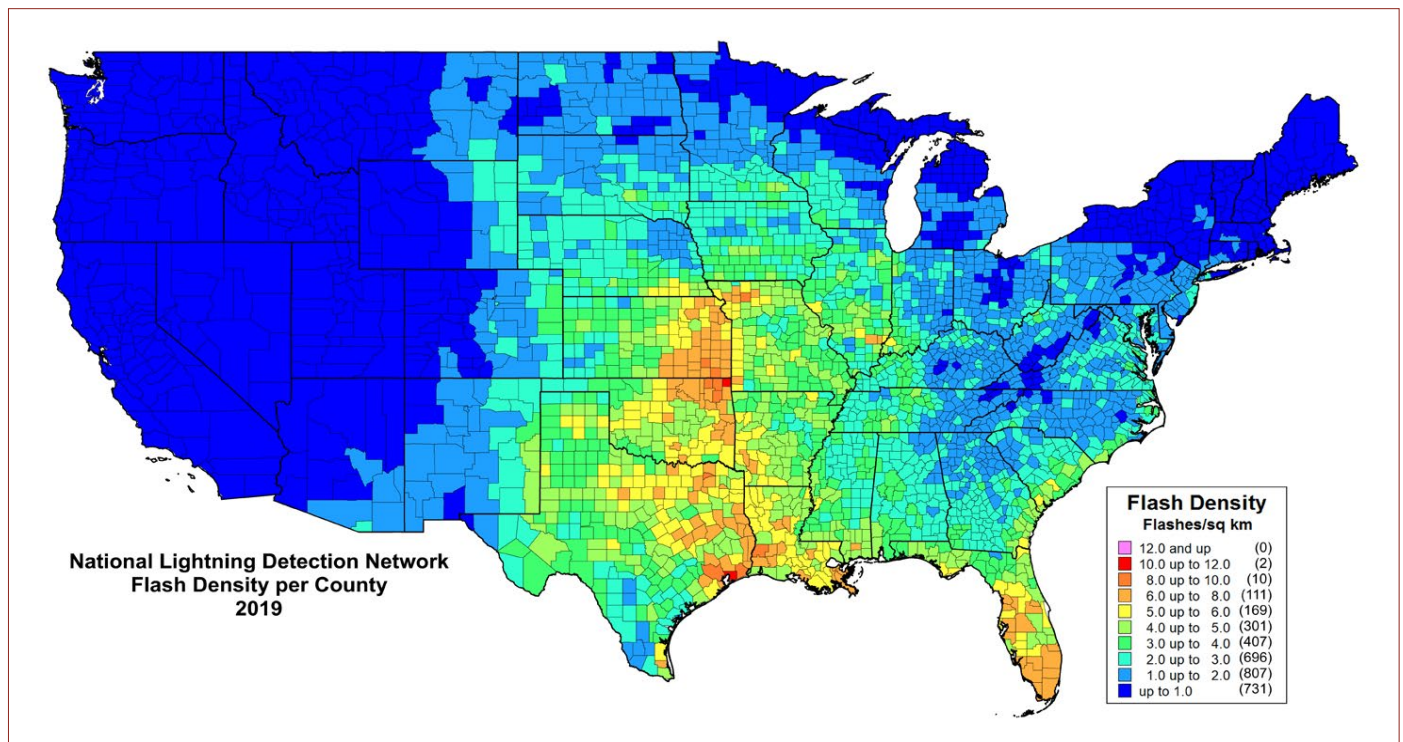
4.10.2 Location

Lightning is typically a by-product of thunderstorms or other atmospheric events, making the location of lightning uniform over the planning area.

4.10.3 Extent

Extent is determined by density of lightning strikes that reach the ground (cloud-to-ground strikes). Oklahoma has one of the highest average lightning densities in the United States. Ponca City, like most of Northcentral Oklahoma, has higher-than-average lightning strike densities compared to the rest of the state. The National Lightning Detection Network estimates that Ponca City experiences 6-8 flashes per square kilometer annually, based on 2019 data (see Figure 1-23 below).

Figure 4-23 Ponca City Lightning Detection Network Lightning Density



The Vaisala 2020 Lightning Report similarly indicated that Kay County experienced between 5 – 8 cloud-to-ground strikes per square kilometer per year.⁸¹ This averages to about 158 - 252 cloud-to-ground lightning strikes per year.⁸² Based on information provided in the extent section, the planning area can expect to experience 158 - 252 cloud-to-ground lightning flashes per year, or 790 – 1,260 flashes since the previous plan was approved.⁸³

4.10.4 Previous Occurrences

The planning area experiences Lightning annually. Based off research of the National Lightning Detection Network Flash Density per county, the planning area experiences 6-8 flashes per square kilometer annually. The NCEI Storm Events Database reported no damaging lightning events between January 2010 – June 2021. The 2017 Plan did not report any lightning events either, during its period of assessment. News reports and local officials did not note any lightning damages.⁸⁴

The low number of reported incidents does not necessarily imply a low incidence of lightning, however. In fact, probability of lightning strikes across the planning area is highly likely. This determination was based on location, which is uniform, and previous occurrences across the planning area. The planning area should expect future lightning events to fall in line with The National Lightning Detection Network (NLDN) data from previous years, with a high probability of lightning occurring on an annual basis. The NLDN estimates that Ponca City experiences about 286-381 flashes annually, based on 2019 data.⁸⁵

4.10.5 Probability of Future Events

Based on the extent section, it is **highly likely** that Ponca City and Ponca City School District will have a lightning occurrence on an annual basis. There is a 90 to 100 percent probability of occurrence in the next year or a recurrence interval of less than 1 year.

4.10.6 Vulnerability and Risk Assessment

A severe drought even has a **medium** overall significance in the planning area, based on the criteria in Table 4-2.

People

All people in the planning area are at risk to lightning. Lightning strikes on individuals can cause serious injuries or death, although this is rare. Fatalities and injuries can be caused directly (being struck by lightning) or indirectly (through a conductor). Common conductors for indirect lightning strikes can include tree, pole, or other tall object, along with household conductors that include electrical or metallic components. Lightning could also cause an explosion, which may lead to secondary hazard effects that can include hazardous materials releases (see hazardous materials section for more information on the potential effects of hazardous materials).

The planning area's recreational areas also can be dangerous during lightning events, especially at Ponca Lake, the City's golf courses, and nearby Kaw Lake. People who do not have access to lightning warnings are at higher

⁸¹ <https://www.vaisala.com/sites/default/files/documents/WEA-MET-Annual-Lightning-Report-2020-B212260EN-A.pdf>

⁸² Ponca City includes an area of about 31.5 Kilometers. The number 5 was assumed to be the lower bound and the number 8 was assumed to be the upper bound.

⁸³ Planning area is approximately 31.5km.

⁸⁴ For an example of a news report, see: https://www.enidnews.com/sports/plainsmen-game-pushed-back-after-lightning-delay/article_62eeb4ee-0d1f-11ec-9306-0f82a46662a6.html. This being said, the planning area reported two events in 2001 and 2002 that totaled approximately 65,000 in damages and causing two injuries. On May, 2001, two 911 dispatchers and a civilian were struck by lightning causing severe injuries. According to NCEI, a house was also struck by lightning and caused \$25,000 in property damages. On June 12, 2002, lightning struck the Conoco Refinery causing a dangerous fire and reported damages totaled to \$50,000.

⁸⁵ The NLDN report suggests that Ponca City's region experiences 6-8 flashes per square kilometer. Ponca City is 47.6 square kilometers. Thus $47.6 * (6 \leq 8) = 286 \leq 381$ (rounded).

risk of being exposed to lightning. Lightning can also spark fires, especially during periods of high heat and low humidity (for vulnerabilities to fire, see the fire section). The planning team could not identify public health impacts for lightning other than the potential effects of mass casualties caused a direct and indirect lightning strikes.

Education and Outreach

Officials noted the lack of consistent outreach and education on a lightning event for developers, builders, realtors, and residents. This can include best practices how to shelter from lightning while outdoors and indoors, as lightning can be conducted indoors through commonly used appliances.⁸⁶ People also should receive education on the importance of lightning mitigation measures, such as lightning rods or surge protection. The City does not have lightning detection systems in place nor a communication strategy with the public. To this end, Ponca City would benefit from an emergency mobile application, which could assist outreach and education efforts during response scenarios and blue skies.

Economy

Economic impacts from lightning are primarily related to loss of power and business interruption. The amount of impact on the economy depends on the length of time until service restoration (see built environment section for more information).

Built Environment

Existing Structures

All structures in Ponca City are at risk to lightning. Older buildings and densely concentrated businesses and residences that were built prior to the City's adoption of 2015 codes (or more current codes) can be more vulnerable to lightning strikes. These buildings often have fewer protective measures to mitigate against the effects of a lightning strike or the secondary effects of a lightning strike (such as a fire). In addition, structures without lightning mitigation measures, such as lightning rods or enhanced surge protection, may be more at risk.

Infrastructure

The planning team did not identify any gas or transportation infrastructure as being particularly vulnerable to lightning.

Electric: Electrical infrastructure is likely the most infrastructure segment that is vulnerable to lightning. A lightning event could damage electrical generation or transmission (including substations), reducing or cutting off power to critical facilities and other buildings. This would affect business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activity. Although all public buildings have backup generation, many private residential and commercial buildings do not, making them more vulnerable to a power outage and the secondary effects of an outage. It is important to note that many of the basic needs listed could be disrupted with a power outage to residential structures.

Water/Wastewater: Water and wastewater plants have been disabled or damaged by lightning throughout the region (due to electrical issues outlined above). A prolonged water or wastewater outage could lead to a crisis of a lack of drinking water or significant sanitation issues with wastewater. Plant operators should ensure that they have the redundancies to continue to deliver water or treat wastewater (see critical facilities section for some examples) and a way to communicate with their customers in the event of a disabling lightning strike.

Critical Facilities

All critical facilities are at risk to lightning, especially to a power surge or power outage resulting from lightning. For this reason, power generation and distribution networks are important especially important. Critical facilities

⁸⁶ <https://www.cdc.gov/disasters/lightning/safetytips.html>

with high a quantity or quality of electronics are similarly vulnerable since a power outage or surge led to the disabling of key electronic functions and destruction of expensive electronic equipment.

Ponca City should equip all critical facilities with lightning mitigation measures, such as lightning rods and surge protection. Although these measures are helpful mitigation measures, they will not eliminate the threat of lightning. City officials noted that that public buildings lack lightning detection systems and mitigation solutions, such as lightning rods and surge protection for electronic equipment. Lack of mitigation and detection puts these facilities at risks outlined in the general vulnerability sections.

Buildings owned by the City and the School District have developed redundancies, such as backup generation to continue to deliver services in the event of a prolonged power outage due to lightning. Officials should ensure that backup generation is not linked to the grid and that it is maintained and tested.

Cultural Resources

Some of the historic buildings are composed of more flammable materials than more modern buildings, which heightens the risk of a fire resulting from a lightning strike.

Future Development

All future development is at risk to lightning. Ponca City should adopt the latest building and residential codes of enforcement and assign personnel to ensure that public and private buildings meet or exceed current nationally recognized and legal standards. As of this writing, Ponca City has committed to adopting the 2018 building codes. All buildings would also benefit from the installation of lightning mitigation measures, such as lightning rods and enhance surge protection. The National Fire Protection Association document NFPA 780, *Standard for the Installation of Lightning Protection Systems*, for instance, describes lightning protection system installation requirements. NFPA 780.⁸⁷

Ponca City School District

Local officials reported that Ponca City schools lack lightning detection systems and mitigation solutions, such as lightning rods and surge protection for electronic equipment. Lack of mitigation and detection puts these facilities at risks outlined in the general vulnerability sections.

Lightning can cause structural damage (residential and commercial) within the school district area, outside the City limits, which could disrupt critical services in similar ways as outlined above for the City of Ponca City (see above sections on the built environment). These effects could cause students to be unable to attend school or extracurricular activities and may place other burdens on families with school-age children.

Natural Environment

Lightning that strikes water could kill aquatic life and damage the ecosystem in ponds, lakes, and rivers. Lightning strikes can damage trees and other vegetation directly. Fires sparked by lightning also can damage vegetation, flora, and crops, along with contributing to air pollution, depending on the size and duration of the fire.

⁸⁷ NFPA <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards?mode=code&code=780>

4.11 Drought

4.11.1 Hazard Description

A **drought** is a period of unusually persistent dry weather that persists long enough to cause deficiencies in the water supply (surface or underground). Droughts are slow-onset hazards that can severely affect crops, municipal water supplies, recreational resources, and wildlife. If drought conditions persist over many months or years, the direct and indirect economic impacts can be devastating. High temperatures, high winds, and low humidity can worsen drought conditions and make areas more susceptible to wildfire. In addition, human actions and demands for water resources can accelerate drought-related impacts. As discussed in the introduction section, expansive soils were considered as a secondary hazard as a result of drought and was thereby being discussed in this hazard section.

4.11.2 Location

The location of droughts is uniform across the planning area, as drought usually affects an area larger than the planning area.

4.11.3 Extent

The extent of droughts was calculated by determining a drought's severity, using the Palmer Drought Severity Index (PDSI), and its duration. The extent of droughts in Northcentral Oklahoma (including the planning area) was not often expected to be severe or extreme. The PDSI depicts prolonged (months, years) abnormal dryness or wetness. Based on historical averages of the Palmer Drought Index, the drought conditions in central Oklahoma normally range from -2.9 to +2.9.⁸⁸ This being said, droughts in the planning area can range from "near normal" to "extreme" on the PDSI index.

Table 4-31 Palmer Drought Index

Palmer Drought Index			
		-4.0 or less	Extreme Drought
		-3.0 to -3.9	Severe Drought
		-2.0 to -2.9	Moderate Drought
		-1.9 to 1.9	Near Normal
		+2.0 to +2.9	Unusual Moist Spell
		+3.0 to +3.9	Very Moist Spell
		+4.0 and above	Extremely Moist
		Missing/incomplete	--

Although Ponca City has experienced drought, the extent of the drought tends to be less severe than the rest of the state. According to PDSI, only the July 2012 – August 2013 event reached a severe level. All other droughts reached a moderate level, or even barely reached the moderate level.⁸⁹

⁸⁸ <https://www.drought.gov/drought/data-maps-tools/current-conditions> <https://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/>

⁸⁹ <https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/pdi/201001-202012> Planning team analysis

4.11.4 Previous Occurrences

Ponca City experiences drought frequently. Of the 137 months from the beginning of January 2010 to the beginning of June 2021, the planning area has experienced 47 months of drought, according to NCEI data. Based on this average, the planning area had approximately a 34% of experiencing drought every month. Every full year examined experienced at least one month of drought except for 2019. It is interesting to note that droughts have decreased in frequency and duration over the last several years (also seen in PDSI), although more information is needed to determine a trend. No damages or injuries were reported by NCEI or local officials due to drought during this time period.

Table 4-12 Historic Drought Events

Date	Event Narrative
July 2011 – March 2012	This 8-month drought impacted much of Oklahoma at differing levels of severity. Scattered showers throughout the area provided intermittent local relief during the drought.
July 2012 – August 2013	The summer of 2012 lacked the necessary amount of rainfall for Oklahoma and by the end of June, persistent hot and dry conditions had become established across the region. Most east central Oklahoma had only received 10 to 50% of normal rainfall for the month, which persisted throughout December. This resulted in severe drought conditions (Palmer index) the planning area in the fall of 2012 and through the early winter of 2013.
March 2014 – May 2015	Although this period of drought lasted for 14 months, it was much less extreme than the previous event, as conditions only reached moderate conditions (Palmer Index). Some precipitation lessened drought conditions throughout the planning area.
January 2017 – April 2017	An abnormal dry December combined with several months of below-average precipitation to create drought conditions in the planning area. The region barely experienced moderate drought conditions (Palmer Index) until spring precipitation ended the drought.
January 2018 – September 2018	A dry December brought the planning area into moderate drought conditions (Palmer Index) for several months. The drought ceased at the end of the summer when some precipitation lessened drought conditions for the planning area.
July 2020	Abnormally dry conditions were alleviated by rainfall at the end of the month.

4.11.5 Probability of Future Events

Based on drought occurrences over the past 10 years, it is **highly likely** that the planning area will experience the effects of a moderate drought cycle annually.

4.11.6 Vulnerability and Risk Assessment

A severe drought even has a **low** overall significance and minimal impact on the planning area, based on the criteria in Table 4-2. In addition to direct effects of a drought, the secondary effects of a drought event can affect the planning area; namely, expansive soils and increased fire activity (for vulnerability to fire, see fire hazard section).

People

All residents in Ponca City are at risk to drought. Drought rarely impacts people's health directly. The most significant vulnerability from a drought is a lack of access to drinking water. Ponca City's primary municipal drinking water is drawn from Lake Ponca and serves citizens throughout Ponca City and Ponca City School District. There are 5 wells within the boundaries of Ponca City and 3 wells just outside the boundary as secondary water supply. A water treatment plant located south along the Arkansas River also serves residents in the City.

At the time of this plan update, the water supply is adequate to meet the current needs in Ponca City. Officials expressed some concern that extreme drought conditions could lead to reductions in potable water. To increase resiliency, Ponca City is considering adding a water supply line to Kaw Lake and has secured right-of-way needed to complete the project. Drought also could negatively affect rural communities surrounding Ponca City. During periods of drought, Ponca City sees has seen an influx in the request for meals at shelters.

Drought conditions can cause prices for food to increase because of a drop-in supply for people living in Ponca City. If people are not able to afford increasing prices during drought conditions, it is possible for them to suffer health problems because of the lack of healthy food. This is especially true in areas identified as having a high vulnerability in Ponca City based on their socio-economic status.

Public Health and Safety

Drought poses several far-reaching health implications, of which long-term public health problems to be considered are a shortage of drinking water (see above), degraded clean water, and degraded air quality.

A reduction in water volume can stagnate water. Stagnant water can degrade the quality of clean water by increasing likelihood of infectious disease. This is particularly the case for people who draw from private wells. Farmers may be more likely to use water with diseases to water or wash crops, increasing the risk to food-borne illness.

The dusty and dry conditions from drought, along with an uptick in drought-induced wildfires, can degrade air quality. Drought conditions can increase the number of particulates in the air, which can irritate people with lung, nasal, or eye problems, especially those with preexisting conditions. Similarly, toxic blooms from stagnant waters (e.g. cyanobacteria) can cause decreases in air quality.

Education and Outreach

Officials noted the lack of consistent education and outreach related to drought for developers, builders, realtors, and residents. This can include best practices on water conservation, along with other building materials. Education and outreach could be enhanced by the development of an electronic mobile application to assist with disseminating educational materials.

Economy

A drought would negatively affect Ponca City, due to the importance of agriculture for the City and the surrounding areas. In addition to a decrease in available water supply, drought also affects agricultural communities surrounding the City, which can increase wind erosion, insect infestations, and crop diseases.

The Oklahoma Drought Management Plan outlines several additional economic impacts that could apply to Ponca City during a drought:

- Increases in consumer prices for food
- Reduction in tourism and recreational activities. The lakes and golf courses were noted as being particularly impactful
- Increases in unemployment
- Reduction tax revenues due to reduced expenditures. The lakes and golf courses were noted as being particularly impactful
- Foreclosures on bank loans to farmers and businesses⁹⁰

To avoid some of these affects, Ponca City should develop water conservation plans and programs, including rate structures and implementation.

⁹⁰ https://www.owrb.ok.gov/supply/drought/reports/drought_plan.pdf, 6

Built Environment

Existing Structures

The secondary effects of a drought event can affect the built environment; namely, expansive soils and increased fire activity (for vulnerability to fire, see fire hazard section). All structures in Ponca City are at risk to these hazards. Expansive soils, for example, can damage foundations and walls of all existing structures, especially structures with poor masonry and foundations.

Infrastructure

The planning team did not identify specific vulnerabilities to Ponca City's electric infrastructure from a drought.

Gas Lines: City gas lines could leak or break due to expansive soils. This could cause toxic soil seepage into the ground or groundwater, which could affect the environment or human health. This may also cause a disruption in gas services to homes, which would make people more vulnerable to temperature fluctuations, especially during extreme heat or extreme cold events (see extreme heat or severe winter storm sections for more information).

Water/Wastewater: Water lines and structures in Ponca City are vulnerable to damages from expansive soils. Depending on damage levels, water and wastewater plants may not meet daily intake levels due to water shortages. This could cause a water crisis for certain populations, if redundancies to supply drinking water are not established. In addition to water and wastewater infrastructure, the City expressed concern that a drought would cause wells to run dry. Extreme drought could place additional strain on the City's other water sources. Ponca City should ensure that it has developed enough redundancies to meet all its residents' water needs. Ponca City has a water line to Lake Ponca, which can allow it to meet water needs during an extreme reduction in water supply from other sources. Ponca City is also considering adding additional redundancies (see future development section).

Transportation: Roadways and streets in the City could be weakened or damaged due to expansive soils. This may disrupt traffic, including emergency services, or may weaken transportation infrastructure, making it more vulnerable to other hazards. The planning team did not identify any roadways that are uniquely at risk to this hazard, however. The planning team recommends that the City continue consistent maintenance on roadways and that City officials incorporate design standards that account for higher heat fluctuations.

Critical Facilities

Critical facilities in the City of Ponca City have no specific vulnerability to severe drought outside from expansive soils. Nonetheless, significant damage to a critical facility from expansive soils could disrupt Ponca City's ability to respond to a disaster or provide key services including electricity, gas, water/wastewater, and internet. The likelihood of this occurrence, however, is extremely low. Damage from expansive soils more likely would weaken the structural integrity of a critical facility, exposing it to increased risk to other hazards, especially tornado and high winds and earthquake events. All FEMA lifelines are at risk to drought, especially the food, water, and shelter lifeline.

Cultural Resources

The primary threat to historic properties and cultural resources such as structures and cemeteries within Ponca City are from shrinkage of expansive soils and wind erosion, in the case of cemeteries. Destruction to cultural resources would constitute a loss of property and, possibly, irreplaceable historic value.

Future Development

The City should continue with building inspections to make sure that buildings are up to at least the 2018 international codes, which the City plans to adopt as of this writing. This may decrease the vulnerability to expansive soils for the buildings that are evaluated based on these higher building standards.

To reduce the vulnerability to water loss, Ponca City is considering constructing a water line to Kaw Lake. As of this writing, Ponca City has secured the right of way to the lake. A project of this magnitude is expected to take years to complete, if the City decides to pursue it.

Ponca City School District

Although Ponca City School District has not faced widespread water restrictions or school closures in recent years, it remains vulnerable to the impacts of drought. The main vulnerability of Ponca City PS to Drought is the lack of a Drought Management plan with response triggers during episodes of Drought, communication guidelines, and pre-ordained actions based on threat levels (codified in triggers). The impact of this vulnerability is the inability for school administration staff to properly manage water consumption during periods of Drought. Having a Drought Management plan would improve communication and response to drought, and the school district should codify and formally adopt a drought management plan with triggers, communication guidelines, and execute pre-ordained actions based on threat levels (codified in triggers).

In addition, school facilities face the same risks from expansive soils as critical facilities. No vulnerability unique to the school structures was identified. Nonetheless, expansive can cause structural damage (residential and commercial) within the school district area, outside the City limits, which could disrupt critical services in similar ways as outlined above for the City of Ponca City (see above sections on the built environment). These effects, along with transportation disruptions could cause students to be unable to attend school or extracurricular activities and may place other burdens on families with school-age children.

Natural Environment

Drought has many negative effects on the natural environment. The general effects of drought on the natural environment are similar to extreme heat, although there may be increased vulnerabilities from the lack of water, such as soil erosion. Drought can lead to crop loss and can stress flora and fauna. Drought conditions could cause animals to leave their natural habitats to search for cooler places or places with more water. Aquatic life are especially at risk. Of particular concern is the Ponca Lake, which relies on water from the Lake to sustain local habitats.

4.12 Earthquake

4.12.1 Hazard Description

An **earthquake** is a sudden release of energy that generates a seismic shift in the earth's crust. This section is not concerned with seismic tremors that do not cause any damage and are not a threat to human or natural life, which Federal agencies define as below a 3.0 Magnitude on Richter Scale (see extent section). Only seismic movements that exceed 3.0 on the Richter scale will be defined as earthquakes. Most severe earthquakes take place at tectonic fault lines. They can also occur along any of the multitudes of fault and fracture lines within the plates themselves.

4.12.2 Location

Given an earthquake's possible geographic reach, the risk of this hazard is uniform over the entire planning area.

4.12.3 Extent

It is probable that an earthquake would impact the entire planning area. In fact, an earthquake with an epicenter in an entirely different County or state also could affect the entire planning area.

Table 4-32 Richter Scale

Class	Magnitude
Great	8+
Major	7-7.9
Strong	6-6.9
Moderate	5-5.9
Light	4-4.9
Minor	3-3.9

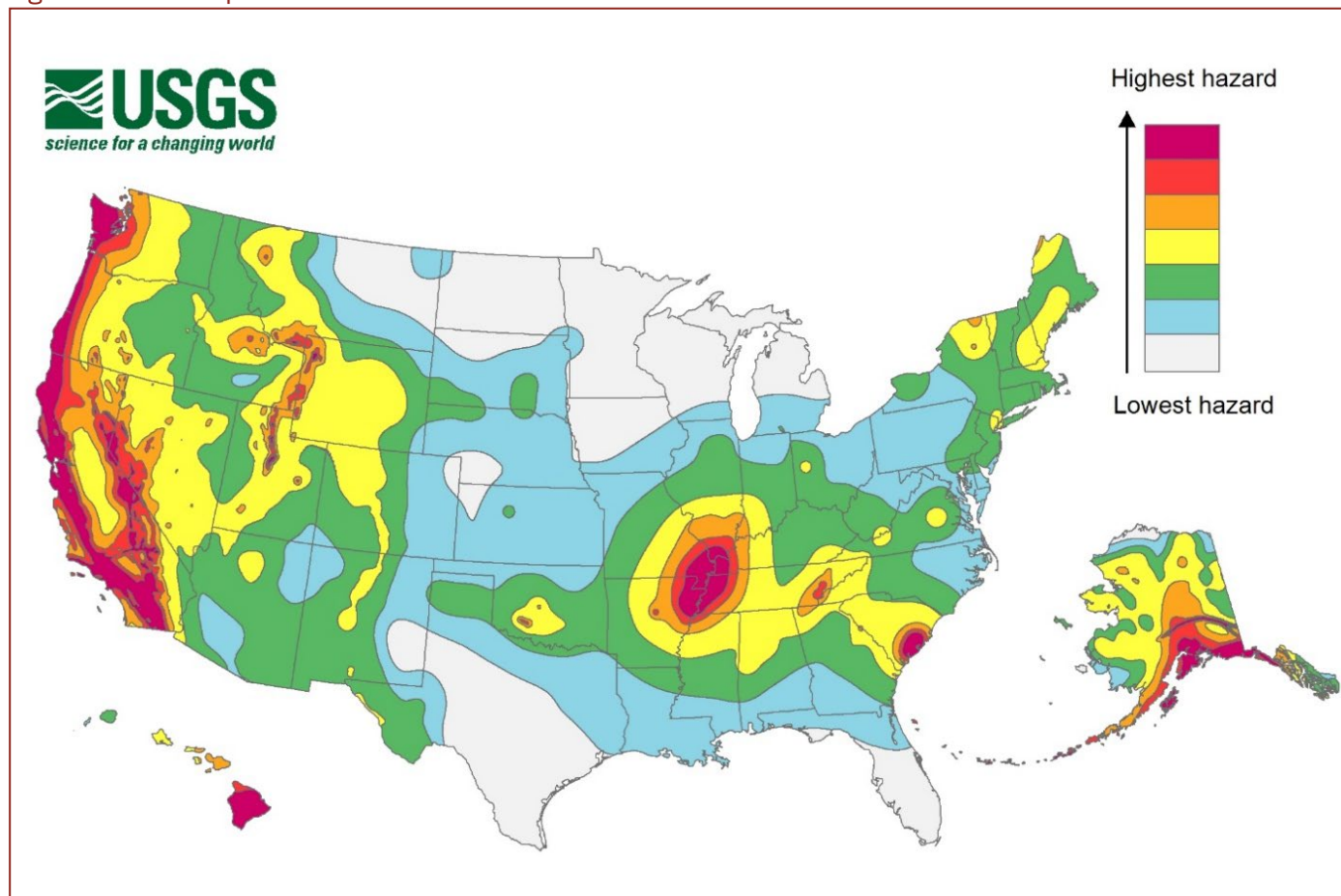
Two standard measures are used to classify an earthquake's extent: magnitude and intensity. In the past, these measures were sometimes referred to as the Richter Scale (magnitude) and the Modified Mercalli (intensity). As more seismograph stations were installed around the world, it became apparent that the method developed by Richter was strictly valid only for certain frequency and distance ranges. Because of the limitations of all three magnitude a new, more uniformly applicable extension of the magnitude scale, known as moment magnitude, was developed. For very large

earthquakes, moment magnitude gives the most reliable estimate of earthquake size. Earthquakes are classified in categories ranging from minor to great, depending on their magnitude.

From these and other measures, USGS has charted the probability of peak ground accelerations that have only a 2% probability of being exceeded in 50 years. The map below reflects the upper limits of earthquake severity compared to the rest of the county. According to USGS, Ponca City and Ponca City Public Schools are at a moderate risk for earthquakes compared to the rest of Oklahoma and lower risk compared to the other areas in the United States.⁹¹

⁹¹ <https://www.usgs.gov/media/images/2018-long-term-national-seismic-hazard-map>

Figure 4-24 Earthquake Hazards



4.12.4 Previous Occurrences

Earthquakes are often not felt until they reach a magnitude of 3.0 on the Richter Scale. For this reason, OGS data was queried for earthquakes of 3.0 and higher in Kay County from January 2010 – June 2021, which identified 25 discrete events during this period. Despite the frequency of these events, the highest recorded event reached a 3.5 magnitude, and no damages or injuries were reported in the planning area. Some of the more impactful events, in terms of magnitude, are recorded below. As evidenced in the table below, most of the significant seismic events over the last decade have occurred in several miles northwest of Ponca City.

Table 4-33 Historic Earthquake Events

Date	Event Narrative
July 27, 2013	A 3.3 magnitude earthquake was recorded in the about 7 miles southwest of Ponca City.
April 13, 2016	A 3.5 magnitude earthquake was recorded in the northwest corner of Kay County, about 10 miles northwest of Ponca City.
November 17, 2017	A 3.3 magnitude earthquake was recorded in the northwest corner of Kay County, about 12 miles northwest of Ponca City.
June 22, 2020	A 3.5 magnitude earthquake was recorded in the northwest corner of Kay County, about 12 miles northwest of Ponca City.
July 15, 2020	A 3.5 magnitude earthquake was recorded in the northwest corner of Kay County, about 18 miles northwest of Ponca City.

Date	Event Narrative
October 23, 2020	A 3.3 magnitude earthquake was recorded in the northwest corner of Kay County, about 15 miles northwest of Ponca City.

4.12.5 Probability of Future Events

Based on previous occurrences, it is **highly likely** the planning area, or the area immediately surrounding the planning area, will experience an earthquake event with a magnitude of 3.0 or greater.

4.12.6 Vulnerability and Risk Assessment

The hazard has a minimal impact on the planning area and has a **low** overall significance based on classifications in Table 4-2.

People

A severe earthquake, although unlikely, would threaten people across the entire planning area. Although these events are rare, earthquakes could be dangerous. Most earthquake injuries and fatalities occur within buildings from structural collapse and its associated affects, such as glass and the movement of other objects. Contents in a home can be equally, if not more, dangerous than the structure itself. Any unsecured objects that can move, break, or fall during an earthquake event are potential safety hazards and can cause potential property losses. All residents in the City should receive education on best practices to take during an earthquake event. Populations considered most vulnerable are people located in structures with unreinforced or weakened masonry construction (see built environment).

Public Health and Safety

All people in Ponca City can be affected by degradation in air quality and or the accidental release of hazardous materials due to an earthquake event (see the built environment for additional commentary on its effects). Populations at heightened risk of inhalation would be young people and the elderly, given their psychological vulnerability, lower-income people, and people with pre-existing respiratory conditions. The planning area has about 7% residents who are young (under 5), which is the county and state average, and 18% residents over 65, which is slightly above the state average. Lower income people are also at risk, as they may live in housing that is less ventilated and as they may not be able to afford personal respiratory protection. Nearly 18% of Ponca City residents live below the poverty line, which is higher than the state average. In addition, people with pre-existing respiratory conditions would also be at risk (the planning team was not able to collect data on this indicator). Although these vulnerable populations are spread throughout the planning area, many are concentrated in the southwest of the planning area.

Education and Outreach

Ponca City and its citizens would benefit from consistent Earthquake drill scenarios to mitigate reduce confusion and to serve as an estimate of potential losses related to loss/injuries, types of potential damage, and to confirm existing roles and priorities.

Ponca City and Ponca City School District should plan for many traditional communication channels to be inoperable for some time. Clear, concise, unified messages provided by trusted leaders before, during, and after an incident can help residents be better informed to take protective action measures and make important health-related decisions to help ensure their safety. Messages should be accessible in multiple formats.

During and after earthquakes, families and friends could be separated. Reuniting them should be a priority for healthcare facilities, health officials, and emergency managers by establishing a coordinated approach for accessing search and rescue data. This should include social media, community hotlines and assistance centers, shelter rosters, and healthcare facility information, which can be improved by the development on a mobile electronic emergency management application.

Economy

Earthquakes could affect the economy in the planning area. Small business owners should make their businesses safer to be in during earthquakes and more resistant to earthquake damage by assessing its structure and contents and correcting any weaknesses, as structural damage could limit or eliminate business activity (see the build environment for more information).

Built Environment

Existing Structures

All buildings in Ponca City are vulnerable to earthquakes. Depending on when and how it was designed and built, a structure may have weaknesses that make it more vulnerable to earthquakes. Common examples include structures that are not anchored to foundations, or unreinforced/unbraced masonry walls or foundations. In addition, structures with a higher potential for structural weaknesses, such as mobile or prefabricated homes, may wish to be examined. Given the City's BCEGS rating, however, the likelihood of many buildings with unreinforced masonry is low (see Chapter 3 for more information).

Infrastructure

It is not likely Ponca City's infrastructure will be impacted by an earthquake, as the City is in an area of low seismicity. This being said, an earthquake with high magnitude could disrupt vital infrastructure services, which are explained below.

Electric: An extreme earthquake could damage electrical generation or transmission (including substations) anywhere in Ponca City, reducing or cutting off power to critical facilities and other buildings. This would affect business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activity. All critical facilities should ensure that their backup generation is up-to-date and secured as best as possible from the effects of an earthquake event. Many private residences and businesses lack adequate backup generation, making them vulnerable to these effects.

Gas: An extreme event could cause major gas leaks or leaks in other hazardous materials in the City. Leaks from hazardous material in storage facilities can affect human health and the environment, or it could increase the risk of fires (see the fire section). Depending on rainfall or other conditions, this can occur miles from the initial earthquake zone.

Water/Sewer: An extreme event could damage lines or the facility itself, causing a disruption in services. This could cause a water crisis for certain populations, if redundancies to supply drinking water are not established. The City should ensure that its system has sufficient redundancies, including producing or procuring alternative forms of water delivery, such as water buffaloes.

Transportation: In the event of an extreme earthquake, roads across Ponca City may be damaged or destroyed, which could delay emergency response times or disrupt evacuation routes, further straining public health systems and threatening personal health.

Critical Facilities

Critical facilities face the same potential impacts to earthquakes as other structures/buildings in Ponca City. Of particular concern are critical facilities, such as hospitals and transportation facilities, oil and gas pipelines, electrical power and communication facilities, and water supply and sewage treatment facilities and lines. Although all public buildings have backup generation, damage to emergency response facilities, including EMR, police, and fire would hinder the City's response efforts.

Cultural Resources

Earthquakes could cause minor structural damages to historic structures. A more significant concern is the contents of structures, such as museum collections and cultural items with historic and story-telling value.

Future Development

Ponca City adopted the ICC International Building Code, 2015, and the ICC International Residential Code for One and Two-Family Dwellings, 2015 Edition. As of this writing, Ponca City is considering reinforcing their critical facilities to meet current 2018 standards. All future development going forward should enforce all 2018 ICC codes going forward to better mitigate from earthquake damage.

Ponca City School District

No critical facility or cultural resource, including school buildings, reported any specific vulnerability to earthquake other than general structural vulnerabilities. Nonetheless, schools should ensure that all buildings are protected against earthquake events as much possible. Ponca City Schools could serve as temporary shelters for students and are equipped with backup generation to minimize vulnerability due to power outages.

In addition, earthquakes can cause structural damage (residential and commercial) within the school district area, outside the City limits, which could disrupt critical services in similar ways as outlined above for the City of Ponca City (see above sections on the built environment). This includes the impact of secondary air quality issues listed in the Public Health section. These effects, along with transportation disruptions could cause students to be unable to attend school or extracurricular activities and may place other burdens on families with school-age children.

Natural Environment

Earthquakes can cause land subsidence, either directly related to an earthquake or as the result of shaking.

4.13 Hazards: Summary of Observations and Recommendations

This section outlines an overview of observations and recommendations from the risk assessment. It is intended to provide the reader with a summary of vulnerabilities across hazards and recommendations to mitigate against these vulnerabilities. This approach aligns with an assets-based approach to hazard mitigation (see Chapter 1), since actions are described in light of their impact to mitigating a class of hazards, rather than by hazard. In order to maintain this section as an overview, this section does not seek to provide hazard-specific details of the observations. For example, flooding can cause a much different failure to transportation infrastructure, than extreme heat. This level of analysis is provided in the hazard profiles themselves—mainly in the vulnerability sections.

Observation	Recommendation	Hazards	Action(s)
People in the planning area would benefit from addition outreach and education all hazards (see individual vulnerability sections and Chapter 3 for more information).	Develop and fund hazard preparedness, education, information, and awareness programs.	All	1
Residents would benefit from a warning system that integrates data across hazards (see people sections in the hazard profiles for more information).	Develop automated hazard warning systems—especially for flooding—which integrate existing weather stations, storm sirens, and reverse 911 system. Develop or purchase a voluntary emergency management app to send notifications about various hazards throughout the planning area.	All	4, 13
The current Emergency Operations Center (EOC)’s location makes the center prone to flooding following heavy rainfall events.	Move the EOC out of flood-prone basement and into new Police station building.	Flooding	5
Some of Ponca City’s public facilities and schools lack a safe room, exposing staff and students to higher risk from tornadoes and high winds.	Evaluate and install employee shelters/safe rooms at public critical facilities and schools that do not already have one.	Tornado/ High Wind	8
Hazard events have damaged and/or can damage government and other critical facilities. Infrastructure throughout the planning area, including roads, water delivery systems, and other infrastructure are also vulnerable (see hazard sections for specific effects).	When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies.	All	11

Observation	Recommendation	Hazards	Action(s)
School staff, students, and other personnel, along with school structures, can be affected by all identified hazards on school grounds and at school-sanctioned events. In addition, bus routes can be affected by flooding events.	Complete hazard studies of schools and retrofit or remodel buildings to make them more disaster resistant (schools).	All	14
Cultural resources and some critical facilities (see flooding and dams section for specifics), especially the water and wastewater treatment plant are vulnerable to flood or a dam breach event.	Study ways to mitigate at-risk critical facilities and cultural resources from flooding and dam incidents and implement findings from the study.	Flooding and Dam Incidents	15
Power outages caused by hazard events (see vulnerabilities sections in the hazard profiles, especially critical facilities and electrical) can effect people, the economy, critical facilities, and school districts in Ponca City.	Study ways to mitigate power infrastructure from power failure due to hazard events and implement findings from the study. Maintain tree trimming services (severe winter storm and tornado/ high wind especially). Install backup generators on all critical facilities and conduct routine testing to ensure that current backup generators are adequate.	All	16, 30, 32
Local officials noted two areas of increased location (and extent) of fire hazard near Lake Ponca and in the Southwestern border of the City. In addition, several school district facilities lie within or just outside the Wildland-Urban Interface.	Provide and maintain defensible space around structures vulnerable to wildfires, especially around Lake Ponca and in grasslands in the southwestern part of the City.	Fire	20
Electrical infrastructure can be damaged during Severe Winter Storm, Tornado/ High Wind, Fire, Lightning, Hail, Earthquake events, cutting power to the planning area.	Harden, strengthen, or bury electrical infrastructure when cost-effective.	Severe Winter Storm, Tornado/ High Wind, Fire, Lightning, Hail, Earthquake	21
Roadways in the planning have been damaged by hazard events or could be damaged by hazard events (see hazard profiles), increasing their vulnerability during future events.	Improve the quality and design of roadways that have been damaged by repeated hazard events to mitigate against the effects of future events, when applicable.	Flooding, Severe Winter Storm, Dam Incident, Drought, Earthquake	22
Gas infrastructure in the planning have been damaged by hazard events or could be damaged by	Improve the quality and design of gas infrastructure that has been damaged by repeated hazard	Severe Winter Storm, Dam Incident,	23

Observation	Recommendation	Hazards	Action(s)
hazard events (see hazard profiles), increasing their vulnerability during future events.	events to mitigate against the effects of future events, when applicable.	Hazardous Materials, Extreme Heat, Drought, Earthquake	
All people in the planning area are vulnerable to a lack of water from extreme drought situations.	Develop water conservation plans and programs, including rate structures and implementation. Construct a waterline to Kaw lake.	Drought	24, 35
Safe Rooms can prevent loss of life from tornado and high wind events.	Evaluate and install shelters/safe rooms that meet ICC 500 and FEMA 361 requirements at public critical facilities and schools that do not have shelters that meet ICC 500 and FEMA 361 requirements.	Tornado/ High Wind	26
Residential, commercial, and public structures would be better protected from high wind, hail, earthquakes by adopting Institute for Business and Home Safety (IBHS) standards.	Encourage residents and businesses to build to IBHS fortified standards and offer IBHS trainings for builders, architects, developers, engineers, and other interested parties.	Tornado/ High Wind, Hail, Earthquake	28
Residential and commercial properties have been subjected to flooding, sometimes over the course of multiple flooding events	Acquire properties in the FEMA Floodplain and in Repetitive Loss/Severe Repetitive Loss properties	Flooding	31
Development may lead to increased stream use or development in floodplains, which may threaten the natural environment. In addition, pollutants and biohazards like e-coli can threaten the health of streams throughout the planning area.	Incorporate nature-based solutions into mitigation projects, when appropriate.	Flooding and Dam Incidents	33
Critical facilities and schools lack lightning mitigation measures and lightning detection systems.	Construct lightning rods or air terminals for protection of critical facilities and schools.	Lightning	36

Chapter 5 Mitigation Strategy

This chapter includes the hazard mitigation strategy, created by the planning team, officials, and stakeholders in Ponca City and Ponca City School Districts. The mitigation strategy is made up of three components: mitigation goals, mitigation actions, and a plan for implementation. There is some overlap across these three components, but each generally represents a different aspect of the strategy. The goals section addresses the *why*, the actions section addresses the *what*, and the implementation section addresses the *how*. The comprehensive mitigation strategy, which is the final section in this chapter, builds on elements of all three components. This strategy will enable the planning area to best identify, prioritize, and implement actions to reduce risks across its planning area. For an itemized list of mitigation actions in the strategy, see Section 5.4 of this chapter.

5.1 Mitigation Goals

Goals from the 2017 Ponca City Hazard Mitigation Plan were reviewed and evaluated by the core planning group and the stakeholder working group based on both progress and actions taken in the plan maintenance period, and on development or review of other pertinent plans. Goals that were deemed to be effective and pertinent to the current plan were retained and incorporated into the 2022 Plan.

5.1.1 Mission Statement

To create a disaster-resistant community and improve the safety and well-being of Ponca City and Ponca City School District by reducing deaths, injuries, property damage, environmental and other losses from natural and technological hazards in a manner that advances community goals, quality of life, and results in a more livable, viable, and sustainable community.

5.1.2 Mitigation Goal

To identify community policies, actions and tools for long-term implementation in order to reduce risk and future losses stemming from natural and technological hazards that are likely to impact the community.

5.1.3 Goals for All Hazards

- Minimize loss of life and property from natural hazard events
- Protect public health and safety
- Increase public awareness of risk from natural hazards
- Reduce risk and effects of natural hazards
- Identify hazards and assess risk for local area
- Ascertain historical incidence and frequency of occurrence
- Determine increased risk from specific hazards due to location and other factors
- Improve disaster prevention
- Improve forecasting of natural hazard events
- Limit building in high-risk areas
- Improve building construction to reduce the dangers of natural hazards
- Improve government and public response to natural hazard disasters

5.2 Recommended Mitigation Activities

A mitigation action is a policy, project, activity, or process taken to reduce or eliminate long-term risk to people, property, and the environment from hazards. Based on the goals section and FEMA CRS guidance, the types of mitigation actions reviewed to reduce long-term vulnerability include:

- Preventative Activities
- Floodplain Management Regulatory/Current and Future Conditions
- Property Protection Activities
- Natural Resource Protection Activities
- Emergency Services Activities

- Structural Projects
- Public Information Activity

Specific observations and problem statements, resulting in the actions listed below, are included at the end of each hazard section in chapter 4, the Risk Assessment. Stakeholders reviewed actions to mitigate against the observations identified in the risk assessment.

This actions section is divided into two parts. A review of the 2017 mitigation actions identified in the previous plan was completed by the planning team. Previous items received one of three categories: “completed,” “ongoing,” and “not started.” Actions were evaluated with the intent of carrying over “ongoing” and “not started” actions that also remain relevant to the planning area. Actions with the same intent were combined into a general action item to allow more opportunity for FEMA funding. These actions were reviewed and prioritized in the prioritization section for the 2022 Plan update.

The second part discusses how these previous actions and newly proposed actions were prioritized. The benefits and costs of an action, which included qualitative and quantitative measures, were measured together to generate a Benefit-Cost Review (BCR). The planning team prioritized actions based on the BCR.

5.2.1 Actions from the 2017 Hazard Mitigation Plan

Of the 50 action items listed in the 2017 plan, 5 had been completed, half had not been started, and the remaining were listed as ongoing (see appendix A). Most of the actions that were not started have been in incorporated into the current list of mitigation action items.

Completed:

- Action Number 4. *Provide a NOAA Weather Radio to students and residents in the city to warn them of weather events.* This action has been completed as 1000 radios have been obtained via grant.
- Action Number 8. *Improvements to Water Treatment Plant.* Updates have been made to the water treatment plant; the electrical equipment & drives into sludge drying beds have been elevated out of floodplain.
- Action Number 16. *Debris Transport and Process.* This equipment has been acquired.
- Action Number 38. *Underground Electrical Service to Water Treatment Plant & to Back feed to Pecan Park.* This item has been completed according to City officials.

Not Started:

- Dam Incident (includes Flooding), Number 2. *Develop a 10-year Plan to Rehabilitate Lake Ponca Dam.* Ponca City has evaluated the action item and cited the \$1.4MM project last year that replaced the concrete crest of the dam—no additional work is needed.
- Dam Incident (includes Flooding), Number 5. *Retrofit critical facilities to strengthen the older facilities for hazardous events.* No progress has been made. The intent of this action was incorporated into the current list of action items.
- Dam Incident (includes Flooding), Number 7. *Install dam inundation warning devices at the dams to notify the public of potential failure or overflow.* No progress has been made. The intent of this action was incorporated into the current list of action items.
- Flooding, Number 11. *Improve wastewater treatment plant to prevent damages during hazardous events.* No progress has been made since the City feels that a separate action item—construct access road to the wastewater plant that is not subject to Arkansas River Flooding—is preferred. The intent of this action was incorporated into the current list of action items.
- Number 18. *Residential Assessment Team.* City officials determined that the intent of this action did not meet their goals for Ponca City and removed this item.

- Tornado/High Wind (includes Flooding, Hail, Severe Winter Storm), Number 20. *Remote Weather Cameras*. Local officials cited differing priorities regarding why this action was not started. The intent of this action was incorporated into the current list of action items.
- Lightning, Number 21. *Surge Protector Program*. No progress was made due to limited funding for this initiative. The intent of this action was incorporated into the current list of action items.
- Tornado/High Wind, Number 22. *Equipment and Furniture Strap Program*. No progress was made due to limited funding for this initiative. The intent of this action was incorporated into the current list of action items.
- Lightning, Number 24. *Lightning Detection Systems*. No progress was made due to limited funding for this initiative. The intent of this action was incorporated into the current list of action items.
- Tornado, Number 26. *Storm Shelter/Safe Room Database*. This action was not prioritized, although local officials see its value and wish to implement it in the future. The intent of this action was incorporated into the current list of action items.
- Severe Winter Storm, Number 27. *Blanket, Heater, and Coat Program*. This action required additional analyses to determine need and the scope of impact. The intent of this action was incorporated into the current list of action items.
- Fire, Number 28. *Become a Firewise Community*. No progress was made on this initiative, although officials would like to execute this action. This was added to the current action items list.
- Number 31. *Construct Separate Waterline from Well Field*. This action was not started due to a change in interest to develop a waterline to Kaw lake. This action has been replaced with a an action to develop a waterline to Kaw lake.
- Tornado/High Wind (Lightning, Hail) Number 34. *Two Additional Weather Stations*. Local officials recognize the importance of digital mediums of communication, which is the priority for the current action items list. The intent of this action—emergency communication about hazards—was incorporated into the current list of action items.
- Flooding, Number 35. *Elevation of Critical Facilities*. This initiative is a significant undertaking, which required more time. The intent of this action was incorporated into the current list of action items.
- Tornado/High Wind, Number 39. *1000 MCM underground electric supply lines along Harford Ave. from Highland to Hartford Ave*. Progress: No longer a priority”
- Hazardous Materials Incident, Number 41. *Tubgrinder for Solid Waste*. This action was not prioritized and, given a lack of interest from City officials, was not reconsidered in the current mitigation action items.
- Hazardous Materials Incident, Number 42. *Rolloff Trash Container with Crane Attachment for Solid Waste Division*. This action was not prioritized and, given a lack of interest from City officials, was not reconsidered in the current mitigation action items.
- Hazardous Materials Incident, Number 43. *Skid-Steer Loader with Loading Claw Attachment*. This action was not prioritized and, given a lack of interest from City officials, was not reconsidered in the current mitigation action items.
- Lightning, Number 45. *Construction to Correct Defects in Electrical Surge & Service Entrance in Public Buildings*. Other hazard initiatives related to lightning were prioritized. The intent of this action was incorporated into the current list of action items.
- Lightning, Number 46. *Inspection and Testing of Grounding System & Lightning Protection of Communication and Water Towers*. Other hazard initiatives related to lightning were prioritized. The intent of this action was incorporated into the current list of action items.
- Number 47. *Construction to correct defects in communication and water tower grounding systems and installation of lightning arrestors and electrical surge protection for lightning induced electrical surges*. Other hazard initiatives related to lightning were prioritized. The intent of this action was incorporated into the current list of action items.
- Number 48. *Construction of Facilities for street/road salt storage*. This action was not prioritized. The intent of this action was incorporated into the current list of action items.

- Number 49. *Federal Commander Digital System*. This action was not prioritized. The intent of this action was incorporated into the current list of action items.
- Number 50. *E-911 Consoles*. The City never went to an E-911 system, instead went with a different system. The intent of this action was incorporated into the current list of action items.

5.2.2 Prioritization

In addition to the previous mitigation actions, stakeholders considered a broad array of different actions to mitigate against the observations. Potential mitigation actions were evaluated using the criteria recommended on Worksheet 6.1 in the *FEMA Local Mitigation Planning Handbook* and developed, an Action Plan for the actions determined to be highly effective and feasible. A summary of criteria considered can be found in Table 5-1. Certain mitigation measures are recommended for multiple hazards. To prioritize all hazard mitigation action items, a benefit/cost review was employed. This informal analysis reflects FEMA's BCA and prioritizes projects on how they accomplish the plan's mission and their estimated cost.

Table 5-1 Evaluation Criteria

Criterion	Question
Life Safety	How effective will the action be at protecting lives and preventing injuries?
Property Protection	How significant will the action be at eliminating or reducing damage to structures and infrastructure?
Technical	Is the mitigation action technically feasible? Is it a long-term solution? Eliminate actions that, from a technical standpoint, will not meet the goals.
Political	Is there overall public support for the mitigation action? Is there the political will to support it?
Legal	Does the community have the authority to implement the action?
Environmental	What are the potential environmental impacts of the action? Will it comply with environmental regulations?
Social	Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?
Administrative	Does the community have the personnel and administrative capabilities to implement the action and maintain it or will outside help be necessary
Local Champion	Is there a strong advocate for the action or project among local departments and agencies that will support the action's implementation?
Other Community Objectives	Does the action advance other community objectives, such as capital improvements, economic development, environmental quality, or open space preservation? Does it support the policies of the comprehensive plan?

The benefits of each measure are scored as High (H), Medium (M), or Low (L) based on how well it moves the City towards the stated mission statement "To create a disaster-resistant community and improve the safety and well-being of the Ponca City by reducing deaths, injuries, property damage, environmental and other losses from natural and technological hazards in a manner that advances community goals, quality of life, and results in a

more livable, viable, and sustainable community.” The Costs are also measured as H, M, or L. Costs estimate the resources needed to implement the measure. While monetary cost is the primary resources, staffing and other resources should also be considered. The ratio of Benefits/Costs then determines whether an action item is considered High, Medium, or Low. Table 5-2 explains the process.

Table 5-2 Prioritization

Topic		Question		
Benefits	High	The project will effectively and immediately accomplish the mission statement.		
	Medium	The project may protect lives in the long term or would have an immediate impact on protecting property.		
	Low	It is difficult to quantify if the project will protect lives and/or property.		
Costs	Low	Funds, staffing, or resources exist to implement the project.		
	Medium	Existing funds or resources would have to be reallocated to implement.		
	High	Additional funds, staffing, or other resources would have to be secured.		

		Benefits		
		Low	Medium	High
Costs	High	Low/High	Med/High	High/High
	Medium	Low/Med	Med/Med	High/Med
	Low	Low/Low	Med/Low	High/Low

Measures that are H/M or H/L or M/L are high priority.

L/L, M/M, or H/H are medium priority.

L/M, L/H, or M/H are low priority.

5.3 Implementation

Considering implementation as a separate component in the mitigation strategy allows jurisdictions to understand more clearly the resources needed to execute mitigation actions. This section identifies external funding sources, partnerships, and integration with other plans as crucial components in an action’s implementation.

The external funding subsection provides guidance on which funding options can best meet the planning area’s priority actions. The partnerships subsection highlights key stakeholders in the community and suggests the formation of new partnerships with other stakeholders to strengthen mitigation actions.

5.3.1 Internal Funding

Ponca City has greater financial capabilities to leverage for hazard mitigation projects than most of the rest of the Oklahoma. This is due, in large part, to the City’s tax scheme. The City draws from a range of taxes including: sales tax, a stormwater fee, sewer taxes, and several other public utility taxes and fees. The City also receives funding from the state to maintain roads within the planning area. Overall, the City draws in several hundred thousand dollars in funding per-year. Ponca City School District receives money from taxes and state grants, which can be used to fund mitigation projects. This funding, combined with careful and thoughtful financial management, has enabled and will enable the City and the School District to continue funding hazard mitigation projects (see Chapter 3 for more information).

5.3.2 External funding and external programs

This section compliments and aggregates the previous section by identifying external funding programs that would allow the participating jurisdictions to pursue funding sources to meeting their highest-priority mitigation goals. This section provides a general overview of major funding programs, highlights their differences, and identifies which programs would best meet the highest-priority mitigation actions in this plan. State agencies in Oklahoma play an important role in the administration and funding of these grants, but these programs are considered federal programs due to the federal government's role in developing the criteria for selection and participation in the selection process. Chapter 3 includes more details on the universe of possible external funding sources and the federal grants that Ponca City has been awarded in the last several years.

FEMA Funding Opportunities

FEMA administers programs that provide funding for eligible mitigation planning and projects that reduce disaster losses and protect life and property from future disaster damages. The three largest and most accessible programs are the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) Program, and the Building Resilient Infrastructure and Communities Program (BRIC).

- HMGP assists in implementing long-term hazard mitigation planning and projects following a Presidential disaster declaration.
- BRIC provides funds for large scale, resilient infrastructure projects on an annual basis.
- FMA provides funds for planning and projects to reduce or eliminate the risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis.

HMGP funding is generally 15% of the total amount of Federal assistance provided to a State, Territory, or federally recognized tribe following a major disaster declaration. FMA funding depends on the amount Congress appropriates each year the program. FEMA can set aside up to 6% of total estimated disaster expenditures associated with each presidential disaster declaration to fund BRIC. Individual homeowners and business owners may not apply directly to FEMA. Eligible local governments, like Ponca City, may apply on their behalf.

5.4 2022 Mitigation Action Items

The mitigation strategy combines the previous three sections into a cogent and comprehensive approach to mitigating risk in Ponca City. Each action includes components from the goals, actions, and implementations sections to provide planners with a clear *why, what, how* template that can drive actions.

Action 1	Develop and fund hazard preparedness, education, information, and awareness programs.
Responsible Agency	Ponca City Emergency Management, Ponca City PPI, Ponca City Planning, Ponca City Stormwater/Floodplain Management, local private organizations, Ponca City School Board
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	All
Type of Activity	Public Information Activity
Priority	Highest
Jurisdiction(s)	Ponca City and Ponca City School District

Action 2 Create and maintain a Program for Public Information (PPI) that aligns with CRS guidance.

Responsible Agency	Ponca City Commission
Potential Resources	Local/General
Timeframe	2022-Ongoing
Hazards Addressed	Flood and Dam
Type of Activity	Public Information Activity
Priority	Highest
Jurisdictions	Ponca City

Action 3 Update stormwater master plan and implement findings in the plan, including structural projects.

Responsible Agency	Ponca City Stormwater/Floodplain Management, Ponca City Planning, Ponca City Engineering, Ponca City School District Representative
Potential Resources	Local/General
Timeframe	2022-2024
Hazards Addressed	Food and Dam
Type of Activity	Floodplain Management/Regulatory Activity
Priority	High
Jurisdictions	Ponca City and Ponca City School District

Action 4 Develop automated hazard warning systems that integrate existing weather stations, storm sirens, and reverse 911 system.

Responsible Agency	Ponca City PPI, Ponca City Emergency Management, Ponca City School Operations Director
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-2026
Hazards Addressed	All
Type of Activity	Emergency Services Activity
Priority	High
Jurisdictions	Ponca City

Action 5 Move EOC out of flood-prone basement and into new Police station building.

Responsible Agency	Ponca City Emergency Management
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-2026
Hazards Addressed	Flood and Dam
Type of Activity	Preventative Activities
Priority	High
Jurisdictions	Ponca City

Action 6	Update ordinances to follow the guidance in the 2021 CRS addendum, in addition to the 2017 CRS coordinators' manual, and the most current state guidance (see other floodplain and stormwater management section).
Responsible Agency	Ponca City Engineering, Ponca City Floodplain/Stormwater
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-2026
Hazards Addressed	Dam
Type of Activity	Floodplain Management/Regulatory Activity
Priority	Moderate
Jurisdictions	Ponca City and Ponca City School District

Action 7	Develop Continuity of Operations Plans for Ponca City.
Responsible Agency	Ponca City Emergency Management, Ponca City Commission, Ponca City PPI, Ponca City Transportation, Ponca City Planning
Potential Resources	Local/General
Timeframe	2022-2024
Hazards Addressed	All
Type of Activity	Emergency Services Activity
Priority	High
Jurisdictions	Ponca City

Action 8	Evaluate and install employee shelters/safe rooms that meet ICC 500 and FEMA 361 requirements at public critical facilities and schools that do not have shelters that meet ICC 500 and FEMA 361 requirements.
Responsible Agency	Ponca City Engineering, Ponca School District Board

Potential Resources	Local/General, FEMA HMA, OEM Funding
Timeframe	2022-Ongoing
Hazards Addressed	Tornado/High Wind
Type of Activity	Structural Project
Priority	High
Jurisdictions	Ponca City and Ponca City School District

Action 9

Complete Finished Floor Elevations and other data collection for benefit-cost analyses (BCA)s on potential projects to assist in identifying grant funding.

Responsible Agency	Ponca City Stormwater/Floodplain Management, Ponca City Grant Administration, Ponca City Engineering, Ponca City PPI
Potential Resources	Local/General
Timeframe	2022-Ongoing
Hazards Addressed	Flood and Dam
Type of Activity	Floodplain Management/Regulatory Activity
Priority	High
Jurisdictions	Ponca City

Action 10

Update EAPs for Cremers Park and Lake Ponca high hazard dams and revise to better fit CRS 600 requirements.

Responsible Agency	Ponca City Engineering, Ponca City Emergency Management, USACE
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-2026
Hazards Addressed	Dam
Type of Activity	Emergency Services Activity
Priority	High
Jurisdictions	Ponca City and Ponca City School District

Action 11

When critical facilities or school buildings are damaged, rebuild with disaster resistant construction techniques and technologies.

Responsible Agency	Ponca City Engineering, Ponca City Utilities, Ponca City School Board
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing

Hazards Addressed	All
Type of Activity	Structural Project
Priority	High
Jurisdictions	Ponca City and Ponca City School District

Action 12	Update floodplain and CRS ordinances and regulations to follow most current state and FEMA guidance.
Responsible Agency	Ponca City Stormwater/Floodplain Management, Ponca City Engineering, Ponca City PPI
Potential Resources	Local/General
Timeframe	2022-Ongoing
Hazards Addressed	Flood and Dam
Type of Activity	Floodplain Management/Regulatory Activity
Priority	High
Jurisdictions	Ponca City

Action 13	Develop or purchase a voluntary emergency management app to send notifications about various hazards throughout the planning area.
Responsible Agency	Ponca City PPI, Ponca City Emergency Management
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-2026
Hazards Addressed	All
Type of Activity	Public Information Activity
Priority	High
Jurisdictions	Ponca City and Ponca City School District

Action 14	Complete hazard evaluations of schools and retrofit or remodel buildings to make them more disaster resistant.
Responsible Agency	Ponca City School Board
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	All
Type of Activity	Structural Project
Priority	High
Jurisdictions	Ponca City School District

Action 15

Study ways to mitigate at-risk critical facilities and cultural resources, or access to these facilities, from flooding and dam incidents and implement findings from the study.

Responsible Agency	Ponca City Engineering, Ponca City Emergency Management
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	Flooding and Dam Incident
Type of Activity	Preventative Activity
Priority	High
Jurisdictions	Ponca City

Action 16

Study ways to mitigate power infrastructure from power failure due to hazard events and implement findings from the study.

Responsible Agency	Ponca City Engineering
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	All
Type of Activity	Preventative Activity
Priority	High
Jurisdictions	Ponca City

Action 17

Conduct mapping and regulating based on fully developed watersheds.

Responsible Agency	Ponca City Stormwater/Floodplain Management, Ponca City Engineering, Ponca City PPI
Potential Resources	Local/General
Timeframe	2022-Ongoing
Hazards Addressed	Flood and Dam
Type of Activity	Floodplain Management/Regulatory Activity
Priority	High
Jurisdictions	Ponca City

Action 18

Maintain and continue to develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to

	distribute information on risks through web-based and mobile technology.
Responsible Agency	Ponca City GIS
Potential Resources	Local/General
Timeframe	2022-Ongoing
Hazards Addressed	All
Type of Activity	Public Information Activity
Priority	Moderate
Jurisdictions	Ponca City and Ponca City School District

Action 19	Adopt and enforce 2021 international building codes for new construction and, when appropriate, for retrofits as well.
Responsible Agency	Ponca City Building Services, Ponca City School Board
Potential Resources	Local/General, FEMA HMA
Timeframe	2024-2026
Hazards Addressed	All
Type of Activity	Property Protection Activity
Priority	Moderate
Jurisdictions	Ponca City and Ponca City School District

Action 20	Provide and maintain defensible space around structures vulnerable to wildfires, especially around Lake Ponca and in grasslands in the southwestern part of the City.
Responsible Agency	Ponca City Emergency Management, Ponca City Fire Department, Ponca City Representative (Garfield ES)
Potential Resources	Local/General, FEMA HMA, State Funding
Timeframe	2022-Ongoing
Hazards Addressed	Fire
Type of Activity	Preventative Activity
Priority	Moderate
Jurisdictions	Ponca City and Ponca City School District

Action 21	Harden, strengthen, or bury electrical infrastructure when cost-effective.
Responsible Agency	Ponca City Engineering
Potential Resources	Local/General, FEMA HMA

Timeframe	2022-Ongoing
Hazards Addressed	Severe Winter Storm, Tornado/ High Wind, Fire, Lightning, Hail, Earthquake
Type of Activity	Structural Project
Priority	Moderate
Jurisdictions	Ponca City

Action 22

Improve the quality and design of roadways that have been damaged by repeated hazard events to mitigate against the effects of future events, when applicable.

Responsible Agency	Ponca City Traffic Engineering, Ponca City Department of Transportation
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	Flooding, Severe Winter Storm, Dam Incident, Drought, Earthquake
Type of Activity	Structural Project
Priority	Moderate
Jurisdictions	Ponca City

Action 23

Improve the quality and design of gas infrastructure that has been damaged by repeated hazard events to mitigate against the effects of future events, when applicable.

Responsible Agency	Ponca City Engineering, Ponca City Department of Transportation
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	Severe Winter Storm, Dam Incident, Hazardous Materials, Extreme Heat, Drought, Earthquake
Type of Activity	Structural Project
Priority	Moderate
Jurisdictions	Ponca City

Action 24

Develop water conservation plans and programs, including rate structures and implementation.

Responsible Agency	Ponca City Engineering, Ponca City Water Collection
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-2026
Hazards Addressed	Drought
Type of Activity	Preventative Activity
Priority	Moderate

Jurisdictions	Ponca City

Action 25 Participate in the FireWise Program

Responsible Agency	Ponca City PPI, Ponca City Emergency Management, Ponca City School Operations Director
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-2026
Hazards Addressed	Fire
Type of Activity	Public Information Activity
Priority	Moderate
Jurisdictions	Ponca City

Action 26 Implement a residential safe room program with criteria that meet or exceed criteria of FEMA P361 and ICC 500.

Responsible Agency	Ponca City Stormwater/Floodplain Management, Ponca City PPI
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	Flood
Type of Activity	Preventative Activity
Priority	Moderate
Jurisdictions	Ponca City

Action 27 Improve National Flood Insurance Program (NFIP) compliance and exceed NFIP standard requirements.

Responsible Agency	Ponca City Stormwater/Floodplain Management, Ponca City PPI
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	Flood
Type of Activity	Floodplain Management/Regulatory Activity
Priority	Moderate
Jurisdictions	Ponca City

Action 28 Encourage residents and businesses to build to IBHS fortified standards and offer IBHS trainings for builders, architects, developers, engineers, and other interested parties.

Responsible Agency	Ponca City PPI, Ponca City Engineering, Ponca City Building Services, Private

	Agencies
Potential Resources	Local/General, National Funds
Timeframe	2022-2024
Hazards Addressed	Tornado/ High Wind, Hail, Earthquake
Type of Activity	Property Protection Activity
Priority	Moderate
Jurisdictions	Ponca City

Action 29	Develop a substantial damage management plan based on CRS guidelines.
Responsible Agency	Ponca City Stormwater/Floodplain Management, Ponca City Engineering, Ponca City PPI
Potential Resources	Local/General
Timeframe	2022-Ongoing
Hazards Addressed	Flood
Type of Activity	Floodplain Management/Regulatory Activity
Priority	Moderate
Jurisdictions	Ponca City

Action 30	Acquire properties in the FEMA Floodplain and in Repetitive Loss/Severe Repetitive Loss properties.
Responsible Agency	Ponca City Stormwater Management, Ponca City Engineering
Potential Resources	Local/General, FEMA HMA, HUD
Timeframe	2022-Ongoing
Hazards Addressed	Flooding
Type of Activity	Property Protection
Priority	Moderate
Jurisdictions	Ponca City

Action 31	Construct a water line to Kaw Lake.
Responsible Agency	Ponca City Engineering, Ponca City Water Collection
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	Drought
Type of Activity	Structural Project
Priority	Moderate

Jurisdictions	Ponca City

Action 32

Construct a water line to Kaw Lake.

Responsible Agency	Ponca City Engineering, Ponca City Water Collection
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	Drought
Type of Activity	Structural Project
Priority	Moderate
Jurisdictions	Ponca City

Action 33

Maintain tree trimming services in the planning area.

Responsible Agency	Ponca City Traffic Engineering, Private entities
Potential Resources	Local/General
Timeframe	2022-Ongoing
Hazards Addressed	Severe Winter Storm, Tornado/ High Winds
Type of Activity	Preventative Activity
Priority	Moderate
Jurisdictions	Ponca City

Action 34

Incorporate nature-based solutions into flood and dam mitigation projects, when appropriate.

Responsible Agency	Ponca City Engineering
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-Ongoing
Hazards Addressed	Flooding and Dam
Type of Activity	Natural Resource Protection Activity
Priority	Low
Jurisdictions	Ponca City

Action 35

Improve BCEGS rating.

Responsible Agency	Ponca City Engineering, Ponca City Building Services
Potential Resources	Local/General
Timeframe	2022-Ongoing
Hazards Addressed	Tornado/ High Wind, Hail, Earthquake

Type of Activity	Property Protection Activity
Priority	Low
Jurisdictions	Ponca City

Action 36	Construct lightning rods or air terminals for protection of critical facilities and schools.
Responsible Agency	Ponca City Engineering, Ponca City School Board
Potential Resources	Local/General, FEMA HMA
Timeframe	2022-2026
Hazards Addressed	Lightning
Type of Activity	Property Protection Activities
Priority	Low
Jurisdictions	Ponca City and Ponca City School District

Chapter 6 Plan Maintenance and Adoption

This chapter includes a discussion of the plan maintenance process and documentation of the adoption of the plan by Ponca City and Ponca City School District. There is no overall change to priorities regarding Ponca City or Ponca City School Districts' vision for hazard mitigation. This being said, the participating jurisdictions have made some changes to the priorities of the mitigation action items (see Chapter 5) and regarding how the plan will be maintained (via Program for Public Information), which is outlined in this Chapter.

Since the last plan update, the City of Ponca City intends to establish the Core Planning Team for this plan as the Program for Public Information Committee under FEMA's Community Rating System (see Chapter 2). Ponca City has resolved to establish this group by formal resolution. Until the time of resolution, the Core Planning Team will serve as the interim committee to oversee the maintenance and adoption of this Plan.

The PPI committee serve as the committee that oversees all maintenance efforts in this Plan, which is also discussed in other sections. All mitigation activities on the PPI committee will be directed and coordinated by Ponca City's Assistant City Engineer.

Led by the Assistant City Engineer, the PPI committee will hold quarterly sessions beginning in February of each year, or as needed, to complete the monitoring, evaluation, updating, public involvement, and plan incorporation activities required to meet the targets listed in each of the respective sections. The Plan will be updated and resubmitted to FEMA for approval prior to the 5-year approval period expiration, per FEMA requirements (see: updating the Plan section).

The PPI committee will continue to meet to evaluate progress and recommend changes to the plan. As the committee lead, the Assistant City Engineer will ensure that a regular review and update of the Multi-Hazard Mitigation Plan occurs. The Plan will be updated and resubmitted to the State and FEMA for approval prior to the 5-year approval period expiration, as per FEMA requirements.

6.1 Monitoring the Plan

Monitoring of the 2022 Plan will involve city and school representatives tracking the mitigation actions and plan integration that their individual jurisdictions are tasked to undertake in Chapter 5. An annual meeting, open to the public, will allow the planning team to report on progress and discuss future mitigation steps.

Monitoring of the Plan, the Action Plan, and Mitigation Measures is primarily the responsibility of the PPI committee, which will be led by the Assistant City Engineer. The Emergency Manager, school officials, floodplain Administrators, city officials, and other private and public officials will assist when necessary. Jurisdictions responsible for implementation of the Action Plan and the Mitigation Measures will create or update Progress Reports on an annual basis, and report to the Planning Committee as a whole on progress and/or impediments of the mitigation measures.

A worksheet, similar to Worksheet 7.1 of Appendix A of the *FEMA Local Mitigation Handbook 2013*, will be used to concisely summarize mitigation action progress as the Progress Report. Individual action items will be noted as "Not Started," "Underway," "Ongoing," or "Complete." Any additional planning mechanisms or processes that integrate the mitigation plan will be tracked.

The PPI committee will host an annual meeting, at minimum, for participating community representatives and general public to report and comment on plan implementation success and continued challenges. At minimum,

this meeting will address recent hazard events, evaluate current the plan's goals and priorities, prioritize mitigation action items for the upcoming year, summarize plan implementation and integration, and discuss plan updates.

These annual meetings should provide an opportunity to summarize the beforementioned progress reports and collaborate on upcoming projects, opportunities, grants, or similar matters. To this end, City Departments and other stakeholders responsible for implementing the action items or other components of this Plan will update their progress reports, including impediments to progress of the mitigation measures. These reports will be made available to the PPI committee prior to the annual evaluation of the plan. Monitoring of the Plan will adhere to the schedule outlined in Table 6-1.

Table 6-1 Plan Maintenance Schedule

Meeting Year	Topic
2022	Monitor Plan Progress and Hazard Activity
2023	Monitor Plan Progress and Hazard Activity
2024	Monitor Plan Progress, Hazard Activity, and Start Plan Update
2025	2026 Update Planning Process
2026	Adopt Plan Update and Begin Monitoring Process

6.2 Evaluating the Plan

The Ponca City and Ponca School District Hazard Mitigation Plan Update will be continually evaluated by the Assistant City Engineer, and a report will be made to the PPI Committee. This evaluation will include:

- Adequacy of adopted Goals and Strategy in addressing current and future expected conditions.
- Whether the nature and magnitude of the risks have changed.
- Appropriateness of current resources allocated for implementation of the Plan.
- To what extent the outcomes of the Mitigation Measures occurred as expected.
- Whether agencies, departments and other partners participated as originally anticipated.
- Whether Mitigation Measures have been incorporated into new planning processes.

These programs will continue to be evaluated and updated on an annual basis. The annual monitoring meeting and reports from City Departments, School District members, and other stakeholders will provide the information necessary for the PPI committee to evaluate the plan.

6.3 Updating the Plan

The Assistant City Engineer will be responsible for updating the Hazard Mitigation Plan. The Plan will be updated according to the following schedule:

Revise and Update

The City and the school district will begin the planning process in 2024. The City and School District will incorporate revisions to the plan document identified during the monitoring and evaluation period, as well as items identified in the previous Planning Tool.

Submit for Review

The revised plan will be submitted to ODEMHS and FEMA through the State Hazard Mitigation Officer for review and approval, and to FEMA no later than six (6) months prior to the plan expiration date.

Final Revision and Adoption

If necessary, the plan will be revised per ODEMHS and FEMA remarks, adopted by the participating jurisdictions, and the updated plan sent to FEMA prior to the expiration of the 5-year approval period.

6.4 Public Involvement

Ponca City and Ponca City School District remain committed to involving the public directly in updating and maintaining the Plan. Public involvement includes incorporating public opinion on the plan update and other mitigation activities. Public involvement activities will include, but are not limited to:

- Maintaining a current copy of the Plan on the City's website
- Maintaining a hard copy at relevant locations, such as City Hall, the Engineering Department, and the Emergency Management Department
- Routine and ad hoc public meetings, which will be announced and advertised with sufficient advanced notice
- Periodic information updates on the Plan's progress, which can include meetings, presentations, media summaries, or official releases
- Any outreach involving hazard education or partnership with another entity to achieve the same goal (see Chapter 5)

6.5 Incorporating the Multi-Hazard Mitigation Plan

The Ponca City and Ponca School District Hazard Mitigation Plan Update will be approved and adopted by the Ponca City Commission and the Ponca City School District School Board as a guide to the City and School Districts mitigation actions. Both jurisdictions are responsible for integrating this plan into appropriate plans, policies, regulations, and actions.

Incorporating the Previous Hazard Mitigation Action Items

Ponca City has incorporated the previous hazard mitigation plan into strategy, goals, data, and mitigation actions strategy, goals, data, and mitigation actions of several planning mechanisms, including, but not limited to:

- Floodplain and Stormwater Ordinances⁹²
- Capital Improvements Plan Actions⁹³
- The Emergency Operations Plan Strategy and understanding of hazards
- The development of the Continuity of Operations Plan (currently in development as of this writing)
- The adoption and enforcement of higher building standards

Ponca City School District has incorporated the previous hazard mitigation plan into strategy, goals, data, and mitigation actions strategy, goals, data, and mitigation actions of several planning mechanisms, including, but not limited to:

- The move toward higher saferoom standards
- The Safety Action Plan
- Mandatory and annual hazard-based drills

⁹² During this process, for example, the City's CFMs will review the insight listed in the capabilities or hazards section, use this data and other information to make a determination, and propose a new criterion or set of criteria. These criteria would be presented to the City Council for review and potential adoption.

⁹³ Vulnerabilities to structures or public works from hazards would be examined. Better building practices (e.g. building to higher wind standards) would be examined for incorporation into public building practices. In addition, public works identified as at-risk would be considered for improvement or fortification.

As discussed in section 6-1, the PPI committee is responsible for overseeing the implementation and integration of the Hazard Mitigation Plan. Planning team members are responsible for integrating the Plan into their departmental and school planning and capital improvement efforts.

As City departments update or adopt new planning mechanisms or other capabilities (as discussed in Chapter 3), it will be the responsibility of their planning team representatives to integrate this Mitigation Plan into those planning efforts. The City and School District's efforts to incorporate the findings from the hazard mitigation plan will occur at least annually through several channels. One channel for the City includes departmental review and revision of ordinances (for the City departments that oversee these ordinances, please see Chapter 3). The City Council also plays a significant role in reviewing and approving major changes to the documents listed above. The City Council meets monthly, at a minimum. Ponca City's school district's administration and school board drive most of the incorporation and review of saferoom standards, updating the safety action plan, and mandating annual hazard-based drills.

Future Implementation

Implementing the mitigation action items of this Plan Update will include:

Ponca City

- The stormwater department will review ordinance recommendations and projects at periodic meetings
- The construction department will seek to build to reinforced standards outlined in Chapter 3, when possible
- The engineering department will incorporate drainage recommendations and seek to remedy problem areas during a meeting that will occur at least annually
- Grants managers will review a list of hazard mitigation projects to pursue at least annual
- During the annual review of the budget, the finance department will seek to include capital projects and personnel goals into the budget
- The responsible department managers will report to the Planning Committee on the progress made on each measure, identifying successes and impediments to their implementation
- Mitigation actions that require adoption will go through the appropriate boards, councils, or commissions for formal adoption
- As other planning processes are initiated, appropriate Planning Committee members will serve as advocates for integrating appropriate mitigation goals into that planning effort. These planning processes could include comprehensive plans, building code updates, zoning/subdivision codes updates, or similar items

Ponca City School District

- The operations director will review the Emergency operations plan at least annually to incorporate findings and recommendations from this plan
- The school board will consider capital projects identified as high value by this plan during their recurrent meetings at least annually
- The school board will seek to implement more education and outreach activities identified in this plan during their recurrent meetings at least biannually

Chapter 3 provides a detailed description of existing plans that would integrate with this hazard mitigation update. Chapter 5, section 4 also provides an overview of similar information. A review to integrate these plans into the HMP process should occur annually at minimum, which would match the monitoring schedule outlined in section 6-1. As Ponca City and Ponca City School District update or adopt new planning mechanisms, it will be the responsibility of their planning team representatives to facilitate integrating the Mitigation Plan into those planning efforts.

To be included on the following pages of this Chapter are Resolutions of Adoption of *The Ponca City and Ponca School District Hazard Mitigation Plan Update*.

Appendix A: Previous Action Items

Mitigation action items from the *2017 Ponca City Hazard Mitigation Plan* and were assessed to determine their status. Items determined to still be operable in reducing the planning area's exposure to hazards were incorporated into the 2022 mitigation strategy in Chapter 5.

Table A-1 2017 Action Items

Item #	Action Description	2022 Status
1	Public Education for drought, dam failure, earthquake, extreme heat, thunderstorms, tornadoes, wildfires, winter storms	Ongoing
2	Develop 10 Year Plan for Lake Ponca Dam	Not Started
3	Multi-Purpose Public Address and Warning System	Ongoing
4	NOAA Weather Radio Program	Completed
5	Retrofit Critical Facilities	Not Started
6	Improvements to Power Transmission Systems	Ongoing
7	Install Dam Warning Devices	Not Started
8	Improvements to Water Treatment Plant	Completed
9	Continue Participation in the National Flood Insurance Program	Ongoing
10	Debris Removal Program	Ongoing
11	Improve Waste-Water Treatment Plant	Not Started
12	Develop a City Resiliency Plan	Ongoing
13	Tree Trimming and Branch Removal Program	Ongoing
14	Backup Generator for Critical Facilities	Ongoing
15	Wind proofing School Windows and Doors	Ongoing
16	Debris Transport and Process	Completed
17	Mitigation Tabletop Exercises	Ongoing
18	Residential Assessment Team	Not Started
19	Secondary Water Sources	Ongoing
20	Remote Weather Cameras	Not Started
21	Surge Protector Program	Not Started
22	Equipment and Furniture Strap Program	Not Started
23	Protective Window Film	Ongoing
24	Lightning Detection Systems	Not Started
25	Individual Safe Room Program	Ongoing
26	Storm Shelter/Safe Room Database	Not Started
27	Blanket, Heater, and Coat Program	Not Started
28	Become a Firewise Community	Not Started
29	Reverse 911 System	Ongoing
30	Repetitive Loss Properties Acquisition	Ongoing

31	Construct Separate Waterline From Well Field	Not Started
32	Replace Water Lines	Ongoing
33	Continue CRS Program	Ongoing
34	2 Additional Weather Stations	Not Started
35	Elevation Survey of Critical Facilities	Not Started
36	Improvements to Arkansas River Flooding Problem Areas	Ongoing
37	Improvements to Bois d'Arc Creek Flooding Problem Areas	Ongoing
38	Underground Electric Service for 2nd Feed to Water Treatment Plant and Back feed to Pecan Park Substation	Completed
39	1000 MCM underground electric supply lines along Hartford Ave. from Highland to Hartford Ave.	Not Started
40	Battery Backup for Traffic Signals on Arterial Streets.	Ongoing
41	Tubgrinder for Solid Waste	Not Started
42	Rolloff Trash Container with Crane Attachment for Solid Waste Division	Not Started
43	Skid-Steer Loader with Loading Claw Attachment	Not Started
44	911 System Integration	Ongoing
45	Construction to correct defects in Electrical Surge and Electrical Service Entrance into Public Buildings to improve lightning protection and lightning induced electrical surges	Not Started
46	Engineering Inspection and Testing of Grounding System, and Lightning Protection of Public Owned Communication and Water Towers to improve Lightning Protection	Not Started
47	Construction to correct defects in communication and water tower grounding systems and installation of lightning arrestors and electrical surge protection for lightning induced electrical surges	Not Started
48	Storage Facilities for street/road salt storage	Not Started
49	Federal Commander Digital System	Not Started
50	E-911 Consoles	Not Started

Appendix B: FEMA Hazard Mitigation Strategies

The following items illustrate many of the broad mitigation strategies that communities, tribes, counties, and other entities can implement to help protect lives, property and the environment in their jurisdictions. The following grid lists the six basic mitigation categories outlined by FEMA (introduced in Chapter 5), the strategies that fall in those categories, and the hazards that could be mitigated from those strategies.

Many of the strategies, while listed under one category, may have elements that include other categories as well. For example, almost all strategies have a Public Information & Education component, where homeowners, business owners, and other stakeholders can be educated about possible measures they may take on their own.

Category	Mitigation Strategy		Hazards Mitigated
Public Information & Education	B.1.1	Public Information Program Strategy	All Hazards
	B.1.2	Educational Programs	All Hazards
	B.1.3	Outreach Projects	All Hazards
	B.1.4	Technical Assistance	All Hazards
	B.1.5	Map Information	All Hazards
	B.1.6	Library	All Hazards
	B.1.7	Web Sites	All Hazards
	B.1.8	Real Estate Disclosure	Flood, Expansive Soils
	B.1.9	Firewise Communities	Wildfire
	B.1.10	Business Continuity Planning & Mitigation	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Heat, Wildfire, Earthquake, Dam incident
Preventive Measures	B.2.1	Planning	All Hazards
	B.2.2	Zoning	All Hazards
	B.2.3	Floodplain Development Regulations	Flood, Dam incident
	B.2.4	Stormwater Management	Flood, Dam incident
	B.2.5	Building Codes	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Expansive Soil, Wildfire, Earthquake
	B.2.6	IBHS Fortified Home Program	Flood, Tornado, High Wind, Lightning, Hail, Wildfire, Earthquake
	B.2.7	Smoke Detectors	Fires
	B.2.8	Hurricane Fasteners	Tornado, High Wind, Earthquake
	B.2.9	Mobile Home Tie-Downs	Tornado, High Wind
	B.2.10	Lightning Warning Systems	Lightning
	B.2.11	Power Outages from Winter Storms	Winter Storm, Lightning
	B.2.12	Standby Electric Generators	Tornado, High Wind, Lightning, Winter Storm
	B.2.13	Critical Facility Protection	All Hazards
	B.2.14	Extreme Heat Protection	Extreme Heat
	B.2.15	Proper Storage and Disposal of Hazardous Materials	Floods
	B.2.16	Water Conservation	Drought

Category	Mitigation Strategy		Hazards Mitigated
	B.2.17	Open Space Preservation	Flood, Drought, Dam incident
Structural Projects	B.3.1	Safe Rooms	Tornado, High Wind
	B.3.2	School Safe Rooms	Tornado, High Wind
	B.3.3	Reservoirs & Detention	Flood
	B.3.4	Levees & Floodwalls	Flood, Dam incident
	B.3.5	Channel Improvements	Flood, Dam incident
	B.3.6	Crossings & Roadways	Flood, Dam incident
	B.3.7	Drainage & Storm Sewer Improvements	Flood, Dam incident
	B.3.8	Drainage System Maintenance	Flood, Dam incident
Property Protection	B.4.1	The Planning Area's Role	All Hazards
	B.4.2	Insurance	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Wildfire, Earthquake, Dam incident
	B.4.3	Acquisition & Relocation	Flood
	B.4.4	Building Elevation	Flood, Dam incident
	B.4.5	Barriers	Flood, Dam incident
	B.4.6	Retrofitting	Flood, Tornado, High Wind, Lightning, Hail, Expansive Soil, Wildfire, Earthquake
	B.4.7	Impact Resistant Windows & Doors	Tornado, High Wind, Hail
	B.4.8	Lightning Protection Systems	Lightning
	B.4.9	Surge and Spike Protection	Lightning
	B.4.10	Landscaping for Wildfire Prevention	Wildfire
Emergency Services	B.5.1	Threat Recognition	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Heat, Drought, Wildfire, Earthquake, Dam incident
	B.5.2	Warning	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Heat, Drought, Wildfire, Earthquake, Dam incident
	B.5.3	9-1-1 & 2-1-1	All Hazards
	B.5.4	Emergency Telephone Notification Systems (ETNS)	Flood, Winter Storm, Heat, Wildfire
	B.5.5	Response	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Heat, Drought, Wildfire, Earthquake, Dam incident
	B.5.6	Emergency Operations Plan (EOP)	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Wildfire, Earthquake, Dam incident
	B.5.7	Incident Command System (ICS)	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Wildfire, Earthquake, Dam incident
	B.5.8	Mutual Aid / Interagency Agreements	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Wildfire, Earthquake, Dam incident
	B.5.9	CERT (Community Emergency Response Teams)	Flood, Tornado, High Wind, Winter Storm, Heat, Wildfire, Earthquake, Dam incident
	B.5.10	Debris Management	Flood, Tornado, High Wind, Winter Storm, Wildfire, Earthquake
	B.5.11	Critical Facilities Protection	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Wildfire, Earthquake, Dam incident

Category	Mitigation Strategy		Hazards Mitigated
	B.5.12	Site Emergency Plans	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Wildfire, Earthquake, Dam incident
	B.5.13	Post-Disaster Recovery & Mitigation	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Wildfire, Earthquake, Dam incident
	B.5.14	StormReady Communities	Flood, Tornado, High Wind, Hail, Winter Storm
Natural Resource Protection	B.6.1	Wetland Protection	Flood, Wildfire
	B.6.2	Erosion and Sedimentation Control	Flood, Wildfire
	B.6.3	River Restoration	Flood, Wildfire
	B.6.4	Best Management Practices	Flood
	B.6.5	Dumping Regulations	Flood, Tornado, High Winds, Winter Storm

B.1 Public Information and Education

A successful public information and education program involves both the public and private sectors. Public information and education activities advise and educate citizens, property owners, renters, businesses, and local officials about hazards and ways to protect people and property from them. Public information activities are among the least expensive mitigation measures and, at the same time, are often the most effective. All mitigation activities – preventive, structural, property protection, emergency services, and natural resource protection – begin with public information and education.

B.1.1 Public Information Program Strategy

Getting Your Message Out

Professional advertising agencies may be willing to help get the message out regarding disaster preparedness and mitigation at little or no cost. Local agencies have a vested interest in their community and want to keep it safe. The same holds true for the media. The local newspaper, radio or television will contribute to keeping a safe and prepared community. Invite them to, and let them participate in special events, meetings, practice exercises, etc.

Education alliance partners, such as a restaurant, convenience stores or the library, can put preparedness tips on tray liners or sacks, distribute brochures or allow you to erect a display with disaster information of local interest.

Many other options are available such as including brochures with utility bills, presentations at local gatherings, billboards, direct mailing and websites.

General

Numerous publications on tornadoes, thunderstorms, lightning, winter storms and flooding are available through NOAA. Many of the brochures can be downloaded from www.nws.noaa.gov/om/brochures.shtml. For a nominal fee the American Red Cross offers videos on general preparedness, winter storms, chemical emergencies, hurricanes and earthquakes.

The National Weather Service issues watches and warnings for tornadoes, severe thunderstorms, floods, winter storms and extreme heat. The messages appear on the NWS telephone line, the local weather service office website and on television stations carrying Emergency Alert System messages. Mobile emergency applications can incorporate NWS data and directives.

Communities can encourage residents to prepare themselves by stocking up with necessary items and planning for how family members should respond if any of a number of possible emergency or disaster events strike.

Hazard Brochures

FEMA, local agencies, and nonprofits can offer free brochures and other material related to hazards, mitigation, response, and recovery. Example fliers used across Oklahoma have included: *Are You Ready For a Heat Wave?*, *Are You Ready For a Winter Storm?*, and *Are You Ready For a Thunderstorm?*

B.1.2 Educational Programs

Environmental education programs can teach children about natural hazards, the forces that cause them, and the importance of protecting people, property, and nature, such as watersheds and floodplains. Educational programs can be undertaken by schools, park and recreation departments, conservation associations, and youth organizations. An activity can be complex enough as to require course curriculum development, or as simple as an explanatory sign near a river.

Educational programs designed for children often reach adults as well. Parents often learn innovative concepts or new ideas from their children. If a child comes home from school with an assignment in water quality monitoring, the parents will normally become interested in finding out about it as well.

Youth programs and activities often include posters, coloring books, games, and references. Hands-on models that allow students to see the effects of different land use practices are also available through local natural resources conservation districts.

There are many programs that provide information and curriculum materials on nature and natural hazards. Agencies, such as FEMA, Red Cross, and the Salvation Army have provided free access to materials in the past.

B.1.3 Outreach Projects

Mapping and library activities are not of much use if no one knows they exist. An outreach project can remedy this lack of awareness. Sending notices to property owners can help introduce the idea of property protection and identify sources of assistance.

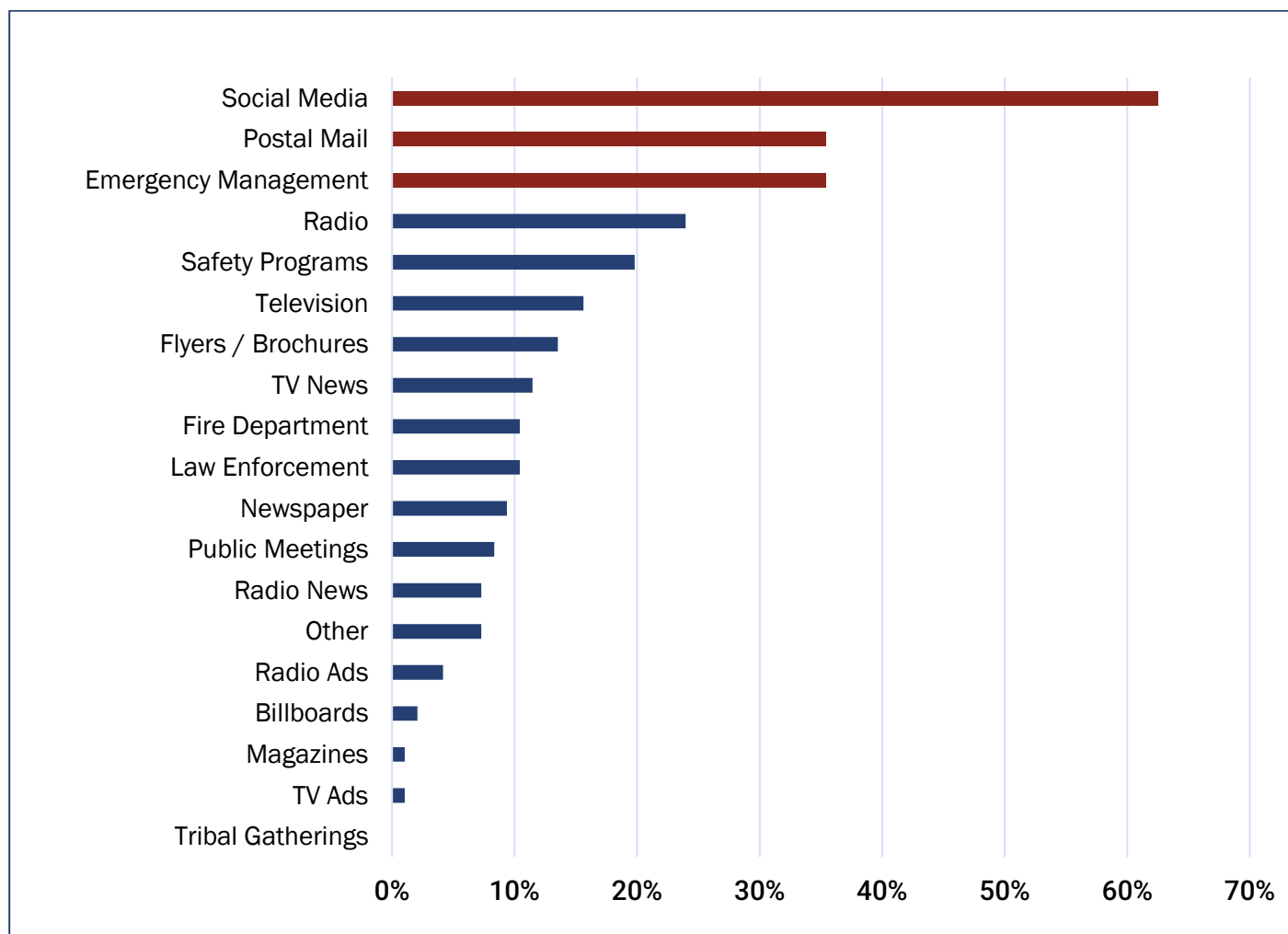
Outreach projects are the first step in the process of orienting property owners to property protection and assisting them in designing and implementing a project. They are designed to encourage people to seek out more information in order to take steps to protect themselves and their properties.

Some of the most effective types of outreach projects are mailed or otherwise distributed to flood-prone property owners or to everyone in the community. Other approaches include the following:

- Articles and special sections in newspapers
- Radio and TV news releases and interview shows
- Hazard protection video for cable TV programs or to loan to organizations
- Presentations at meetings of neighborhood, civic or business groups
- Displays in public buildings or shopping malls
- Floodproofing open houses

According to survey results recorded during the hazard mitigation planning process, shown on Figure B-1, most people in the planning area would prefer messaging through social media, postal mail, and the emergency management department. The planning team should prioritize activities to include a social media component, when possible, given the overwhelming number of respondents who selected social media as a preferred choice of outreach.

Figure B-1 Percentage of Respondents in the Planning Area Who Prefer Specific Modes of Communication



n=96; Data collected between August – November 2021

Research has proven that outreach projects work. However, awareness of the hazard is not enough. People need to be told what they can do about the hazard, so projects should include information on safety, health, and property protection measures. Research has also shown that a properly run local information program is more effective than national advertising or publicity campaigns.

B.1.4 Technical Assistance

While general information helps, most property owners do not feel ready to take major steps, like retrofitting their buildings, without help or guidance. Local building department staff members are experts in construction. They can provide free advice, not necessarily to design a protection measure, but to steer the owner onto the right track.

Building, public works, and engineering staff members visit properties and offer suggestions. Most can recommend or identify qualified or licensed companies, an activity that is especially appreciated by owners who are unsure of the project or the contractor.

Technical assistance can be provided in one-on-one sessions with property owners or can be provided through seminars. For instance, seminars or “open houses” can be provided on retrofitting structures, selecting qualified contractors, and carrying out preparedness activities.

B.1.5 Map Information

Many benefits stem from providing map information to inquirers. Residents and businesses that are aware of the potential hazards can take steps to avoid problems and reduce their exposure to flooding, dam failure or releases, expansive soils, and other hazards that have a geographical distribution. Real estate agents and house hunters can find out if a property is flood-prone and whether flood insurance may be required.

Maps provide a wealth of information about past and potential hazards. Geographic Information Systems can provide efficiency and add to capabilities of many government services. Assessors, public works, parks and recreation, and 911 services are all typical departments capable of applying GIS applications to improve their services. GIS allows trained users to complete comprehensive queries, extract statistical information, and completely manage all relevant spatial information and the associated attribute information that pertain to those departments.

Flood maps

Several legal requirements are tied to FEMA’s Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study Maps. These include building regulations and the mandatory purchase of flood insurance. FEMA provides floodplain and FIRM information as a mitigation service. Local officials can help residents submit requests for map amendments and revisions when these are needed to show that a building is outside the mapped floodplain.

Although FEMA maps are accurate, users and inquirers must remember that maps are not perfect. They display only the larger flood-prone areas that have been studied. In some areas, watershed developments make even recent maps outdated. Those inquiring about flood maps must be reminded that being outside the mapped floodplain is no guarantee that a property will never flood. In fact, many properties that flood are not located in a designated floodplain.

By taking the initiative locally to accurately map problem areas with information not already on FEMA maps, a community can warn residents about potential risks that may not have been anticipated. Upgrading maps provides a truer measure of risks to a community.

Other Hazard Data

Other data that can be shown on maps include those hazards that are distributed geographically. These include:

- Dam breach inundation areas
- Levee failure inundation areas
- Expansive soils
- Wildfire risk zones
- Earthquake risk zones
- Hazardous materials sites
- Wetlands

General location maps for many of these natural and man-made hazards have been developed by USACE, Oklahoma Geological Survey, and Meshek and Associates, several of which are included in this plan.

B.1.6 Libraries

The Ponca City Library can serve as locations to hold information on hazards, hazard protection, and protecting natural resources. Historically, libraries have been the first place people turn to when they want to research a topic. Although this has changed with the development of the internet, interested property owners can read or check out handbooks or other publications that cover their situation. The libraries also have their own public information campaigns with displays, lectures, and other projects, which can augment the activities of the local government.

The local public library System maintains flood related documents required under the NFIP and CRS. The documents are available to the public in the library.

B.1.7 Web Sites

Today, the internet is the primary research tool that provides quick access to a wealth of public and private sites and sources of information. Through links to other Web sites, there is almost no limit to the amount of up-to-date information that can be accessed by the user. The development of smart tools, including GIS mapping, updated weather data, digital risk mapping (e.g. floodplain) can give local officials and residents a better understanding of the areas of greatest risk before, during, and after disasters.

B.1.8 Real Estate Disclosure

After a flood or other natural disaster, people often say they would have taken steps to protect themselves if they had known their property was exposed to a hazard.

Flood insurance is required for buildings located within the base floodplain if the mortgage or loan is federally insured. However, because this requirement has to be met only ten days before closing, applicants are often already committed to purchasing a property when they first learn of the flood hazard.

The "Residential Property Condition Disclosure Act" requires sellers to provide potential buyers with a completed, signed and dated "Residential Property Condition Disclosure Statement". Included in the statement are disclosures regarding flooding and flood insurance.

B.1.9 Firewise Communities

While incorporating components from several of the different mitigation strategies, Firewise primarily depends on homeowners taking actions to protect their own property, so Public Education and Information is key to the success of the Firewise program. While it is not possible, or in many cases even desirable, to prevent wildfires, it is certainly possible, by interrupting the natural flow of the fire, to assure that wildfires will not produce catastrophic home or crop losses.

Firewise Community USA is a project of the National Wildfire Coordinating Group. It recognizes communities that have gone through a process to reduce the dangers of wildfires along what is referred to as the Wildland-Urban Interface (WUI). Additional information on the Firewise Community program can be found at www.firewise.org/usa. In order to become a Firewise Community, a community can:

1. Contact a Firewise Specialist. In Oklahoma, the Firewise Specialist may be reached through the Oklahoma Department of Agriculture, Forestry Services. The Specialist will coordinate with local fire officials to schedule a site visit and assess the community.
2. The community will create a Firewise Board that includes homeowners, fire professionals, and other stakeholders.
3. The Firewise Specialist will schedule a meeting with the Board to present the assessment report for review and acceptance.

4. The Board will use the report to create agreed-upon, area-specific solutions to the fire issues, which the Specialist will review and, if acceptable, will work with the community to seek project implementation funds, if necessary.
5. Local solutions will be implemented following a schedule designed by the local Board and the Specialist, A permanent Firewise task force or committee is created that will maintain the program into the future.
6. A completed plan and registration form will be submitted to Firewise Communities/USA for formal recognition of the Community.

B.1.10 Business Continuity Planning and Mitigation

While Business Continuity Planning (BCP) can include portions from many of the categories listed in this chapter, an integrated program for businesses is a frequently neglected component in a community's mitigation strategy. It has been demonstrated repeatedly that many businesses that close their doors following a disaster either fail to re-open, or struggle to remain open following the event. This is especially true of small to medium businesses that may rely on a limited number of locations and a narrow customer base, or may not have the economic reserves to recover from financial losses. The lack of ability to recover may be for several reasons:

- Absenteeism from employees who are affected or who have affected family members;
- Psychological trauma from losing co-workers;
- Loss of an irreplaceable executive or manager;
- Economic stress on the business from having to make repairs and replenish stock over and above what may be covered by insurance;
- Loss of revenue from having the doors closed for even a short period of time;
- Loss of the customer base, either from people who are forced to evacuate the area or who may not have immediate disposable income for the company's products;
- Loss of a critical customer or the vendor of a critical inventory item ("upstream" and "downstream" issues);
- Loss of critical data, either paper or electronic records;
- An interruption in community infrastructure (utilities, road access, media losses, etc.).
- In addition, the loss of a business, even for a short period of time, may adversely affect the community in many ways, some of which may include:
 - Loss of tax revenue
 - Loss of jobs for community residents
 - Loss of access to the company's products (especially significant if the company supplies an essential service or product, such as construction equipment, medications, transportation, or groceries)

Effective Business Continuity Planning (BCP) may include such activities as:

- Making regular back-ups of critical data and keeping it in an off-site location
- Maintaining accurate contact information (phone, e-mail, pager, etc.) on critical employees
- Identifying potential off-site locations that can be used in case the primary location of the company is damaged or inaccessible
- Reviewing all activities of a company and identifying which activities are critical and must resume right away, which are less critical and may not need to resume for a short period of time, and which activities can be put on hold for a longer period of time
- Developing "canned" PR pieces that can be quickly disseminated in the event of an incident at the company
- Having an honest conversation with insurers to determine that policies are sufficiently inclusive and appropriate for the business
- Communicating with suppliers and critical customers on what their emergency response and business resumption plans include.

Business continuity planning can be facilitated by the community in a number of ways, primarily in the area of Public Information. The Chamber of Commerce may sponsor programs such as the Institute for Business & Home Safety's (IBHS) *Open For Business* presentation.

The American Red Cross has also teamed with the Federal Emergency Management Agency to produce the Emergency Management Guide for Business and Industry. More information is available at www.redcross.org/services/disaster/0,1082,0_606_,00.html.

Several professional groups such as the Association of Contingency Planners or the professional organization of Records & Information Management professionals (ARMA) may be available in your area to assist with developing disaster preparedness and mitigation plans or exploring ways to safeguard critical records and information.

In addition, if a community is promoting Community Emergency Response Teams (CERT), business CERTs can be developed to respond to a disaster, not only within a neighborhood, but also within a business establishment. CERTs are trained in disaster organization, immediate disaster evaluation, immediate disaster first aid, light search and rescue, and light fire suppression.

B.1.11 Conclusions

1. There are many ways public information programs can be used so people and businesses will be more aware of hazards they face and how they can protect themselves.
2. Most public information activities can be used to advise people about all hazards, not just floods.
3. Other public information activities require coordination with other organizations, such as schools and real estate agents.
4. There are several area organizations that can provide support for public information and educational programs.

B.1.12 Recommendations

The areas of greatest likelihood to strengthen the community in this area would include identifying and developing a Public Education and Outreach manager,, and coordinating with other agencies engaged in these kinds of activities. In addition, the recent ice storms have indicated a strong need for developing business continuity support for the small business community. Refer to *Chapter 5: Mitigation Strategy* for a complete listing of all recommended mitigation measures by hazard and priority.

B.2 Preventive Measures

Preventive activities are designed to keep matters from occurring or getting worse. Their objective is to ensure that future development does not increase damages or loss of life, and that new construction is protected from those hazards. Preventive measures are usually administered by building, zoning, planning, and code enforcement offices. They typically include planning, zoning, open space preservation, building codes, drainage criteria, master drainage plans and floodplain development regulations, and stormwater management.

The first three measures (planning, zoning, and open space preservation) work to keep damage-prone development *out* of hazardous or sensitive areas.

The next two measures (building codes and floodplain development regulations) impose standards on what is allowed to be built *in* the floodplain. These protect buildings, roads, and other facilities from flood damage and prevent the new development from making any existing flood problem worse. Building codes are also critical to mitigating the impact of non-flood hazards on new buildings.

Stormwater management addresses the runoff of stormwater from new developments onto other properties and into floodplains.

B.2.1 Planning

While plans generally have limited authority, they reflect what the community would like to see happen in the future. Plans guide other local measures such as zoning, capital improvements, and the development of ordinances.

B.2.2 Zoning

Zoning ordinances are considered the primary tool to implement a comprehensive plan's guidelines for how land should be developed (see Chapter 3 for more information on deficiencies).

B.2.3 Floodplain Development Regulations

Most communities with a flood problem participate in the National Flood Insurance Program (NFIP). The NFIP sets minimum requirements for subdivision regulations and building codes. These are usually spelled out in a separate ordinance.

Experience showed that the National Flood Insurance Program's minimum standard is insufficient for developing urban communities, including the City of Ponca City. The city's regulations exceed the NFIP's minimum national standards in several significant ways.

Community Rating System

The Community Rating System (CRS) is a companion program to the NFIP. It rewards a community for taking actions over and above minimum NFIP requirements with the goal of further reducing flood damages in the community. The more actions a community takes, the lower the premiums for flood insurance within that community.

Subdivision regulations govern how land will be subdivided into individual lots and set the construction and location standards for the infrastructure the developer builds to serve those lots, including roads, sidewalks, utility lines, storm sewers, and drainageways. They provide an additional vehicle for floodplain development rules. For example, some communities require that every subdivision in a floodplain provide a building site above the flood level for every lot and/or require streets to be at or no more than one foot below the base flood elevation.

Floodplains are only part of flood-management considerations. Water gathers and drains throughout entire watersheds, from uplands to lowlands. Each watershed is an interactive element of the whole. A change at one

place can cause changes elsewhere, whether planned or inadvertent. Ponca City is continuing the process of updating and refining comprehensive, basin-wide Master Drainage Plans that identify existing and potential future drainage and flooding problems to public facilities and private property.

CRS uses three factors to measure the impact of stormwater management regulations on downstream flooding:

1. What developments have to account for their runoff? If only larger subdivisions have to detain the increased runoff, the cumulative effect of many small projects can still produce greater flows to downstream properties.
2. How much water is managed? Historically, local stormwater management programs address smaller storms, such as the 2- or 10-year storms. The CRS reflects the growing realization nationally that the runoff from larger storms must be managed. It provides full credit only for programs that address all storms up to the 100-year storm.
3. Who is responsible to ensure that the facility works over time? Roads and sewers are located on dedicated public rights-of-way and the community assumes the job of maintaining them in the future. Stormwater management detention basins have traditionally stayed on private property and maintenance has been left up to owner. Often homeowners associations do not know how and do not have the capability to properly maintain these facilities. Half the CRS credit is based on whether the community assumes responsibility to ensure that the facilities are maintained.

B.2.4 Stormwater Management

Development outside a floodplain can contribute significantly to flooding problems. Runoff is increased when natural ground cover is replaced by urban development. To prevent stormwater from flooding roads and buildings, developers construct storm sewers and improve ditches to carry the water away more efficiently.

As watersheds develop, runoff usually becomes deeper and faster and floods become more frequent. Water that once lingered in hollows, meandered around oxbows, and soaked into the ground now speeds downhill, shoots through pipes, and sheets off rooftops and paving.

Insurance purposes require that NFIP floodplain maps must be based on existing watershed development, but unless plans and regulations are based on future watershed urbanization, development permitted today may flood tomorrow as uphill urbanization increases runoff.

This combination of increased runoff and more efficient stormwater channels leads to increases in downstream storm peaks and changes in the timing when storm peaks move downstream. Unconstrained watershed development often will overload a community's drainage system and aggravate downstream flooding.

A second problem with stormwater is its impact on water quality. Runoff from developed areas picks up pollutants on the ground, such as road oil and lawn chemicals, and carries them to the receiving streams.

The planning area enforces the NFIP minimum regulations and maps, in order to maintain eligibility for federal flood insurance.

Retention / Detention

Some communities with stormwater management regulations require developers to build retention or detention basins to minimize the increases in the runoff rate caused by impervious surfaces and new drainage systems. Generally, each development must not let stormwater leave at a higher rate than under pre-development conditions.

The Community Rating System (CRS) uses three factors to measure the impact of stormwater management regulations on downstream flooding:

4. What developments have to account for their runoff? If only larger subdivisions have to detain the increased runoff, the cumulative effect of many small projects can still produce greater flows to downstream properties.
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Watershed Approaches

The standard regulatory approach of requiring each development to manage stormwater to the same criteria has several shortcomings:

1. It does not account for differences in stream and watershed conditions (although the standards can be revised to reflect findings from watershed studies).
2. Municipalities within the same watershed may require different levels of control of stormwater.
3. There is no review of the downstream impacts from runoff or any determination of whether the usual standards compound existing flooding problems.
4. It results in many small basins on private property that may or may not be properly maintained.

The way to correct these deficiencies is to conduct a master study of the watershed to determine the appropriate standards for different areas and, sometimes, to identify where a larger central basin would be more effective and efficient than many smaller ones. The CRS provides up to double the stormwater management regulations credit if communities adopt such master plans.

B.2.5 Building Codes

Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. These standards should include criteria to ensure that the foundation will withstand flood forces and that all portions of the building subject to damage are above, or otherwise protected from, flooding.

Building codes are also a prime mitigation measure for other natural hazards, especially earthquakes, tornadoes, windstorms and heat and cold. When properly designed and constructed according to code, the average building can withstand the impacts of most of these forces. The code could include provisions such as:

- Requiring sprinkler systems for fire protection in larger or public buildings,
- Regulating overhanging masonry elements that can fall during an earthquake,
- Ensuring that foundations are strong enough for earth movement and that all structural elements are properly connected to the foundation, and
- Making sure roofing systems will handle high winds and expected snow loads.

B.2.6 IBHS Fortified Home Program

The *Fortified...for Safer Living* home program gives builders and homeowners a set of criteria for upgrades that help reduce the risk of damage from natural disasters. The program raises a homes' overall safety above building code minimum requirements. During construction and upon completion a home is inspected and certified as a "Fortified...for Safer Living" home.

The combination of materials and techniques produces residences equipped to better resist hurricanes, tornadoes, fire and floods. The fortified home construction method produces homes that are comfortable while being resistant to natural disasters. The following are features of a “Fortified...for Safer Living” home:

- The home and critical utilities are elevated by reinforced continuous piles a minimum of two feet above ground-level walls, stairs and Base Flood Elevation (BFE).
- The home is connected from the peak of the roof to the foot of the reinforced piles to form a continuous load path capable of withstanding 130 mph winds.
- Windows, doors and other openings are properly flashed and protected to withstand the impact of windborne debris without penetration of wind and water.
- The roof truss system has a 110 mph wind rated covering, a secondary moisture barrier, twice the required underlayment, thicker plywood deck sheathing and a stronger holding nail and nailing pattern.
- Other features include non-combustible roof materials, reinforced entry garage doors and landscaping techniques reducing wildfire and flooding vulnerability.
- A certified inspector verifies all required Fortified home products and materials are installed correctly in accordance with manufacturer’s specifications for “Fortified...for Safer Living” program specifications.
- The home and property are also verified to be a low risk hazard for exposure to wildfire.

Depending on the quality of the material the buyer chooses, the cost to add fortified features could be as low as five percent of the total cost of a new home.

Cost (existing home)

Many of the fortification techniques used to build new homes are too expensive as retrofits. Fortifying is much more expensive when a home is already built. However, there are creative ways to reduce costs and still fortify an existing home. Improving roof decking on an existing structure would cost about \$5,000. For \$50 a certain type of glue gun available in most hardware stores can retrofit a roof as effectively as if a new roof had been put on with wood screws.

Savings Example

In Florida, a fortified home has been able to save homeowners over 20% in insurance premiums. A standard brick, stone, or masonry house in a coastal area, with a deductible of \$500 and a 2% hurricane deductible, would generate an annual premium of \$2,240. In contrast, the same home with the additional fortified construction features would pay an annual premium of \$1,746, a savings of \$504, or 22.5%. Also, underwriting guidelines may be relaxed for fortified homes. Insurers may make exceptions for fortified homes in areas where they wouldn’t normally write policies.

Lower deductibles may be available. In Florida, policies covering wind damage typically have a deductible of 2% of the covered amount. On a \$150,000 home the deductible would be \$3,000. Fortified homeowners may be eligible for a flat deductible of \$500.

As for intangible savings, personal photographs, important family documents and computer data are just a few of the items a fortified home may protect. Additionally, there is the inconvenience and cost of other living arrangements while a home is being rebuilt.

B.2.7 Smoke Detectors

Smoke detectors save lives. Approximately two-thirds of fatal fires occur in the 10% of homes not protected with smoke detectors. You are twice as likely to die in a fire if you do not have a properly operating smoke detector.

There are two basic types of smoke detectors - photoelectric and ionization. Photoelectric smoke alarms generally are more effective at detecting slow-smoldering fires, fires that might smolder for hours before bursting

into flames. Ionization smoke alarms are more effective at detecting fast-flaming fires, fires that consume materials rapidly and spread quickly.

Test smoke detectors every month, change the batteries twice per year, clean detectors at least once per year and replace smoke detectors every 10 years.

B.2.8 Hurricane Fasteners

A home's roof system is its most vulnerable and expensive component. Hurricane roof-to-wall and additional straps are metal connectors designed to hold a roof to its walls in high winds. They make a home's roof-to-wall connection five-to-15 times stronger than traditional construction and can prevent damage in winds at least 75 mph. In many coastal communities, reinforcing connections are enforced as a code restriction for new homes. Although designed to protect roofs during the extended and violent winds of hurricanes, these fasteners have proven effective in preventing roof removal in tornado events.

B.2.9 Mobile Home Tie-Downs

Tie-downs are devices that anchor or otherwise secure a mobile home to the ground in order to protect the mobile home and its surroundings from damage caused by wind and/or other natural forces. All tie-downs should comply with the specifications of the home manufacturer or, in the absence of such specifications, with standards set by the a Building Inspector.

Anchors are available for different types of soil conditions, including concrete slab. Auger anchors have been designed for both hard soil and soft soil. Rock anchors or drive anchors allow attachment to a rock or coral base. This type of anchor is also pinned to the ground with crossing steel stakes.

B.2.10 Lightning Warning Systems

There are two basic types of warning systems:

Strike Location and Identification Systems sense the electromagnetic pulse or the electrostatic pulse that accompanies a lightning discharge. Sensors and processing equipment work from those pulses or transients. These systems are most useful for tracking storms, locating a lightning strike and producing density plots of lightning activity by geographical area. They do not provide early warning of an impending storm.

Pre-storm Warning Systems sense the conditions that precede a storm. All severe storms create a related electrostatic field. This field provides a reliable storm signature that is peculiar to severe storms and can be related to the severity of the storm. That signature is present prior to lightning activity and provides a measurable parameter for pre-storm warning. The electrostatic field strength is directly related to the state of the storm and/or its proximity to the site. Therefore, an increase in the electrostatic field is an indicator of a storm moving into or building up over the area. The warning time is determined by the rate of buildup or the rate of movement of the storm.

Essential companions to any type of lightning warning system include:

- A written Lightning Safety Policy;
- Designation of Primary Safety Person;
- Determination of when to suspend activities;
- Determination of Safe/Not Safe Shelters;
- Notification to Persons at Risk;
- Education: at a minimum consider posting information about lightning and the organization's safety program;
- Determination of when to resume activities.

The above options can be developed with many variations, up to and including all-in-one units that include a lightning threat detector, strobe light and 360° warning horn, and fully-automated programmable computer to pre-set various options for different types of facilities, such as times of operation, degrees of sensitivity, and appropriate sounding of an “all clear” signal.

B.2.11 Power Outages from Winter Storms

Power outages from winter storms can lead to an abundance of problems. Traffic can be disrupted with the loss of traffic signals. Homeowners without power will resort to candles or open flames for heat and light. Generators are noisy, produce potentially deadly exhaust and can cause power spikes damaging equipment. Kerosene heaters burn oxygen and increase the potential of asphyxiation and production of carbon monoxide. With fuel burning equipment there is a constant danger of fire or explosion, burns and breathing poisonous exhaust. In addition, the inability to heat a home increases the risk of pipes freezing. Power lines can be protected and power outages prevented by:

- Replacing existing power lines with heavier T-2 line, shorter spans, and heavier poles and crossbars. It is estimated this will increase the overall strength of power distribution lines by 66%.
- Burying utility lines. This removes the risk of power outages due to ice accumulation or tree limbs bringing down power lines.
- Pruning trees away from power lines and enforcing policies regarding tree limb clearances.
- Designed failure, allowing for lines to fall or fail in small sections rather than as a complete system.

When power outages occur, the first imperative in emergency power planning is to equip essential facilities with permanent backup power, and to make sure existing backup sources are properly sized and maintained. Essential post-disaster services include:

- Medical care
- Drinking water supply
- Police and fire protection
- Refrigeration
- Communications
- Pollution control (especially wastewater treatment)
- Transportation (especially airports and seaports)
- Weather forecasting
- Temporary relief shelter
- Emergency response command and control

Backup systems should be sized to meet the requirements of a facility's necessary public services. Some facilities, such as wastewater treatment plants and hospitals, are so important that backup systems should be sized to carry full loads. All backup power systems should be covered by a complete and consistent planned maintenance program that includes regular inspection and operational testing.

B.2.12 Standby Electric Generators

Standby electric generators can provide an extra sense of security during unpredictable weather and resulting power outages. But even small, portable electric generators – if used improperly – can threaten resident safety and the safety of power company linemen working on the electrical system. For information on safely purchasing and using a residential generator, see <http://www.redcross.org/prepare/disaster/power-outage/safe-generator-use>.

Before purchasing a generator, consider how it will be used. That will help ensure buying a generator that is correctly sized for the application in mind. Portable, gasoline-driven generators are designed to be used for appliances with cords connected to them. Typically, they are not designed to be connected to a home or building wiring. Citizens should not attempt to install these devices to an electrical panel.

Fixed Generators

Large, fixed generators generally are directly connected to building wiring to provide standby power during emergencies or power outages. However, the wiring needs to be properly installed by a qualified electrical contractor. Properly installing a “permanent” generator is extremely dangerous, and usually requires an electrical permit from the local electrical or building inspector's office. Picking an appropriate fixed-site emergency generator involves a number of issues including:

Type of fuel – Usually a choice between natural gas or diesel, depending on the availability of either fuel in an emergency, and any possible regulations concerning on-site storage. Natural gas emits far fewer exhaust emissions, which may also be a factor.

Proper voltage – It's usually best for an emergency generator to match your standard incoming voltage, whether it's single-phase 120/240 or three-phase 277/480, which is the more common commercial application.

Power requirements – this will entail (a) identifying your critical functions, and (b) having an electrical professional rate the running/start-up kilowatt (kW) requirements for those functions. (See Table B-4 below for some basic power ratings for typical applications.)

Cost – even a small (30-45 kW, 277/480 volt) natural gas standby generator can cost \$10,000, plus expenses for installation and automatic transfer switches. Most emergency operations centers, 911 dispatch centers, and other critical facilities will need a generator with higher requirements.

“Back feeding” - a dangerous condition”- Improperly connecting a portable generator to electric wiring can produce “back feed” – a dangerous current that can electrocute or critically injure residents or others. Back feed into power lines from a generator could create “hot” power lines during an outage. Linemen who expect the line to be de-energized could be injured.

One good way to avoid back feeding is to install a double-pole, double throw transfer-switch gear. A qualified electrical contractor can install this transfer switch so that dangerous back feed can be prevented. “In accordance with the National Electrical Code, paragraph 700-6; Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and emergency sources of supply in any operation of the transfer equipment. Automatic transfer switches shall be electrically operated and mechanically held.” The transfer switch must be a break-before-make switch, which will “break” the electrical connection with commercial power lines before it “makes” the connection between the generator and wiring. The switch also will prevent utility power from damaging the generator when regular service is restored. An electrical diagram of an installation using a transfer switch appears in Figure B-2.

Since transfer switches can be expensive, another way to install a generator is to have a sub-panel with main breakers and power from the main panel or generator. Main panel breaker and generator breaker in sub-panel would have handles interlocked to prevent both from being opened and closed at the same time. This prevents back feed to commercial power when the generator is in use.

For commercial emergency installations, it is also critical that an electrical professional review what the standard and max loads will be on the system. An evaluation needs to be made as to what critical functions need to be operational – HVAC, communications, lighting, security, cooking capabilities, and so on. In health care facilities, assistive devices and water supply equipment can pull large quantities of power, which will need to be taken into account.

B.2.13 Critical Facility Protection

Critical facilities require a higher level of protection because they are vital public facilities, reduce pollution of floodwaters by hazardous materials, and ensure that the facilities will be operable during emergencies. The

Community Rating System (CRS) provides credit for regulations protecting critical facilities from the 500-year flood.

Critical facilities should be constructed on properly compacted fill and have the lowest floor (including basement) elevated at least one foot above the elevation of the 500-year flood. A critical facility should have at least one access road connected to land outside the 500-year floodplain capable of supporting a 4,000-pound vehicle. The top of the road must be no lower than six inches (6") below the elevation of the 500-year flood.

B.2.14 Extreme Heat Protection

Some of the people in the planning area that are more vulnerable to extreme heat is:

- Elderly, children, low-income individuals and people with compromised immune systems are more vulnerable to health risks due to intense climate changes, especially extreme heat.
- Aging is often accompanied by chronic illnesses that may increase susceptibility to extreme environmental conditions. Poverty among elderly increases the risk.
- Children are vulnerable due to their size, behavior and fact that they are growing and developing. Children living in poverty or without access to proper medical care are especially vulnerable.
- Low-income individuals are less likely to be able to afford air-conditioning and have less access to health care.
- Cancer, AIDS and diabetes compromise individual's immune systems. Afflicted individuals are more susceptible to physical stresses such as those during extreme heat.

Steps to protect individuals from the heat include:

- Install window air-conditioners snugly and insulate spaces for a tighter fit.
- Hang shades, draperies, awnings or louvers on windows receiving morning or afternoon sun. Awnings or louvers can reduce heat entering the house by as much as 80%.
- Stay indoors as much as possible. If air conditioning is not available stay on the lowest floor out of the sunshine.
- Drink plenty of water and limit alcoholic beverages.
- Dress in light-colored, loose fitting clothes that cover as much skin as possible.
- Take a cool bath.
- Slow down.

Suggestions for a community heat emergency intervention plan include:

- Standardizing guidelines for providing warnings to the public, including not only the National Weather Service, but also Emergency Medical Services, the Health Department, Emergency Management and other recognized community agencies.
- The public must have access to the steps to take to lessen the likelihood of heat problems, such as staying in air-conditioning, if possible, and drinking plenty of fluids.
- A room air conditioner loan program for bed-ridden/chair-ridden individuals can assist those individuals who cannot physically leave their homes to visit an air-conditioned location each day.
- "Buddy systems" can be established where an individual is assigned to check on people at risk. The "buddy" should be trained to deal with heat related emergencies.
- Utility companies should not be allowed to terminate service during a heat emergency, even if individuals have not paid their bill.

B.2.15 Proper Storage and Disposal of Hazardous Materials

Household chemicals and motor oil dumped down drains or directly onto the ground can work their way into the waterways and ground waters. Oil from a single oil change can ruin one million gallons of fresh water. Used crankcase oil has been reported to account for more than 40% of the oil pollution in waterways.

Most public and private vehicle maintenance facilities have well-developed systems to store their waste oil for recycling. However, "do-it-yourselfers" account for a large percentage of the oil changes in any community. Therefore, it is important for community recycling and solid waste management programs to include a system for waste oil collection and provide ways to collect and dispose of household chemicals.

Many counties and communities offer household pollutant collection events. Among the pollutants collected are oil-based paints, paint thinners, pesticides, fertilizers, cleansers, acids, ammunition, batteries, motor oil, and antifreeze. Residents are not charged for items collected. Events are typically funded by participating communities.

Containers of hazardous materials should not be located in a flood hazard area. If such a location is necessary hazardous material containers need to be anchored. Contents can contaminate water and multiply the damaging effects of flooding by causing fires or explosions, or by otherwise making structures unusable. Buoyant materials should be anchored. If they float downstream they may cause additional damage to buildings or bridges or may plug a stream resulting in higher flood heights.

Websites, such as earth911.com, provide lists of hazardous waste recycling centers and used oil collection facilities based on zip code and materials.

B.2.16 Water Conservation

97% of the earth's water is in the oceans and 2% is trapped in icecaps and glaciers, leaving only about 1% of the earth's water available for human consumption. The water supply is taxed to supply all the competing interests: residential - including drinking and sanitation, manufacturing, environmental, agricultural, and recreational.

Conserving water conserves energy - gas, electric or both, reduces monthly water and sewer bills and postpones the construction of or eliminates the need to build expensive capital projects such as wastewater or water treatment plants that will need future maintenance.

Plumbing codes implemented in Phoenix Arizona in 1990 required low-flow faucets, shower heads, and toilets. Since then water consumption per capita has decreased 27 percent. Other cities, such as Wilsonville, Oregon, have implemented an inverted block water rate structure charging customers higher rates as water consumption increases.

Public education can have the most significant impact. Household water conservation tips include:

- Updating plumbing fixtures with low-flow devices.
- Keeping a pitcher of water in the refrigerator instead of running the tap.
- Watering the yard and gardens in the morning or evening when temperatures are cooler to minimize evaporation.
- Collecting water used for rinsing and reusing it to water plants.
- Turning off the water while brushing teeth and shaving.
- Landscaping with drought-resistant, low water use plants.
- Using a hose nozzle and turning off the water while washing cars.

B.2.17 Open Space Preservation

Keeping the floodplain open and free from development is the best approach to preventing flood damage. Preserving open space is beneficial to the public in several ways. Preserving floodplains, wetlands, and natural water storage areas maintains the existing stormwater storage capacities of an area. These sites can also serve as recreational areas, greenway corridors and provide habitat for local flora and fauna. In addition to being preserved in its natural landscape, open space may also be maintained as a park, golf course, or in agricultural use.

B.2.18 Conclusions

1. Planning and zoning will help the planning area develop the community proactively so that the resulting infrastructure is laid out in a coherent and safe manner.
2. Building codes for foundations, sprinkler systems, masonry, and structural elements such as roofs are prime mitigation measures for occurrences of floods, tornadoes, high winds, extreme heat and cold, lightning strikes, and earthquakes.
3. Public education (see Section 0.1) can demonstrate preventive measures individuals and businesses can use to protect their own lives and facilities.
4. The planning area participates in the NFIP and uses subdivision regulations to control the direction of floodplain development.
5. Deficiencies in stormwater management can be corrected by conducting a master study of watersheds to determine appropriate standards for different areas.

B.2.19 Recommendations

Refer to *Chapter 5: Mitigation Strategy*, for a complete listing of all recommended mitigation measures by hazard and priority.

B.3 Structural Projects

Structural projects are usually designed by engineers or architects, constructed by the public sector, and maintained and managed by governmental entities. Structural projects traditionally include stormwater detention reservoirs, levees and floodwalls, channel modifications, drainage and storm sewer improvements, and community tornado safe-rooms.

B.3.1 Safe Rooms

Safe rooms are specially constructed shelters intended to protect occupants from tornadoes and high winds. Constructed of concrete and steel, properly built safe rooms can provide protection against wind speeds of 250mph and airborne debris traveling as fast as 100mph.

A safe room can be incorporated into the construction of a new home, or can be retrofitted above or below ground into an existing home. The cost of constructing a safe room is between \$2500 and \$6000, depending on the room size, location and type of foundation on which the home is built. Safe rooms can function year-round as a usable area, such as a bathroom, closet or utility room.

The State of Oklahoma, FEMA and communities may offer reimbursement grants for construction of certain categories of Safe Rooms through the Hazard Mitigation Grant Program (HMPG).

FEMA 320, *Taking Shelter From the Storm: Building a Safe Room Inside Your Home* has specific designs for tornado and hurricane safe rooms. To obtain a copy of FEMA 320 refer to <http://www.fema.gov/safe-room-resources/fema-p-320-taking-shelter-storm-building-safe-room-your-home-or-small-business>.

National Storm Shelter Association

The National Storm Shelter Association (NSSA) is an industry organization developed to ensure the highest quality of manufactured and constructed storm shelters. The NSSA has developed a program to verify that design, construction, and installation of storm shelters are in compliance with the most comprehensive and extensive safety standards available. Without full compliance with the standard, vulnerabilities may exist and safety may be compromised. Shelter-producing members of the NSSA submit shelter designs to the scrutiny of an independent third-party engineering company and have their shelters tested for debris impact resistance (FEMA 320 designs have been tested). In addition they will file a certificate of installation with NSSA for each shelter.

Upon building or installing a storm shelter, the member applies a seal to the shelter certifying that it is designed, built, and installed to meet the NSSA standard. Only the shelter producer or an agency that carefully inspects the shelter design, construction, and installation may certify compliance with an applicable standard. Claims of “FEMA Certified” or “Texas Tech Certified” are misleading since neither FEMA nor the Texas Tech Wind Science and Engineering Research Center (contributors to the FEMA standards for individual and community SafeRooms) certifies shelter quality. This program not only provides assurance to the user of a storm shelter that it has been built to a certain performance standard, but it shifts some responsibility from the community to provide verification from building inspectors for compliance and reduces building inspectors’ training requirements. Additional information on the NSSA certification program can be obtained at www.nssa.cc.

B.3.2 School Safe Rooms

In the past, a school’s interior areas, especially hallways, have been designated as the best place to seek refuge from violent storms. However, in 1999 the hallways of two schools in Sedgwick County, Kansas received significant damage which could have resulted in student casualties had school been in session.

FEMA 361 publication, *Design and Construction Guidance for Community Shelters*, provides guidelines for constructing school safe rooms. A community shelter strong enough to survive a violent storm can also be used as a cafeteria, gymnasium or other common area.

Schools, administration buildings, and institutions of higher learning are required to have written plans and procedures in place for protecting students, faculty, administrators, and visitors from natural and man-made disasters and emergencies.

To receive a copy of FEMA 361, see <http://www.fema.gov/safe-room-resources/fema-p-361-design-and-construction-guidance-community-safe-rooms>.

B.3.3 Reservoirs and Detention

Reservoirs control flooding by holding high flows behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate that the river can accommodate downstream. The lake created may provide recreational benefits or water supply (which could help mitigate a drought).

Reservoirs are suitable for protecting existing development downstream from the project site. Unlike levees and channel modifications, they do not have to be built close to or disrupt the area to be protected. Reservoirs are most efficient in deeper valleys where there is more room to store water, or on smaller rivers where there is less water to store. Building a reservoir in flat areas and on large rivers may not be cost-effective, because large areas of land have to be purchased.

In urban areas, some reservoirs are simply manmade holes dug to store floodwaters. When built in the ground, there is no dam for these retention and detention basins and no dam failure hazard. Wet or dry basins can also serve multiple uses by doubling as parks or other open space uses.

B.3.4 Levees and Floodwalls

Probably the best-known flood control measure is an earthen barrier (levee) or concrete (floodwall) erected between the watercourse and the property to be protected. Levees and floodwalls confine water to the stream channel by raising its banks. They must be well designed to account for large floods, underground seepage, pumping of internal drainage, and erosion and scour.

Failure to maintain levees can lead to significant loss of life and property if they are stressed and broken or breached during a flood event. An inspection, maintenance and enforcement program helps ensure structural integrity.

Levees placed along the river or stream edge degrade the aquatic habitat and water quality of the stream. They also are more likely to push floodwater onto other properties upstream or downstream. To reduce environmental impacts and provide multiple use benefits, a setback levee (set back from the floodway) is the best project design. The area inside a setback levee can provide open space for recreational purposes and provide access sites to the river or stream.

B.3.5 Channel Improvements

By improving channel conveyance, more water is carried away at a faster rate. Improvements generally include making a channel wider, deeper, smoother or straighter. Some smaller channels in urban areas have been lined with concrete or put in underground pipes.

B.3.6 Crossings and Roadways

In some cases, buildings may be elevated above floodwaters, but access to the building is lost when floodwaters overtop local roadways, driveways, and culverts or ditches. Depending on the recurrence interval between floods, the availability of alternative access, and the level of need for access, it may be economically justifiable to elevate some roadways and improve crossing points.

For example, if there is sufficient downstream channel capacity, a small culvert that constricts flows and causes localized backwater flooding may be replaced with a larger culvert to eliminate flooding at the waterway crossing point. The potential exacerbating of adjacent or downstream flooding needs to be considered before implementing any crossing or roadway drainage improvements.

B.3.7 Drainage and Storm Sewer Improvements

Man-made ditches and storm sewers help drain areas where the surface drainage system is inadequate, or where underground drainageways may be safer or more practical. Storm sewer improvements include installing new sewers, enlarging small pipes, and preventing back flows. Particularly appropriate for depressions and low spots that will not drain naturally, drainage and storm sewer improvements usually are designed to carry the runoff from smaller, more frequent storms.

Because drainage ditches and storm sewers convey water faster to other locations, improvements are only recommended for small local problems where the receiving stream or river has sufficient capacity to handle the additional volume and flow of water. To reduce the cumulative downstream flood impacts of numerous small drainage projects, additional detention or run-off reduction practices should be provided in conjunction with the drainage system improvements.

B.3.8 Drainage System Maintenance

The drainage system may include detention ponds, stream channels, swales, ditches and culverts. Drainage system maintenance is an ongoing program to clean out blockages caused by an accumulation of sediment or overgrowth of weedy, non-native vegetation or debris, and remediation of stream bank erosion sites.

“Debris” refers to a wide range of blockage materials that may include tree limbs and branches that accumulate naturally, or large items of trash or lawn waste accidentally or intentionally dumped into channels, drainage swales or detention basins. Maintenance of detention ponds may also require revegetation or repairs of a restrictor pipe, berms or overflow structure.

Maintenance activities normally do not alter the shape of a channel or pond, but they do affect how well a drainage system can do its job. Sometimes it is a very fine line that separates debris that should be removed from natural material that helps form habitat.

B.3.9 Conclusions

1. Reservoirs can hold high flows of water that can later be released slowly or retained for recreational purposes or drought mitigation.
2. Levees and floodwalls are not as effective overall because of possible underground seepage, erosion, degradation of aquatic habitat and water quality, and ineffectiveness in large floods.
3. Channel improvements allow more water to be carried away faster.
4. The effectiveness of elevating buildings depends on the availability of alternative access when flooding occurs.
5. Crossing and roadway drainage improvements must take into account additional detention or run-off reduction.
6. Drainage and storm sewer improvements carry runoff from smaller, more frequent storms.
7. Drainage system maintenance is an ongoing project of removing debris that decreases the effectiveness of detention ponds, channels, ditches, and culverts.

B.3.10 Recommendations

Refer to *Chapter 5: Mitigation Strategies*, for a complete listing of all recommended mitigation measures by hazard and priority.

B.4 Property Protection

Property protection measures are used to modify buildings or property subject to damage from various hazardous events. The property owner normally implements property protection measures. However, in many cases technical and financial assistance can be provided by a governmental agency. Property protection measures typically include acquisition and relocation, flood-proofing, building elevation, barriers, retrofitting, safe rooms, hail resistant roofing, insurance, and the like.

B.4.1 The Role of Officials

Property protection measures are usually considered the responsibility of the property owner. However, local officials should be involved in all strategies that can reduce losses from natural hazards, especially acquisition. There are various roles these officials can play in encouraging and supporting implementation of these measures.

Providing basic information to property owners is the first step in supporting property protection measures. Owners need general information on what can be done. They need to see examples, preferably from nearby.

Financial Assistance

Communities can help owners by helping to pay for a retrofitting project, just like they pay for flood control projects. Financial assistance can range from full funding of a project to helping residents find money from other programs. Some communities assume responsibility for sewer backups and other flood problems that arose from an inadequate public sewer or drain system.

Less expensive community programs include low interest loans, forgivable low interest loans and rebates. A forgivable loan is one that does not need to be repaid if the owner does not sell the house for a specified period, such as five years. These approaches do not fully fund the project but they cost the community treasury less and they increase the owner's commitment to the flood protection project.

Often, small amounts of money act as a catalyst to pique the owner's interest to get a self-protection project moving. These programs have helped install hundreds of projects that protect buildings from low flood hazards.

Acquisition Agent

In most cases, when acquisition of a property is feasible in urban areas, the incorporated governing body is the ultimate owner of the property, but in other cases, the school district or other public agencies can assume ownership and the attendant maintenance responsibilities.

Other Incentives: "Non-financial Incentives"

Sometimes only a little funding is needed to motivate a property owner to implement a retrofitting project. A flood insurance premium reduction will result if a building is elevated above the flood level. This reduction is not enough to take much of a bite out of the cost of the project, but it reassures the owner that he or she is doing the right thing. Other forms of floodproofing are not reflected in the flood insurance rates for residential properties, but they may help with the Community Rating System, which provides a premium reduction for all policies in the community.

Other incentives to consider are programs to help owners calculate the benefits and costs of a project and a "seal of approval" for retrofitted buildings. The latter would be given following an inspection that confirms that the building meets certain standards. There are many other personal but non-economic incentives to protect a property from flood damage, such as peace of mind and increased value at property resale.

B.4.2 Insurance

Insurance has the advantage that, as long as the policy is in force, the property is protected and no human intervention is needed for the measure to work. There are three types of insurance coverage:

1. The standard homeowner's, dwelling, and commercial insurance policies cover against the perils of wildfire and the effects of severe weather, such as frozen water pipes.
2. Many companies sell earthquake insurance as an additional peril rider on homeowner's policies. Individual policies can be written for large commercial properties. Rates and deductibles vary depending on the potential risk and the nature of the insured properties.
3. Flood insurance is provided under the National Flood Insurance Program.

Flood Insurance

Although most homeowner's insurance policies do not cover a property for flood damage, an owner can insure a building for damage by surface flooding through the National Flood Insurance Program (NFIP). Flood insurance coverage is provided for buildings and their contents damaged by a "general condition of surface flooding" in the area.

Building coverage is for the structure. Contents coverage is for the removable items inside an insurable building. A renter can take out a policy with contents coverage, even if there is no structural coverage.

Some people have purchased flood insurance because the bank required it when they got a mortgage or home improvement loan. Usually these policies just cover the building's structure and not the contents.

In most cases, a 30-day waiting period follows the purchase of a flood insurance policy before it goes into effect. The objective of this waiting period is to encourage people to keep a policy at all times. People cannot wait for the river to rise before they buy their coverage.

B.4.3 Acquisition and Relocation

Moving out of harm's way is the surest and safest way to protect a building from damage. Acquiring buildings and removing them is also a way to convert a problem area into a community asset and obtain environmental benefits.

The major difference between the two approaches is that acquisition is undertaken by a government agency, so the cost is not borne by the property owner, and the land is converted to public use, such as a park. Relocation can be either government or owner-financed.

While almost any building can be moved, the cost goes up for heavier structures, such as those with exterior brick and stone walls, and large or irregularly shaped buildings. However, experienced building movers know how to handle any job.

Cost

An acquisition budget should be based on the median price of similar properties in the community, plus \$10,000 to \$20,000 for appraisals, abstracts, title opinions, relocation benefits, and demolition. Costs may be lower after a flood or other disaster. For example, the community may have to pay only the difference between the full price of a property and the amount of the flood insurance claim received by the owner.

One problem that sometimes results from an acquisition project is a "checkerboard" pattern in which nonadjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, prove reluctant to leave. Creating such an acquisition pattern in a community simply adds to the maintenance costs that taxpayers must support.

Relocation can be expensive, with costs ranging from \$30,000 for a small wood frame building to over \$60,000 for masonry and slab on grade buildings. Two story houses are more expensive to move because of the need to relocate wires and avoid overpasses. Additional costs may be necessary for acquiring a new lot on which to place the relocated building and for restoring the old site. Larger buildings may have to be cut and the parts moved separately. Because of all these complications, there are cases where acquisition is less expensive than relocation.

Where Appropriate

Acquisition and relocation are appropriate in areas subject to:

- Flash flooding
- Deep waters
- Dam incident flooding
- Landslides
- Potential hazardous materials spills
- Other high hazard that affects a specific area

Acquisition and relocation are not appropriate for hazards like tornadoes or winter storms because there are no areas safe from the hazard. Relocation is also preferred for large lots that include buildable areas outside the hazardous area or where the owner has a new lot in a safer area.

Acquisition (followed by demolition) is preferred over relocation for buildings that are difficult to move, such as larger, slab foundation, or masonry structures, and for dilapidated structures that are not worth protecting.

B.4.4 Building Elevation

Raising a building above the flood level is the best on-site property protection method for flooding. Water flows under the building, causing little or no damage to the structure or its contents. Alternatives are to elevate on continuous foundation walls (creating an enclosed space below the building) or elevation on compacted earthen fill.

B.4.5 Barriers

Barriers keep surface waters from reaching a building. A barrier can be built of dirt or soil (“berm”) or concrete or steel (“floodwall”). In cases of shallow flooding, regrading a yard can provide the same protection as a separate barrier.

B.4.6 Retrofitting

This term covers a variety of techniques for modifying a building to reduce its susceptibility to damage by one or more hazards.

Where Appropriate

Some of the more common approaches are:

Floods and dam failures:

- Dry floodproofing keeps the water out by strengthening walls, sealing openings, or using waterproof compounds or plastic sheeting on walls. Dry floodproofing is not recommended for residential construction.
- Wet floodproofing, using water resistant paints and elevating anything that could be damaged by a flood, allows for easy cleanup after floodwaters recede. Accessory structures or garages below the residential structure are potential candidates for wet floodproofing.
- Installing drain plugs, standpipes or backflow valves to stop sewer backup.

Tornado:

- Constructing an underground shelter or in-building “safe room”
- Securing roofs, walls and foundations with adequate fasteners or tie downs
- Strengthening garage doors and other large openings

High winds:

- Installing storm shutters and storm windows
- Burying utility lines
- Using special roofing shingles designed to interlock and resist uplift forces
- Installing/incorporating backup power supplies

Hailstorms:

- Installing hail resistant roofing materials

Lightning:

- Installing lightning rods and lightning surge interrupters
- Burying utility lines
- Installing/incorporating backup power supplies

Winter storms:

- Adding insulation
- Relocating water lines from outside walls to interior spaces
- Sealing windows
- Burying utility lines
- Installing/incorporating backup power supplies

Extreme heat and drought:

- Adding insulation
- Installing water saver appliances, such as shower heads and toilets

Fire:

- Replacing wood shingles with fire resistant roofing
- Adding spark arrestors on chimneys
- Landscaping to keep bushes and trees away from structures
- Installing sprinkler systems
- Installing smoke alarms

Earthquake:

- Retrofitting structures to better withstand shaking.
- Tying down appliances, water heaters, bookcases and fragile furniture so they won't fall over during a quake.

Common Measures

From the above lists, it can be seen that certain approaches can help protect from more than one hazard. These include:

- Strengthening roofs and walls to protect from wind and earthquake forces.
- Bolting or tying walls to the foundation protect from wind and earthquake forces and the effects of buoyancy during a flood.
- Adding insulation to protect for extreme heat and cold
- Anchoring water heaters and tanks to protect from ground shaking and flotation

- Burying utility lines to protect from wind, ice and snow.
- Installing backup power systems for power losses during storms
- Installing roofing that is hail resistant and fireproof.

B.4.7 Impact Resistant Windows and Doors

Doors and windows can be the most vulnerable components of your home. During high wind events, such as thunderstorms or tornadoes, wind-driven debris can easily penetrate unprotected or unreinforced windows and doors, breaching the secure envelope of the structure. The debris and rain may cause damage to interior furnishings or harm to residents, but the wind itself can create extreme pressures on the walls and ceiling, leading to catastrophic structural failure. This danger can be mitigated by the installation of impact-resistant windows and doors.

Windows

Today's impact-resistant glass sandwiches a laminated inner layer made of polyvinyl butyral, a plastic, between two sheets of glass. Stronger than a car windshield, the glass might shatter if a heavy object crashes into it, but it won't break to bits. That makes wind less likely to penetrate the envelope of a home and create interior pressure severe enough to blow a roof off. Impact-resistant windows are only as strong, though, as the frame in which they rest.

The second type of impact-resistant glass uses a film applied to the surface. Impact-resistant film is placed over the glass to keep windows from shattering into sharp particles if broken. Since these films are added to the glass, they may not be as effective as a standard impact-resistant system. Their durability depends on how well the glass and protective laminate stay in the frame and window assembly. They will be effective against smaller objects, but larger pieces of debris may still take the window out of the frame. For more information on protective window films and other technologies, visit the International Window Film Association's website. (<http://www.iwfa.com/ConsumerInfo/SafetySecurity.aspx>).

While costs for replacing window glass or using impact-resistant glass in new construction can be expensive, there are additional benefits that may be gained. Impact-resistant glass has been used successfully to reduce burglaries, vandalism and break-ins with both homes and businesses. In addition, using an impact-resistant glazing that is also more energy efficient can produce substantial energy savings. According to the Partnership for Advancing Housing Technology (PATH), a public-private partnership between leaders in the homebuilding, product manufacturing, and insurance industries and several Federal agencies:

Special glass "...can be used to both make windows impact resistant and more energy efficient. Low-E and solar control low-E (also called spectrally selective) coatings can be used to boost the energy efficiency of windows. Low-E double pane windows, most common in cold and moderate climates, are more energy efficient than clear windows because the low-E coating reduces heat loss through the window.

Solar control glass, also called Low E2, is a good glass for hot climates because, in addition to improving the insulating ability of windows, it also limits solar heat gain by blocking passage of infrared and some ultraviolet rays. Solar control glass allows a higher level of visible light to pass through a window with less solar heat gain reduction than tinted window coatings."

Garage Doors

Garage doors are particularly vulnerable, especially doublewide garage doors because of their long span and, frequently, lightweight materials. Reinforced garage door and track systems are available to help avoid that problem. Retrofit kits are also available to reinforce existing garage doors, but the retrofit kits do not provide the same level of protection as system designed to be wind and impact-resistant. (Source: Federal Alliance for Safe Homes – FLASH. www.flash.org.)

B.4.8 Lightning Protection Systems

The purpose of a lightning protection system is to intercept lightning and safely direct its current to ground. If the system is properly designed, installed and maintained it can provide almost 100% protection to buildings.

The system for an ordinary structure includes at least air terminals (lightning rods), down conductors, and ground terminals. These three elements of the system must form a continuous conductive path for lightning current. Many systems of air terminals now may not even be connected to the building. They may be comprised of freestanding cables or towers above or next to the building.

National Fire Protection Association document NFPA 780, *Standard for the Installation of Lightning Protection Systems* describes lightning protection system installation requirements. NFPA 780 is available through <http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=780>.

B.4.9 Surge and Spike Protection

The average home has 2,200 or more power surges annually, 60% of which are generated within the home. Most surges are caused by motors starting in air conditioners, garage doors, refrigerators and other major appliances. Electronic appliances can be damaged or destroyed by over-voltage surges or spikes.

Whole house surge protectors offer the first line of defense against high-energy, high-voltage surges. These devices thwart the energy of the initial surge and reduce it before it reaches electrical appliances. In many cases this level of protection is enough to protect the home. Surge protectors should be sufficient to also provide “spike protection,” which can defend against the extremely high spiking voltage created by lightning strikes. Many surge protectors, while effective against routine voltage fluctuations, may not defend against high level spikes.

Surge protection devices connected directly to appliances offer the second line of defense. They are the only defense against surges within the home as when, for example, a large appliance kicks in. The combination of whole house and point-of-use surge protection provides the best possible protection.

For more information on whole house and point-of-use surge protectors, refer to www.howstuffworks.com/surge-protector.htm.

B.4.10 Landscaping for Wildfire Prevention

The chance of losing property due to wildfire can be reduced using fire prevention landscaping techniques. The amount of cleared space around a home improves its ability to survive a wildfire. A structure is more likely to survive when grasses, trees and other common fuels are removed, reduced or modified to reduce a fire's intensity and keep it away from the structure.

B.4.11 Conclusions

1. Acquisition and relocation of property is the most effective for property protection in the case of hazards that are expected to occur repeatedly in the same locations. Acquisition followed by demolition is preferable.
2. Other methods of property protection for flooding include raising building elevations and building berms and floodwalls.
3. Building modifications are also appropriate for some hazards.
4. Property insurance has the advantage of protecting the property without human intervention.
5. The planning area can help in reducing losses from natural hazards by providing financial assistance, having an acquisition program, and other incentives.

B.4.12 Recommendations

Refer to *Chapter 5: Mitigation Strategy*, for a complete listing of all recommended mitigation measures by hazard and priority.

B.5 Emergency Services

Emergency services measures protect people during and after a hazard event. In the planning area, the City Emergency Management Director coordinates these measures in cooperation with emergency management in nearby counties and communities. Measures include preparedness, threat recognition, warning, response, critical facilities protection, and post-disaster recovery and mitigation.

B.5.1 Threat Recognition

Threat recognition is the key. The first step in responding to a flood, tornado, storm or other natural hazard is being aware that one is coming. Without a proper and timely threat recognition system, adequate warnings cannot be disseminated.

B.5.2 Emergency Alert System (EAS)

Using digital technology to distribute messages to radio, television and cable systems, the EAS provides state and local officials with the ability to send out emergency information targeted to a specific area. The information can be sent electronically through broadcast stations and cable systems even if those facilities are unattended.

Floods

A flood threat recognition system provides early warning to emergency managers. A good system will predict the time and height of the flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels.

On larger rivers the National Weather Service does the measuring and calculating, which is in the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Flood threat predictions are disseminated on the NOAA Weather Wire or NOAA Weather Radio. NOAA Weather Radio is considered by the federal government to be the official source for weather information.

- The National Weather Service issues notices to the public, using two levels of notification:
- *Flood watch*: conditions are right for flooding
- *Flood warning*: a flood has started or is expected to occur

On smaller rivers, local rainfall and river gages are needed to establish a flood threat recognition system. The National Weather Service may issue a "flash flood watch." This means the amount of rain expected will cause ponding and other flooding on small streams and depressions. These events are sometimes so localized and rapid that a "flash flood warning" may not be issued, especially if no gages or other remote threat recognition equipment is available.

Meteorological Hazards

The National Weather Service is the prime agency for detecting meteorological threats, such as tornadoes, thunderstorms, and winter storms. As with floods, the Federal agency can only look at the large scale, e.g., whether conditions are appropriate for formation of a tornado. For tornadoes and thunderstorms, the county or the City can provide more site-specific and timely recognition by sending out spotters to watch the skies when the Weather Service issues a watch or warning.

NOAA All-Hazard Radios

The National Oceanographic and Atmospheric Administration (the parent agency for the National Weather Service) maintains a nationwide network of radio stations broadcasting continuous weather information direct from regional National Weather Service offices. The NWS broadcasts warnings, watches, forecasts, Amber Alerts and other hazard and safety information 24 hours a day. Post-event information is also broadcast for natural hazards (such as tornados and earthquakes) and environmental hazards (such as chemical releases or oil spills).

These broadcasts can be received by any radio capable of receiving the Weather Service frequency. NOAA All Hazard Radios have the additional advantage of being activated by a pre-broadcast signal transmitted by the NWS, coming off standby and sounding an alert tone loud enough to wake sleeping individuals before transmitting the warning message. NOAA Weather Radio receivers can be purchased at many retail stores that sell electronic merchandise. Typical cost of a residential grade NOAA Weather Radio is between \$20 and \$200. For more information on NOAA Weather Radios, see www.nws.noaa.gov/nwr/

Warning

After the threat recognition system tells the CEMA that a flood or other hazard is coming, the next step is to notify the public and staff of other agencies and critical facilities. Earlier and more specific warnings enable more people to implement protective measures. The following are some of the more common warning methods:

Broadcast announcements & EAS	Good tools for delivering an alert to a wide coverage area but not well-suited for delivering “actionable” information to specific population segments. For an EAS to be effective, it is essential for the target audience to be tuned in to a regional station. Actual practice shows this is not always the case, particularly late at night when the general population is asleep.
Door-to-door Notification	Door-to-door notification would be an ideal way to communicate with specific individuals or neighborhoods. However, efficiency is impacted by the number of addresses to be contacted, the number of personnel available to “walk the streets”, and the amount of time available prior to the event (i.e., evacuation). It is highly unlikely that sufficient public safety personnel would be available to effectively provide such door-to-door notification services. Door-to-door also has the potential of putting first responders in harm’s way.
Mass Notification System	Mass notification systems can be used to reach large numbers of citizens quickly and efficiently with warning messages. Citizens are able to enter their contact preferences (phone, text, or email) and opt out of non-emergency messages.
Other Communications Devices	There are other communication devices available that may be able to receive emergency notifications. However, as with Weather Alert Radio, their level of penetration throughout the population is too low to ensure effective delivery. Selecting distinct population segments based on geography with such devices is also a problem.
Outdoor warning sirens	Sirens can be effective in their ability to alert people within hearing distance that a crisis or emergency situation may exist. Outdoor warning sirens and public address systems are commonly located in densely populated urban settings, but are not as useful in rural areas. Sirens are intended to alert the public to implement some pre-determined action (i.e., tune to radio and television for specific information on a hazard). However the public generally has no awareness of the need to do so and often will ignore sirens thinking they are a “test” unless they see the hazard approaching, which is often then too late to take appropriate action. In addition, in many areas, sirens are used only for specific emergencies, such as floods or tornadoes, and are of little use in helping public safety personnel alert residents to other events/crises.

NOAA Weather Radio	Weather Alert Radio, while an invaluable tool, has limited applicability. Lacking proper feedback, public safety and emergency management officials have no way of being sure that everyone in their jurisdiction can be reached with such announcements because, similar to broadcast announcements, the audience must have a NOAA radio, and be tuned in.
Sirens on public safety vehicles	These have many of the same drawbacks as both door-to-door notification and outdoor warning sirens. Emergency vehicle sirens do not provide “actionable” information on how to respond. In addition, crucial emergency service personnel may be tied up when their services are more urgently needed for response.

Adapted from NENA Minimum Standards for Emergency Telephone Notification Systems, NENA 56-003, June 12, 2004

Multiple or redundant systems are the most effective, since people do not hear one warning, they may still get the message from another part of the system. Each has advantages and disadvantages. Outdoor warning sirens can reach the most people quickly (except those around loud noise, such as at a factory or during a thunderstorm), but they do not explain what hazard is coming and cannot be sounded unless a timely means of threat recognition exists. Radio and TV provide a lot of information, but people have to know to turn them on. Telephone trees are fast, but can be expensive and do not work when phones lines are down.

Just as important as issuing a warning is telling people what to do. A warning program should have a public information aspect. People need to know the difference between a tornado warning (when they should seek shelter in a basement) and a flood warning (when they should stay out of basements).

Emergency Telephone Notification Systems (ETNS)

It has become more common to use a “Emergency Telephone Notification System” (frequently referred to as reverse 9-1-1) with which a community can send out a mass telephone announcement to targeted numbers in the 9-1-1 system, effectively supplementing a community’s other warning systems. An effective ETNS can offer certain advantages over other systems:

ETNS systems provide the ability to precisely target populations in specific geographic locations better than existing alternatives, particularly when ETNS systems were integrated with geographic information systems (GIS) maps commonly used by 9-1-1 systems;

The telephone, more than any other communications medium, allows officials to deliver specific actionable information that lets those in harm’s way know exactly what to do, what to expect, or what to look for;

The telephone is always on, providing the opportunity to reach nearly everyone in a target area either live or through voicemail.

Many systems also offer the option of allowing people to call in and retrieve the same message or an updated one. This can reduce the subsequent number of calls to 9-1-1 from people who did not fully understand the message the first time.¹

¹ Source: NENA Minimum Standards for Emergency Telephone Notification Systems, NENA 56-003, June 12, 2004

B.5.3 Response

The protection of life and property is the foremost important task of emergency responders. Concurrent with threat recognition and issuing warnings, a community should respond with actions that can prevent or reduce damage and injuries. Typical actions and responding parties include the following:

- Activating the emergency operations room (emergency management)
- Closing streets or bridges (police or public works)
- Shutting off power to threatened areas (utility company)
- Holding children at school/releasing children from school (school district)
- Passing out sand and sandbags (public works)
- Ordering an evacuation (mayor)
- Opening evacuation shelters (Red Cross)
- Monitoring water levels (engineering)
- Security and other protection measures (police)

An emergency action plan ensures that all bases are covered and that the response activities are appropriate for the expected threat. These plans are developed in coordination with the agencies or offices that are given various responsibilities.

Emergency response plans should be updated annually to keep contact names and telephone numbers current and to make sure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and changing conditions. The end result is a coordinated effort implemented by people who have experience working together so that available resources will be used in the most efficient manner.

Emergency Operations Plan (EOP)

An EOP develops a comprehensive (multi-use) emergency management program which seeks to mitigate the effects of a hazard, to prepare for measures to be taken which will preserve life and minimize damage, to respond during emergencies and provide necessary assistance and to establish a recovery system in order to return communities to their normal state of affairs. The plan defines who does what, when, where and how in order to mitigate, prepare for, respond to and recover from the effects of war, natural disasters, technological accidents and other major incidents / hazards.

The *Comprehensive Preparedness Guide (CPG) 101: Developing and Maintaining Emergency Operations Plans* version 2.0 is available from FEMA. The guide provides ideas and advice to state and local emergency managers in their efforts to develop and maintain an EOP. More information and complete copies of the guide are available through FEMA and their website at <http://www.fema.gov/plan>.

Funding for creating or updating an EOP is available from FEMA. For information on how to obtain funding contact the Oklahoma Office of Homeland Security or go to <http://www.ok.gov/homeland/>.

The State of Oklahoma's Emergency Operations Plan is published on [http://www.ok.gov/OEM/Programs & Services/Planning/State Emergency Operations Plan - EOP.html](http://www.ok.gov/OEM/Programs%20&%20Services/Planning/State%20Emergency%20Operations%20Plan%20-%20EOP.html).

Incident Command System (ICS)

The Incident Command System is the model tool for the command, control and coordination of resources at the scene of an emergency. It is a management tool of procedures for organizing personnel, facilities, equipment and communications. ICS is based upon basic management skills managers and leaders already know: planning, directing, organizing, coordinating, communicating, delegating and evaluating.

Continuity of Operations (COOP) planning should be addressed in the EOP. COOP ensures the essential functions of an organization, including government, can continue to operate during and after an emergency incident. An incident may prevent access to normally operating systems, such as physical plant, data or communication networks, or transportation. Government, business, other organizations, and families should be encouraged to prepare by regularly backing up computer drives, copying essential files, and storing these items in a separate location.

ICS is not a means to wrestle control or authority away from agencies or departments, a way to subvert the normal chain of command within a department or agency, nor is it always managed by the fire department, too big for small everyday events or restricted to use by government agencies and departments. ICS is an adaptable methodology suitable for emergency management as well as many other categories. If leadership is essential for the success of an event or a response, ICS is the supporting foundation for successfully managing that event.

The Incident Command System is built around five major management activities. These activities are:

1. Command – sets objects and priorities and has overall responsibility at the incident or event.
2. Operations – conducts tactical operations to carry out the plan and directs resources.
3. Planning – develops the action plan to accomplish objectives and collects and evaluates information.
4. Logistics – provides resources and services to support incident needs.
5. Finance / Administration – monitors costs, provides accounting, reports time and cost analysis.

The system can grow or shrink to meet changing needs. This makes it very cost-effective and efficient. The system can be applied to a wide variety of situations such as fires, multi-jurisdiction and multi-agency disasters, hazardous material spills and recovery incidents, pest eradication programs and state or local natural hazards management.

Mutual Aid / Interagency Agreements

Local governments should establish mutual aid agreements for utility and communications systems, including 9-1-1. Mutual aid or interagency agreements have value for preventing or responding to other hazard or emergency situations, as fire and police departments often do.

CERT (Community Emergency Response Team)

After a major disaster, local emergency teams quickly become overwhelmed. CERT is designed to have trained groups of citizens in every neighborhood and business ready to assist first responders (police, firefighters and EMSA) during an emergency.

CERT programs train and equip citizens in neighborhoods and businesses enabling them to “self-activate” immediately after a disaster. CERT teams are trained in:

- Disaster preparedness.
- Light fire and suppression.
- Light search and rescue.
- Basic medical care.

FEMA grants have been given to states for funding CERT programs or expanding existing teams. For more information on the CERT program talk to your local emergency management official or visit <http://www.fema.gov/community-emergency-response-teams>

B.5.4 Debris Management

The tornados of May 3, 1999 left an estimated 500,000 cubic yards of debris. Debris in the aftermath of a disaster poses significant health and safety risks. Debris can include fuel containers, chemicals, appliances and explosives.

Two key considerations regarding debris management are the need for rapid removal and protection of the public health and environment. Before a disaster strikes, communities should set up staging area(s) where citizens and cleanup crews can take debris prior to final disposal.

Community members can participate in debris control by securing debris, yard items, or stored objects that may otherwise be swept away, damaged, or pose a hazard if floodwaters would pick them up and carry them away. Additionally, a community can pass and enforce an ordinance regulating dumping.

B.5.5 Critical Facilities Protection

“Critical facilities” generally fall into three categories:

- Buildings or locations vital to the response and recovery effort, such as police and fire stations and telephone exchanges;
- Buildings or locations that, if damaged, would create secondary disasters, such as hazardous materials or utility facilities, or water treatment plants; and
- Locations that would require extraordinary response or preparedness measures, such as hospitals, retirement homes, or childcare facilities.

In addition, since September 11th, FEMA has also included financial institutions as critical facilities, because of the potential devastating effect on the community infrastructure upon their loss.

Protecting critical facilities during a disaster is the responsibility of the facility owner or operator. However, if they are not prepared for an emergency, the rest of the community could be impacted. If a critical facility is damaged, workers and resources may be unnecessarily drawn away from other disaster response efforts. If the owner or operator adequately prepares such a facility, it will be better able to support the community's emergency response efforts.

Most critical facilities have full-time professional managers or staff who are responsible for the facility during a disaster. These people often have their own emergency response plans. Many facilities would benefit from early disaster warning, disaster response planning, and coordination with community disaster response efforts.

Schools are critical facilities not only because of the special population they accommodate, but because they are often identified as shelter sites for a community. Processes and procedures can be developed to determine mitigation priorities incorporated into capital improvement plans that will ensure these buildings function after an event.

Site Emergency Plans

Communities can encourage development and testing of internal emergency plans and procedures, including continuity planning, by businesses and other organizations.

Communities should develop and test site emergency plans for schools, factories, office buildings, shopping malls, hospitals, correctional facilities, stadiums, recreation areas, and other similar facilities.

B.5.6 Post-Disaster Recovery and Mitigation

After a disaster, communities should undertake activities to protect public health and safety, facilitate recovery, and help people and property for the next disaster. Throughout the recovery phase, everyone wants to get “back

to normal.” The problem is, “normal” means the way they were before the disaster. Measures needed include the following:

- Recovery Actions
- Patrolling evacuated areas to prevent looting
- Providing safe drinking water
- Monitoring for diseases
- Vaccinating residents for tetanus
- Clearing streets
- Cleaning up debris and garbage
- Regulating reconstruction to ensure that it meets all code requirements, including the NFIP’s substantial damage regulations

B.5.7 Mitigation Actions

Conducting a public information effort to advise residents about mitigation measures they can incorporate into their reconstruction work

- Evaluating damaged public facilities to identify mitigation measures that can be included during repairs
- Acquiring substantially or repeatedly damaged properties from willing sellers
- Planning for long term mitigation activities
- Applying for post-disaster mitigation funds

Requiring permits, conducting inspections, and enforcing the NFIP substantial improvement/substantial damage regulations can be very difficult for local, understaffed overworked offices after a disaster. If these activities are not carried out properly, not only does the municipality miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations under the NFIP.

B.5.8 StormReady Communities

StormReady, a program started in Oklahoma in 1999, helps arm America's communities with the communication and safety skills needed to save lives and property before and during an event. *StormReady* communities are better prepared to save lives from the onslaught of severe weather through better planning, education, and awareness.

StormReady has different guidelines for different sized communities. To be *StormReady* a community must:

- Establish a 24-hour warning point and emergency operations center.
- Have more than one way to receive severe weather warnings and forecasts and to alert the public.
- Create a system that monitors weather conditions locally.
- Promote the importance of public readiness through community seminars.
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

The economic investment in *StormReady* will depend on current assets. There is currently no grant funding for becoming *StormReady*. However, the Insurance Services Organization (ISO) may provide community rating points to *StormReady* communities. Those points may be applied toward lowering flood insurance rates.

B.5.9 Conclusions

1. Using solid, dependable threat recognition systems is first and foremost in emergency services.

2. Following a threat recognition, multiple or redundant warning systems and instructions for action are most effective in protecting citizens.
3. Good emergency response plans that are updated yearly ensure that well-trained and experienced people can quickly take the appropriate measures to protect citizens and property.
4. To ensure effective emergency response, critical facilities protection must be part of the plan.
5. Post-disaster recovery activities include providing neighborhood security, safe drinking water, appropriate vaccinations, and cleanup and regulated reconstruction.

B.5.10 Recommendations

Refer to *Chapter 5: Mitigation Strategies*, for a complete listing of all recommended mitigation measures by hazard and priority.

B.6 Natural Resource Protection

Natural resource protection activities are generally aimed at preserving and restoring the natural and beneficial uses of natural areas. In doing so, these activities enable the beneficial functions of floodplains and drainageways to be better realized. These natural functions include:

- Storage of floodwaters
- Absorption of flood energy
- Reduction of flood scour
- Infiltration and aquifer/groundwater recharge
- Removal/filtration of excess nutrients, pollutants, and sediments from floodwaters
- Habitat for flora and fauna
- Recreation and aesthetic opportunities, and
- Opportunities for off-street hiking and biking trails

This Section reviews natural resource protection activities that protect natural areas and mitigate damage from other hazards. Integrating these activities into the hazards mitigation program will not only reduce the City's susceptibility to flood damage, but will also improve the overall environment.

B.6.1 Wetland Protection

Wetlands are often found in floodplains and low lying areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as a natural filter, which helps to improve water quality, and provide habitat for many species of fish, wildlife, and plants.

Wetlands are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency under Section 404 of the Clean Water Act. Before a "404" permit is issued, the plans are reviewed by several agencies, including the Corps and the U.S. Fish and Wildlife Service. Each of these agencies must sign off on individual permits. There are also nationwide permits that allow small projects that meet certain criteria to proceed without individual permits.

B.6.2 Erosion and Sedimentation Control

Farmlands and construction sites typically contain large areas of bare exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Sediment tends to settle where the river slows down and loses power, such as when it enters a lake or a wetland.

Sedimentation will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters. When channels are constricted and flooding cannot deposit sediment in the bottomlands, even more is left in the channels. The result is either clogged streams or increased dredging costs.

Not only are the drainage channels less able to do their job, but also the sediment in the water reduces light, oxygen, and water quality and often brings chemicals, heavy metals and other pollutants. Sediment has been identified as the nation's number one nonpoint source pollutant for aquatic life.

Practices to reduce erosion and sedimentation have two principal components:

1. Minimize erosion with vegetation and
2. Capture sediment before it leaves the site.

Slowing surface water runoff on the way to a drainage channel increases infiltration into the soil and reduces the volume of topsoil eroded from the site. Runoff can be slowed down by measures such as terraces, contour strip

farming, no-till farm practices, sediment fences, hay or straw bales (as illustrated), constructed wetlands, and impoundments (e.g., sediment basins and farm ponds).

Erosion and sedimentation control regulations mandate that these types of practices be incorporated into construction plans. They are usually oriented toward construction sites rather than farms. The most common approach is to require applicants for permits to submit an erosion and sediment control plan for the construction project. This allows the applicant to determine the best practices for the site.

One tried and true approach is to have the contractor design the detention basins with extra capacity. They are built first, so they detain runoff during construction and act as sediment catch basins. The extra capacity collects the sediment that comes with the runoff until the site is planted and erosion is reduced.

B.6.3 River Restoration

There is a growing movement that has several names, such as “stream conservation,” “bioengineering” or “riparian corridor restoration.” The objective of these approaches is to return streams, stream banks and adjacent land to a more natural condition, including the natural meanders. Another term is “ecological restoration” which restores native indigenous plants and animals to an area.

A key component of these efforts is using appropriate native plantings along the banks that resist erosion. This may involve “retrofitting” the shoreline with willow cuttings, wetland plants, and/or rolls of landscape material covered with a natural fabric that decomposes after the banks are stabilized with plant roots.

Studies have shown that after establishing the right vegetation, long-term maintenance costs are lower than if the banks were concrete. The Natural Resources Conservation Service estimates that over a ten-year period, the combined costs of installation and maintenance of a natural landscape may be one-fifth of the cost for conventional landscape maintenance, e.g., mowing turf grass.

B.6.4 Best Management Practices

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. State and federal water quality laws have reduced the pollutants that come from these facilities.

Non-point source pollutants come from non-specific locations and are harder to regulate. Examples are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground’s surface by stormwater and flushed into receiving storm sewers, ditches and streams.

Best management practices (BMPs) are measures that reduce nonpoint source pollutants that enter the waterways. BMPs can be implemented during construction and as part of a project’s design to permanently address nonpoint source pollutants.

There are three general categories of BMPs:

1. Avoidance—Setting construction projects back from the stream.
2. Reduction—Preventing runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage.
3. Cleansing—Stopping pollutants after they are *en route* to a stream, such as using grass drainageways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained.

In addition to improving water quality, BMPs can have flood related benefits. By managing runoff, they can attenuate flows and reduce the peaks after a storm. Combining water quality and water quantity measures can result in more efficient multi-purpose stormwater facilities.

Because of the need to clean up our rivers and lakes, there are several laws mandating the use of best management practices for new developments and various land uses. The furthest reaching one is the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) requirements.

Dumping Regulations

NPDES addresses liquid pollutants. Dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' ability to convey or clean stormwater.

Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations need to also apply to "non-objectionable" materials, such as grass clippings or tree branches which can kill ground cover or cause obstructions in channels.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard not realizing that it is needed to drain street runoff. They may not understand how regrading their yard, filling a wetland, or discarding leaves or branches in a watercourse can cause a problem to themselves and others. Therefore, a dumping enforcement program should include public information materials that explain the reasons for the rules as well as the penalties.

Regular inspections to catch violations also should be scheduled. Finding dumped materials is easy; locating the source of the refuse is hard. Usually, the owner of property adjacent to a stream is responsible for keeping the stream clean. This may not be fair for sites near bridges and other public access points.

B.6.5 Conclusions

1. Wetlands play an important role in natural course of flood control, preservation of water quality, and wildlife habitation, making a strong case for their protection.
2. Erosion can be reduced by use of vegetation. Sedimentation should be captured before it leaves its original location with oversized detention basins.
3. Vegetation used along riverbanks works more effectively in river maintenance than using banks made of concrete.
4. Nonpoint source pollutants are best managed by keeping construction projects away from streams, reducing sediment runoff, and using grass drainageways and detention basins for filtration.
5. Dumping regulations need to be communicated to the public and enforced.
6. The establishment and maintenance of wildlife habitat and natural ecosystems should be an important aspect of any drainage system program the City may implement in regards to floodplain management. This can be developed in cooperation with the Oklahoma Department of Wildlife Conservation, allowing aquatic plants and wildlife to be established in stormwater detention ponds and floodways.

B.6.6 Recommendations

Refer to *Chapter 5, Mitigation Actions* for a complete listing of all recommended mitigation measures by hazard and priority.

Appendix C: Critical Facilities

This appendix provides an overview of Critical Facilities in the planning area. It is based on FEMA Community Lifelines (see Chapter 4, Introduction for more information) and the decisions of the core planning team. It is not an exhaustive list. The facilities are organized by Lifeline. “General location” refers to the area where the critical facility is located, not which entity has authority over the facility.

Some of these facilities include acronyms for conciseness. The full title for the acronyms is as follows: MHP (Mobile Home Park), ES (Elementary School), MS (Middle School), HS (High School), CCC (Child Care Center).

Table C-1 Critical Facilities in the Planning Area

Facility Type	Name	Address
Fire Department	Ponca City Fire Department Station 1 - Headquarters	500 East Grand Avenue
Fire Department	Ponca City Fire Department Station 3	627 East Hartford Avenue
Fire Department	Ponca City Fire Department Station 4	2510 Donner Avenue
Fire Department	Ponca City Fire Department Station 2	2600 North Ash Street
Hospital	Alliance Health Ponca City	1900 North 14th Street
Nursing Home	Ponca City Nursing & Rehabilitation Center	1400 North Waverly
Nursing Home	Creekside Village	1500 East Bradley Avenue
Nursing Home	Shawn Manor Nursing Home	2024 Turner Road
Nursing Home	The Renaissance of Ponca City	2616 Turner Road
Nursing Home	Westminster Village, Inc.	1601 Academy Road
Health Services	Kay County Health Department	433 Fairview Avenue
Urgent Care	Urgent Care and Family Practice Center	1715 North 5th Street
Urgent Care	Physicians Urgent Care Clinic	1201 East Hartford Avenue
Urgent Care	Adams Medical Clinic Urgent Care Plus - Ponca City	2101 North 14th Street
Emergency	Ponca City Emergency Operations Center	200 East Oklahoma Avenue
Law Enforcement	Ponca City Police Department	200 East Oklahoma Avenue
Utility Water	Ponca City Water Intake	
Tier II- Hazardous Chemical Facility	Airgas USA LLC	1124 N Waverly
Tier II- Hazardous Chemical Facility	Jupiter Sulphur LLC	200 Jupiter Pky
Tier II- Hazardous Chemical Facility	ConocoPhillips/Ponca City Refinery	1000 S Pine St
Tier II- Hazardous Chemical Facility	Thorn Apple Valley Inc. Ponca City Div.	2000 Thorn Apple Valley Dr
Utility Sewer	Ponca City Wastewater Treatment Plant	2800 S River St
Child Care	Pioneer Tech Center Children's Lab	2101 North Ash
Child Care	Building Blocks Learning Center ii	1304 Princeton Ave
Child Care	Ponca City Head Start	407 S. Ash
Child Care	First Lutheran School	1104 N 4th
Child Care	Building Blocks Learning Center	1519 N. Union
Child Care	Child Development Center	702 E. Grand Ave

Facility Type	Name	Address
Child Care	Kim Waller's Nursery and Preschool	1700 Hathaway St
Child Care	PCA Kids Academy	2313 E. Prospect Avenue
Child Care	St. Mary's School CCC	602 E. Ponca Ave
Mobile Home Park	Big Country MHP	3508 AA Street
Mobile Home Park	Meadowbrook Village MHP	2900 North Union Street
Mobile Home Park	Trailer Village Mobile Home	3200 North 14th Street
Mobile Home Park	Not Available	1213 Shirlee Ave
Private School	First Lutheran School	1104 N 4th St
Private School	St Mary's Catholic School	415 S 7th St
Public School	Garfield ES	600 South 8th Street
Public School	Ponca City West MS	1401 West Grand Avenue
Public School	Ponca City HS	927 North Fifth
Public School	Roosevelt ES	815 East Highland Avenue
Public School	E. M. Trout ES	2109 East Prospect
Public School	Ponca City East MS	612 East Grand
Public School	Woodlands ES	2005 East Woodland Road
Public School	Liberty ES	505 West Liberty
Public School	Union ES	2617 North Union
Public School	Lincoln ES	1501 West Grand Avenue
College	Pioneer Technology Center	2101 N Ash
College	Ponca City Beauty College	3010 N 14th St
Utility Power Plant	Ponca	1420 N Union
Utility Power Plant	Conoco	1200 S. Pine St
Utility Power Plant	Ponca City	1420 N. Union
Utility Power Plant	Ponca City Refinery	1000 S Pine
Utility Water	Ponca City Water Treatment Plant	1801 E Central Ave
Public School	Washington Pre Kg Center	1615 N 7th
Child Care	Building Blocks Learning Center iii	1101 W Grand Ave

Appendix D: Sign-In Sheets

This appendix provides an overview of the personnel (name and position) that participated in the planning process. Sheets from the stakeholder meetings are included in this section, the in-person public event is including, along with a sample sign in sheet from a Core Group meeting (see Chapter 2 for more details).

Sign in Sheet - Stakeholder Meeting #1



Ponca City Hazard Mitigation Plan Update



Date: July 27, 2021

Time: 1:30 p.m. - 4:30 p.m.

Location: Ponca City Commission Chambers-City Hall

1/4

Name	Organization	Title	Phone	Email
 Adam Leaming	PC Public Schools	Exec Dir of Operations	580-304-2668	leamia@pcps.us
 Annie Vest	Meshek & Associates			avest@meshekengr.com
 Bill Smiley	Kaw Dam			William.E.Smiley@usace.army.mil
 Bret Smith	PC Public Schools			smithb@pcps.us
 Chris Henderson	COPC	DEVELOPMENT SERVICES DIR.	580-767-0334	hendecd@poncacityok.gov
 David Myers	Development Authority		580-765-7070	 dmyers@goponca.com
 Eric Newell	COPC	PARKS DIRECTOR		newelek@poncacityok.gov
 Erin Liberton	P66	Relations Coordinator	580-767-3662	Erin.M.Liberton@p66.com
 Frances Coonrod	Century21	Realtor	580-761-1712	frances.coonrod@gmail.com
 Janet Meshek	Meshek & Associates			jmeshek@meshekengr.com
 Jesse Beck	COPC	ASST. CITY ENGINEER		beckje@poncacityok.gov
 Jim Fairbanks	COPC			fairbjv@poncacityok.gov

Called & Cancelled

Called & Cancelled

Called & Cancelled

Below

Sign in Sheet - Stakeholder Meeting #1



Ponca City Hazard Mitigation Plan Update



Date: July 27, 2021

Time: 1:30 p.m. - 4:30 p.m.

Location: Ponca City Commission Chambers-City Hall

2/4

Name	Organization	Title	Phone	Email
<i>Jonah Vasquez</i> Jonah Vasquez	Meshek & Associates	PROJECT MANAGER	405-618-2981	jvasquez@meshekengr.com
<i>Kacey Flaney</i> Kacey Flaney	COPC	GRANTS		flanekb@poncacityok.gov
<i>Laura Corff</i> Laura Corff	Cimarron Transit	TRANSIT DIRECTOR	918 762 3041 EXT 101 580 761 5598	lcorff@ucapinc.org
<i>Maci Heppel</i> Maci Heppel	PC Mainstreet	EXEC. DIRECTOR	580-761-6516	maci@poncacitymainstreet.com
<i>Mary Beth Moore</i> Mary Beth Moore	Coldwell Banker	Realtor	580-401-3456	mbclarkmoore@yahoo.com
<i>Kim Jensen</i> Kim Jensen	OEM			matthew.rollins@oem.ok.gov
Melissa Young	United Way PC	Interim Director		uwcampaign@outlook.com
<i>Nga Wells</i> Nga Wells	State Farm	Agent	508-765-7282	nga.wells@yahoo.com
<i>Paula Cain</i> Paula Cain	COPC			cainpk@poncacityok.gov
<i>Rhonda Skrapke</i> Rhonda Skrapke	COPC	GRANTS		skraprr@poncacityok.gov
Richard Smith	National Weather Service/NOAA			
<i>Rob Dick</i> Rob Dick	COPC	PUBLIC WORKS		dickre@poncacityok.gov

Signed Below

Signed Below

Sign in Sheet - Stakeholder Meeting #1



Ponca City Hazard Mitigation Plan Update



Date: July 27, 2021

Time: 1:30 p.m. - 4:30 p.m.

Location: Ponca City Commission Chambers-City Hall

3/4

Name	Organization	Title	Phone	Email
 Russ Didlake	KW Select	Realtor	580-763-2760	russdidlake@kw.com
Tana McKinley	COPC	ASSISTANT CITY MANAGER	580-767-0343	mckintr@poncacityok.gov Tana McKinley
 Todd Smith	COPC	Water Utility Manager	580 716 0039	fuhong@poncacityok.gov ~~Todd Smith~~ Smith@Ponca city
Tom Short	NERA	Director		nera.director@outlook.com
William Coomer	Alliance Health			william.coomer@alliancehealth.com
Peat Robinson	USACE Kaw	Lake Manager	580-762-5611	peat.robinson@usace.army.mil
Rick Smith	NWS	Meteorologist	405-325-3395	richard-smith@noaa.gov
Jim Jensen	OEM	HM Planner	405-510-0106	Jim.jensen@oem.ok.gov
Matt Rollins	ODEMITS	SHMD	405-496-3004	Matthew.rollins@oem.ok.gov
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called?
cancelled
called?
cancelled

Sign in Sheet - Stakeholder Meeting #1



Ponca City Hazard Mitigation Plan Update



Date: July 27, 2021

Time: 1:30 p.m. - 4:30 p.m.

Location: Ponca City Commission Chambers-City Hall

4/4

Name	Organization	Title	Phone	Email
Joe L Carter	USACE	OPM	580-230-8319	
Jim Finkbeiner	City of P.C.	City Engineer	580-767-0333	fairbjv@poncacityok.gov
Johnny Thorburgh	Ponca Tech			
Katie Mosher	Meshek + Associates	Planner	720-290-6245	Kmosher@meshekengr.com
Daniel Thompson	Meshek + Associates	PM	610-240-0038	dthompson@meshekengr.com



Sign In Sheet - Stakeholder Meeting #2

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall

Date/Time: Wednesday, September 1, 2021; 1:30 pm. - 4:30 p.m.



1/3

Signature	Name	Organization	Phone	Email
	William Coomer	Alliance Medical	580-765-0554	william.coomer@myalliancehealthok.com
	Frances Coonrod	Century21	580-761-1712	frances.coonrod@gmail.com
	Laura Corff	Cimarron Transit	918-762-3041, ext 181	lcorff@ucapinc.org
	Joe L Custer	US Army Corps of Engineers	580-230-8390	Joe.L.Custer@usace.army.mil
	Rob Dick	City of Ponca City	580-767-0453	dickre@poncacityok.gov
	Russ Didlake	KW Select	580-763-2760	russsdidlake@kw.com
	Jim Fairbanks	City of Ponca City	580-767-0333	fairbjv@poncacityok.gov
	Kacey Flanery	City of Ponca City	580-763-4577	flanekb@poncacityok.gov
	Chris Henderson	City of Ponca City	580-767-0334	hendecd@poncacityok.gov
	Maci Heppel	PC Mainstreet	580-763-8082	maci@poncacitymainstreet.com
	Kim Jenson	OEM	405-590-0106	kim.jenson@oem.ok.gov
	Adam Leaming	PC Public Schools	580-767-8000	leamia@pcps.us

Jesse Beck



Sign In Sheet - Stakeholder Meeting #2

2/3

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall



Date/Time: Wednesday, September 1, 2021; 1:30 pm. - 4:30 p.m.

Signature	Name	Organization	Phone	Email
	Erin Liberton	P66	580-767-3662	Erin.M.Liberton@p66.com
	Tana McKinley	City of Ponca City	580-767-0343	mckintr@poncacityok.gov
	Janet Meshek	Meshek & Associates	918-392-5620, ext. 204	Jmeshek@meshekengr.com
	Aaron Michaud	Ponca City Energy	580-763-0587	michaaw@poncacityok.gov
	Mary Beth Moore	Coldwell Banker	580-401-3456	mbclarkmoore@yahoo.com
	Katie Mosher	Meshek & Associates	918-392-5620	kmosher@meshekengr.com
	David Myers	Development Authority	580-765-7070	dmyers@goponca.com
	Eric Newell	City of Ponca City	580-767-0431	newelek@poncacityok.gov
	Peat Robinson	US Army Corps of Engineers	580-762-5611	peat.robinson@usace.army.mil
	Matt Rollins	ODEMHS	405-496-3009	matthew.rollins@oem.ok.gov
	Tom Short	NERA	580-765-5372	nera.director@outlook.com
	Rhonda Skrapke	City of Ponca City	580-763-8094	skraprr@poncacityok.gov



Sign In Sheet - Stakeholder Meeting #2

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall



Date/Time: Wednesday, September 1, 2021; 1:30 pm. - 4:30 p.m.

Signature	Name	Organization	Phone	Email
	Bill Smiley	US Army Corps of Engineers	918 30-6516	William.E.Smiley@usace.army.mil
	Todd Smith	City of Ponca City	580-763-8022	smithth@poncacityok.gov
	Richard Smith	National Weather Service/NOAA	405-325-3395	richard_smith@noaa.gov
	Bret Smith	PC Public Schools	580-767-8000	smithb@pcps.us
Attended, not signed	Daniel Thompson	Meshek & Associates	918-392-5620	dthompson@meshekengr.com
	Johnny Thornburgh	Pioneer Tech	580-718-4328	johnnyt@pioneertech.edu
	Jonah Vasquez	Meshek & Associates	918-392-5620	jvasquez@meshekengr.com
	Annie Vest	Meshek & Associates	918-392-5620, ext 219	avest@meshekengr.com
	Nga Wells	State Farm	508-765-7282	nga.wells@yahoo.com
	Melissa Young	United Way PC	580-765-2476	uwcampaign@outlook.com
	Paula Cain	EM	767-0380	
	Aaron Michael	PCE	767-0384	



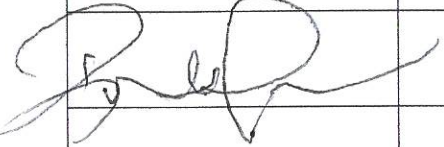
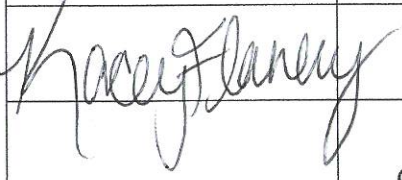
Sign In Sheet - Stakeholder Meeting #3

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall

1/4

Date/Time: Wednesday, September 29, 2021; 1:30 pm. - 4:30 p.m.



Signature	Name	Organization	Phone	Email
	Dakota Allison	US Army Corps of Engineers	580-762-5611	Dakota.L.Allison@usace.army.mil
	Jesse Beck	City of Ponca City	580-763-8046	beckje@poncacityok.gov
	Paula Cain	City of Ponca City	580-767-0380	cainpk@poncacityok.gov
	William Coomer	Alliance Medical	580-765-0554	william.coomer@myalliancehealthok.com
	Frances Coonrod	Century21	580-761-1712	frances.coonrod@gmail.com
	Joe L Custer	US Army Corps of Engineers	580-230-8390	Joe.L.Custer@usace.army.mil
	Rob Dick	City of Ponca City	580-767-0453	dickre@poncacityok.gov
	Russ Didlake	KW Select	580-763-2760	russtdidlake@kw.com
	Jim Fairbanks	City of Ponca City	580-767-0333	fairbjv@poncacityok.gov
	Kacey Flanery	City of Ponca City	580-763-4577	flanekb@poncacityok.gov
	Chris Henderson	City of Ponca City	580-767-0334	hendecd@poncacityok.gov



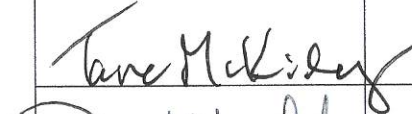
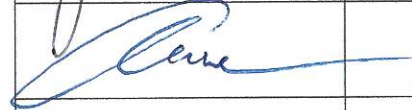
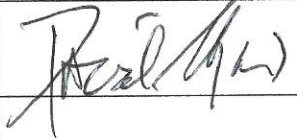
Sign In Sheet - Stakeholder Meeting #3

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall

2/4

Date/Time: Wednesday, September 29, 2021; 1:30 pm. - 4:30 p.m.



Signature	Name	Organization	Phone	Email
	Maci Heppel	PC Mainstreet	580-763-8082	maci@poncacitymainstreet.com
	Kim Jenson	OEM	405-590-0106	kim.jenson@oem.ok.gov
	Adam Leaming	PC Public Schools	580-767-8000	leamia@pcps.us
	Erin Liberton	P66	580-767-3662	Erin.M.Liberton@p66.com
	Tana McKinley	City of Ponca City	580-767-0343	mckintr@poncacityok.gov
	Janet Meshek	Meshek & Associates	918-392-5620, ext. 204	Jmeshek@meshekengr.com
	Aaron Michaud	Ponca City Energy	580-763-0587	michaaw@poncacityok.gov
	Mary Beth Moore	Coldwell Banker	580-401-3456	mbclarkmoore@yahoo.com
	Katie Mosher	Meshek & Associates	918-392-5620	kmosher@meshekengr.com
	David Myers	Development Authority	580-765-7070	dmyers@goponca.com
	Eric Newell	City of Ponca City	580-767-0431	newelek@poncacityok.gov



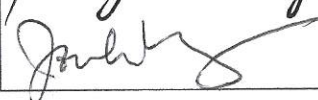
Sign In Sheet - Stakeholder Meeting #3

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall

3/4

Date/Time: Wednesday, September 29, 2021; 1:30 pm. - 4:30 p.m.



Signature	Name	Organization	Phone	Email
	Peat Robinson	US Army Corps of Engineers	580-762-5611	peat.robinson@usace.army.mil
	Matt Rollins	ODEMHS	405-496-3009	matthew.rollins@oem.ok.gov
	Tom Short	NERA	580-765-5372	nera.director@outlook.com
	Rhonda Skrapke	City of Ponca City	580-763-8094	skraprr@poncacityok.gov
	Bill Smiley	US Army Corps of Engineers		William.E.Smiley@usace.army.mil
	Bret Smith	PC Public Schools	580-767-8000	smithb@pcps.us
	Richard Smith	National Weather Service/NOAA	405-325-3395	richard_smith@noaa.gov
	Todd Smith	City of Ponca City	580-763-8022	smithth@poncacityok.gov
	Daniel Thompson	Meshek & Associates	918-392-5620	dthompson@meshekengr.com
	Johnny Thornburgh	Pioneer Tech	580-718-4328	johnnyt@pioneertech.edu
	Jonah Vasquez	Meshek & Associates	918-392-5620	jvasquez@meshekengr.com



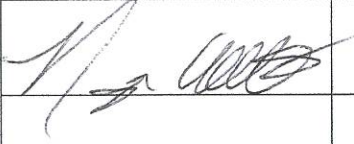
Sign In Sheet - Stakeholder Meeting #3

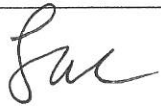
Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall

4/4

Date/Time: Wednesday, September 29, 2021; 1:30 pm. - 4:30 p.m.



Signature	Name	Organization	Phone	Email
	Annie Vest	Meshek & Associates	918-392-5620, ext 219	avest@meshekengr.com
	Nga Wells	State Farm	508-765-7282	nga.wells@yahoo.com
	Melissa Young	United Way PC	580-765-2476	uwcampaign@outlook.com



LAURA CORFF



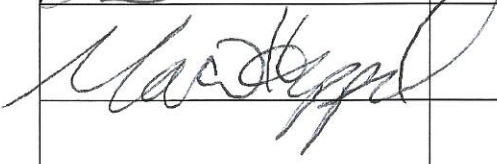
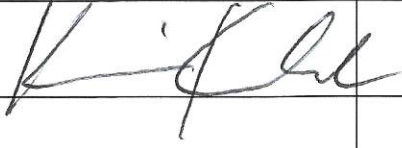
Sign In Sheet - Stakeholder Meeting #4

Ponca City Hazard Mitigation Plan Update
City Center Building –Summit Room

1/4

Date/Time: Friday, October 22, 2021; 12:30 pm. - 4:30 p.m.



Signature	Name	Organization	Phone	Email
	Dakota Allison	US Army Corps of Engineers	580-762-5611	Dakota.L.Allison@usace.army.mil
	Jesse Beck	City of Ponca City	580-763-8046	beckje@poncacityok.gov
	Paula Cain	City of Ponca City	580-767-0380	cainpk@poncacityok.gov
	William Coomer	Alliance Medical	580-765-0554	william.coomer@myalliancehealthok.com
	Frances Coonrod	Century21	580-761-1712	frances.coonrod@gmail.com
	Joe L Custer	US Army Corps of Engineers	580-230-8390	Joe.L.Custer@usace.army.mil
	Rob Dick	City of Ponca City	580-767-0453	dickre@poncacityok.gov
	Maci Heppel	PC Mainstreet	580-763-8082	maci@poncacitymainstreet.com
	Kim Jenson	OEM	405-590-0106	kim.jenson@oem.ok.gov
	Kevin Kloesel	OK Climate Survey	405-398-9652	longhorne@ok.edu
	Adam Leaming	PC Public Schools	580-767-8000	leamia@pcps.us



Sign In Sheet - Stakeholder Meeting #4

Ponca City Hazard Mitigation Plan Update
City Center Building –Summit Room

2/4

Date/Time: Friday, October 22, 2021; 12:30 pm. - 4:30 p.m.



Signature	Name	Organization	Phone	Email
	Erin Liberton	P66	580-767-3662	Erin.M.Liberton@p66.com
	Kathy Mack	Microsoft		
	Tana McKinley	City of Ponca City	580-767-0343	mckintr@poncacityok.gov
	Aaron Michaud	Ponca City Energy	580-763-0587	michaaw@poncacityok.gov
	Mary Beth Moore	Coldwell Banker	580-401-3456	mbclarkmoore@yahoo.com
	~~Katie Mosher~~	Meshek & Associates	918-392-5620	kmosher@meshekengr.com
Signed Below	Lori Henderson for David Myers	Development Authority	580-765-7070	dmyers@goponca.com
	Eric Newell	City of Ponca City	580-767-0431	newelek@poncacityok.gov
	~~Peat Robinson~~	US Army Corps of Engineers	580-762-5611	peat.robinson@usace.army.mil
	~~Matt Rollins~~	ODEMHS	405-496-3009	matthew.rollins@oem.ok.gov
	~~Tom Short~~	NERA	580-765-5372	nera.director@outlook.com



Sign In Sheet - Stakeholder Meeting #4

Ponca City Hazard Mitigation Plan Update
City Center Building –Summit Room

3/4

Date/Time: Friday, October 22, 2021; 12:30 pm. - 4:30 p.m.



Signature	Name	Organization	Phone	Email
	Rhonda Skrapke	City of Ponca City	580-763-8094	skraprr@poncacityok.gov
	Bill Smiley	US Army Corps of Engineers	918-306-516	William.E.Smiley@usace.army.mil
	~~Bret Smith~~	PC Public Schools	580-767-8000	smithb@pcps.us
	~~Richard Smith~~	National Weather Service/NOAA	405-325-3395	richard_smith@noaa.gov
	~~Todd Smith~~	City of Ponca City	580-763-8022	smithth@poncacityok.gov
	Daniel Thompson	Meshek & Associates	918-392-5620	dthompson@meshekengr.com
	Jonah Vasquez	Meshek & Associates	918-392-5620	jvasquez@meshekengr.com
	Annie Vest	Meshek & Associates	918-392-5620, ext 219	avest@meshekengr.com
	Nga Wells	State Farm	508-765-7282	nga.wells@yahoo.com
	Lori Henderson	PCDA	765-7070	lhenderson@goponca.com
	Kenneth Bradley	City of Ponca City	580-485-6337	Bradikne@poncacity.gov



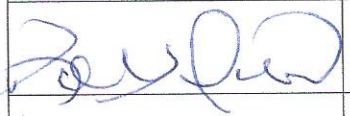
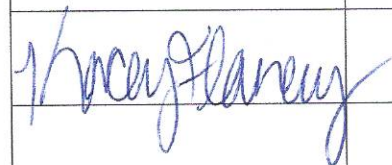
Sign In Sheet - Stakeholder Meeting #5

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall

1/3

Date/Time: Wednesday, November 3, 2021; 1:30 pm. - 4:30 p.m.



Signature	Name	Organization	Phone	Email
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	Maci Heppel	PC Mainstreet	580-763-8082	maci@poncacitymainstreet.com
	Adam Leaming	PC Public Schools	580-767-8000	leamia@pcps.us



Sign In Sheet - Stakeholder Meeting #5

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall

2/3

Date/Time: Wednesday, November 3, 2021; 1:30 pm. - 4:30 p.m.



Signature	Name	Organization	Phone	Email
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<i>Rhonda Skrapke</i>	Rhonda Skrapke	City of Ponca City	580-763-8094	skraprr@poncacityok.gov
	Richard Smith	National Weather Service/NOAA	405-325-3395	richard_smith@noaa.gov



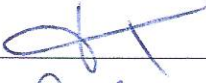
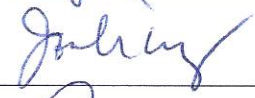
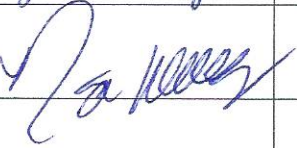
Sign In Sheet - Stakeholder Meeting #5

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall

3/3

Date/Time: Wednesday, November 3, 2021; 1:30 pm. - 4:30 p.m.



Signature	Name	Organization	Phone	Email
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Sign In Sheet - Public Meeting # 1

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall

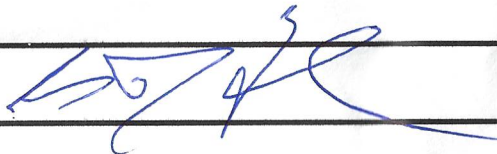
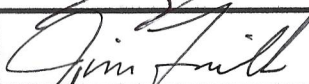
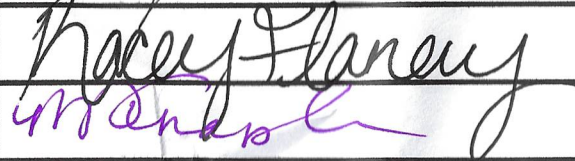
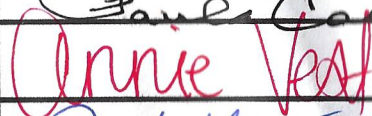
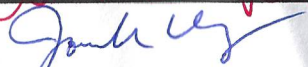


Date/Time: Wednesday, August 18, 2021; 5:30 p.m.

Signature	Name	Address	Phone	Email
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	Janet Meshek			
	Jonah Vesquez			
	Paula Cain			
	Homer Nicholson			
	Braven Dyer			ponca.civile@gmail.com
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	Colleen Lomar	413 Lombard St	580-765-3311	colleen@poncacitynews.com
	Tami Givens			
	Tiffany Givens			
	Jan Brookshire			

Ponca City Hazard Mitigation Planning Core Group Meeting #1

Wednesday, July 7, 2021

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Bret Smith

Bret Smith

PC Public Schools

Smith@pcps.us



Sign In Sheet – Public Meeting #2

Ponca City Hazard Mitigation Plan Update
Ponca City Commission Chambers - City Hall

Date/Time: Wednesday, February 9, 2022; 6:00 pm. – 7:00 p.m.



Signature	Name	Organization	Phone	Email
	JESSE BECK	City of Ponca City	580-761 0021	beckj@poncacityok.gov
	Janet Meshek	Meshek & Ass.		
	Marilyn Epley			
	Jonah Vasquez	Meshek & Ass.		
	Michael Smith			
	Lynn Boyer	1435 Pioneer Road		



2024 Muskogee County Multi-Hazard Mitigation Plan Update

MESHEK
& ASSOCIATES, LLC

Tulsa | OKC | Springdale

1988 35 Years of Serving Communities 2023



FEMA

April 17, 2024

Kim Jenson, Mitigation Planning Team Lead
Oklahoma Department of Emergency Management and Homeland Security
P.O. Box 53365
Oklahoma City, OK 73152-3365

RE: Approval of the Muskogee County, Oklahoma Multi-Jurisdiction Hazard
Mitigation Plan
Funding Source: HMGP; FEMA-4530-DR-OK 12

Dear Mrs. Jenson:

This office has concluded its review of the referenced plan and we are pleased to provide our approval of this plan in meeting the criteria set forth by 44 CFR § 201.6. By receiving this approval, eligibility for the Hazard Mitigation Assistance Grants will be ensured for five years from the date of this letter, expiring on April 16, 2029.

This approval does not demonstrate approval of projects contained in the plan. This office has provided the enclosed Local Hazard Mitigation Planning Tool with reviewer's comments, to further assist the community in refining the plan going forward. Please advise the referenced community of this approval.

If you have any questions, please contact Shanene Thomas, HM Community Planner, at (940) 898-5492.

Sincerely,

A handwritten signature in black ink, appearing to read "Ronald C. Wanhanen".

Ronald C. Wanhanen
Chief, Risk Analysis Branch

Enclosure: Approved Participants

cc: Shona Gibson, R6-MT-HM

Approved Participants

Attached is the list of approved participating governments included in the April 17, 2024 review of the referenced Hazard Mitigation plan.

Community Name
1) Fort Gibson Public Schools
2) Hilldale Public Schools
3) Warner Public Schools

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Chapter 1 Introduction

1.1 Introduction

This document serves as the 2024 Hazard Mitigation Plan update (the Plan, or “the plan”) for Muskogee County. It includes all participating jurisdictions and updates the 2019 Muskogee County Hazard Mitigation Plan. Developed in accordance with and fulfilling all requirements of Title 44 Code of Federal Regulations (CFR) §201.6, it meets criteria for FEMA approval and provides eligibility for application to FEMA Hazard Mitigation Assistance grant programs.



All assessments and strategies from the 2019 plan are integrated and updated throughout this document. Included is the entire geographic area of Muskogee County. Some entities within the county participated directly in the planning process, and all were invited to review and adopt the Plan before FEMA issued their formal letter of approval. “Pre-adopting” in this manner helps the 2024 Muskogee County HMP Update take immediate effect and any participating jurisdiction wanting to pursue a mitigation activity would be allowed to do so as soon as the federal review process concludes. Otherwise, each participating jurisdiction waited until FEMA provided the official Letter of Approval before adopting at the local level.

1.1.1 Participating Jurisdictions

Twenty-five jurisdictions, including Muskogee County, are participants in this update. Jurisdictions are broken into three categories: County, Incorporated Areas, and School Districts. Each is listed in the appropriate section below.

Muskogee County

Representing all census-designated areas and unincorporated areas within the political boundaries of Muskogee County.

Incorporated Areas

2024 update participants include Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Muskogee, Oktaha, Porum, Summit, Taft, Wainwright, Warner, and Webbers Falls.

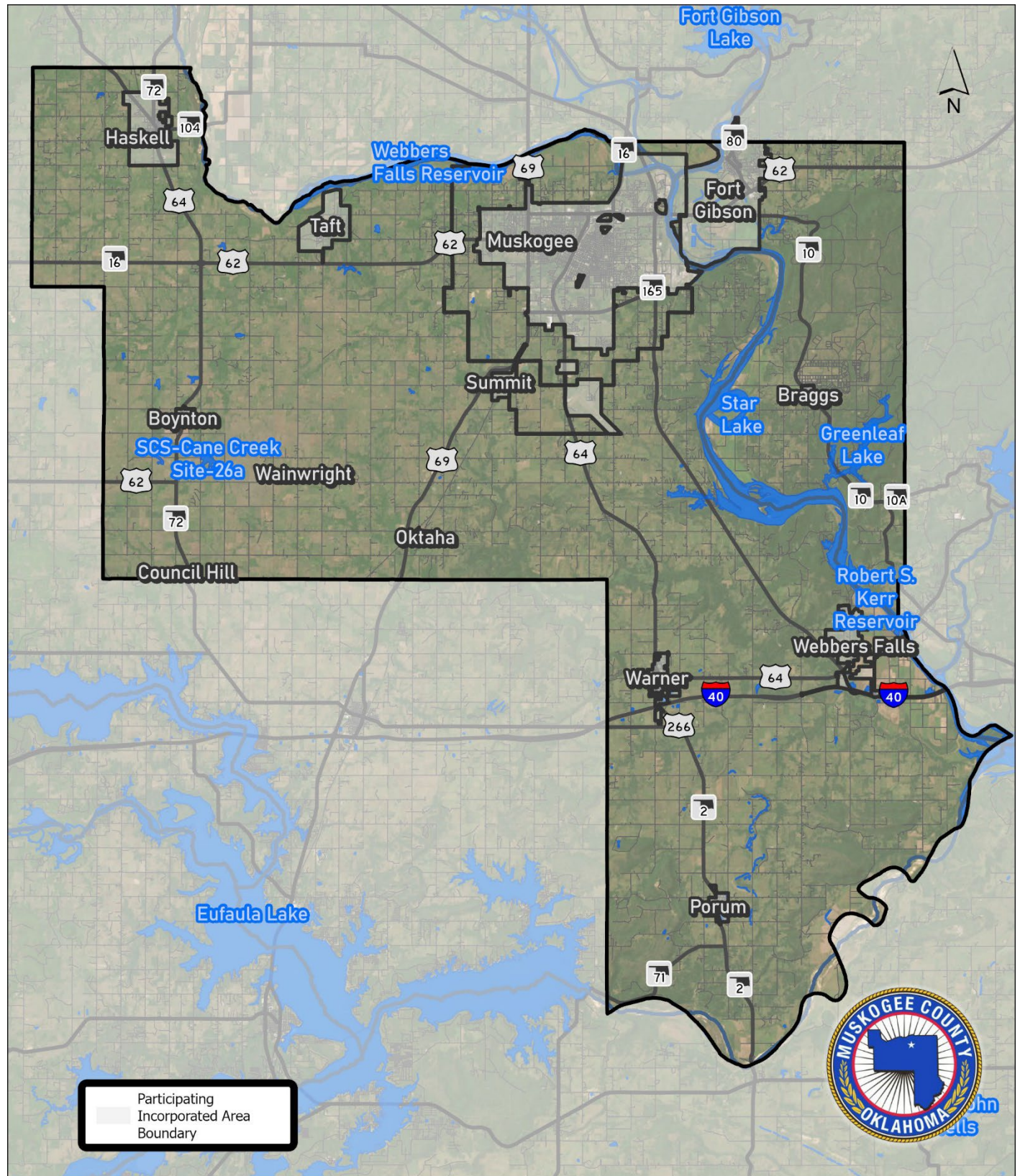
School Districts

Eleven public school districts including Braggs, Fort Gibson, Haskell, Hilldale, Midway, Muskogee, Oktaha, Porum, Wainwright, Warner, and Webbers Falls are participating.

The Planning Area

Each of the twenty-five jurisdictions listed above will be referred to as “participating jurisdictions,” and collectively, all comprise what is called the “planning area.”

Figure 1-1 Participating Incorporated Areas in Muskogee County, OK



1.2 Plan Organization

The plan and planning process is built from community and hazard assessments to create a specific and actionable mitigation strategy. Surveys, assessments, research, and analysis are organized into six chapters:

- Chapter 1: Introduction
- Chapter 2: Planning Process
- Chapter 3: Capability Assessment
- Chapter 4: Hazard Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Maintenance and Adoption

1.3 Purpose and Scope

Hazard mitigation is a proven, cost-effective approach to address threats posed by natural hazards to all communities in the United States. In addition to saving lives, hazard mitigation reduces the fiscal impact of disasters on individuals, businesses, and governments. Figure 1-2 provides a summary of how investments in mitigation can prevent future losses from natural hazards.¹

Figure 1-2 National Institute of Building Sciences 2019 Report

		ADOPT CODE	ABOVE CODE	BUILDING RETROFIT	LIFELINE RETROFIT	FEDERAL GRANTS
National Institute of BUILDING SCIENCES™						
Overall Benefit-Cost Ratio		11:1	4:1	4:1	4:1	6:1
Cost (\$ billion)		\$1/year	\$4/year	\$520	\$0.6	\$27
Benefit (\$ billion)		\$13/year	\$16/year	\$2200	\$2.5	\$160
 Riverine Flood		6:1	5:1	6:1	8:1	7:1
 Hurricane Surge		not applicable	7:1	not applicable	not applicable	not applicable
 Wind		10:1	5:1	6:1	7:1	5:1
 Earthquake		12:1	4:1	13:1	3:1	3:1
 Wildland-Urban Interface Fire		not applicable	4:1	2:1	not applicable	3:1

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Participating communities are assessed in this plan, as are their risks to natural and manmade hazards. A mitigation strategy geared toward reducing risk and enhancing resilience is included. This comprehensive, long-range, and initiative-taking approach to hazard mitigation will increase the effectiveness of mitigation actions and provide communities with a return on investments that will save money for taxpayer's long term. This plan intends to guide actions over the next 5 years, as will federal and state funding opportunities for use toward funding eligible projects.

1.3.1 Authority

In addition to 44 CFR §201.6, current requirements reflected in Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (also known as "The Stafford Act"), 42 U.S.C. 5165, enacted under Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390), provide an innovative approach to mitigation planning. Section 322, in concert with other sections of the Act, provides a significant opportunity

¹ <https://www.nibs.org/projects/natural-hazard-mitigation-saves-2019-report>

to reduce disaster losses in the United States through mitigation planning. The Act emphasizes a need for tribal, state, and local entities to closely coordinate mitigation planning and implementation efforts.

1.4 Goals

The goals of the 2024 HMP remain unchanged from those of 2019 – to build a disaster-resistant community and improve the safety and well-being of the citizens of Muskogee County by reducing deaths, injuries, property damage, and environmental impact from natural hazards. The 2024 Plan continues the effort to build resilience across the County in a manner that advances community goals, and quality of life and results in a more livable, viable, and sustainable community. Additional narratives on mitigation goals are in Chapter 5 of this document.

1.5 Approach

To meet Muskogee County's core goal stated in Section 1.4, this plan follows an assets-based approach. In addition to critical structures and services, assets include people. During this identification process, communities examine all capabilities available to protect resources and analyze the effects of natural hazards on them. This analysis allows communities to understand the entire scope of vulnerability, rather than examining how each capability or hazard affects an asset individually.

An assets-based approach prioritizes key assets' vulnerabilities, helping communities best identify where to allocate resources to mitigate the biggest threats. This approach helps Muskogee County align its risk reduction with other community objectives, meeting another FEMA guidance objective.² Additionally, this approach positions Muskogee County to utilize partnerships and larger, system-wide solutions to mitigate risk to some assets, which is encouraged in guidance and pre-disaster mitigation programs.³

1.6 Community Description

Muskogee County continues to face a variety of hazards, both natural and man-made. Several factors contribute to how the county and specific areas within its boundaries are vulnerable or resilient to these hazards, including its history, governance, and geography.

1.6.1 History

Founded in 1907 when Oklahoma gained statehood, Muskogee County was established from lands in the Muskogee District of Creek Nation, and the Canadian and Illinois Districts of Cherokee Nation. People have inhabited the lands that make up this county for far longer, however⁴. Archaeological studies show the earliest residents of this area date back to 6,000 B.C.E. More extensive evidence of Mound Builders living in this area has been found within the county, dating to the Caddoan Stage (300 C.E. – 1200 C.E.). By the time of the first European arrival in this area in the early 18th Century, peoples of the Wichita and Osage tribes lived on and hunted these lands. In the late 18th Century, the first European settlement established here was a fur trading post at the Three Forks set up by Auguste Pierre Chouteau at the confluence of the Arkansas, Verdigris, and Grand Rivers.

Fort Gibson was the first American settlement in the present-day county, established in April 1824 as a settlement housing military families, Native Americans desiring military protection, and freed African

² https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-planning-handbook_03-2013.pdf

³ One such program is BRIC: <https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities>

⁴ <https://muskogee.okcounties.org/about>

Americans by the U.S. Army. It is one of the oldest settlements in Oklahoma that persists to this day. The adjacent military garrison, from which the namesake was taken, is a dark period of American history set up to facilitate the removal and relocation of Native Americans from their traditional homes to the east, serving as the end point of the Trail of Tears.

Established on January 17, 1872, a post office named “Muscogee” provided the earliest development in what is the present-day county seat for Muskogee County: The City of Muskogee. The spelling changed to its current iteration on July 19, 1900.

Railroads played a significant role in the development and continued settlement of Muskogee County in the late 19th and early 20th centuries, including the establishment of the City of Muskogee and the Town of Oktaha, as the Missouri, Kansas, & Texas (MK&T) Railway expanded into the area. Other railroads followed suit, including Kansas and Arkansas Valley Railway, Midland Valley Railroad, Ozark and Cherokee Central Railway, Shawnee, Oklahoma, and Missouri Coal and Railway, Muskogee Union Railway, and the Missouri, Oklahoma, and Gulf (MOG) Railway.

Historic hazard events have occurred in Muskogee County, including a major flood in 2019 which damaged many areas near the Arkansas, Verdigris, and Grand Rivers, and a strong earthquake rocked Fort Gibson in 1882. More details on these events are in Chapter 4.

1.6.2 Governance

Muskogee County’s governing structure is comprised of nine elected officials: three commissioners, county clerk, treasurer, assessor, sheriff, court clerk, and district attorney. These officials perform state-mandated duties including assessment of property, record keeping (e.g., property and vital statistics), maintenance of rural roads, administration of election and judicial functions, and law enforcement for county residents.

Most incorporated areas within Muskogee County are served primarily by boards of trustees and a mayor. The City of Muskogee government consists of a city council and mayor, with a more expansive governing structure.

Aside from County employees and the City of Muskogee, most communities in Muskogee County have limited staff, with some serving in a part-time capacity. The governing structure and the size of staff relative to each community can serve as a measure of each community’s capability to protect it from hazards, as well as provide response activities during a disaster. More discussion on capabilities is in Chapter 3.

1.6.3 Geography

Located in east-central Oklahoma, Muskogee County has a total area of 840 square miles (2,200 km²), 810 square miles (2,100 km²) of which is land, and 30 are comprised of lakes. Seated at the intersection of prairie land to the west and the Ozark Mountains to the east, Muskogee County showcases a variety of topographical features and sits at the confluence of the Arkansas, Verdigris, and Neosho Rivers.

These rivers, while having served a significant role in the development and history of Muskogee County, also hold enormous potential to produce damaging flooding during periods of heavy rainfall as well as inundation from dam incidents, as discussed in finer detail in Chapter 4.

Climate

As is much of the body of Oklahoma, Muskogee County’s climate classification is Humid subtropical (Cfa) on the Köppen Climate Classification system, with hot summers and cool to mild winters. Spring and

autumn are transitional seasons which bring a wide range of weather and temperatures to the area, with the average annual temperature in Muskogee County holding at 60.5°F (15.8°C). Average daily high temperatures during July and August are 95.5°F (35.3°C), while average daily low temperatures in January are 25.4°F (-3.7°C). The record high temperature for Muskogee County is 118°F (47.8°C), set on August 10, 1936. The record low temperature is -15°F (-26.1°C), reached on February 10, 2011. On average, there are 75 days above 90°F (32°C), with twenty-one of those days on average above 100°F (38°C). 83 days per year on average experience a low temperature below 32°F (0°C), while 7 of those days on average see a high temperature that remains below that threshold. Muskogee County's first freeze typically occurs on October 30, and the last seasonal freeze usually happens on April 6.

Muskogee County averages 47.41 inches (120.42 cm) of precipitation annually, with May statistically being the wettest month at an average of 5.93 inches (15.1 cm) monthly precipitation. The driest month is typically February, with 2.31 inches (5.9 cm). Average annual snowfall in the county is 3.2 inches (8.1 cm). The wettest year occurred in 1945, when the county recorded 72.00 inches (182.9 cm) of precipitation, while the driest year was in 1954 when only 19.64 inches (49.9 cm) of precipitation fell. The greatest daily rainfall to occur was on June 10, 1945, when 10.47 inches (26.6 cm) of rain fell. The largest daily snowfall occurred on February 19, 1921, when 12.5 inches accumulated.

Muskogee County generally experiences 53 days of thunderstorms per year, with 4-5 of those producing 1 inch (2.5 cm) hail or larger. Additionally, the planning area averages 0.81 days per year where severe storms produce a tornado somewhere within the boundaries of the county.

Muskogee County is affected by many climate-related hazards, and these "future conditions" are further discussed in Chapter 4.

Population

Muskogee County has a total population of 66,339 residents⁵, which shows a decline of 4,351 people, or a 6 percent decrease, from the 2010 U.S. Decennial Census. The City of Muskogee is the largest population center in the county at 36,878 residents, followed by Fort Gibson (3,814), Haskell (1,626), and Warner (1,593). Table 1-1 outlines additional population statistics for the County as well as all participating incorporated areas in the planning area.

1.7 Community Assets

Characteristics of a community, including its people, economy, and built environment contribute to overall culture, and provide an indication of how vulnerable they may be to natural hazards.

1.7.1 Vulnerable Populations

Every resident in Muskogee County has exposure to at least one hazard identified in this plan. Understanding which populations are affected by disaster is important when preparing for future events. Social and economic characteristics may limit an individual's ability to understand risk, respond to and recover from disasters.

Muskogee County's demographic profile is shaped by its history. Since Fort Gibson served as the end of the historic Trail of Tears during the mid-19th Century, Muskogee County hosts a sizeable Native American population. In fact, the County is bisected by two of the Big Five tribal nations in Oklahoma – the Cherokee

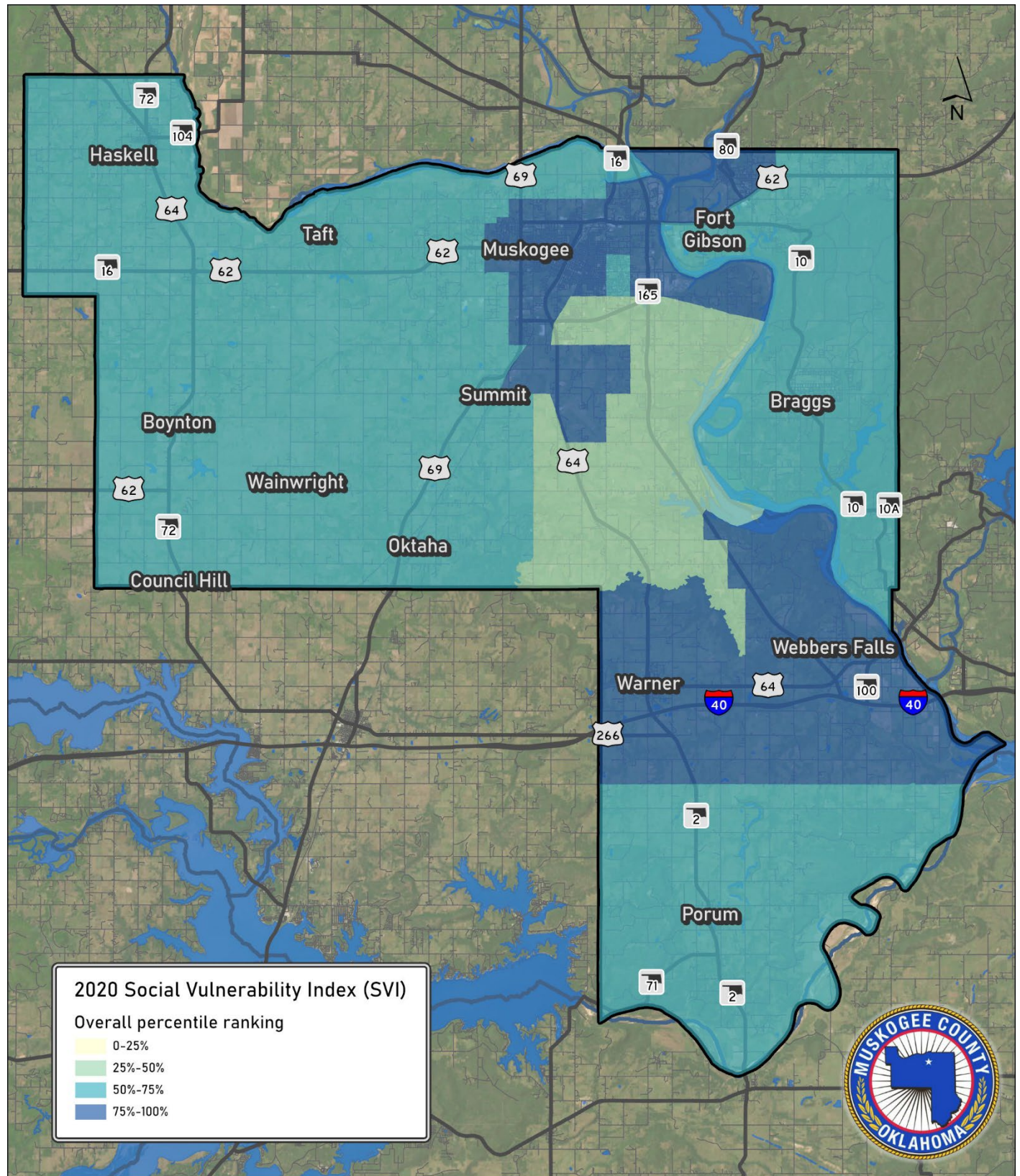
⁵ <https://data.census.gov/all?q=Muskogee+County,+Oklahoma>

Nation in the East and Muscogee (Creek) Nation to the West. As people migrated westward following the Civil War, scores of emigrants of European and African descent settled in the area, which helped produce a diverse population. In Muskogee County, approximately 6% of the population identifies as Hispanic or Latino, representing another significant demographic.

Social vulnerability refers to potential negative effects on communities caused by external stresses on human health. Such stresses include natural disasters, and to summarize this factor, the CDC/ATSDR Social Vulnerability Index uses 16 U.S. census variables to help local officials identify communities who may need support before, during, or after disasters. Socially vulnerable populations are especially at-risk during disasters because of factors like socioeconomic status, household characteristics, racial and ethnic minority status, or housing type and transportation. To help emergency response planners meet the needs of socially vulnerable populations during emergency response and recovery phases, the CDC/ATSDR Social Vulnerability Index (SVI) was created.⁶ Figure 1-3 below shows a general breakdown of overall vulnerability across the planning area.

⁶ https://www.atsdr.cdc.gov/placeandhealth/svi/at-a-glance_svi.html

Figure 1-3 Social Vulnerability Index (SVI) for Muskogee County (CDC/ATSDR)



Other demographic considerations include segments of the population by age (those under 5 years, or over age 65), primary language spoken at home, highest level of education, poverty status, and disability. These characteristics are distinguished at the county and community level below in Table 1-1. Higher proportions of a community's population in one or more of these categories can increase vulnerability to hazards. Conversely, there exists an inverse relationship between a community's population and their level of vulnerability. A smaller community can have higher vulnerability to hazards, which is discussed in Chapter 3.

Muskogee County is home to the Oklahoma School for the Blind (OSB), located in the City of Muskogee. This is a significant consideration which should be noted since this institution represents a concentration of disabled people in one area that is not represented in census data for the county or the City of Muskogee. OSB representatives were contacted and invited to participate in each of the Stakeholder Workshop meetings (see Chapter 2), but because OSB follows Muskogee Public School District protocol, this institution is not specifically itemized in tables like Table 1-1 below.

Table 1-1 Muskogee County Demographic Vulnerability Indicators⁷

Jurisdiction	Population	Ages < 5 Years Old (%)	Ages > 65 Years Old (%)	Primary Language not English (%)	No High School Diploma (%)	One or more disability (%)
Muskogee Co.	66,339	5.7	18.9	5.7	10.7	25.2
Boynton	161	4.3	20.5	0.0	23.6	29.5
Braggs	270	10.0	17.0	0.0	5.9	19.8
Council Hill	108	7.4	231	0.0	7.4	20.0
Fort Gibson	3,814	6.0	17.0	1.4	9.9	16.9
Haskell	1,626	6.5	18.4	0.8	11.9	15.3
Muskogee	36,878	6.3	18.3	6.8	10.9	21.8
Oktaha	343	6.1	13.4	0.7	7.0	18.6
Porum	602	8.0	15.3	0.0	20.6	24.6
Summit	108	4.6	22.2	2.0	34.3	53.4
Taft	174	4.6	30.0	3.0	2.3	17.5
Wainwright	93	2.2	26.9	0.0	22.6	18.1
Warner	1,593	4.4	17.2	2.7	11.9	20.0
Webbers Falls	338	5.6	26.3	1.4	19.8	17.4

⁷ 2020 U.S. Census data <https://data.census.gov/>

Figure 1-4 Percent of the Population Under the Age of 5

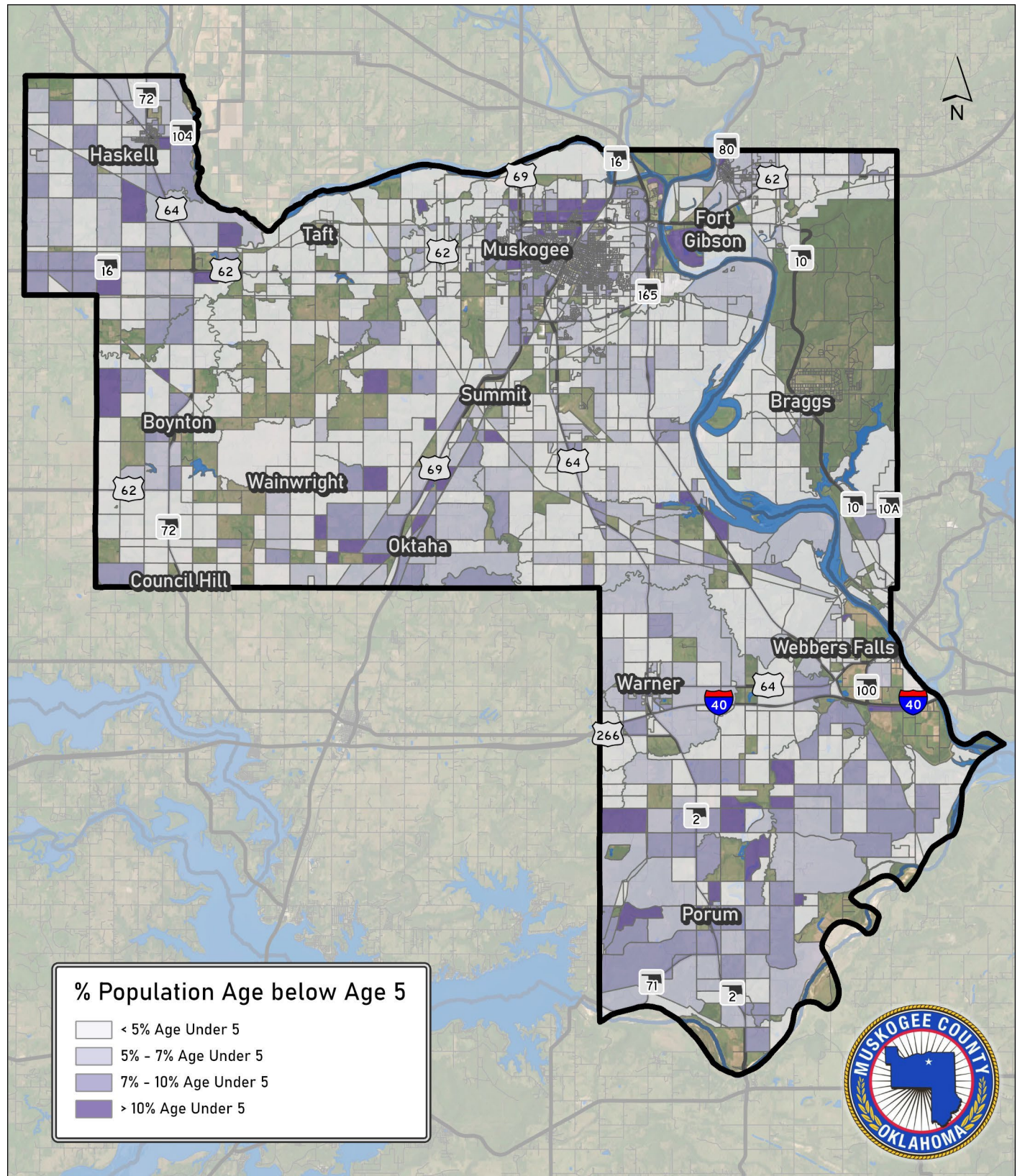


Figure 1-5 Percent of the Population Over the Age of 65

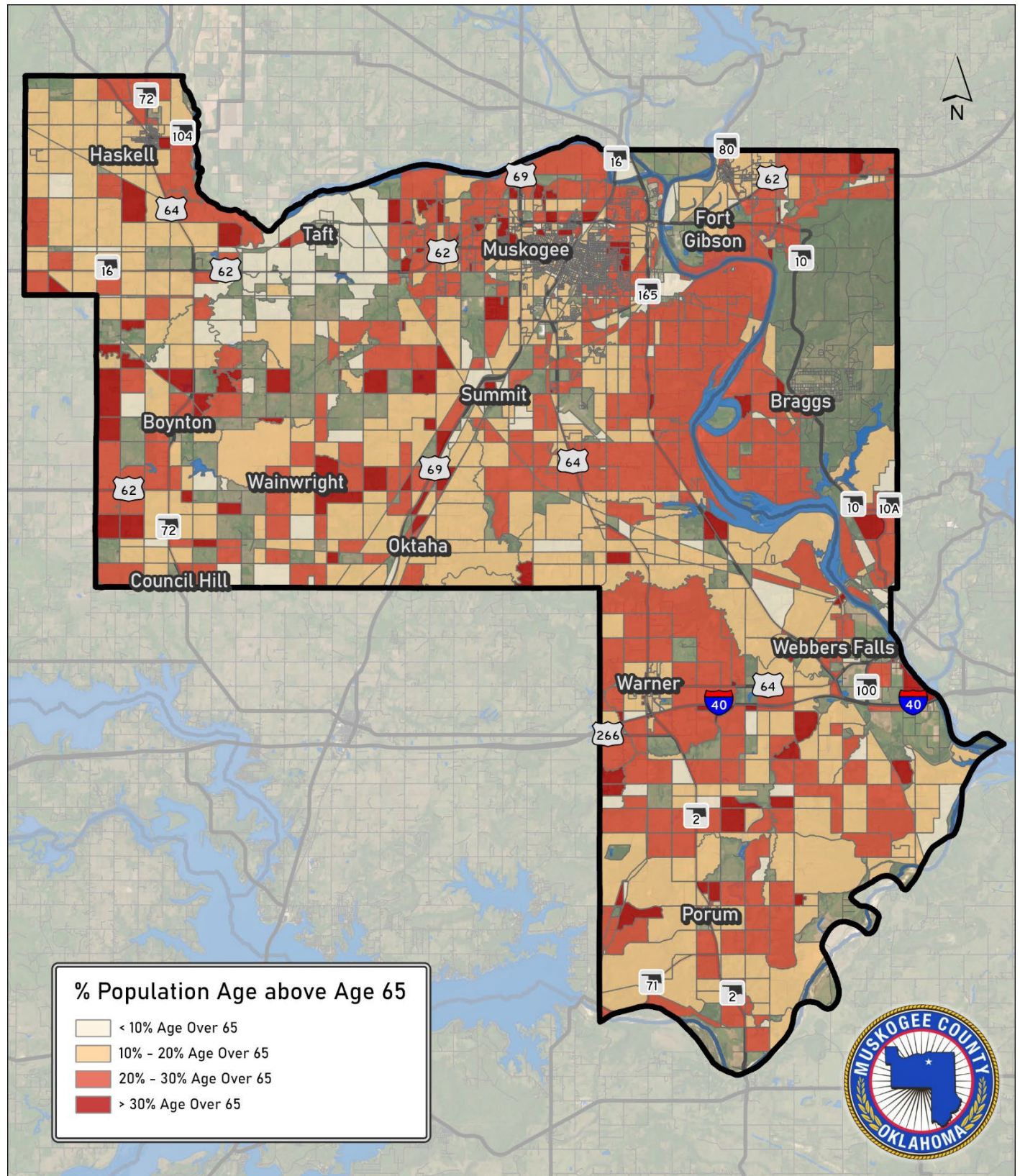


Figure 1-6 Percent of the Population Non-English Speaking

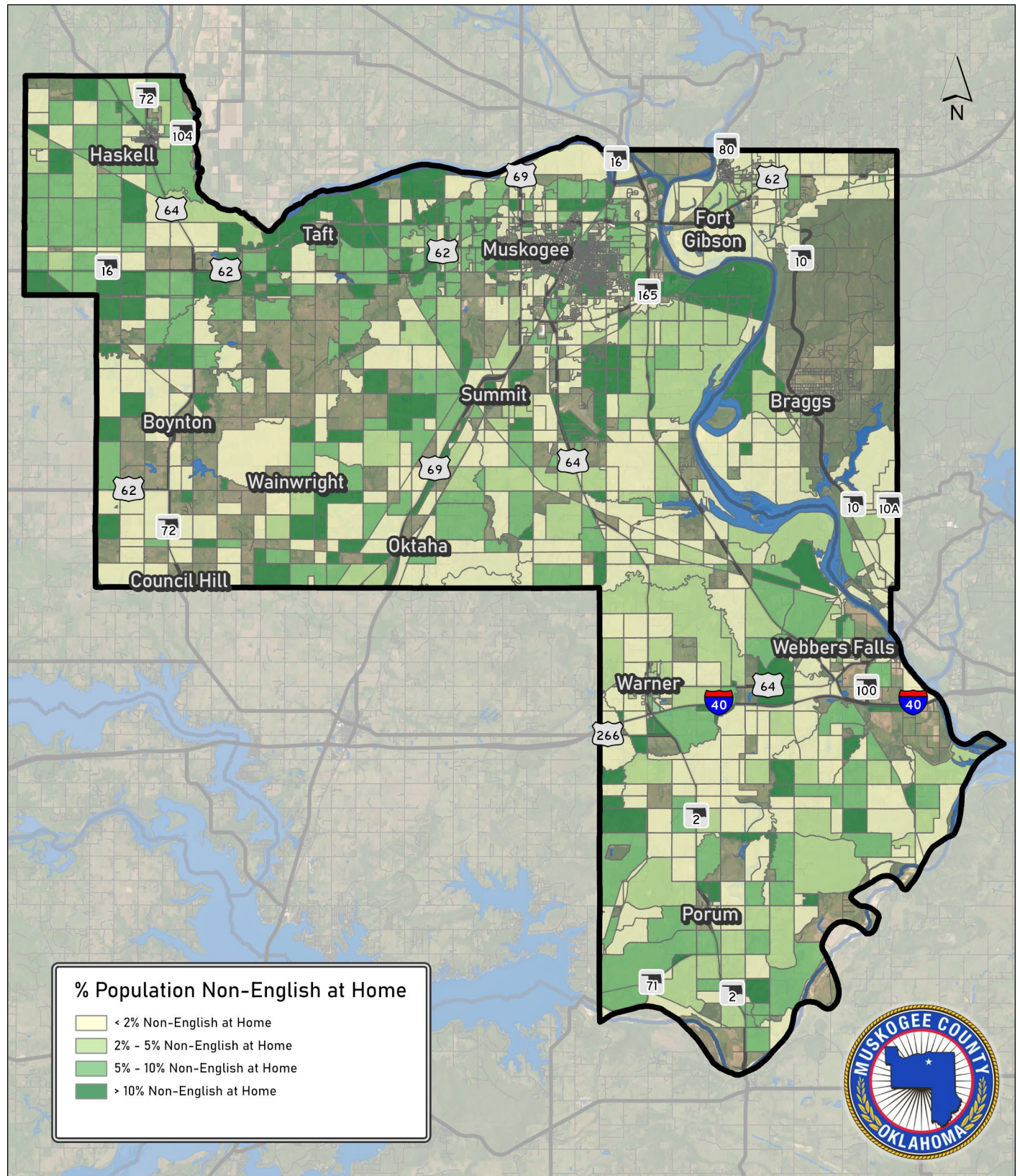


Figure 1-7 Percent of the Population without a High School Diploma

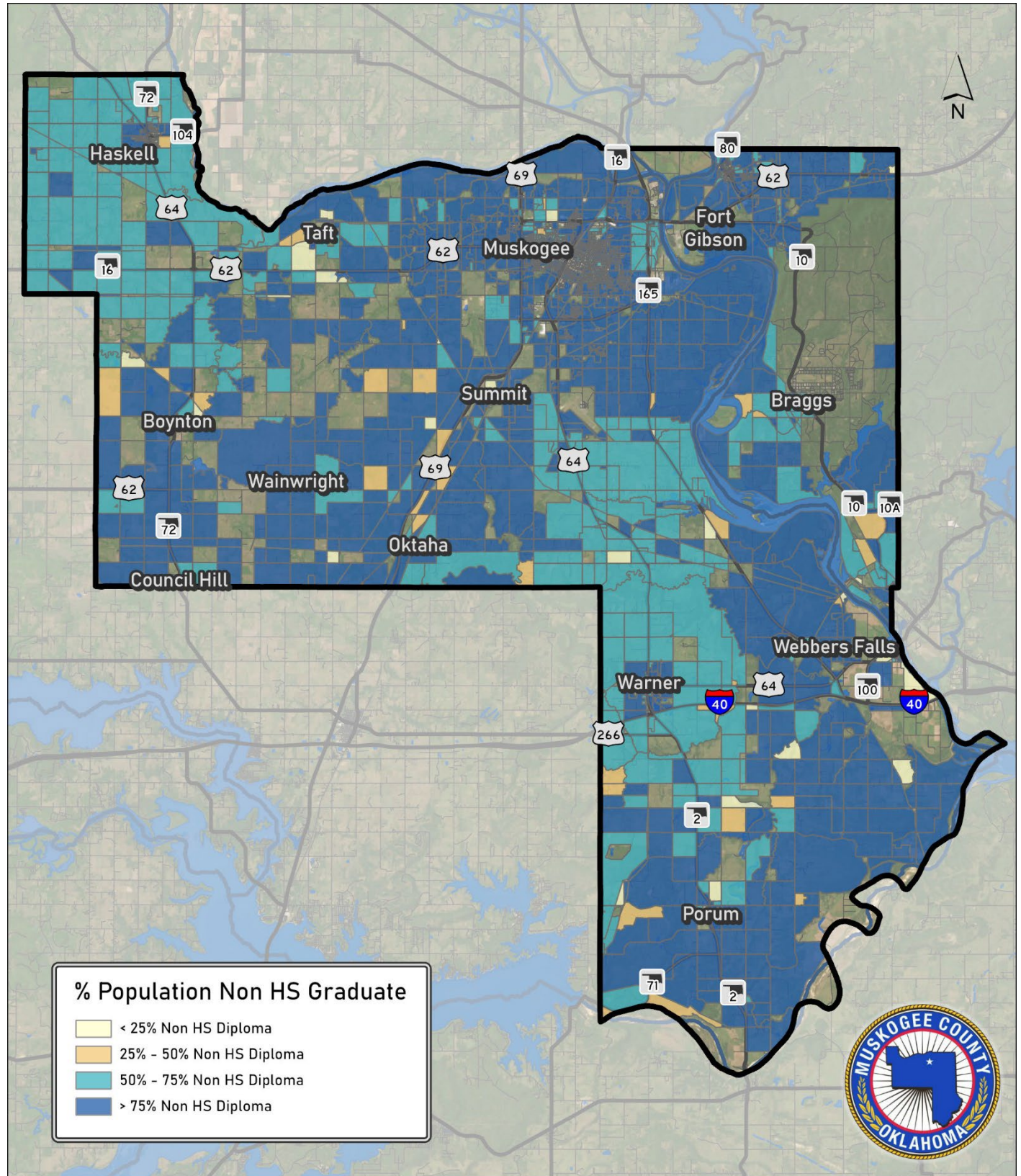


Figure 1-8 Percentage of Non-White Population

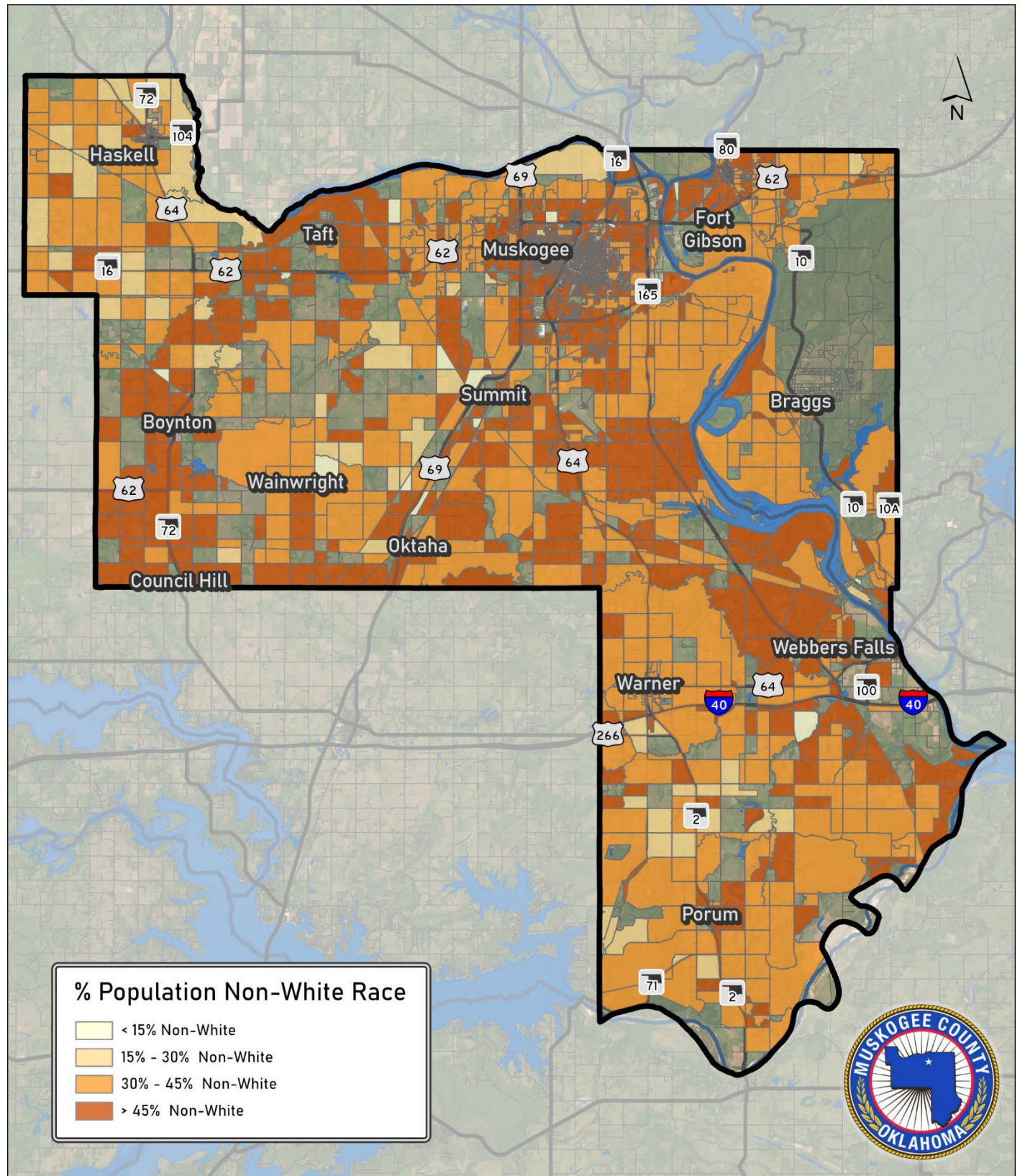


Figure 1-9 Percent of the Population with at Least One Reported Disability

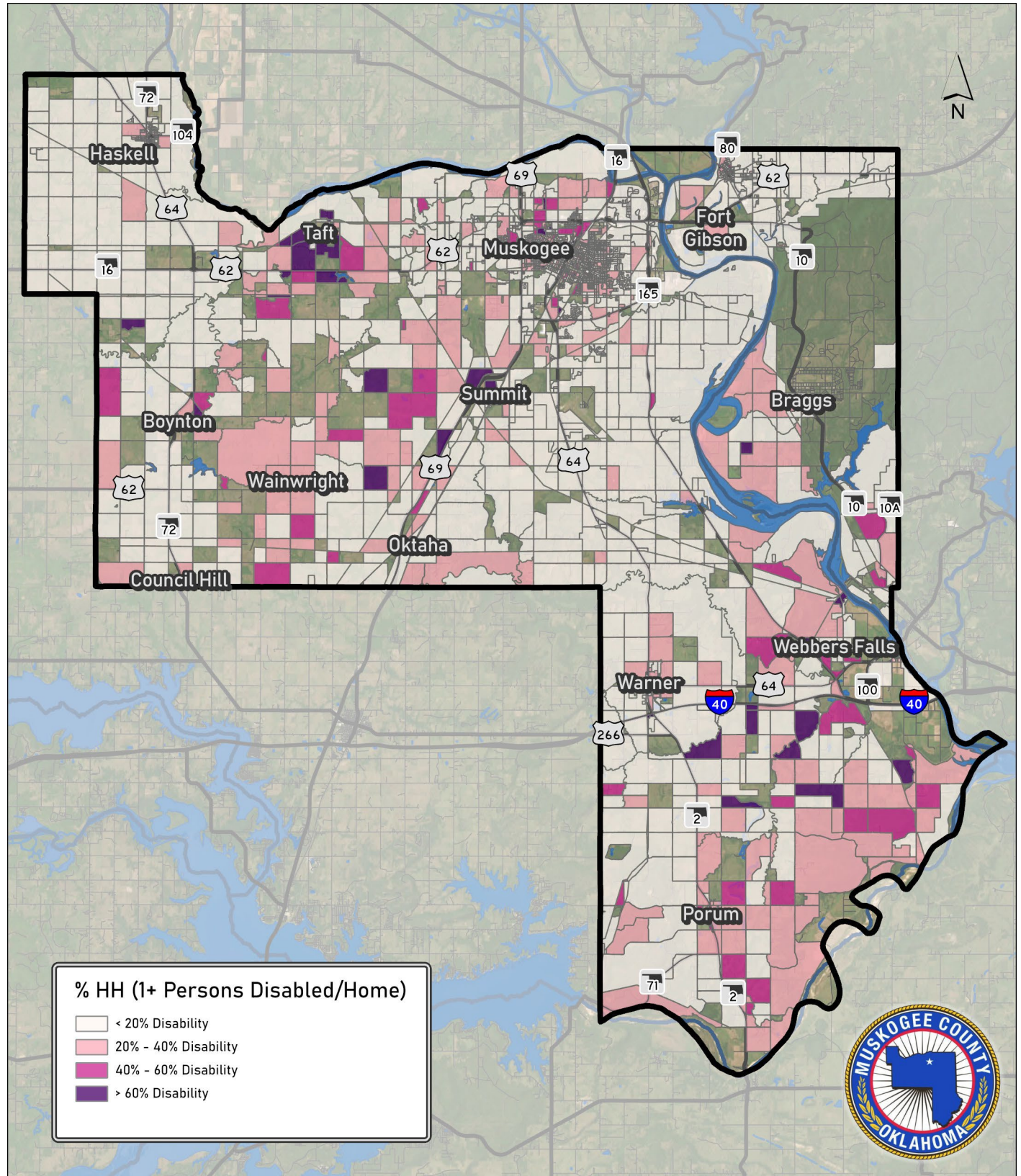


Figure 1-10 Percent of the Population Living Below the Poverty Line

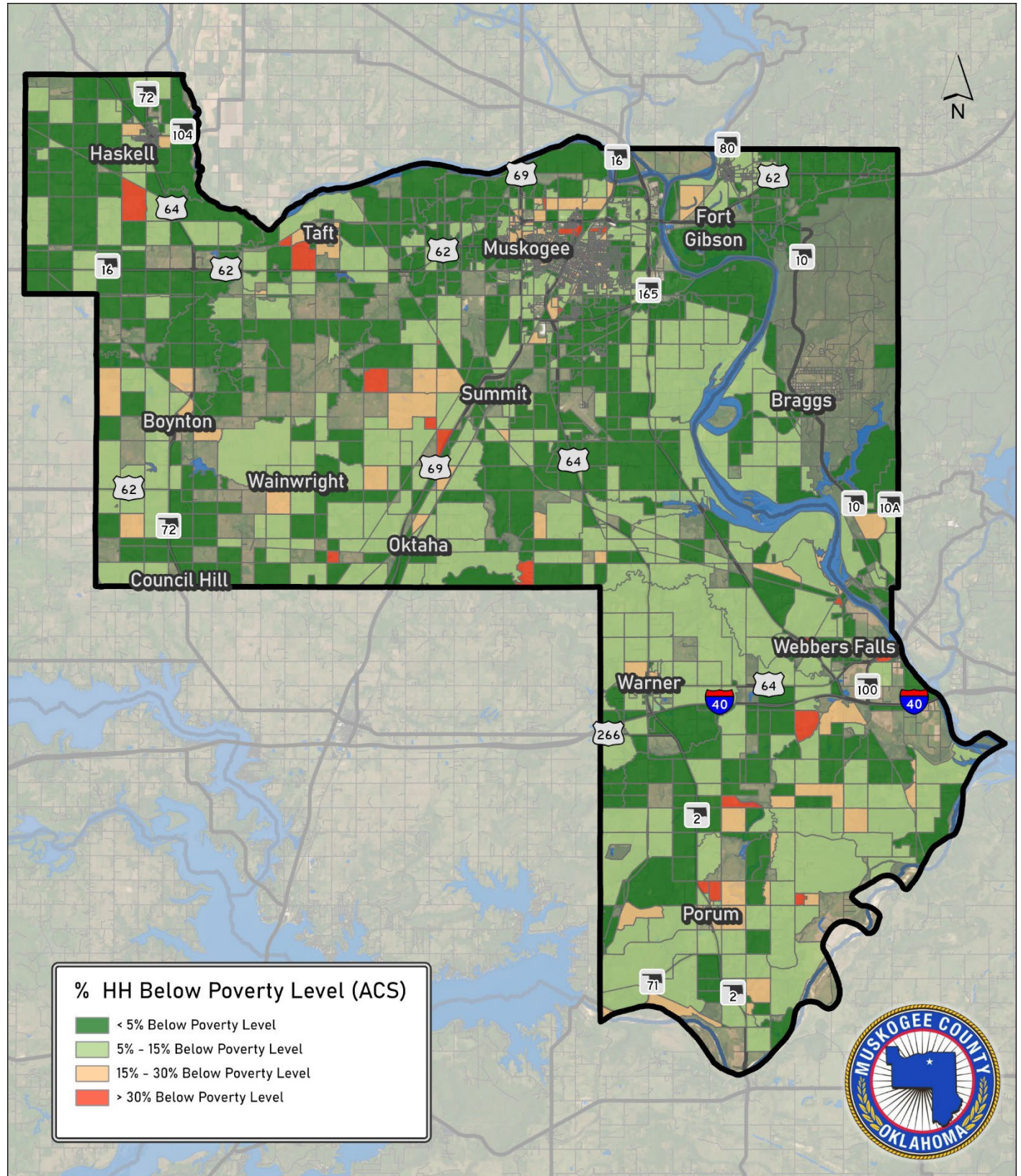
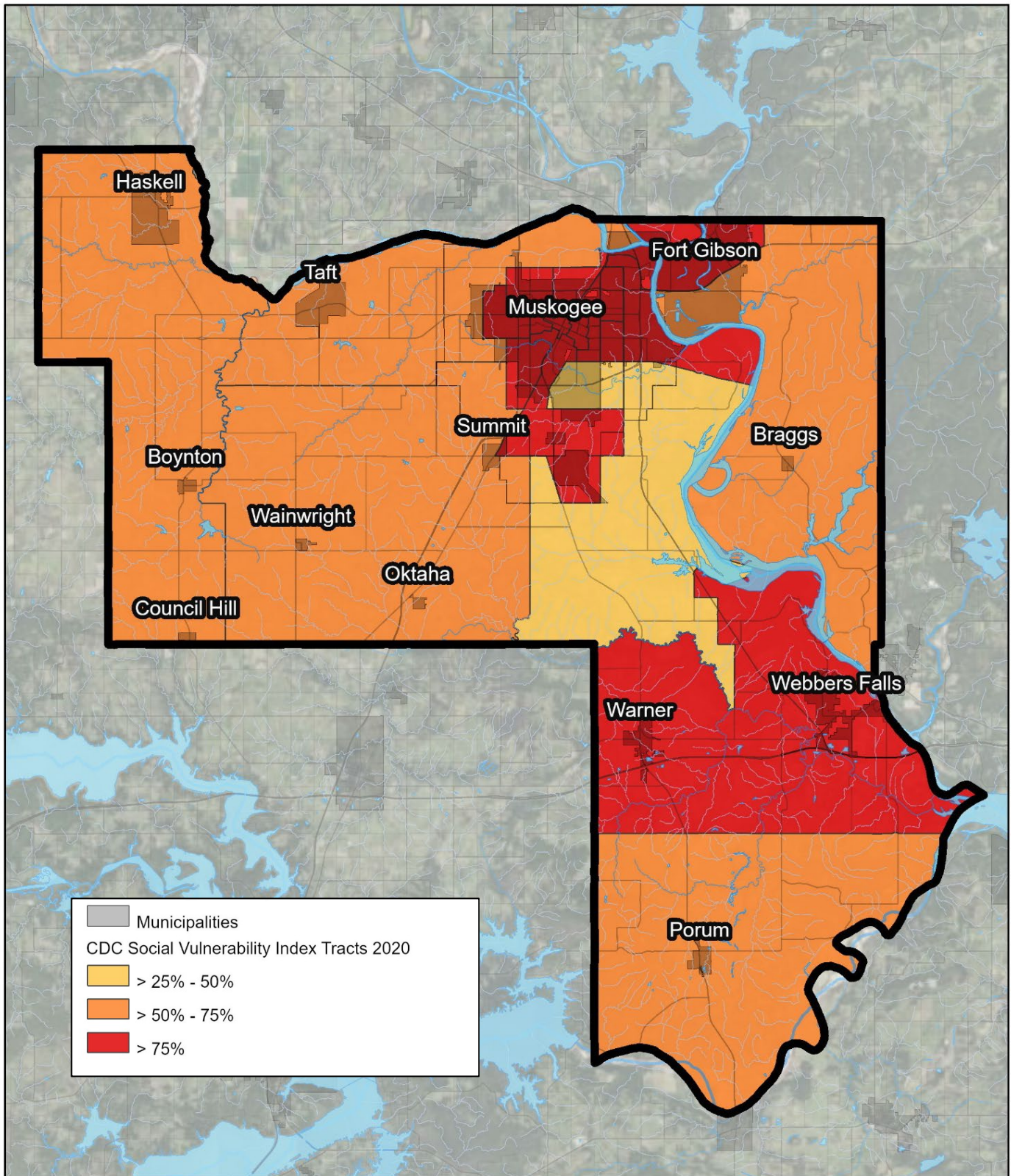


Figure 1-11 FEMA Social Vulnerability Index (SVI) Percentages in Muskogee County, OK



1.7.2 Economy

Throughout its history, agriculture has been a significant part of Muskogee County's economy. After World War II, wholesale grocery distribution became an economic sector which grew as truck farming increased and Griffin Grocery Company, now known as Griffin Foods, was established. O.W. Coburn developed an optical business, known today as Coburn Technologies, in Muskogee after World War II. This venture went on to become a leading supplier and manufacturer of ophthalmic equipment which continues to the present day. Other notable economic sectors in the county include oil, gas and coal, state and federal government, transportation (nautical, rail, and road), and education.

Economic factors can affect a community's capability to fund mitigation projects. A community with a healthy economy will generally have greater capacity to fund projects to enhance hazard resilience. Select economic elements are in Table 1-2.

Table 1-2 Muskogee County Economic Indicators

Jurisdiction	Employment Rate	Median Household Income	Poverty Status	Total Housing Units
Muskogee Co.	53.3%	\$54,070	18.0%	29,278
Boynton	43.5%	\$25,694	35.5%	72
Braggs	45.1%	\$48,125	21.4%	125
Council Hill	37.7%	\$31,250	26.7%	52
Fort Gibson	59.5%	\$56,875	14.6%	1,593
Haskell	39.0%	\$33,563	15.4%	761
Muskogee (City)	51.9%	\$41,430	23.4%	17,316
Oktaha	57.1%	\$45,417	12.8%	141
Porum	38.9%	\$26,912	36.3%	304
Summit	30.0%	\$59,673	31.1%	49
Taft	49.5%	\$27,917	22.8%	97
Wainwright	38.2%	\$39,375	27.5%	37
Warner	40.4%	\$31,667	24.6%	560
Webbers Falls	38.3%	\$50,313	27.0%	179

1.7.3 Built Environment

The planning area consists of a mixture of rural and urban environments, with roadways, highways, and byways connecting each.

Infrastructure

Utility services are provided to residents in Muskogee County from a range of companies. Residents often have a variety of options when it comes to choosing utilities, those mentioned below have the greatest involvement with the planning area.

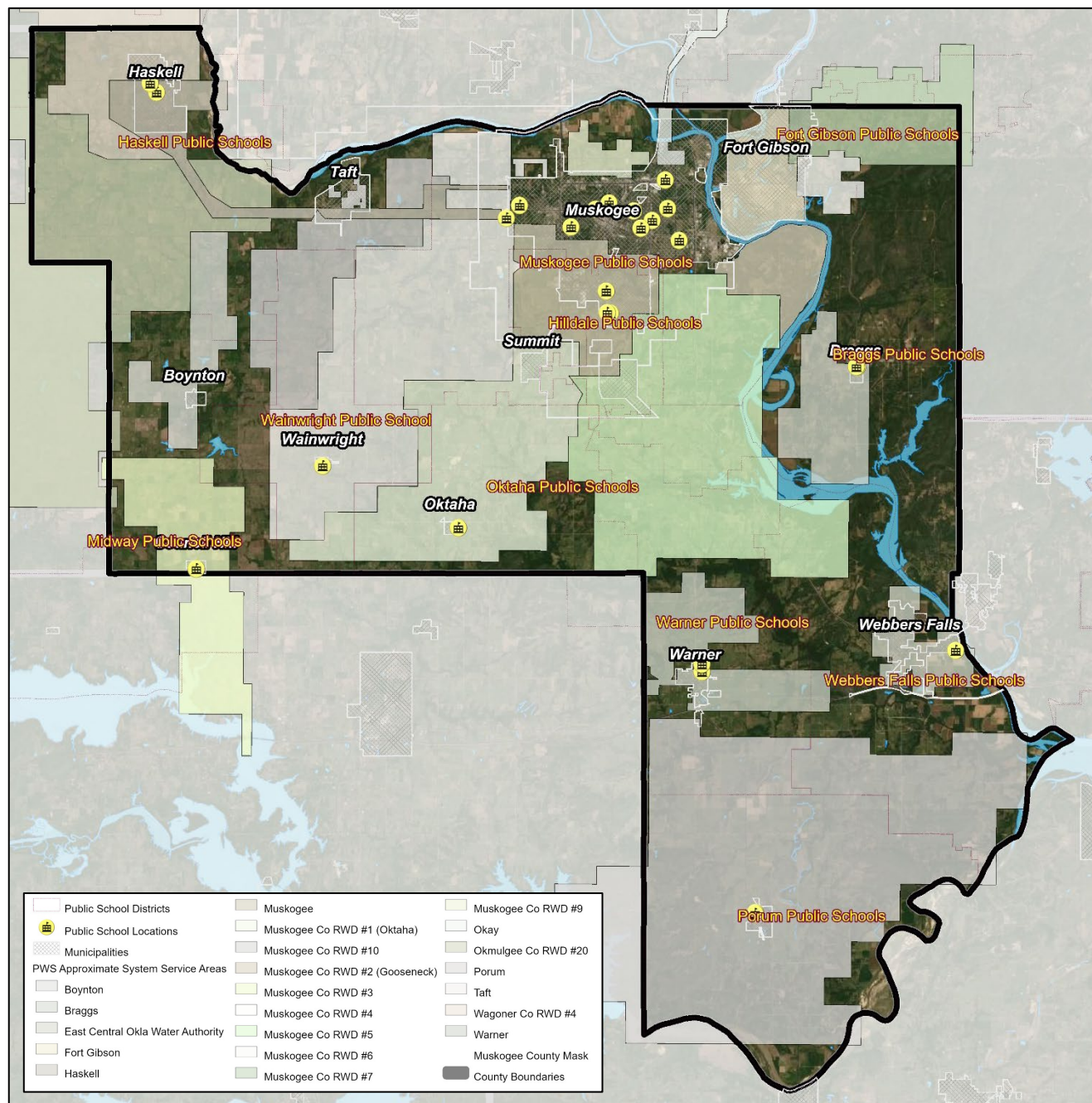
Water/Wastewater

A variety of systems work together to support water needs across the planning area each day. Public, private and city-owned water systems function to bring safe, clean drinking water to the residents across

Muskogee County. Population density is highest in the City of Muskogee, and their Water Department serves as a back-up supply to many locations in the County. Based on population served, The City of Muskogee is the top provider according to the Oklahoma Department of Environmental Quality⁸.

Twenty public water systems work alongside the City of Muskogee's Water Department to provide services throughout much of Muskogee County. Figure 1-12 shows the geographic boundaries of each, and information for all 20 are detailed in Table 1-3 below.

Figure 1-12 Public Water System in Muskogee Co.



⁸ Oklahoma Safe Drinking Water Information System (SDWIS), <http://sdwis.deq.state.ok.us/DWW/JSP/WaterSystems.jsp?PointOfContactType=none&number=&name=&county=Muskogee>

Table 1-3 Public Water Systems Servicing Muskogee County, OK

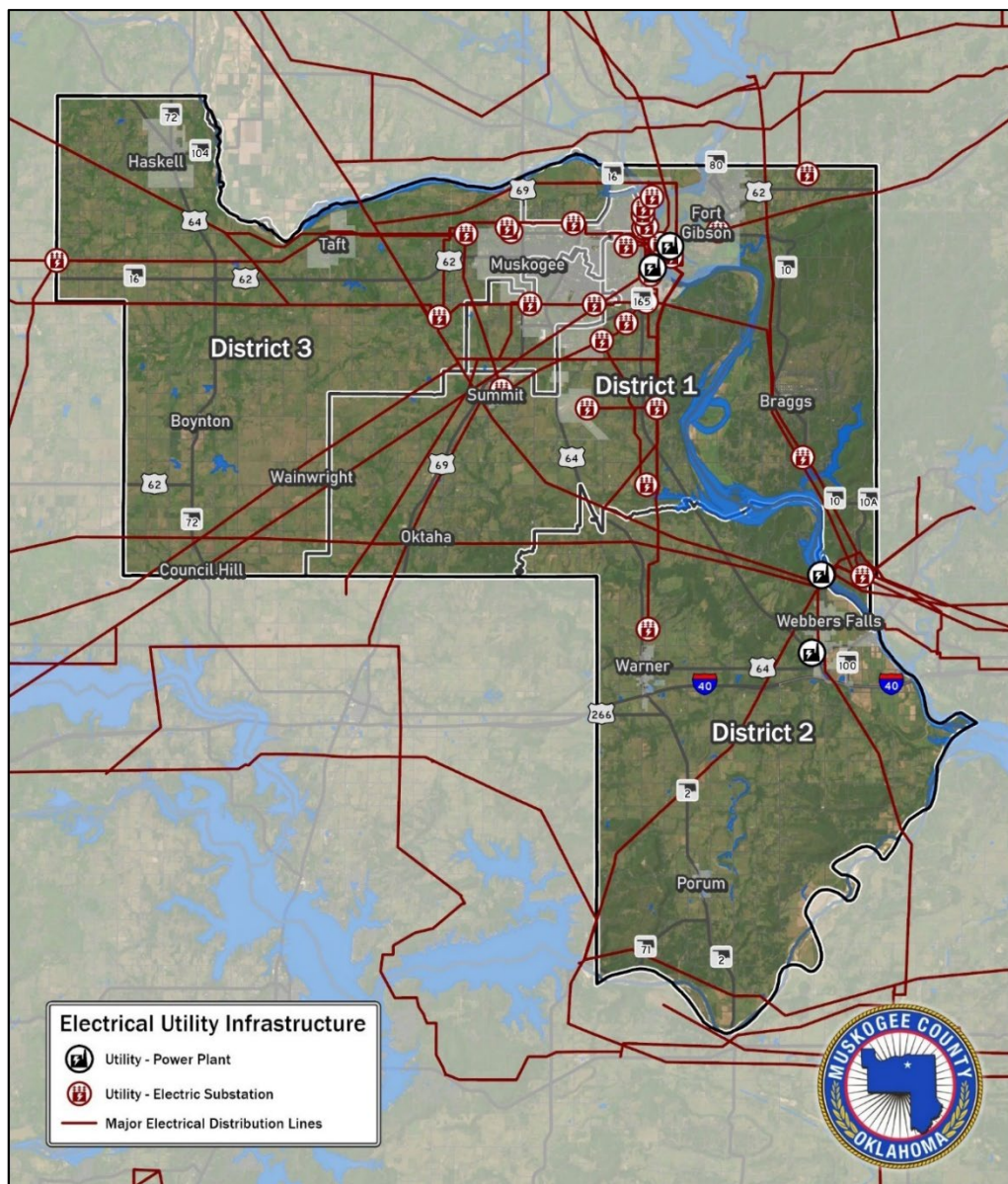
System Name	Pop. Served		Connections		Sources of Water	
	Number	Type	Number	Type	Name	Type
Boynton PWA	450	R	179	RS	Haskell	CC
Braggs Water Works	1,030	R	412	RS	Camp Gruber (Emergency)	CC
					Well 1	WL
					Well 2	WL
					Well 3	WL
					Well 4	WL
Camp Gruber/ OK Military Dept	70	NT	50	RS	Greenleaf Lake	IN
	2,399	T				
East Central Water Auth.	1200	R	437	RS	Null	CC
Fort Gibson	4,700	R	1,814	RS	Grand River	IN
	1,686	W				
Greenleaf State Park	650	T	86	RS	Greenleaf Lake	IN
Haskell PWA-SWP	250	R	100	RS	Muskogee	CC
	3,716	W				
Haskell PWA-Wells	1,765	R	1,291	RS	Muskogee (Emergency)	CC
					Wells 1 - 19	WL
Muskogee	38,310	R	15,374	RS	Ft Gibson Lake	IN
	15,697	W				
Muskogee Co. RWD #1 (Oktaha)	2,280	R	912	RS	Muskogee	CC
Muskogee Co. RWD #2 (Gooseneck)	1,000	R	432	RS	Muskogee	CC
Muskogee Co. RWD #3	1,300	R	350	RS	Eufaula Lake	IN
	425	W				
Muskogee Co. RWD #4	783	R	313	RS	Fort Gibson	CC
Muskogee Co. RWD #5	4,135	R	1,654	RS	Muskogee	CC
Muskogee Co. RWD #6	2,550	R	1,022	RS	Muskogee	CC
Muskogee Co. RWD #7	1,710	R	742	RS	Fort Gibson	CC
Muskogee Co. RWD #9	300	R	105	RS	Muskogee	CC
Muskogee Co. RWD #14	60	R	29	RS	Boynton PWA	CC
Okay PWA	419	R	1	UN	Verdigris River	IN
Okmulgee Co. RWD #20	2377	R	1013	UN	Mission	CC
					Skyline	CC
Porum PWA	5000	R	2000	RS	Eufaula Lake	IN
	290	W				
Taft	250	R	87	RS	Muskogee	CC
Warner	2020	R	808	RS	Eufaula Lake	IN
	85	W				
Wagoner Co. RWD #4	25792	R	10317	UN	Bixby PWA, Tulsa AB Jewell	CC
					Emergency Intake, Verdigris River	IN

Legend & Abbreviations	Population Served	R	Residential
		W	Wholesale
		T	Transient
		NT	Non-Transient
	Service Connection	RS	Residential
		UN	Unknown
		CC	Consecutive Connection
	Sources of Water	IN	Intake
		WL	Well

Electric

A network of high-voltage electrical transmission lines crosses the County with dozens of electrical sub-stations scattered throughout. Figure 1-13 shows where primary electrical utility lines are, and closer to the City of Muskogee, an industrial complex along both sides of the Arkansas River houses a variety of power generating stations. OG&E serves as the primary electric provider for all residents living within the City of Muskogee boundaries, while those in other parts of the County receive power from other providers including Lake Region Electric Cooperative, East Central Electric Cooperative, and Cookson Hills Electric Cooperative.

Figure 1-13 Electrical Transmission Lines and Facilities in Muskogee Co.



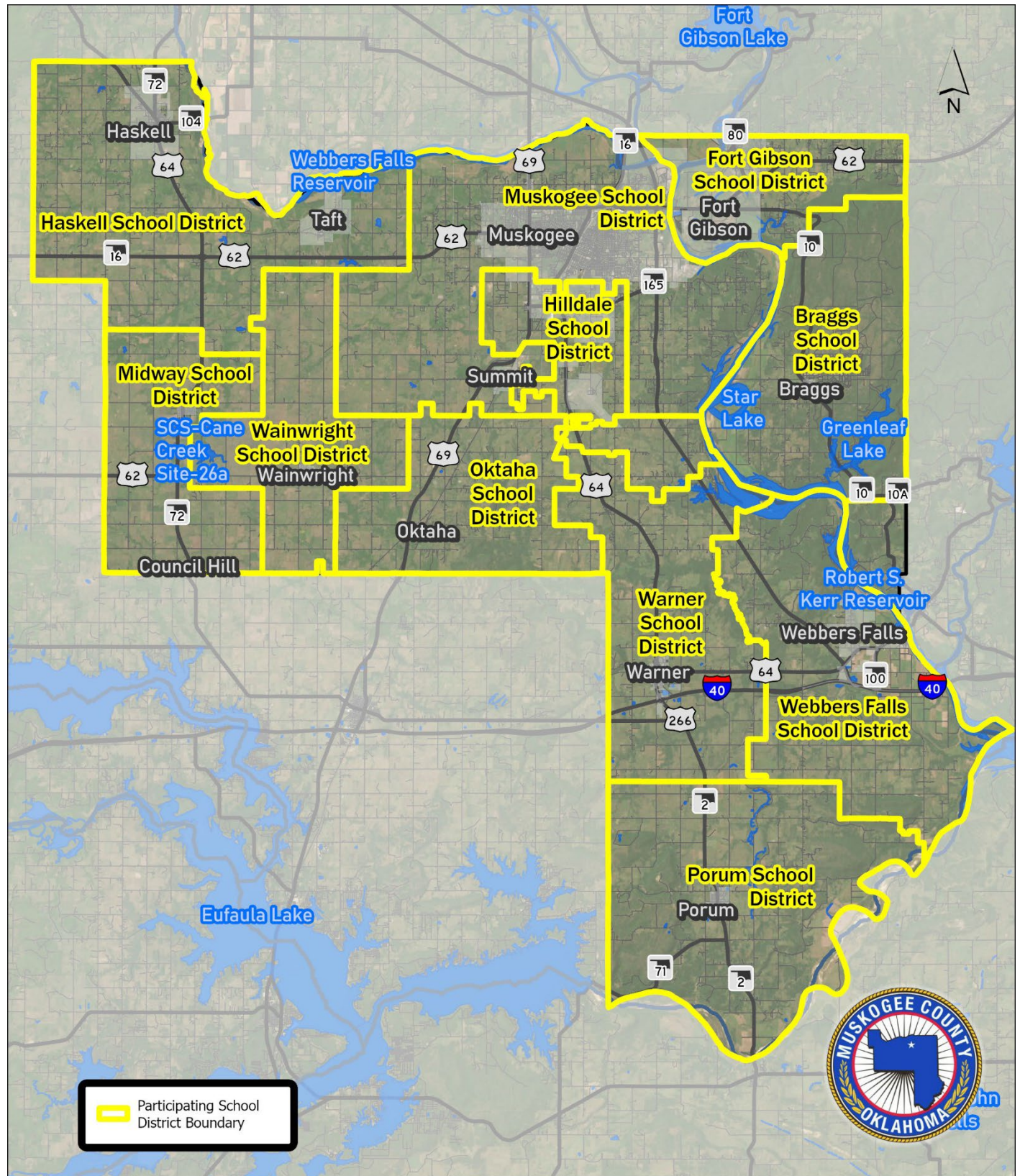
1.7.4 Public School Districts

Eleven public school districts are additional participating jurisdictions in the 2024 HMP Update. Within these districts, there are a total of 38 different public schools or institutions. Table 1-4 below details how each school is categorized according to which public school district.

Table 1-4 Public Schools Participating in Muskogee County, OK

District	School/Institution Name	City/Town
Braggs Public Schools District	Braggs ES	Braggs, OK
	Braggs HS	
Fort Gibson Public Schools District	Fort Gibson Intermediate ES	Fort Gibson, OK
	Fort Gibson HS	
	Fort Gibson MS	
	Fort Gibson Early Learning Center	
Haskell Public Schools District	Haskell MS	Haskell, OK
	Mary White ES	
	Haskell HS	
Hilldale Public Schools District	Hilldale Lower ES	Muskogee, OK
	Hilldale MS	
	Hilldale HS	
Midway Public Schools District	Midway ES	Council Hill, OK
	Midway HS	
Muskogee Public Schools District	Oklahoma School for The Blind (ES, MS, & HS)	Muskogee, OK
	6th and 7th Grade Academy	
	Muskogee HS	
	Cherokee ES	
	Irving ES	
	Pershing ES	
	Tony Goetz ES	
	Whittier ES	
	Sadler Arts Academy	
	Creek ES	
	Muskogee Early Childhood Center	
	6th Grade Academy	
	8th and 9th Grade Academy	
Oktaha Public Schools District	Oktaha ES, Oktaha HS	Oktaha, OK
Porum Public Schools District	Porum ES, Porum HS	Porum, OK
Wainwright Public Schools District	Wainwright Public School	Wainwright, OK
Warner P Public Schools District SD	Warner ES & Warner HS	Warner, OK
Webbers Falls Public Schools District	Webbers Falls ES, Webbers Falls HS	Webbers Falls, OK

Figure 1-14 Public School Districts in Muskogee County



1.7.5 Recent and Future Development

Development since 2019 HMP

Development since the previous Hazard Mitigation Plan has included residential and commercial growth across most of the County, according to officials. For example, since the “2019 Arkansas River Flood”, several mobile home parks and multiple homes destroyed by floodwaters were not rebuilt, and instead, residents of those structures were relocated across various regions of the County. Using the latest satellite data available via Esri, certain changes can be observed in terms of land use.

Figure 1-15 Sentinel-2 Land Use Changes from 2019 to 2021

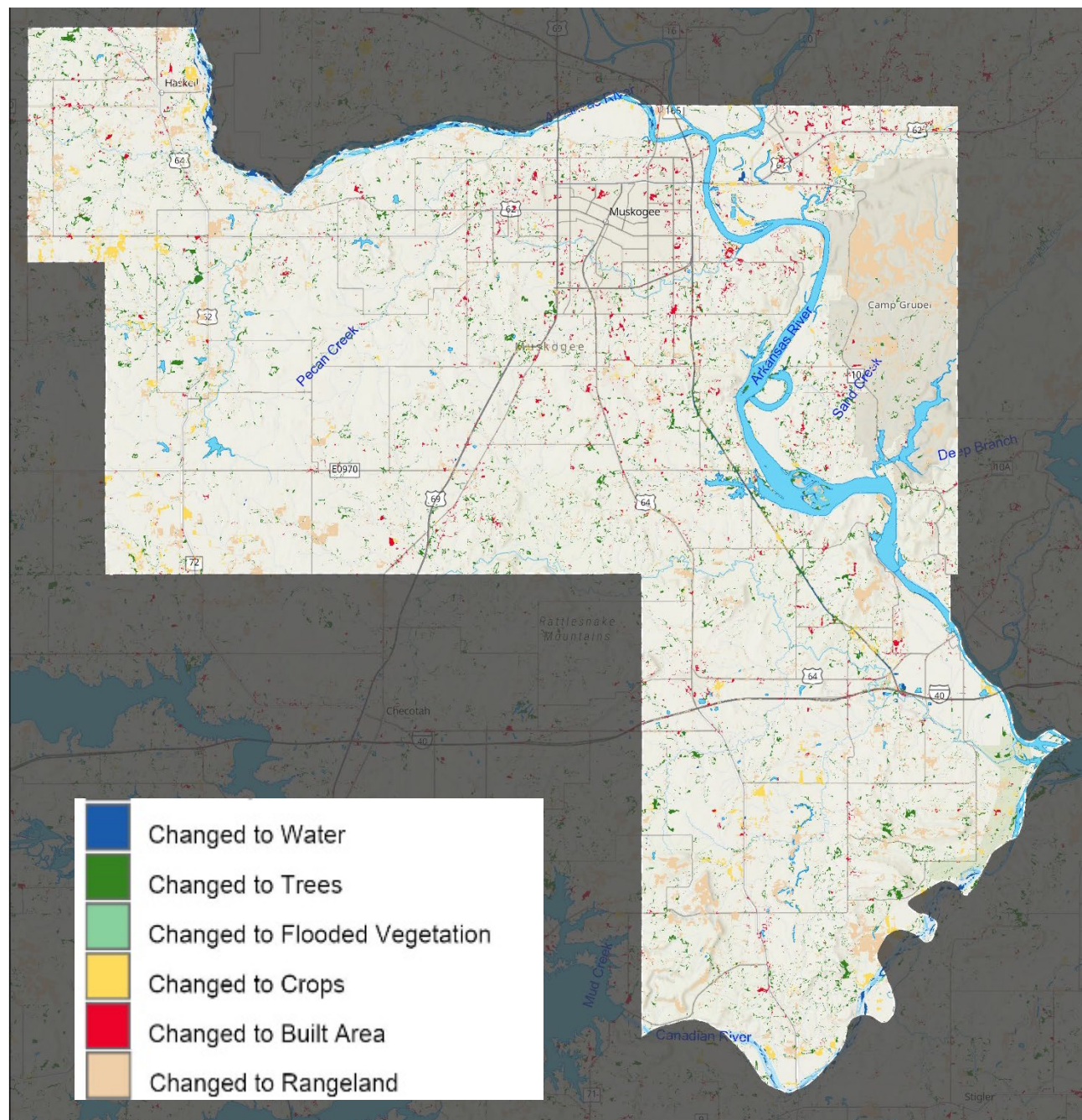


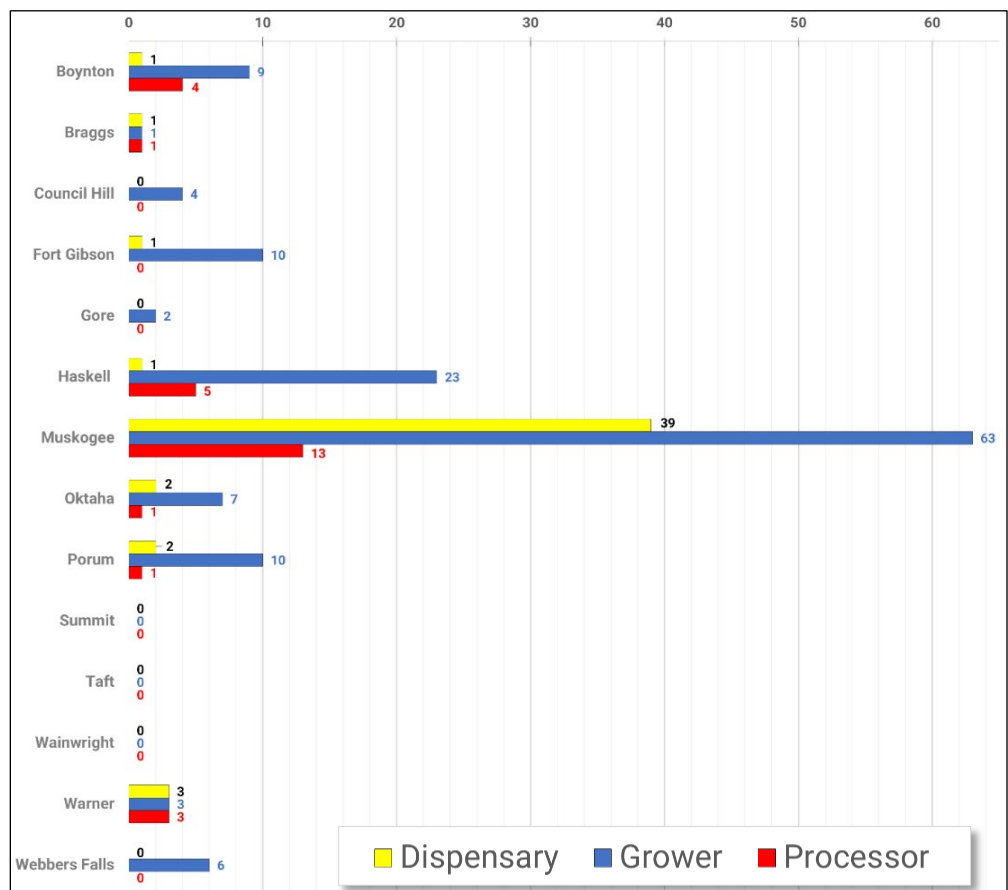
Figure 1-15 features data collected by the Sentinel-2 satellite and shows land use changes between the years 2018 and 2021. Data for more recent years is not yet available, but this graphic does encompass some of the major natural hazard events that have impacted the County in that timeframe. While satellite data can be helpful, it does not account for other types of development such as new business ventures, like the medical marijuana industry which has seen an explosion in growth over the last few years statewide.

Since 2019, County officials and planning team members reiterated the single most substantial change has been in the number of medical marijuana facilities which have popped up across the County. Publicly available data from the Oklahoma Medical Marijuana Authority provides insight into the types of medical marijuana facilities as well as their location. While not all registered facilities provided physical street addresses, OMMA statistics do show where the facilities are located.

Medical marijuana facilities have been increasing in coverage and numbers each year, and the statistics shown in Figure 1-16 are

accurate as of November 2023. While growing facilities, dispensaries, and processing facilities are contributors to the local economy, these types of businesses remain unregulated when it comes to other aspects, such as building code adoptions, water usage and regulation, and others. Hazardous Materials is not a natural hazard profiled in the 2024 Muskogee County HMP Update; however, medical marijuana facilities are worth noting because of their role during other natural hazard events. Further explanation of how and why these businesses matter is provided in Chapter 4.

Figure 1-16 Medical Marijuana Facilities Registered in Muskogee Co.



Future Development

Through conversations with City and County planning team members, future development across the planning area is expected to remain on par (or exceed) the latest trends. Improvements and changes made following the 2019 flood have led to more vacant spaces in the floodplain, while re-development has taken place with improved floodplain management requirements. Officials did not specify any significant or imminent future development that might take place over the next few years; however, population growth and urbanization will likely continue.

Chapter 2 Planning Process

Overview of the Planning Process

Guidance from FEMA’s Local Mitigation Plan Review Guide, the Local Mitigation Planning Handbook, and the Community Rating System (CRS), are used to create a ten-step planning process to develop this plan. Authorized representation from each participating jurisdiction and school district provides additional guidance and content. In-person meetings, email communication, digital surveys, and virtual attendance options are used throughout the process to provide maximum participation options for all stakeholders.

Officially, the planning process kicked off in August of 2023 with a Kickoff Meeting. Funding for the development of this Plan Update was secured by Muskogee County through the Hazard Mitigation Grant Program. Through a series of in-person and virtual meetings, community members were allowed numerous occasions for collaboration and input. Table 1-1 below provides an overview of the meeting schedule, most of which took place at the Martin Luther King Center in Muskogee, OK. Here, the planning process allowed for numerous groups to unite for workshops and presentations from the team at Meshek & Associates.

2.1 Organize to Prepare the Plan

Muskogee County’s 2024 Update had participation from several diverse groups of individuals on the Planning Team, and below, Table 1-1 describes when certain milestone meetings occurred during the planning process.

Table 1-1 Workshop & Meeting Schedule

Meeting	Date
Kickoff Meeting	August 21, 2023
Stakeholder Workshop #1	September 21, 2023
Core Group #1	September 28, 2023
Stakeholder Workshop #2	October 19, 2023
Core Group #2	October 30, 2023
Stakeholder Workshop #3	November 16, 2023
Core Group #3	December 4, 2023
Public/VOAD Meeting	December 18, 2023
Stakeholder Workshop #4	January 11, 2024

Each engagement listed to the left allowed members of the Planning Team ample time and space to participate, and

Table 1-3 details this participation. Community-specific information was gathered through these interactions that helped shape the narrative of the 2024 HMP Update. A timeline of these events is summarized in Table 1-1. In addition to the Planning Team, the public group serves as the fourth and final collection of community members who took part in the planning process. Together, these groups came together over the course of the planning process for a series of workshops, meetings, phone calls, and

presentations.

2.2 Involve the Public

Attempts to involve the public manifested itself in two separate ways – a bilingual survey online as well as the Public Meeting. Outreach to inform residents was conducted through the Muskogee County Emergency Management Facebook page.

An English and Spanish version of a hazard mitigation survey was published online where respondents were given the opportunity to provide input, as well as a blank space where concerns and needs could be communicated. To solicit participation in the online survey, digital flyers were created and distributed to the entire Planning Team outreach directory (see Appendix D). Additionally, paper copies of the survey promo were distributed to Core group members at Stakeholder Workshop #2.

Table 1-2 Public/VOAD Meeting Overview & Presentation Summary

Meeting	Overview Description
Public/VOAD Meeting	Explanation of what the 2024 Muskogee County Hazard Mitigation Plan Update contained as well as what this planning mechanism does for communities across the planning area. A brief presentation of HMP components was followed by a review of the upcoming mitigation strategy developed by the entire planning team. Guests were invited to take part once again in the online survey. Finally, information regarding the final plan draft was presented, and an explanation of the 1-week review period when the public will have the opportunity to read, comment, and provide feedback on the HMP draft before it is sent to ODEMHS for initial review.

A second method used to gather public input was via the Public Meeting, which served as a time and place devoted specifically to the public, private, and volunteer members of the Muskogee County community. Invitations also targeted specific VOAD groups that serve residents of Muskogee County so their partnership and degree of mitigation could be understood. To prepare for this meeting, a digital meeting flyer was created and distributed to Core Group members (see Appendix D), and requests were made to share the announcement on any/all channels available to them.

The gathered feedback became a valuable aspect in the development of the plan. Based on meeting participation and survey responses, three overarching themes/priorities were extracted: 1) additional warning devices, 2) improved warning communication methods, and 3) increased education and training on hazards. Survey results can be seen in Appendix H. Information gathered from results is incorporated into various parts of the plan, including the Capability Assessment in Chapter 3 and the Hazard Risk and Vulnerability Assessments found throughout Chapter 4. Appendix H incorporates all public and stakeholder feedback gathered through the online survey.

2.3 Coordinate with Other Agencies & Organizations

Stakeholders from within and outside Muskogee County were invited to participate in the planning process. Invitations were extended via email and phone calls. Additionally, flyers were created to solicit participation from other agencies and organizations connected with the planning area. Meeting announcements, as well as digital flyers/promo graphics, were distributed before each meeting. Meeting reminders were also made at least one week in advance of each workshop, with a request to spread the invite to other contacts not held by planners.

The Planning Team

Throughout the planning process, there were many individuals and groups who participated in the 2024 Muskogee County HMP Update. Planning Team members included mitigation planners from Meshek & Associates, Emergency Management Directors and their Deputies for Muskogee Co. and the City of Muskogee (referred to as the Core Group), as well as a variety of jurisdictional representatives across the county and those neighboring the Planning Area.

The update incorporates new feedback and input from the entire Planning Team, and this information was gathered via in-person conversations, phone calls, emails, as well as through a series of meetings. Meetings included virtual Core Group conference calls, in-person Stakeholder Workshops, Public Meetings, while online surveys enabled further participation from planning team members as well as stakeholders (see Table 1-4). Participation in the planning process is noted in

Table 1-3, with meeting abbreviations defined in the footnotes.

Table 1-3 Planning Team Members

Name	Jurisdiction	Title / Role	Participation ⁹
Nathan Parker *	Boynton	Fire Department Chief	S1, S2, S4
Leannette Hutchinson	Boynton	Floodplain Administrator	S3
Jared Wilson	Boynton	VFD Fire Chief	Reviewed Plan
Kay Lang	Boynton	Mayor	Reviewed Plan
Alicia Beasley	Braggs	Town Clerk	Reviewed Plan
Walter Cohen	Braggs	VFD – Fire Chief	Reviewed Plan
Kenneth Richardson	Braggs	FPA	Reviewed Plan
Lisa Tyler *	Braggs	Mayor	S3, S
Chad Harp	Braggs PS	Superintendent	Reviewed Plan
Rick Hoss *	Braggs PS	Superintendent	S4
Eldon Staton	Council Hill	Mayor / County Treasurer	Reviewed Plan
Hoss Horsley *	Council Hill	Vol. Fire Chief	S4
Brent Williams	Council Hill	VFD Fire Chief	Reviewed Plan
Bryan Farmer	Fort Gibson	Code Enforcement	Reviewed Plan
Nathan Parker *	Fort Gibson	Fire Department Chief	S1, S2, S4
James Walters	Fort Gibson	Town Administrator	Reviewed Plan
Rob Frazier	Fort Gibson	Police Chief	Reviewed Plan
George Kunsman *	Fort Gibson PS	Facilities	S3, P, S4, S
Scott Farmer	Fort Gibson PS	Superintendent	S
Tom Stiles	Fort Gibson PS	Assistant Superintendent	P, S
Caleb Brewer *	Haskell	Fire Department Chief	S1, S2, S3
Dwayne Points	Haskell	Town Administrator / Floodplain Admin.	Reviewed Plan

⁹ **S1, S2, S3, S4** = Stakeholder Workshop #1, #2, #3, #4 respectively.

C1, C2, C3 = Core Group #1, #2, #3 respectively

S = Survey participation **P** = Public Meeting

Name	Jurisdiction	Title / Role	Participation ⁹
Michael Keene	Haskell	Floodplain Administrator	S1, S3
Zach Stephens	Haskell	Police Chief	S1
Rod Luellen	Haskell PS	Superintendent	S3, S
Chad Kirkhart *	Hilldale PS	Assistant Superintendent	S1, S
Eric Puckett	Hilldale PS	Superintendent	Reviewed Plan
Bruce Douglas	Midway PS	Superintendent	Reviewed Plan
Abigail Wright	Muskogee	Floodplain Administrator	S1, S4, S
Avery Rigney	Muskogee	Assistant Public Works Director	S1, S
Jimmy Wood	Muskogee	GIS Specialist	S1, S2, S3, S4, S
Jody Moore	Muskogee	Fire Chief	S1, S3, S
John K. Lumpkins	Muskogee	Water Plant Superintendent	S1, S
Michael Stewart	Muskogee	Director of Public Works	Reviewed Plan
Mike Miller	Muskogee	City Manager	Reviewed Plan
Scott Fletcher	Muskogee	Wastewater Treatment Plant Maintenance	S1, S
Steve Beauvais	Muskogee	Fire Department Special Ops Officer	S1, S4, S
Tyler Evans *	Muskogee	Emergency Management Director	S1, C1, S4, S
Kelly Bolding	Muskogee	Deputy Emergency Management Director	S1, S2, S3, S
Jeff Smith *	Muskogee County	Director of EM / FPA / ADA Compliance	S1, C1, C2
Carrie Wages	Muskogee County	Deputy Emergency Management Director	S1, C1, S2, C2, S3, S4
Ron Dean	Muskogee County	Muskogee Co. Assessor / MCDRC	Reviewed Plan
Ken Doke	Muskogee County	District 1 Commissioner	Reviewed Plan
Brian DeShazo	Muskogee County	District 1 Deputy Commissioner	Reviewed Plan
Josh Wood	Muskogee County	LEPC / Rural Fire Chief	Reviewed Plan
Keith Hyslop	Muskogee County	District 2 Commissioner	Reviewed Plan
Kenny Payne	Muskogee County	District 3 Commissioner	Reviewed Plan
Ron Dean	Muskogee County	Assessor	Reviewed Plan
Dan Hall	Muskogee PS	LEPC / Chief of Police	S1
Rita Echelle	OK School for the Blind	Superintendent	Reviewed Plan
Levi Hill *	Oktaha	FD – Fire Chief	Reviewed Plan
Sheila Whittle	Oktaha	Town Clerk	Reviewed Plan
Barbara Tyra	Oktaha	Floodplain Administrator	Reviewed Plan
Jerry Needham	Oktaha PS	Superintendent	Reviewed Plan
Laura Holt *	Oktaha PS	Assistant Superintendent	S1, S3, S
Jimmy Robinson *	Porum	PW Super. / FPA / Water Super.	S4, S
Trampas Tripp	Porum	VFD – Fire Chief	Reviewed Plan
Landon Berry	Porum PS	Superintendent	S3, S

Name	Jurisdiction	Title / Role	Participation ⁹
Greg Smith	Summit	VFD – Fire Chief	Reviewed Plan
Brian Lee	Taft	VFD – Fire Chief	Reviewed Plan
Darren Royce *	Taft	Assistant Fire Chief	S
Bryce Newton	Wainwright	VFD – Fire Chief	Reviewed Plan
Jim Ogden	Wainwright PS	Superintendent	Reviewed Plan
Colby Hyslope *	Warner	Fire Department	S3, S
Hannah Moore	Warner	Fire Department	S3, S
David Vinson	Warner PS	Superintendent	S4
Johnny Pollard *	Webbers Falls	Town Clerk	S3
Norma Griffith	Webbers Falls	Town Clerk/Treasurer	S3
Chris Whelan	Webbers Falls PS	Superintendent	S3

* primary point of contact within this group

Members representing underserved populations in and around Muskogee County were also invited to participate, like the Lake Area United Way as well as the Oklahoma School for the Blind. These participants as well as other stakeholders are listed below in Table 1-4.

Table 1-4 Stakeholder Team Members

Name	Jurisdiction/Agency	Title/Role	Participation ¹⁰
Mike Underwood	Cherokee County	Director of Emergency Management	Reviewed Plan
Amy Tanner	Cherokee Nation	EM Director	S2
Blake Lyons *	Cherokee Nation	Deputy Sheriff	S1, S2, S3, P, S4
Brad Wagnon	Cherokee Nation	Community Outreach Coordinator	S2
Joy Sloan	Green Country Behavioral Health Sciences	Chief Executive Officer	Reviewed Plan
Bobby Howard	Muscogee (Creek) Nation	Emergency Management Director	Reviewed Plan
Chad Bonds *	Muscogee (Creek) Nation	Deputy Emergency Management Director	S1, S2
Lisa Robinson	ODEMHS	NE Regional Coordinator	Reviewed Plan
Rita Echelle	OK School for the Blind	Superintendent	Reviewed Plan
Jeff Moore	Okmulgee County	Director of Emergency Management	S2, S4
Steve Rutherford	Sequoyah County	Director of Emergency Management	Reviewed Plan
Kyle Kuhns	St. Francis	Emergency Manager	Reviewed Plan
Jenny Jamison	United Way (Lake Area)	Executive Director	S1
Kim Jaquez *	United Way (Lake Area)	Outreach Coordinator	S1, S2, S3, P

* primary point of contact within this group

¹⁰ S1, S2, S3, S4 = Stakeholder Workshop #1, #2, #3, #4 respectively.

C1, C2, C3 = Core Group #1, #2, #3 respectively

S = Survey participation P = Public Meeting

Lastly, mitigation planning participation was provided by members of the public in two different arenas – an online survey as well as a Public Meeting. Section 1.2 below further describes the way the public was involved throughout the planning process.

Planning Team member involvement is noted in the “Participation” columns and serves as a summary of all meeting sign-in sheets which can be found in Appendix D. Participants in this plan include officials from fire departments, utilities, public officials, law enforcement agencies, businesses, and other organizations. The planning team also contacted neighboring communities, tribes, state, and federal agencies, and private or non-profit organizations via email and/or phone. Extensive outreach efforts resulted in more than 75 agencies, officials, and/or individuals, and Table D-1 shows who received invitations to which meeting. This same list also documents which personnel/group attended.

During Stakeholder Workshops, participants provided insight and expertise for inclusion in the plan, reviewed presentation handouts/slides, and identified/assessed hazards so that jurisdictional-specific vulnerabilities/impacts are clearly understood. Workshops produced a status update on previous HMP action items (see Appendix A) and provided an environment for stakeholders to formulate and discuss a mitigation strategy for the 2024 Muskogee County HMP Update.

Table 1-5 Stakeholder Workshop Meeting Overviews and Summaries

Meeting	Overview Description
Stakeholder Workshop #1	Overview of the planning process, disaster history in Muskogee County, the purpose of HMPs, and iteration of what jurisdictional capabilities look like.
Stakeholder Workshop #2	Review of public survey responses and items from Stakeholder 1, demonstration of the Muskogee Co. HMP Viewer, and review of natural hazards. Three disaster scenarios were presented, and discussions were made in small groups and collectively at the end.
Stakeholder Workshop #3	Review of Community Goals, presented on various funding and grant opportunities as well as how to make the most out of each. Each action item from 2019 was reviewed to prioritize and/or make modifications. Mitigation strategy elements/requirements were also reviewed to understand how to properly develop new 2024 hazard mitigation action items. Also, a preview of what adoption resolution letters look like, and an overview of this process was made to prepare jurisdictions for what lies ahead.
Stakeholder Workshop #4	A review of the steps involved with Implementing the HMP into local planning mechanisms as well as the maintenance process for the next five years; what the adoption process entails, including the planning team’s responsibilities as well as general timeline expectations.

Core Group Members were provided drafts of Chapters 5 and 6 before the final Stakeholder Workshop so Core Group members had sufficient time to review and make edits to the HMP strategy before Stakeholder 4. At the end of the planning process and once the final draft was prepared, a link was provided and sent to all Stakeholders. Each was invited to review the draft and encouraged to send feedback before the document was submitted to ODEMHS for its first round of review. Also invited to participate in the review was the public. Using a publicly accessible URL link, the [Muskogee County HUB Page](#) housed the draft document and notices were posted online via Core Group member's social media platforms.

Table 1-6 Core Group Meeting Overviews and Summaries

Meeting	Overview Description
Core Group #1	A review of the GIS web viewer, which helped gather information on critical facilities as well as any recent changes/developments that may have occurred since the 2019 HMP. Members were informed of the latest survey responses as well as a reminder that a Public/VOAD Meeting needed to be scheduled. Planners also gathered information on vulnerable populations in the County and identified specific jurisdictional officials who were needed to have their participation at Stakeholder 2. Members also were given the online public survey link and promo flyer (see Appendix D), with verbal requests made for Core members to share on social media.
Core Group #2	Questions asked about public water systems, and wastewater facilities, including representatives who planners could contact and invite to Stakeholder 3. Other items discussed included: general utility questions for the County, land use changes since 2019, future development inquiries, and jurisdictional participation up to this point. Things concluded with a complete review of the 2019 mitigation action items, with Core Group members providing general status updates on each of the 29 action items.
Core Group #3	A review of Mitigation Action Items was performed to determine the prioritization of each. After the meeting, it was agreed that a draft of Chapters 5 and 6 would be sent so Core Group members could review the entire mitigation strategy and implementation narratives.

2.4 Assess the Hazard

Hazards assessed in the 2024 Muskogee County Hazard Mitigation Plan are selected based on the county's 2019 plan, the 2019 Oklahoma State Standard Hazard Mitigation Plan, and deliberation of the planning team and stakeholder groups. These hazards are profiled in Chapter 4, along with a description of the selection process and assessments of each hazard's risks to the planning area. Data from several sources are used to assess hazards, including the Simple Planning Tool for Oklahoma Climate Hazards, the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the National Weather Service (NWS), the Oklahoma Climate Survey (OCS), among other sources, and are used throughout Chapter 4. Additionally, stakeholders assessed, prioritized, and verified these hazards with key members of the county at Stakeholder Workshops 1, 2, and 3 (see sections above).

2.5 Assess the Problem

Hazard data is analyzed based on the impact on public safety, health, the built environment, transportation, infrastructure, critical facilities, the natural environment, wildlife, and the economy. Each assessment includes an analysis of previous occurrences, location, and extent along with vulnerabilities specific to each jurisdiction. Assessments were also made using the planning team's input along with public feedback collected using the online survey. Respondents and workshop participants conveyed their hazard-specific impacts and vulnerabilities which were then incorporated into the 2024 Update.

Building footprints are used to estimate potential losses from flood and wildfire hazard areas identified in Chapter 4 and from a standalone GIS web viewer developed by Meshek & Associates, LLC. GIS specialists performed modern analysis of repetitive loss/severe repetitive loss structures as well as thorough NFIP calculations available at that time. For these statistics and other GIS results, see Section 3.2 as well as the [Muskogee County HUB Page](#).

Chapter 4 builds off the 2019 Muskogee County Hazard Mitigation Plan risk assessment while utilizing material and narratives contained in the 2019 Oklahoma State Standard Hazard Mitigation Plan.

Furthermore, Chapter 4 updates the list of previous events for each of the 11 natural hazards and culminates with an identification of specific vulnerabilities in the planning jurisdictions to each hazard. Assessments include data on the expected frequency, magnitude, and likelihood of future occurrences of hazards as well as some of the historic impact costs absorbed by the planning area since 2019. Additional documents reviewed include local jurisdiction ordinances and codes, basic regulatory documents, NFIP data, and additional desktop research, all of which are compiled in Chapters 3 and 4 of this document.

2.6 Set Goals

Goals for the planning area and participating jurisdictions were created by the Planning Team after presentations at Stakeholder Workshops #2 and #3. No revisions were made, and no suggested changes were offered to planners throughout the planning process. These goals are listed in Chapter 5.

2.7 Review Possible Activities

Action items from the previous plan were reviewed to determine progress toward completion using the following status categorizations: completed, ongoing, and not started (see Appendix A). Previous activities that officials wanted to modify, or edit were noted by planners. Following Stakeholder Workshop #3, final revisions to these as well as the incorporation of participant input were also reviewed to formulate potential new activities in the 2024 Update. New action items were drafted based on community assessments, hazard observations, vulnerability analyses, and input from the Planning Committee (see Chapter 5).

2.8 Plans, Documents & Literature Reviewed

Information regarding hazards, disaster history, future patterns, and local capabilities incorporated into this plan are listed in Table 1-7 below.

Table 1-7 Resources & Information Used in the 2024 HMP Update

Reference / Source	Information Used
2019 Muskogee County Hazard Mitigation Plan	• Previous hazard risk assessments and vulnerabilities • Capability assessments as well as points of contact for participating jurisdictions • Past mitigation actions/activities • Community goals and previous mitigation strategies
NCEI – Storm Events Database	Historical occurrences of most natural hazards profiled in Chapter 4
FEMA Disaster Declaration History	Historical disaster declarations, impacts, and funding statistics that came from it
FEMA Floodplain, FIRM depth maps	Used in the flood vulnerability assessment as well as other areas of the plan
U.S. Census Bureau	Community statistics and overview.
OK Department of Education Emergency Guidelines	Statistics and regulations are used in the description of public school districts and their capabilities.
OK Department of Environmental Quality (OKDEQ)	Utility information extracted from the Drinking Water Branch to profile active water systems
OK Medical Marijuana Authority (OMMA)	Summary graphic of OMMA facilities and impacts they can have during drought, and extreme heat events (See Chapter 4)

Reference / Source	Information Used
National Weather Service (NWS)	Damage Assessment Toolkit provided high wind and/or tornado damage assessments which informed hazard profiles
Sperry-Piltz Ice Accumulation (SPIA) Index	Analysis of Severe Winter Storm Extent
Storm Prediction Center (SPC)	Hazard graphics
Municipal & School websites	Used in the capabilities assessment as well as the general community description narrative
Oklahoma Water Resources Board (OWRB)	Used to determine the extent and boundaries of public water systems in the County
International Code Council (ICC)	Used while referencing current building practices as well as in the identification of areas where future development could be enhanced, and damage mitigated.
U.S. Drought Monitor (USDM)	Used in the determination and delineation of drought categories as well as a historical time-series examination of Muskogee County
Enhanced Fujita (EF) Rating Scale	Analysis of Tornado hazard/extent
NWS Residential Tornado Damage Descriptions	Analysis of Tornado hazard/extent
Combined NOAA/TORRO Hailstorm Intensity Scale	Analysis of Hail Extent
Keetch-Byram Drought Index (KBDI)	Analysis of Wildfire and Drought Hazards Extent
Lightning Activity Level (LAL)	Analysis of Lightning Extent
FEMA National Risk Index (NRI)	Analysis of social vulnerability indices/maps
FEMA Social Vulnerability Index (SVI)	Analysis of social vulnerability indices/maps
OK Fire Marshall Fire Run	Analysis of Wildfire previous occurrences
OK Climatological Survey (OCS) Fire Danger Model	Analysis of Wildfire Extent
Combined Fire Danger Rating & Burning Index (BI)	Analysis of Wildfire Extent
Palmer Drought Severity Index	Analysis of Drought hazard extent
U.S. Geological Survey (USGS)	Analysis of historical Earthquake events
Southern Climate Impacts Planning Program (SCIPP)	Analysis of future conditions and projected changes in hazards
Emergency Action Plan (EAP) for: • Eufaula Lake Dam • Fort Gibson Lake Dam • Heyburn Lake Dam • Keystone Reservoir Dam • Oologah Lake Dam • Pensacola Dam • Robert S. Kerr (Lake Hudson) Dam • SCS Cane Creek Sites 5 • SCS Cane Creek Site 22 • Skiatook Dam • Tenkiller Ferry Dam • Webbers Falls Lock and Dam • Choteau Lock and Dam	• Communities, structures, and infrastructure that can be affected by inundation scenarios. • Expected floodwater arrival times

2.9 Draft an Action Plan

The Planning Team reviewed observations from the Risk Assessment and results of the Capability Assessment to consider actions. From this analysis and through the Planning Team's involvement at Workshops, an update to the County's action plan was developed and incorporated into Chapter 5 of this document. Actions were evaluated, prioritized, and then combined with new activities to formulate a comprehensive update to the mitigation strategy & implementation techniques of Muskogee County.

2.10 Adopt the Plan

Upon completion, the 2024 Muskogee County Hazard Mitigation Plan was submitted to the Oklahoma Department of Emergency Management and Homeland Security (ODEMHS), and then to FEMA for approval. Individual adoption resolutions were approved by Muskogee County and each participating jurisdiction, indicating their participation in, and approval of, the 2024 Muskogee County Hazard Mitigation Plan.

2.11 Plan Maintenance

Adoption of the 2024 Muskogee County Hazard Mitigation Plan is only the first step in continuing resilience to natural hazards in the planning area. Community offices, as well as other agencies and private partners, will proceed with implementation. The Planning Team will continue to meet regularly to monitor progress, evaluate activities, and periodically recommend revisions and amendments to the plan, and mitigation action items, as necessary. A formal update to the 2024 Plan will occur in 2029 as required by FEMA. Chapter 6 outlines this step in more detail, and Chapter 5 contains more information on how this process will be maintained.

Chapter 3 Capability Assessment

3.1 Overview

Regulatory measures such as building and zoning codes, planning mechanisms, administrative structure of local government, equipment (including quantity and types), and existing mitigation measures all factor into a community's ability to enhance resilience against natural hazards. Based on Task 4 of FEMA's Local Mitigation Planning Handbook, the following assessment examines each jurisdiction's existing authorities, policies, programs, and resources.

Existing capabilities identified to reduce disaster losses or have the potential to do so in the future have been reviewed by the planning team. Information provided in the 2019 Muskogee County Hazard Mitigation Plan was reviewed along with relevant community studies, plans, reports, and technical documents used to develop that plan. Additionally, information from public officials, existing planning mechanisms, and stakeholders was used to further identify areas where future growth and development may be vulnerable to the effects of natural hazards so that appropriate mitigation measures may be taken. Any studies, plans, or information possessed by all planning participants pertinent to hazard mitigation was provided to the planning team for inclusion in the capabilities assessment.

Critical Facilities

Across the planning area, numerous facilities are deemed "critical" for the regular and daily operation of County services. For this plan, critical facilities have been categorized into two groups – primary and secondary. Planning team members provided input into these classifications and information pulled from the national HiFLD (Homeland Infrastructure Foundation-Level Data) dataset. In addition to the figures in this plan, these facilities can be examined using the interactive GIS Viewer, available on the [Muskogee County HUB Page](#). For further information, please see Appendix B.

3.2 Planning and Regulatory

An assessment of plans, ordinances, codes, and other guidance possessed by the county and each participating incorporated area is conducted in this section. The planning team collected data through interviews, desktop research, and written reports. Higher numbers of planning and regulatory mechanisms possessed by each jurisdiction indicate a higher capability to protect these communities against the effects of natural hazards.

3.2.1 Overview Assessment

Key	
Specific document/Addressed specifically	●
In-place or included in another document	◐
None Identified	○
Not Applicable	–

Table 3-1 Planning Capabilities Identified within Muskogee County and Incorporated Areas

	Hazard Mitigation Plan	Comprehensive Plan	Emergency Operations Plan	Continuity of Operations Plan	Capital Improvements Plan	Floodplain Ordinances	National Flood Insurance Program	Building Codes and Permitting	Zoning, Subdivision, & Landscape
Muskogee Co. (unincorporated)	●	○	◐	○	●	●	●	◐	○
Boynton	●	○	○	○	○	●	●	◐	○
Braggs	●	○	○	○	○	●	●	◐	○
Council Hill	●	○	○	○	○	—	○	◐	○
Fort Gibson	●	●	○	○	●	●	●	◐	●
Haskell	●	●	○	○	●	●	●	◐	●
Muskogee	●	●	●	○	●	●	●	◐	●
Oktaha	●	●	○	○	●	●	●	◐	●
Porum	●	○	○	○	●	●	●	◐	○
Summit	●	○	○	○	○	—	○	◐	○
Taft	●	○	○	○	○	●	●	◐	○
Wainwright	●	○	○	○	○	○	●	◐	○
Warner	●	●	○	○	●	●	●	●	●
Webbers Falls	●	○	○	○	○	●	●	◐	○

3.2.2 Qualitative Assessment

Hazard Mitigation Plan

Hazard mitigation is any sustainable action that reduces or eliminates long-term risk to people and property from future disasters.¹¹ A hazard mitigation plan (HMP) allows communities to identify which hazards impact them the most, assess vulnerabilities, and identify projects to achieve resilience against those hazards. Updating the HMP every five years allows communities to assess the progress of previously identified mitigation projects and conduct an updated assessment of hazard prioritization based on significant impacts since the previous update.

¹¹ <https://training.fema.gov/programs/emischool/el361/toolkit/glossary.htm#H>

This plan signifies Muskogee County's intention to continue recurring formal hazard mitigation planning, including formulation of mitigation actions. Each participating jurisdiction relies on this document to serve its mitigation needs, as none has an independent plan.

HMPs are living documents, which means these plans are meant to serve as a reference throughout their five-year lifespan. Regular review and updates to this plan will occur annually, allowing communities opportunities to enhance resilience against hazards and ensure the safety of residents. Additional information on plan maintenance and a monitoring schedule can be found at the beginning of Chapter 6.

Comprehensive Plan

Often referred to as a master or general plan, a comprehensive plan is a guide for a community's long-term growth and development. Broad, general ideas for hazard mitigation projects and land use policies can be integrated into a comprehensive plan, which goes beyond the 5-year window of a hazard mitigation plan.

The City of Muskogee utilizes a comprehensive plan developed in 2013, allowing them to manage improvements and developments across the city over 15 to 20 years. County officials have expressed concern about the increase in marijuana growing facilities, which present issues of water usage during periods of drought, along with conformity to building codes and county ordinances. Other participating communities reporting a Comprehensive Plan include Fort Gibson, Haskell, Oktaha, and Warner. This capability allows these communities to address issues and plans as they arise through regular updates.

Emergency Operations Plan (EOP)

FEMA defines an Emergency Operations Plan as a living document used to respond to various potential hazards. It describes how people and property will be protected, details who will be responsible for specific actions, identifies personnel, equipment, facilities, supplies, and other resources available during a response, and outlines how all efforts will be coordinated.¹² Muskogee County and the City of Muskogee are the only participating jurisdictions with a fully developed Emergency Operations Plan.

Continuity of Operations Plan (COOP)

A Continuity of Operations Plan is an effort within individual executive departments and agencies to ensure primary, essential governmental functions can be performed during emergencies, including disasters, accidents, and technological or attack-related emergencies. The lack of an active COOP can be considered a vulnerability shared by each town and community participating in this plan. Muskogee County is the only participating jurisdiction with a Continuity of Operations Plan, and officials note that an update to this plan is necessary.

Capital Improvements Plan (CIP)

Capital improvement planning (or program) is a list of all proposed projects, together with the priority of their construction.¹³ This plan can be considered a "wish list" of publicly funded projects compiled and maintained by a governmental entity for the purview of their jurisdiction. Like a comprehensive plan, it has a narrower, more specific focus and usually operates over a shorter time frame. Muskogee County, the City of Muskogee, Fort Gibson, Haskell, Oktaha, Porum, and Warner have developed capital improvement plans.

¹² <https://training.fema.gov/programs/emischool/el361toolkit/glossary.htm#E>

¹³ <https://www.planning.org/pas/reports/report151/>

Flood and Stormwater Management

Floodplain management is defined by FEMA as a community-based effort to prevent or reduce the risk of flooding, resulting in a more resilient community. Floodplain and stormwater management form the cornerstone of a mitigation strategy to protect a community from flooding. A primary planning mechanism that falls under this umbrella is a master drainage plan. Communities frequently use these plans to manage stormwater runoff with facilities and structures that help manage flood waters. These critical elements of hazard mitigation allow communities to invest to save residents' lives and protect property from damage or destruction.

While no communities in the planning area report having a master drainage plan, the City of Muskogee does have a Stormwater Management Plan, which serves a similar function in minimizing stormwater runoff that may cause flooding by overwhelming stormwater drainage systems. The City is currently developing a Master Drainage Plan, which is not complete at the time of this report.

National Flood Insurance Program (NFIP)

Participation in the NFIP enables homeowners to purchase federal flood insurance, allowing for quicker recovery after a flooding event for policyholders. Of the 16 communities participating in the 2024 Update, two are not participating members in the NFIP – Council Hill and Summit. An overview of all municipalities in the County is detailed in Table 3-2 below.

Table 3-2 Jurisdictional Participation in the NFIP and CRS

Participating Jurisdiction	CID	Effective Map Date	CRS Participation	Policies in Force	Total \$ Coverage
Muskogee Co. (unincorporated)	400491	02/04/2011	No	64	\$14,959,000
Boynton	400120	02/04/2011	No	—	—
Braggs	400121	02/04/2011	No	1	\$70,000
Council Hill	400122	<i>Not Participating</i>			
Fort Gibson	400123	02/04/2011	No	26	\$6,333,000
Haskell	400124	02/04/2011	No	5	\$690,000
Muskogee	400125	02/04/2011	No	71	\$14,944,000
Oktaha	400126	02/04/2011	No	—	—
Porum	400127	02/04/2011	No	1	\$38,000
Summit	400578	<i>Not Participating</i>			
Taft	400128	02/04/2011	No	1	\$170,000
Wainwright	400129	02/04/2011	No	—	—
Warner	400130	02/04/2011	No	3	\$502,000
Webbers Falls	400131	02/04/2011	No	9	\$2,484,000
TOTAL				181	\$40,190,000

To participate, NFIP requires communities to implement floodplain management requirements in their codes of ordinances. 44 CFR Parts 59 and 60 outline these requirements, with mapping regulations contained in Parts 65 and 70. FEMA 480: NFIP Floodplain Management Requirements is a desk reference

produced by FEMA designed for local officials containing FEMA's expectations for ordinances and other floodplain management activities, such as floodplain mapping and tracking substantial damage/substantial improvement properties, as well as those which have experienced repetitive losses.

For smaller or more rural communities that lack financial and human resources to facilitate involvement in the NFIP, it can preclude their involvement. Such is the case for the two communities participating in this plan who do not participate in the NFIP: Council Hill and Summit.

Wainwright is listed as a participant in NFIP, but no floodplain or substantial improvement ordinances for this community were provided during the development of this plan. Efforts were made to locate these documents via phone, email, and at stakeholder workshops, but none were available. State NFIP coordinators were also contacted by phone and email, and responses from the state produced no results either. In lieu of these files, an action item has been added in Chapter 5 for this data deficiency.

Table 3-3 NFIP Claims Information for Communities in Muskogee County, OK¹⁴

Participating Jurisdiction	Number of RL Properties*	Number of RL Claims	NFIP Total \$ RL Paid	NFIP Claims Locations	NFIP Total \$ Claims Paid
Muskogee Co. (unincorporated)	2	5	\$361,254	48	\$4,426,145
Boynton	--	--	--	--	--
Braggs	--	--	--	--	--
Council Hill	--	--	--	--	--
Fort Gibson	3	13	\$311,649	34	\$3,204,113
Haskell	--	--	--	--	--
Muskogee	18	77	\$2,271,386	122	\$3,063,944
Oktaha	--	--	--	--	--
Porum	--	--	--	--	--
Summit	--	--	--	--	--
Taft	--	--	--	--	--
Wainwright	--	--	--	--	--
Warner	--	--	--	--	--
Webbers Falls	--	--	--	--	--
TOTAL	23	95	\$2,944,289	218	\$12,080,043

*Unmitigated

Substantial Damage/Improvement Provision Implementation

Substantial damage, as defined by FEMA, refers to damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged conditions would equal or exceed 50 percent of the market value of the structure before the damage occurred.¹⁵

Substantial improvement, as defined by FEMA, refers to any construction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This includes structures that have incurred

¹⁴ NFIP data used in this assessment is 2022 information due to 2023 data not being available from FEMA. See section 4.6.6 of the Hazard Risk Assessment for more information and timeline details as well as Action Item #31 in Ch. 5

¹⁵ <https://www.ecfr.gov/current/title-44/chapter-I/subchapter-B/part-59>

“substantial damage,” regardless of the actual repair work performed. This does not, however, include any project: 1) for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions, or 2) any alteration of a “historic structure”, provided that the alteration will not preclude the structure’s continued designation as a “historic structure.”

A designated local official, usually an assessor, building official, or floodplain manager, is responsible for determining properties with substantial damage or improvement. Federal statute 44 CFR 60.3 and Oklahoma statute Title 82, OK Stat § 1608 (2022) require all NFIP participating communities to adopt floodplain regulations to include substantial damage/improvement. Ordinances for each jurisdiction that have been implemented to meet these requirements have been included in Appendix E and are summarized in Table 3-4.

When an event results in substantial damage, floodplain managers in NFIP-participating jurisdictions will comply with all required ordinances to enact the substantial damage/improvement provisions of floodplain management regulations.

Table 3-4 Substantial Damage/Improvement Provisions Adopted by Jurisdictions

Jurisdiction	Substantial Damage/Improvement Provisions Adopted by Jurisdictions (Statute Number)	Date Adopted
Muskogee Co. (unincorporated)	Article V, Section B	02/04/2011, updated on 03/27/2023
Boynton	Article V, Section B	01/10/2011
Braggs	Article V, Section B	01/06/2011
Fort Gibson	Title XV, Chapter 155 (Ordinance 2020-004)	06/22/2020
Haskell	Article 5, Section B	05/11/1987
Muskogee	Part I, Chapter 64, Article III, Sections 64-72 and 64-73 (Ordinance 3862-A), updated by Chapter 90, Article 22 (Ordinance 3948-A)	01/24/2011, updated on 09/22/2014, and again on 03/27/2023
Oktaha	Article 5, Section B	06/23/1977
Porum	Article V, Section B	01/04/2011
Taft	Article V, Section B	01/03/2011
Wainwright¹⁶	Unknown	Unknown
Warner	Article V, Section B	01/12/2011
Webbers Falls	Article V, Section B	01/18/2011

Community Rating System (CRS)

NFIP’s Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements of NFIP.

Communities who elect to participate in CRS signify their effort to go beyond to enhance resilience against flooding.

¹⁶ OWRB maintains that Wainwright is a participating community in the NFIP, although neither OWRB nor County officials were able to obtain floodplain ordinances for confirmation. This data deficiency is reflected in Mitigation Action #13 in Chapter 5

Table 3-5 CRS Classification Structure

CRS Level	Credit Points	Policy Discount
Class 1	4500+	45%
Class 2	4000-4499	40%
Class 3	3500-3999	35%
Class 4	3000-3499	30%
Class 5	2500-2999	25%
Class 6	2000-2499	20%
Class 7	1500-1999	15%
Class 8	1000-1499	10%
Class 9	500-999	5%
Class 10	0-499	0%

CRS has 19 activities, each with between one and thirteen elements, which provide credit points. Participating communities are organized into classes from 1 to 10, with 1 being the highest possible rating. The system is stratified into 500-point increments for each class. The higher the classification a community achieves is commensurate with a larger discount on federal flood insurance premiums for residents. This system is shown in Table 3-5.

Currently, no communities in this plan update participate in CRS. Participation in this program would provide benefits to Muskogee County, particularly considering that flooding is a hazard of high concern with recurring impacts on many communities. Much-needed enhancements to fortify the planning area against threats associated with flooding can be achieved through activities within CRS. Doing so would afford Muskogee County and its residents a greater degree of

freedom from the risks to life and property associated with flooding.

Floodplain Ordinance Permitting

Floodplain ordinances protect people and assets from flooding by incorporating design, storage, and other standards with proven flood mitigation outcomes into enforceable regulation. Communities with these ordinances and regulation measures have been summarized in Table 3-4.

Master Drainage Plan and Stormwater Management Plan

Master drainage and stormwater management plans allow communities to manage runoff resulting from rainfall and reduce the impacts of flooding on neighborhoods and businesses. As of this writing, only the City of Muskogee has a stormwater management plan. No communities report having a master drainage plan; however, the City of Muskogee did report that a MDP is in development. These types of planning mechanisms provide enhanced benefits to each jurisdiction participating in this plan (see Section 1.1.1). To identify this potential mitigation benefit for the County, this notion has been added to the 2024 list of mitigation action items (see Chapter 5).

Building Codes and Permitting

Muskogee County follows the 2018 International Building Codes and the 2018 International Residential Codes adopted by the State of Oklahoma. Other participating jurisdictions that report using 2018 I-Codes are Fort Gibson, Haskell, Muskogee, Oktaha, Porum, and Warner. Education and outreach efforts are ongoing to encourage builders and homeowners to build or retrofit structures to withstand forces from high winds, tornadoes, hail, and earthquakes.

Mobile/Prefabricated Homes

Building standards for manufactured housing produced after June 15, 1976, in all areas of the United States are set by the U.S. Department of Housing and Urban Development's Office of Manufactured Housing Programs through the Federal Manufactured Home Construction and Safety Standards. These regulations serve as federal building codes for all manufactured housing within the United States. Of the mobile home parks in Muskogee County, several have been relocated out of the flooding areas following the 2019 flood, however, the one that continually appeared in risk assessments during dam incidents was the Bella Vista

Village along the western shores of the Arkansas River. These residents are some of the more vulnerable in those situations. See Chapter 4 for more information.

Zoning, Subdivision, and Landscape

Enhancing and enforcing zoning, subdivision, and landscape regulations in Muskogee County that correspond to the size (both population and geographic area) and economic activity of incorporated areas participating in this plan provide benefits by allowing communities to manage land use which can then further enhance resilience to hazards. One example is providing setback requirements, which not only increases the aesthetic value of homes but also reduces the risk of the spread of wildfires.

Fire Suppression Rating Schedule

Fire Suppression Rating Schedule (FSRS) is an evaluation system produced by ISO for fire companies throughout the United States which is weighted on four performance characteristics:

- Emergency Communications
- Fire Department
- Water Supply
- Community Risk Reduction

This system is broken into 9 classes of fire rating, called a Public Protection Classification (PPC)¹⁷. A rating of 1 is the highest, 9 being the lowest. A rating of 4 or higher is desired, since at this level a fire company has demonstrated sufficient capabilities in water supply and community risk reduction to appropriately respond to fires. Additionally, a higher rating translates to lower insurance premiums for homeowners¹⁸. ISO ratings for each fire department in Muskogee County have not been made available to the planning team for incorporation into this plan.

Planning Documents Referenced in the 2024 Update

Several planning documents were referenced during the planning phase of the 2024 Update, including the City of Muskogee's 2023 Emergency Operations Plan (EOP), and the County building codes information as well as zoning, subdivision, landscaping, and stormwater management data. Furthermore, additional floodplain ordinances for NFIP communities were also collected during stakeholder engagements and through verbal conversations. All floodplain ordinances were then combined into a single file to provide documentation for participation and adherence to NFIP policies (see Appendix E). On top of these planning documents, information surrounding community Memoranda of Understanding (MOUs) was collected during meaningful conversations at Stakeholder Workshops and Core Group Meetings, as well as through one-on-one interaction with local officials. The value and importance of MOUs were clear as the planning team was able to identify established agreements between the City of Muskogee EM and Muskogee Public Schools for the use of school buses during times of need. Transportation assistance is also available through the Muskogee (Creek) Nation, providing the planning area emergency management a solid foundation of additional resources when they are needed.

3.3 Administrative and Technical Capabilities

Administrative and technical capabilities are those that refer to the community's staff, skills, and tools that a community possesses and can access for mitigation activities. Information presented in this section reflects data collected during the planning process from interviews and written reports.

¹⁷ <https://www.isomitigation.com/ppc/fsrs/>

¹⁸ <http://www.eoddok.org/rural-fire>

3.3.1 Overview Assessment

Key	
Full-Time Personnel / Identified	●
Part-Time Personnel / Identified	◐
None / Not Included	○
Unknown / Not Reported	—

Table 3-6 Overview Assessment of Existing Administrative and Technical Capabilities

Jurisdiction	Mayor/Elected Leaders	Emergency Management	General/Mitigation Planning Committees	Floodplain Administration	Building Inspector/Code Enforcer	Mutual Aid Agreements	Warning Systems/Services	Utilities Departments	GIS	Backup Generation
Muskogee Co. (unincorporated)	●	●	●	●	◐	●	●	●	●	◐
Boynton	●	◐	○	●	◐	◐	●	◐	○	○
Braggs	●	◐	○	●	◐	◐	●	◐	○	○
Council Hill	●	◐	○	○	◐	◐	●	○	○	○
Fort Gibson	●	●	●	●	●	◐	●	●	○	○
Haskell	●	●	○	●	●	◐	●	●	○	◐
Muskogee	●	●	●	●	●	◐	●	●	●	○
Oktaha	●	◐	○	●	◐	◐	●	◐	○	○
Porum	—	◐	○	●	◐	◐	●	●	○	○
Summit	●	●	○	○	◐	◐	●	○	○	○
Taft	●	◐	○	●	◐	◐	—	◐	○	○
Wainwright	—	◐	○	●	◐	◐	●	◐	○	○
Warner	●	●	○	●	◐	◐	●	◐	○	○
Webbers Falls	●	●	○	●	◐	—	●	◐	○	◐

3.3.2 Qualitative Assessment

Mayor/Elected Leaders

In addition to the Emergency Management Director and Deputy Director, Muskogee County's governance structure consists of nine elected officials: three commissioners, each representing one district, a County Sheriff, a County Assessor, a County Clerk, a County Treasurer, a Court Clerk, and District Attorney.

Incorporated areas within the county are served primarily by boards of trustees and a mayor. The City of Muskogee is the only participating incorporated area that is a city, not a town. They have a city council and mayor, along with a more expansive governing structure, commensurate with this jurisdiction having a much larger population than other incorporated areas in Muskogee County.

Since the other incorporated areas within the county are much smaller and have a limited tax base to fund salaries, most have a smaller number of staff, some serving in a part-time capacity. Each town also has an organized governing structure with elected officials.

Emergency Management

Emergency management officials play an essential role in more functions than disaster response. EM duties are paramount in advancing preparedness, hazard mitigation, and resilience. In Muskogee County, the Muskogee County Emergency Management Director's office works closely with the City of Muskogee's Emergency Management team. Other communities with Emergency Management capabilities include Fort Gibson, Haskell, Summit, Warner, and Webbers Falls.

General/Mitigation Planning

Muskogee County supports the Local Emergency Planning Committee (LEPC). The City of Muskogee has a planning department responsible for zoning and subdivision regulations for development within city limits, as well as preparing and administering applications for community development grants. No other jurisdictions in the planning area have planning capabilities on staff.

Floodplain Administration

A floodplain manager holds the responsibility for implementing floodplain ordinances and ensuring the community follows NFIP standards, including enforcement of any locally imposed higher standards. As they oversee community-based efforts to prevent or reduce the risk of flooding, their work allows communities to be more resilient to flooding. Floodplain administration in a community is typically managed by an individual who fulfills the role of a floodplain manager or administrator. This role can be a full-time role, part-time, or fulfilled at the county level and shared among multiple communities.

Floodplain Administrators for each jurisdiction participating in NFIP in Muskogee County are listed in Table 3-7, along with their contact information. Muskogee County's Director of Emergency Management also assumes the role of Floodplain Administrator at the county level.

Table 3-7 Floodplain Administrators in Muskogee County

Jurisdiction	Community Status	Floodplain Administrator
Muskogee Co. (unincorporated)	Participating	Jeff Smith
Boynton	Participating	Leanette Hutchinson
Braggs	Participating	Kenneth Richardson
Council Hill	Not Participating	—
Fort Gibson	Participating	Bryan Farmer
Haskell	Participating	Michael Keene
Muskogee	Participating	Abigail Wright
Oktaha	Participating	Barbara Tyra
Porum	Participating	Jimmy Robinson
Summit	Not Participating	—
Taft	Participating	Kasandra McGee
Wainwright	Participating	Debra Summers
Warner	Participating	Johnny Lewis
Webbers Falls	Participating	Shawn Smith

Response Network & Mutual Aid Agreements

Mutual aid agreements establish the legal basis for two or more entities to share resources. Mutual aid agreements may authorize mutual aid between two or more neighboring communities, among all jurisdictions within a state, between states, between Federal agencies, and/or internationally.¹⁹

During the response phase of an event, mutual aid agreements commonly allow jurisdictions to share resources as part of disaster recovery and assistance efforts. Memoranda of Understanding (MOUs) and mutual aid agreements are critical resources that allow jurisdictions to provide disaster recovery and assistance to communities and people in need during and after an event. Tribal agreements with the County are also in place between the Cherokee Nation and the Muskogee (Creek) Nation.

¹⁹https://emilms.fema.gov/is_0200c/groups/84.html#:~:text=Mutual%20aid%20agreements%20establish%20the,agencies%2C%20and%20For%20internationally.

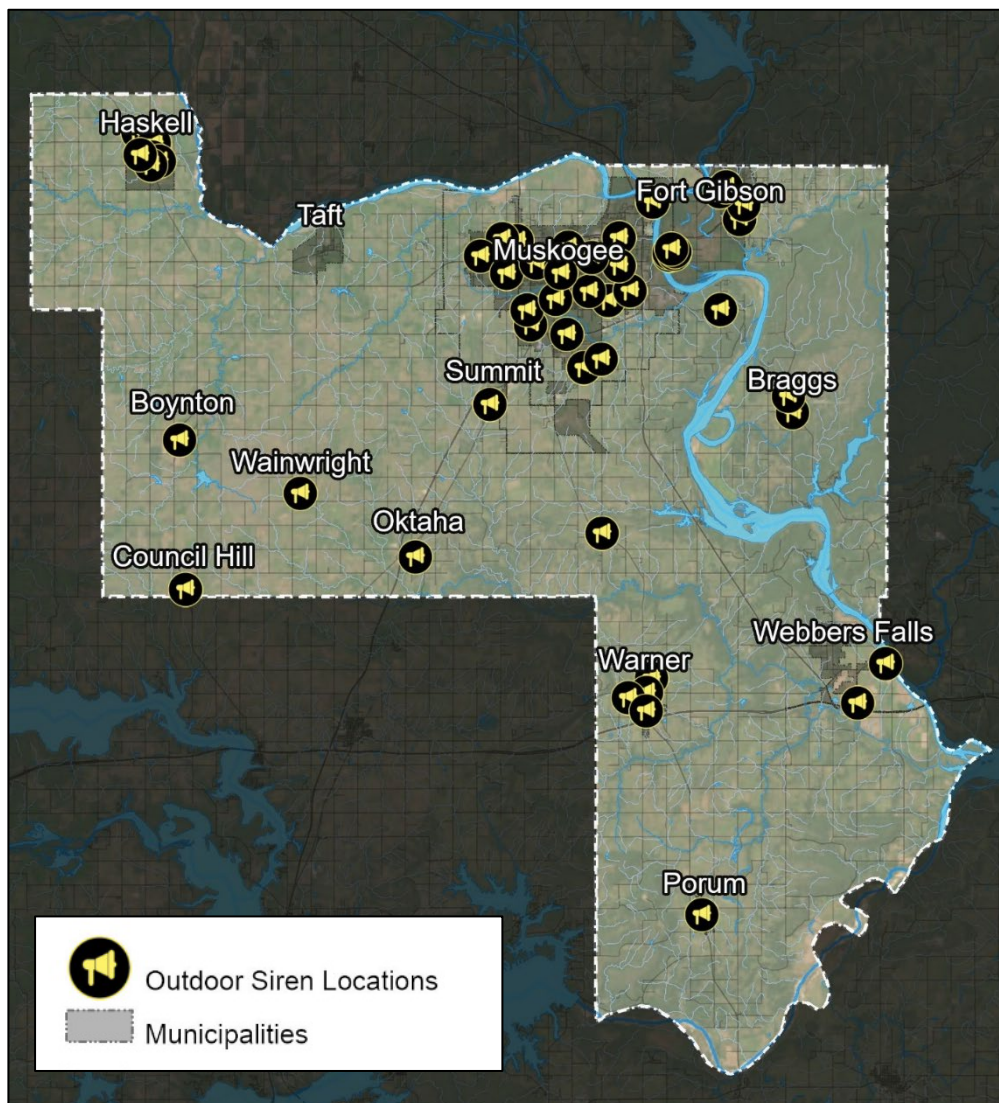
Warning Systems/Services

Warning systems or service capabilities used to warn people in Muskogee County of impending hazardous conditions are in place in the following communities and areas: Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Muskogee, Oktaha, Porum, Wainwright, Warner, Webbers Falls.

Sirens/Outdoor Warning Devices

The City of Muskogee has a network of warning sirens, as do all jurisdictions across the remainder of the planning area, apart from Taft. In the City of Muskogee, there are 20 sirens with software allowing them to produce various tones depending on the threat. These outdoor sirens are connected to cell phones and can be controlled remotely. The remainder of Muskogee County contains a variety of sirens activated by local fire departments. Figure 3-1 is a map of siren locations across Muskogee County.

Figure 3-1 Outdoor Warning Sirens/Devices in Muskogee Co.



Electronic Communications

Muskogee County Emergency Management utilizes the Hyper-Reach electronic alert system, which disseminates notifications through mobile and landline telephones, as well as through email. This system is an effective method to notify residents who may be indoors or otherwise outside of the audible reach of a warning siren of impending threats from natural hazards. Emergency notifications are sent via a mobile application, email, telephone (mobile and landline), and/or TDD (for hearing-impaired residents).

City and Rural Storm Shelters

A mapped database of community shelters is retained by all 911 call centers and will remain that way for safety/liability purposes. In rural areas of the County, private shelters are common, and these locations are undisclosed at the time of this writing.

Building Inspection/Building Code Enforcement

An official who fulfills the responsibilities of a building inspector or code enforcer serves a critical role in ensuring the safety and integrity of structures within their jurisdiction. By doing so, they ensure these structures are more resilient to the threats posed by natural hazards, such as winds, hail, and earthquakes.

Fort Gibson, Haskell, and Muskogee all have a building inspector or code enforcer who serves their communities. For the County, this role is not explicitly specified but instead, is shared between commissioners and local leadership.

Utilities/Streets Departments

Entities responsible for maintaining streets and public works infrastructure in communities play an underrated role in resilience to natural hazards. Streets provide access for first responders to reach areas that require their attention. Sewer service and water treatment facilities are critical lifelines that sustain the health of residents, before, during, and after disasters. Electricity and natural gas provide similar critical functions for allowing the sustenance of residents' health and well-being. Telephone and internet service provide critical communications capabilities, which allow residents to contact emergency response when needed. These FEMA lifelines—Transportation; Food, Water, and Shelter; Health and Medical; Communications; and Safety and Security—are considered critical to community functions.

GIS

Personnel

Muskogee County does not have GIS personnel on staff however, they do contract with a third party for County-specific GIS needs. On the municipal level, the City of Muskogee was the only other participating jurisdiction that employed full-time GIS personnel in the City's Planning Department. Other Towns in the planning area either lack funding or staffing opportunities for these types of positions within their jurisdictions and should funding opportunities arise, GIS personnel in these communities could greatly enhance mitigation planning efforts.

Technical Capabilities/Data Collection

GIS capabilities can be a powerful tool for officials to map and identify areas of vulnerability, and areas where hazards have an outsized extent relative to others within the planning area. Such a tool allows officials to serve their residents more effectively and promote safety and resilience, as well as provide an accurate assessment for the scoping of hazard mitigation projects.

Flood mapping through FEMA and GIS layers through the ArcGIS Living Atlas are available to officials across the entire planning area. Additional needs across Muskogee County have been identified in three key areas:

1. Identify and model critical components of the built environment.
2. Provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms; and
3. Develop the ability to distribute information on risks through web-based and mobile technology (for more information, see the discussion on Warning Systems/Services preceding this section).

Although base-level data has been identified in some incorporated areas and from government surveys, more work is needed to enhance usability for hazard mitigation and emergency response. In the future, the

planning area would benefit from additional mapped information helpful for emergency operations, such as a backup generator or water supply inventory.

Other Personnel/Technical Capabilities

Grant Writing

Staffing within the City of Muskogee's Planning Department prepares and administers grant writing for such things as community development grants, however, other incorporated areas in the planning area lack such personnel. One key benefit of having a grant writer on staff is the ability to submit proposals to fund mitigation projects across the planning area. Projects like these promote the safety, security, and resilience of residents and communities in Muskogee County.

Virtual Capabilities

Internet connectivity has become a FEMA Communications lifeline as we have progressed through the 21st Century. Internet communication is one valuable tool used by Muskogee County officials to disseminate emergency notification information, particularly through social media and mobile apps. School districts, like Fort Gibson PSD, utilize social media avenues for all types of communication, including public education/awareness campaigns as well as hazard-specific messages to their constituents. Every survey respondent reported using or relying on social media, mobile apps, or the internet as their primary source for gathering and disseminating hazardous/dangerous weather information to their people (see Appendix H). Broadband internet access has put the power in the hands of rural communities, like Braggs, who reported using the internet to communicate hazard risks and preparedness information to town residents. Other towns, like Porum, do not have to utilize these types of communication methods, and with socially disadvantaged/vulnerable groups "all over town", future communications might greatly benefit from exploring these virtual capabilities.

What makes this line of communication effective is the network of high-speed internet providers servicing the planning area. Broadband internet, characterized by wide bandwidth over a high-speed connection, is critical for quick and reliable information transmission. In the United States, there exists a gap in broadband connectivity between rural and urban areas. The U.S. Department of Agriculture (USDA) and Federal Communications Commission (FCC) report that 22.3% of Americans in rural areas, and 27.7% on Tribal lands, lack broadband connections from a fixed terrestrial broadband provider, or an ISP. This contrasts with 1.5% of residents in urban areas.

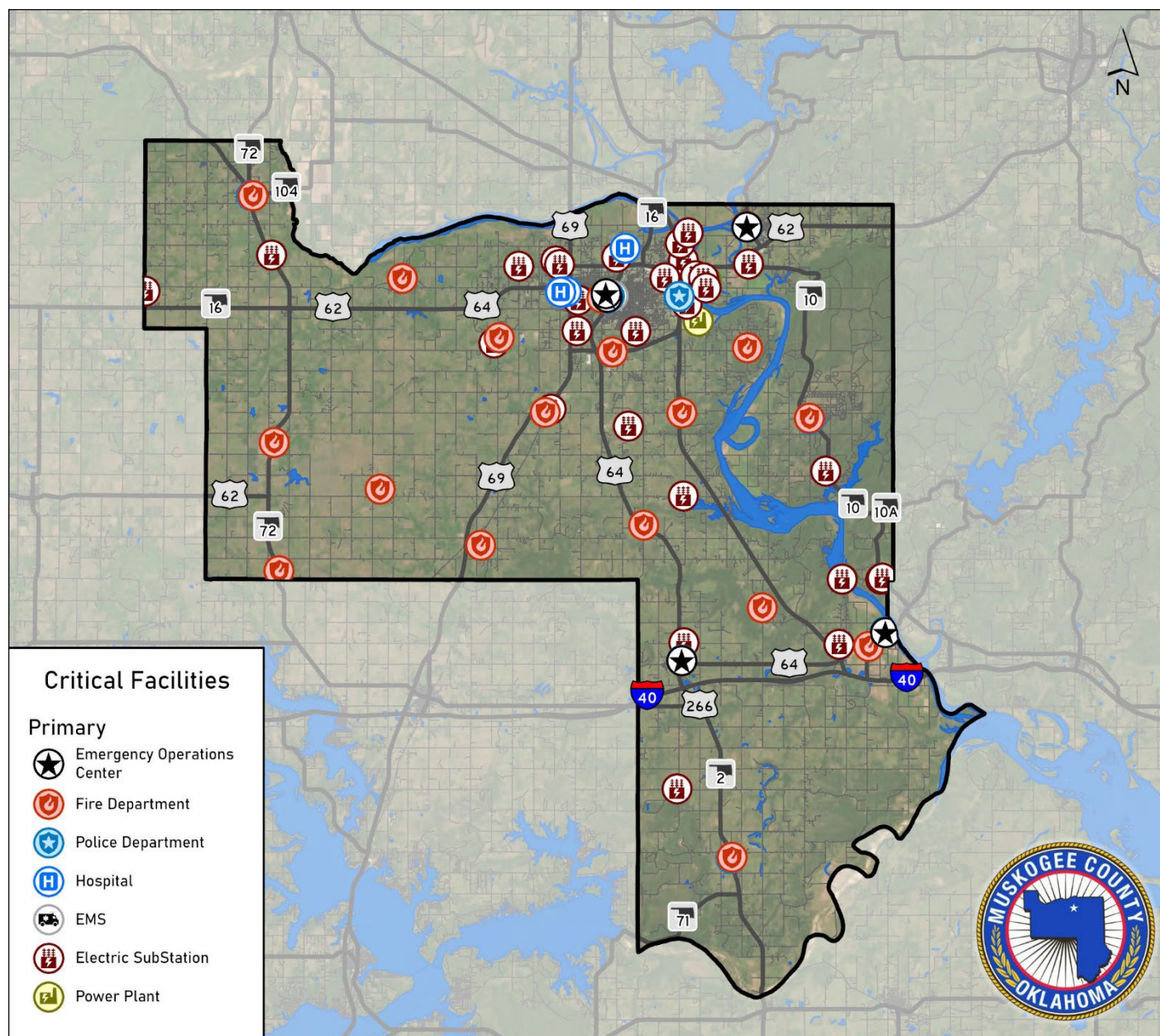
Backup Generation

Communities with backup generation capabilities have an essential tool to build resiliency during times of disaster. Across Muskogee County, participating jurisdictions voiced a general agreement that additional backup generators are needed, and/or current generators in place would greatly benefit from hardening retrofits to protect these tools. As shown during the 2019 Arkansas River Flood, backup generators at some of the water and wastewater treatment facilities continued operation for a time but eventually succumbed to floodwaters since generators were not protected. What ensued after critical facilities went offline created a hazardous and difficult living environment for residents who were stuck.

Critical facilities that lack backup power generators include the town halls of Braggs, Boynton, Council Hill, Fort Gibson, Haskell, Oktaha, Porum, Summit, Taft, Wainwright, Warner, and Webbers Falls. Additionally, police departments lack generators in Braggs, Fort Gibson, Haskell, Porum, and Webbers Falls. Other facilities noted without generators include ten nursing centers and four assisted living centers.

Public water systems that serve Muskogee County (see Chapter 1) traditionally do not have backup power generators, however, officials reported that the Haskell and East Oklahoma Water Authority do have generators. Additionally, “most” primary critical facilities (see Figure 3-2) have backup generators but are not “hardened” – generators sit out in the open. In October of 2023, the County approved a new generator and housing to be installed at the Muskogee County Courthouse. Pursuing grant funding to provide additional generators and housing will fortify the planning area during future hazard events. See Chapter 4 for more on hazard-specific vulnerabilities.

Figure 3-2 Primary Critical Facilities in Muskogee County, OK



3.4 Financial Capabilities

Communities that possess financial leverage and resources are in a better position to fund projects that mitigate risk to natural hazards and increase community resilience. For specific plans that authorize or enable access to such financial capabilities, please see Section 3.2.

3.4.1 Overview Assessment

This assessment of financial capabilities centers on two areas: external and internal. Internal financial capabilities are financial resources generated by the county or incorporated areas. External financial capabilities are funding opportunities not generated within the county or incorporated areas. Examples of such funding sources include state and federal grants, local and regional partnerships with other entities.

3.4.2 Qualitative Assessment

Internal

While jurisdictions have several potential sources of revenue, the foundation for any government's revenue comes from taxes. In Muskogee County, the county and each jurisdiction collect a sales tax on each purchase made within their bounds. Community improvement projects, including mitigation projects, can be funded with this revenue.

Table 3-8 Internal Revenue Streams by Jurisdiction

Jurisdiction	Sales/Use Tax	Other Sources of Revenue
Muskogee Co.	5.15%	5.00% County Lodging Tax
Boynton	7.15%	--
Braggs	8.15%	--
Council Hill	7.15%	--
Fort Gibson	9.65%	--
Haskell	9.50%	--
Muskogee	9.15%	--
Oktaha	5.15%	--
Porum	10.15%	--
Summit	8.15%	--
Taft	9.15%	--
Wainwright	9.15%	--
Warner	9.15%	--
Webbers Falls	10.65%	--

Sales/use tax is calculated based on three levels of taxation: state sales tax rate, county sales/use tax, and city/town sales/use tax. The state sales tax rate is 4.5%. On top of that, Muskogee County adds 0.65%. Most jurisdictions levy an additional tax, ranging from 2% in Boynton to 5.5% in Webbers Falls. Oktaha is the only jurisdiction participating that does not levy an additional tax. Thus, the minimum sales tax rate on purchases in Muskogee County is 5.15% in Oktaha and unincorporated areas of Muskogee County, while the maximum is 10.65% in Webbers Falls. Muskogee County also levies an additional 5.00% County Lodging Tax. Details of sales/use tax rates for Muskogee County and all participating jurisdictions are listed in Table 3-8.

In addition to sales and use taxes, some communities institute additional taxes, fees, or charges. These measures in combination with revenues from sales and use taxes can go toward public works and community improvement projects, including those

which mitigate hazards that have presented problems for those communities.

External

External funding sources provide a critical complement, some of which are explored in this section.

State and Federal Programs

External funding is available to jurisdictions from federal, state, and other governmental sources. Communities who have adopted and participated in a hazard mitigation plan have an even larger selection from which to choose, many are included in Table 3-9.

Table 3-9 Sources of External Funding and Intended Uses

Possible Funding Sources	Uses
Capital Improvements Program (CIP)	Used for various infrastructure projects throughout the county and participating communities
Incur debt through General Obligation or special tax bonds	Funding specifically identified projects
Community Development Block Grant (CDBG)	Used to enhance infrastructure, public facilities, economic development projects, housing rehabilitation projects, and more in low to moderate-income areas
Hazard Mitigation Grant Program (HMGP)*	Post-disaster rebuilding to include mitigation measures aimed at reducing loss of life and property from future disasters
Flood Mitigation Assistance (FMA)*	Projects that reduce or eliminate the risk of repetitive flood damage to NFIP-insured structures
Building Resilient Infrastructure and Communities (BRIC)*	Projects that reduce overall risk to population and structures from future disasters and natural hazards, while also reducing reliance on federal funding to respond to future disasters
Pre-Disaster Mitigation (PDM)*	Sustainable cost-effective projects are designed to reduce the risk to individuals and property from future natural hazards, while also reducing reliance on federal funding for future disasters.
Federal Highway Administration (FHWA) Funding	FHWA funding is used for eligible transportation projects
Safeguarding Tomorrow Revolving Loan Fund*	Projects that reduce disaster risks for homeowners, businesses, nonprofit organizations, and communities to help them build climate resilience
Emergency Management Performance Grant (EMPG)	Projects that develop emergency management capabilities and provide resources required for the implementation of the National Preparedness System, which outlines an organized process for everyone in the whole community to move forward with their preparedness activities and achieve the National Preparedness Goal.
Federal, State, and County Highway, Roads, and Bridges funds	Projects which build, maintain, repair, and improve upon roadways within the planning area
Oklahoma Water Resources Board	OWRB loans are used for water and wastewater projects.

* Requires adoption of a FEMA-approved hazard mitigation plan

Increased Aid

Communities with a population less than 3,000 and per capita income less than 80% of the federal standard can benefit from increased federal match on several grant programs through the Justice40 initiative

implemented by the Biden-Harris Presidential Administration. This program delivers at least 40% of the overall benefits of federal investments to disadvantaged communities. Based on the most recent available data from the 2021 ACS 5-year estimate, 80% of the federal per capita income is about \$30,664²⁰. Using this figure and ACS population estimates for each participating jurisdiction, 9 communities qualify for federal aid under this initiative (see Chapter 1 for specific demographic information on participating jurisdictions).

- Boynton
- Braggs
- Council Hill
- Haskell
- Oktaha
- Porum
- Taft
- Wainwright
- Warner

Partnerships

Muskogee County sits at the intersection of the Muscogee Creek Nation and the Cherokee Nation, two entities with whom the county shares resources. More information on these, and other partnerships utilized by the county, can be found in the Response Network & Mutual Aid Agreements discussion in Section 3.3.2 above.

3.5 Educational and Outreach Activities

Each participating community in the 2019 Muskogee County Hazard Mitigation Plan indicated efforts to educate residents and increase awareness of how hazards affect them. This section will review those efforts and assess where opportunities for further outreach or new avenues for activities may exist.

3.5.1 Overview Assessment

While there are endless opportunities to inform and make residents aware of the effects of hazards, the two primary programs that have wide-ranging benefits are the FireWise and StormReady Programs.

3.5.2 Qualitative Assessment

FireWise

FireWise is a program developed by the National Fire Protection Association (NFPA) to help communities who voluntarily meet a set of criteria determined by NFPA. This program provides education and collaboration resources for residents and members of the community to enable them to reduce threats posed by wildfires to homes and neighborhoods. As of this update, there are no recognized FireWise communities in Muskogee County.

StormReady

StormReady is designed by the U.S. NOAA National Weather Service (NWS) to recognize communities and organizations (e.g., counties, universities, military bases, etc.) that have demonstrated a high level of severe weather preparedness²¹. To be recognized as a StormReady community, they must meet criteria which include:

- Establishment of a 24-hour warning point and an Emergency Operations Center
- Having multiple ways of receiving NWS warning products
- Creating a system to monitor local weather/river conditions

²⁰ Per Capita Income, as calculated by the 2021 American Community Survey 5-year estimate is \$37,638. Thus, 80% of that is \$30,664. <https://data.census.gov/table/ACSDT5Y2021.B19301?q=per+capita+income>

²¹ <https://www.weather.gov/mob/stormready>

- Having multiple ways of alerting the public
- Promoting public readiness through community seminars and presentations
- Developing a formal hazardous weather plan
- Having trained spotters
- Conducting periodic drills/exercises
- Interacting with their local NWS office.

Participating communities who have achieved StormReady designations are Muskogee County, the City of Muskogee, and the Town of Haskell. Communities who wish to become recognized can learn more about the five steps required at <https://www.weather.gov/stormready/become>.

3.6 School District Capabilities

Public school districts serve a vital role in communities extending beyond education. Public schools offer many services considered FEMA Community Lifelines, including food, hydration, shelter, security, safety, communications infrastructure, and medical care. This section will explore these capabilities for each school district. Any gaps that produce vulnerabilities will be identified and recommended as mitigation action items included in Chapter 5.

3.6.1 Overview Assessment

Table 3-10 Capabilities of Public-School Districts in Muskogee County, OK

	Oklahoma Emergency Guidelines	Staff Need	Funding	Hazard- Specific Education	Free/Reduced Meals	Safe Rooms	Backup Generation	Community Lifelines	Virtual Capabilities *
Braggs Public Schools	—	●	●	●	●	◐	○	●	●
Ft Gibson Public Schools	●	◐	●	●	●	●	○	●	●
Haskell Public Schools	●	●	●	●	●	◐	○	●	●
Hilldale Public Schools	●	●	●	●	○	●	●	●	●
Midway Public Schools	—	●	●	●	—	◐	○	●	●
Muskogee Public Schools	●	◐	●	●	●	◐	○	●	●
Oktaha Public Schools	○	●	●	●	○	◐	○	●	●
Porum Public Schools	●	●	●	●	●	●	○	●	●
Wainwright Public Schools	●	●	◐	●	●	◐	○	●	—
Warner Public Schools	●	●	●	●	●	●	◐	●	●
Webbers Falls Public Schools	●	●	●	●	—	◐	○	●	●

KEY			
Yes / Implemented / Full-time position:	●	Some / Part-Time or Secondary Position:	◐
No / None:	○	Unknown / No Response:	—

3.6.2 Qualitative Assessment

Oklahoma Emergency Guidelines

Standards for student safety mandated by the Oklahoma State Department of Education include lifesaving action, developing a school safety and emergency plan, and sheltering procedures, among other activities. Although the importance of these activities cannot be understated, these standards primarily focus on incidents that may occur on school grounds and are not designed to wholly address pre-disaster mitigation activities^{22,23}.

Staff

General Need

Fort Gibson and Muskogee indicate some need for staffing positions but are adequately staffed, for the most part. Haskell, Hilldale, Oktaha, Porum, Warner, and Webbers Falls have indicated their levels of staffing are adequate to meet their needs. The remainder of the school districts participating in this plan have not provided any indication of their level of staffing needs.

Emergency Training for Staff

Fort Gibson, Haskell, Muskogee, Hilldale, and Webbers Falls indicate meeting state requirements for state emergency guidelines. These guidelines include annual in-service training and drills for fire, tornado, and first aid/CPR certification.

Funding

Internal and external funding sources can assist school districts in funding projects to increase resiliency to natural hazards. These projects rely on the ability to raise funds. Previous funding avenues are outlined below. Like the sources of funding available for communities, there are 3 primary categories of funding available to school districts: federal, state, and local. The distribution of federal funding for school districts is managed by the State of Oklahoma Department of Education.

Students

Student enrollment is one variable used to calculate the amount of state funding each district receives. Money is distributed by the State Department of Education and includes federal funding, some of which is geared toward areas like student nutrition and transportation. Student enrollment numbers for each district

²² <https://oklahoma.gov/content/dam/ok/en/homeland-security/documents/security/Developing-School-Emergency-Operations-Plans.pdf>

²³ <https://sde.ok.gov/sites/ok.gov.sde/files/Prev-SafeSchlGuide2.pdf>

play a role in those allotments. In Table 3-11, student enrollment figures for each participating public school district are detailed, along with the overall 5-year trend for each one.

Key	 Decrease	 No Change	 Increase

Table 3-11 Student Enrollment Trends in Participating Public School Districts in Muskogee County

School District	2018-19 Enrollment	2019-20 Enrollment	2020-21 Enrollment	2021-22 Enrollment	2022-23 Enrollment	5-year Trend
Braggs	153	160	115	134	109	
Fort Gibson	1,793	1,775	1,743	1,762	1,795	
Haskell	751	740	650	674	711	
Hilldale	1,827	1,960	1,936	1,964	2,033	
Midway	212	224	216	239	222	
Muskogee	5,691	5,367	4,794	4,811	4,819	
Oktaha	702	665	656	692	704	
Porum	462	448	438	451	425	
Wainwright	89	93	83	68	79	
Warner	846	810	806	805	814	
Webbers Falls	280	306	272	294	307	

Data for 2022-23 represents the most current available at the time of writing.

Trends in enrollment numbers over the past 5 years for each district across the planning area are mixed. Midway, Hilldale, Oktaha, and Webbers Falls have experienced an increase in enrollment numbers, while Braggs, Haskell, Muskogee, Porum, Wainwright, and Warner have trended in the opposite direction.

Several districts experienced a significant decrease in enrollment numbers during the 2020-21 school year, due to the COVID-19 pandemic. Though some districts were not impacted as much as others, Braggs, Haskell, Muskogee, Wainwright, and Webbers Falls saw dramatic drops in enrollment compared to numbers for 2019-20. While enrollment numbers in Webbers Falls have returned to their pre-pandemic enrollment numbers, the other four districts have yet to bounce back.

In addition to funding, enrollment factors into needs in other areas, like the level of staffing required to accommodate new students. Districts who experience increases in enrollment expect to hire more staff and more teachers accordingly. Bussing and sheltering are also areas that experience secondary effects from fluctuations in enrollment. Sheltering considerations are discussed further in the Safe Rooms section.

Hazard Specific Education

Several initiatives promoting student safety are enacted by the Oklahoma State Department of Education's (OSDE's) Office of School Safety and Security. Initiatives include emergency operations planning, drill reporting, and the Readiness and Emergency Management for Schools program developed by the U.S. Department of Education.

Safe Rooms

Safe rooms are among the highest-impact resources a school can maintain to protect students from hazards associated with severe thunderstorms. Those that meet FEMA and ICC 500 standards ensure the safety and well-being of students and staff when tornadoes threaten. Safe rooms provide schools and, in some instances, a community's residents, safety and shelter from high wind and tornado events.

In addition to serving as a FEMA lifeline, some shelters lack backup power generation which would further benefit staff members and students of each district, particularly if these groups were sheltered in place for an extended period. For school districts experiencing growth, ensuring safe room capacity is adequate is important.

Districts participating in this plan that require more adequate sheltering options could benefit from stronger, more resilient safe rooms on campus. While gymnasiums may provide enhanced safety, students and staff members are at risk of high-end wind events (see Chapter 4). Furthermore, schools like those in the Fort Gibson public school district who have saferooms on-site need backup power generation which is described below. Warner Public Schools have designated safe rooms; however, officials report that increasing enrollment means additional saferoom space on campus would be "very beneficial." Hilldale Public Schools has three shelter locations at each site. The Elementary shelter holds 1,250 while the Middle and High School shelters each can hold 600. Fort Gibson's shelters have a capacity of over 2,000 while Porum's capacity was reported at 550. Officials at Muskogee Public Schools show theirs can hold 125. An underground shelter at Oktaha Public School can hold only about 350 while the student body is nearly 650 and staff numbers are nearly 100. The shelter floods easily and is not a safe place for sheltering.

Backup Generation

Sufficient backup generation is critical to protect people and property during periods of extreme heat or cold when loss of power occurs. Warner Public School district reports having one backup generator for the Warner Event Center, which is the school's main gym on the Elementary School Campus, however, it only powers the main gym and none of the other school buildings – the High School has no generators. In addition to Warner, the Hilldale Public School District was the only other district that reported as having backup power generators on campus – the rest do not. At Stakeholder Workshop #4, school representatives expressed concern that their shelters do not have backup generators, and acquiring one was highly sought after to mitigate the impacts of future disasters (see Action #26 in Chapter 5).

FEMA Community Lifelines/People Served

In general, schools serve this important function in communities by providing services such as food, hydration, shelter, security, safety, communications infrastructure, and medical care. Without these services, at-risk children may lose access to them, increasing their vulnerability to hazards. In this section, discussions will explore how schools serve a critical role in communities by focusing on four areas: meal service, services to tribal students and those who are homeless, and technology services, including those in the virtual realm.

Meal Service

While all school districts participating in this plan offer meal service, the scope of this discussion will focus on those districts that offer free and reduced-price meals to students. Federal funding under the National School Lunch Program for child nutrition is distributed to schools through OSDE. At a minimum, means-tested qualification for meal service does more to ensure all students have access to proper nutrition, though current trends in the numbers of free or reduced-price meals through schools show an increase over the past several years²⁴.

Research indicates that students participating in school meal programs consume more whole grains, milk, fruits, and vegetables during mealtimes and have a better overall quality of diet than nonparticipants. Additionally, those students who eat breakfast at school have exhibited higher test scores, better attendance rates, and fewer missed school days²⁵.

Johnson O'Malley Program

Initially part of the Indian New Deal of the 1930s, the Johnson O'Malley Program is federally authorized by the Johnson-O'Malley Act of 1934 and updated in 2018 in the Johnson-O'Malley Supplemental Indian Education Program Modernization Act (JOM Modernization Act). Regulations provided in 25 CFR § 273 authorize contracts for the education of eligible Indigenous students to address their needs through enhanced funding²⁶. The purpose of this program is to meet the specialized and unique needs of Indigenous children attending public and some tribal schools using supplemental education programs. Eligibility requirements include membership in a federally recognized tribe, being one-fourth degree of Indian blood, and being between age 3 and grade 12, with priority given to students enrolled in public schools on or near tribal lands. This program provides critical resources to address and prevent vulnerabilities that may arise among Indigenous children and ensure they are afforded the same access to education and the critical services considered FEMA Community Lifelines offered by public schools that other children have. Haskell, Hildale, Midway, Muskogee, Oktaha, and Wainwright's programs are facilitated through the Muskogee (Creek) Nation. The Cherokee Nation provides support to the following school districts in Muskogee County located within their tribal boundaries: Braggs, Fort Gibson, Porum, Warner, and Webbers Falls.

McKinney-Vento Program

Passed in 1987 and reauthorized in 2015 by Title XI, Part A of the Every Student Succeeds Act (ESSA), the McKinney-Vento Homeless Assistance Act is the primary piece of federal legislation related to the education of children and youth experiencing homelessness. The act defines the term "homeless children and youths" as individuals who lack a fixed, regular, and adequate nighttime residence and includes children and youths who are sharing the housing of other persons due to loss of housing, economic hardship, or a similar reason, are living in motels, hotels, trailer parks, or camping grounds due to the lack of alternative adequate accommodations, are living in emergency or transitional shelters, or are abandoned in hospitals; those who have a primary nighttime residence that is a public or private place not designed for or ordinarily used as a regular sleeping accommodation for human beings; children and youths who are living in cars, parks, public spaces, abandoned buildings, substandard housing, bus or train stations, or similar settings;

²⁴ <https://www.ers.usda.gov/topics/food-nutrition-assistance/child-nutrition-programs/national-school-lunch-program/#:~:text=In%20FY%202021%2C%20the%20first,or%20at%20a%20reduced%20price.>

²⁵ <https://www.cdc.gov/healthyschools/nutrition/schoolmeals.htm>

²⁶ <https://www.bie.edu/landing-page/johnson-omalley>

and migratory children who qualify as homeless for Subtitle VII-B of this act because the children are living in circumstances described in the previous clauses.

Rights and services to these children and youths are provided by this program to ensure transportation to and from school free of charge, allowing children to attend their school of origin or the last school they attended when they first became homeless. Further, children and youths experiencing homelessness are allowed to enroll in a public school even if they lack the normally required documents, such as immunization records or proof of residence.

Fort Gibson, Hilledale, Muskogee, Oktaha, Porum, Wainwright, Warner, and Webbers Falls give attention in some form to this program or homelessness in general on their websites. No information was provided by Braggs, Midway, Oklahoma School for the Blind, or Haskell. Since homelessness can strike suddenly, ensuring this information is readily and publicly available to all parents and students is important to reduce the vulnerability of school-aged children within the planning area and ensure their continued access to critical FEMA Community Lifelines offered by schools.

Virtual and Technology Services

Students' ability to access educational resources inside and outside of school can be achieved through online educational portals (websites), software, mobile applications, and hardware such as computer labs, laptops, and mobile devices such as tablets/iPads.

If safety concerns such as closing school due to weather or other emergencies necessitate virtual or distance learning, it becomes increasingly important for students to be able to access educational resources from home. Virtual capabilities offered by each school district to meet these needs are detailed in Table 3-12.

Table 3-12 Virtual Capabilities in Participating Public School Districts

District	App, Service, or Capability Used
Braggs	On-campus computers, distance learning
Fort Gibson	FTG 1:1 Initiative, PowerSchool, Renaissance, Mobile Tablets, Chromebooks
Haskell	IXL, Edmentum Study Island, Imagine Edgenuity
Hilledale	Destiny Library Manager, Hilledale Virtual Academy, On-campus computers, Chromebooks, iPads
Midway	School Door mobile app (Android/iOS)
Muskogee	Muskogee Public Schools Rougher Innovations Academy, Edgenuity, Chromebooks
Oktaha	Edgenuity, Chromebooks
Porum	Edgenuity, Follett Destiny, Fun Brain, PBS Kids, Chromebooks
Wainwright	Unknown
Warner	IXL, Generation Genius, XtraMath, typing.com, BrainPOP, ABCMouse, Starfall, ABCya, Teach Your Monster, Reflex, Renaissance, ReadWorks, Mystery Science, VocabularySpellingCity
Webbers Falls	Renaissance, SoftSeven, Chromebooks, iPads

Virtual capabilities are utilized in a variety of ways by school districts across Muskogee County. Fort Gibson's 1:1 Initiative is a bring-your-own-device (BYOD) policy that allows students and staff to use their laptops and electronic devices during class time in ways that enhance their educational experience. On top of robust technology capabilities, Hilldale and Muskogee both offer virtual academies through their school districts that offer students a self-paced option while allowing opportunities to participate in school-related extracurricular activities.

3.7 Ability to Expand on Existing Capabilities

Building on key takeaways from existing capabilities, the planning team, officials, and stakeholders identified opportunities to expand capabilities beyond what already exists to reduce vulnerabilities in each jurisdiction and enhance resilience. Table 3-13 lists a variety of ways in which each jurisdiction can improve upon or expand its current capabilities.

Table 3-13 Ability to Expand on Existing County/City/Town Capabilities

Capability/Capability Gap	Ability to Expand/Improve
MUSKOGEE COUNTY	
<i>Administrative and Technical</i>	• Increase the number of generators at critical facilities
	• Provide hardened retrofits for current and future generators
	• Install much-needed vehicle barns at each of the three County Commissioner District facilities to protect County assets
	• Install additional outdoor warning sirens needed in southeastern parts of District 2 as well as central District 3 where no coverage is reported
	• Develop a GIS position within County leadership to help general planning, EM, and hazard mitigation planning efforts
<i>Educational and Outreach</i>	• Join FireWise program and help develop wildfire awareness campaigns for areas of the county, particularly those that are served by VFD.
BOYNTON	
<i>Administrative and Technical</i>	• Install generators at Boynton PWA / City Hall where no backup power generators exist
	• Install generators at Boynton VFD, especially since it is located within FEMA Flood Zone AE
<i>Planning and Regulatory</i>	• Develop an Emergency Operations Plan for the Town to improve emergency response activities
BRAGGS	
<i>Administrative and Technical</i>	• Install generators to ensure power is not lost at any of the four wells used by the Braggs PWA. These water wells are located along Sand Creek southwest of the Town, with 3 located in FEMA Flood Zone A
<i>Planning and Regulatory</i>	• Develop an Emergency Operations Plan for the Town to improve emergency response activities
COUNCIL HILL	

Capability/Capability Gap	Ability to Expand/Improve
<i>Planning and Regulatory</i>	• Develop an Emergency Operations Plan for the Town to improve emergency response activities • Currently the town is not a participating community in the NFIP
FORT GIBSON	
<i>Planning and Regulatory</i>	• Develop an Emergency Operations Plan for the Town to improve emergency response activities • Develop an Economic Development Plan
<i>Administrative and Technical</i>	• Install backup power generators at critical facilities such as the water treatment plants, and Town EOC/FD/PD
HASKELL	
<i>Administrative and Technical</i>	• Increase the number of generators in place to safeguard critical facilities. Haskell PWA is currently reported as having one, however, additional
<i>Planning and Regulatory</i>	• Develop an Economic Development Plan
MUSKOGEE	
<i>Administrative and Technical</i>	• Increase the number of generators which service critical facilities in the City
<i>Educational and Outreach</i>	• Develop flood hazard awareness programs and educational campaigns to target vulnerable populations living in flood-prone areas, like at the Meadowbrook RV Park which is in FEMA Floodway and FEMA Flood Zone AE
<i>Planning and Regulatory</i>	• Develop a Continuity of Operations Plan
OKTAHA	
<i>Administrative and Technical</i>	• Install backup power generators at the Oktaha Fire Dept.
PORUM	
<i>Administrative and Technical</i>	• Porum Public Water Authority lacks backup generators
<i>Planning and Regulatory</i>	• Develop and implement a FireWise program to raise awareness of wildfire threats in/around Porum
SUMMIT	
<i>Planning and Regulatory</i>	• No head or planning role is currently in place which would help Summit acquire grant/funding opportunities
TAFT	
<i>Administrative and Technical</i>	• Install outdoor warning sirens in town to help alert the public • Backup power generators are needed at Taft City Hall and Taft Volunteer Fire Department
WAINWRIGHT	
<i>Administrative and Technical</i>	• Install backup power generators at critical facilities like the Wainwright VFD

Capability/Capability Gap	Ability to Expand/Improve
	• Create Mutual Aid Agreements with neighboring communities and Muskogee County to fill in gaps where the capabilities of community officials are not able to keep up with the expectations of their duties. This should include increased NFIP compliance and sharing floodplain management resources with neighboring communities.
WARNER	
<i>Administrative and Technical</i>	• Install backup power generators at critical facilities like the Warner EOC/PD/FD as well as at elderly care centers, like Countryside Estates
WEBBERS FALLS	
<i>Administrative and Technical</i>	• Install backup power generators at critical facilities like the Webbers Falls EOC. Harden generators as well to withstand flooding since the entire town is in FEMA Flood Zones AE and X.
<i>Planning and Regulatory</i>	• Develop an Emergency Operations Plan • Develop a planning position to help the town with general planning and mitigation efforts

Similarly, public schools across the planning area also have a specific set of capabilities in place while some can be expanded upon or improved. Table 3-14 provides an overview of what some of these avenues are.

Table 3-14 Ability to Expand on Existing School District Capabilities

Capability/Capability Gap	Ability to Expand/Improve
ALL PUBLIC-SCHOOL DISTRICTS	
<i>Administrative and Technical</i>	• Backup power generation would help ensure continuity of operations and a safe environment for staff & students • Installation of bus barns or sheltered covering for school vehicles • Retrofit existing saferoom areas of gymnasiums and potentially install more rigid or larger saferooms for staff and students • Coordinate and make communications between Schools and the Muskogee County Office of Emergency Management more efficient and reliable
BRAGGS, MIDWAY, HILDALE, OKTAHA, PORUM, WAINWRIGHT, WARNER, and WEBBERS FALLS PUBLIC SCHOOL DISTRICTS	
<i>Administrative and Technical</i>	• Develop and implement some sort of alert notification or app that would transmit essential information during hazardous weather conditions
FORT GIBSON PUBLIC SCHOOLS	
<i>Administrative and Technical</i>	• School District uses the Alert Now system to inform parents of inclement weather.

Capability/Capability Gap	Ability to Expand/Improve
HASKELL PUBLIC SCHOOLS	
Administrative and Technical	• The School District uses school messenger, social media, and SchoolWay app to inform parents of inclement weather.
MUSKOGEE PUBLIC SCHOOLS	
Administrative and Technical	• District uses SchoolStatus to notify parents of inclement weather

Chapter 4 Hazard Risk Assessment

Disasters can inflict economic hardships, including damage to buildings, businesses, homes, infrastructure, agriculture, and more – they also inflict damage to social infrastructure. Social costs of disasters are largely unquantified but directly impact Muskogee County’s ability to provide services to residents. Due to the overwhelming nature of disaster impacts, many communities face challenges in understanding the scope of natural hazards. In Chapter 4, eleven natural hazards are profiled at great length to convey the breadth of impacts better. Building off the capability assessment found in Chapter 3, the Hazard Risk Assessment will examine how common types of hazards impact capabilities.

4.1 Introduction to the 2024 Hazard Risk Assessment

Through research and conversations with jurisdictional representatives (see Section 2.3), an analysis of Muskogee County’s mitigation efforts comes into focus. Using an assets-based approach along with an analysis of individual hazards, this assessment provides a deeper understanding of specific hazards and their impacts. This approach, which aligns with current FEMA guidance, allows communities to identify assets critical to stability and those vulnerable to hazards. Beyond the scope of this mitigation plan, results from the risk assessment can be integrated into future emergency management planning, recovery planning, and development efforts.

4.1.1 Developing the 2024 Hazard Risk Assessment

Developing the 2024 Hazard Risk Assessment begins with a review of the 2019 Muskogee County Hazard Mitigation Plan (the 2019 Plan), the 2019 Oklahoma State Standard Hazard Mitigation Plan, previous events, and jurisdiction-specific vulnerabilities. Changes in priorities by county and local officials are incorporated into the 2024 risk assessment, as is information on the frequency, magnitude, future patterns, and costs associated with hazards that threaten the planning area. Muskogee County is all too familiar with how staggering the economic and social consequences of disasters are. Also familiar is the reality that impacts linger for months or years following an event like the 2019 Arkansas River Flood. Disasters destroy natural or man-made infrastructure and sometimes result in a loss of place and/or a loss of human life. It is for these reasons that the 2024 Risk Assessment aims to directly inform hazard mitigation actions which are the driving forces behind mitigation action items presented in the next Chapter.

The 2024 update evaluates hazards through extensive outreach efforts by the planning team to engage subject matter experts, stakeholders, and the public to obtain a clear understanding of changes from 2019. Utilizing government datasets, such as the National Center of Environmental Information (NCEI) Storm Events Database and NOAA Storm Prediction Center Storm Reports Archives, plus the most recent publicly available data, the 2024 risk assessment incorporates pertinent elements of each hazard. In addition to planning efforts, the Muskogee County HMP Update leverages the latest GIS information for analyzing each hazard sub-section.

4.1.2 Muskogee Co. Disaster Declaration History

Historical disasters logged by FEMA show Muskogee County included in nine Emergency Disaster (EM) declarations, one Fire Disaster (FM) declaration, and 23 Major Disaster (DR) declarations, shown in Table 4-1. Hazards included from declarations profiled in this assessment include severe winter storms, flooding, tornadoes, high winds, and severe thunderstorms (which, by extension, include hail and high winds).

Table 4-1 Major Disaster Declarations Involving Muskogee County through 2023

Disaster Number	Declaration Date	Declaration Title	Incident Period	
			From	To
DR-392-OK	1973-06-13	Severe Storms, Flooding, and Tornadoes	1973-06-13	1973-06-13
DR-778-OK	1986-10-14	Severe Storms and Flooding	1986-09-26	1986-10-15
DR-1355-OK	2001-01-05	Severe Winter Ice Storm	2000-12-25	2001-01-10
DR-1384-OK	2001-06-29	Severe Storms, Flooding, and Tornadoes	2001-05-27	2001-05-30
DR-1465-OK	2003-05-10	Severe Storms and Tornadoes	2003-05-08	2003-05-30
DR-1623-OK	2006-01-10	Extreme Wildfire Threat	2005-11-27	2006-03-31
DR-1678-OK	2007-02-01	Severe Winter Storms	2007-01-12	2007-01-26
DR-1712-OK	2007-07-07	Severe Storms, Flooding, and Tornadoes	2007-06-10	2007-07-25
DR-1752-OK	2008-05-05	Severe Storms, Tornadoes, and Flooding	2008-03-17	2008-03-23
DR-1754-OK	2008-05-09	Severe Storms, Tornadoes, and Flooding	2008-04-09	2008-04-28
DR-1823-OK	2009-02-17	Severe Winter Storm	2009-01-26	2009-01-28
DR-1876-OK	2010-02-25	Severe Winter Storm	2009-12-24	2009-12-25
DR-1883-OK	2010-03-05	Severe Winter Storm	2010-01-28	2010-01-30
DR-1988-OK	2011-05-27	Severe Storms and Flooding	2011-04-21	2011-04-28
DR-4222-OK	2015-05-26	Severe Storms, Tornadoes, Straight-Line Winds, and Flooding	2015-05-05	2015-06-22
DR-4256-OK	2016-02-10	Severe Winter Storms and Flooding	2015-12-26	2016-01-05
DR-4315-OK	2017-05-26	Severe Storms, Tornadoes, and Flooding	2017-04-28	2017-05-02
DR-4324-OK	2017-07-25	Severe Storms, Tornadoes, Straight-Line Winds, and Flooding	2017-05-16	2017-05-20
DR-4438-OK	2019-06-01	Severe Storms, Straight-Line Winds, Tornadoes, and Flooding	2019-05-07	2019-06-09
DR-4530-OK	2020-04-05	COVID-19 Pandemic	2020-01-20	2023-05-11
DR-4587-OK	2021-02-24	Severe Winter Storms	2021-02-08	2021-02-20
DR-4657-OK	2022-06-29	Severe Storms, Tornadoes, and Flooding	2022-05-02	2022-05-08
DR-4721-OK	2023-07-19	Severe Storms, Straight-Line Winds, and Tornadoes	2023-06-14	2023-06-18

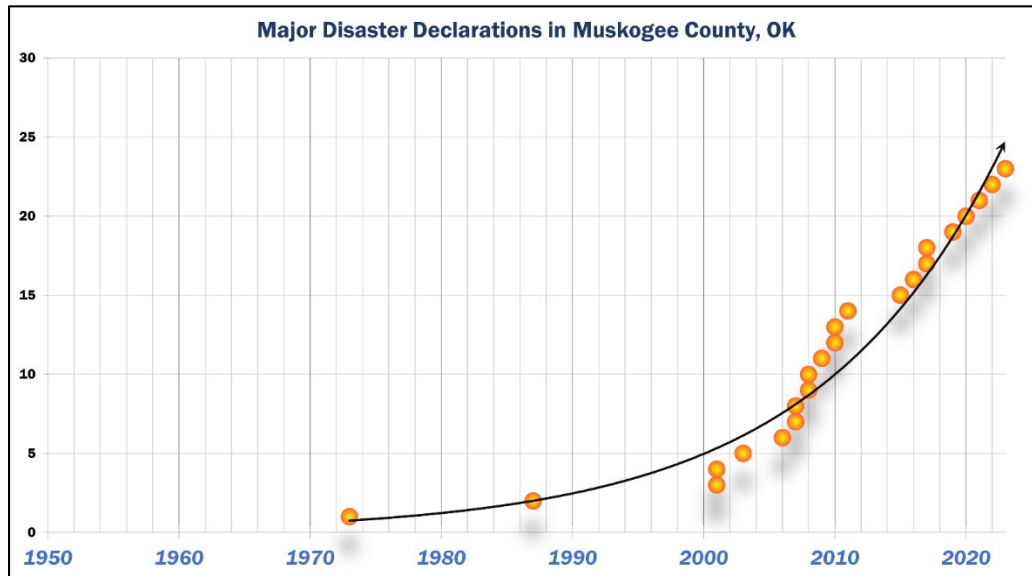


Figure 4-1 History of Major Disaster Declarations involving Muskogee County²⁷

All 23 declarations, which include Muskogee County, are plotted in Figure 4-1 below, where a temporal scale quickly shows a notable uptick since 2000. Each orange dot represents a separate disaster while the black line is the best fit once all

are plotted. This upward trend is mirrored in the NOAA/NCEI Billion-Dollar Weather and Climate Disasters portal.²⁸ While not available at the County level, weather and climate risk time series maps for Oklahoma depict a noticeable uptick in billion-dollar disaster events starting in 2000.

4.1.3 Hazard Identification & Classification

A full range of hazards, including their effect on each participating jurisdiction, are considered for the 2024 Muskogee County Hazard Mitigation Plan Update. Natural hazards are environmental phenomena that can impact societies and the human environment. Natural hazards profiled include Drought, Earthquake, Extreme Heat, Flooding, Hail, Lightning, Severe Winter Storm, Tornadoes, High Wind, and Wildfire. Dam Incidents are the only manmade hazard profiled in this plan. According to a review of the 2019 Muskogee County Hazard Mitigation Plan and the 2019 Oklahoma State Standard Hazard Mitigation Plan, this update identifies hazard types in a slightly different way than the 2019 plan.

Table 4-2 Hazard Comparisons in 2019 and 2024 HMPs

2019		2024
Dam Failure		Dam Incidents
Drought		Drought
Earthquake		Earthquake
Extreme Heat		Extreme Heat
Flood		Flood
Hailstorms		Hail
High Winds		High Winds
Lightning		Lightning
Severe Winter Storm		Severe Winter Storm
Tornado		Tornado
Wildfires		Wildfires

Listed alphabetically, Table 4-2 compares hazards profiled in each Plan. Differences are noted in the terminology used for two hazards: dam failure/dam incidents and hailstorms/hail. Terminology is adjusted to accurately capture the risks that may stem from their occurrences. Dam failure implies one or more breaches at a structure erected to manage or block the flow of water in a waterway. Migrating from dam failure to dam incidents allows a narrative to fully capture the varieties in which dams can fail. Simultaneously, this method is also for the identification of different incidents with

²⁷ Data points originate from the [Disaster Declarations for States and Counties – FEMA](https://www.fema.gov/disaster-declarations) website

²⁸ <https://www.ncei.noaa.gov/access/billions/time-series/OK>

adverse and damaging effects downstream, such as releases of water during heavy rainfall events, like what occurred in 2019. Details are discussed at length in the Dam Incidents section below.

Since 2019 there have been several large-scale and notable changes in land use practices that influence how natural hazards can affect the planning area. *FEMA's Local Mitigation Planning Handbook Worksheet 5.1* provides a basis for the hazard risk profile found in this section. It will profile each hazard's probability, location, extent, vulnerability, and overall significance to the planning area.

Location and Extent

After each hazard description, narratives are provided for the location and extent of all eleven natural hazards. "Location" is the area where a hazard event is likely to occur if such an area can be determined based on the best available data, and certain hazards can have locations that are uniform across the entire planning area, (like Extreme Heat or Drought). The nature in which they occur does not have discrete, identifiable areas but instead has much broader limits. On the contrary, other hazards, such as Flooding, have locations that are much more specific and discrete.

"Extent" refers to the potential severity of the hazard or the range of magnitudes in which they occur, and this assessment aims to specify the magnitudes or range of values that can be observed in the Muskogee County planning area. To help accomplish this assessment, a range of information and data sources are used, because historical records themselves cannot convey what may be possible in the future.

Probability of Future Events

To gauge the chances of each hazard occurring on an annual basis, the same methodology is used for all eleven natural hazards. Historical occurrences are closely examined over the same

ten-year period. Using historical data, an annual average is computed by dividing the total number of occurrences by 10. The result yields an annual average which is then used to project how likely a hazard is to occur in any given year. Although rudimentary, the equation shown to the right provides a way to relate each of the 11 natural hazards. Unless otherwise stated in each hazard profiled below, probabilities are used to quantify the recurrence interval of each hazard as well as a qualitative description of the hazard's threat to Muskogee County. Table 4-3 shows how future occurrence statements are generated. Unless otherwise stated, these metrics serve to convey how likely each hazard is to impact Muskogee County in the future.

$$\text{Total \# of Events Impacting the Planning Area from 01/01/2013 to 12/31/22} \div 10 = \text{Annual Probability}$$

Table 4-3 Metrics Used to Classify Probabilities of Future Events

Probability Classification	Annual Probability Threshold	Recurrence Interval
Highly Likely	> 90%	< 1 year
Likely	> 10% - 90%	1 – 10 years
Occasional	> 1% - 10%	11 – 100 years
Unlikely	0% - 1%	> 100 years

Classification Changes

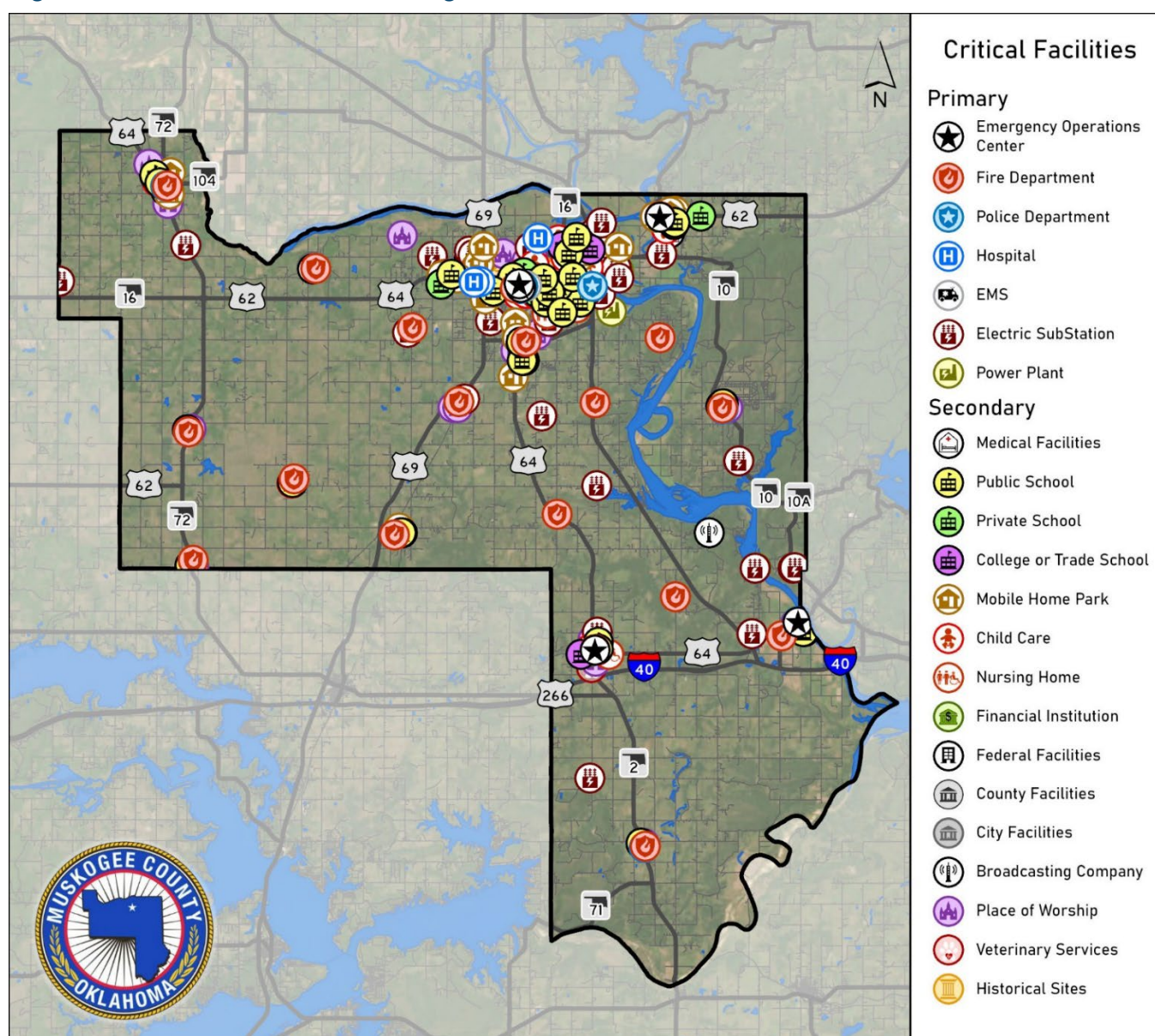
Muskogee's 2019 HMP described recurrence intervals as annually, 3 years, 5 years, and 10 years, but these are expanded for the 2024 Update to better represent the actual frequency in which these hazards impact the planning area. Additionally, a longer recurrence interval draws attention to the long-term future of Muskogee County, an idea becoming more mainstream as changes in the Earth's climate begin to manifest in shifting

disaster paradigms. Recurrence intervals used in this plan align closely with recommendations in the [FEMA Local Mitigation Planning Policy Guide](#).

Vulnerability and Impacts

An important consideration in assessing hazards is the effects those events have on individual communities. How do observed impacts expose levels of vulnerabilities that should be addressed? To build a more resilient planning area, it is important to assess where and how each participating jurisdiction is vulnerable to each hazard. Chapter 4 attempts to analyze and summarize the vulnerabilities and impacts observed. While these assessments are not comprehensive, they certainly can be used as a benchmark as the community strives to build a stronger tomorrow. Exhaustive efforts are made to collect as much data as possible, with desktop research, stakeholder input, and other community officials so each hazard's assessment is valid.

Figure 1-2 Critical Facilities in Muskogee Co.



Natural hazards can impact Muskogee County on a variety of levels, including the built environment, people, or the natural environment. Spotlighting specific impacts helps the community raise awareness of what mitigation efforts might be most beneficial. Together, the vulnerabilities and impacts listed in Chapter 4 directly influence Muskogee County's strategy for mitigation which is discussed in Chapters 5 and 6 ahead.

A significant portion of this Chapter revolves around vulnerability assessments as they pertain to critical facilities, and the 2024 Update groups these facilities into two groups – primary critical facilities and secondary critical facilities. Primary critical facilities are those that ensure the successful day-to-day operation of the County and municipalities, while secondary critical facilities are additional assets that officials maintain are important in the planning area. Icons depicted in Figure 1-2 can be studied using the [Muskogee County GIS Viewer](#) online. This interactive tool allows users to home in on aspects of their jurisdiction, while also allowing the user to filter out unwanted facilities. Appendix B in this document collects and summarizes basic information for each of the critical facilities shown below.

Overall Significance

For 2024, a second classification is assigned to each hazard to further describe how communities are impacted. Overall significance (see Table 4-4) summarizes the importance of each hazard on planning jurisdictions. This metric combines the three variables and describes their influence on individual communities across the planning area.

Table 4-4 Metrics Describing the Overall Significance of Natural Hazards

Metric	Description of Significance Levels
High	The event's criteria consistently fall in the "High" classifications and the event is typically likely/highly likely to occur with severe strength over a sizable portion of the area.
Medium	The event's impacts on the planning area or to specific areas in the community are noticeable.
Low	Minimal impact on the planning area.

Hazard Risk Profile

Upon completing the hazard risk & vulnerability assessments, the planning team summarized how each natural hazard ranks in comparison to one another, and the results are listed in Table 4-5 below. The following hazard sections include the data, narratives, and assessments to understand these classifications.

Table 4-5 Risk Assessment Summary

Natural Hazard	Probability	Significance
Dam Incidents	Unlikely	Medium
Drought	Likely	Medium
Earthquake	Unlikely	Low
Extreme Heat	Likely	Medium
Flooding	Highly likely	High
Hail	Highly likely	High
High Winds	Highly likely	High
Lightning	Highly likely	Medium
Severe Winter Storm	Highly likely	High
Tornado	Highly likely	High
Wildfire	Highly likely	Medium

Future Conditions

Through detailed investigative research, a multitude of datasets were utilized for each of the 11 natural hazards so that the 2024 HMP Update could provide a reasonable statement on the probability of occurring annually. Once these determinations were assessed, this information then allowed the planning team to quantify what each hazard's frequency looks like. Annual probability statements were crafted thanks to the following:

- Historical occurrences of each hazard
- Overall significance of each hazard
- Current trends in frequency and extent of each hazard
- Other forensic meteorological evidence available in governmental databases
- Past FEMA disaster declarations

While science has overwhelmingly determined that global climate is changing, several factors can alter the trajectory of these trends. Thus, the exact nature of what future conditions may look like in Muskogee County cannot be determined with 100% certainty. Such speculation is outside of the scope of this hazard mitigation plan.

Work by scientists and researchers to provide insight into how hazards may affect interests in Oklahoma in the coming decades is done by the Southern Climate Impacts Planning Program (SCIPP). SCIPP serves as one of 11 NOAA Regional Integrated Sciences and Assessments (RISA) teams and conducts research on climate hazards that affect states in the south-central United States, including Oklahoma, Texas, Arkansas, and Louisiana. One goal of this organization is to enhance the resilience of this region against natural hazards and provide information to officials to increase the level of preparedness for their communities and organizations.

Future conditions have been assessed for each hazard in this plan using the Simple Planning Tool for Oklahoma Climate Hazards released by SCIPP in January 2023. This tool provides an overview of climate impacts and projections across the state²⁹. Future projections for each hazard are summarized below.

Dam Incident

While an increase in extreme rainfall (Easterling et al. 2017) may raise the likelihood of dam failure, this is highly dependent upon the quality and integrity of these structures. Many dams in Oklahoma and across the U.S. have reached or exceeded their 50-year design life, so the probability of dam failure simply as a function of quality degradation will continue to increase over time. Those which are not well maintained are at an increased risk of failure. Early signs of potential dam failure if not addressed include washed out spillways, deteriorated primary spillway conduits, collapsed riser structures, and slope instability. Any development downstream of a dam may increase the potential consequences of a dam incident. To date, major dam failures in Oklahoma have been few as dam owners are required to perform routine inspections and maintenance (OWRB 2019).

²⁹ <https://www.southernclimate.org/wp-content/uploads/SPTOK.pdf>

Drought

Highly variable precipitation patterns across the state have contributed to periods of drought in Oklahoma. However, the severity and frequency of these events are expected to increase in the future (Frankson et al. 2022). Even if annual precipitation does not change much, higher projected temperatures would lead to an increase in evaporation from lakes, soils, and plants, leading to undue stresses on agricultural interests and natural systems. Climatological forecast models indicate Oklahoma will experience a decrease in soil moisture across all seasons by the year 2100, with the greatest decrease expected during the summer months (Wehner et al. 2017). Further, higher projected temperatures will also lead to an increased demand for water and energy, which will place additional strains on natural resources (Shafer et al. 2014) during periods of drought.

Earthquake

Prior to 2009, only 1-2 earthquakes per year were recorded in Oklahoma with a magnitude of 3.0 or greater (M3.0+). However, between 2009 to 2015, the rate of M3.0+ earthquakes increased to about 3 per day. This increase is concurrent with a statewide increase in hydraulic fracturing techniques employed by petroleum exploration interests in search of oil and natural gas. As this activity has declined since 2015 by over half. The rate of M3.0+ earthquakes decreased to less than 1 per day in late 2018. Thus, future seismic activity of M3.0+ events is expected to remain at less than 1 per day for at least the next decade (OGS 2017), assuming the current trend in hydraulic fracturing practices continues to decrease. However, any increase in these techniques, or other activity which may influence seismic activity in Oklahoma in the future, may cause these numbers to increase again.

Extreme Heat

An increase in the frequency and intensity of heat waves and extreme heat events has been observed across the United States dating back to the mid-1960s (Wuebbles et al. 2017b). The coolest times of the year, the winter, and spring seasons, have become increasingly warmer in Oklahoma (Frankson et al. 2022). These trends, as well as projections by climate models, indicate that extreme heat events are projected to increase. Average temperatures in Oklahoma are projected to increase by as much as 7°F, with the number of days above 100°F expected to increase by approximately 15 to 45 days by the year 2050. These projections depend on several factors, including trends in emissions levels during this timeframe.

Flood

Heavy rainfall and flooding have long been common to Oklahoma. An increase in annual precipitation has been observed across most of the state, with the highest seasonal change occurring in winter. Seasonally, rainfall is projected to increase in winter and spring, with a decrease expected during summer and autumn months by the year 2100. Projected changes are small compared to natural variations. Strong confidence exists that an increase in the frequency and intensity of heavy rainfall events will unfold throughout the course of the 21st century (Easterling et al. 2017), which will thereby increase the chance of flooding. This statement does not account for local factors, such as impervious surfaces and drainage efficiency, which also influence the severity of flooding.

Hail

Hail is a byproduct of thunderstorms, with large hail a byproduct of severe thunderstorms. Since climate models project an increase in the frequency and intensity of severe thunderstorms, it is thereby concluded that a concurrent increase in events with large hail is expected (Kossin et al. 2017). The same models project an overall decrease in the number of days with hail each year (Brimelow et al. 2017). Researchers place low confidence in these model projections due to the isolated and sporadic nature of hail events.

Additionally, limited comprehensive datasets of occurrences of hail make it difficult to track long-term trends (Wuebbles et al. 2017a).

High Wind

High winds in Muskogee County are most associated with severe thunderstorms. As more favorable environments for thunderstorms are expected, increasing severe wind events are projected. Further, climate models project an increase in the frequency and severity of severe thunderstorms in Oklahoma, particularly during peak storm season (March, April, and May). Uncertainty does remain in the assumption that increasingly favorable environments for thunderstorm development will translate into an increased potential of producing damaging winds (Kossin et al. 2017).

Lightning

Like hail, lightning occurrences are tied to thunderstorm development. Thus, as more favorable environments for thunderstorms are expected across the U.S., including Oklahoma and Muskogee County, an increase in lightning is also expected. Climate models project an increase in the frequency and intensity of severe thunderstorms (Kossin et al. 2017), therefore not only are lightning occurrences expected to increase, an increase in the potential for the strongest, most damaging type of lightning, which originates from the top of a thunderstorm cloud, is also expected. It should be noted that the confidence level of these projections is currently low, due to the sporadic and isolated nature of lightning events and limited comprehensive sets of data, which make it difficult to track long-term trends (Wuebbles et al. 2017).

Severe Winter Storm

An increase in the number of years with many snowfall days has declined significantly across the southern United States between 1930 and 2007, including Oklahoma. Climate models indicate the decrease is expected to continue; however, they also project warming temperatures which have a higher moisture capacity. Thus, the potential for heavy snowfall events, when snow does fall, is expected to increase despite the overall trend of warming temperatures (Krasting et al. 2013). It should be noted that a high degree of uncertainty exists regarding ice storms in Oklahoma. Observational data limitations and the complexity of events themselves make it difficult to determine with specificity whether patterns have and/or will change. A general northward shift of the rain/sleet/snow dividing line is projected by these climate models to take place by the year 2050. This shift will add to the complexity of determining climatic trends for precipitation types for winter events (rain, ice, or snow) in Oklahoma. However, as temperatures are expected to warm, atmospheric moisture capacity is expected to increase similarly. Thus, the occurrence of significant ice storm accumulations may increase during this timeframe (Easterling et al. 2017). Further research is needed to reach a more determinate projection, however.

Tornado

Over the past 40 years, records indicate an increase in the frequency of days with a large number of tornadoes, referred to as tornado outbreaks. However, there has also been an observed decrease in the overall frequency of days with tornadoes (Kossin et al. 2017). When tornadoes do occur, they are more likely to do so in conjunction with a tornado outbreak. Due to the small scale spatially at which tornadoes occur, it is currently difficult to model trends in tornado occurrences in climate models, which operate on a large scale temporally. Thus, more research is needed to understand how the number of tornado occurrences will be affected throughout the 21st century. Climate models project an increase in the frequency and intensity of severe thunderstorms which are responsible for producing large tornadoes. Thus, a low-confidence projection of an increase in the potential for large tornadoes can be stated,

particularly during the peak storm season months of March, April, and May. Confidence in all projections for tornadoes of any size remains low (Kossin et al. 2017).

Wildfire

An increase in the number of large wildfires was observed between 1984 and 2011 across the Southern Plains, including Oklahoma (Wehner et al. 2017). Wildfires in Oklahoma are dependent upon current weather conditions, seasonal climate patterns, vegetation conditions, and an available source for ignition (such as a spark, flame, or intentional). Since this relationship is complex, so too is determining the future trend for wildfires. Projected increases in temperatures that can dry out fine fuels such as grasses, as well as enhanced wet/dry cycles that promote vegetation growth and drying or dormancy, coupled with population growth within the wildland-urban interface, can combine to increase the risks of wildfires.

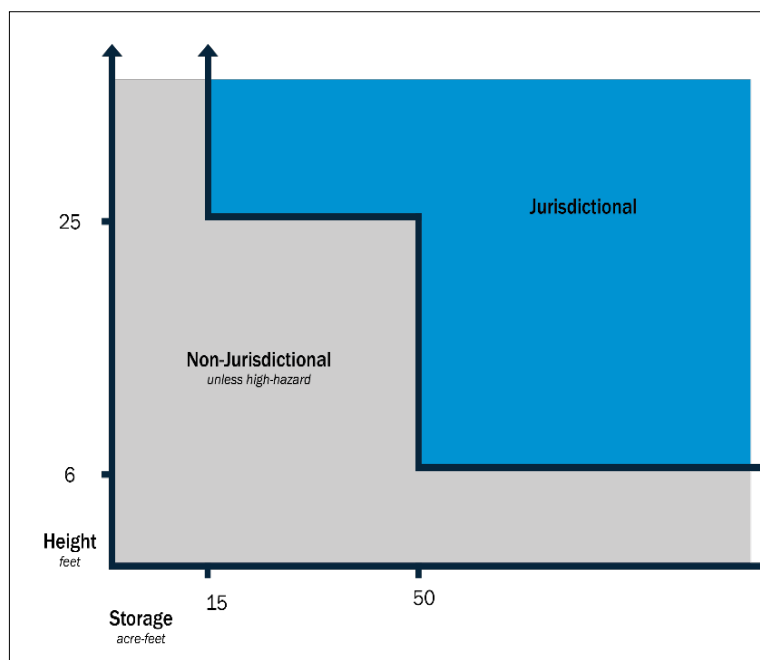
4.2 Dam Incidents

4.2.1 Description

Dam is defined by the Federal Emergency Management Agency (FEMA) as a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. Dams are typically constructed of earth, rock, concrete, or tailings (chaff) from mining operations. Any dam with a height of 25 feet or more from the natural streambed and/or 50 acre-feet or more of storage capacity is under the jurisdiction of the Oklahoma Water Resources Board (see Figure 4-3). A dam is considered small if it has a maximum storage of less than 10,000 acre-feet and a maximum height of less than 50 feet. Intermediate sized dams are those that have a maximum height between 50 and 100 feet. Large dams are those with a maximum storage of over 50,000 acre-feet and a maximum height of over 100 feet.



Figure 4-3 Jurisdictional Sizes of Dams per OWRB



Coordination of the Oklahoma Dam Safety Program is facilitated by the Oklahoma Water Resource Board to ensure the safety of more than 4,500 dams across the state, particularly those that could impact lives and property downstream. OWRB uses 3 categories to classify dams based on hazard potential, as described in Table 4-6: low, significant, and high. These classifications do not reflect the likelihood that a dam will have an emergency release or fail – they pertain to the effects they would cause should the dam fail.

In addition to annual inspections, all high hazard dams must have an Emergency Action Plan as well as an accompanying breach inundation map, which shows the areas downstream inundated by at least one foot of water based on hydrologic studies. A breach or break in the dam is shown in two different scenarios – incidents that are not storm-related, called “Sunny Day” breaches, and dam incidents resulting from a water surface elevation at least one foot higher than the water surface elevation from the spillway design. Inundation scenarios proposed in Muskogee County include Sunny Day breaches and Overtop (or PMF) scenarios. OWRB maintains these maps in their files, and all high-hazard dams in the planning area have approved EAPs.

Table 4-6 Dam Hazard Classifications according to OWRB

Hazard-Potential Classification	Risk Involved with Dam Failure	Inspection Frequency
High	Probable loss of human life	Annually, by a registered professional engineer
Significant	No probable loss of human life but can cause economic loss or disruption of lifeline facilities	Every 3 years by a registered professional engineer
Low	No probable loss of human life and low economic loss	Every 5 years

Extremely dangerous flood situations can arise due to this hazard as high velocities and large volumes of water can travel at high speeds downstream. In the event of a dam incident, the potential energy of water stored behind even a small dam can cause significant property damage and loss of life to anyone caught within the inundation area. The extent of such inundation can range from minimal in uninhabited farmland areas, to catastrophic in densely populated and developed urban environments. Sometimes, to prevent overtopping and catastrophic failure, dams are forced to make emergency releases of large amounts of water, causing flooding downstream.

Dam Incidents are primarily caused by two types of deficiencies -- hydrologic or structural deficiencies. Hydrologic deficiencies refer to inadequate spillway capacity caused by excessive runoff from heavy precipitation. Structural deficiencies pertain to seepage, erosion, cracking, sliding, and overturning, mainly caused by the age of the dam and lack of maintenance. The operation of a reservoir can also influence the safety of the structure.

There are varying levels of dam failure. Partial dam failures include inadequate spillway capacity that causes excess flow to overtop the dam or internal erosion through the dam or foundation. Complete failure occurs if internal erosion or overtopping results in a total structural breach, releasing a high-velocity wall of debris-laden water rushing downstream, which has the potential to damage and destroy everything in its path.

Dam Incidents refer to scenarios when the release (intentional or unintentional), collapse, breach, or other type of dam failure results in downstream flooding. In this assessment, two types of dam inundation scenarios are used. Normal Pool (or "Sunny Day") conditions describe the pool level maintained by the dam throughout the year when not in a flood operation. Max High Pool is the pool level near the top of the dam resulting from water flowing into the reservoir from heavy rainfall or other significant high-water events.

Water volume impounded in the reservoir behind a dam is measured in acre-feet. An acre-foot is the volume of water that covers an acre of land to a depth of one foot, or approximately 325,000 gallons. As a function of upstream topography, even a very small dam may impound or detain many acre-feet, or millions of gallons, of water.

Sunny Day (Normal High) breach scenarios for eleven dams which would have inundation effects in Muskogee County are mapped, along with Probable Maximum Failure (PMF) scenarios. Although OWRB gives a high hazard rating to Webbers Falls Lock and Dam 16 and Chouteau Lock and Dam 17, neither produce inundation areas that would exceed the existing flood hazard areas shown in Figure 4-11. For the 2024 HMP Update, both are included in this assessment because each appeared in the 2019 HMP. Dam

Incidents are conveyed through a series of inundation maps provided in Appendix C as well as on the [Muskogee County HUB Page](#). This hazard is unique to some jurisdictions based solely on impacts modeled from Normal High and Max PMF failure scenarios and Table 4-7 provides an overview as to which participating jurisdictions are affected and to what degree. Locations of each dam are provided in Figure 4-4. Collectively, this group of dams form the basis of this hazard assessment.

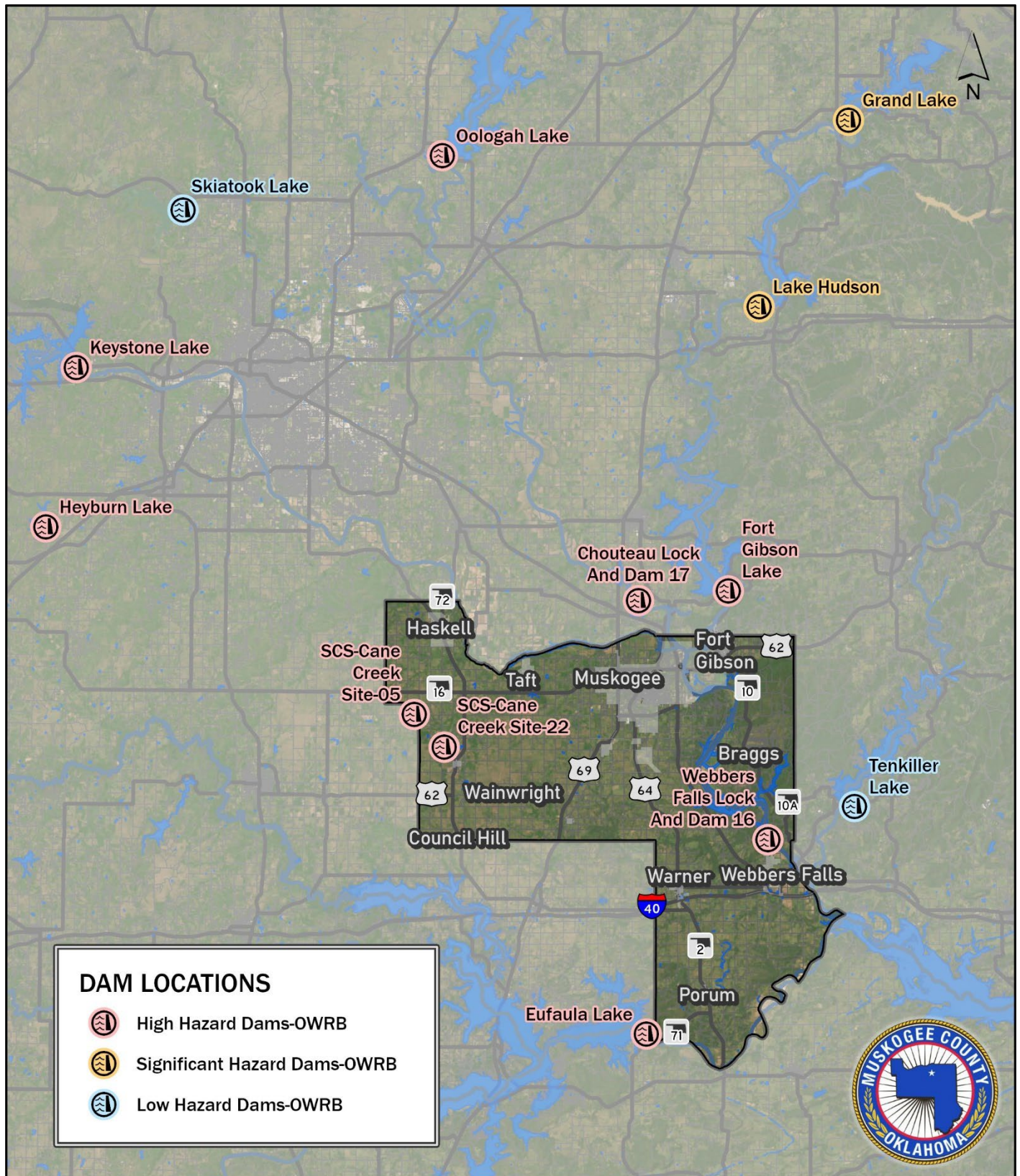
4.2.2 Location

Locations of Dam Incidents are conveyed through a series of inundation maps provided in Appendix C and on the [Muskogee County GIS Viewer](#). This hazard is unique to some jurisdictions based solely on impacts modeled from Normal High and PMF scenarios (see 4.2.1), and Table 4-22 provides an overview as to which participating jurisdictions are affected and to what degree. Locations where each dam is located is provided in Table 4-7 and Figure 4-4 below. Collectively, they form the basis of this hazard assessment.

Table 4-7 Dams that Produce Inundation Areas in Muskogee County

GRDA Dams				
ID	Name	County	OWRB Hazard Rating	Source
OK00134	Robert S. Kerr (Lake Hudson)	Mayes	Significant	Neosho River
OK00135	Pensacola (Grand Lake) Dam	Mayes	Significant	Neosho River
NRCS Dams				
ID	Name	County	OWRB Hazard Rating	Source
OK01334	SCS – Cane Creek Site 22	Muskogee	High	Cane Creek
OK01357	SCS – Cane Creek Site 05	Okmulgee	High	Cane Creek
Federal Dams				
ID	Name	County	OWRB Hazard Rating	Source
OK10303	Chouteau Lock and Dam 17	Wagoner	High	Verdigris River
OK10304	Webbers Falls Lock and Dam 16	Muskogee	High	Arkansas River
OK10308	Lake Eufaula Dam	Haskell	High	Canadian River
OK10309	Keystone Lake Dam	Tulsa	High	Arkansas River
OK10310	Oologah Lake Dam	Rogers	High	Verdigris River
OK10311	Tenkiller Lake Dam	Sequoyah	Low	Illinois River
OK10313	Lake Heyburn Dam	Creek	High	Polecat Creek
OK10314	Fort Gibson Reservoir Dam	Wagoner	High	Neosho River
OK22200	Skiatook Lake Dam	Osage	Low	Neosho River

Figure 4-4 Dams with Inundation Areas Impacting Muskogee County



Dam Overviews

Table 4-8 General Information for Eufaula Dam

Lake Eufaula Dam	
Location	Haskell Co. (Lat. 35.30450, Lon. -95.36025)
Source	Canadian River
Owner / Operator	U.S. Army Corps of Engineers – Tulsa District
Year Completed	1964
Length / Height	3,200 feet / 114 feet
Surface Area	143,000 Acres
Construction Material	Earth with rock/soil foundation
Use of Dam	Flood Risk Reduction, Other, Recreation, Hydroelectric, Water Supply
Capacity	2,314,600 Acre-feet (<i>normal</i>) / 3,825,400 Acre-feet (<i>maximum</i>)
Results of Failure	Unclear due to data deficiency. See Appendix C
Jurisdictions Impacted by a Dam Failure	Muskogee Co., Fort Gibson, Muskogee, Webbers Falls, Braggs PSD, Fort Gibson PSD, Muskogee PSD, Oktaha PSD, Porum PSD, Warner PSD, Webbers Falls PSD
EAP	Yes, 2022

Table 4-9 General Information for Fort Gibson Dam

Fort Gibson Reservoir Dam	
Location	Wagoner Co. (Lat. 36.86965, Lon. -95.23083)
Source	Neosho (Grand) River
Owner / Operator	U.S. Army Corps of Engineers – Tulsa District
Year Completed	1949
Length / Height	2,990 feet / 110 feet
Surface Area	19,900 Acres
Construction Material	Earth with rock foundation
Use of Dam	Flood Risk Reduction, Hydroelectric
Capacity	365,200 Acre-feet (<i>normal</i>) / 1,284,400 Acre-feet (<i>maximum</i>)
Results of Failure	See Appendix C
Jurisdictions Impacted by a Dam Failure	Muskogee Co., Fort Gibson, Muskogee, Taft, Braggs PSD, Fort Gibson PSD, Haskell PSD, Muskogee PS, Oktaha PS, Warner PSD, Webbers Falls PSD
EAP	Yes, 2021

Table 4-10 General Information for Heyburn Dam

Lake Heyburn Dam	
Location	Creek Co. (Lat. 35.94808, Lon. -96.29594)
Source	Polecat Creek
Owner / Operator	U.S. Army Corps of Engineers – Tulsa District
Year Completed	1950
Length / Height	2,920 feet / 89 feet
Surface Area	880 Acres
Construction Material	Earth with rock/soil foundation
Use of Dam	Flood Risk Reduction, Other, Recreation, Water Supply
Capacity	7,105 Acre-feet (<i>normal</i>) / 55,395 Acre-feet (<i>maximum</i>)
Results of Failure	See Appendix C
Jurisdictions Impacted by a Dam Failure	Muskogee Co., Fort Gibson, Muskogee, Taft, Webbers Falls, Braggs PSD, Fort Gibson PSD, Haskell PSD, Muskogee PSD, Webbers Falls PSD
EAP	Yes, 2019

Table 4-11 General Information on Keystone Dam

Keystone Lake Dam	
Location	Tulsa Co. (Lat. 36.14989, Lon. -96.25297)
Source	Arkansas River
Owner / Operator	U.S. Army Corps of Engineers – Tulsa District
Year Completed	1964
Length / Height	4,600 feet / 121 feet
Surface Area	22,420 Acres
Construction Material	Earth with rock foundation
Use of Dam	Flood Risk Reduction, Other, Recreation, Hydroelectric, Water Supply
Capacity	505,381 (<i>normal</i>) / 1,672,613 (<i>maximum</i>)
Results of Failure	See Appendix C
Jurisdictions Impacted by a Dam Failure	Muskogee Co., Fort Gibson, Haskell, Muskogee, Taft, Braggs PSD, Fort Gibson PSD, Haskell PSD, Hilldale PSD, Muskogee PSD, Oktaha PSD, Warner PSD
EAP	Yes, 2018

Table 4-12 General Information for Oologah Lake

Oologah Lake Dam	
Location	Rogers Co. (Lat 36.42235, Lon. -95.68019)
Source	Verdigris River
Owner / Operator	U.S. Army Corps of Engineers – Tulsa District
Year Completed	1963
Length / Height	4,328 feet / 137 feet
Surface Area	31,040 Acres
Construction Material	Earth core with rock foundation
Use of Dam	Flood Risk Reduction, Other, Recreation, Water Supply
Capacity	552,210 Acre-feet (<i>normal</i>) / 1,559,270 Acre-feet (<i>maximum</i>)
Results of Failure	See Appendix C
Jurisdictions Impacted by a Dam Failure	Muskogee Co., Fort Gibson, Muskogee, Webbers Falls, Braggs PSD, Fort Gibson PSD, Muskogee PSD, Oktaha PSD, Warner PSD, Webbers Falls PSD
EAP	Yes, 2016

Table 4-13 General Information for Pensacola Dam

Pensacola (Grand Lake) Dam	
Location	Mayes Co. (Lat. 36.47055, Lon. -95.03632) S14 T23N R21E
Source	Neosho (Grand) River
Owner / Operator	Grand River Dam Authority
Year Completed	1940
Length / Height	6,565 feet / 155 feet
Surface Area	46,500 Acres
Construction Material	Concrete core with rock foundation
Use of Dam	Hydroelectric, Flood Risk Reduction
Capacity	1,630,000 Acre-feet (<i>normal</i>) / 2,197,000 Acre-feet (<i>maximum</i>)
Results of Failure	See Appendix C
Jurisdictions Impacted by a Dam Failure	Muskogee Co., Fort Gibson, Muskogee, Taft, Braggs PSD, Fort Gibson PSD, Haskell PSD, Hilldale PSD, Muskogee PSD, Oktaha PSD, Warner PSD, Webbers Falls PSD
EAP	Yes, 2022

Table 4-14 General Information for Lake Hudson Dam

Lake Hudson (Robert S. Kerr)	
Location	Mayes Co. (Lat. 36.2342, Lon. -95.1824) S9 T20N R20E
Source	Neosho (Grand) River
Owner / Operator	Grand River Dam Authority
Year Completed	1964
Length / Height	3,900 feet / 87 feet
Surface Area	11,000 Acres
Construction Material	Earth with rock foundation
Use of Dam	Hydroelectric, Flood Risk Reduction
Capacity	215,000 Acre-feet (<i>normal</i>) / 565,674 (<i>maximum</i>)
Results of Failure	See Appendix C
Jurisdictions Impacted by a Dam Failure	TBD. See Mitigation Action #30
EAP	Yes, 2018

Table 4-15 General Information for SCS Cane Creek Site 05

SCS - Cane Creek Site 5	
Location	Okmulgee Co. (Lat. 35.71120, Lon. -95.72064) Sec 4
Source	Tributaries of Cane Creek
Owner / Operator	Okmulgee County Conservation District
Year Completed	1965
Length / Height	2,200 feet / 24 feet
Surface Area	33 Acres
Construction Material	Earth with soil foundation
Use of Dam	Flood Risk Reduction
Capacity	94 Acre-feet (<i>normal</i>) / 785 Acre-feet (<i>maximum</i>)
Results of Failure	One house and three county roads may be inundated by a dam breach
Jurisdictions Impacted by a Dam Failure	Muskogee Co., Haskell PSD
EAP	Yes, 2014

Table 4-16 General Information for SCS Cane Creek Site 22

SCS – Cane Creek Site 22	
Location	Muskogee Co. (Lat. 35.67087, Lon. -95.6739) Section 24 T14N R15E
Source	Tributaries of Cane Creek
Owner / Operator	Muskogee County Conservation District
Year Completed	1964
Length / Height	2,100 feet / 34 feet
Surface Area	34 feet
Construction Material	Earth core with soil foundation
Use of Dam	Flood Risk Reduction
Capacity	162 Acre-feet (<i>normal</i>) / 1,486 Acre-feet (<i>maximum</i>)
Results of Failure	One double-wide home and two bridge and roadway sections may be affected by a dam breach.
Jurisdictions Impacted by a Dam Failure	Muskogee Co., Midway PSD
EAP	Yes, 2022

Table 4-17 General Information for Skiatook Dam

Skiatook Reservoir Dam	
Location	Osage Co. (Lat. 36.35167, Lon. -96.09167)
Source	Hominy Creek
Owner / Operator	U.S. Army Corps of Engineers – Tulsa District
Year Completed	1984
Length / Height	3,590 feet / 143 feet
Surface Area	10,540 Acres
Construction Material	Earth with rock/soil foundation
Use of Dam	Flood Risk Reduction, Recreation, Water Supply
Capacity	331,200 Acre-feet (<i>normal</i>) / 893,000 Acre-feet (<i>maximum</i>)
Results of Failure	Only the Normal Pool failure scenario was available due to data deficiency. See Appendix C
Jurisdictions Impacted by a Dam Failure	Muskogee Co., Fort Gibson, Muskogee, Braggs PSD, Fort Gibson PSD, Muskogee PSD, Oktaha PSD, Warner PSD, Webbers Falls PSD
EAP	Yes, 2017

Table 4-18 General Information for Tenkiller Lake Dam

Tenkiller Lake Dam	
Location	Sequoyah Co. (Lat. 35.5937, Lon. -95.0379)
Source	Illinois River
Owner / Operator	U.S. Army Corps of Engineers – Tulsa District
Year Completed	1952
Length / Height	4,940 feet / 197 feet
Surface Area	12,900 Acres
Construction Material	Earth with rock foundation
Use of Dam	Flood Risk Reduction, Hydroelectric
Capacity	654,100 Acre-feet (<i>normal</i>) / 1,230,800 Acre-feet (<i>maximum</i>)
Results of Failure	Max High Pool Breach would pose a risk to 18,022 Daytime people at risk and 8,378 Nighttime People at Risk. 3,797 Buildings are also at risk, which equates to an economic cost of around \$856,564,668
Jurisdictions Impacted by a Dam Failure	Muskogee Co., Fort Gibson, Webbers Falls, Braggs PSD, Fort Gibson PSD, Oktaha PSD, Porum PSD, Warner PSD, Webbers Falls PSD
EAP	Yes, 02/28/2023

Table 4-19 General Information for Chouteau Lock and Dam #17

Chouteau Lock and Dam #17	
Location	Wagoner Co. (Lat. / Lon.)
Source	Verdigris River
Owner / Operator	U.S. Army Corps of Engineers – Tulsa District
Year Completed	1970
Length / Height	12,200 feet (total structures) / 75 feet (spillway)
Construction Material	Earth and concrete with rock foundation
Use of Dam	Navigation, flood control
Results of Failure	N/A – see Appendix C
Jurisdictions Impacted by a Dam Failure	According to EAP, none – see Appendix C
EAP	Yes, May 2019

Table 4-20 General Information for Webbers Falls Lock and Dam #16

Webbers Falls Lock and Dam #16	
Location	Muskogee Co. (Lat. / Lon.)
Source	Arkansas River
Owner / Operator	U.S. Army Corps of Engineers – Tulsa District
Year Completed	1973
Length / Height	4,370 feet / 87 feet (total structures)
Construction Material	Earth and concrete with rock foundation
Use of Dam	Navigation, Flood control
Results of Failure	N/A – see Appendix C
Jurisdictions Impacted by a Dam Failure	According to EAP, none. See Appendix C
EAP	Yes, April 2023

Dam Inundation Maps

Dam mapping in Muskogee County is based on available analyses. Inundation maps for dams profiled in this assessment have mapping criteria based on guidance from the State of Oklahoma. Incidents for these dams are subject to measurements under 50% Probable Maximum Flood (PMF) and/or Sunny Day breaches. A 50% PMF failure covers an area of maximum expected inundation expected to result from a dam incident. A Sunny Day breach refers to an incident not caused by inflows. This can include structural, mechanical, or other types of failure. All inundation maps are presented in Appendix C with the exception of Both Chouteau Lock and Dam 17³⁰ and Webbers Falls Lock and Dam 16³¹ were evaluated for breach conditions, and both EAPs make the following statements:

This dam breach assessment predicts flood elevations that are unlikely to reach “Action Stage” at USGS Gages or cause population at risk at locations downstream. Although no consequences are predicted in this assessment, consequences could occur from breaches of larger dams in the river system.

4.2.3 Extent

The extent of dam incidents is assessed through an examination of the storage capacity of the reservoir behind a dam because this volume of water determines the range of flood inundation levels for both Sunny Day and PMF breach scenarios. Appendix C contains inundation maps, at-risk structures, and more. Table 4-22 below breaks down which jurisdiction is impacted by dam incidents based on inundation maps provided in Appendix C and by those provided online at the [USACE Inventory of Dams](#) website. To see which critical facility is impacted in each jurisdiction, see tables provided in Appendix C.

³⁰ Chouteau Lock & Dam #17, McClellan-Kerr Arkansas River Navigation System, NID: OK10303, Verdigris River, Oklahoma, OPERATION AND MAINTENANCE MANUAL, VOLUME II, EMERGENCY ACTION PLAN, USACE May 2019

³¹ Webbers Falls Lock and Dam #16, Operation and Maintenance Manual, Volume II, EMERGENCY ACTION PLAN, USACE April 2023.

4.2.4 Previous Occurrences

Between January 1, 2014 to December 31, 2023, no dam incidents of note are on record as having affected interests in Muskogee County.

4.2.5 Probability of Future Occurrences

Due to the sparing occurrence of dam incidents that have affected Muskogee County between 2014 through 2023, the probability of a dam incident is considered **unlikely**.

4.2.6 Vulnerability and Impacts

Risks of inundation from Dam Incidents apply to the following jurisdictions: Muskogee County, Haskell, Fort Gibson, Muskogee, Taft, Webbers Falls, and the Fort Gibson Public School District. Direct vulnerabilities and impacts are summarized in Table 4-21 below. Additionally, indirect vulnerabilities, and impacts are also described below. Based on the classifications in Table 4-5, and the high degree of impact potential of this hazard, the overall significance of this hazard is **medium** in the planning area.

Table 4-21 Vulnerabilities and Impacts due to Dam Incidents

Vulnerability	Participating Jurisdiction(s)	Impact
Floodwaters can inundate critical facilities such as the Muskogee Water Plant, OG&E Factory, electrical substations, and Muskogee's Pollution Control facility.	• Muskogee County • Muskogee • Fort Gibson	Outages at critical facilities would produce limited available utilities (such as clean drinking water, electricity, and wastewater service) for residents in the planning area
Floodwaters can render Water Plant inoperable, which can lead to cascading / indirect disruptions at other water districts that utilize direct connections with PWA that pull water directly from rivers and lakes, such as Muskogee, Fort Gibson, Porum, Warner, Muskogee Co. RWD #3, Camp Gruber, and East Central Water Authority	• Boynton * • Braggs * • Council Hill * • Haskell • Haskell Public School District • Oktaha * • Porum * • Summit * • Taft • Muskogee Co. Districts 1, 2, and 3 • Wainwright * • Warner * • Webbers Falls • Braggs Public School District • Fort Gibson Public School District • Haskell Public School District • Hilledale Public School District • Midway Public School District • Muskogee Public School District • Oktaha Public School District • Porum Public School District • Wainwright Public School District * • Warner Public School District • Webbers Falls Public School District	A lack of sustainable and potable water can not only be a direct threat to human health and safety, but it can result in closures of schools and businesses across the entire planning area. A disruption of this utility can prevent fire departments and first responders from using water for firefighting purposes.

* Impacts are solely a result of indirect/cascading effects. No floodwater reaches these jurisdictions. See Table 4-22.

Appendix C details at great length all critical facilities (primary and secondary) which can potentially see impacts from dam inundations for each of the structures profiled in this chapter. Jurisdictions which will experience impacts from a dam incident have been displayed in Table 4-22. Specifics in terms of flood water depths are available for some, while others are not immediately available due to data deficiencies. The absence or unavailability of some Emergency Action Plans has been noted, which results in new action items being added to Chapter 5.

Key	
Critical Facility and/or School Structure Impacted	●
Jurisdictional Impacts but no Critical Facility and/or School Structure	◐
No Impacts	○
Unknown / Data Deficiency	—

Table 4-22 Jurisdictions Impacted by Dam Incidents

	Cane Creek Site 5	Cane Creek Site 22	Chouteau L&D 17	Eufaula Dam	Fort Gibson Dam	Pensacola Dam	Heyburn Dam	Lake Hudson Dam	Keystone Dam	Oologah Dam	Skiatook Dam	Tenkiller Dam	Webbers Falls L&D 16
Muskogee Co. (unincorporated)	◐	◐	○	●	●	◐	●	—	●	◐	●	◐	○
Boynton	○	○	○	○	○	○	○	—	○	○	○	○	○
Braggs	○	○	○	○	○	○	○	—	○	○	○	○	○
Council Hill	○	○	○	○	○	○	○	—	○	○	○	○	○
Fort Gibson	○	○	○	●	●	●	●	—	●	◐	●	◐	○
Haskell	○	○	○	○	○	○	○	—	●	○	○	○	○
Muskogee	○	○	○	●	●	●	●	—	●	●	●	○	○
Oktaha	○	○	○	○	○	○	○	—	○	○	○	○	○
Porum	○	○	○	○	○	○	○	—	○	○	○	○	○
Summit	○	○	○	○	○	○	○	—	○	○	○	○	○
Taft	○	○	○	○	◐	◐	◐	—	◐	○	○	○	○
Wainwright	○	○	○	○	○	○	○	—	○	○	○	○	○
Warner	○	○	○	○	○	○	○	—	○	○	○	○	○
Webbers Falls	○	○	○	●	○	○	◐	—	○	●	○	●	○
Braggs PS	○	○	○	◐	◐	◐	◐	—	◐	◐	◐	◐	○
Fort Gibson PS	○	○	○	◐	◐	◐	◐	—	●	◐	◐	◐	○
Haskell PS	◐	○	○	○	◐	◐	◐	—	●	○	○	○	○

	Cane Creek Site 5	Cane Creek Site 22	Chouteau L&D 17	Eufaula Dam	Fort Gibson Dam	Pensacola Dam	Heyburn Dam	Lake Hudson Dam	Keystone Dam	Oologah Dam	Skiatook Dam	Tenkiller Dam	Webbers Falls L&D 16
Hilldale PS	○	○	○	○	○	◐	○	—	◐	○	○	○	○
Midway PS	○	◐	○	○	○	○	○	—	○	○	○	○	○
Muskogee PS	○	○	○	◐	◐	◐	◐	—	◐	◐	◐	◐	○
Oktaha PS	○	○	○	◐	◐	◐	○	—	◐	◐	◐	◐	○
Porum PS	○	○	○	◐	○	○	○	—	○	○	○	◐	○
Wainwright PS	○	○	○	○	○	○	○	—	○	○	○	○	○
Warner PS	○	○	○	◐	◐	◐	○	—	◐	◐	◐	◐	○
Webbers Falls PS	○	○	○	●	◐	◐	◐	—	○	◐	◐	●	○

As discussed by the Association of State Dam Safety Officials in FEMA Publication “Assessing the Consequences of Dam Failure,” consequences of dam failure include economic impacts (costs of repair and debris removal, replacement of contents, and loss of jobs), social impacts (disruptions in social patterns, loss of services provided by institutions in the inundation area, and loss of recreational opportunities), and environmental impacts (polluted water and soils, loss of habitat, and erosion of stream banks). All jurisdictions that have been indicated to experience impacts as a result of a dam incident in Table 4-22 will experience one or more of these consequences, depending upon the nature of the incident.

4.2.7 Future Conditions

Climatological Effects

Increases in extreme rainfall (Easterling et al. 2017) may raise the likelihood of dam failure, however, it is highly dependent upon the quality of the structures. Most dams are at or near their 50-year design life, so the probability of failure increases with time. Dams not well maintained have an increased likelihood of failure. Washed out spillways, deteriorated primary spillway conduits, collapsed riser structures, and slope instability can lead to a dam breach. New development downstream of existing dams increases the potential consequences that would occur if a dam were to fail. Major dam failures across Oklahoma are few since owners are required to perform routine inspections and maintenance (OWRB 2019).

Land Use Changes

Future development in the planning area must be performed with great care taken to avoid being performed within areas that would experience impacts in the event of a dam incident. Proper and stringent floodplain management procedures can address these potential risks effectively, in addition to preventing development from occurring in portions of Muskogee County that appear within inundation areas. Such areas with the most noted vulnerabilities are those that have been analyzed to be at risk of inundation, outlined in Appendix C.

Population Patterns

Population growth in the planning area can be prevented from experiencing the effects of dam failure by avoiding development within floodplains and areas that have been analyzed in inundation maps to experience effects resulting from a dam incident. Officials across the County can manage and regulate development in the areas at risk of inundation, which are identified in Appendix C, in order to keep residents safe from potential dam incidents.

4.3 Drought

4.3.1 Description

Drought is defined as a deficiency of moisture resulting in adverse impacts on people, animals, or vegetation over a sizeable area³². Relative to other hazards, droughts are generally slow-onset hazards that develop over the course of weeks or months and can severely damage crops, lower municipal water supplies, and have adverse effects on natural and recreational resources and wildlife. If drought conditions persist for many months or years, direct and indirect economic impacts can become devastating. Extreme temperatures, high winds, and low humidity can exacerbate drought conditions and make areas more susceptible to wildfire. Additionally, human actions and demands for water resources can accelerate and compound drought-related impacts.



4.3.2 Location

Drought is a hazard that poses a uniform risk across the entire planning area, since this hazard commonly affects regions on a scale larger than county-level. Since drought can affect public water supplies, water service providers who have not secured a backup source of water to distribute to customers may experience difficulties during periods of extreme drought. More details on specific locations within the planning area with unique vulnerabilities to this hazard can be found in Section 4.3.6.

4.3.3 Extent

A drought's extent can be considered quantifiable. It is calculated by determining duration as well as severity. While the 2019 Plan utilized the Palmer Drought Severity Index to determine a drought's severity, it is known as a soil moisture index, which is better applied to making short-term drought forecasts and outlooks. To properly assess historical drought conditions and drought severity levels in Muskogee County, this plan incorporates the index provided by the U.S. Drought Monitor (USDM). Not only does the USDM serve as a comprehensive national database for drought hazards, but it also provides historically observed impacts that are state-specific. Using the USDM "Drought Classification" chart as well as the "State Impacts" description Table 4-23 describes how categorical drought indices correlate with known impacts in Oklahoma based on previously observed occurrences. In Muskogee County, drought conditions can range from D0 (Abnormally Dry) to D4 (Exceptional Drought) on the USDM scale.

³² <https://w1.weather.gov/glossary/index.php?letter=d>

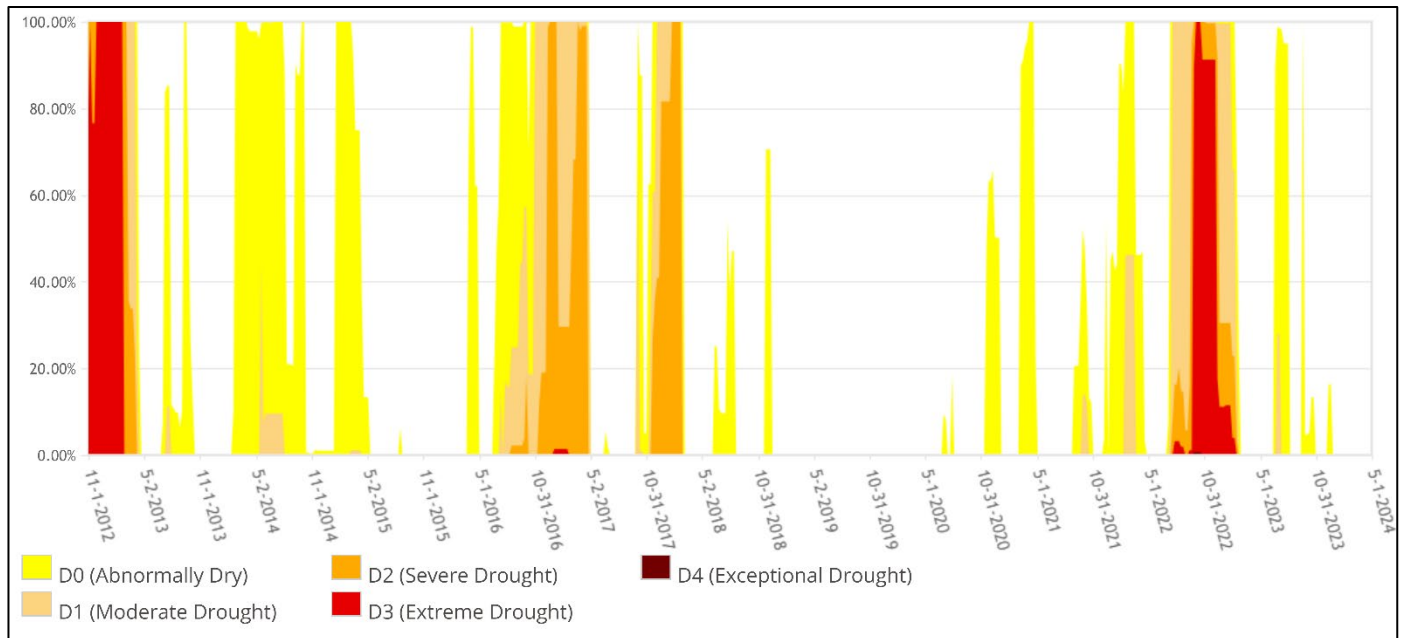
Table 4-23 USDM Index and Historical Drought Impacts Observed in Oklahoma

Category	Description	Historically Observed Impacts in OK
D0	Abnormally Dry	• Crops are stressed (wheat, canola, alfalfa, pecans); winter wheat germination is delayed. • Stock pond levels decline
D1	Moderate Drought	• Summer crop and forage yields are reduced. • Wildfire risk increases. • Lake recreation activities are affected; deer reproduction is poor
D2	Severe Drought	• Dryland crops are severely reduced; pasture growth is stunted. • Cattle are stressed. • Burn bans begin. • Trees show significant wilting. • Spring-fed ponds are slow to refill
D3	Extreme Drought	• Grasses are dominant and hay is nonexistent; planting is delayed; fields are spotty; emergency CRP grazing is authorized. • Cattle have little water and feed. • Wildfires are increasing in number and severity. • Fishing is down; boating is hazardous with low lake levels; game bird populations decline. • Air quality is poor, with dust storms and smoke. • Lakes are critically low; producers are hauling water for cattle; wells are drying
D4	Exceptional Drought	• Ground is cracking; farmers are bailing failed crops or abandoning fields; pastures are bare; land is abandoned. • Cost of hay and water is high, and supplies are scarce; producers are liquidating herds. • Burn restrictions increase. • Fire season is long; rural fire departments are running out of finances. • Ranchers/farmers are desperate & experience huge economic loss. • Water lines are breaking; reservoir levels are nearing intake; mandatory water restrictions are implemented; water quality is poor

4.3.4 Previous Occurrences

Drought is a commonly occurring hazard which affects Muskogee County. To establish thresholds for this assessment, USDM metrics were used. Between January 1, 2013, and December 31, 2023, Muskogee County, OK has experienced four distinct periods of severe drought, there have been four discrete occurrences of D2 (Severe Drought) events or greater as shown in the time series map found in Figure 1-5.

Figure 1-5 Historical Drought Conditions in Muskogee Co. (2013-2023)



Droughts are long-term hazards, but regardless, evidence is examined for periods of Severe Drought (D2 level) or worse. Table 4-24 provides narratives of drought events that impacted Muskogee County since 2013. Information is sourced from the publicly available NCEI Storm Events Database.

Table 4-24 Noteworthy Drought Impacts across Muskogee and Surrounding Counties (NCEI)

Date	Narrative
07/2012 - 04/2013	Very hot temperatures during the summer of 2012 combined with a lack of appreciable rainfall resulted in significantly worsening drought conditions in Muskogee County during July. By the end of the month, Extreme Drought (D3) had set in, with all counties in eastern Oklahoma declared disaster areas by the USDA due to this drought event. Rainfall deficits continued to grow throughout Autumn 2012, despite some rainfall in association with seasonal cold fronts. D3 conditions persisted into January 2013 on below-average precipitation. Throughout the course of the remainder of the January to April 2013 timeframe, several precipitation events gradually lifted Muskogee County out of drought conditions.
11/2016 - 04/2017	A pattern of below-normal precipitation began in late summer 2016 in Muskogee County, and drought conditions set in during November. Severe drought (D2) conditions persisted into the new year. Several rounds of showers and thunderstorms developed in March 2017, with widespread, heavy rainfall across much of eastern Oklahoma in April. This resulted in consecutive months of above average rainfall, which allowed drought conditions to be alleviated by the end of the month of April.
11/2017 - 02/2018	Drought conditions returned to Muskogee County in November as abundant rainfall which fell during the spring waned by late summer and early fall. The county received less than 25 percent of normal average rainfall during November. Dry conditions continued into December, as severe drought (D2) conditions set in. Relief came in mid-February, as multiple rain events over the course of more than a week began on the 16 th . More rainfall toward the end of the month allowed for an end to drought conditions.

Date	Narrative
07/2022 - 02/2023	A prolonged period of unseasonably dry weather with very few rain events, combined with unseasonably hot weather, resulted in severe drought (D2) conditions developing by the end of July across all eastern Oklahoma, including Muskogee County. Severe drought (D2) conditions progressed into Extreme (D3) territory in September. Drought conditions continued into autumn, despite several widespread, heavy rain events in eastern Oklahoma during the October through December time frame, as D3 conditions persisted, with only limited improvement. Precipitation was well below normal in Muskogee County in January, which allowed D3 conditions to persist. In February, multiple rainfall events brought 150 to 300 percent of average precipitation to eastern Oklahoma, which brought drought removal to Muskogee County.

4.3.5 Probability of Future Events

Four events over the previous 11 years gives drought hazards a **likely** chance of occurring on any given year. This claim stems from the guidelines outlined in Table 4-3.

4.3.6 Vulnerability and Impacts

Unless explicitly noted in the vulnerabilities described in this section, the risks associated with this hazard apply to all participating jurisdictions within the planning area. The overall significance of a drought is **medium** based on the classifications listed in Table 4-5, while vulnerabilities, and the resulting impacts, on jurisdictions in the planning area can be found in Table 4-25 below.

Table 4-25 Vulnerabilities and Impacts due to Drought Events

Vulnerability	Jurisdiction	Impact
Muskogee County has seen an increase in the development of marijuana growing facilities which often deplete water resources or ignore water rationing guidance due to a lack of enforcement.	• Muskogee County (unincorporated)	These facilities can exacerbate the strain on water supplies during periods of drought when the planning area is already susceptible to water supply shortages. Similarly, facilities that disobey or disregard water rationing guidelines can use critical water needed by firefighters and first responders during wildfire events.
Severe drought conditions can cause a drop in river & lake levels, like Fort Gibson Lake, Eufaula Lake, Greenleaf Lake, Tenkiller Lake as well as the Neosho and Verdigris Rivers. When this occurs, intake valves located on those bodies of water can potentially fail to pull sufficient water for Public Water Systems (PWS) that use these as sources of water. PWS that remain vulnerable in these scenarios include Camp Gruber PWS, East Central Water Authority, Fort Gibson PWS, Greenleaf State Park, City of Muskogee PWS, Muskogee Co. RWD #3, Okay PWS, Porum PWS, and Warner PWS.	• Muskogee Co. Districts 1, 2 & 3 • Braggs • Council Hill • Fort Gibson • Muskogee • Porum • Warner • Webbers Falls • Braggs PSD • Fort Gibson PSD • Midway PSD • Muskogee PSD • Porum PSD • Warner PSD • Webbers Falls PSD	Loss of water to a jurisdiction can be detrimental to the daily functions of that municipality or school district, with severe droughts potentially leading to a reduction in available water. When severe drought conditions persist for long enough, it can mean a complete disruption of water service in these jurisdictions, and this directly threatens the lives and safety of those residents. This can be especially dangerous when droughts coincide with other hazards like extreme heat and/or wildfires.

Vulnerability	Jurisdiction	Impact
Several PWS share direct connections with larger providers like the City of Muskogee or Fort Gibson, and when severe drought conditions disrupt service at larger PWS, there are cascading effects for smaller systems like Boynton PWS, Haskell PWS, Muskogee Co. RWD #1, #2, #4, #5, #6, #7, #9, #14, and Taft PWS. Jurisdictions relying on these smaller PWS are vulnerable to disruptions or interruptions of their water service as a result.	• Boynton • Haskell • Oktaha • Summit • Taft • Wainwright • Haskell PSD • Wainwright PSD • Oktaha PSD	Loss of water to a jurisdiction can be detrimental to the daily functions of that municipality or school district. Severe drought conditions can prevent PWS from sharing water through direct connections, and this means a reduction or disruption in available water threatens the lives and safety of residents in the smaller PWS areas. Impacts in these areas are exacerbated when these drought conditions coincide with extreme heat or wildfire events, which can generate even more cascading impacts to the lives and safety of residents.
Drought conditions can lower water table levels to the point where water wells fail to pump ground water to the surface. PWS utilizing well water include those of Braggs and Haskell, and these systems are vulnerable during droughts due to the increased risk of wells failing to extract adequate water for the jurisdictions they serve.	• Haskell • Haskell PSD	When water wells run dry during droughts, residents and customers who are reliant on underground water reserves are directly impacted. If conditions persist for long enough, droughts can completely disrupt water service which directly threatens the lives and safety of those residents. This can be especially dangerous during extreme heat events and/or during wildfires because there would be no water available for protecting life and property.
Agricultural producers account for over 50% of those using water from lakes, rivers, streams, and wells. As droughts cause water levels to drop, agricultural assets and resources in the County are vulnerable, because these groups do not have connecting water lines to larger, neighboring water systems.	• Muskogee County (unincorporated) • Braggs • Muskogee	A lack of water connections/suppliers mean agricultural and livestock efforts can be severely impacted or even halted when water supply runs short. Water rationing efforts area-wide generally do not help producers and ranchers since their sources of water are not tied in with neighboring public water systems.
No drought management plan is in place in the event that drought conditions result in extreme water restrictions.	• All Participating Public School Districts	Extreme water restrictions can impact students and staff when restrictions could result in a failure to hold sports practices due to a lack of water for fields and/or hydration.

During periods of severe drought, the public water supply in Muskogee County faces heightened vulnerability. Braggs utilizes several wells, with Camp Gruber serving as an emergency source of water. East Central Oklahoma Water Authority, which serves Webbers Falls, also has an emergency source of water. These two public water providers are the only two that serve interests within the planning area that identify having a backup source of water. The remaining communities in the planning area are at risk of strained water supplies during periods of extreme drought.

Industrial and agricultural sources are another consideration that can factor into the demand on a public water supply. An increase in marijuana growing facilities within the planning area is a factor which local officials have indicated use an outsized share of water for operations. During periods of extreme drought, inordinate use of water by this sector can not only strain the water supply but can also exacerbate and

cause a risk to the health and well-being of residents who rely upon these water supplies. This risk arises when a lack of rainfall leads to a lack of available water to be treated and distributed, causing water levels to drop. As water levels drop in these affected reservoirs, the risk of contamination rises as algal blooms, bacteria, and other coliform develop and solute concentrations increase, both of which can also contribute to a rise in the number of cases of health conditions, such as cholera and typhoid, as well as fluctuations in pH levels.

4.3.7 Future Conditions

Climatological Effects

Drought has always been part of Oklahoma's climate due to highly variable precipitation patterns. However, droughts are projected to increase in severity and frequency in the future (Frankson et al. 2022). Even if annual precipitation amounts do not change much, higher temperatures will increase evaporation from lakes, soils, and plants, stressing agricultural and natural systems. Models project Oklahoma will experience a decrease in soil moisture across all seasons by the end of the century, with the greatest decrease in the summer (Wehner et al. 2017). Rising temperatures will also lead to an increase in demand for water and energy, which will stress natural resources (Shafer et al. 2014).³³

Land Use Changes

Land that is changed to cropland will experience the most effects, and the most adverse, resulting from drought. Crops that are damaged from drought will then have a cascading adverse impact on the County's economy. As stated in Table 4-25, agricultural interests account for 50% of water use from lakes, rivers, streams, and wells. Such areas which have been transitioned to cropland within the County since 2018 include the following locations of notable size:

- Several areas along SH 16 in the western portion of the County
- Areas along Cane Creek in the western portion of the County, west of U.S. 62
- Areas in the southwestern portion of the County along and west of U.S. 62 and SH 72
- Areas in southwestern portions of Fort Gibson along U.S. 62 & southward toward the Arkansas River
- Areas along SH 351 west of Webbers Falls
- An area along I-40 along the Arkansas River
- An area between U.S. 64 and I-40 just east of Warner
- Several areas in the southern portion of the County north of Porum and south of I-40
- Several areas in the southern portion of the County along or near the Arkansas River

Population Patterns

Any increases in population in Muskogee County would experience impacts to health discussed throughout Section 4.3, in addition to economy as discussed in the previous paragraph. These effects would be exacerbated as increased demand on the water supply would have an adverse effect on the amount of water available to each resident. Jurisdictions without a backup water source would be the most affected. These jurisdictions have been identified in Table 4-25.

³³ <https://www.southernclimate.org/wp-content/uploads/SPTOK.pdf>

4.4 Earthquake

4.4.1 Description

An earthquake is a sudden release of energy that generates a seismic shift in the earth's crust. While these events most commonly occur because of tectonic plate interaction, earthquakes can also result from other causes, such as hydraulic fracturing methods (colloquially referred to as "fracking") employed by interests exploring energy resources below the ground surface. While any earthquake can potentially cause damage or injuries, it is very rare with lower magnitude earthquakes (see extent section). Historically, the USGS did not report lower magnitude earthquakes.



4.4.2 Location

The risk to Muskogee County from earthquakes can be uniform across the entire planning area. In fact, an earthquake with an epicenter in a different state has potential to affect the entire planning area. Effects to individual communities depend upon several factors, including local building codes and ordinances which can affect how well buildings are constructed to withstand shearing forces associated with earthquakes. Further discussion on specific locations with unique vulnerabilities to this hazard can be found in Section 4.4.6.

4.4.3 Extent

An earthquake's extent is defined by both its magnitude (Mw) and its intensity (MMI). Due to the limitations of the Richter Scale, a more uniformly applicable scale was developed to categorize event magnitudes. This new scale is referred to as the moment magnitude, abbreviated as Mw, and it "provides an estimate of earthquake size (at its source) that is valid over the complete range of magnitudes, a characteristic that was lacking in other magnitude scales."³⁴ The scale is reliable for earthquakes of all magnitudes and provides the most reliable estimate for their size.

Along with earthquake magnitude, extent can be determined by earthquake intensity measured using the Modified Mercalli Intensity scale. The MMI scale estimates the shaking intensity from an earthquake at a specific location and takes into consideration the effects these events have on people, objects, and buildings. "This scale, composed of increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical basis; instead, it is an arbitrary ranking based on observed effects."³⁵ For the purposes and scope of this plan, a combination of MMI and Mw scales are used to assess the extent of earthquake and Table 4-26 combines both of these metrics.

³⁴ <https://www.usgs.gov/faqs/moment-magnitude-richter-scale-what-are-different-magnitude-scales-and-why-are-there-so-many#:~:text=The%20moment%20magnitude%20provides%20an,lacking%20in%20other%20magnitude%20scales>.

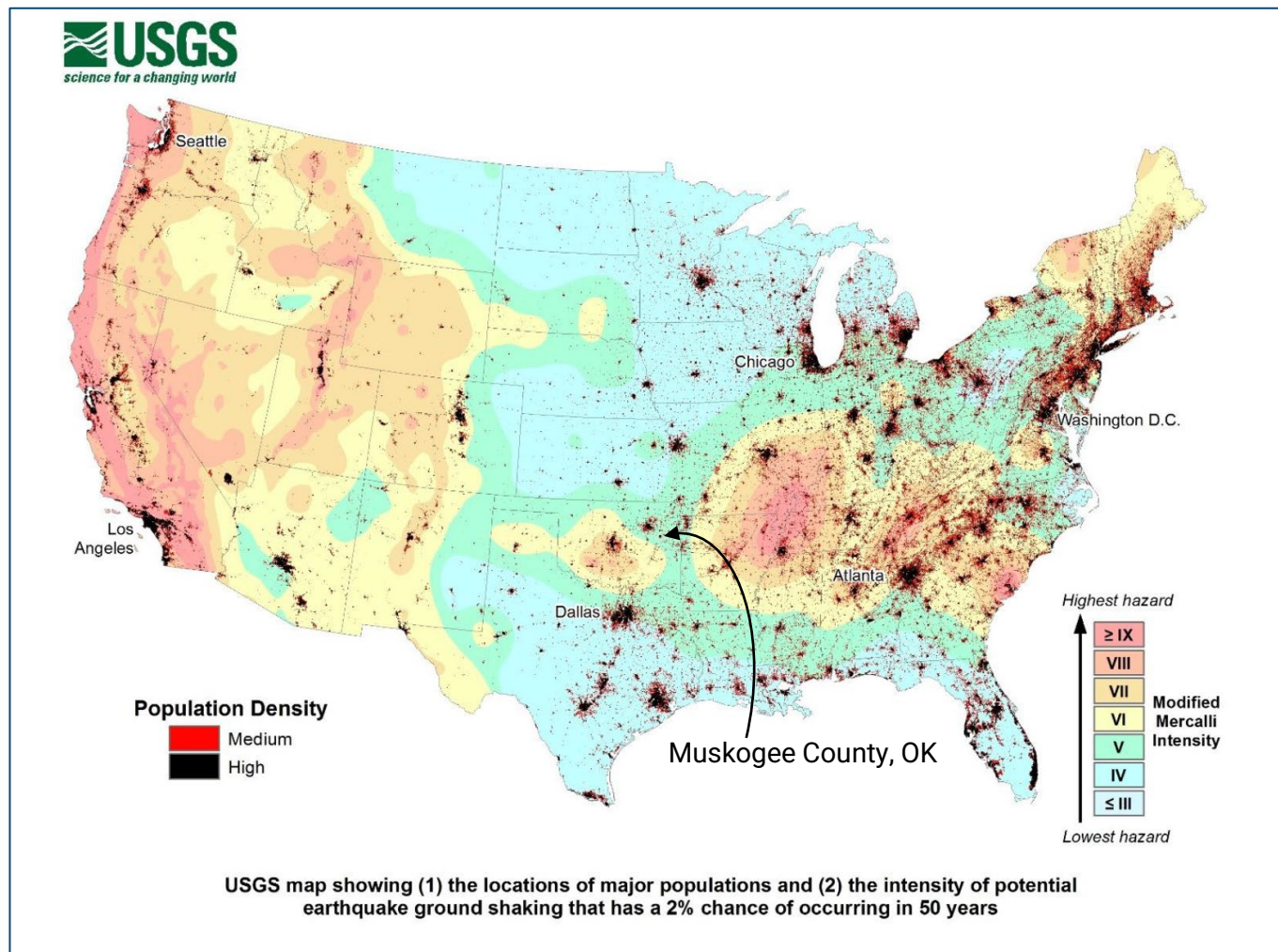
³⁵ <https://www.usgs.gov/programs/earthquake-hazards/modified-mercalli-intensity-scale>

Table 4-26 Earthquake Intensities, Classifications, and Potential Damages (USGS)

Intensity (MMI)	Potential Damages	Class (Mw)	Magnitude (Mw)	Description
I	none	Micro	1.0 – 1.9	Not felt except by a very few under especially favorable conditions.
II	none	Minor	2.0 – 2.9	Felt only by a few persons at rest, especially on upper floors of buildings.
III	none	Minor	3.0 – 3.9	Felt quite noticeably by people indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations are like the passing of a truck. Duration estimated.
IV	Light	Light	4.0 – 4.9	Felt indoors by any, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing motor cars rocked noticeably.
V	Light	Moderate	5.0 – 5.9	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Light	Strong	6.0 – 6.9	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster.
VII	Moderate	Major	7.0 – 7.9	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Moderate/ Heavy	Great	8.0 +	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage is great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Heavy			Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Heavy damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Very Heavy			Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Indications from USGS show that the planning area may experience earthquakes ranging from 0 to 5 on the MMI scale, with Figure 4-6 showing this range maxing out in the green shade indicates the USGS indicates the planning area could experience an earthquake ranging from imperceptible movement to moderate shaking, or those with intensities between 0 and 5 on the Modified Mercalli Intensity scale.

Figure 4-6 Population Exposed to Potentially Damaging Earthquake Ground Shaking



4.4.4 Previous Occurrences

Between January 1, 2014 and December 31, 2023, there were no earthquakes with an epicenter located *within* the planning area. Prior to 2014, the only event recorded as having an epicenter located within the planning area was one back in 1882. Shaking has been felt, however, like in April of 2023 when a magnitude 4.0 Mw occurred approximately 2.5 miles southeast of Carney, OK. Weak shaking (II-III intensity on the MMI scale) in Muskogee County was reported on April 6, 2023. This event, along with other notable reports are listed in Table 4-27.

Table 4-27 Notable Earthquake Events Felt in Muskogee County, OK

Date	Narrative
10/22/1882	The Cherokee Advocate reported that at Fort Gibson, “the trembling and vibrating were so severe as to cause door and window shutters to open and shut, hogs in pens to fall and squeal, poultry to run and hide, the tops of weeds to dip, and cattle to low.” ³⁶ The magnitude and epicenter were unable to be determined since much of Oklahoma was still considered Indian Territory at this time.
04/09/1952	An earthquake registering 5.7 magnitude on the Richter Scale (VII intensity on the Mercalli Scale) was centered near El Reno, caused by slippage along the Nemaha Fault. This earthquake is tied for the 2 nd strongest earthquake on record in Oklahoma history. Shaking was felt as far away as Austin, TX and Des Moines, IA.
04/28/1998	A 4.2 magnitude earthquake on the Richter Scale was centered near Lawton at Richard’s Spur. This event caused a 14-foot crack on the 2 nd floor of the Comanche County Courthouse building.
11/06/2011	An earthquake centered 5 miles northwest of Prague registered 5.7 on the Richter Scale, tying it with the 1952 El Reno quake for the 2 nd strongest in state history. National Weather Service radar in Norman, OK detected birds and bats which took flight in response to the shaking. This event is the first significant quake in a swarm that started in 2009 that is thought to be related to hydraulic fracturing and drilling practices by companies in the oil and gas industry across the region. A foreshock on the 5 th and an aftershock on the 8 th , both near Sparks in Lincoln County, both registered 4.8 magnitude on the Richter Scale. USGS Shakemap estimates that shaking on the order of IV to V on the Modified Mercalli Scale occurred across Muskogee County.
09/03/2016	The strongest earthquake on record to be centered in Oklahoma is a 5.8 magnitude event centered about 8 miles northwest of Pawnee. Shaking and damage associated with this event occurred as far away as Kansas City, KS, 225 miles away, where the Wyandotte County Courthouse experienced a crack which developed from the roof to the ground because of this event. ³⁷ One injury was reported in Pawnee, as a man was injured by a toppled chimney, though no deaths were reported. USGS Shakemap estimates show that shaking on the order of IV-V MMI intensity occurred across Muskogee County during this event. Aftershocks up to 5.0 magnitude continued for 2 months following this event.
11/07/2016	An earthquake registering 5.3 magnitude, centered about 2 miles west of Cushing, OK, produced shaking on the order of about II MMI intensity on the USGS Shakemap in Muskogee County.
04/06/2023	An earthquake with a magnitude of 4.0 Mw centered approximately 2.5 miles southeast of Carney, OK produced weak shaking (II-III intensity on the MMI scale) in Muskogee County. Shaking was felt as far away as Wichita, KS.

³⁶ <https://www.okhistory.org/publications/enc/entry.php?entry=EA004>

³⁷ <https://www.kshb.com/news/local-news/oklahoma-earthquake-causes-damage-to-wyandotte-courthouse>

4.4.5 Probability of Future Events

Since the entire planning area has a uniform risk of experiencing an earthquake, the probability of future earthquake events occurring *within* Muskogee County is **unlikely**. The probability of individuals in Muskogee County *feeling* ground shaking, however, is a different matter. Table 4-27 details a growing trend in the number of stronger earthquakes measuring 4.0+ Mw occurring in Oklahoma, and if this trend continues, the number of shaking events felt by individuals within the planning area may show an increase. More studies on these trends are needed, as the data in this figure is five years old.

4.4.6 Vulnerability and Impacts

Unless explicitly noted in the vulnerabilities described in this section, the risks associated with this hazard apply to all participating jurisdictions within the planning area. Based on the classifications in Table 4-5, the overall significance of an earthquake is **low** in the planning area.

Table 4-28 Vulnerabilities and Impacts due to Earthquake Events

Vulnerability	Jurisdiction(s)	Impacts
While the county has reported it has adopted the state standard of IBC, unincorporated areas remain unchecked due to the lack of a county-wide building code enforcement officer	Muskogee County (unincorporated)	With no designated building code enforcer, unincorporated areas of Muskogee County remain at risk. Structures not constructed to current code standards may be damaged during earthquake events, which may result in injuries to occupants of those buildings during ground shaking events.
Bookshelves are not strapped or secured properly at any of the public schools in Muskogee County.	All participating school districts	Earthquakes can cause bookshelves and other classroom furniture to topple or collapse, injuring students and/or staff members.
Older buildings not built to current codes are vulnerable to earthquakes due to their structural deficiencies	Oktaha Public Schools	Damage to school buildings can harm staff members and students during earthquakes. They can also render school facilities unusable while repairs are being made.
Areas with older building codes are more vulnerable to earthquake events because the construction standards are not as rigorous as more recent codes.	All incorporated areas	Severe shaking from earthquake events would threaten public safety. Most injuries and fatalities occur within buildings from collapsed structures.

Among the benefits of adherence to current standards for the International Building Code (IBC) include resilience to the shearing forces on manmade structures produced by earthquakes. Buildings not constructed or retrofitted to these standards are vulnerable to damage resulting from earthquake events. While earthquake events are not affected by changes in climate, any future development that doesn't adhere to IBC codes will be vulnerable to damage by earthquakes.

As discussed in Section 3.2, Muskogee County and all participating communities have adopted the 2018 standards for International Building Codes and the 2018 standards for the International Residential Codes. However, no Code Enforcement Officer has been indicated during the development of this plan. Thus, buildings located in unincorporated areas of the county remain vulnerable to damage resulting from earthquakes due to there not being the capability at the county level to inspect buildings and ensure adherence to the 2018 IBC and IRC standards.

4.4.7 Future Conditions

Climatological Effects

Prior to 2009, Oklahoma experienced 1-2 earthquakes per year that were magnitude 3.0 or greater. The rate of M3.0+ earthquakes increased to a peak of about 3 per day in 2015 concurrent with a statewide increase in wastewater injection into deep underground strata (Andrews and Holland 2015). As wastewater injection volumes have declined by over half, compared with 2015, the rate of M3.0+ earthquakes has decreased to less than 1 per day in late 2018. Thus, the future seismic hazard is interlinked with wastewater disposal well activity but will likely remain elevated, compared to background tectonic rates, for at least the next decade (OGS 2017).³⁸

Since earthquakes are geological processes that occur independently of atmospheric effects, climatological changes will not influence the type, location, or range of anticipated intensities of earthquake hazards.

Land Use Changes

New development within the planning area, particularly that which does not meet the standards set forth in the most recent set of the International Building Code, will be at risk of damage due to earthquakes. These areas have been identified in Table 4-28 found in the Vulnerability and Impacts section above.

Population Patterns

Population growth within the planning area and changes in how that population is distributed spatially can affect the levels of risk those populations face. Additionally, populations of lower socioeconomic status who are generally relegated to living in substandard structures face an elevated risk of injury or death due to those structures failing during an earthquake. Areas where at least the 2018 International Building Code standards have not been adopted have been identified in Table 4-28 in the Vulnerability and Impacts section above.

³⁸ <https://www.southernclimate.org/wp-content/uploads/SPTOK.pdf>

4.5 Extreme Heat

4.5.1 Description

Extreme heat is defined as unusually hot weather (maximum, minimum, daily average) over a region persisting at least two consecutive days based on local climatological conditions (WMO 2015). While there is no universally recognized metric for what constitutes extreme heat, the World Meteorological Organization recommends characterizing a wave by its magnitude, duration, severity, and extent. This definition aligns with that used in the State of Oklahoma's 2019 Hazard Mitigation Plan.

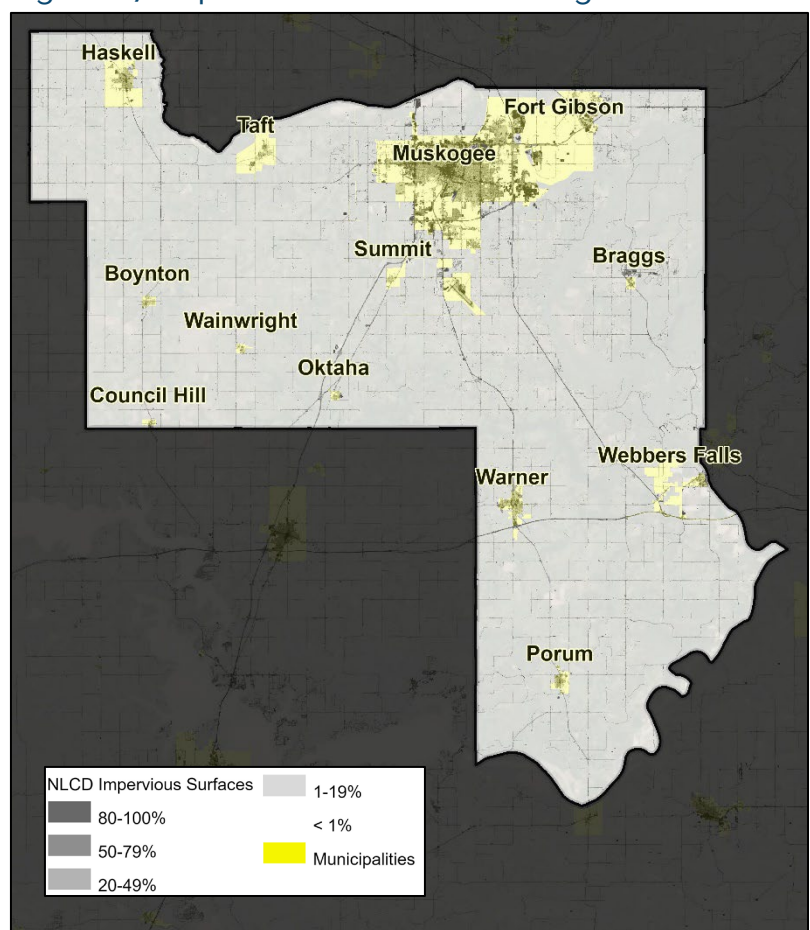


Extreme heat events occur when high pressure dominates the region during the summer months. Skies remain generally cloud-free which allows daytime temperatures to soar. Furthermore, southerly winds help transport abundant moisture northward from the Gulf of Mexico, and elevated humidity values combine with high temperatures to produce dangerous heat indices area-wide.

4.5.2 Location

Although Muskogee County and all participating jurisdictions see uniform risk from extreme heat hazard events, impacts from these events can be greater in urban areas compared to rural areas. Muskogee, for example, has a greater percentage of concrete and asphalt when compared to rural locations, and due to this difference in land coverage, Extreme Heat events are exacerbated in more urban environments. Because the landscape is not uniform across all participating jurisdictions, the extent of Extreme Heat can be somewhat different in these urban areas mainly because towns and cities contain structures such as buildings, roads, and other infrastructure that absorb and re-emit the sun's heat more than natural landscapes, like forests or bodies of water. Urban areas, where these structures are highly concentrated and greenery is limited (like in), become "islands" of higher temperatures relative to outlying areas. Impervious surfaces are often strong indicators of where Extreme Heat events can be exacerbated because many of these surfaces are materials like concrete and asphalt – both of which are significant contributors to the intensification of the sun's heat near the surface. Figure 1-7 shows where these types of materials are concentrated the most. Extreme Heat can affect urban areas in a greater way when compared to the more rural areas across Muskogee County.

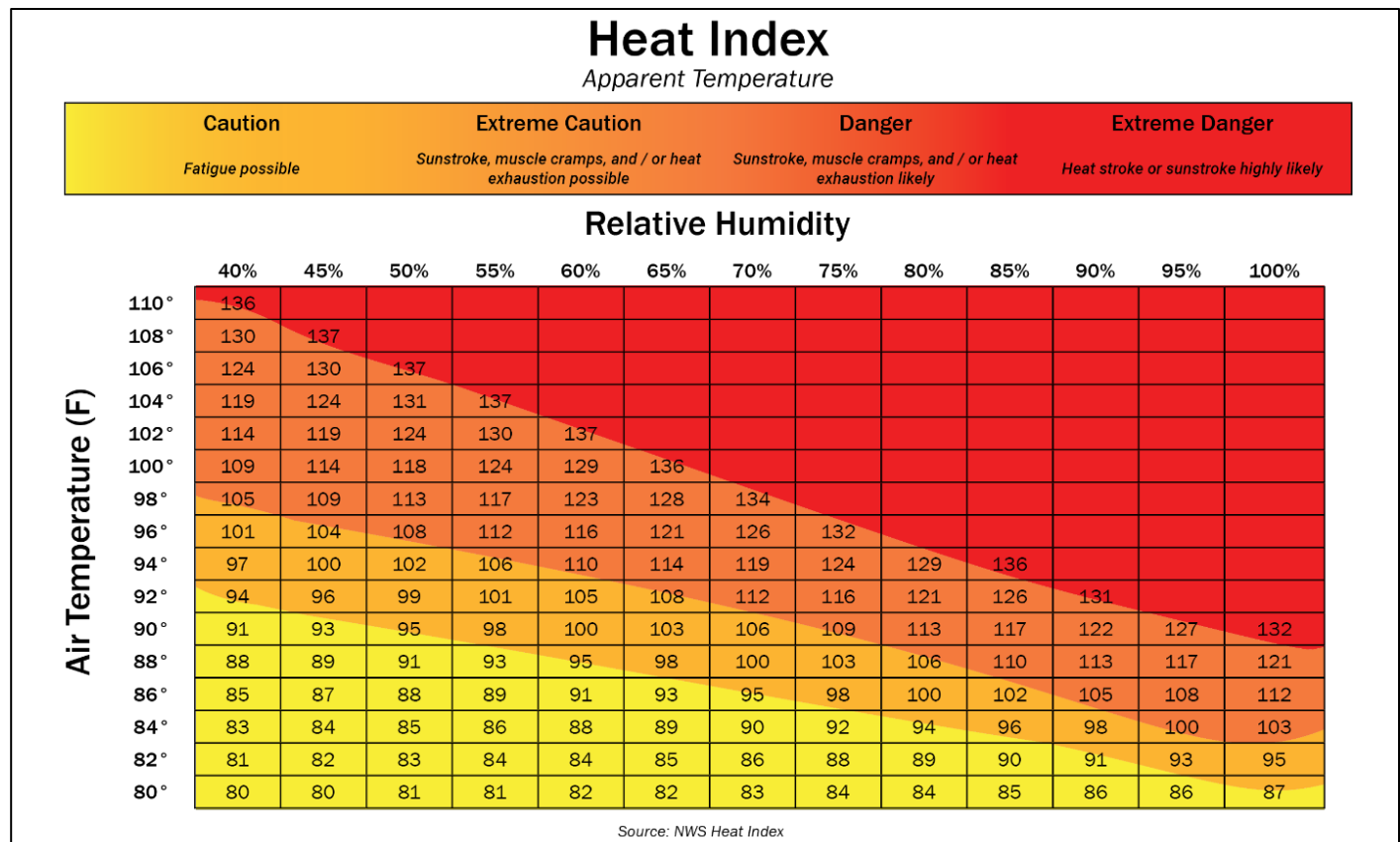
Figure 1-7 Impervious Surfaces in Muskogee Co.



4.5.3 Extent

Temperature and relative humidity are factored together to depict the range of health risks associated with extreme heat in Figure 4-8. The planning area can expect to experience Extreme Heat events where heat indices range from 80°F to 137°F. These tables suggest varying degrees of likelihood of experiencing a heat-related health condition, with associated degrees of caution to be exercised for each level depending upon the combination of relative humidity level with temperature.

Figure 4-8 Heat Indices and Heat-Related Illnesses



4.5.4 Previous Occurrences

Muskogee County has experienced extreme heat nearly annually since 2014 according to NCEI Storm Events Database records. From January 1, 2014, to December 31, 2023, there are 32 events recorded by NCEI that qualify either as “Excessive Heat” or “Heat” events³⁹. Notable events which occurred in Muskogee County are detailed in Table 4-29 below.

³⁹ [NWS Directive 10-1605](#)

Table 4-29 Notable Extreme Heat Events in Muskogee County

Date	Narrative
07/14/2015 – 08/09/2015	A ridge of high pressure in the middle and upper atmosphere centered over the south-central United States promoting strong subsidence across eastern Oklahoma during a considerable stretch of the summer in 2015, producing three notable heat waves which affected Muskogee County. On July 14, high temperatures in the mid-90s, with heat index values of 110° to 115°F with low temperatures near 80 produced excessive heat conditions. Toward the end of the month on the 24 th and 25 th , a similar situation set up over a 2-day period where hot conditions became excessive. Once more in August, high temperatures near 100 degrees with similar heat indices and low temperatures caused excessively hot conditions before more seasonal conditions returned.
06/15/2016 - 06/17/2016	A strong ridge of high pressure aloft was anchored over the south-central United States during the middle of the month. This pattern resulted in temperatures in the mid-90s to nearly 100°F across much of eastern Oklahoma. This heat combined with unseasonably high humidity resulted in heat indices in the 110° to 115°F degree range during the afternoons of the 15 th through the 17 th .
08/10/2016 - 08/11/2016	A strong ridge of high pressure in the middle and upper atmosphere over the south central and southeastern United States resulted in unseasonably hot weather across eastern Oklahoma during the middle of August. Afternoon temperatures in the upper 90s to near 100°F prevailed across much of the area. This heat, combined with very humid conditions, resulted in heat index values in the 110° to 115°F degree range during the afternoons of August 10 th and 11 th .
08/10/2019 – 08/26/2019	An upper-level ridge of high pressure over the south-central United States resulted in a period of unseasonably hot weather over eastern Oklahoma, with excessive heat conditions occurring during 3 times over a span of 2 weeks. First, afternoon high temperatures in the upper 90s to near 100°F between the 10 th and the 12 th combined with high humidity to produce heat indices between 110°F to 115°F each afternoon. High temperatures near 100°F on the 19 th and 20 th once again combined with high humidity to produce heat indices between 110°F to 115°F. Finally, on the 26 th , very high humidity combined with high temperatures in the mid-90s produced heat index values between 110° to 115°F.
07/24/2021 – 08/22/2021	A ridge of high pressure in the middle and upper atmosphere developed over the south-central United States during late July, and persisted through late August, producing 5 excessive heat events. The first occurred from the 24 th through the 31 st of July, when daily high temperatures in the upper 90s to near 100°F combined with high humidity to produce heat index values in the 110° to 115°F range. Excessive heat returned on August 9 th , when high temperatures in the mid to upper 90s combined with high humidity to produce heat index values in the 110°F to 115°F range. On the 12 th , the scene nearly repeated itself, with high temperatures in the upper 90s to near 100°F producing heat index values between 110°F to 115°F. This scene set up twice more, on the 20 th and the 22 nd , with high temperatures on each day in the upper 90s to near 100°F combining with humidity to produce heat index values in the 110° to 115°F range.
07/19/2022 – 08/05/2022	A ridge of high pressure in the middle and upper atmosphere developed over the southern United States during mid-July and produced 3 periods of excessive heat. On the 19 th through 21 st , high temperatures reached the 100° to 110°F range and combined with high humidity to produce heat index values between 110° to 115°F. After a brief reprieve of a few days, excessive heat returned on July 24 th and persisted through the 28 th . During this period, high temperatures once again ranged from 100° to 110°F with heat index values between 110° to 115°F. One last bout of excessive heat occurred on August 5 th , when high temperatures near 100°F combined with high humidity to produce heat index values between 110° to 115°F.
7/12/2023 – 8/26/2023	A ridge of high pressure in the middle and upper atmosphere persisted over the south central United States during multiple periods from mid-July to late August. Unseasonably hot temperatures, with heat index values consistently in the 110°F to 120°F range, were common across much of eastern Oklahoma during this period. Over 100 people in this region were treated for heat-related issues during this time frame.

4.5.5 Probability of Future Events

Based on previous occurrences recorded between January 1, 2014 and December 31, 2023, the annual probability of Extreme Heat events is **likely**, according to Table 4-3.

4.5.6 Vulnerability and Impacts

Unless explicitly noted in the vulnerabilities described within this section, the risk associated with this hazard applies to all participating jurisdictions within the planning area.

Based on classifications in Table 4-4, the overall significance of extreme heat events in the planning area is **medium**. As discussed further in the Future Conditions section below, this hazard's significance may increase over the near future as climate change produces warmer temperatures.

Table 4-30 Vulnerabilities and Impacts due to Extreme Heat Events

Vulnerability	Jurisdiction	Impact
Extreme heat can cause increased energy usage during summer months, and this can strain the electrical grid, resulting in brownouts or blackouts	All participating jurisdictions	Disruption of electrical services can pose a risk to the health and life of residents. Additionally, schools will be forced to suspend instruction and/or move to virtual instruction to prevent students and staff from developing heat-related illnesses.
Fixed and low-income populations within Muskogee County have financial barriers to obtaining air conditioning units and paying the costs to use them	- Muskogee County (unincorporated) - All incorporated areas	A lack of access to air conditioning or adequate cooling centers can cause heat-related illnesses or death.
Schools have outdoor classes and/or sports activities that place students and staff in unsafe conditions during extreme heat events	All participating school districts	Extreme heat events can cause heat exhaustion, stroke, or even death if unmonitored.

While heat affects the planning area during extended periods each summer, extreme heat poses a risk to all people in Muskogee County. Because residents in the planning area experience summer heat so often, dangerous effects can creep up on some, even the physically fit.

Those at highest risk of extreme heat are the elderly and those who live in poverty. Risks to extreme heat even affect public schools since the fall semester typically begins in August. Some extracurricular activities that involve students and staff spending time outside after school during hot parts of the day in the afternoon hours expose them to the risks to health associated with extreme heat.

An important tool communities can easily implement to cope with extreme heat is cooling centers. These facilities provide a critical resource to residents in need of relief from the heat. Such buildings typically include government buildings, fire departments, libraries, nonprofit entities (e.g., churches), or some private businesses. These locations are often the same that serve as warming centers during winter weather and extreme cold events. Some limitations of cooling centers include:

- Some facilities are not open 24 hours a day
- A facility may not have enough capacity to serve a large number of people who seek relief

- Backup generators may not be available
- Residents may not seek shelter or even know of the existence of such facilities

Developed areas of concrete and asphalt surfaces (also called impervious surfaces) produce feedback in heat near the ground. This feedback, in turn, reflects the sun's energy and further contributes to extreme heat events. Urban heat islands develop due to the thermodynamics that take place when the lowest levels of the atmosphere interact with developed environments, such as those in larger urban areas, to enhance and retain heat during these events. Such a phenomenon is not prevalent in Muskogee County. As the City of Muskogee is a larger, developed area in relation to other participating communities in this plan, interactions such as those found in urban heat islands will be more noticeable there in relation to communities across the rest of the planning area. Further development here, or in other areas of the county, will contribute to an enhanced risk of extreme heat in the future.

Increased demand during periods of extreme heat place strain on the electrical grid. Effects on the grid can include but are not limited to failure of vital delivery components due to exposure to high heat, excessive demand, or insufficient field and office staff to effectively manage repairs and increased workload. Due to the setup of the electrical grid spanning an area beyond Muskogee County, the risk to the planning area can be considered uniform. To mitigate potential power outages due to extreme heat, officials may consider installing adequate backup generators in all government, public, and critical facilities in the planning area, including schools. In the planning area, only the towns of Haskell and Webbers Falls, and Muskogee County, report having at least partial backup generation capabilities.

Another result of extreme heat on water and wastewater infrastructure is increased water usage, which typically happens during periods of extreme heat. This leads to lower water pressure which can produce complications for firefighting efforts. Drought conditions can also accompany, or be caused by, extreme heat events. In those cases, challenges can arise with water availability when water rationing efforts are implemented by local officials.

4.5.7 Future Conditions

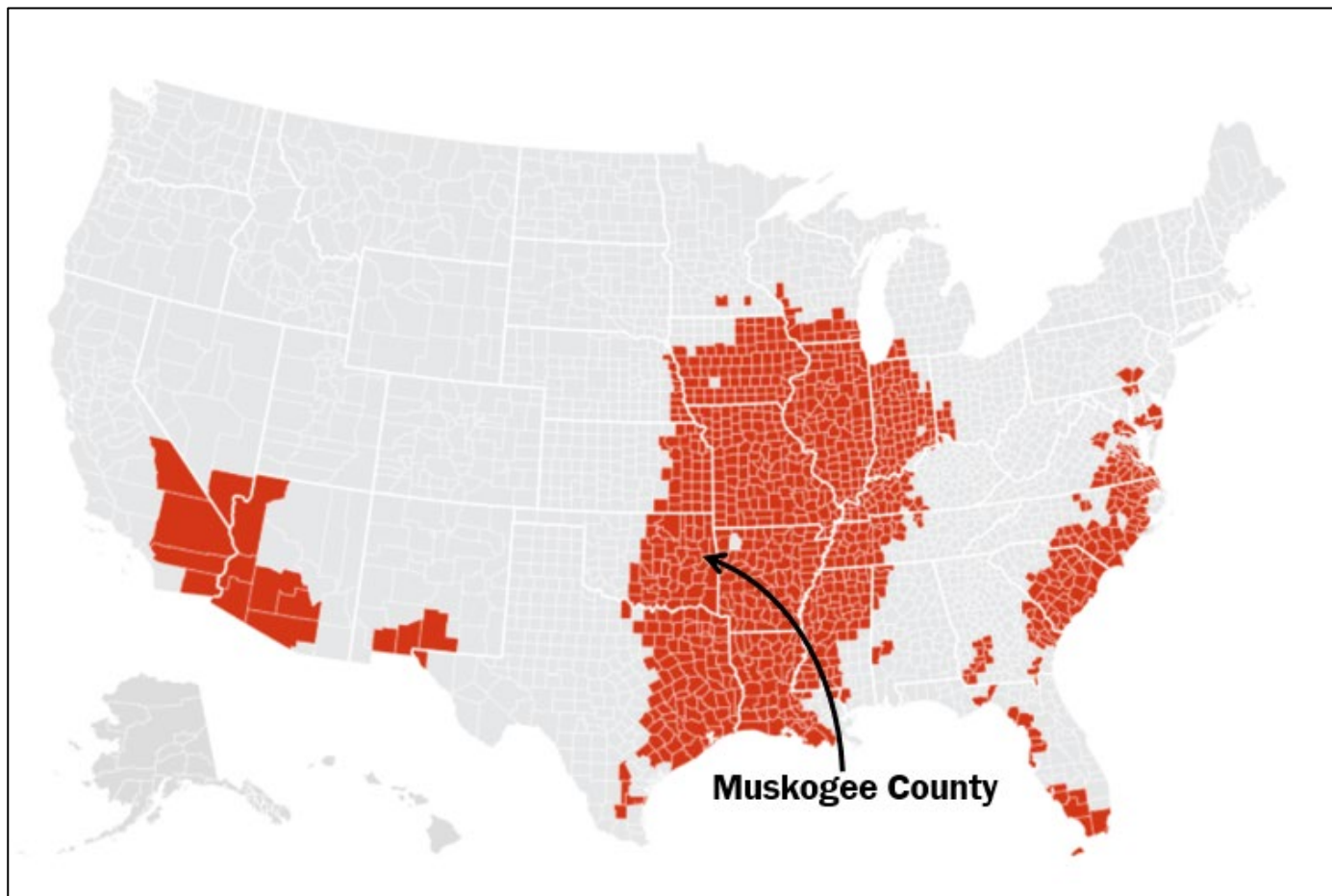
Climatological Effects

The frequency and intensity of heat waves and extreme heat events have increased across the United States since the mid-1960's (Wuebbles et al. 2017b). Warming in Oklahoma has occurred mostly during the winter and spring seasons (Frankson et al. 2022). As time progresses, the occurrence and intensity of extreme heat events are projected to increase as well (Wuebbles et al. 2017b). As seen from the Climate Explorer tool, average temperature across Oklahoma is projected to increase by up to 7°F and the number of days over 100°F could increase by approximately 15 to 45 days per year by mid-century, depending on several factors.

Additional studies conducted by the First Street Foundation report in the next 30 years, there will be an emergency of an "extreme heat belt" from Texas to Illinois where heat indices could reach 125F at least once a year by 2053.⁴⁰

⁴⁰ <https://www.axios.com/2022/08/15/extreme-heat-belt-global-warming>

Figure 4-9 Counties Expected to Experience Heat Indices >125°F by 2053



Land Use Changes

Effects relating urban heat islands to increasing levels of development in incorporated areas have been proven. Thus, land use changes that transition parcels to developed areas can exacerbate the effects of extreme heat within the planning area. Areas that have seen land use transitioned to built area are most notable in and near the City of Muskogee, in northwestern portions of the County, on the northeastern periphery of the Town of Taft, and within and just east of the Town of Fort Gibson. Scattered smaller areas of development have been noted in the southern portions of the county, particularly along and south of I-40.

Population Patterns

From 2010 to 2020, Muskogee County's population declined from 70,990 to 66,339, and a similar trend is noted in participating incorporated areas. Downward trends in population patterns do not influence the extreme heat hazard impacts. In theory, an increase in population would result in more people who would be exposed to the effects of extreme heat. This would naturally lead to an increase in the number of people who will experience heat-related illnesses. Cascading impacts resulting from this would result in an increased strain on the healthcare system in Muskogee County. Residents most vulnerable to the effects of extreme heat are those on fixed and low incomes. Jurisdictions with these populations have been identified in Table 4-30 in the Vulnerability and Impacts section above.

4.6 Flooding

4.6.1 Description

Flood is defined by the National Weather Service as any high flow, overflow, or inundation by water which causes or threatens damage. A flooding hazard event occurs when a complete inundation of water covers land which is normally dry and exposed. Common impacts of flooding include damage to personal property, buildings, and infrastructure; bridge and road closures, service disruptions; and injuries or fatalities. Muskogee County commonly experiences three common types of flooding: riverine flooding, flash flooding, and urban flooding.



Riverine flooding occurs from excessive rainfall in upstream areas which cause rivers to rise and overflow their banks, inundating adjacent floodplains. Riverine flooding is usually a gradual process with several hours to several days of warning time for downstream communities. This type of event usually remains in flood for a longer period than the other two types of flooding because it has a slow onset nature, and often causes more damage due to the length of time structures are inundated, the velocity and depth of water, and floating debris.

Flash flooding is associated with large, convective thunderstorms that drop between one and five inches of rain in one hour. Saturated soil can exacerbate the extent and quickness of the onset of this type of flooding, as rainfall from storms can converge in creeks and streams suddenly with little to no warning. Flash floods can reach peak flows within a few minutes. Waters from this type of flooding move with great force and velocity and have been observed to tear out trees, carry away houses and outbuildings, and destroy roads and bridges. These walls of water often carry large amounts of debris, sewage, and pollutants. Although potentially hazardous to life and property, flash flooding usually only lasts a matter of hours.

Urban flooding occurs when heavy rainfall runs off structures, parking lots, and streets and converges in culverts and drainage systems which become clogged with debris. This causes streets to flood and storm sewers to back up. Widespread use of impervious surfaces (asphalt, concrete, etc.) covering urban areas allows rainfall to quickly gather in low-lying spots. Without stormwater drainage systems that can tolerate sudden increases in water runoff, flooding occurs at the surface.

4.6.2 Location

Flooding can occur anywhere in the planning area, though the level of risk varies from one location to another. Heavy rainfall events cause flooding which affects the same areas, while others may not have experienced flooding in a long time. For the purposes and scope of this assessment, location refers to areas within Muskogee County which are at the highest risk of flooding, including those located in a FEMA Floodway, areas within Zones A or AE (1% Annual Chance), or Zone X (0.2% Annual Chance). Location is also determined by those locations which experience repeated flooding during heavy rainfall events, like specific low-lying areas, creeks, etc. Determining flooding location is based on FEMA digital flood data as well as datasets collected from the communities in Muskogee County.

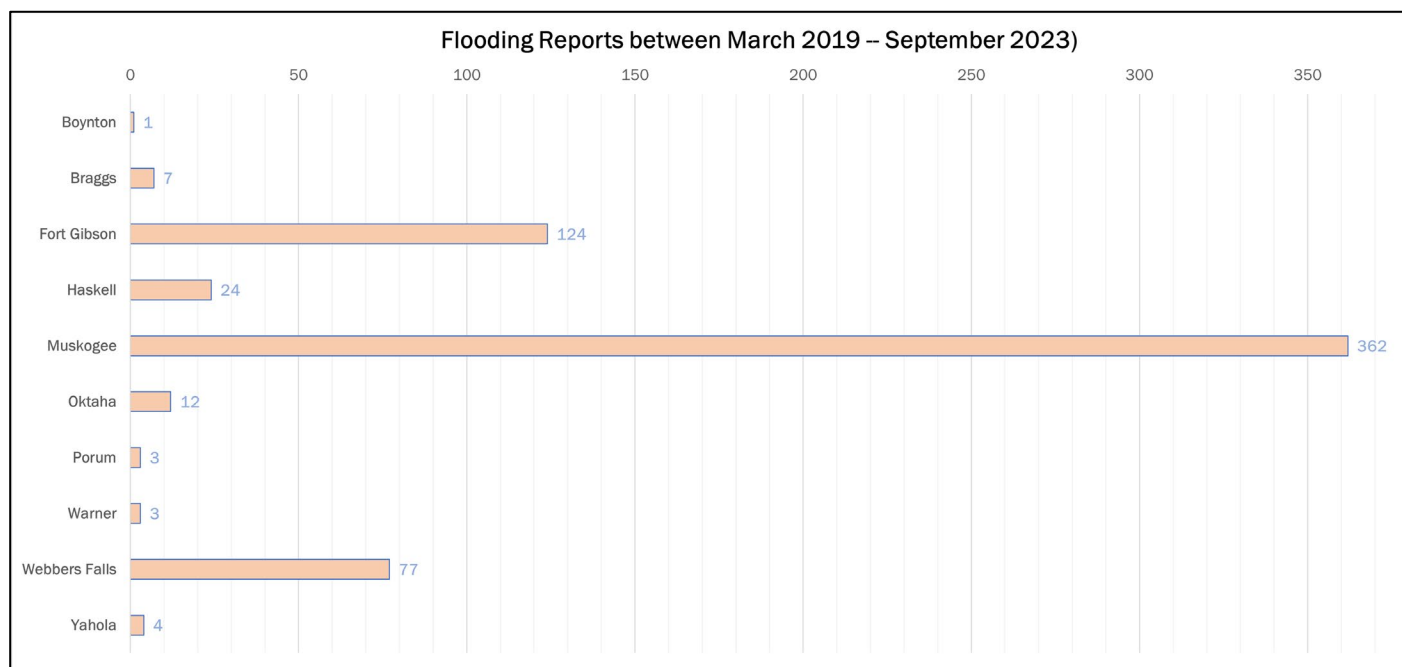
Using extensive flood data in their database, FEMA highlights flood scenarios for planning areas across the nation by classifying them into flood zones, which are incorporated into Flood Insurance Rate Maps (FIRMs). Figure 4-11 shows the location of FEMA floodplain zones in Muskogee County, which include

Zones A, AE, and X while Appendix G contains community-specific maps for flood zones and flooding reports.

Historic Flooding

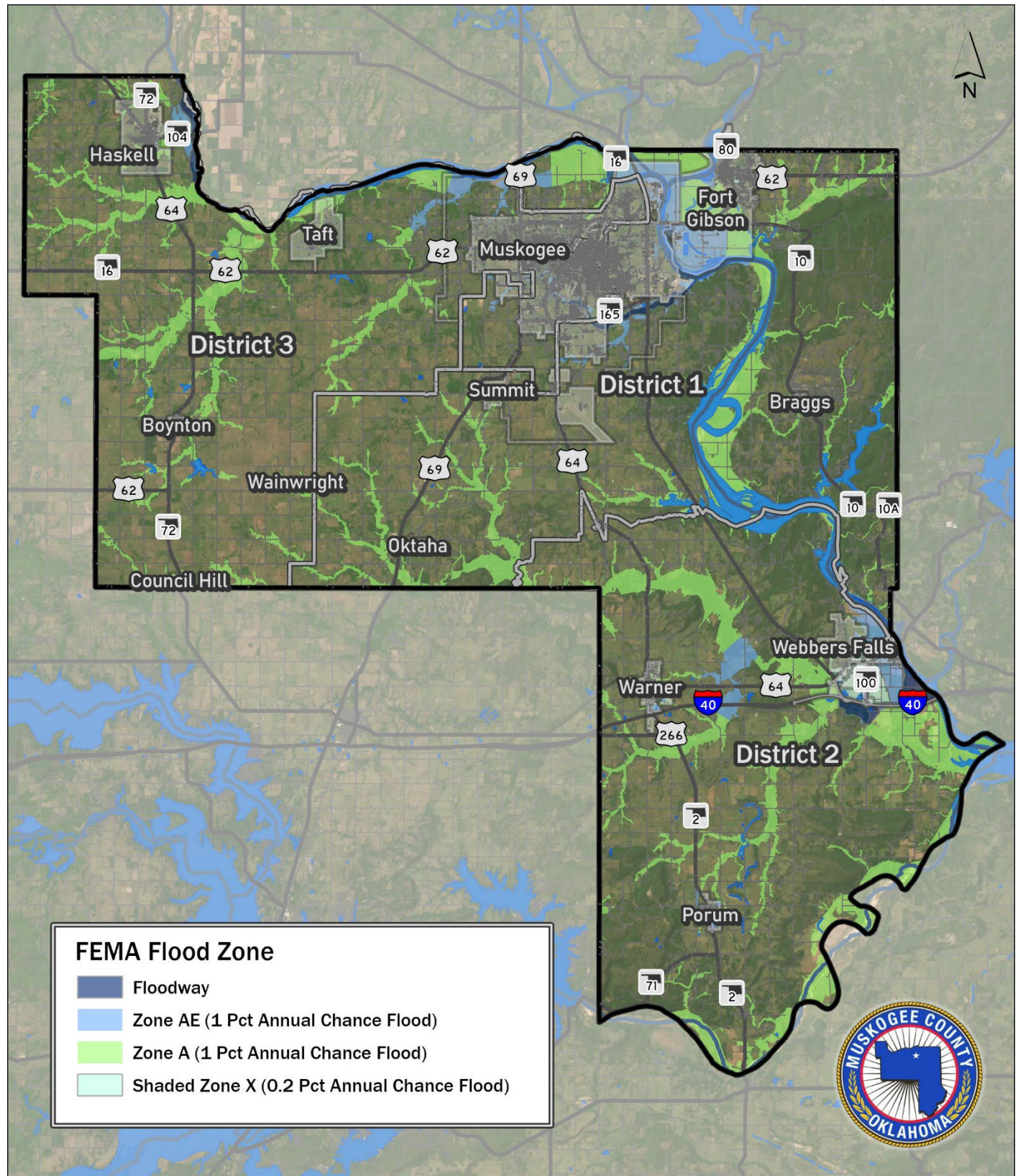
The graphic shown in Figure 4-10 is one that describes specific flooding areas reported to ODEMHS during recent disasters. Collected via Survey123, this data provides specific information as to the location, cause, depth of water, and more.

Figure 4-10 Flooding Reports Collected by ODEMHS in Muskogee County



Appendix G offers jurisdictional-specific flooding information with detailed maps and tables describing the extent and location of flooding reports. In all, ODEMHS collected 617 flooding reports across the County between March 2019 and September 2023, and this dataset reveals the most extensive flood depth reported just west of the Muskogee Golf Club in 2019. Floodwater reached a staggering 30 feet deep (M-225).

Figure 4-11 FEMA Floodplains in Muskogee County, OK



4.6.3 Extent

FEMA Flood Zone A is commonly referred to as the “100-year flood hazard area”, but the term is a misnomer. A “100-year flood” is an example of a return period for a flood event. The metric describes the likelihood a hazard could hit at, or above, a specific intensity. A 100-year flood has a 1 in 100 chance of being equaled or exceeded each year.

FIRMs defined by FEMA are used in regulation of development within floodplains and to determine insurance rates for properties located within. It is estimated that the average structure in a Special Flood Hazard Area (SFHA), or an area having special flood, mudflow, or flood-related erosion hazards, will experience two feet of flooding, which will result in 25% damage to the structure and 25% damage to its contents.

Table 4-31 FEMA Flood Insurance Rate Map (FIRM) Zones

FIRM Zones		
Zone A	The 1% Annual Chance (100-year) or Base Floodplain. There are six types of A zones:	
	A	The base floodplain mapped by approximate methods, i.e., BFEs, are not determined. This is often called an unnumbered A zone or an approximate A zone.
	A1-30	These are known as numbered A zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
	AE	The base floodplain where base flood elevations are provided. AE zones are now used on new format FIRMs instead of A1-30 zones.
	AO	The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided.
	AH	Shallow flooding base floodplain. BFE's are provided.
	A99	Area to be protected from base flood by levees or Federal flood protection systems under construction. BFEs are not determined.
	AR	The base floodplain that results from the de-certification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection.
Zone V and VE	V	The coastal area subject to velocity hazard (wave action) where BFEs are not determined on the FIRM.
	VE	The coastal area subject to velocity hazard (wave action) where BFEs are provided on the FIRM.
Zone B, Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and the 500-year floods. B zones are also used to designate base floodplains or lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than one square mile.	
Zone C, Zone X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as exceeding the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood.	
Zone D	Area of undetermined but possible flood hazards.	

Across the planning area, flooding extent can range anywhere from 0" to 30', depending on a variety of factors other factors. Areas of the planning area that see the worst flooding continue to be urban areas along the shores of the Arkansas River – Muskogee, Fort Gibson, and Webbers Falls. Table G-1 provides more specifics on these areas.

4.6.4 Previous Occurrence

From January 1, 2014, to December 31, 2023, NOAA's NCEI Storm Events Database shows 39 Flash Flood and/or Flood events occurred in Muskogee County, and each event's location has been mapped below. These, along with other noteworthy flooding events over the past 10 years, are described in Table 4-32.

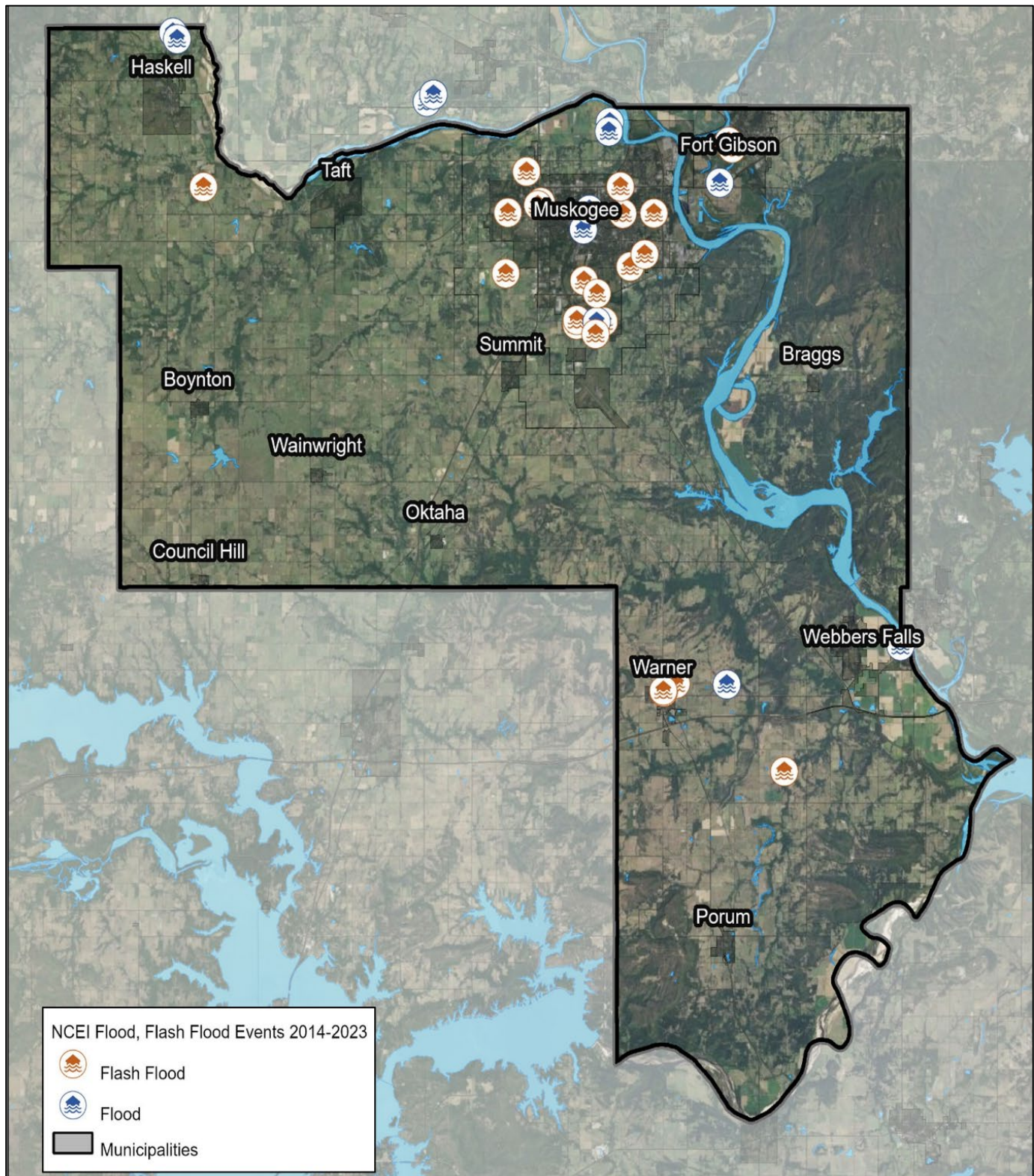
Table 4-32 Noteworthy Flooding Events in Muskogee County (NCEI and NWS Tulsa)

Date(s)*	Narrative
5/26/2014	Locally heavy rainfall resulted in flash flooding of some residential areas in Fort Gibson and Warner. \$175,000 property damage was assessed in association with this event.
3/25/2015	Heavy rainfall because of storms moving repeatedly across the same locations resulted in flash flooding. Two flash flood fatalities occurred in Muskogee County near Warner when a vehicle was driven into flood waters where an estimate 1.00 to 1.25 inches of rain had fallen over the previous few hours and was swept off the road.
5/5/2015 – 6/22/2015	Two upper-level systems affecting Muskogee County produced flooding which resulted in the declaration of DR-4222-OK on May 26, 2015. Several rounds of thunderstorms developed and moved across eastern Oklahoma, resulting in widespread heavy rainfall and flash flooding in the planning area. Collectively, areas that flooded included several roads in Fort Gibson, Smith Ferry Rd in southern Muskogee.
05/31/2015	The Arkansas River near Muskogee rose above its flood stage of 28 feet at 8:15 pm CDT on May 29th. The river crested at 32.39 feet at 9:45 am CDT on the 30th, resulting in moderate flooding. Agricultural land was inundated by flood water. The river remained in flood through the end of the month, falling below flood stage at 2:15 pm CDT on June 2nd.
7/7/2015	Flood waters in Coody Creek washed out the bridge on E 55 th Street South in Muskogee. Additionally, flood waters covered Smith Ferry Rd on the SE side of Muskogee. The following day, portions of the Meadows neighborhood in Muskogee were severely flooded, resulting in some evacuations. In total, there was \$50,000 in property damage was assessed with this event.
12/26/2015 – 1/5/2016	Several roads were closed due to flooding, like Main St. just south of Highway 16, Highway 10 near US 62, as well as portions of Highway 64 near Warner to the Highway 100 junction near Webbers Falls. Other impacts included flooding at an automobile dealership in Muskogee where water levels rose to the bottom of the vehicles' doors. This event prompted the declaration of DR-4256-OK on February 10, 2016.
4/28/2017 – 5/2/2017	Several roadways across Muskogee County were flooded and impassable, with one bridge damaged. Residents on the south side of Muskogee were evacuated due to flood water inundation. \$100,000 property damage resulted from this event in Muskogee County and prompted the declaration of DR-4315-OK on May 26, 2017.
02/23/2018	Heavy rainfall flooded portions of Gulick St near Muskogee Davis Airport which resulted in the roadway becoming impassable.

Date(s)*	Narrative
5/7/2019 – 6/9/2019	A persistent, convectively active pattern, consisting of a deep trough over the western U. S. and ridging along the Gulf Coast and southeastern U. S., set the stage for numerous rounds of rainfall across the Southern Plains from May 18th into early June. The atmospheric moisture remained unseasonably high during this period, resulting in very efficient rainfall-producing showers and thunderstorms. Antecedent conditions from the rainfall in late April and early May meant that soil moisture was already high, and any additional rainfall would quickly become runoff. Antecedent river and lake levels were also above normal ahead of this active storm period. Six to sixteen inches of rain fell between May 18th and May 30th along and northwest of a line from near Okmulgee, OK to near Bentonville, AR, and three to five inches of rain fell southeast of this line. Widespread ten-to-sixteen-inch amounts fell across portions of southern Kansas and northern Oklahoma. During this period, six USACE Tulsa District flood control reservoirs set new pools of record in northeastern Oklahoma: Kaw, Keystone, Skiatook, Birch, Oologah, and Hudson Lakes. The result was 31 river floods at 22 river forecast points in eastern Oklahoma. The Arkansas River near Muskogee was above its flood stage of 28 feet for approximately 22 days and 5 hours, beginning at 3:00 am CDT on May 21, and was also above the major flood category for approximately 13 days and 12 hours. It crested at 46.39 feet at 9:00 am CDT on the 26th and crested a second time 46.00 feet at 7:30 am CDT on the 30th, both crests resulting in major flooding. The crest of 46.39 feet was the second highest crest on record, and the crest at 46.00 feet was the third highest crest on record. Very severe flooding occurred from Muskogee to Webbers Falls. Homes and businesses were flooded, and numerous roads were closed. Monetary damage from this flood is unknown. The river remained above flood stage through the end of May, crested again at 32.63 feet at 3:15 pm CDT on June 7th, and then finally fell below flood stage at 7:30 am CDT on June 12th. Haskell also experienced flooding from the Arkansas River. The river rose above its flood stage of 19 feet at 3:00 am CDT on May 22nd. The river crested at 24.24 feet at 10:15 pm CDT on the 29th, resulting in major flooding. This was the second highest crest on record. Severe agricultural flooding occurred, and county roads were flooded. Monetary damage from this flood is unknown. The river remained above flood stage through the end of May, and finally fell below flood stage at 9:45 pm CDT on June 1st. Days later, widespread showers and thunderstorms developed across eastern Oklahoma during the afternoon and evening of the 6th. Unseasonably moist air across the region resulted in locally heavy rainfall with one to four inches of rain across the area, and as much as seven inches occurring locally. This heavy rainfall resulted in widespread flash flooding, inundating, and causing the closure of several streets on the west side of Muskogee. This event led to the declaration of DR-4438-OK on June 1, 2019.
07/18/2021	Thunderstorm rainfall resulted in flooded roadways in Muskogee, one of which resulted in a vehicle being washed off the road and into a ditch, where the driver needed to be rescued.
5/2/2022 – 5/8/2022	Heavy rainfall in association with an upper-level system caused heavy rainfall, with 7.16 inches of rainfall observed in Muskogee, which produced flooding and prompted the declaration of DR-4657-OK on June 29, 2022. County Emergency Management officials issued an alert for parts of town to avoid travel on inundated roadways across the county, many of which were closed due to flooding, as several residents had to be rescued from their homes due to inundation.
06/10/2022	Several rounds of storms dropped prolific rainfall totals across Muskogee, and W Broadway St. became flooded with several feet of water near N 51 st Street.

* - Dates which appear in bold font are those tied to a federal disaster declaration

Figure 1-12 Historic Flooding/Flash Flooding Events from 2013 to 2022 (NCEI)



4.6.5 Probability of Future Events

Based on the historical instances of flooding events occurring in Muskogee County, the probability of experiencing a flooding event in the planning area remains **highly likely**.

4.6.6 Vulnerability and Impacts

Unless explicitly noted in the vulnerabilities described within this section, the risk associated with this hazard applies to all participating jurisdictions within the planning area. Based on classifications in Table 4-4, the overall significance of flooding is **high** in the planning area. Specific vulnerabilities and impacts attributed to flooding are detailed in Table 4-33 below.

Table 4-33 Vulnerabilities and Impacts due to Flooding Events

Vulnerability	Jurisdiction(s)	Impact
Critical facilities located in FEMA Floodplain zones (see Table 4-37) are vulnerable during flood events due to the threat of rising flood waters, because flood events can disrupt power. Critical facilities that lack sufficient backup power generators can be rendered inoperable.	- Muskogee Co. (unincorporated) - Fort Gibson - Haskell - Muskogee - Webbers Falls - Fort Gibson PS - Webbers Falls PS	When flood events disrupt power at critical facilities, it renders them inoperable unless those facilities have backup generators in place. Critical facilities that fall offline can directly threaten the health and safety of people. Hospitals, EOCs, Fire Departments, and Police Departments are a few examples that are crucial to the well-being of residents in the planning area.
Floodwaters can be contaminated with e-coli and fecal coliforms from sanitary sewer overflows, animal waste, and other forms of hazardous waste materials.	All participating jurisdictions	Contaminated flood waters can result in long term health and environmental impacts, and buildings impacted with flood waters may develop mold. This mold also poses long-term health risks.
All school districts rely on bus transportation for students, and each district has routes that use roadways which have been noted as flooding frequently in the past.	All participating school districts	Flooding events can block roadways which prevent buses from being able to transport students.

Oktaha Public Schools reported that although their schools are not located near any waterway, they do experience flooding in buildings due to poor drainage in the immediate vicinity of the school. Table 4-34 identifies a structure count of those parcels that are in one of FEMA's Floodplain zones.

Table 4-34 Number of Structures in Identified Areas of Flood Risk (FEMA Floodplain)

Jurisdiction	Floodway	Zone AE	Zone A	Zone X	TOTAL
		1% Floodplain	1% Floodplain	0.2% Floodplain	
Muskogee Co. (unincorporated)	18	95	279	48	440
Boynton	-	-	-	-	-
Braggs	-	-	17	-	17
Council Hill	-	-	-	-	-
Fort Gibson	-	54	66	85	205
Haskell	-	24	79	10	113
Muskogee	72	105	4	37	218
Oktaha	-	-	-	-	-
Porum	-	-	-	-	-
Summit	-	-	-	-	-
Taft	-	-	2	-	2
Wainwright	-	-	-	-	-
Warner	-	-	-	-	-
Webbers Falls	2	122	2	190	316
TOTAL	92	400	449	370	1,311

The information presented in these tables is data collected from FEMA in 2022. Data provided by the State of Oklahoma was used in the absence of current, county-level NFIP data. This data deficiency has been added to Chapter 5 Action Items.

Table 4-35 NFIP Claims across Muskogee County (2022 FEMA data)

Jurisdiction	RL Properties*	RL Claims	NFIP Total \$ RL Paid	NFIP Claim Locations	NFIP Total \$ Claims Paid
Unincorporated Muskogee Co.	2	5	\$361,254	48	\$4,426,145
Boynton	-	-	-	-	-
Braggs	-	-	-	-	-
Council Hill	-	-	-	-	-
Fort Gibson	3	13	\$311,649	-	\$3,204,113
Haskell	-	-	-	-	-
Muskogee	18	77	\$2,271,386	-	\$3,063,944
Oktaha	-	-	-	-	-
Porum	-	-	-	-	-
Summit	-	-	-	-	-
Taft	-	-	-	-	-
Wainwright	-	-	-	-	-
Warner	-	-	-	2	\$219,934
Webbers Falls	-	-	-	12	\$1,165,907
TOTAL	23	95		218	\$12,080,043

Table 4-36 RL Parcel Type by Jurisdiction

Parcel Type	Jurisdiction	Count
Agriculture Improved	Muskogee Co. (unincorporated)	1
Exempt	Muskogee	11
	Muskogee Co. (unincorporated)	1
Residential Improved	Muskogee	4
	Fort Gibson	3
Residential Vacant	Muskogee	3

Of the 23 RL properties listed below, seven structures were listed as “residential improved”, three as “residential vacant”, one as “agriculture improved” and twelve as “exempt”. These designations are given by the Muskogee County Tax Assessor, and “exempt” is to be understood as parcels that are exempt from paying taxes, which includes things like churches, government properties, tribal lands, etc.

Table 4-37 Critical Facility Structures Located in FEMA Floodplain Zones

Facility Name	Jurisdiction	FEMA Floodplain	Structure Count
Tiny Tots Childcare Center	Fort Gibson	Zone X (Shaded)	1
Electrical Substation (118413)		Zone A	1
All Nations 7 th Day Adventist Church	Haskell	Zone A	1
Bella Vista Village Mobile Home Park	Muskogee	Zone AE	10
Bella Vista Village Mobile Home Park		Zone X (Shaded)	14
Electrical Substation (118411)		Zone AE	1
Electrical Substation (119166)		Zone AE	1
OG&E Muskogee Power Plant		Zone AE	surrounded
Muskogee Water Plant		Zone AE	3
Pollution Control (WWTP)		Zone AE	3
Pollution Control (WWTP)		Zone X (Shaded)	5
Pollution Control (WWTP)		Floodway	2
Meadowbrook RV Park		Floodway	6
Mountain View VFD	Muskogee Co. (unincorporated)	Zone A	1
Electrical Substation (18445)		Zone A	1
Webbers Falls Lock and Dam		Zone A	1
Electrical Substation (148808)		Zone A	1
First Baptist Church	Webbers Falls	Zone X (Shaded)	1
EOC / Town Hall		Zone AE	2
First Assembly of God		Zone AE	1
Webbers Falls ES / HS		Zone X (Shaded)	5
Webbers Falls ES / HS		Zone AE	6
US Post Office		Zone X (Shaded)	1
St. Joseph		Zone X (Shaded)	1

4.6.7 Future Conditions

Climatological Effects

Heavy rainfall and flooding have always been part of Oklahoma's climate. Annual precipitation has increased over the vast majority of Oklahoma, with the highest change occurring in winter. According to Easterling et al. (2017), heavy rainfall (top 1% of annual events) increased by 12% between 1958 and 2016. Seasonally, rainfall is projected to increase in winter and spring and decrease in summer and fall by the end of the 21st century, but projected changes are small compared to natural variations. There is strong confidence there will continue to be an increase in the frequency and intensity of heavy rainfall events over the 21st century (Easterling et al. 2017) which increases the chance of flooding. However, flooding is a locally complex phenomenon and can be exacerbated by human action (or inaction) as much as it can be caused by atmospheric conditions.

Land Use Changes

Development can increase flooding risk in any location, but has been particularly noted in areas which have been identified as floodplains. Areas of development in floodplains in Muskogee County have been identified in Table 4-33. Critical facilities in floodplains have been detailed in Table 4-37.

Population Patterns

Although the planning area has seen a gradual decline in population over the last 10 years, this population pattern does influence the flooding hazard impacts. After the 2019 Arkansas River flooding event, for example, many residents who were inundated with floodwaters either moved to higher grounds or relocated to less flood-prone areas. Webbers Falls had a 2010 population total of 616, but by 2020, only 338 were reported in the US Census. Much of this town lies in a FEMA floodplain, and so a population shift meant future impacts from flooding would be less extensive.

Housing is strongly discouraged from being constructed in floodplains. However, those individuals who are lower socioeconomic status are often the ones who live in floodplains, since land in these areas is more affordable and is more accessible than land in areas at a lower risk of flooding. Areas along the Arkansas River in Muskogee, Fort Gibson and Webbers Falls coincide with populations at a higher SVI, as discussed in Section 1.7.1.

4.7 Hail

4.7.1 Description

Hail forms when water droplets within a thunderstorm get caught in strong updrafts within the cloud and are carried into sub-freezing temperatures higher in the storm, where they freeze into irregularly shaped lumps of ice. As hailstones become heavy, they fall back through the storm, sometimes repeating the updraft process several times, which allows hailstones to increase in size. Once they are too heavy to remain aloft, they fall to the ground where they can produce significant damage. Severe thunderstorms contain hail measuring at least 1.00" in diameter and/or are storms that produce wind gusts greater than 58mph. The National Weather Service amended the definition of "severe hail" from 0.75" to 1.00." Data presented in this section is reflective of this change.

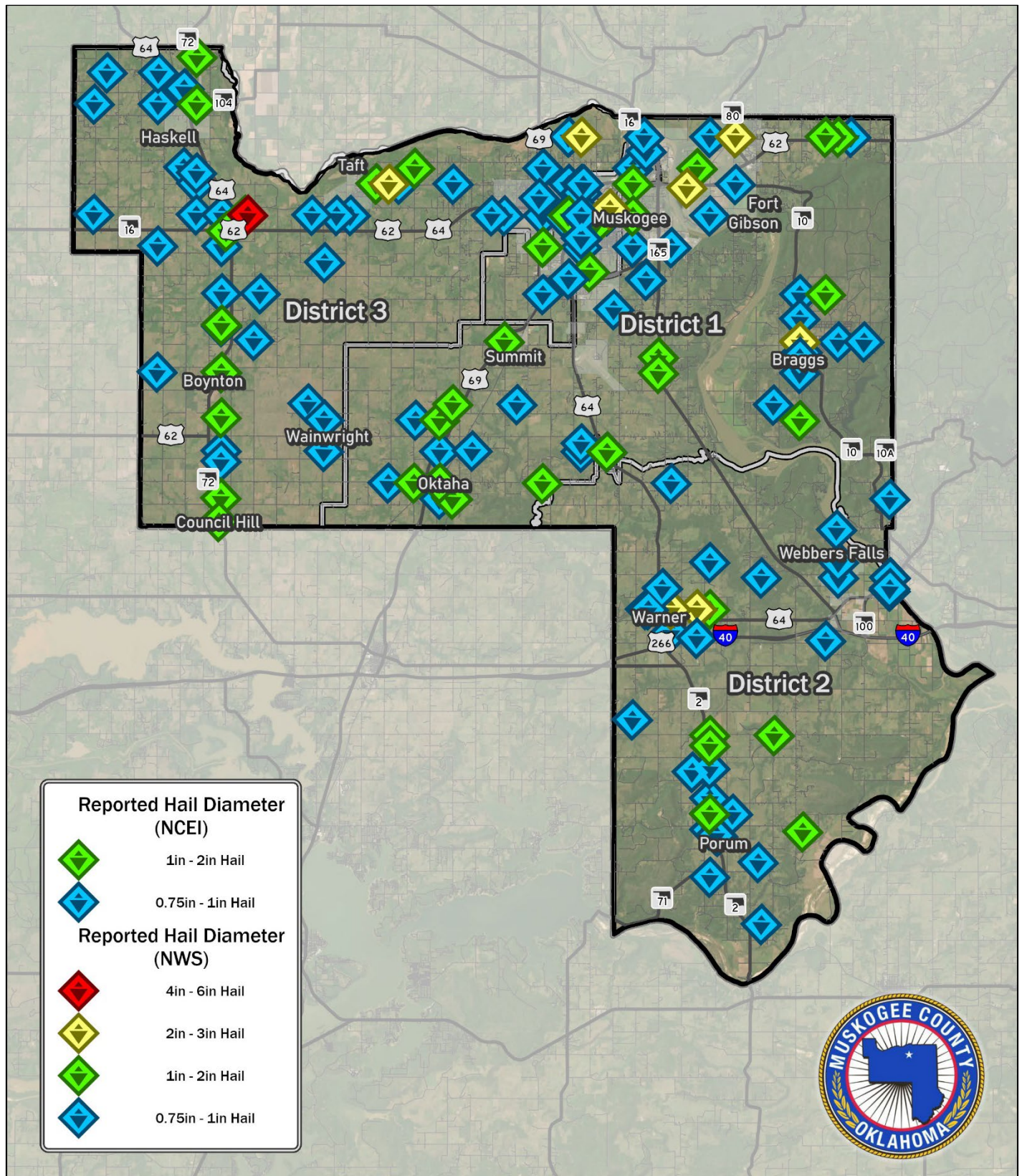


4.7.2 Location

Since hail is a byproduct of thunderstorms that contain intense vertical motion, and the probability of a thunderstorms affecting any given point within the planning area can be considered uniform, the location of hail is thus considered to be uniform across the planning area.

Since factors that go into the development of thunderstorms and hail can occur at any location within the planning area, there are not any locations that have a unique risk of experiencing large hail in relation to others within the planning area. Figure 4-13 plots all severe hail reports as listed by NCEI and NWS records, and for a more in-depth examination of hail reports, please refer to the [Muskogee County GIS Viewer](#).

Figure 4-13 Hail Reports Across Muskogee County (greater than 0.75 inch diameter)



4.7.3 Extent

To define the extent of hail events in the planning area, the combined NOAA/TORRO hail intensity scale is used (see Table 4-38), and in Muskogee County, hail diameters can range anywhere from 0.33" to more than 4.00" (or a range of H0 to H10 on the NOAA/TORRO scale). According to the NWS archives, the largest hailstone to fall in the planning area was one that fell near the intersection of OK State Hwy 72 & US Hwy 62 on March 26, 2020. Hailstone diameter measured 4.50" in diameter. As with location, the extent of hail events is uniform across the entire planning area.

Table 4-38 Combined NOAA/TORRO Hail Intensity Scale⁴¹

Size Code	Intensity	Diameter (in.)	Approximate Size	Typical Damage Impacts
H0	Hard Hail	Up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33 – 0.60	Small marble or mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60 – 0.80	Dime or grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80 – 1.20	Nickel to Quarter	Severe damage to fruit & crops, damage to glass & plastic structures, paint & wood scored
H4	Severe	1.20 – 1.60	Half Dollar to Ping-Pong Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.60 – 2.0	Silver Dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0 – 2.4	Lime or Egg	Aircraft bodywork dented; brick walls pitted
H7	Destructive	2.4 – 3.0	Tennis Ball	Severe roof damage, risk of serious injuries
H8	Destructive	3.0 – 3.5	Baseball	Severe damage to aircraft bodywork
H9	Super Hailstorms	3.5 – 4.0	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	> 4.0	Softball & up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

4.7.4 Previous Occurrences

Between January 1, 2013, and December 31, 2023, NCEI Storm Events Database accounts for 38 events occurring in Muskogee County where hail stones had a diameter of 1.00" or greater, or an annual average of more than two events each year. Hail events during this period accounted for \$270,000 in damage, with Table 4-39 detailing some of the more notable hail events impacting the planning area.

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Table 4-39 Noteworthy Hail Events in Muskogee County (NCEI)

Date	Location	Size	Damage	Narrative
03/30/2013	Fort Gibson	3.00"	\$25K	Severe thunderstorms developed along and ahead of a dry line over central Oklahoma during the afternoon hours. Very unstable air along with very strong low level wind shear resulted in several supercell thunderstorms. These storms produced numerous tornadoes, very large hail, and damaging wind gusts as they moved eastward across eastern Oklahoma during the evening hours.
	Hyde Park	2.50"	\$20K	
04/03/2014	Shopton	2.00"	\$5K	High-based thunderstorms moved through eastern Oklahoma during the late morning hours of the 3rd. Large hail and isolated damaging wind gusts occurred. Other severe thunderstorms developed along an approaching cold front and dry line during the early afternoon over eastern Oklahoma. These storms produced large hail up to tennis ball size and damaging wind gusts.
	Muskogee	1.25"	\$15K	
	Bacone	2.50"	\$25K	
03/23/2016	Jamesville	1.75"	\$20K	Strong to severe thunderstorms developed along and ahead of a dry line over central Oklahoma during the late afternoon hours of the 23rd. Storms developed eastward across eastern Oklahoma and northwestern Arkansas during the evening hours. The storms produced a strong tornado, hail up to golf ball size, and damaging wind across eastern Oklahoma as they moved through the region.
04/24/2020	Porum	1.50"	\$10K	Strong to severe thunderstorms developed across eastern Oklahoma during the afternoon of the 24th, as an upper-level disturbance and associated surface low pressure system translated across the region from the west. The strongest thunderstorms produced hail up to ping pong ball size and damaging wind gusts as they moved east across the area.
04/15/2022	Council Hill	2.00"	\$75K	Severe thunderstorms developed ahead of the dry line over portions of eastern Oklahoma during the evening of the 15th. The combination of moderately strong instability and strong deep layer wind shear resulted in some of the thunderstorms becoming supercells. These storms produced hail up to tennis ball size as they moved across eastern Oklahoma during the evening of the 15th, and early morning hours of the 16th.
05/15/2022	Muskogee Davis Airport	2.00"	\$50K	Scattered strong to severe thunderstorms developed near an outflow boundary across northeastern Oklahoma during the early morning hours of the 15th. The strongest thunderstorms produced large hail up to ping pong ball size. Additional strong to severe thunderstorms developed during the afternoon and evening hours, along a southward-moving outflow boundary from earlier thunderstorms that moved through southwestern Missouri and northwestern Arkansas. The atmosphere along and south of this outflow boundary in eastern Oklahoma had become very unstable by the afternoon and combined with strong deep layer wind shear across the area, an environment supportive of supercells was in place as the storms developed. Several supercells moved across the region, producing large hail up to softball size.
	West Muskogee	1.50"	\$25K	

4.7.5 Probability of Future Events

Using Table 4-3 and previous occurrences reported by NCEI, Muskogee County averaged more than three 1-inch hail events each year from 2013 through 2023, making the future probability of this hazard **highly likely**.

4.7.6 Vulnerability and Impacts

Unless explicitly noted in the vulnerabilities described in this section, the risks associated with this hazard apply to all participating jurisdictions within the planning area. Based on the classifications in Table 4-5, the overall significance of a hail event in the planning area is **high**. The most significant vulnerabilities identified in Muskogee County are in damages to structures' roofs and to vehicles.

Table 4-40 Vulnerabilities and Impacts due to Hail Events

Vulnerability	Jurisdiction(s)	Impact
Muskogee County lacks covered parking for county vehicles	Muskogee County	Damage or destroyed vehicles can incur repair or replacement costs. Cascading impacts include rising property taxes to pay for such repairs and replacement
Public School Districts lack adequate covered parking for school buses and school vehicles	All participating school districts	Hail events can damage or destroy windshields which can render vehicles unusable. School districts that provide transportation to students would be unable to service the staff/student population.
Hail events can damage and/or destroy school property, such as rooftop HVAC units and windows	All participating public school districts	Damage to HVAC units is extremely costly and if damage is severe enough, schools will lose air conditioning which can pose a health risk to students and staff – particularly during periods of extreme heat or cold. Broken windows pose a direct safety threat to staff and students inside the building
Neither ICC 2018, 2021, nor 2024 International Building Code standards have been adopted	- Boynton - Braggs - Council Hill - Summit - Taft - Wainwright - Webbers Falls	Structures that fail to comply with the latest IBC can be dangerous for those inside during hail events, as the fortitude and durability of those structures can be more substantially damaged, producing a threat to health and safety.
Jurisdictions lack covered parking for municipal vehicles. Unsheltered vehicles owned or operated by these communities are at greater risk of damage due to hail stone impacts.	- Muskogee County - Fort Gibson - Haskell - Muskogee - Oktaha - Porum - Warner	Damaged or destroyed vehicles incur repair or replacement costs. Cascading impacts include rising property taxes in order to pay for such repairs and/or replacement

Large hail often produces damage to structures, most commonly to roofs, although windows are also susceptible. Structures can be erected to prevent damage to property, as well. One type of such structure is garages and covered parking structures. When hail produces damage, vehicles are often an asset affected. County officials have indicated there exists a shortage of sheltering structures to protect county vehicles from hail damage. Ensuring investments in these public assets made by taxpayers are protected is a fundamental action that will benefit from the construction of adequate shelter.

Other common hail impacts are structural damage to roofing material. More recent building codes strengthen and fortify roofing standards, and any community that lacks adoption of the newest codes is directly at risk for hail stone damages.

4.7.7 Future Conditions

Climatological Effects

Hail is commonly associated with severe thunderstorms. Climate models project an increase in the frequency and intensity of severe thunderstorms, and events with large hail are projected to increase (Kossin et al. 2017). At the same time, models project an overall decrease in the number of days with hail per year (Brimelow et al. 2017). Confidence in the projections is currently low, however, due to the isolated and sporadic nature of hail events and limited comprehensive datasets which make it difficult to track long-term trends (Wuebbles et al. 2017a).

Land Use Changes

While the built environment will experience an ever-present risk of hail damage, adopting and enforcing all new development to adhere to the most currently available International Building Code requirements can go a long way toward reducing the extent of these damages. As stated in Chapter 3, Muskogee County, Fort Gibson, Haskell, Muskogee, Oktaha, Porum, and Warner all report having adopted the 2018 International Building Code standards. All other things being even, any new development in these communities will be more resilient to hail damage than others in the planning area.

Population Patterns

From 2010 to 2020, Muskogee County's population declined from 70,990 to 66,339, and on a jurisdictional level, a similar downward trend is noted. A downward-trending population pattern, however, does not influence hail hazard impacts in the planning area.

4.8 High Winds

4.8.1 Description

High wind is defined by the National Weather Service as sustained wind speeds of 40 miles per hour or greater lasting for 1 hour or longer, or winds of 58 miles per hour or greater for any duration. In Oklahoma, this hazard is associated with thunderstorms. Damage resulting from high winds, for the purpose and scope of this section, are being examined independently to differentiate from the damage caused by rotating flow found within tornadoes.



4.8.2 Location

Mechanisms which produce high winds mostly affect areas on a scale from county level and larger. High winds which result from thunderstorms typically develop in association with linear squall lines, which extend across multiple counties and sometimes even multiple states. Thus, it can be said that high winds pose a uniform risk to the entire planning area. Section 1.8.6 discusses location-specific vulnerabilities to high winds in further detail, while Figure 4-14 shows historic high wind reports across the entire planning area.

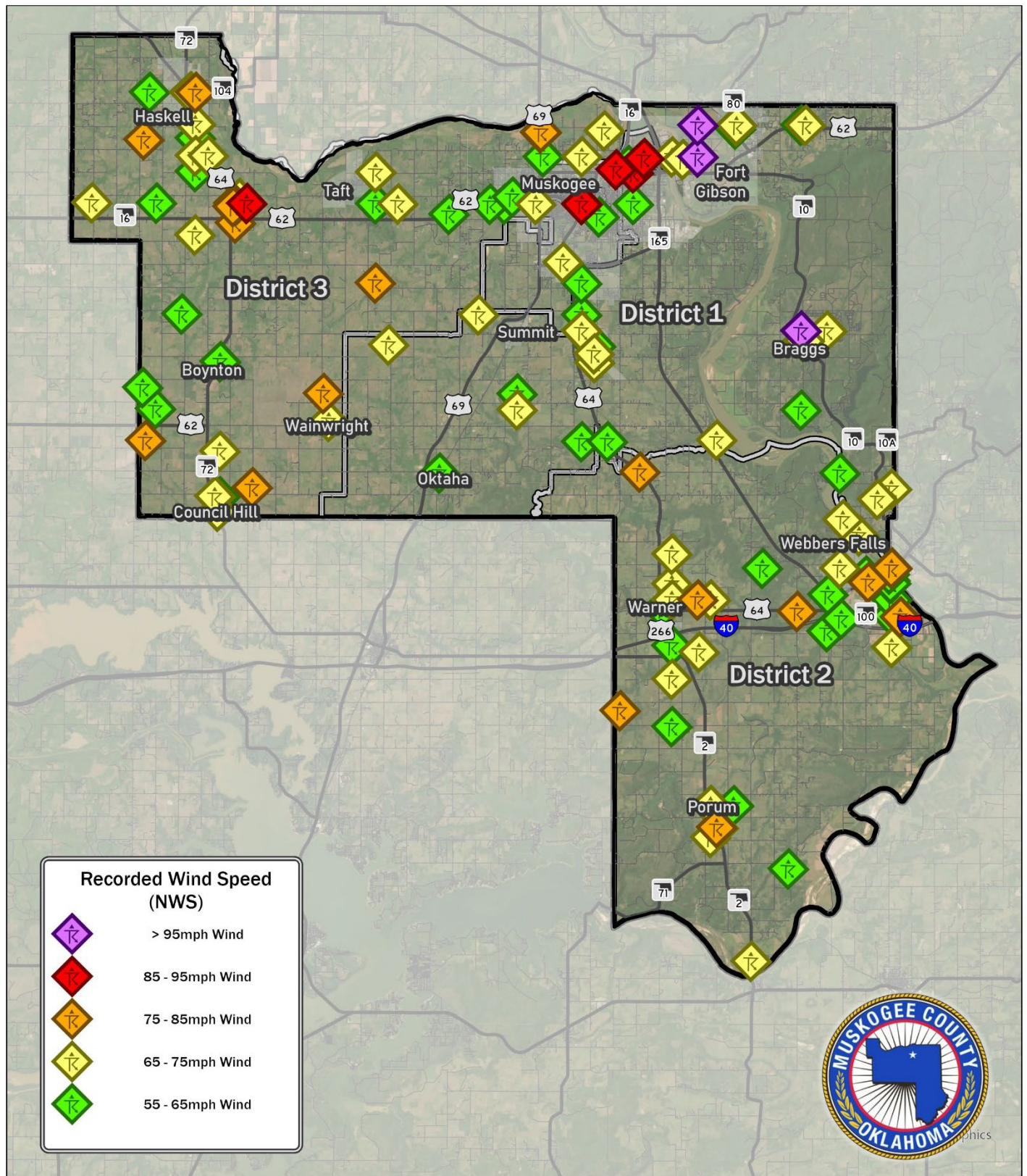
4.8.3 Extent

To describe the extent of high wind events, the Beaufort Wind Scale is used (see Table 1-41), and throughout the planning area, high wind events can range between 0 and 12 on this metric (or anywhere from 0mph to 73+ mph). As with location, the extent of high wind events is uniform across the entire planning area.

Table 1-41 Beaufort Wind Scale (NWS)

Beaufort Number	Wind Speed (mph)
0	< 1
1	1 – 3
2	5 – 7
3	8 – 12
4	13 – 17
5	18 – 23
6	24 – 30
7	31 – 38
8	39 – 46
9	47 – 54
10	55 – 63
11	64 – 72
12	> 73

Figure 4-14 High Wind Reports in Muskogee County (NWS)



4.8.4 Previous Occurrences

A combination of community reporting, NWS reports, and NCEI data is used to examine previous occurrences of high winds in Muskogee County. Event types searched in the NCEI database for this assessment were “High Wind” and “Thunderstorm Wind,” and according to NCEI, there are 77 events reported between January 1, 2013, to December 31, 2023, in Muskogee County. Together, property damage estimates totaled \$859,000, and Table 4-42 provides narratives on some notable events observed in the planning area.

Table 4-42 Noteworthy High Wind Events in Muskogee County (NCEI)

Date	Location	Magnitude	Damage	Narrative
07/10/2013	Council Hill	80 mph	\$25K	Thunderstorms developed along and south of a weak cold front across the region during the afternoon of the 10th. Strong thunderstorm winds destroyed a mobile home and a barn and removed part of a metal roof from a permanent home.
07/23/2013	Muskogee	80 mph	\$25K	Strong thunderstorm wind blew down several trees and power lines in Muskogee. Strong thunderstorm winds blew down numerous trees and power poles and severely damaged small outbuildings in and around Porum.
	Porum	80 mph	\$25K	
04/26/2016	Martin	80 mph	\$100K	Strong thunderstorm winds destroyed outbuildings, damaged the roofs of homes, and uprooted trees between the county line and the Muskogee Turnpike.
07/14/2016	Bacone	85 mph	\$200K	Strong thunderstorm winds caused significant damage to a shopping center on the north side of Muskogee.
03/06/2017	Neha	70 mph	\$10K	Strong thunderstorm winds damaged the roof of a church, damaged the roofs of five homes, and uprooted two trees.
05/15/2020	Wainwright	70 mph	\$10K	Strong thunderstorm winds damaged the roofs of homes, damaged a barn, and snapped large tree limbs near Wainwright.
06/26/2021	Hatbox Airport	65 mph	\$25K	Strong thunderstorm winds damaged barns and outbuildings.
10/10/2021	Warner	75 mph	\$25,000	Strong thunderstorm winds damaged the roofs of poultry buildings.
06/17/2023	Boynton	70 mph	\$346,000	Thunderstorm winds resulted in at least \$346,000 in debris removal and damage to the utility infrastructure across the county.

4.8.5 Probability of Future Events

Based on the number of previous occurrences of high wind observed in the planning area as discussed in Section 1.8.4, the probability of an annual occurrence of high wind in Muskogee County is **highly likely**.

4.8.6 Vulnerability and Impacts

Unless explicitly noted in the vulnerabilities described in this section, the risks associated with this hazard apply to all participating jurisdictions within the planning area. Based on the classifications in Table 4-5, the

overall significance of high winds to the planning area is **high**. High winds, as well as damage resulting from this hazard, can result in injury and economic loss.

Table 4-43 Vulnerabilities and Impacts due to High Wind Events

Vulnerability	Jurisdiction	Impact
Very few electrical lines are buried in the planning area – the rest are above-ground. High wind events can damage and/or destroy utility poles and lines which can create widespread power outages.	All participating jurisdictions	Downed power lines pose a safety risk as they can electrocute and/or kill anyone who comes in contact. Disruption of power supply is also a significant impact which can mean homes, businesses, and/or schools are closed or rendered unusable. For school districts, a lack of power means school activities must be cancelled and/or postponed, particularly when impacts occur during summer or winter months. When power is knocked out for extended periods of time, vulnerable populations who depend on electricity are directly at risk, particularly when outages last for multiple days (like nursing centers or schools). Facilities such as these who lose power will be unable to provide adequate cooling/heating. Furthermore, resulting power outages negatively impact residents in the planning area, particularly when outages coincide with periods of extreme heat or severe winter storms. A lack of electricity can render critical facilities (including schools) inoperable.
High winds can peel roofing shingles on homes, businesses, and public buildings, including schools.	All participating jurisdictions	When high winds damage or remove roofing material, water damage can quickly create costly and disruptive impacts. Structures can be rendered unusable or unlivable which places economic, personal, and financial stress on those who are impacted. In the case of public buildings, this can cause an interruption to essential government services and functions.
Outdoor school equipment located on school property can blow away or be damaged during high wind events	Oktaha Public Schools	Loss of school equipment (such as track & field mats and sports equipment) can disrupt school activities and can be quite costly to repair. High winds that blow equipment away can also cause bodily injury to staff and students who may be caught outside during these events.

Extended power outages resulting from high wind events can last for hours, or even days. Prolonged outages can lead to the disruption of critical services including those needed for health and life-sustaining devices, business operations, heating/air conditioning, light, communications, and other essential functions. While home generators are available to residents, the cost of such capabilities can be prohibitive for those who subsist on fixed or low incomes. Thus, vulnerable populations such as these or the elderly who require electricity to sustain their health and life are impacted disproportionately during extended power outages.

High wind events can break tree limbs and snap power poles, and in a similar fashion, this hazard can also result in downed communication lines. They can also produce flying debris which pose a risk to the safety of people and property.

Further development into currently undeveloped areas within Muskogee County, particularly that which does not adhere to the most current standard of the International Building Code, which is the 2024 IBC at the time of this writing, will be at an enhanced risk of damage to high winds. Similarly, any human occupation of these areas will be at an enhanced risk of injury or death due to high winds.

4.8.7 Future Conditions

Climatological Effects

Damaging winds in Oklahoma are associated with severe thunderstorms. More favorable environments for severe thunderstorms are expected and increases in severe wind occurrences are projected. Climate models project an increase in the frequency and intensity of severe thunderstorms over the Southern Great Plains, especially during peak storm season (March, April, May). Uncertainty remains, however, in the assumption that favorable environments will reach potential of producing damaging winds (Kossin et al. 2017).

High winds can also theoretically occur during other meteorological phenomena such as cyclones, cold front passages, or gradient winds, strong cold front passages, or gradient winds between high and low pressure. Robust, peer-reviewed research in this area is lacking, thus no conclusions on the effects of a changing climate on these phenomena, and their ability to produce high winds in Muskogee County or elsewhere in Oklahoma, can be drawn at this time.

Land Use Changes

Further development into currently undeveloped areas within Muskogee County, particularly that which does not adhere to the most current standard of the International Building Code, which is the 2024 IBC at the time of this writing, will be at an enhanced risk of damage to high winds. Similarly, any human occupation of these areas will be at an enhanced risk of injury or death due to high winds.

Population Patterns

From 2010 to 2020, Muskogee County's population declined from 70,990 to 66,339, and on a jurisdictional level, a similar downward trend is noted. Recent population patterns do not influence high wind hazard impacts in the planning area.

4.9 Lightning

4.9.1 Description

Lightning is defined by the National Weather Service as a visible electrical discharge produced by a thunderstorm. Discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground or between the ground and a cloud. Lightning occurring between a cloud and the ground is referred to as cloud-to-ground, or “C-G,” lightning. Discharges that travel within or between clouds are referred to as cloud-to-cloud, or “I-C,” lightning. When clouds begin to produce electrical discharges, it is a sign a storm is developing or intensifying. While lightning bolts generally remain near the parent thundercloud, C-G discharges can travel many miles from its origination point within the storm and may contact objects and people on the ground 10 to 12 miles from the thunderstorm⁴². This is often farther than the sound of thunder travels.



As thunderstorms mature, clouds can reach heights of nine or ten miles in altitude. During this stage in a thunderstorm’s life cycle, storm tops shear laterally due to winds aloft. During this process, the cumulonimbus cloud begins to resemble an anvil. High-altitude cloud debris is referred to as an anvil cloud, and these features can quickly spread great distances from the central structure of the thunderstorm. As anvil clouds stretch further from the central structure, they sometimes begin to generate lightning. Intensity of cloud-to-ground lightning corresponds with the height of its origination. Due to the high altitudes of the anvil clouds, lightning which originates from these clouds or near the top of the central structure of the thunderstorm is often the most powerful variety. Additionally, they can pose a very dangerous threat in the distance from their origination point to where contact is made on the ground. These types of discharges can strike 20 miles or more away, which perpetuates the “bolt from the blue” phenomenon. Due to the immense amount of energy discharged, this type of lightning phenomenon is often the deadliest. Discharges of this type have even been observed upwards of 60 miles away from the primary thunderstorm!

4.9.2 Location

Lightning is a byproduct of thunderstorms, which pose a uniform risk to the entire planning area. Therefore, lightning has been determined to pose a uniform risk across all of Muskogee County.

4.9.3 Extent

The extent of Lightning is determined by a metric designed by NOAA and the U.S. Wildfire Service called the Lightning Activity Level (LAL), and this scale categorizes lightning activity using six groups. Table 4-44 below are details of this metric. This hazard extent is uniform across the entire planning area and can range from LAL 1 to LAL 6.

⁴² https://www.weather.gov/media/ilm/Lightning_NWSILM.pdf

Table 4-44 Lightning Activity Level (LAL)

LAL Value	Description
LAL 1	No Thunderstorms
LAL 2	Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground strikes in a five-minute period.
LAL 3	Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud-to-ground strikes in a 5-minute period.
LAL 4	Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud-to-ground strikes in a 5-minute period.
LAL 5	Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud-to-ground strikes in a 5-minute period.
LAL 6	Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag Warning.

4.9.4 Previous Occurrences

Previous occurrences of lightning events are best communicated through Vaisala's database, which provides maps showing the density of cloud-to-ground (CG) lightning strikes – the most hazardous form of lightning due to impact on life and property. Figure 4-15 depicts the average number of cloud-to-ground lightning strikes in Oklahoma as measured between 2016 and 2022, with Figure 4-16 depicting the same information for 2023. For Muskogee County, it shows the annual number of CG bolts per square kilometer each year. Considering that Muskogee County is 2,200 km² in size, this rate means the planning area can typically see anywhere from 12,400 to 21,500 CG lightning bolts each year.

Figure 4-15 Cloud-to-Ground Lightning Density 2016-2022 in Oklahoma (Vaisala)

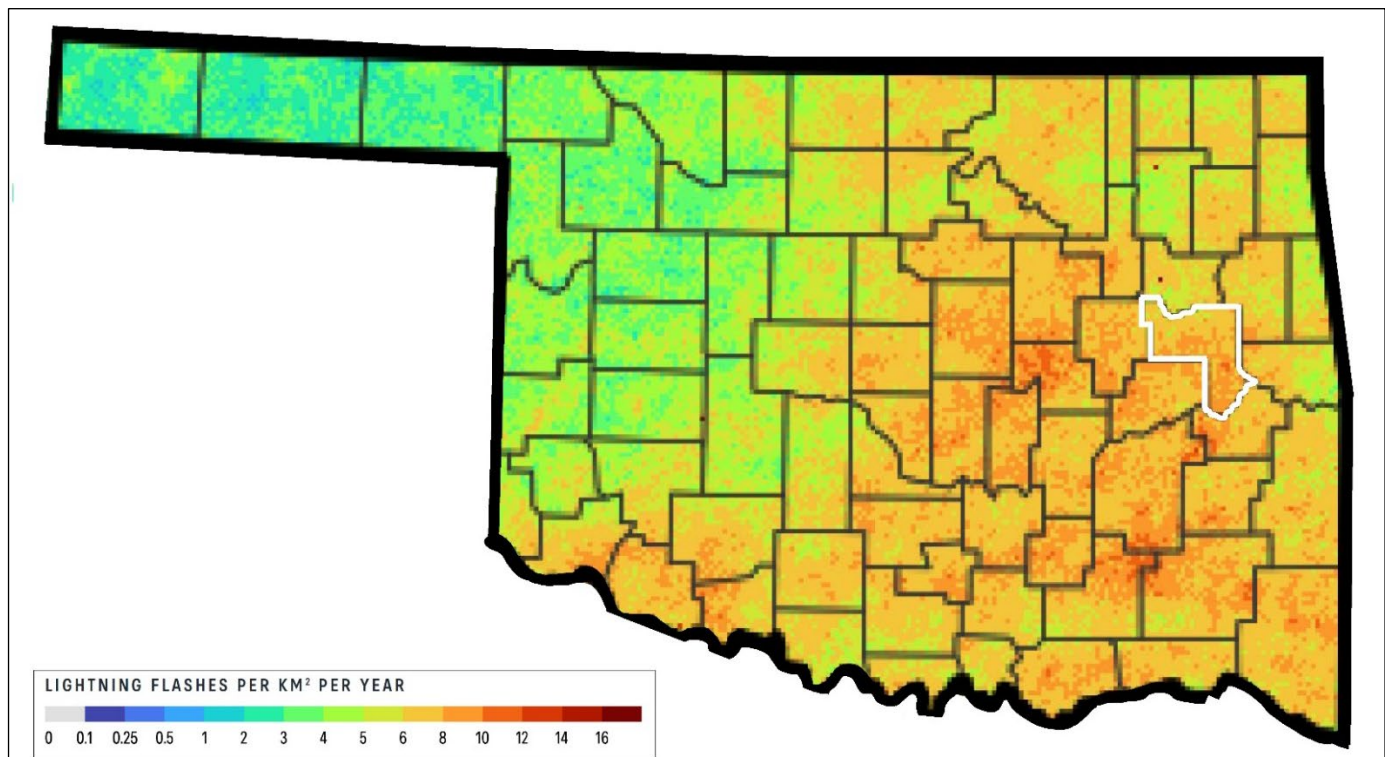
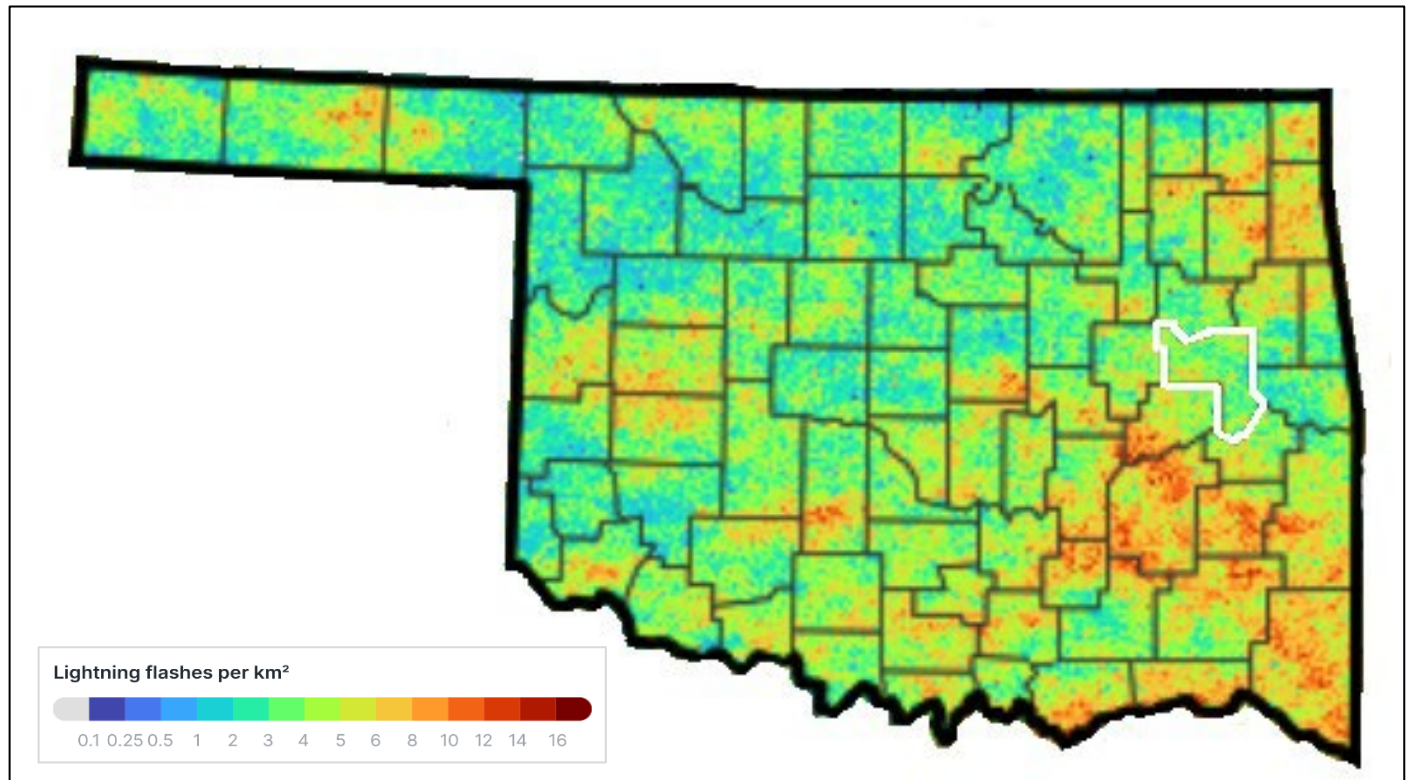


Figure 4-16 Cloud-to-Ground Lightning Density 2023 in Oklahoma (Vaisala)



4.9.5 Probability of Future Events

From January 1, 2014, to December 31, 2023, NCEI data shows 19 lightning events occurring across all of Oklahoma, none of which are listed in Muskogee County. Because NCEI data grossly underrepresents this hazard, NCEI statistics cannot be used to determine the probability of future events. Instead, Vaisala's annual lightning reports are used. As previously mentioned, the number of Cloud-to-Ground lightning strikes in Muskogee County can range between 12,400 to 21,500 strikes per year, making the probability of this hazard **highly likely** in the future.

4.9.6 Vulnerability and Impacts

Unless explicitly noted in the vulnerabilities described in this section, the risks associated with this hazard apply to all participating jurisdictions within the planning area. Based on classifications in Table 4-4, the overall significance of lightning in the planning area is **medium**. Lightning strikes can cause fires, especially in areas experiencing heat and low humidity. These fires can threaten people, the economy, and the built environment. Lightning can also cause wildfires, which is a hazard discussed in greater detail in Section 3.12.

Table 4-45 Vulnerabilities and Impacts due to Lightning Events

Vulnerability	Jurisdiction	Impact
There are critical facilities in Muskogee County and the incorporated areas that lack proper lightning deterrent systems and/or suppression capabilities, and this greatly increases their risk of damage during lightning events.	- Muskogee County (unincorporated) - All incorporated areas - All Public-School Districts	In addition to damage to critical facilities across the county, power outages often result from lightning strikes. Loss of functions as a result from these incidents can cause cascading impacts which adversely impact residents in these jurisdictions who rely on the governments of these communities to continuously provide these functions.
Students and staff members who are outdoors are vulnerable to lightning events because no early detection or warning system is in place at the school.	- Hilldale Public School - Oktaha Public School	Lightning strikes can kill or cause serious injury to those caught outside during this type of event.
School electronics, servers, and computer systems are vulnerable to lightning events	Oktaha Public Schools	A loss of computer equipment, TVs, laptops, and internal servers can lead to schools being unable to provide instruction to students. It also can severely hamper schools' ability to communicate internally as well as externally.
All jurisdictions have at least one critical facility that is in need of backup power generators for when lightning disrupts power supply.	All participating jurisdictions	In the event of a power outage, a disruption to electrical service could mean that critical facilities and schools, which provide services that meet the standards for FEMA Community Lifelines, would be interrupted. Residents and students who rely on these services would be vulnerable until those services can be restored once again, which may not happen for days or weeks in some circumstances.

Residents who fall within vulnerable populations are particularly vulnerable to the loss of government services and cascading impacts of lightning strikes. Additionally, students who rely on schools to provide services, including meals and nutrition, are at risk during periods when schools are required to close due to loss of electrical power. Lightning strikes can cause damage, and in some cases destruction, to trees. During periods of heat, low humidity, and drought, an increased cascading risk of wildfires resulting from lightning strikes is also possible.

As discussed in Table 4-45, lightning strikes can cause damage to homes and buildings, start fires, and cause electrical surges within electrical infrastructure that result in power outages. Lightning can have a range of adverse effects on school districts, stemming from a lack of warning/detection and mitigation measures directed at reducing the impacts of lightning. For example, in 2021, lightning struck the roof of a Fort Gibson Public School building, frying their HVAC system.

Students, staff, and spectators at outdoor events sponsored by school districts are at risk when thunderstorms approach venues where these events are being held. Equipping administrative officials, such as athletic directors, principals, hazard mitigation officers or safety officers, and/or superintendents with

lightning detection capabilities, such as a mobile application designed for such a capability, would allow them to make timely, critical decisions to protect all people in attendance.

Electrical surges due to lightning strikes can overwhelm utility sub grids and cause power outages. Such power outages usually affect residents on a scale of neighborhoods to sections of communities, or anywhere from tens to thousands of residents. As discussed with other hazards that may have effects on electrical reliability, such outages can affect vulnerable populations who rely on the continuous flow of electricity for life, health, and well-being.

Power outages resulting from lightning strikes can adversely affect the reliability of public water supplies. Water treatment facilities which lack backup generation capabilities are at risk of ceasing operations until power can be restored to these facilities. This can result in the issuance of boil water notices, and risk to public health and wellbeing. Communications infrastructure is also at risk of power outages resulting from lightning strikes. Power outages can prevent residents from being able to contact emergency services during health or safety emergencies, and it signifies a disruption to a critical FEMA Community Lifeline.

4.9.7 Future Conditions

Climatological Effects

Lightning is associated with thunderstorms, so as more favorable environments for thunderstorms are expected across the United States, increases in lightning are also projected. Studies have shown an increase in lightning associated with severe storms (Schultz et al. 2011). Climate models project an increase in the frequency and intensity of severe thunderstorms (Kossin et al. 2017), therefore, lightning occurrences are likely to increase. Confidence in projections is currently low, however, due to the isolated and sporadic nature of lightning events and limited comprehensive datasets which make it difficult to track long-term trends (Wuebbles et al. 2017a).

Land Use Changes

Absent of the implementation of lightning deterrent or lightning resistant component(s) incorporated into their development, changes in land use and other development within the planning area will be at risk to lightning.

Population Patterns

From 2010 to 2020, Muskogee County's population declined from 70,990 to 66,339, and on a jurisdictional level, a similar downward trend is noted. Regardless, these trends do not influence lightning hazard impacts in the planning area. Residents in areas identified in Table 4-45 can be considered to be at an increased risk of effects from lightning.

4.10 Severe Winter Storm

4.10.1 Description

A severe winter storm is a winter weather event producing significant and impactful accumulations of frozen precipitation types such as freezing rain/ice, sleet, and/or snow. Such systems may include heavy snowfall, blowing and drifting snow, high winds, ice storms, or extreme cold temperatures. When high winds and extreme cold temperatures accompany these events, they can often exacerbate impacts.



Severe winter storm events of different types affect Muskogee County, including blizzards, ice storms, and extreme cold. One example of a type of severe winter storm event is a blizzard. As defined by the National Weather Service, a blizzard is a snowfall event where, for a period of 3 hours or longer, sustained winds or frequent gusts up to 35 miles per hour or greater occur and falling or blowing snow reduces visibility to less than $\frac{1}{4}$ mile. Another type of severe winter storm experienced in the planning area is ice storms, which can be quite destructive. Ice storms, which produce freezing rain/ice and/or sleet, are defined as an occasion when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines, resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are on the order of $\frac{1}{4}$ inch or greater.

Winter storms can be measured by snowfall, ice accumulations, and/or wind chill indices. This hazard most frequently occurs in Muskogee County between the months of November and March.

4.10.2 Location

Winter storms extend across multiple states, making their location expansive and widespread, as well as their potential severity and duration. These events develop because of low-pressure systems, which are sizable weather features. With this being the case, the effects from a winter storm can be considered uniform across the entire planning area, with no unique effects on any specific locations within the planning area identified. For a detailed discussion of how this hazard affects specific locations within Muskogee County, please see Section 4.10.6.

4.10.3 Extent

A winter storm's extent can be measured by snowfall and/or ice accumulations, along with its duration and severity. The severity of a winter storm can be determined by several factors including precipitation type, precipitation rate, and measured precipitation totals. Factors such as these and others, including high winds and extreme cold temperatures, ultimately determine the overall severity of severe winter storms in Muskogee County.

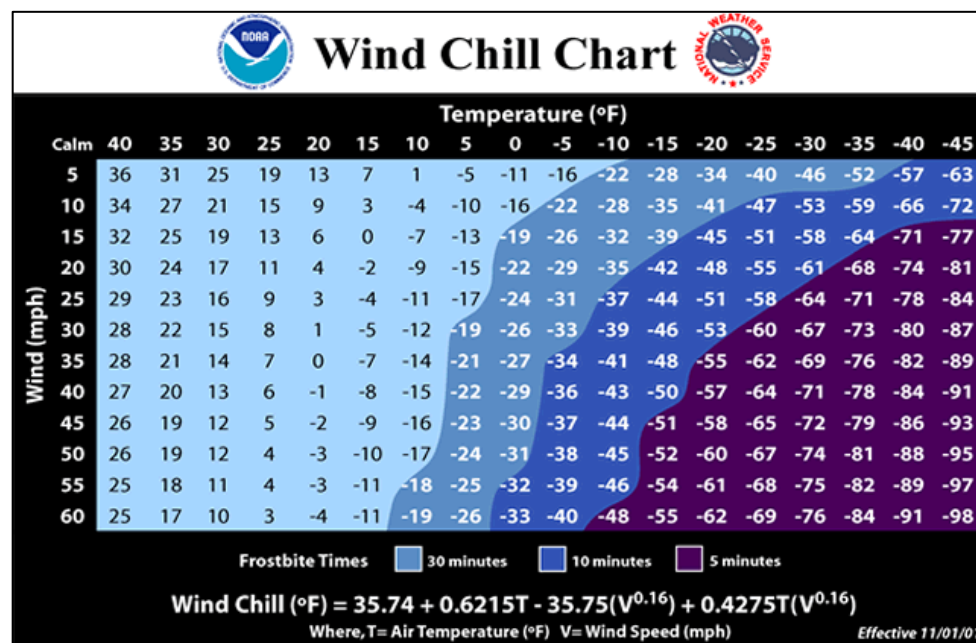
Metrics used to assess a winter storm's extent include the Sperry-Piltz Ice Accumulation Index (SPIA) and the National Weather Service Wind Chill Chart. These indices are referenced in Table 4-46 and Figure 4-17, respectively.

Table 4-46 Sperry-Piltz Ice Accumulation (SPIA) Index

Ice Damage Index	Damage and Impact Descriptions
0	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
2	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
3	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 to 5 days.
4	Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 to 10 days.
5	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.

An index which correlates ice accumulation to the amount of damage caused on a six-level scale ranging from 0 to 5, the Sperry-Piltz Ice Accumulation Index is used to predict an ice storm's projected footprint, total accumulation, and resulting damage potential which may result from an ice storm. The SPIA Index is used to predict the location, timing, and severity of ice storm impacts up to days in advance of the event. It serves as a tool allowing organizations and communities to better prepare for these events. Across the planning area, the extent of Severe Winter Storms events can range anywhere from 0 to 5 on the SPIA Index.

Figure 4-17 Wind Chill Chart (NWS)



Extreme cold can have a significant impact on the extent of a winter storm. How a wind chill temperature is calculated is depicted in Figure 4-17. This chart is one of the most widely used charts in the nation. Wind chill temperature, or the apparent temperature one feels while exposed to wind and temperatures at or below 50°F, as shown in this figure, is used primarily as an indication of the immediate threat to human safety by listing

approximate time periods for exposed skin to develop frostbite. Rapid onset times for frostbite, though rare, are possible. Based on the record low observed in Muskogee County (-15°F) and maximum sustained winds in the 95th percentile of records (25 mph), the extent to which the planning area may experience wind chill values ranges between -44°F to 50°F.

Since winter storms affect areas on a scale larger than that of Muskogee County, the extent of a winter storm can be considered uniform across the entire planning area, with no unique effects on any specific locations within the planning area identified.

4.10.4 Previous Occurrences

Across the 11-year period between January 1, 2013 and December 31, 2023, NOAA's NCEI Storm Events Database shows 15 events where winter weather of the types "Winter Storm" and "Ice Storm" occurred in Muskogee County. While winter storms often produce monetary damage to crops and property, that information has not been made available through this database for the events on record during this period. In Table 4-47, some notable severe winter storms affecting Muskogee County are listed, including the dates of occurrence and a brief narrative describing the event.

Table 4-47 Notable Severe Winter Storms in Muskogee County 2013-2022

Date	Narrative
12/05/2013	Arctic air spread across eastern Oklahoma on the 4th as a strong storm system developed across the western United States. Several upper-level disturbances moved through the south-central part of the country on the 5th through the 6th, resulting in widespread wintry precipitation across the region beginning during the morning hours of the 5th. The precipitation fell mainly as freezing rain across southeastern Oklahoma and as snow and sleet across northeastern Oklahoma. The precipitation changed to all snow by the time it ended on the 6 th . Several inches of snow and ice fell across southeastern Oklahoma, while portions of northeastern Oklahoma received up to eight inches of snow. Roads were snow and ice covered across much of the region for days as temperatures remained below freezing.
12/20/2013 – 12/24/2013	Freezing temperatures near the surface interacted with precipitation across eastern OK producing widespread freezing rain. Much of eastern Oklahoma north of the McAlester–to–Stillwell line received 0.25" – 0.50 "of ice with locally near 0.75" in some areas of northeastern Oklahoma. Scattered to numerous power outages and widespread tree damage occurred across the region. The freezing rain changed to snow during the evening of the 21st with very light accumulations across portions of northeastern Oklahoma. The ice and snow resulted in slick and hazardous roads. The ice finally melted off trees and power lines on the 24th, when temperatures climbed above freezing for the first time since the storm.
02/02/2014	A strong upper-level disturbance moved into the Southern Plains from the southwest on February 2nd. Arctic air was already in place across eastern Oklahoma ahead of this system. Precipitation developed during the morning hours and continued into the late afternoon and evening hours. Four to seven inches of snow occurred across much of east central and northeastern Oklahoma during this event. Roads were snow and ice covered, resulting in numerous automobile accidents.
02/15 /2015	An arctic cold front moved through eastern Oklahoma late on the 14th and early on the 15th. A strong upper-level disturbance moved into the Southern Plains late on the 15th, resulting in widespread precipitation developing across the region as warm and moist air was lifted over the low-level cold air. The rain gradually changed over to sleet over east central and southeastern Oklahoma during the late evening of the 15th. Sleet accumulations across this region were also in the half inch to nearly two-inch amounts, with some embedded convection responsible for rapid accumulations.

Date	Narrative
01/06/2017	An upper-level disturbance moved into the Southern Plains on the 6th. Arctic air had previously settled into the region and became deep enough to support snow as the disturbance approached. Light snow fell across much of eastern Oklahoma south of the Pawnee-Tulsa-Jay line. A heavy band of snow of four to five inches fell across portions of Muskogee, McIntosh, Adair, Okmulgee, and Cherokee Counties.
02/08/2021 – 02/20/2021	A strong storm system translated into the Southern Plains from the Southern Rockies on the 14th and 15th. Heavy snow began across the area with the approach of the main storm system during the early morning hours of the 14th. Several rounds of widespread heavy snow produced four to eight inches of accumulation, as the snow continued into the early afternoon hours of the 15th in some areas as the storm system moved away from the region. The heaviest snow fell in a swath along and south of I-44, and north of I-40, across portions of Okfuskee, Creek, Okmulgee, Tulsa, Wagoner, Rogers, Mayes, Cherokee, and Delaware Counties. In addition to the heavy snow, much of eastern Oklahoma experienced excessively cold wind chill from the 14th through the 16th. Temperatures fell below zero across the area on the 15th and 16th, and wind chill values were as low as -20 to -30 degrees. Collectively, these events resulted in the issuance of disaster declaration DR-4587-OK, which included Muskogee County.
02/01/2022 – 02/04/2022	Arctic air spread into the region during the evening of the 1st through the morning of the 2nd, as a strong upper-level disturbance translated from the Pacific Northwest into the Southern Rockies. Light wintry precipitation developed across northeastern Oklahoma during the early morning hours of the 2nd, as this system approached, with light freezing rain and light sleet. Patchy freezing drizzle developed during the day of the 2nd, with more widespread precipitation developing across the area during the afternoon and evening. The precipitation continued through the morning of the 3rd. Heavy amounts of ice occurred across southeastern Oklahoma, where up to a half inch of glaze occurred, with heavy snow falling across much of northeastern Oklahoma where up to eight inches of snow fell. There was a swath between the heavy snow and heavy ice that received heavy amounts of sleet up to one and a half inches, with some ice and snow. A final round of snow developed into eastern Oklahoma during the evening of the 3rd, and that produced another one to three inches of snow through the early morning hours of the 4th. Storm total snowfall amounts were generally four to eight inches across much of northeastern and east-central Oklahoma, with locally up to ten inches reported.

* Dates which appear in bold font are those tied to a federal disaster declaration

4.10.5 Probability of Future Events

According to FEMA, Muskogee County has received seven Severe Winter Storm disaster declarations, two of which were between January 1, 2013, and December 31, 2023. NCEI storm events data showed during this same period, there were 15 severe winter weather events provided for Muskogee County. Based on these statistics, the annual average number of Severe Winter Weather events is 1.36, making this hazard **highly likely**, according to Table 4-3.

4.10.6 Vulnerability and Impacts

Unless explicitly noted in the vulnerabilities described in this section, the risks associated with this hazard apply to the county and all incorporated areas participating in this planning process. Based on the classifications in Table 4-4, the overall significance of a severe winter storm event in the planning area is **high**.

Vulnerabilities to and impacts resulting from severe winter storms are uniform across the planning area. Communities and individuals exposed to such events are at risk of adverse effects on their health and well-

being, electrical service disruptions, dangerous travel conditions, and other dangers that put interests and residents at an elevated risk.

Table 4-48 Vulnerabilities and Impacts due to Severe Winter Storm Events

Vulnerability	Jurisdiction	Impact
Above ground power lines service each of the participating jurisdictions within the planning area. These structures are commonly impacted during severe winter storm events.	- Muskogee County (unincorporated) - All incorporated areas - All PS Districts	Damage to power lines resulting from winter storm events increases the probability of power outages, some of which can be prolonged, particularly during more severe events which cause more widespread outages. When combined with slick roads and/or extreme cold temperatures, power restoration efforts can become complicated. In those situations, the danger to vulnerable populations can increase significantly. For example, without electrical service, many residents who are vulnerable lose access to a reasonably safe, proper source of heat, which can then put them in a potentially life-threatening situation.
Fire Departments and Town Halls do not have backup power generators in the event of a loss of electricity. Other critical facilities identified included water departments and sewage treatment facilities along with designated warming stations and shelters in the Planning Area	- Braggs - Boynton - Council Hill - Fort Gibson - Haskell - Oktaha - Porum - Summit - Taft - Wainwright - Warner - Webbers Falls	A loss of critical government functions in these areas resulting from a loss of electricity during a severe winter event can become a public tragedy without the capabilities afforded by having any level of backup electrical generation. Residents whose health and wellbeing may depend upon a continuous flow of electricity, and access to heating during cold weather, lose those things and do not have a place to go to seek refuge face a mortal risk during these events.
Schools are vulnerable during severe weather events when temperatures are extremely cold. Pipes can freeze and school equipment can stop working	Oktaha Public Schools	Frozen pipes in schools can then burst and flood school buildings, rendering those structures unusable until leaks can be repaired. Past events have led to gymnasium floors and other school rooms being destroyed due to flooding after pipes ruptured.
Severe winter events can lead to roads which are unsafe to drive on, especially for school buses. Many routes include rural roads which are not regularly treated during icy weather conditions.	All public school districts	Icy roadways can mean bus transportation is halted and school children cannot safely get to/from schools. Many times, icy roads have led to school delays or closures.

A significant buildup of ice during winter storms on tree limbs and branches can produce devastating impacts across much of the planning area. Ice-laden tree limbs can fall onto power lines, disrupting electricity and rendering “live” wires on the ground. Anyone who encounters these wires can sustain serious or life-threatening injuries. Ice storms also cause tree limbs to crash onto homes and businesses which

exposes those inside to extreme winter conditions. Downed tree limbs can be particularly impactful when trees still have their leaves, like in late Fall.

School districts often experience disruptions to classroom instruction and events due to severe winter storms. Such cases may require districts to make decisions to transition to online instruction or cancel classes until they can be resumed safely. This can have cascading impacts on students who rely on services provided by schools, such as meals.

Threats to electrical services are a significant adverse effect stemming from severe winter storms. Snow, ice, and high winds are all threats associated with severe winter storms which can cause downed power lines and place an undue strain on the electrical grid. Increased energy demand during severe winter storm events accompanied by extreme cold temperatures can reduce the reliability of the electrical grid. Power outages can range from hours to days, depending upon the severity and the scope of the damage to the electrical infrastructure. Power outages lasting for more than 8 hours can pose risks to vulnerable populations, such as the elderly, people with disabilities, or those who don't have the means to seek shelter elsewhere. Loss of power during severe winter storms can quickly become a significant problem, particularly when outages last for an extended length of time.

Roadways and railways within the planning area can experience a reduction or stoppage of flow of traffic because of ice and snow accumulations. With the Arkansas River bisecting the County, bridges over the river can be lifelines if other routes become unusable. Rendering aid or assistance during severe winter storms can sometimes rely on the use of these bridges, and when they are not drivable, response times can be greatly extended as responders must re-route to other crossings.

4.10.7 Future Conditions

Climatological Effects

Years consisting of many snowfall days declined significantly across the southern United States between 1930 and 2007. Models suggest although the number of snowfall events will likely continue to decrease given overall atmospheric warming, when snow does occur, accumulations will be greater due to increases in atmospheric moisture (Krasting et al. 2013). There is significant uncertainty surrounding the future of ice storms in Oklahoma. Observational data limitations and the complexity of the events themselves make it difficult to determine with much specificity whether patterns have and/or will change. Models show that by mid-century there will generally be a northward shift of the rain, sleet and snow dividing line across the central United States. This shift will add to the complexity of determining precipitation type for winter events (rain, ice, or snow) in Oklahoma, however, the increase in atmospheric moisture may bring an increase to the amount of precipitation that does fall (Easterling et al. 2017).

Land Use Changes

Further development within the planning area, particularly transportation, electrical, and water delivery infrastructure, would be vulnerable to the effects of winter storms. New structures within the planning area would also be vulnerable to the effects of extreme cold, if such construction does not conform to the most current standard of International Building Codes that have been released at the time of construction.

Population Patterns

From 2010 to 2020, Muskogee County's population declined from 70,990 to 66,339, and on a jurisdictional level, a similar downward trend is noted. Regardless, these trends do not influence severe winter storm impacts in the planning area.

Increases in population in Muskogee County would naturally lead to changes in several infrastructure elements, such as transportation and electrical. Such changes would increase the burden on local governments to treat roads according to the winter weather hazard, as well as place an increased strain on the power grid as demand increases due to customers using more energy to heat their buildings, not to mention the effects of some hazards, such as accumulating ice, on trees and power lines from ice storms.

Residents in the planning area who can be expected to experience increased vulnerabilities to severe winter storms have been identified in the communities listed in Table 4-48 in the Vulnerability and Impacts section. Population patterns

4.11 Tornado

4.11.1 Description

A tornado is defined by the National Weather Service as a violently rotating column of air, usually pendant to a cumulonimbus (cloud), with circulation reaching the ground. It nearly always starts as a funnel cloud and may be accompanied by a loud, roaring noise. On a local scale, it is the most destructive of all atmospheric phenomena.



For the scope of this plan, tornadoes are being assessed independently from high wind. As discussed in Section 1.8, high winds, as considered in this plan, are linear in nature, while winds in association with a tornado rotate around a vortex that can be as small as less than 100 feet in diameter.

Tornadoes in Muskogee County generally form as a product of severe thunderstorms. Thunderstorms, and the low-level atmospheric conditions around them, may facilitate the formation of numerous tornadoes, some remaining on the ground for durations longer than others. While the least common type of thunderstorm, supercell thunderstorms, also known as supercells, are the type of thunderstorm which most commonly produces tornadoes. For such a thunderstorm to develop, the following parameters are usually present, to varying degrees: abundant low-level moisture, atmospheric instability, vertical wind shear, and a forcing mechanism (i.e., frontal boundary, dry line, etc.). When and where supercell thunderstorms develop, there is a high propensity to produce severe weather such as damaging winds, large hail, and/or tornadoes, the latter of which produces the most violent and destructive impacts. While forecasting the development of a tornado is not an exact science, there are some parameters that factor into their genesis. As updrafts increase in strength in supercells, a horizontal rotating column of air becomes picked up by this vertical flow and allows the thunderstorm to rotate independently of a larger scale low pressure system. Downdrafts in the rear of the storm subsequently intensify, which allow the intense rotation to be pulled down. When that rotation extends all the way to the ground, a tornado develops. Tornadoes which develop in association with supercell thunderstorms are unique, and these thunderstorms produce the strongest tornadoes. Other environments in which tornadoes may form in Muskogee County are along squall lines, derechos, and remnants of tropical systems which have moved inland over the planning area.

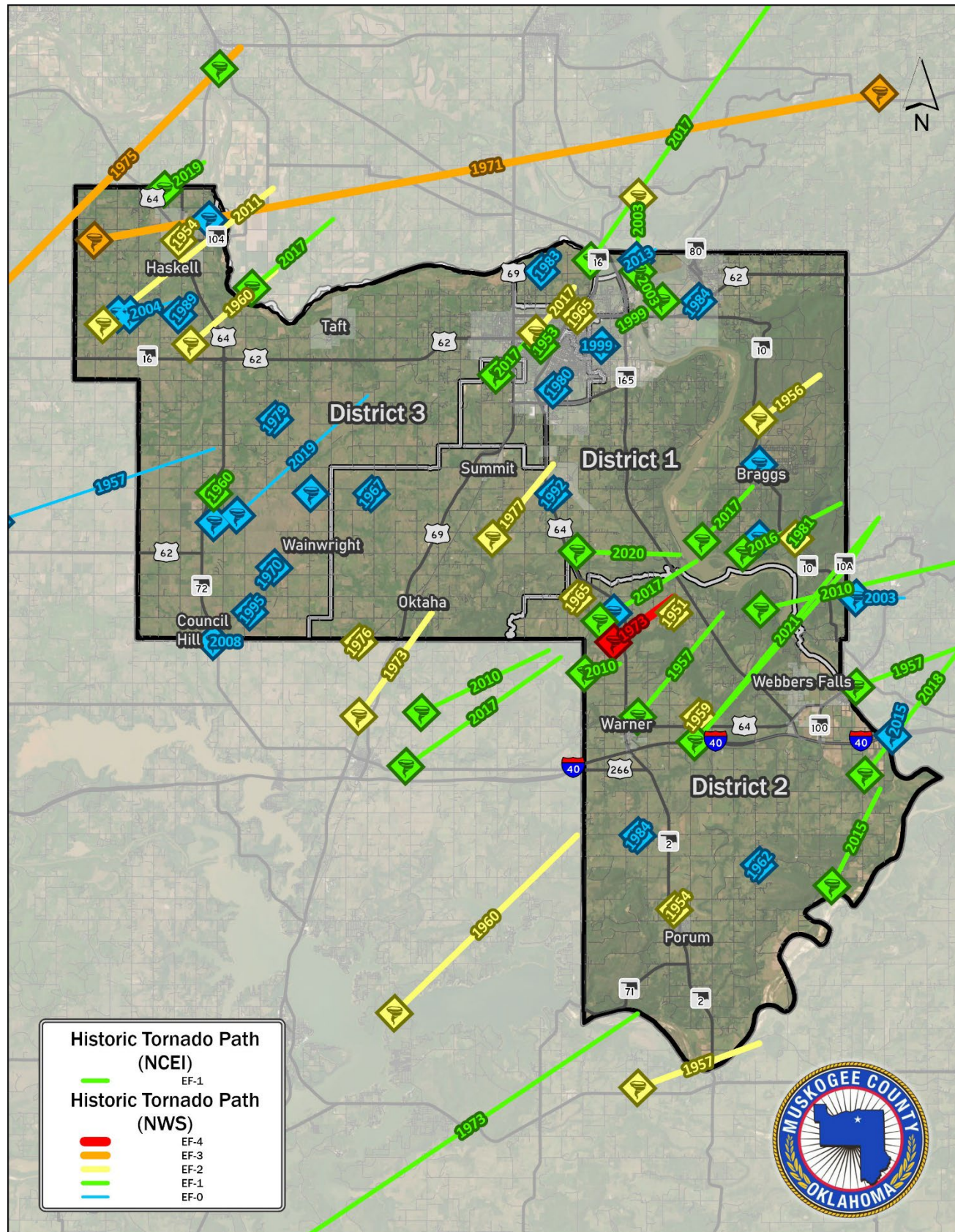
4.11.2 Location

Assessed in a similar fashion to lightning, which is another byproduct of thunderstorms, the entire planning area shares a uniform risk to tornadoes. This is due to the risk of thunderstorms being uniform across Muskogee County, and although a tornado will produce effects very localized in relation to other hazards. A trade-off in this consideration is the fact that in those more concentrated areas which may experience the effects of a tornado, more severe damage may occur.

Unlike hazards that are seasonal, such as winter storms or extreme heat, tornadoes are a threat that can occur at any time of the year within the planning area. Since the Köppen Climate classification for Muskogee County is Cfa (Humid subtropical), periods of above normal temperatures and atmospheric moisture content can produce conditions favorable for the development of thunderstorms which have the potential to produce tornadoes during each month of the year.

While there are no locations within the planning area identified as having a unique risk to tornadoes, a detailed discussion on vulnerabilities of specific locations within Muskogee County to this hazard can be found in Section 4.11.6. This can be seen in Figure 4-18, where the locations of tornado paths, their date, and their intensity are overlaid across a map of the county.

Figure 4-18 Historic Tornado Paths Within Muskogee County



4.11.3 Extent

Extent of tornadoes is assessed using the Enhanced Fujita (EF) scale which is shown in Table 4-49. Based on wind speed estimations and damage surveys, officials use this scale to classify tornadoes the intensity of tornadoes. On February 1, 2007 after revisiting the Fujita scale metrics, officials at the NWS fully implemented the Enhanced Fujita (EF) as a way to rate tornadoes using more variables than the original F Scale. Inclusive in the EF Scale are 28 damage indicators which align more closely with estimated winds within a tornado.

Table 4-49 Enhanced Fujita Scale for Tornadoes

Tornado Rating	3-Second Wind Gust
EF-0	65 mph – 85 mph
EF-1	86 mph – 110 mph
EF-2	111 mph – 135 mph
EF-3	136 mph – 165 mph
EF-4	166 mph – 200 mph
EF-5	> 200 mph

While any tornado can cause damage or injury, NOAA highlights those being an EF-3 or higher as being more significant because of their ability to produce damage, injuries, or even fatalities. In fact, FEMA and NOAA estimate the 85% of all fatalities due to tornadoes resulted from those rated EF-3 or higher.⁴³ Across the planning area, the extent of tornado events can range between EF-0 and EF-5. As with location, the extent of the tornado hazard is uniform across the entire planning area.

4.11.4 Previous Occurrences

Throughout the course of history, tornadoes have produced nine federal disaster declarations in Muskogee County, five have occurred over the examined period. In Table 4-50 below, some notable tornado events affecting the planning area are listed. Between January 1, 2013, and December 31, 2023, records show 14 tornadoes have impacted Muskogee County, and each is described in Table 4-50 below. Combined, these events produced \$967,000 in property damage and only one injury.

Table 4-50 Tornado Events in Muskogee County from 2013 to 2022 (NCEI)

Date	EF Rating	Property Damage	Narrative
03/30/2013	EF-0	\$25,000	An EF-0 tornado damaged a center-pivot irrigation system, snapped large tree limbs, damaged a permanent home, and damaged barns. The damage path in Muskogee County was 200 yards wide and 1 mile long, and estimated maximum winds ranged from 80 to 85 mph. As it moved into Wagoner County, the tornado dissipated.
05/29/2015	EF-1	\$30,000	This tornado developed in or just north of the Canadian River bottoms in southern Muskogee County and moved north-northeast uprooting trees, snapping a few tree trunks, damaging outbuildings, and damaging a couple homes. Based on this damage, maximum estimated wind in the tornado was 90 to 100 mph. Damage surveys the tornado was roughly 400 yards wide and travelled 5 miles near the Sequoyah National Wildlife Refuge. This tornado was part of a larger outbreak which prompted the issuance of DR-4222-OK .
04/26/2016	EF-1	\$50,000	An EF-1 grew to about 800 yards wide and travelled more than 5 miles in eastern Muskogee County. This tornado snapped or uprooted numerous trees, damaged buildings at Greenleaf State Park, and snapped power poles. The end

⁴³ https://www.fema.gov/sites/default/files/documents/fema_safe-rooms-for-tornadoes-and-hurricanes_p-361.pdf

Date	EF Rating	Property Damage	Narrative
			point is estimated based on radar data as the tornado moved onto Camp Gruber, which was inaccessible to the survey team. Based on this damage, maximum estimated wind in the tornado was 100 to 110 mph.
05/18/2017	EF-1	\$20,000	An EF-1 travelled about 5.3 miles across central Muskogee County, growing to a width of about 900 yards at one point. The storm snapped or uprooted numerous trees, damaged outbuildings, and blew down power poles. Based on this damage, maximum estimated winds in the tornado ranged from 90 to 100 mph. This event was part of an outbreak which prompted the issuance of DR-4324-OK
05/18/2017	EF-1	\$25,000	An EF-1 clipped the western parts of Muskogee, developing near the Eagle Crest Golf Club where several homes were damaged, and trees were uprooted. It moved NE blowing down trees and power poles before finally dissipating on the west side of Muskogee. Maximum estimated winds ranged from 90 to 100 mph, and this event was part of a larger outbreak that prompted the issuance of DR-4324-OK .
05/18/2017	EF-2	\$350,000	This tornado developed over the north side of Muskogee where it damaged homes and snapped or uprooted trees. The tornado destroyed a well-constructed metal framed building south of Highway 62 and then tore the roof off a couple of apartment buildings north of Highway 62. Trees and power poles were snapped and businesses along Highway 62 had roof damage and broken windows. The tornado continued northeast destroying outbuildings and blowing down trees, dissipating northeast of the intersection of N Main and E Harris Road. Based on this damage, the maximum estimated wind in the tornado was 115 to 125 mph, and this event was part of a larger outbreak which prompted the issuance of DR-4324-OK .
05/18/2017	EF-1	\$20,000	This tornado developed east of S 75 th St E and north of the E 965 Road. It moved east-northeast until crossing E 93 rd St S where it turned northeast. The tornado then turned north as it crossed the N 4380 Road. The tornado uprooted trees, snapped numerous large tree limbs, damaged outbuildings, and blew down power poles. Based on this damage, maximum estimated wind in the tornado was 85 to 95 mph, and this event was part of a larger outbreak which prompted the issuance of DR-4324-OK
05/18/2017	EF-1	\$0	This is the first segment of a three segment tornado. In Muskogee County, an EF-1 travelled 0.6 miles NE of Chase and snapped and uprooted numerous trees. The tornado continued into Wagoner County. Based on this damage, maximum estimated wind in this segment of the tornado was 90 to 100 mph. This event was part of a larger outbreak which prompted the issuance of DR-4324-OK
11/30/2018	EF-0	\$40,000	This is the first segment of a two segment tornado. This tornado developed in the Arkansas River bottoms of far southeastern Muskogee County, where several center pivot irrigation systems were destroyed, and barns were damaged. The tornado crossed the Arkansas River into Sequoyah County. Based on this damage, maximum estimated wind in this segment of the tornado was 80 to 85 mph.
04/30/2019	EF-0	\$5,000	This is the first segment of a two-segment tornado which occurred in extreme NW Muskogee County near Haskell. An EF-0 damaged the roof of a home and uprooted small trees. Multiple people observed it. Based on the damage, maximum estimated wind in this segment of the tornado was 75 to 80 mph. The tornado continued into Wagoner County

Date	EF Rating	Property Damage	Narrative
05/22/2019	EF-0	\$0	A trained storm spotter reported a brief tornado. An NWS damage survey found that the tornado snapped large tree limbs. Based on this damage, maximum estimated wind in the tornado was 70 to 80 mph. While this tornado had limited effects in Muskogee County, it was part of a larger outbreak which prompted the issuance of DR-4438-OK .
10/20/2019	EF-0	\$2,000	A tornado developed southeast of Boynton to the south of W 83 rd Street S, and moved northeast to a point north of W 33 rd Street S. It uprooted a couple medium sized trees, blew down a power pole, and snapped large tree limbs. Much of the tornado path was across farmland, so the damage noted above generally occurred as the tornado crossed section line roads. Based on this damage, maximum estimated wind in the tornado was 80 to 85 mph
05/15/2020	EF-1	\$350,000	This tornado developed along Elm Grove Road, west of S 25 th Street E, where outbuildings were damaged, and trees were uprooted. It moved eastward for 4.8 miles with a maximum width of 525 yards at its widest point damaging or destroying about sixteen homes. It also destroyed several outbuildings, uprooting numerous trees, and snapping numerous power poles until it dissipated just east of the Muskogee Turnpike. Based on this damage, the maximum estimated wind in the tornado was 100 to 110 mph. One injury was reported in association with this event.
10/10/2021	EF-1	\$50,000	This is the first segment of a two segment tornado. A long-track supercell produced this tornado, which developed near I-40 east-southeast of Warner, to the east of S 75 th Street E. It moved northeast across Highway 64, and then crossed the Muskogee Turnpike near E 163 rd Street S. The tornado then moved over the Arkansas River and crossed into Sequoyah County near the intersection of the county line and Highway 10A. Its total path length was 10.9 miles, with a maximum width of 900 yards at its widest point. In Muskogee County, the tornado damage homes, destroyed outbuildings, snapped, or uprooted numerous trees, and blew down power poles. Based on this damage, maximum estimated wind in this segment of the tornado was 100 to 110 mph.

* Dates which appear in bold font are those tied to a federal disaster declaration

4.11.5 Probability of Future Events

With a total of 14 tornado events impacting the planning area from January 1, 2013, to December 31, 2023, the annual probability of future tornadoes averages to 1.27 events per year, and according to the classification method described in Table 4-3, tornadoes are **highly likely** across the planning area.

4.11.6 Vulnerability and Impacts

Unless explicitly noted in the vulnerabilities described in this section, risks associated with this hazard apply to all participating jurisdictions within the planning area. Based on the classifications in Table 4-4, the overall significance of a tornado in the planning area is **high**. Tornadoes most notably can cause injury and death, and there can be significant loss to the built environment throughout the planning area.

Table 4-51 Vulnerabilities and Impacts due to Tornado Events

Vulnerability	Jurisdiction	Impact
Above ground power lines, which serve each of the participating jurisdictions in the planning area, are vulnerable during tornado events.	All participating jurisdictions	Tornadoes can damage and destroy power lines, and the poles from which they hang. Downed power lines pose a risk of electrocuting individuals who may encounter them. Resulting power outages caused by downed power lines are also a source of risk to affected residents, particularly those who rely on electricity for health reasons. Tornado events that occur during school hours and during school district sponsored functions also pose a risk to students and staff at schools. Injuries, and even death, may result due to inadequate shelter.
Students and staff members at public school districts are vulnerable to tornadoes because the on-site shelter is insufficient for the number of students/staff.	Oktaha Public Schools	Inadequate sheltering options can mean there is not sufficient room or that sheltering options are dangerous due to cascading hazards, like flooding.
No outdoor warning sirens are in place, which makes residents vulnerable due to the lack of advanced warning when tornadoes approach.	- Muskogee Co. (unincorporated areas of District 3) - Taft	Individuals caught outside in areas such as these without siren coverage when a tornado is approaching are at a significant risk to their lives if they are unaware of the level of danger.
Critical facilities that lack backup power generators are vulnerable during tornado events when electricity is disrupted.	- Muskogee County (unincorporated) - All Incorporated Areas - All Public-School Districts	In the event of a power outage, a disruption to electrical service could mean that critical facilities and schools, which provide services that meet the standards for FEMA Community Lifelines, would be interrupted. Residents and students who rely on these services would be vulnerable until those services can be restored once again, which may not happen for days or weeks in some circumstances.

Tornado events can damage homes, businesses, and infrastructure across the entire planning area, and these areas are some of the most susceptible to damage or destruction from this hazard. Rural and undeveloped areas of the county are uniquely vulnerable to the effects of tornadoes. Isolation from emergency services, first responders, and individuals involved with rescue, response, and recovery efforts may not have an awareness of any individuals in these areas who need assistance or rescue. Damage or debris blocking access routes to these areas may delay or obstruct efforts to reach those in need.

For school districts, tornadoes threaten the safety of students and staff members, especially those who do not have adequate sheltering spaces located within the school buildings themselves. Aside from physically damaging school buildings, tornadoes can disrupt or cancel classes, or in extreme circumstances, force a school district to locate their student body to a neighboring school if damages are severe enough. Individuals attending school-sponsored events are at risk if a tornado develops and poses an imminent risk during those events. Detection, warning systems, emergency plans, and shelters/safe rooms are all

important capabilities that serve to save lives when tornadoes threaten schools. Any schools who lack these capabilities will experience an increased risk relative to the number of these capabilities they do not have or are less than optimal.

Critical facilities can likewise see direct impacts from tornadoes, and while many have shelters, the services they provide can be delayed or disrupted, which can negatively impact the remainder of the community in which they serve.

Tornadoes can have enormous effects on Muskogee County's infrastructure, particularly electric utilities. Flying debris and high winds can damage and destroy power lines, snap utility poles and high-voltage transmission lines and tear apart transformer units. Residents across the planning area are vulnerable for this reason to encountering power outages as these transmission lines are severed. Vulnerable populations such as the elderly or sick are at a higher risk of tornadoes due to their reliance upon electricity for their safety and wellbeing. Power outages resulting from a tornado can affect thousands of residents and leave them without electrical service to their homes for days or weeks, and cascading impacts to losing power is how other hazards may worsen conditions. Extreme Heat can (and often does) follow tornado events as these hazards mostly occur in the Spring-Fall timeframe. Without generators, facilities are often unable to provide service which can have a direct threat to people's life and safety.

Water treatment plants are at risk of damage resulting from tornadoes, which can cause a disruption in operations at these facilities. Additionally, tornadoes which result in a disruption of power delivery can have the same effect on water treatment plants. If operations at water treatment plants are forced to pause or cease operations until repairs can be made or electrical power can be restored, cascading impacts which are produced consequently include risks to the health and wellbeing of residents and issuance of boil water notices.

Tornadoes can damage communications lines, which are hung on the same poles as electrical distribution lines. Cellular services and radio towers can also be damaged or destroyed by tornadoes. Degraded service, or reduced quality service, can result, which can hamper or prevent residents in need of emergency services from being able to reach dispatchers. A cascading impact resulting from this is a risk to life and health to those residents.

Debris blown onto roadways by tornadoes can block passage of traffic, including emergency officials and first responders. Additionally, the strongest of tornadoes have been observed to scour pavement, which would also serve to block passage of traffic on those roadways. Cascading impacts include delayed recovery and response times and replacement costs for these roadways.

4.11.7 Future Conditions

Climatological Effects

Records over the past 40 years show that there has been an increase in the frequency of days with a large number of tornadoes (i.e., tornado outbreaks). However, there has also been a decrease in the frequency of days with tornadoes (Kossin et al. 2017). In other words, increasingly, when tornadoes occur, they are more likely to occur in conjunction with a tornado outbreak. It is currently difficult to account for tornadoes in climate models because they occur on a very small scale. Therefore, more research is needed to understand how climate change is influencing tornadoes (Walsh et al. 2014). Progress has recently been made, however, in understanding how the large-scale climate system relates to the conditions that support tornadoes. As such, climate models project an increase in the frequency and intensity of severe

thunderstorms, which can include tornadoes, most commonly during the months of March, April, and May. However, confidence in the details of this projected increase remains low (Kossin et al. 2017).

Land Use Changes

Further development within the planning area, particularly transportation and electrical infrastructure, would be vulnerable to the effects of tornadoes. New structures within the planning area will also be vulnerable much like the built environment of today. New development that fails to conform to the latest International Building Codes standards will place that new development at higher risk, especially if future climate trends mean more intense tornadoes are to be expected. Communities in Muskogee County who have not adopted the 2018 IBC standard include: Muskogee County, Fort Gibson, Haskell, Muskogee (city), Oktaha, Porum, and Warner.

Population Patterns

Population patterns are influencing tornado hazard impacts, because as population numbers continue to increase area-wide, so too, is the exposure and potential risk to residents. A more dispersed population and development pattern leads to greater median and mean tornado-society impact probabilities. There will be an increasing need to ensure residents are prepared for tornado events in the future. Educational programs and community outreach initiatives will be important for local officials to promote. In doing so, planning officials will help ensure there is equity and transparency for all sub-groups of the population, especially for those who are deemed socially vulnerable or disadvantaged. More people living in the planning area translates to an increase in the number of residents who will be exposed to future tornado events. Cascading impacts resulting from this include an increased strain on first responders and the healthcare system in the County in responding to a tornado disaster and treating victims.

4.12 Wildfires

4.12.1 Description

Wildfire is defined by the National Weather Service as any free burning, uncontrollable, wildland fire not prescribed for the area which consumes the natural fuels and spreads in response to its environment. Wildfires can result in widespread damage to property and loss of life. Fire can also produce secondary hazards, such as thick, impenetrable smoke, which can obscure visibility and cause health problems. Such issues can adversely affect transportation and evacuate burning structures. While wildfire is a hazard which can occur in the planning area any time of year, many wildfires in Oklahoma occur during the climatologically driest periods annually of late fall through early spring.



4.12.2 Location

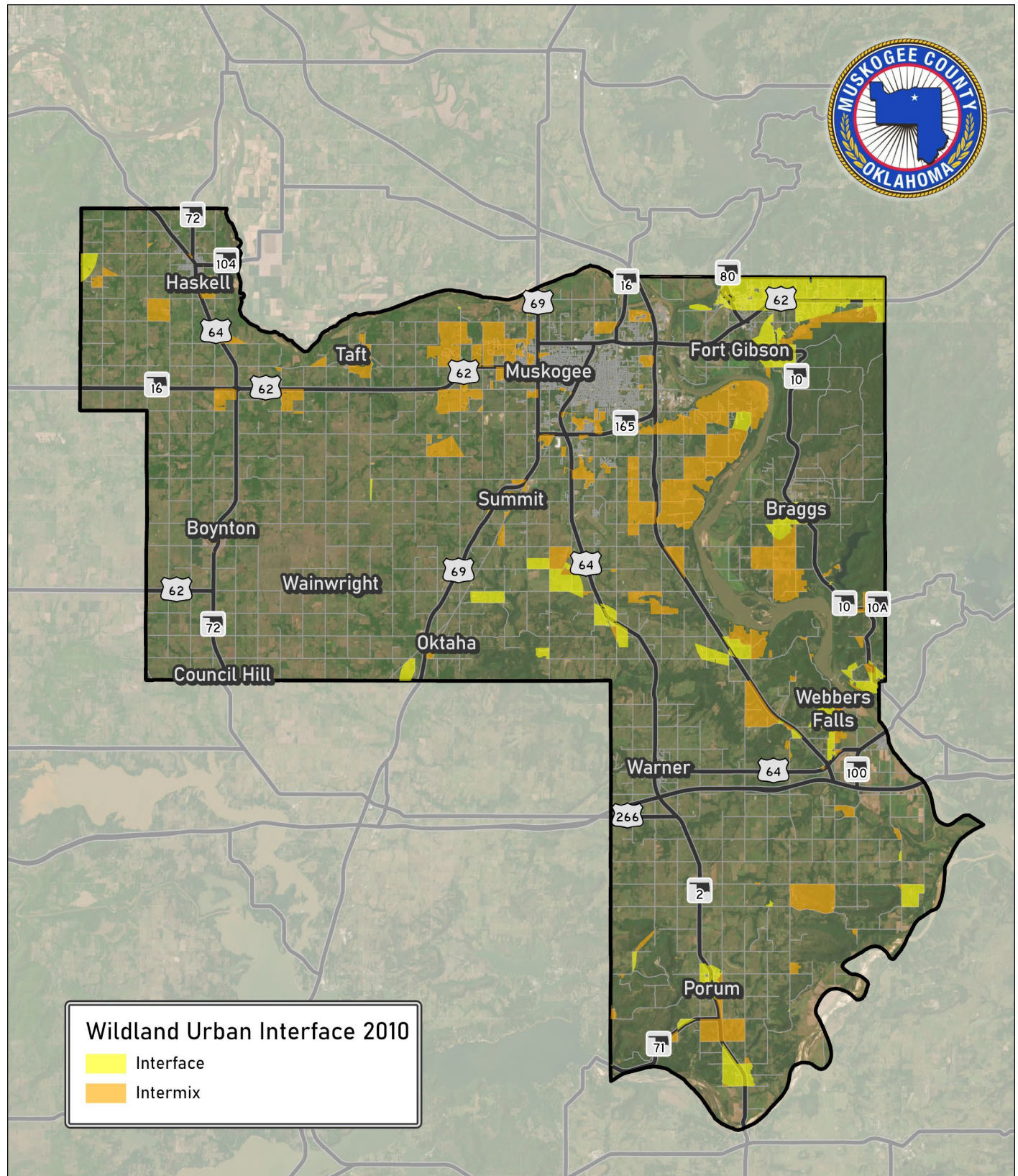
To establish the location of wildfires, the Wildland-Urban Interface (WUI) is used. WUI areas note the zone of transition between unoccupied land and human development. It is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. To determine the WUI, structures per acre and population per square mile are used. The WUI in the area is divided into two categories: intermix and interface. Intermix areas have more than one house per 40 acres and have more than 50% vegetation. Interface areas have more than one house per 40 acres, have less than 50% vegetation, and are within 1.5 miles of an area over 1,235 acres that is more than 75% vegetated. Based on the best available data and analyses, WUI maps can be used to determine an area's wildfire hazard within Muskogee County.

Areas of Wildland-Urban Interface (WUI), along with reports from local officials, have been used to determine the locations within the planning area at the highest risk of wildfire. Generally, unincorporated areas, small, isolated towns in rural areas, and developed areas on the fringes of urban areas are those that are located within WUI and are at the highest risk of wildfire. Thus, it can be said that unincorporated portions of Muskogee County, the outskirts of the City of Muskogee, and the towns of Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Oktaha, Porum, Summit, Taft, Wainwright, Warner, and Webbers Falls are at the highest risk of wildfire in the planning area.

Locations within the WUI are those found within the transition zone between lands which are developed and those which are not. The U.S. Fire Administration defines Wildland-Urban Interface as the zone of transition between unoccupied land and human development. It is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. The density of structures and population are two factors used to determine WUI. WUI can be divided into two categories: interface and intermix. Intermix areas have more than one house per 40 acres, less than 50% vegetation, and are within 1.5 miles of an area over 1,235 acres that is more than 75% vegetated. WUI information has been obtained through the Southern Group of State Foresters, Wildfire Risk Assessment Portal. Based on the best available data and analyses, WUI can be used to determine areas of fire hazard location within Muskogee County.⁴⁴

⁴⁴ <https://southernwildfirerisk.com/>

Figure 4-19 Wildland-Urban Interface (WUI) across Muskogee County, OK



All structures in Muskogee County, including all participating jurisdictions, are at risk to Wildfire events. While this risk is subjective and depends on several factors such as age of structures, type of construction, and distance from the nearest fire stations. Land use also plays a major role, including whether a parcel is in a developed area, location within that developed area, or whether it is in a mostly undeveloped area such as open woods or grassland. To further understand each participating incorporated wildfire risk, community WUI maps have been created and included above. Locations in the planning area that are at higher risk to seeing Wildfire events are unincorporated portions of Muskogee County, the outskirts of the City of Muskogee, and the towns of Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Oktaha, Porum, Summit, Taft, Wainwright, Warner, and Webbers Falls.

4.12.3 Extent

Wildfire extent is determined by the following indices: Keetch-Byram Drought Index (KBDI), the Burning Index (BI), and the Oklahoma Fire Danger Model (OFDM). The fire hazard risk within the planning area is mostly uniform but varies for all structures due to multiple determining factors. These factors include the age of structures, construction type, purposes, proximity to fire stations, and land use characteristics such as whether the parcel is situated in open woods or grassland. Generally, the areas with a higher risk level for this hazard encompass the unincorporated regions of Muskogee County, as well as the peripheries of Muskogee City, along with Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Oktaha, Porum, Summit, Taft, Wainwright, Warner, and Webbers Falls towns.

Keetch-Byram Drought Index (KBDI)

Although KBDI is a drought measurement tool, it is designed specifically to measure an area's potential for fire. This index measures factors like precipitation, moisture levels in soil and vegetation, and evapotranspiration rates to estimate the flammability of organic material in the ground. As displayed in Table 4-52, KBDI uses a scale of 0 to 800 in 200-point increments.⁴⁵ The extent of Wildfire events across the planning area are KBDI values ranging between 0 to 800.

Table 4-52 Keetch-Byram Drought Index (KBDI)

KBDI Value	Description
0 – 200	Soil moisture and large class fuel moistures are high and do not contribute much to fire intensity. Typical in spring dormant season following winter precipitation.
200 – 400	Typical in late spring, early growing season. Lower litter and duff layers are drying and beginning to contribute to fire intensity.
400 – 600	Typical in late summer and early fall. Lower litter and duff layers actively contribute to fire intensity and will burn actively.
600 – 800	Often associated with more severe drought with increased wildfire occurrence. Intense, deep burning fires with significant downwind spotting can be expected. Live fuels can also be expected to burn actively at these levels.

Burning Index (BI)

Another tool used to assess wildfire extent is the Burning Index (BI), because it relates temperature, relative humidity, wind speed, and solar radiation to the relative greenness of vegetation. A higher BI value

⁴⁵ https://www.wfas.net/index.php?option=com_content&view=article&id=86&Itemid=487

correlates to a higher potential severity of a fire, and the scale ranges from 0 and 100. BI values on the higher end of this spectrum generally accompany periods of severe or greater drought. In the planning area, wildfire extent can range between 0 to 100 on the Burning Index.

Oklahoma Fire Danger Model (OFDM)

A third tool used to assess wildfire risk by the planning team is the OFDM. Utilized by officials at Oklahoma Mesonet, the OFDM uses input from four separate fire danger components, including the Burning Index, Spread Component, Energy Release Component, and Ignition Component. Together, this scale assigns a fire danger rating based on a multitude of factors, and it ranges from Low, Moderate, High, Very High, and Extreme. The extent of Wildfire events in the planning area can range between “Low” and “Extreme” on the OFDM scale. Table 4-53 combines the BI and OFDM scales into a narrative that describes the various threat levels of wildfires in the planning area.

Table 4-53 Combined Fire Danger Rating (OFDM) and Burning Index (BI)

OFDM	BI	Flame Length	Description
Low	< 20	< 2 ft	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.
Moderate	20 – 40	2 – 4 ft	Fires can start from most accidental causes, but except for lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.
High	40 – 80	4 – 8 ft	All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High	80 – 110	8 – 11 ft	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme	> 110	> 11 ft	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash (trunks, branches, and treetops) or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks until the weather changes, or the fuel supply lessens.

4.12.4 Previous Occurrences

Across the 10-year period between 2013 and 2022 (2023 data not yet available), inclusive, NOAA's NCEI Storm Events Database shows 3 records of wildfires within Muskogee County. While this database contains information on some wildfire occurrences that are noteworthy, it is not the most comprehensive database for this hazard available. In Oklahoma, the State Fire Marshal's office tracks statistics for all fire department activity. Prior to 2021, the OK Fire Marshall's office reported the department's total number of fire runs, and this metric is used for this plan. After 2021, OK Fire Marshall changed the way in which fire runs were reported, including omission of statistics of acres burned and dollar losses assessed for each fire to which a fire department made a run. For fidelity purposes and to obtain an accurate metric for the number of previous occurrences, this plan will use "Number of Wildland Incidents" to account only for wildfires for the scope of this assessment. Furthermore, OK Fire Marshal data is made available in March or April of each calendar year, therefore, the 2023 wildfire statistics were not yet available during the development of this plan.

Information from both NCEI and OK Fire Marshall is used in the scope of this assessment, however the previous occurrences were determined strictly from OK Fire Marshal. Under these assumptions, the number previous occurrences for wildfires in Muskogee County between January 1, 2013, and December 31, 2022, is 1,759.

Table 4-54 Wildfire Impacts in Muskogee County, 2013 to 2022 (OK Fire Marshal)

Year	# of Wildfire Runs	Acres Burned	Losses (USD)
2013	132	1241	\$18,100
2014	152	13954	\$240,000
2015	188	5611	\$108,000
2016	329	8704	\$66,340
2017	282	4475	\$26,460
2018	240	5598	\$23,776
2019	201	2239	\$11,000
2020	145	4022	\$26,020
2021	50	--	--
2022	40	--	--
Total*	1759	45,844	\$519,696
Average/year	176	4,584.4	\$51,970

Table 4-55 Noteworthy Wildfire Events in Muskogee County, 2013 to 2022 (NCEI)

Date	Narrative
02/11/2017 – 02/14/2017	Unseasonably warm temperatures, exceptionally low relative humidity, and gusty wind combined with drought-stricken, dormant vegetation to promote the rapid spread of several wildfires across eastern Oklahoma during mid-February 2017. Muskogee County saw 500 acres burned. These fires burned for several days before they were contained.

Date	Narrative
03/03/2017 – 03/06/2017	Unusually warm temperatures, extremely low relative humidity, and gusty wind combined with drought-stricken, dormant vegetation to promote the rapid spread of several wildfires across eastern Oklahoma during early March 2017. Wildfires in Muskogee County burned over 1400 acres.
11/18/2020 – 11/19/2020	Southerly wind gusting to 30 to 40 mph, unseasonably warm temperatures, and relative humidity values from 20 to 35 percent combined with mostly dormant and cured fine fuels to promote the rapid spread of wildfires across eastern Oklahoma during the afternoon of the 18th through the 19th. A couple dozen wildfires developed across the area, most notably in Muskogee County where over 300 acres were burned.

4.12.5 Probability of Future Events

Wildfire probability depends on local weather conditions, outdoor human activities such as camping, debris/waste burning, construction, and the degree of public cooperation with fire prevention measures. Between January 1, 2013, and December 31, 2022, data from the Oklahoma State Fire Marshal shows 1,759 wildfire runs in Muskogee County, which averages 176 per year. On this basis, the annual probability of wildfire occurring in the planning area is **highly likely**.

4.12.6 Vulnerability and Impacts

Based on the classifications in Table 4-5, the overall significance of a wildfire event in Muskogee County is **medium**. Wildfires can cause structural and crop damage and result in injuries and even fatalities. Cascading impacts from this hazard include economic impacts and damage to infrastructure, as well as costs to business owners due to business disruption or closure.

Table 4-56 Vulnerabilities and Impacts due to Wildfire Events in Muskogee County, OK

Vulnerability	Jurisdiction	Impact
Portions of the planning area are at heightened risk for wildfires due to lack of defensible space between structures and vegetative fuels	Muskogee County (unincorporated)	Areas unprepared for or unmitigated against wildfire are susceptible to direct impacts from wildfires. Additionally, fires in these areas can constrain firefighting resources during Red Flag conditions and destroy structures and elements of the natural environment.
Schools located in the "Interface" or "Intermix" regions of the Wildland Urban Interface are at increased risk of wildfires.	- Braggs PS - Fort Gibson PS - Hilldale PS - Oktaha PS - Porum PS	School facilities located in the "Interface" or "Intermix" regions are at a greater risk of wildfire
Damage and destruction resulting from wildfires can occur to above ground power delivery infrastructure	- Muskogee County (unincorporated) - All incorporated jurisdictions - All public school districts	Interests without backup power generation capabilities, particularly critical facilities, can cause residents to be at an increased vulnerability if electrical power is lost as a result of fire damage to electrical delivery components in the form of interruptions to critical government functions, including first responders

Wildfires pose a health risk to residents and first responders, with burns and smoke inhalation being two of the top variables. Air quality quickly deteriorates near and downwind of wildfires, and this can be particularly impactful to vulnerable populations in the planning area, like the sick, elderly, or those with chronic illnesses.

Economic impacts of wildfires can include crop damage, business disruptions, delays in the transport of goods on roadways obstructed by smoke or closed for safety reasons, and forestry. Overall, the economic impact from wildfires remains low.

Wildfires can damage and destroy trees and other flora that make up the natural environment across the planning area. Additionally, particulates and pollutants can be released into the air, further degrading already low air quality due to smoke from these fires.

Many of the participating incorporated jurisdictions have abandoned structures of one sort or another scattered around their town/city limits. These parcels are particularly vulnerable to wildfires since many are located at the intersection of WUI Interface/Intermix regions and the highly developed urban areas. Incorporated areas often have vulnerable populations living along the outskirts of town while others do not. Table 4-57 below summarizes a few of the more vulnerable groups/structures which are found in WUI-identified zones while maps are collected in Appendix G.

Table 4-57 Critical Facilities and Structures in/near the WUI

Facility Name	Jurisdiction	WUI
Braggs Volunteer Fire Department	Braggs	Interface
Braggs Elementary School and High School	Braggs Public Schools	Interface
Cedarwoods Mobile Home Park	Haskell	Intermix
Mobile Home Park on E. Duncan St.	Haskell	Intermix
Mobile Home Park on E. Skelly Rd.	Haskell	Intermix
Mobile Home Park on N. Scott St.	Fort Gibson	Interface
Mobile Home Park on Cemetery Rd.	Fort Gibson	Interface
Town & Country Mobile Home Park	Fort Gibson	Interface
Fort Gibson Nursing Home	Fort Gibson	Interface
All Public Schools	Fort Gibson Public Schools	Interface
Muskogee Co. Mobile Home Park	Muskogee	Intermix
Brentwood Extended Care & Rehab		Intermix
Cranke's Mobile City	Muskogee	Intermix
Paradise Hills Mobile Home Park	Muskogee	Intermix
Grandview Mobile Home Park	Muskogee	Intermix
Paradise Properties	Muskogee	Intermix
Hilldale Lower & Upper Elementary School	Hilldale Public Schools	Intermix
Oktaha Mobile Home Community	Oktaha	
Porum Elementary School & High School	Porum Public Schools	Interface
Keifton Volunteer Fire Department	Muskogee Co. District 2	Interface

Facility Name	Jurisdiction	WUI
Buckhorn Volunteer Fire Department	Muskogee Co. District 2	Intermix
Council Hill Volunteer Fire Department	Council Hill	Intermix
Brushy Mountain Volunteer Fire Department	Muskogee Co. District 1	Intermix
Gooseneck Bend Volunteer Fire Department	Muskogee Co. District 1	Intermix
Muskogee Fire Department #6	Muskogee	Intermix
Porum Volunteer Fire Department	Porum	Interface

School facilities located in WUI zones are at a greater risk of experiencing effects and damage resulting from wildfires. While most schools in the planning area are within a 10-minute drive of a fire department, should roadways be obstructed due to visibility issues, risks to school facilities affected can increase. Furthermore, rural school districts like Midway PS, Wainwright PS, and Oktaha PS all rely on a network of volunteer fire department groups scattered across the County. Districts that have school facilities located in a WUI Interface or Intermix region are outlined in Table 4-57.

Impacts to the Muskogee County built environment can occur in a variety of ways. Wildfires can damage utility poles and melt insulation on power lines, which can result in disruptions to electrical service. Many electrical sub-stations and key asset points are in WUI regions where their remoteness creates a longer response time should there be any electrical spark that ignites vegetation. (see the [Muskogee County GIS Viewer](#) for more detailed analysis. Critical facilities without backup generation are at risk of failure to provide critical functions to their communities during these times. Further development, particularly that in rural areas and on the fringes of incorporated areas, will be at risk to wildfire and all associated hazards.

Since wildfire risk can be elevated during periods of drought, when public water supplies are already constrained, water shortages due to communities who do not have a backup or emergency source of water may not have adequate water pressure needed for firefighters to fight wildfires.

As with electrical power lines, wildfires can burn utility poles and melt insulation on communications lines that are above ground. According to a report compiled by researchers at the University of Wisconsin, approximately one out of four people in the United States live in an area served by mobile communications towers at risk of an outage caused by wildfires.⁴⁶ As such, residents are susceptible to cascading impacts resulting from wildfires damaging or destroying communications infrastructure, which may prevent them from receiving critical notices and updates on how nearby fires may affect them, their residences, and their personal possessions.

One of the most common effects of wildfires on transportation is smoke obscuring visibilities. This can affect roadway traffic, as well as railway and air traffic in the planning area. Additionally, transport of goods using these methods can be impacted, producing cascading economic effects. This is especially notable due to major thoroughfares such as Interstate 40, U.S. Highways 62, 69, and 64, and the Muskogee Turnpike.

⁴⁶ [Cellular networks vulnerable to wildfires across U.S. \(wisc.edu\)](#)

4.12.7 Future Conditions

Climatological Effects

Between 1984 and 2011, the number of large wildfires increased in the Southern Plains, which includes Oklahoma (Wehner et al. 2017). Wildfires in Oklahoma are dependent upon current weather conditions, seasonal climate patterns, vegetation conditions, and an available source for ignition (such as a spark, flame, or intentional). Given this complex relationship, the future trend for wildfire is also complex. However, projected increases in temperatures that can dry fine fuels such as grasses and enhanced wet/dry cycles that promote vegetation growth and drying or dormancy, coupled with population growth along the wildland-urban interface, suggests the risks of wildfires is likely to continue to increase. Read more about future wildfire risk in the resources found in Appendix C.

Land Use Changes

Rural structures and those on the outskirts of incorporated areas are often surrounded by vegetative fuels that bring an elevated risk of wildfire events. While Muskogee County maintains excellent partnerships between the various Fire Departments in the planning area, some of the more remote incorporated areas like Boynton, Wainwright, Council Hill, and Oktaha would most certainly require mutual aid should a wildfire ignite in these rural areas. Additionally, these school districts located in “Interface” or “Intermix” zones are at an increased risk of effects from wildfire: Braggs PS, Fort Gibson PS, Hilldale PS, Oktaha PS, Porum PS.

Population Patterns

Residents in jurisdictions and areas identified in Table 4-56 and Table 4-57 are at increased risk of effects from wildfire. From 2010 to 2020, Muskogee County’s population declined from 70,990 to 66,339, however, changes in population, both in an increase and a decrease, within the planning area does influence wildfire hazard impacts.

Increases in population patterns and/or development would lead to increases in vulnerability on the periphery of communities in Muskogee County. Such development has been recorded in the *Sentinel-2 10m Land Use/Land Cover Change from 2018 to 2021* layer in ArcGIS, where the communities of Haskell, Taft, Boynton, Wainwright, Council Hill, Summit, Oktaha, Warner, Porum, Webbers Falls, Braggs, Fort Gibson, and the City of Muskogee have seen land areas on the periphery of their communities become developed. As municipalities gradually expand, individuals and structures will become more entwined with Interface and Intermix regions, which means there will be an increase of the number of residents exposed to wildfire hazards.

Conversely, losses in population or buildings located in the WUI that become abandoned or unused also lead to a greater wildfire risk to communities. Unless they are addressed/demolished, abandoned structures around the outskirts of a community can contribute to wildfires should one approach. Wildfires w future wildfires, and they also pos as they seek to defend themselves against fire. Not only do those structures result in an increase of the potential fuel for wildfires.

Chapter 5 Mitigation Strategy

Goals, Actions, and Implementation – each section represents a different aspect of the County’s mitigation strategy. The Mitigation Goals section addresses “Why?,” the Mitigation Action section addresses “What?,” and the Implementation section addresses “How”.

These aspects work together to develop a comprehensive mitigation strategy that will serve Muskogee County over the lifespan of the 2024 Update, and help the County identify, prioritize, and implement mitigation actions to reduce long-term risks across the entire planning area. Itemized mitigation action items can be found in Section 5.4.

5.1 Goals

Muskogee County’s core mitigation goal remains unchanged from the 2019 Plan – Muskogee County aims to create a stronger, more disaster-resilient community and improve the safety and well-being of citizens across the planning area. Efforts will continue to reduce deaths, injuries, property damage, and environmental losses as well as others from natural and technological hazards. Success in these aspirations will advance community goals, and quality of life, and will result in a more livable, resilient, and sustainable community moving forward.

The Planning Committee reviewed and analyzed the risk assessment studies. During Stakeholder Workshops and core Group Meetings, Planning Team members were polled. All agreed no changes were to be made regarding community mitigation goals when compared to 2019. The goals and objectives identified in Table 5-1 carry over for the 2024 Update and align with each participating jurisdiction described in Chapter 1.

Table 5-1 Muskogee County Mitigation Goals

Goals	Objectives
Increase County-wide ability to communicate and respond quickly and efficiently to disasters	Provide interconnected mobile telecommunications or other communication methods such as “Reverse 911” to all areas of Muskogee County through a collaborative countywide effort
Enhance public awareness and understanding of hazard mitigation	Seek methods to provide funding and opportunities for trainers and materials to implement ongoing community and public education outreach practices and hazard awareness programs
Reduce the impacts of repetitive flooding in flood-prone areas of Muskogee County	Encourage the development and implementation of programs to purchase, remove, and prevent development and construction in flood-prone areas, and by addressing at-risk transportation routes
Develop and educate responders and healthcare providers regarding mitigation measures for specific hazards	Provide training opportunities to these personnel
Enhance pre-disaster and prevention activities	Adopt administrative actions and processes that influence the way land and buildings are developed and built
Mitigate the short-term & long-term impact of natural hazards on Muskogee County	Reduce the loss of life, injuries to citizens, and damage to property in Muskogee County
Protect natural resources in Muskogee County	Determine projects or actions that will minimize losses of valuable resources during storm events and define actions to restore functions of natural systems

5.1.1 Guiding Principles

To meet the planning area's mitigation goals and overall mission statement, mitigation actions are guided by several principles which are actionable components of the Mitigation Goals section of this plan. Not every mitigation action will meet all principles listed below, but each action will fill at least one.

- Minimize property loss/damage from natural hazard events,
- Protect public health and safety,
- Increase public awareness of risk from natural hazards,
- Continue to assess and update hazard risk for local areas,
- Improve forecasting of natural hazard events
- Improve forecasting of natural hazard events
- Improve building construction & enforce current building codes to reduce the dangers of natural hazards
- Improve governmental and public response to natural hazard disasters,
- Limit or cease development in high-risk areas,
- Ensure that jurisdictions maintain NFIP participation or make efforts to become involved in NFIP.

5.2 Actions

According to FEMA, mitigation action is a policy, project, activity, or process taken to reduce or eliminate long-term risk to people, property, and the environment from hazards. Based on the guiding principles shown above, the types of mitigation actions reviewed to reduce long-term vulnerability include:

- Preventative Activities
- Floodplain Management Regulation/ Current & Future Conditions
- Property Protection Activities
- Natural Resource Protection Activities
- Emergency Services Activities
- Structural Projects
- Public Information Activity

5.2.1 Review of Actions in the 2019 Muskogee County Plan

A review of mitigation actions from the 2019 Muskogee County Hazard Mitigation Plan was completed during the planning process for the 2024 Plan Update. During the second Core Group meeting and the third Stakeholder Workshop, there was an evaluation of how each action has been integrated into other planning mechanisms or otherwise completed. 28 of the 29 actions from the 2019 plan are being carried over to this plan update. Incomplete actions have been reviewed and prioritized in the prioritization section.

In addition to items identified by stakeholders and core group members, Chapter 5 Action Items combine actions identified in the 2019 Plan which are either not started or deemed as ongoing. 29 action items are identified in the previous plan. Items are categorized below into one of four groups: Completed, Ongoing, Not Started, or Omitted. All 2019 Action Items have been included in Appendix A.

Completed

Action Item 2. *Elevate At-Risk Structures in Floodplain.* Regulations for floodplain development to require the elevation of at-risk structures in floodplains have been implemented.

Not Started

Action Item 8. *Water Management and Drought Planning.* Officials indicate no progress has been made on implementing this action item.

Action Item 9. *Database and Map of Special Needs Population.* Officials indicate no progress has been made on creating this database and would like to roll this action item into the 2024 Plan to work on this goal.

Action Item 16. *Building Material Awareness/Education – Insurance Agents, Contractors, Schools, and Citizens.* While this is a topic that is included in some of the outreach efforts officials perform at community events, no formal awareness or education program has been developed.

Action Item 19. *Install a Steel Roof on the Muskogee County Structure.* While the roof on the Muskogee County Courthouse has been replaced, steel gable material was not used. Officials indicated they would like to keep this item to apply to two other county structures: the Muskogee County Services Building and the Muskogee County Annex.

Action Item 21. *Purchase Lightning Detection Equipment/Systems.* Officials indicate preliminary work in reviewing the technology available has been performed, but no efforts have been made to acquire this equipment due to pricing, and the relation to how effective it would be for them.

Action Item 24. *Install Residential and Commercial Storm Shelters.* No work has been done on this front in over 10 years.

Action Item 26. *Join the FireWise Program.* Officials indicate no efforts have been made to promote this program to communities in Muskogee County.

5.2.2 Prioritization

Actions to mitigate risk in communities across Muskogee County have been identified. From these potential mitigation actions, the planning team and community stakeholders weighed the benefits and costs of each action. Such a review allows Muskogee County officials to prioritize actions that mitigate risk across Muskogee County's most vulnerable areas.

Included in this section are discussions on the benefits and costs that have been considered for each action. Benefits and costs for each action were weighed against each other to calculate a Benefit-Cost Review (BCR). The prioritization of actions was determined by the BCR.

Benefits

Mitigation actions are evaluated using these benefits criteria. Although this list does not include every specific benefit discussed during this process, this list of items covers all categories of benefits considered.

Table 5-2 Benefit Criteria when Evaluating Action Items

Criteria	Description
Public Safety	How effective will the action be at protecting lives and preventing injuries?
Critical Infrastructure	Will the action safeguard assets vital for the community's functioning?
Other Public Property	How significant will the action be in eliminating or reducing damage to infrastructure and public open spaces? What is the approximate dollar value of the expected benefit(s)?
Other Private Property	How significant will the action be in eliminating or reducing damage to private property? What is the approximate dollar value of the expected benefit(s)?
Development	Does the action mitigate or prevent development in high-risk areas?
Environmental	Will the action include natural solutions or safeguard the environment?
Partnerships	Will the action provide an opportunity to foster new partnerships or strengthen existing ones?
NFIP	Will the action maintain, increase, or commence a jurisdiction's compliance with NFIP requirements? (For more information, see the capability section)
Other Community Objectives	Does the action advance other community objectives, such as capital improvements, economic development, environmental quality, or open space preservation?

Costs

An action's costs are also considered for review. Some costs made it difficult to execute an action, while other costs made an action impossible to complete. Items considered impossible to complete were discarded at this stage. The list below provides an overview of all general categories of costs considered.

Table 5-3 Cost Criteria when Evaluating Action Items

Criteria	Description
Technical	Is the mitigation action technically feasible? Is it financially feasible? Is it a long-term solution?
Construction	Is the action financially feasible?
Political	Is there overall public support for the mitigation action? Is there the political will to support it?
Legal	Does the community have the authority to implement the action?
Environmental	What are the potential environmental impacts of the action? Will it comply with environmental regulations?
Social	Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of marginalized people?
Administrative	Does the community have the personnel and administrative capabilities to implement the action and maintain it or does it require outside help? Will this strain community resources excessively? Could the cost of maintaining partnerships necessary to complete this project be burdensome?

Benefit-Cost Review

The benefits of each action are assigned a high, medium, or low rating, based on which benefits an action incorporates and to what degree those benefits are incorporated. Costs are measured as high, medium, or low. Costs estimate the internal and external resources needed to implement an action, including the likelihood of obtaining those resources. External resources will be discussed in the implementation section.

Table 5-4 Visualizing and Understanding Benefit-Cost Reviews and Ratings

Costs			
Classification	Description	Classification	Description
High	The action meets many priority benefit criteria and/or meets these criteria to a significant degree	Low	The action does not strain community resources and minimal external assistance is required
Medium	The action meets some priority benefit criteria and/or meets criteria to a moderate degree	Medium	The action could strain community resources, making external assistance a significant component of the action
Low	The action meets almost no priority benefit criteria and/or meets criteria to a minimal degree	High	The action strains community resources significantly; external assistance, which is crucial, is not guaranteed

From these metrics, the planning team developed a benefit-cost review. The higher the Benefit Cost Review assigned to an action, the higher that action was prioritized. The prioritized actions can be found in Section 5.4 of this chapter.



5.3 Implementation

Implementation of action items identified in the hazard mitigation plan is a crucial step in enhancing the resilience of communities against hazards. Communities remain at risk if mitigation actions are not implemented.

In this plan, implementation is considered as a separate component of the mitigation strategy. This allows communities to understand more clearly the resources needed to execute mitigation actions. External funding sources, partnerships, and integration with other plans as crucial components in an action's implementation are identified in this section.

Internal funding, which includes sources such as sales taxes, is discussed in the following subsection, followed by a discussion on external funding sources. This section explores the universe of funding sources

available to Muskogee County and provides guidance on which funding options can best meet the planning area's priority actions.

5.3.1 Internal Funding

Sales tax makes up most of the revenue for Muskogee County and incorporated jurisdictions participating in this plan. A percentage of this revenue could be used to cover local cost shares for hazard mitigation projects for which federal or state funding has been pursued, as described in state HB3819, passed in 2022. As discussed in further detail in Chapter 3, Muskogee County levies a 0.65% sales tax on top of Oklahoma's 4.5% sales tax rate for a total sales tax rate of 5.15% within the county. Nearly every community levies an additional sales tax on top of this, which varies from one town to the next.

Additional internal funding sources include bonds, most often used by school districts for mitigation projects such as safe rooms and increasing virtual capabilities. Development and implementation of other planning mechanisms, such as a Capital Improvements Plan, can complement a Hazard Mitigation Plan by assisting decision-makers in each community in prioritizing projects.

Other taxes, such as gasoline taxes, are levied by the state. Revenue from this source is typically allocated toward transportation and roadway treatments and improvements. Such funding sources are also considered internal since they are used to invest in local projects and local jurisdictions do not need to apply or compete for the award.

5.3.2 External Funding & External Programs

Building upon and complementing the preceding section, this part outlines external funding programs enabling participating jurisdictions to seek financial resources to address their top-priority mitigation goals. Here, a comprehensive overview of key funding programs is presented, emphasizing distinctions, and pinpointing programs best suited to address the high-priority mitigation actions outlined in this plan.

Federal grant dollars are administered by state agencies (State Administrative Agencies) in Oklahoma. While the funds are passed down to the local level from the state, the application and selection criteria as well as the compliance guidance are developed by the federal entity where the grant program resides. More details on potential external funding sources have been discussed in Chapter 3.

FEMA Funding Opportunities

FEMA administers programs that provide funding for eligible mitigation planning and projects that reduce disaster losses and protect life and property from future damage due to disasters. The three largest and most accessible programs communities can access are the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) Program, and the Building Resilient Infrastructure and Communities (BRIC) Program.

- HMGP assists in implementing long-term hazard mitigation planning and projects following a Presidential disaster declaration.
- BRIC provides funds for large-scale, resilient infrastructure projects on an annual basis.
- FMA provides funds for planning and projects to reduce or eliminate the risk of flood damage to buildings insured under the National Flood Insurance Program (NFIP) annually.

HMGP funding is generally 15% of the total amount of Federal assistance provided to a state, territory, or federally recognized tribal entity following a major disaster declaration. FMA funding depends upon the

amount Congress appropriates each year for the program. For Fiscal Year 2023, FEMA has set aside \$1 billion to fund BRIC. Individual homeowners and business owners are not allowed to apply directly to FEMA, but, eligible local governments may apply on their behalf.

5.4 Mitigation Action Items for 2024

Below is a series of tables that present the various mitigation action items chosen for the 2024 Muskogee County HMP Update. After reviewing the 2019 action items (see Appendix A), many were carried over to the 2024 Update, with modifications or updates added as deemed necessary. after being modified or updated in some form by County officials and stakeholders.

Each action item table consists of three components, each of which is shaded slightly differently for clarity. Beneath the Action row is the first section which is the Guiding Principles **Description** component. This row provides a basic description of the action item. Following this are three rows that explain “what” the action is aiming to accomplish, and these include the **Action Type, Priority** (determined by the Benefit Cost Review), and **Hazard(s) Addressed**. The third and final component of each action is that which describes the action’s **Implementation**, explaining who the **Lead Agency (or Partners)** are, what **Planning Jurisdiction(s)** would be affected by the action, and potential **Funding Sources**, as well as a proposed **Timeline**. Collectively, these convey “how” the mitigation action will be implemented in Muskogee County.

In this section, certain action items pertain to dam incidents. It is important to note that not every jurisdiction within the planning area faces the risk of dam incidents. Dam Incidents can potentially affect unincorporated areas of Muskogee County , Fort Gibson, Haskell, Muskogee, Taft, and Webbers Falls. Dam Incidents may also potentially impact the following Public School Districts: Braggs, Fort Gibson, Haskell, Hilldale, Midway, Muskogee, Oktaha, Porum, Warner, and Webbers Falls. See Table 4-22 for details.

Action Items

Action 1 Create a GIS Database of all Critical Facilities

Description(s)	Develop a critical facilities inventory to better understand respective risks and vulnerabilities associated with individual facilities and aid in future planning initiatives.
Action Type	Emergency Services Activities
Priority (BCR)	Medium
Hazard(s) Addressed	All hazards*
Lead Agency (Partners)	Muskogee County Emergency Management and Incorporated Areas' Emergency Managers (when applicable) or another representative
Planning Jurisdiction(s) Affected	Muskogee County and all Incorporated Areas
Funding Sources	Local sources, HMGP, Community Budget, REAP funds, Dept. of Agriculture and Dept. of Public Safety Grants
Timeframe	2024 – 2028

* See Section 5.4

Action 2 Acquire and install emergency warning communications systems, including but not limited to outdoor warning sirens, mass communication systems

Description(s)	Protect public health and safety
Action Type	Emergency Services Activities
Priority (BCR)	Medium
Hazard(s) Addressed	Dam Incidents*, High Winds, Flooding, Lightning, Hail, High Wind, Tornadoes, Wildfire
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, all Public School Districts' boards (or representatives)
Planning Jurisdiction(s) Affected	All participating jurisdictions
Funding Sources	Local sources, HMGP and CDBG, REAP, other State and Federal Grants, and Dept. of Agriculture
Timeframe	2024 – 2028

* See Section 5.4

Action 3 Construct communications towers to improve communications for Emergency Response Teams	
Description(s)	Improve governmental and public response to natural hazard disasters
Action Type	Emergency Services Activities
Priority (BCR)	Medium
Hazard(s) Addressed	Dam Incidents*, Extreme Heat, Earthquake, Flooding, Hailstorm, High Wind, Lightning, Severe Winter Storm, Tornado, Wildfire
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or another representative
Planning Jurisdiction(s) Affected	Muskogee County and all Incorporated Areas
Funding Sources	Local sources, HMGP and CDBG, REAP, other State and Federal Grants
Timeframe	2024 – 2028

* See Section 5.4

Action 4 Educate the public about various dangers associated with natural hazards	
Description(s)	Increase public awareness of risk from natural hazards with print materials such as brochures, color books, obtain vendor space at public events/fairs, host awareness or education events
Action Type	Public Information Activity
Priority (BCR)	High
Hazard(s) Addressed	Dam Incidents*, Drought, Earthquake, Extreme Heat, Flooding, Hail, High Winds, Lightning, Severe Winter Storm, Tornado, Wildfires
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or another representative
Planning Jurisdiction(s) Affected	Muskogee County and all Incorporated Areas
Funding Sources	Local sources, HMGP, Municipal and County Resources, FEMA, US Forest Service, OSU Extension Service, Homeland Security Grant, Dept. of Agriculture
Timeframe	2024 – 2028

* See Section 5.4

Action 5 Enlarge the capacity of drainage conduits

Description(s)	Protect public health and safety, Improve disaster prevention
Action Type	Structural Projects
Priority (BCR)	Medium
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, all Incorporated Areas' board/councils
Planning Jurisdiction(s) Affected	Muskogee County and all Incorporated Areas
Funding Sources	Local sources, HMGP, and REAP funding for initial cleanup costs with yearly maintenance addressed by a collaborative effort between the County and local government to share equipment and personnel to implement cleanup and debris removal on an annual basis
Timeframe	2024 – 2028

Action 6 Drill water wells to ensure that an adequate water supply can be continuously maintained for Muskogee County residents

Description(s)	Protect public health and safety
Action Type	Preventative Activities, Emergency Services Activities
Priority (BCR)	Medium
Hazard(s) Addressed	Drought, Wildfires
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, Incorporated Areas' board/councils (when applicable)
Planning Jurisdiction(s) Affected	Muskogee County and all Incorporated Areas
Funding Sources	Local sources, HMGP, OWRB Grants
Timeframe	2024 – 2028

Action 7 Collaborate with water supply providers to develop a Drought Management Plan to manage water supply during periods of drought	
Description(s)	Improve disaster prevention, Improve governmental and public response to natural hazard disasters
Action Type	Preventative Activities, Natural Resource Protection Activities, Public Information Activity
Priority (BCR)	Low
Hazard(s) Addressed	Drought
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, Incorporated Areas' board/councils (when applicable)
Planning Jurisdiction(s) Affected	Muskogee County and all Incorporated Areas
Funding Sources	Local sources, HMGP, CDBG, REAP, and other State and Federal Grants
Timeframe	2024 – 2028

Action 8 Develop a database and map of special needs populations in Muskogee County	
Description(s)	Protect public health and safety, Improve governmental and public response to natural hazard disasters
Action Type	Emergency Services Activities
Priority (BCR)	High
Hazard(s) Addressed	All hazards*
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, all Public School Districts' boards (or representatives)
Planning Jurisdiction(s) Affected	Muskogee County, all Incorporated Areas, and all participating School Districts
Funding Sources	Local sources, HMGP and CDBG, REAP, other State and Federal Grants
Timeframe	2024 – 2028

* See Section 5.4

Action 9 Provide cooling stations and warming stations for residents

Description(s)	Protect public health and safety, Improve governmental and public response to natural hazard disasters
Action Type	Emergency Services Activities
Priority (BCR)	Medium
Hazard(s) Addressed	Extreme Heat, Severe Winter Storm
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, Incorporated Areas' board/councils (when applicable)
Planning Jurisdiction(s) Affected	Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Muskogee, Oktaha, Porum, Summit, Taft, Wainwright, Warner, and Webbers Falls
Funding Sources	Local sources, HMGP, REAP, other state and federal grants
Timeframe	2024 – 2028

Action 10 Install rip-rap along roads and bridges susceptible to erosion

Description(s)	Improve disaster prevention
Action Type	Preventative Activities
Priority (BCR)	Low
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, Incorporated Areas' board/councils (when applicable)
Planning Jurisdiction(s) Affected	Muskogee County and all Incorporated Areas
Funding Sources	Local sources, REAP, HMGP, OWRB Grants
Timeframe	2024 – 2028

Action 11 Work with utility providers to keep trees and vegetation trimmed to prevent impacts to utility infrastructure from hazards

Description(s)	Minimize property loss/damage from natural hazard events, Improve disaster prevention
Action Type	Preventative Activities, Property Protection Activities, Natural Resource Protection Activities
Priority (BCR)	Low
Hazard(s) Addressed	Severe Winter Storm, High Winds, Tornadoes
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable)
Planning Jurisdiction(s) Affected	Muskogee County and City of Muskogee
Funding Sources	Local sources, HMGP, REAP, other State and Federal Grants
Timeframe	2024 – 2028

Action 12 Elevate and/or reinforce roads and bridges throughout Muskogee County

Description(s)	Elevate roads and bridges out of the floodplain or those subject to frequent overtopping and reinforce bridges subject to scouring and washouts due to floodwaters. Improve public safety and transportation during times of flooding
Action Type	Structural Projects
Priority (BCR)	Medium
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, Incorporated Areas' board/councils (when applicable)
Planning Jurisdiction(s) Affected	Muskogee County and all Incorporated Areas
Funding Sources	Local sources, HMGP, Homeland Security Grants, REAP, Dept. of Agriculture, ODOT
Timeframe	2024 – 2028

Action 13 Improve NFIP compliance for the community of Wainwright, and assist the jurisdictions of Summit and Council Hill in joining the NFIP so they can develop floodplain ordinances.

Description(s)	Ensure that jurisdictions maintain NFIP participation, or become involved in NFIP
Action Type	Floodplain Management Regulatory/Current & Future Conditions
Priority (BCR)	Medium
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Floodplain Administrators (when applicable) or another representative
Planning Jurisdiction(s) Affected	Muskogee County and all Incorporated Areas
Funding Sources	Local sources, HMGP, County, and municipal resources. REAP grants
Timeframe	2024 – 2028

Action 14 Identify and map all new development in Special Flood Hazard Areas (SFHAs)

Description(s)	Continue to assess and update hazard risk for the local area
Action Type	Floodplain Management Regulatory/Current & Future Conditions
Priority (BCR)	High
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, Incorporated Areas' board/councils (when applicable), all Public School Districts' boards (or representatives)
Planning Jurisdiction(s) Affected	Muskogee County, Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Muskogee, Oktaha, Porum, Summit, Taft, Wainwright, Warner, and Webbers Falls, all Public School Districts
Funding Sources	Local sources, HMGP, FEMA Grants, CDBG
Timeframe	2024 – 2028

Action 15 Promote the use of hazard-resilient construction materials to insurance agents, homeowner's associations, contractors, and residents

Description(s)	Improve building construction & enforce current building codes to reduce the dangers of natural hazards, increase public awareness of risk from natural hazards, promote the use of hazard-resilient construction materials to insurance agents, homeowner's associations, contractors, and residents through printed public education materials, vendor booths at public fairs and expos and talks at public events.
Action Type	Property Protection Activities, Public Information Activity
Priority (BCR)	Low
Hazard(s) Addressed	All hazards*
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	Muskogee County, Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Muskogee, Oktaha, Porum, Summit, Taft, Wainwright, Warner, and Webbers Falls
Funding Sources	Local sources, HMGP, FEMA Grants, CDBG
Timeframe	2024 – 2028

* See Section 5.4

Action 16 Construct shelters to protect all county-owned vehicles from hazards

Description(s)	Minimize property loss/damage from natural hazard events
Action Type	Property Protection Activities, Structural Projects
Priority (BCR)	High
Hazard(s) Addressed	Hail, High Winds, Severe Winter Storm, Tornadoes
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	All participating jurisdictions
Funding Sources	Local sources, HMGP, REAP
Timeframe	2024 – 2028

Action 17 Install protective film on windows on all county, city/town, and school buildings

Description(s)	Minimize property loss/damage from natural hazard events
Action Type	Property Protection Activities
Priority (BCR)	Medium
Hazard(s) Addressed	Hail, High Winds, Severe Winter Storm, Tornadoes
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, Incorporated Areas' board/councils (when applicable), all Public School Districts' boards (or representatives)
Planning Jurisdiction(s) Affected	All participating jurisdictions
Funding Sources	Local sources, HMGP, REAP
Timeframe	2024 – 2028

Action 18 Install a hazard-resistant, steel gable roof on Muskogee County Court House, Muskogee County Services Building, and Muskogee County Annex

Description(s)	Minimize property loss/damage from natural hazard events
Action Type	Property Protection Activities, Structural Projects
Priority (BCR)	Medium
Hazard(s) Addressed	Hail, High Wind, Tornadoes, Wildfire
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	Muskogee County
Funding Sources	Local sources, HMGP
Timeframe	2024 – 2028

Action 19 Develop a program to educate residents and mobile home dealers on the benefits of securely anchoring mobile homes and other mobile buildings

Principle(s)	Protect public health and safety, minimize property loss/damage from natural hazard events, increase public awareness of risk from public hazards, improve building construction & enforce current building codes to reduce the dangers of natural hazards
Action Type	Property Protection Activities, Structural Projects
Priority (BCR)	Medium
Hazard(s) Addressed	High Wind, Tornadoes
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	Muskogee County, Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Muskogee, Oktaha, Porum, Summit, Taft, Wainwright, Warner, and Webbers Falls
Funding Sources	Local sources, HMGP, REAP, other State and Federal Grants
Timeframe	2024 – 2028

Action 20 Purchase and install cost-effective lightning detection systems for outdoor/public venues and sports facilities

Description(s)	Improve forecasting of natural hazard events, Protect public health and safety
Action Type	Preventative Activities
Priority (BCR)	Low
Hazard(s) Addressed	Lightning
Lead Agency (Partners)	Muskogee County Emergency Management, Town/City Council Members, Public School District Board Members
Planning Jurisdiction(s) Affected	All participating jurisdictions
Funding Sources	Local sources, HMGP, State and Federal Grants
Timeframe	2024 – 2028

Action 21 Purchase and install lightning suppression systems at critical facilities across Muskogee County	
Description(s)	Minimize property loss/damage from natural hazard events
Action Type	Property Protection Activities, Emergency Services Activities
Priority (BCR)	High
Hazard(s) Addressed	Lightning
Lead Agency (Partners)	Muskogee County Commissioners, all public school boards, Town/City Council Members
Planning Jurisdiction(s) Affected	Muskogee County, Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Muskogee, Oktaha, Porum, Summit, Taft, Wainwright, Warner, and Webbers Falls, Braggs PS, Midway PS, Fort Gibson PS, Haskell PS, Muskogee PS, Hilldale PS, Oktaha PS, Porum PS, Wainwright PS, Warner PS, and Webbers Falls PS
Funding Sources	Local sources, HMGP, REAP, CDBG, and Local Utility Provider Rebate Programs
Timeframe	2024 – 2028

Action 22 Purchase, program, and distribute NOAA weather radios to public facilities, residents, and public schools across Muskogee County	
Description(s)	Increase public awareness of risk from natural hazards
Action Type	Public Information Activity
Priority (BCR)	Medium
Hazard(s) Addressed	Dam Incidents, Drought, Earthquake, Extreme Heat, Flood, Hailstorm, High Winds, Lightning, Tornado, Wildfire, Severe Winter Storm
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	All participating jurisdictions
Funding Sources	Local sources, HMGP
Timeframe	2024 – 2028

Action 23 Construct and install adequate storm shelters/safe rooms at critical facilities

Description(s)	Protect public health and safety of employees and visitors at critical facilities (e.g. water treatment plants)
Action Type	Structural Projects
Priority (BCR)	High
Hazard(s) Addressed	Hail, High Winds, Lightning, and Tornadoes
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	All participating jurisdictions
Funding Sources	Local sources, HMGP, REAP, other State and Federal Grants and Private Funding
Timeframe	2024 – 2028

Action 24 Construct and install safe rooms in Muskogee County public schools where saferooms do not already exist. For those currently in place, strengthen or harden these safe rooms to better withstand hazard events and associated impacts

Description(s)	Protect public health and safety of students, staff, and visitors to public school buildings
Action Type	Structural Projects
Priority (BCR)	High
Hazard(s) Addressed	Hail, High Winds, Lightning, Tornadoes
Lead Agency (Partners)	Muskogee County Emergency Management, Public School District Board Members
Planning Jurisdiction(s) Affected	All participating public school districts
Funding Sources	Local sources, School Bond Issue, HMGP
Timeframe	2024 – 2028

Action 25 Join the FireWise program, and encourage all cities and towns across Muskogee County to do the same	
Description(s)	Increase public awareness of risk from natural hazards, Improve governmental and public response to natural hazard disasters
Action Type	Public Information Activity, Emergency Services Activities
Priority (BCR)	Low
Hazard(s) Addressed	Wildfires
Lead Agency (Partners)	Muskogee County Emergency Management, Muskogee County Fire Departments
Planning Jurisdiction(s) Affected	Muskogee County and all incorporated areas.
Funding Sources	Local sources, HMGP, Oklahoma Dept. of Forestry
Timeframe	2024 – 2028

Action 26 Purchase, install, and harden backup electrical generators at critical facilities and essential areas on public school campuses	
Description(s)	Protect public health and safety, Improve governmental and public response to natural hazard disasters
Action Type	Property Protection Activities, Emergency Services Activities
Priority (BCR)	High
Hazard(s) Addressed	Dam Incidents*, Earthquake, Extreme Heat, Flood, Hail, High Wind, Lightning, Severe Winter Storm, Tornado, Wildfire
Lead Agency (Partners)	Muskogee County Emergency Management, Incorporated Areas' Emergency Managers (when applicable) or other representative, all Incorporated Areas' board/councils, all Public School Districts' boards (or representatives)
Planning Jurisdiction(s) Affected	All participating jurisdictions
Funding Sources	Local sources, FEMA HMGP/BRIC, REAP, other State and Federal Grants
Timeframe	2024 – 2028

* See Section 5.4

Action 27 Designate a facility to serve as shelter for families of first responders to serve as a gathering point in times of emergency or disaster

Description(s)	Protect public health and safety
Action Type	Emergency Services Activities
Priority (BCR)	Medium
Hazard(s) Addressed	Dam Incidents*, Drought, Earthquake, Extreme Heat, Flooding, Hail, High Wind, Lightning, Severe Winter Storm, Tornadoes, Wildfires
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	Muskogee County, Boynton, Braggs, Council Hill, Fort Gibson, Haskell, Muskogee, Oktaha, Porum, Summit, Taft, Wainwright, Warner, Webbers Falls
Funding Sources	Local sources
Timeframe	2024 – 2028

* See Section 5.4

Action 28 Develop & Implement a Master Drainage Plan (MDP) and/or Stormwater Management Plan

Description(s)	Minimize property loss/damage from natural hazard events
Action Type	Floodplain Management Regulation/ Current & Future Conditions
Priority (BCR)	Medium
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	All incorporated areas except the City of Muskogee [†]
Funding Sources	Hazard Mitigation Assistance
Timeframe	2024 – 2028

[†] The City of Muskogee is currently in the process of developing an MDP

Action 29 Develop & Implement a Continuity of Operations Plan (COOP)

Description(s)	Improve governmental and public response to natural hazard disasters
Action Type	Preventative Activities
Priority (BCR)	Medium
Hazard(s) Addressed	All Hazards*
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	Muskogee County
Funding Sources	Local Sources, HMGP, other State and Federal Grants
Timeframe	2024 – 2028

* See Section 5.4

Action 30 Collect Emergency Action Plans (EAPs) for all dams with inundation impacts to areas within Muskogee County. Extract inundation maps from EAPs (Tenkiller, Eufaula, Fort Gibson, Lake Hudson, SCS Cane Creek Site 05, Chouteau L&D #17, Webbers Falls L&D #16) and extract information on inundation zones of impact, when applicable, to map and identify structures and residents impacted by Sunny Day and PMF Breach scenarios.

Description(s)	Increase public awareness of risk from natural hazards, improve governmental and public response to natural hazard disasters
Action Type	Floodplain Management Regulation/ Current & Future Conditions
Priority (BCR)	Medium
Hazard(s) Addressed	Dam Incidents*
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	Muskogee County (unincorporated), Fort Gibson, Haskell, Muskogee, Summit, Taft, Webbers Falls, and the following public school districts: Braggs, Fort Gibson, Haskell, Hilddale, Midway, Muskogee, Oktaha, Porum, Warner, and Webbers Falls
Funding Sources	Local Sources, HMGP, other State and Federal Grants
Timeframe	2024 – 2028

* See Section 5.4

Action 31 Obtain 2023 FEMA data for Repetitive Loss (RL) and Severe Repetitive Loss (SRL) structures for Muskogee County to replace 2022 data presented in this Update.

Description(s)	Continue to assess and update hazard risk for local areas, limit or cease development in high-risk areas
Action Type	Floodplain Management Regulation/ Current & Future Conditions
Priority (BCR)	High
Hazard(s) Addressed	Dam Incidents*, Flooding
Lead Agency (Partners)	Muskogee County Emergency Management
Planning Jurisdiction(s) Affected	All participating jurisdictions
Funding Sources	Local Sources, HMGP, other State and Federal Grants
Timeframe	2024 – 2028

* See Section 5.4

Action 32 Develop a comprehensive Repetitive Loss/Severe Repetitive Loss Area Analysis to Identify the most cost-effective and desirable mitigation measure that will minimize current and future flooding problem areas in the planning area.

Principle(s)	Minimize property loss/damage from natural hazard events / Continue to assess and update hazard risk for local areas, limit or cease development in high-risk areas
Action Type	Preventative Activities / Property Protection / Floodplain Management Regulation
Priority (BCR)	Medium
Hazard(s) Addressed	Dam Incidents*, Flooding
Lead Agency (Partners)	Muskogee Co. Emergency Management, Muskogee County Engineering Services
Planning Jurisdiction Affected	All participating jurisdictions
Funding Sources	Local Sources, HMGP, other State and Federal Grants
Timeframe	2024 – 2028

* See Section 5.4

Action 33 Elevate or Acquire Properties in the FEMA Floodplain and Repetitive Loss (RL)/Severe Repetitive Loss (SRL) Properties

Description(s)	Minimize property loss/damage from natural hazard events / Continue to assess and update hazard risk for local areas, limit or cease development in high-risk areas
Action Type	Preventative Activities / Property Protection / Floodplain Management Regulation
Priority (BCR)	Medium
Hazard(s) Addressed	Dam Incidents*, Flooding
Lead Agency (Partners)	Muskogee County Emergency Management, Muskogee County Engineering Services
Planning Jurisdiction(s) Affected	All participating jurisdictions
Funding Sources	Local Sources, HMGP, other State and Federal Grants
Timeframe	2024 – 2028

* See Section 5.4

Action 34 Utilize LIDAR technology to map roadways that have been known to produce flooding fatalities, like E 213th Street S. where it crosses Dirty Creek. Using the LIDAR analysis, identify which mitigation measure would produce the most life-saving outcome during future flooding events.

Description(s)	Minimize property loss/damage from natural hazard events / Continue to assess and update hazard risk for local areas
Action Type	Preventative Activities / Structural Projects
Priority (BCR)	High
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muskogee County Emergency Management, Muskogee County Engineering Services
Planning Jurisdiction(s) Affected	All participating jurisdictions
Funding Sources	Local Sources, BRIC, other State and Federal Grants
Timeframe	2024 – 2028

Chapter 6 Plan Maintenance and Adoption

This chapter includes a discussion of the plan maintenance process and documentation of the plan adoption by Muskogee County, participating incorporated jurisdictions, and school districts within the County. The Core Planning Group will continue to meet and evaluate progress and recommend changes to the plan. Muskogee County's Emergency Management Department will oversee the process to ensure a regular review and update of the Hazard Mitigation Plan occurs. The Plan will be updated and resubmitted to the State and FEMA for approval prior to the 5-year approval period expiration, per FEMA requirements.

6.1 Monitoring the Plan

County, municipal, and school representatives will remain involved in monitoring the 2024 Plan, tracking the progress and implementation of mitigation actions outlined in Chapter 6, along with integration of the plans into their jurisdictions. A public meeting, held annually, will allow the planning team to report on progress and discuss future mitigation steps.

Muskogee County's Emergency Management Director holds primary responsibility for monitoring, including tracking the Mitigation Action Items, plan implementation, and changes in development or priorities. This will be done by maintaining open lines of communication with local Emergency Managers, floodplain administrators, school officials, and other private and public officials as needed. Progress Reports detailing the implementation of Mitigation Action Items and mitigation measures, along with any impediments that may exist, will be generated annually by those responsible for them and provided to the Planning Committee. A worksheet shown in Appendix A is used to summarize mitigation action progress in the Progress Report. Individual action items are grouped into one of four categories, like 2019 in Chapter 6: "Not Started", "Underway", "Ongoing", or "Completed". Any additional planning mechanisms or processes that integrate the mitigation plan will be tracked.

An annual meeting for participating community representatives and the public to report on plan implementation progress, continued challenges, and public comments will be hosted by Muskogee County's Director of Emergency Management. Agenda items at this meeting will include recent hazard events, evaluation of the plan's goals and priorities, prioritization of Mitigation Action Items for the upcoming year, summarization of plan implementation and integration, and discussion of plan updates. A draft monitoring meeting schedule is outlined in Table 6-1. These annual meetings should provide an opportunity to summarize progress reports and collaborate on upcoming projects, opportunities, grants, or similar matters.

Table 6-1 Plan Maintenance Schedule

Meeting Year	Topic
2024	Monitor Plan Progress and Hazard Activity
2026	Monitor Plan Progress, Hazard Activity, and Begin to Plan for Update Process
2027	2028 HMP Update Planning Process
2028	Adopt Plan Update and Begin Monitoring Process

6.2 Evaluating the Plan

The Muskogee County Emergency Management Director will perform continual evaluation of the 2024 Muskogee County Multi-Hazard Mitigation Plan, with regular reports provided to the Core Planning Committee. This evaluation assesses:

- Adequacy of adopted goals and strategy in addressing current and future expected conditions
- Whether the nature and magnitude of the risks have changed
- Appropriateness of current resources allocated for implementation of the plan
- To what extent the outcomes of the mitigation measures occurred as expected
- Whether agencies, departments, and other partners participated as originally anticipated
- Whether mitigation measures have been incorporated into new planning processes.

Annual evaluations and updates of these programs will continue to take place. Furthermore, annual monitoring meetings and reports from members of the planning team will provide the information necessary for the County Emergency Manager to evaluate the plan.

6.3 Updating the Plan

Below are the schedule details for how the *2024 Muskogee County Hazard Mitigation Plan* will be updated.

Revise and Update

Muskogee County, incorporated areas, and participating school districts will revise the plan and make any necessary changes or updates to the plan on an annual basis, beginning in 2024 at LEPC meetings. Revisions may be necessary due to completed or started action items, changing priorities, or changes in planning group information. These revisions and updates will occur annually at approximately the same time, so at the end of the 5 years, there will not be vast amounts of updates to be made. Coordination of these gatherings and responsibility for coordinating and hosting these meetings will be under the direction of Muskogee County Emergency Management. Anything discussed and/or introduced during the update process will be implemented by participating jurisdictions. Representatives from local municipalities and school board members will be responsible for finalizing the implementation process at the jurisdictional level.

Submit for Review

Review and approval of the revised plan will first take place through the State Hazard Mitigation Officer with ODEMHS for their review and approval, then to FEMA no later than six (6) months prior to the plan expiration date. Once the *2024 Muskogee County Hazard Mitigation Plan* receives a formal letter of approval from FEMA, this date marks the beginning of the 5-year period for which it will be valid.

Final Revision and Adoption

Any revisions requested by ODEMHS and FEMA will be made, and adopted by the participating jurisdictions, and the updated plan will be sent to FEMA prior to the expiration of the 5-year validity period.

6.4 Public Involvement

Muskogee County, along with participating incorporated areas and public school districts, remains committed to involving the public directly in updating and maintaining the plan. Physical copies of the plan will be kept at the Muskogee County Courthouse, available to the public and representatives from participating communities and school districts.

Public awareness of the plan maintenance schedule was performed at stakeholder and public meetings. Future changes and edits to this Hazard Mitigation Plan will include a period of public comment for input and feedback. Notices of the meeting dates will be posted on Muskogee County's social media channels and the county's website. These meetings will be advertised on an annual basis beginning in 2024 and will serve as an opportunity to update residents on the progress made in implementing this plan and related capital projects, as well as to distribute literature and educate public attendees on the actions they can take to mitigate natural hazards for themselves and their households, to save lives, and to prevent property damage. Citizen input will be solicited as to how the mitigation process can be more effective.

6.5 Incorporation of the 2024 HMP Update

Serving as a guide for Muskogee County mitigation actions, the *2024 Muskogee County Multi-Hazard Mitigation Plan* will be presented to the Board of Muskogee County Commissioners for their approval to adopt. Similarly, governing bodies for each participating community and public school district will adopt this plan to guide their mitigation strategy. Each jurisdiction is responsible for integrating this plan into other appropriate planning mechanisms, policies, regulations, and actions.

As discussed in Section 6.1, Muskogee County's Emergency Management Director is responsible for overseeing the implementation and integration of the Hazard Mitigation Plan at the county level. Planning team members are responsible for integrating this plan into their local and school planning and capital improvement efforts.

Jurisdictions participating in this plan will benefit from the document as it will serve as a planning mechanism that can directly inform annual budget outlooks. School districts that meet to review their Emergency Operations Plan will incorporate HMP material the same way. Board members will meet, hazard mitigation data will be presented and discussed, resolutions presented and voted on, and finally the school board will vote on whether to adopt. School districts in need of updating their Emergency Operations Plan can also incorporate information and material from the HMP document in a similar process.

6.5.1 Incorporating Action Items into Planning Mechanisms

Muskogee County

- Assess structural mitigation measures, such as improved codes and ordinances, safe rooms, etc. at quarterly LEPC meetings
- Development of recommended plans and studies, particularly those with impacts felt countywide, will also be considered at these meetings

All Incorporated Areas

- Structural mitigation measures, such as improved codes and ordinances, safe rooms, etc. will be assessed at scheduled trustees' or council meetings
- Redundancy measures which allow the continuation of governing functions, such as backup electrical generators, will also be assessed at these meetings
- Development of recommended plans and studies, in addition to any other business, will be considered at these annual meetings
- Elected personnel/representatives will attend an LEPC meeting on at least an annual basis to update the Muskogee County Emergency Management Director on the progress of integrating mitigation measures into planning mechanisms

All Public School Districts

- Structural mitigation measures, such as improved codes and ordinances, safe rooms, etc. will be assessed at quarterly school board meetings
- Redundancy measures which allow continuation of school district operating functions, such as backup electrical generators, will also be assessed at these meetings
- Deficiencies in school plans (such as EOPs, drought plans, etc.) will be reviewed by each school's principal or district superintendent or other administrator, and they will make recommendations to the school board during their quarterly meetings
- Each superintendent or school representative will attend an LEPC meeting at least annually to update the Muskogee County Emergency Management Director on how mitigation measures are being incorporated into planning mechanisms

Muskogee County recognizes the information in this plan is invaluable in making decisions for other planning programs, such as Capital Improvement Plans and Emergency Operations Plans. Existing processes and programs through which this plan should be implemented are detailed in Table 6-2.

Table 6-2 Existing Processes & Programs for HMP Implementation

Process	Action	Implementation of Plan
Administrative	<i>Departmental or organizational work plans, policies, and procedural changes</i>	• Planning Department • Public Works Department • Dept. of Emergency Management • Engineering • Economic Development • Social Services
	<i>Other Organizations' Plans</i>	Include reference to this plan in: • County & local Emergency Operations Plans • Comprehensive/Master Plans • Other County and local plans as necessary
Budgetary	<i>Capital and operational budgets</i>	• Leverage mitigation grant funding to support local funding for such mitigation projects.
Regulatory	<i>Executive Orders, ordinances, policies, and other directives</i>	• Comprehensive Planning - Institutionalize hazard mitigation for new construction and land use • Zoning and Ordinances • Building Codes-enforcement of codes or higher standards in hazard areas • National Flood Insurance Program (NFIP) – Continue participation in this program. • Prior to formal changes (amendments) to any planning mechanism document that controls development, review and ensure they are consistent with the HMP
Funding	<i>Secure traditional sources of financing</i>	Apply for grants from federal (including FEMA Hazard Mitigation Assistance (HMA) and HMGP funding programs), state government, nonprofit organizations, foundations, and private sources. U.S. Department of Housing and Urban Development's Community Development Block Grant (CDBG)

Process	Action	Implementation of Plan
		Other potential federal, state, and regional funding sources include: • Stafford Act, Section 406 – Public Assistance Program Mitigation Grants • Federal Highway Administration • United States Fire Administration – Assistance to Firefighter Grants • United States Small Business Administration Pre- and Post-Disaster Mitigation Loans • U.D. Dept. of Economic Development Administration Grants • U.S. Army Corps of Engineers (USACE) • Other sources yet to be defined
Partnerships	<i>Existing Committees and Councils</i>	Local Government Committees: • Planning & Zoning Boards • Public School Boards • Chambers of Commerce • Property Owners Associations
	<i>Working with other federal, state, and local agencies</i>	• Army Corps of Engineers (USACE) • American Red Cross • Oklahoma Department of Emergency Management & Homeland Security (ODEMHS) • Oklahoma Department of Education • Federal Emergency Management Agency (FEMA) • National Oceanic and Atmospheric Administration (NOAA) • National Weather Service (NWS) • National Fire Protection Association (NFPA) • Oklahoma Department of Transportation (ODOT) • United States Geological Survey (USGS) • Other Non-Profit and NGO Partners

As individual jurisdictions update or adopt new planning strategies or capabilities it will be the responsibility of their planning team representatives to incorporate this mitigation plan into their existing planning efforts as highlighted in Table 3-1 in Chapter 3. Alternatively, they should use this plan while addressing the development of new planning capabilities identified as deficiencies in the table. Hazard Mitigation Plans can help inform annual budget outlooks. School districts that meet to review their Emergency Operations Plan will incorporate HMP material the same way. The board members will meet, hazard mitigation data will be presented and discussed, resolutions presented and voted on, and finally the school board will vote on whether to adopt. Implementing the mitigation action items will include:

- Mitigation measures will be assigned to the appropriate departments for planning and implementation
- The responsible department managers will report to the Planning Committee on the progress made on each measure, identifying successes and impediments to their implementation

- Mitigation actions that require adoption will go through the appropriate boards, councils, or commissions for formal adoption

As other planning processes are initiated, appropriate Planning Team members will serve as advocates for integrating appropriate mitigation goals into that planning effort. These planning processes could include comprehensive plans, building code updates, zoning/subdivision code updates, or related items.

Implementation since 2019

Chapter 3 provides a detailed description of which existing plans were reviewed and utilized in the writing of this Update as well as how portions of the 2019 HMP were implemented into other planning mechanisms utilized by Muskogee County. Examples of how that plan was implemented include:

- Regular review and update of land use strategies, including zoning, subdivision, and other regulatory codes, to enhance the community's resilience and fulfill elements of the Emergency Operations Plan (EOP), Capital Improvement Plan (CIP), as well as requirements outlined in FEMA's NFIP Floodplain Ordinances

6.5.2 Changes in Priorities

Since the previous HMP was adopted in 2019, there has been increased focus on floodplain management and development. Mitigation measures addressing flooding effects have become a significant topic of discussion among participating jurisdictions and school districts. However, all priorities were carefully evaluated, considering costs and benefits, before finalizing the list for the 2024 HMP update.

6.5.3 Changes in Development

Changes in development have been greatly influenced by the 2019 Arkansas River flood when waters inundated the planning area for weeks and caused a shift in the County's planning efforts. After floodwaters receded and damages were surveyed, the primary shifts in development were centered around a collective effort to rebuild more resiliently. Critical facilities that had gone offline because generators were flooded became a focus of planning officials during this cycle. Fortifying these facilities so they're better prepared for future river floods has been a significant priority, but making such significant changes has been slow. As described in Appendix E, floodplain ordinances for NFIP communities stress that no substantial development will occur in risk areas unless many ordinances are followed closely. For a discussion on recent and future development across the planning area, see the "Future Development" section (1.7.5) in Chapter 1 of this plan.

Effects on Vulnerabilities

Upon analysis using the Sentinel-2 10m Land Use/Land Cover change between 2018-2021 layer in ArcGIS, it can be quickly seen that the most notable change in land use across the planning area has been to rangeland. Further inspection of these areas reveals that the most common land cover in these areas prior to the occurrence of changes was crops or trees. The most notable effect on vulnerabilities in these areas is a slight increase in vulnerability to wildfire. The economic vulnerability to this hazard will have decreased in areas where the change from cropland occurred. However, the vulnerability to the extent of impacts from wildfires would indicate a net increase due to the nature of how wildfires can spread more quickly in more open areas. In far southern portions of the planning area, an increase in flood vulnerabilities is also noted in areas where topographic contours are closely clustered, indicating steeper terrain. In these areas, runoff will be more notable, which thereby will have an effect on water levels in channels and low-lying areas adjacent to these areas, such as along the Canadian River east of Forum.

The next largest areas of land use/land cover change occurred with trees becoming the primary land cover in areas across the County, along with areas that have become built area. These areas are much smaller compared to those which have become rangeland. However, coincidences of these areas on the periphery of the limits of current incorporated areas pose an increased vulnerability to wildfire. All jurisdictions in Muskogee County saw changes to one or the other, or both on the periphery of their incorporated limits. Additionally, newly built areas within floodplains can pose a risk of increased vulnerability to flooding, even if adherence to NFIP minimum regulations is taken. Changes to built areas which coincide with Special Flood Hazard Areas include:

- Some areas on the southeastern periphery of the Town of Haskell,
- An area near the intersection of North 204th Street West and West 30th Street North in an unincorporated area southwest of Haskell,
- Three areas along Cloud Creek in an unincorporated area south of Yahola, near West 10th Street North,
- An area along North 40th Street West and the Arkansas River, just west of U.S. Highway 69 northwest of Muskogee,
- Several areas in Muskogee and Fort Gibson within the floodplain downstream of the confluence of Grand River and Arkansas River,
- Several areas within the southeastern periphery of Fort Gibson in the Bayou Manard watershed,
- Several areas within the Coody Creek watershed within southern portions of the City of Muskogee and to its south,
- An area along South 45th Street East associated with the Spaniard Creek watershed,
- Areas along the periphery of the Town of Webbers Falls,
- Areas along U.S. Highway 64 west of State Highway 351 and east of North 4390 Road,
- Areas on the eastern and western peripheries of the Town of Porum,
- Areas in and on the periphery of the Town of Warner, on either side of 13th Street and to its immediate southeast, as well as portions near East 1055 Road/First Street east of 7th Avenue,
- An area on the northern periphery of the Town of Council Hill, along the “bend” in State Highway 72,
- A couple of areas just southwest of the Town of Oktaha within the Anderson Creek watershed, and
- A couple of areas on the periphery of the Town of Wainwright, one within the northeastern periphery and another within the southwestern periphery, both within the Anderson Creek watershed.

6.6 Signed Adoption Resolution Letters

Table 6-3 Governing Bodies for each Jurisdiction and Date of Local Adoption

Participating Jurisdiction	Responsible Group/Party	Adoption Date
Muskogee County	Commissioners	
Boynton	Board of Trustees	
Braggs	Board of Trustees	
Council Hill	Board of Trustees	
Fort Gibson	Board of Trustees	
Haskell	Board of Trustees	
Muskogee	City Council	
Oktaha	Board of Trustees	
Porum	Board of Trustees	
Summit	Board of Trustees	
Taft	Board of Trustees	
Wainwright	Board of Trustees	
Warner	Board of Trustees	
Webbers Falls	Board of Trustees	
Braggs Public School	School Board	
Fort Gibson Public Schools	School Board	February 12, 2024
Haskell Public Schools	School Board	
Hilldale Public Schools	School Board	
Midway Public Schools	School Board	
Muskogee Public Schools	School Board	
Oktaha Public Schools	School Board	
Porum Public Schools	School Board	
Wainwright Public Schools	School Board	
Warner Public Schools	School Board	
Webbers Falls Public Schools	School Board	

Appendix A. Previous Mitigation Actions

In the 2019 Muskogee County Hazard Mitigation Plan, 29 mitigation action items were identified. Table A-1 shows each of these actions together with the 2024 status (Ongoing, Not Started, or Completed). Core Planning Group members have provided notes on each action/activity, and today's Workshop aims at identifying whether the 2019 Action Items need to be modified in any way as well as what their priorities are (High, Medium, or Low). Using the information presented in the table below, the 2024 Update will build off these notes to develop a comprehensive and new list of mitigation actions for the lifespan of this Plan.

Table A-1 Previous Mitigation Actions and Their 2024 Status

#	Action Item	2024 Status	2024 Priority	Notes
1	Creation of a GIS Database of Critical Facilities Susceptible to Flooding by Dam Failure, and Create Flood Inundation Maps for all High Hazard Dams to Improve Risk Assessment: Hire an Engineering firm to make maps	Ongoing	Medium	2024 HMP Update works toward the GIS database creation using the Muskogee County HUB Page . Dam inundation mapping will split into its own action item
2	Elevate At Risk Structure in Flood Plain: Elevate critical facilities and other government facilities in the floodplain that are thought to be at risk of receiving damage or being destroyed from a flooding event.	Completed	N/A	The County has made changes to the regulations of floodplain management which raised the minimum height of new development within the floodplain. Everything else is grandfathered in until they have substantial damage or if they do a remodel.
3	Additional Countywide Outdoor Warning Devices: Purchase and install additional outdoor warning devices for the incorporated communities in Muskogee County to supplement current devices. The Emergency Management Director should review the effectiveness of current warning devices and upgrade as needed. Some current devices can't reach all areas of the communities as growth has caused expansion beyond the capabilities of the original devices	Ongoing	Medium	No new sirens in Taft. We do have some new ones in Muskogee, Gooseneck Bend, and Porum
4	Communications System: Based on a topographical survey, additional communication towers need to be purchased and sites need to be found at which the towers can be constructed allowing telecommunications throughout the county. Obtaining mobile communications equipment for	Ongoing	Medium	Two have been installed since 2019

#	Action Item	2024 Status	2024 Priority	Notes
	spotters and Emergency Response Teams.			
5	Educating the Public about Various Dangers Associated with Natural Hazards: Prepare Radio and TV ads for distribution to the media. Workshops, public meetings, and visiting various support groups (child care, senior citizens centers, etc.). Develop an education program and present it to farmers and ranchers of the area explaining the need for crop insurance and how it can help prevent financial losses from hazards such as hail.	Ongoing	High	<i>The County continues to do this annually</i>
6	Enlarging Capacity of Drainage Conduits: Upgrade the size of culverts, pipes, and boxes to accommodate larger flows. Remove the accumulated debris and cleanup assists in assuring that drainage water following a heavy rain event will flow without damming and overflowing.	Ongoing	Medium	<i>This is something the County Commissioners do all the time</i>
7	Drill additional water wells: Ensure adequate water supply is available for residents of Muskogee County	Ongoing	Medium	<i>One new well is being prepared to be drilled.</i>
8	Water Management and Drought Planning: Develop a program for the Muskogee County and water supply providers defining water management actions along with preparation of a drought management plan.	Not Started	Low	<i>The County wishes to keep this for the 2024 Update</i>
9	Database and Map of Special Needs Population: Work with Muskogee County 911 database, senior citizens centers, and the public in creating a database of citizens with special needs who may be adversely affected by extreme heat events. The database would include a map showing the location of at-risk residents with contact information so their welfare can be verified	Not Started	High	<i>The County wishes to keep this for the 2024 Update</i>
10	Provide cooling stations and warming stations for citizens: Work with Participating Jurisdictions and other public building owners to establish a program that will allow citizens temporary areas of buildings to warm	Ongoing	Medium	<i>Physical locations of warming/cooling centers change each year, but this action will continue in 2024</i>

#	Action Item	2024 Status	2024 Priority	Notes
	up or cool down during extreme heat or excessive cold.			
11	Erosion Assistance on County and Incorporated Roads and Bridges: Heavy rains frequently cause erosion of the roadbed. Implement a program to install rip/wrap at the most susceptible erosion sites to prevent new or existing road and bridge deterioration.	Ongoing	Low	County officials report that repairs are being made.
12	Tree Management: Work with all Muskogee County utility providers, and citizens to develop and implement programs to keep trees from threatening utility infrastructure, lives, and property.	Ongoing	Low	Most lines are above-ground. There are some sporadic locations where lines are buried (like in Warner)
13	Raise and Strengthen Bridges to Allow School Buses to Cross: Build new or strengthen and elevate old bridges throughout the county to accommodate the larger school buses to prevent rerouting of these buses and to ensure the safety of all citizens during times of flooding.	Ongoing	Medium	At this time, no buses are currently being re-routed because of bridge issues. Commissioners get reports each year that classify bridges based on weight & condition. Commissioners build new bridges all the time.
14	Participation in the National Flood Insurance Plan (NFIP): Adopt ordinances that meet minimum Federal and State requirements to comply with NFIP. Designate a local floodplain manager who achieves CFM certification.	Ongoing	Medium	Previous attempts have been made to get Council Hill and Summit on board – the County will continue to emphasize the importance of NFIP participation to all communities in the planning area. This item has been included and modified in the 2024 Update.
15	Improve Compliance in the National Flood Insurance Plan (NFIP): GPS Identification and Mapping of all new and improved buildings located in the Special Flood Hazard Areas (SFHA.)	Ongoing	Medium	The County continues to emphasize the importance of NFIP participation to all communities in the planning area.
16	Building Material Awareness/Education – Insurance Agents, Contractors, Schools, and Citizens: Promote the use of hail-resistant shingles and building materials to local insurance agents, homeowners associations, contractors, and citizens.	Not Started	Low	This is something the County Commissioners do all the time

#	Action Item	2024 Status	2024 Priority	Notes
17	Provide shelters for County/City/Town-Owned vehicles and school buses: Provide shelters for County-owned vehicles to protect from Hail damage.	Ongoing	High	County has some barns and new ones have been built, but there still is a lack of adequate coverage for all County vehicles. Barns needed at each District headquarters
18	Protective Film on Windows in all County/City/Town/School Buildings: Install Protective Film on windows in all county buildings	Ongoing	Medium	The County will continue with this type of educational outreach – some of the County's older buildings and equipment still need tempered glass.
19	Install a steel roof on Muskogee Co Structure: Install a steel gable roof on the Muskogee County Court House to protect from hail damage	Not Started	Medium	Not installed as of now – recently, the roof had been replaced but not with steel. MODIFY ACTION FOR 2024 UPDATE TO INCLUDE THE COUNTY SERVICES BUILDING AND THE COUNTY ANNEX BUILDING
20	Tie Down – Mobile Homes and Other Structures Education Program: Create and distribute printed materials for residents and Mobile Home Dealers on the benefits of Tie Downs to secure mobile homes and other mobile structures helping reduce damage from the high winds.	Ongoing	Medium	Continue outreach initiatives
21	Purchase Lightning Detection Equipment/Systems: Purchase and install lightning warning systems at jurisdiction-owned buildings, Parks and sports complexes, and Public School grounds where students would be playing outside.	Not Started	Low	None are currently in place. The County has been looking into new technology, but so far, nothing's been deployed in the planning area.
22	Lightning Suppression Systems at Critical Facilities: Install lightning protection and suppression systems protecting radios and other essential equipment at critical facilities throughout the county	Ongoing	High	The County has installed measures at the courthouse and 911 center, but there are still areas where these are needed
23	Installation of NOAA receivers in Public Facilities and Homes: Purchase, program, and distribute NOAA weather radios to public facilities, citizens of the Planning Area, and Public Schools to receive hazard information from the National Weather Service.	Ongoing	Medium	It's been several years since we've done that, but the County would like to reapply for this.

#	Action Item	2024 Status	2024 Priority	Notes
24	Install Residential and Commercial Storm Shelters: 20 Storm Shelters must be installed to reduce the loss of life	Ongoing	High	<i>None have been done since 2019 – the last one was installed in 2012 or 2013.</i>
25	Construct Safe Rooms in Participating School Districts: Construction safe rooms at all school districts.	Ongoing	High	<i>In 2009 or 2010 there was a program that all schools took advantage of. All schools were offered and utilized a grant program that resulted in new gymnasiums that served as safe rooms. Regardless, schools need better safe rooms in some of the school buildings.</i>
26	Join the Firewise Program: Join Firewise Program, sponsor local workshops for local officials, developers, and homeowners to educate and encourage best fire prevention practices in the communities.	Not Started	Low	<i>The County wishes to keep this for the 2024 Update</i>
27	Purchase and Installation of Generators to Power Critical Facilities: Retrofit and harden structures including generators for critical care facilities in Muskogee County and participating jurisdictions such as the Muskogee County Court House, County Barns rural water districts, shelters, nursing homes, etc.	Ongoing	High	<i>Historically, none of the water plants have backup power generators, but Haskell and the Eastern OK Water Authority (Webbers Falls) currently DO have generators – however, these assets are not hardened. Several weeks ago the County approved some new housings for the generators</i>
28	Emergency Responder Family Safety: Take measures to assure safety of the families of those responding to emergency hazards. Designate a facility to serve as a temporary shelter place for responders' families to assemble in emergency or disaster conditions.	Ongoing	Medium	<i>It depends on the agency, but yes this has been ongoing and has been a priority</i>
29	Promote Xeriscaping: Promote the use of native plants for landscaping. These plants are better suited to withstand Oklahoma weather extremes and reduce the need for watering during drought periods.	Not Started	Low	<i>Not something the County has done since 2019</i>

Appendix B. Critical Facilities

Figure B-1 Primary and Secondary Critical Facilities in Muskogee County, OK

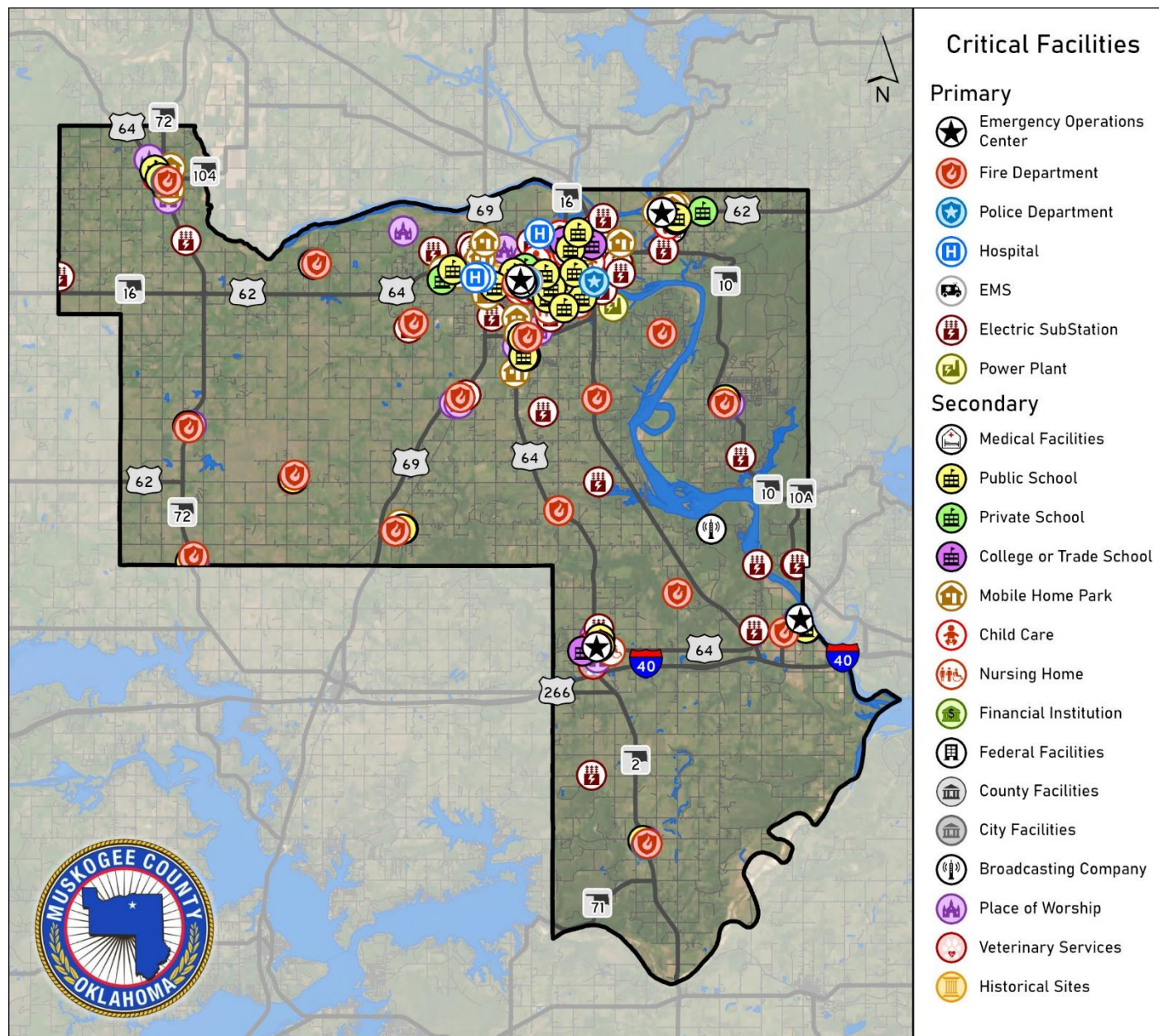


Table B-1 below provides additional information on each of these facilities, and each is presented in alphabetical order according to which municipality they are located. For definitions of acronyms mentioned below, please refer to the footnotes below¹.

¹ ES = Elementary School MS = Middle School JHS = Junior High School HS = High School
MHP = Mobile Home Park VA = Veterans Affairs

Table B-1 Primary and Secondary Critical Facilities in Muskogee County

Facility Type	Facility Class	Facility Name	Address	City/Town
Broadcasting Company	Secondary	Educational Media Foundation	--	--
Broadcasting Company	Secondary	K95.5, Inc.	--	--
Fire Department	Primary	Boynton Volunteer Fire Department	110 E Lucile	Boynton
Electric Substation	Secondary	Unknown118414	--	Braggs
Fire Department	Primary	Braggs Volunteer Fire Department	109 Patrick Ave	Braggs
Police Department	Primary	Braggs Police Department	109 Patrick Ave	Braggs
Public School	Secondary	Braggs ES ²	300 Madden Ave	Braggs
Public School	Secondary	Braggs HS ³	300 Madden Ave	Braggs
Fire Department	Primary	Council Hill Volunteer Fire Department	7th St	Council Hill
Public School	Secondary	Midway HS	316 South Pine	Council Hill
Childcare	Secondary	Fort Gibson Head Start	500 S Ross St	Fort Gibson
Childcare	Secondary	Fort Gibson Before & After School Club	500 S Ross St	Fort Gibson
Childcare	Secondary	Wonderland Preschool And Daycare L.L.C	803 S Lee	Fort Gibson
Childcare	Secondary	Tiny Tots Childcare Center	202 S East St	Fort Gibson
Childcare	Secondary	Tiny Tots Before and After Care	1101 Poplar St	Fort Gibson
Electric Substation	Secondary	Unknown118413	--	Fort Gibson
EOC	Primary	Fort Gibson Emergency Operations Center	200 W Poplar St	Fort Gibson
Fire Department	Primary	Fort Gibson Fire Department	200 W Poplar	Fort Gibson
Medical Facilities	Secondary	Fort Gibson Medical Clinic	105 Lone Oak Circle	Fort Gibson
Mobile Home Park	Secondary	N/A	399 N Scott St	Fort Gibson
Mobile Home Park	Secondary	Town & Country MHP	803 Cemetery Rd	Fort Gibson
Mobile Home Park	Secondary	N/A	505 National Cemetery	Fort Gibson

² Elementary School³ High School

Facility Type	Facility Class	Facility Name	Address	City/Town
Mobile Home Park	Secondary	N/A	401 N Scott St	Fort Gibson
Nursing Home	Secondary	Fort Gibson Nursing Home	205 E Poplar	Fort Gibson
Police Department	Primary	Fort Gibson Police Department	200 W Poplar St	Fort Gibson
Power Plant	Secondary	Muskogee	5501 Three Forks Rd	Fort Gibson
Private School	Secondary	Fort Gibson Christian Academy	1487 E Poplar St	Fort Gibson
Public School	Secondary	Fort Gibson HS	500 S Ross Ave	Fort Gibson
Public School	Secondary	Fort Gibson Intermediate ES	500 South Ross Ave	Fort Gibson
Public School	Secondary	Fort Gibson Early Learning Center	500 S Ross Ave	Fort Gibson
Public School	Secondary	Fort Gibson MS	500 South Ross Ave	Fort Gibson
Childcare	Secondary	Learning Nest Academy	206 SE Railroad	Fort. Gibson
Police Department	Primary	Webbers Falls Police Department	212 N State Hwy 100	Gore
Childcare	Secondary	Haskell Head Start	313 Chickasaw	Haskell
Childcare	Secondary	Haskell Learning Center	485 N Ohio	Haskell
Electric Substation	Secondary	Unknown118445	--	Haskell
Electric Substation	Secondary	Unknown119027	--	Haskell
Fire Department	Primary	Haskell Volunteer Fire Department	119 Commercial	Haskell
Mobile Home Park	Secondary	Cedar Village MHP	300 E Skelly Rd	Haskell
Mobile Home Park	Secondary	N/A	221 Duncan St	Haskell
Nursing Home	Secondary	Haskell Care Center	405 North Choctaw	Haskell
Police Department	Primary	Haskell Police Department	109 South Broadway	Haskell
Public School	Secondary	Haskell MS	900 North Ohio	Haskell
Public School	Secondary	Haskell HS	900 North Ohio	Haskell
Public School	Secondary	Mary White ES	408 W Franklin	Haskell
Childcare	Secondary	Oak Tree Academy LLC	131 N Anthony	Muskogee
Childcare	Secondary	Saint Francis Child Development Center	300 Rockefeller Dr	Muskogee
Childcare	Secondary	Shawnee Early Head Start	2719 Old Shawnee Rd	Muskogee
Childcare	Secondary	Kidco Childcare And Development Center	501 N York	Muskogee
Childcare	Secondary	Muskogee County Head Start Main Campus	540 S 3 rd	Muskogee

Facility Type	Facility Class	Facility Name	Address	City/Town
Childcare	Secondary	MPS Schools Out Grant Foreman	800 Bacone	Muskogee
Childcare	Secondary	MPS Schools Out	2412 Haskell Blvd	Muskogee
Childcare	Secondary	Little Okie Academy LLC	1313 N Main St	Muskogee
Childcare	Secondary	Eastside Head Start	3900 Eufaula	Muskogee
Childcare	Secondary	Green Country Childcare	301 N 6 th	Muskogee
Childcare	Secondary	Champion's Childcare Center	306 South B St	Muskogee
Childcare	Secondary	New Beginnings Childcare Center Inc.	410 Girard	Muskogee
Childcare	Secondary	Mims Enterprises Inc. Dbw Wilkersons CCC East	810 E Okmulgee	Muskogee
Childcare	Secondary	Schools Out Early Childhood	901 Emporia St	Muskogee
Childcare	Secondary	Jack And Jill Learning Center LLC	2701 Keetoowah Trl	Muskogee
City Facilities	Secondary	Muskogee Civic Center	425 Boston St	Muskogee
College or Trade School	Secondary	Bacone College	2299 Old Bacone Rd	Muskogee
College or Trade School	Secondary	Virgil's Beauty College	111 S Ninth St	Muskogee
College or Trade School	Secondary	Indian Capital Technology Center-Muskogee	2403 N 41 st St E	Muskogee
County Facilities	Secondary	Muskogee County Courthouse	220 State St	Muskogee
Electric Substation	Secondary	Unknown118410	--	Muskogee
Electric Substation	Secondary	Unknown118411	--	Muskogee
Electric Substation	Secondary	Unknown118412	--	Muskogee
Electric Substation	Secondary	Unknown118415	--	Muskogee
Electric Substation	Secondary	Unknown118967	--	Muskogee
Electric Substation	Secondary	Unknown119025	--	Muskogee
Electric Substation	Secondary	Unknown119026	--	Muskogee
Electric Substation	Secondary	Unknown119089	--	Muskogee
Electric Substation	Secondary	Unknown119090	--	Muskogee
Electric Substation	Secondary	Unknown119091	--	Muskogee

Facility Type	Facility Class	Facility Name	Address	City/Town
Electric Substation	Secondary	Unknown119163	--	Muskogee
Electric Substation	Secondary	Unknown119164	--	Muskogee
Electric Substation	Secondary	Unknown119165	--	Muskogee
Electric Substation	Secondary	Unknown119166	--	Muskogee
Electric Substation	Secondary	Unknown119167	--	Muskogee
Electric Substation	Secondary	Unknown119168	--	Muskogee
Electric Substation	Secondary	Unknown119169	--	Muskogee
Electric Substation	Secondary	Unknown119171	--	Muskogee
Electric Substation	Secondary	Muskogee	--	Muskogee
Electric Substation	Secondary	Pecan Creek	--	Muskogee
Electric Substation	Secondary	Unknown157384	--	Muskogee
EMS	Primary	Muskogee County Emergency Medical Services	200 Callahan St	Muskogee
EOC	Primary	Muskogee Emergency Operations Center	229 West Okmulgee St	Muskogee
EOC	Primary	Muskogee County Emergency Management Agency- Emergency Operations Center	220 State St	Muskogee
Fire Department	Primary	Keifton Volunteer Fire Department	12000 United States Hwy 64	Muskogee
Fire Department	Primary	Summit Volunteer Fire Department	4900 Chimney Mountain Rd	Muskogee
Fire Department	Primary	Mountain View Volunteer Fire Department	7351 W 27 th St S	Muskogee
Fire Department	Primary	Muskogee Fire Department	505 Columbus St	Muskogee
Fire Department	Primary	Brushy Mountain Volunteer Fire Department	4350 E Davis Field Rd	Muskogee
Fire Department	Primary	Gooseneck Bend Volunteer Fire Department	3094 S Woodland Rd	Muskogee
Hospital	Primary	Saint Francis Hospital Muskogee East	2900 N Main St	Muskogee
Hospital	Primary	Saint Francis Hospital Muskogee	300 Rockefeller Dr	Muskogee

Facility Type	Facility Class	Facility Name	Address	City/Town
Hospital	Primary	Cornerstone Hospital of Oklahoma - Muskogee	351 S 40th St	Muskogee
Medical Facilities	Secondary	Jack C. Montgomery VA Medical Center	1011 Honor Heights Dr	Muskogee
Medical Facilities	Secondary	Muskogee County Health Department	530 S 34th St	Muskogee
Medical Facilities	Secondary	First Care Medical Clinic	3300 Chandler Rd	Muskogee
Medical Facilities	Secondary	Muskogee Immediate Care	3520 Chandler Rd	Muskogee
Mobile Home Park	Secondary	Cranke's Mobile City	6000 W Broadway St	Muskogee
Mobile Home Park	Secondary	Paradise Hills & Paradise	2400 S Cherokee # 7	Muskogee
Mobile Home Park	Secondary	Sleepy Hollow MHP	3301 Brewer St	Muskogee
Mobile Home Park	Secondary	Meadowbrook RV Park	1215 S 32 nd St	Muskogee
Mobile Home Park	Secondary	Grandview MHP	3225 S Cherokee Dr	Muskogee
Mobile Home Park	Secondary	Paradise Properties	5111 S Cherokee St	Muskogee
Mobile Home Park	Secondary	Villa Capri MHP	5150 OK-16	Muskogee
Mobile Home Park	Secondary	N/A	3799 Old Shawnee Rd	Muskogee
Mobile Home Park	Secondary	N/A	2276 N4340	Muskogee
Mobile Home Park	Secondary	N/A	2462 US-69	Muskogee
Nursing Home	Secondary	Broadway Manor Nursing Home	1622 E Broadway	Muskogee
Nursing Home	Secondary	Dogwood Creek Retirement Center	3230 E Shawnee Ave	Muskogee
Nursing Home	Secondary	York Manor Nursing Home	500 South York	Muskogee
Nursing Home	Secondary	Eastgate Village Retirement Center	3500 Haskell Blvd	Muskogee
Nursing Home	Secondary	Pleasant Valley Health Care Center	1120 Illinois	Muskogee
Nursing Home	Secondary	Brentwood Extended Care & Rehab	841 N 38th St	Muskogee
Nursing Home	Secondary	Muskogee Nursing Center	602 N "M" St	Muskogee
Nursing Home	Secondary	Brookdale Muskogee	3211 Chandler Rd	Muskogee

Facility Type	Facility Class	Facility Name	Address	City/Town
Nursing Home	Secondary	The Springs, A Grace Living Center Community	5800 W Okmulgee	Muskogee
Nursing Home	Secondary	Country Gardens Assisted Living Community	611 S Country Club Rd	Muskogee
Police Department	Primary	Muskogee County Sheriff's Office	220 State St	Muskogee
Police Department	Primary	Muskogee Public Schools Security	202 W Broadway St	Muskogee
Police Department	Primary	Muskogee Police Department	112 S 3rd St	Muskogee
Police Department	Primary	Oklahoma Highway Patrol - Troop C	651 N 43 rd St E	Muskogee
Power Plant	Secondary	Muskogee Mill	4901 Chandler Rd	Muskogee
Private School	Secondary	Muskogee Seventh-Day Adventist Christian Academy	170 N Country Club Rd	Muskogee
Private School	Secondary	Bldv Christian School	1700 W Shawnee St	Muskogee
Private School	Secondary	St Joseph Catholic School	323 N Virginia St	Muskogee
Private School	Secondary	Benjamin Franklin Science Academy	300 Virgil Matthews Dr	Muskogee
Private School	Secondary	Sadler Arts Academy	800 Altamont	Muskogee
Public School	Secondary	Muskogee HS	3200 E Shawnee Rd	Muskogee
Public School	Secondary	Hilldale Upper ES	315 East Peak Blvd	Muskogee
Public School	Secondary	Creek ES	200 S Country Club Rd	Muskogee
Public School	Secondary	Oklahoma School for the Blind ES	3300 Gibson St	Muskogee
Public School	Secondary	Tony Goetz ES	2412 Haskell Blvd	Muskogee
Public School	Secondary	Whittier ES	1705 Cincinnati	Muskogee
Public School	Secondary	Muskogee EC Center	901 Emporia	Muskogee
Public School	Secondary	Oklahoma School for the Blind HS	3300 Gibson St	Muskogee
Public School	Secondary	Alice Robertson JHS	402 North S St	Muskogee
Public School	Secondary	Hilldale MS	400 E Smith Ferry Rd	Muskogee
Public School	Secondary	Irving ES	1100 North J St	Muskogee
Public School	Secondary	Cherokee ES	2400 Estelle St	Muskogee
Public School	Secondary	Hilldale HS	300 E Smith Ferry Rd	Muskogee
Public School	Secondary	Hilldale Lower ES	3301 Grandview Park Blvd	Muskogee
Public School	Secondary	Grant-Foreman ES	800 Bacone St	Muskogee
Public School	Secondary	Harris Jobe ES	2809 N Country Club Rd	Muskogee
Public School	Secondary	Pershing ES	301 N 54 th St	Muskogee

Facility Type	Facility Class	Facility Name	Address	City/Town
Fire Department	Primary	Oktaha Volunteer Fire Department	Main	Oktaha
Mobile Home Park	Secondary	N/A	313 N Park Ln	Oktaha
Public School	Secondary	Oktaha HS	531 E Prairie	Oktaha
Public School	Secondary	Oktaha ES	531 E Prairie	Oktaha
Electric Substation	Secondary	Unknown119117	--	Porum
Fire Department	Primary	Porum Volunteer Fire Department	112 North 2 nd St	Porum
Police Department	Primary	Porum Police Department	114 N 2 nd St	Porum
Public School	Secondary	Porum HS	4 th & Osage	Porum
Public School	Secondary	Porum ES	4 th & Osage	Porum
Fire Department	Primary	Taft Fire Association	Main	Taft
Childcare	Secondary	Muscogee Creek Nation Head Start Wainwright	115 E Walnut St	Wainwright
Fire Department	Primary	Wainwright Volunteer Fire Association	110 Main St	Wainwright
Public School	Secondary	Wainwright Public School	115 E Walnut	Wainwright
Childcare	Secondary	Warner Play And Learn Center	1104 Campbell	Warner
Childcare	Secondary	Warner Head Start	1012 5 th Ave	Warner
College or Trade School	Secondary	Connors State College	700 College Rd	Warner
Electric Substation	Secondary	Unknown159664	--	Warner
EOC	Primary	Warner Emergency Operations Center	1000 E United States Hwy 64	Warner
Fire Department	Primary	Warner Volunteer Fire Department	1000 United States Hwy 64	Warner
Nursing Home	Secondary	Countryside Estates	Hwy 64 E	Warner
Police Department	Primary	Warner Police Department	1000 United States Hwy 64	Warner
Public School	Secondary	Warner HS	1012 5 th Ave	Warner
Public School	Secondary	Warner ES	1012 5th Ave	Warner
Electric Substation	Secondary	Unknown118347	--	Webbers Falls
Electric Substation	Secondary	Unknown148808	--	Webbers Falls
EOC	Primary	Webbers Falls Emergency Operations Center	State Hwy 100 & Stan Waite Blvd	Webbers Falls

Facility Type	Facility Class	Facility Name	Address	City/Town
Fire Department	Primary	Webbers Falls Volunteer Fire Department	United States Hwy 100	Webbers Falls
Fire Department	Primary	Buckhorn Volunteer Fire Department	N4370	Webbers Falls
Power Plant	Secondary	Webbers Falls	Route 1, Box 145	Webbers Falls
Public School	Secondary	Webbers Falls HS	200 S St & Waite Blvd	Webbers Falls
Public School	Secondary	Webbers Falls ES	200 S Stand Waite Blvd	Webbers Falls

Appendix C. Dam Inundation Maps

As described in Chapter 4, eleven dams can potentially inundate parts of Muskogee County, and the series of figures below are compiled here in Appendix C. Flood inundation mapping is accompanied by impact tables that describe floodwater arrival times and floodwater depths as extracted from their Emergency Action Plan (EAP).

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C.1 Lake Eufaula Dam

Inundation mapping was unavailable from the Lake Eufaula Dam Emergency Action Plan (EAP), and as such, no analysis was possible to understand the impacts downstream or the times and water depths during a Dam Incident at this location. Due to this data deficiency, an action item has been added in Chapter 5 to focus on gathering this information.

Figure C-1 Lake Eufaula Sunny Day (Normal) Breach Inundation Map

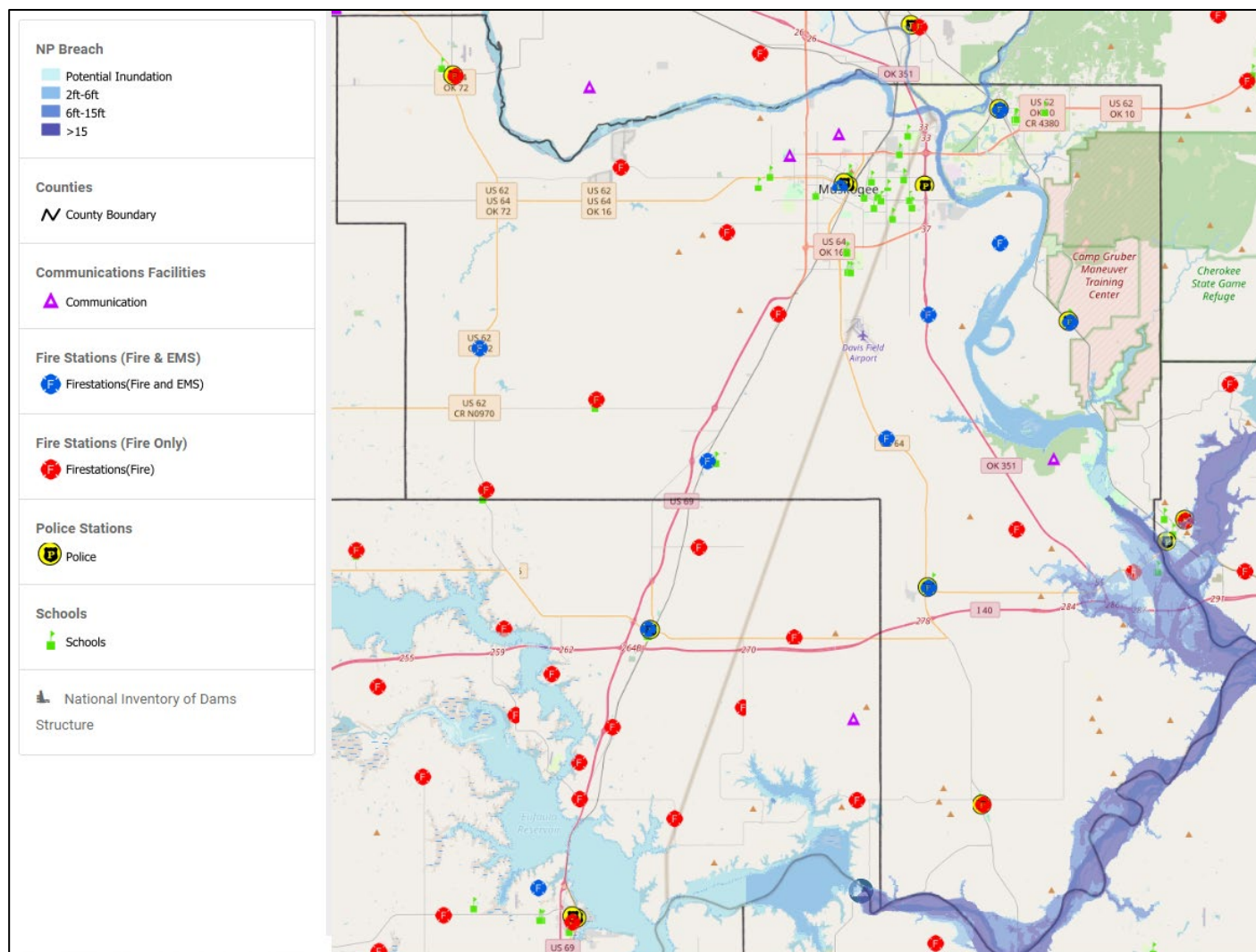


Figure C-2 Lake Eufaula PMF Breach Inundation Map

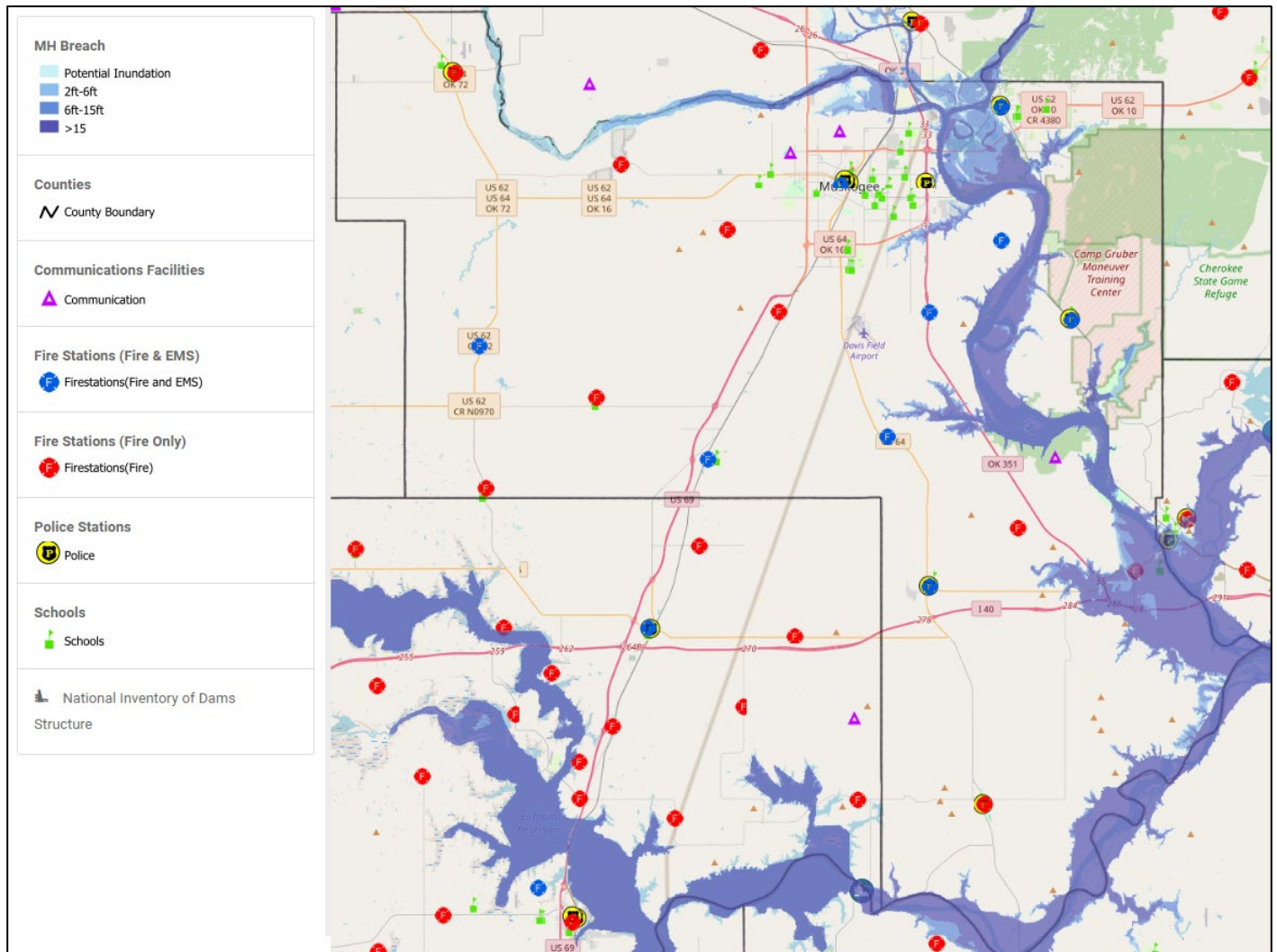


Table C-1 Lake Eufaula Normal Breach Inundation – Water & Arrival Times

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
Water Plant	Webbers Falls	31.5	6 – 15	Unknown
VFD	Webbers Falls	31.5	< 2	Unknown
Elementary School	Webbers Falls	31.6	2 – 6	Unknown
High School	Webbers Falls	31.6	2 – 6	Unknown
Post Office	Webbers Falls	31.6	6 – 15	Unknown
Police Department	Webbers Falls	32.0	2 – 6	Unknown
EOC	Webbers Falls	32.0	2 – 6	Unknown
City Hall	Webbers Falls	32.0	2 – 6	Unknown
N/A	Webbers Falls PSD	32.0	> 15	Unknown
N/A	Fort Gibson	64.0	2 – 6	Unknown
N/A	Fort Gibson PSD	64.0	2 – 6	Unknown
N/A	Braggs PSD	50.0	2 – 15	Unknown
N/A	Muskogee	64.0	2 – 6	Unknown
N/A	Muskogee PSD	64.0	2 – 6	Unknown
N/A	Oktaha PSD	45.0	2 – 15+	Unknown
N/A	Porum PSD	< 10.0	> 15	Unknown
N/A	Warner PSD	45.0	2 – 15+	Unknown

Table C-2 Lake Eufaula PMF Breach Inundation – Water & Arrival Times

Critical Facilities	Town/City Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
N/A	Porum PSD	< 10	> 15	Unknown
Water Treatment Plant	Webbers Falls	31.5	> 15	Unknown
VFD	Webbers Falls	31.5	6 – 15	Unknown
Elementary School	Webbers Falls	31.6	> 15	Unknown
High School	Webbers Falls	31.6	> 15	Unknown
Post Office	Webbers Falls	31.6	> 15	Unknown
Police Department	Webbers Falls	32.0	> 15	Unknown
EOC	Webbers Falls	32.0	> 15	Unknown
City Hall	Webbers Falls	32.0	> 15	Unknown
Electric Sub-Station #148808	Muskogee Co. District 2	35.4	> 15	Unknown
Webbers Falls L&D	Muskogee Co. District 2	35.4	> 15	Unknown
N/A	Oktaha PSD	45.0	2 – 15+	Unknown
N/A	Warner PSD	45.0	2 – 15+	Unknown

Critical Facilities	Town/CityJurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
N/A	Braggs PSD	50.0	2 – 15	Unknown
Electric Sub-Station #118413	Fort Gibson	55.6	> 15	Unknown
Pollution Control Center	Muskogee	58.0	2 – 15	Unknown
Georgia Pacific Power Plant	Muskogee	58.0	< 2	Unknown
OG&E	Fort Gibson	59.4	2 – 6	Unknown
Electric Sub-Station #118412	Fort Gibson	59.5	6 – 15	Unknown
Port of Muskogee	Muskogee	61.4	6 – 15	Unknown
City Water Plant	Muskogee	62.0	2 – 6	Unknown
Water Treatment Plant	Fort Gibson	64.0	6 – 15	Unknown
N/A	Fort Gibson PSD	64.0	2 – 6	Unknown
N/A	Muskogee PSD	64.0	2 – 6	Unknown

C.2 Fort Gibson Lake Dam

Figure C-3 Fort Gibson Dam Normal and PMF Breach Inundation Map

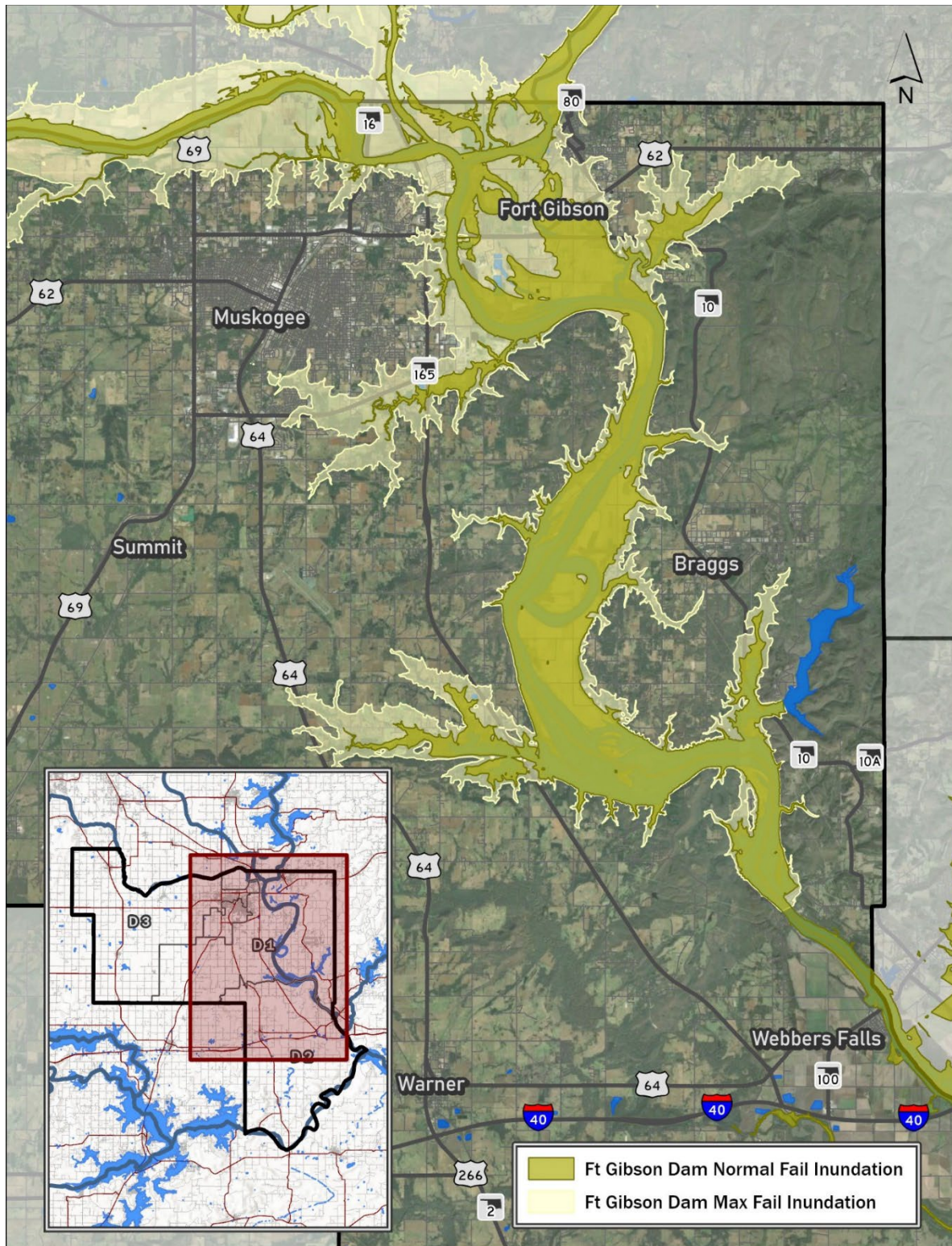


Table C-3 Fort Gibson Dam Sunny Day (Normal) Breach – Times and Water Depths

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
N/A	Fort Gibson PSD	5.0	2 – 15	Unknown
Water Treatment Plant	Muskogee	8.1	< 2	Unknown
Port of Muskogee	Muskogee	8.62	6 – 15	Unknown
Electric Sub-Station #118413	Fort Gibson	9.62	2 – 15	Unknown
N/A	Muskogee PSD	10.0	2 – 15	Unknown
N/A	Oktaha PSD	26.0	2 – 6	Unknown
N/A	Warner PSD	26.0	2 – 6	Unknown
N/A	Braggs PSD	30	2 – 15	Unknown
Electric Sub-Station #148808	Muskogee Co. District 2	34.4	6 – 15	Unknown
Webbers Falls L&D	Muskogee Co. District 2	34.4	6 – 15	Unknown
N/A	Webbers Falls PSD	37.5	2 – 6	Unknown

Table C-4 Fort Gibson Dam PMF Breach – Times and Water Depths

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
N/A	Fort Gibson PSD	5.0	2 – 15+	Unknown
Unnamed Mobile Home Park	Fort Gibson	5.9	2 – 15	Unknown
Water Treatment Plant	Fort Gibson	6.0	> 15	Unknown
Wonderland Preschool & Daycare	Fort Gibson	6	6 – 15	Unknown
Fort Gibson Medical Clinic	Fort Gibson	6	6 – 15	Unknown
City Water Treatment Plant	Muskogee	7.96	> 15	Unknown
Water Treatment Plant	Muskogee	8.1	> 15	Unknown
Electric Sub-Station #119167	Muskogee	8.1	> 15	Unknown
Port of Muskogee	Muskogee	8.62	> 15	Unknown
Electric Sub-Station #119166	Muskogee	8.79	> 15	Unknown
Electric Sub-Station #118413	Fort Gibson	9.62	> 15	Unknown
Electric Sub-Station #118411	Fort Gibson	9.64	> 15	Unknown
Electric Sub-Station #118412	Fort Gibson	9.64	> 15	Unknown
OG&E Power Plant	Fort Gibson	9.64	> 15	Unknown
N/A	Muskogee PSD	10.0	2 – 15+	Unknown
Cedar Village MHP	Muskogee	10.3	6 – 15	Unknown
Electric Sub-Station #119089	Muskogee	11.2	6 – 15	Unknown
Muskogee Mill Power Plant	Muskogee	11.3	> 15	Unknown

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
Pollution Control Plant	Muskogee	11.4	> 15	Unknown
N/A	Taft	23.0	2 – 15	Unknown
Electric Sub-Station #119091	Muskogee Co. District 1	25.9	2 – 6	Unknown
N/A	Oktaha PSD	26.0	2 – 15+	Unknown
N/A	Warner PSD	26.0	2 – 15+	Unknown
N/A	Braggs PSD	30	2 – 15+	Unknown
Electric Sub-Station #118414	Muskogee Co. District 1	30.4	> 15	Unknown
N/A	Haskell PSD	32.0	2 – 15	Unknown
Electric Sub-Station #148808	Muskogee Co. District 2	34.4	> 15	Unknown
Webbers Falls L&D	Muskogee Co. District 2	34.4	> 15	Unknown
N/A	Webbers Falls PSD	37.5	2 – 15	Unknown

C.3 Heyburn Lake Dam

Figure C-4 Heyburn Dam Normal and PMF Inundation Maps

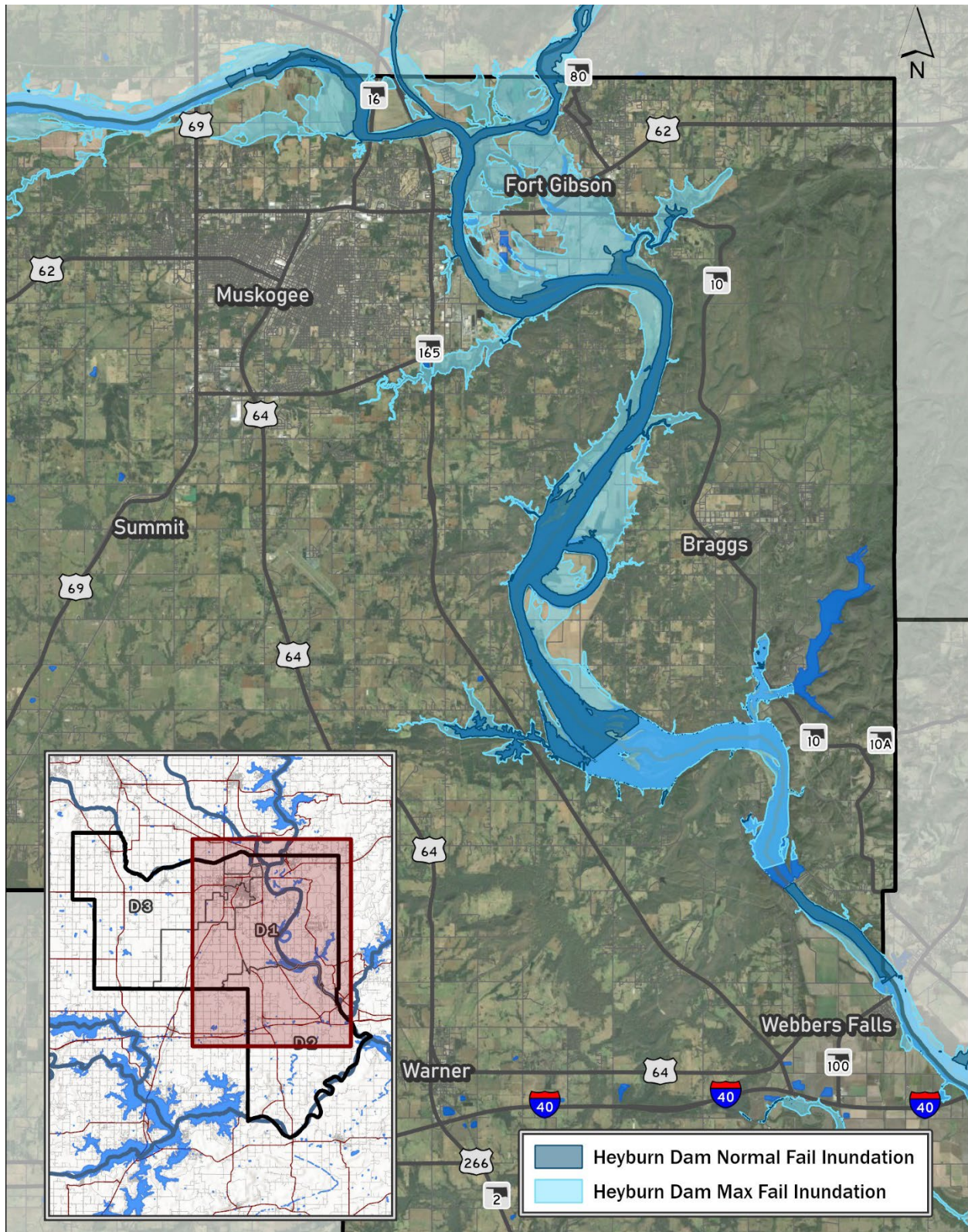


Table C-5 Heyburn Dam Sunny Day (Normal) Breach – Times and Water Depths

House/ Business No.	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
N/A	Muskogee Co. (unincorporated)	83.0	2 - 6	Unknown
Port of Muskogee	Fort Gibson	104.8	< 2	53:30
N/A	Muskogee	108	< 2	Unknown
N/A	Fort Gibson PSD	108	2 – 15	Unknown
N/A	Muskogee PSD	108	< 2	Unknown
N/A	Oktaha PSD	127.0	< 2	Unknown
N/A	Warner PSD	127.0	< 2	Unknown
N/A	Braggs PSD	131	< 2	Unknown
N/A	Webbers Falls	137.0	< 2	Unknown
N/A	Webbers Falls PSD	137.0	< 2	Unknown

Table C-6 Heyburn Dam PMF Breach – Times and Water Depths

Structure	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
N/A	Haskell PSD	83.0	2 – 15	Unknown
N/A	Muskogee Co. (unincorporated)	83.0	2 – 15	Unknown
N/A	Taft	85.0	2 – 6	Unknown
Port of Muskogee	Fort Gibson	104.8	> 15	42:00
Electric Sub-Station 118411	Fort Gibson	106.9	surrounded	42:00
Water Treatment Plant	Fort Gibson	107	< 2	42:00
Electric Sub-Station	Fort Gibson	107.5	< 2	42:00
Electric Sub-Station 118413	Fort Gibson	108	6 – 15	42:00
OG&E Power Plant	Fort Gibson	108	< 2	42:00
N/A	Muskogee PSD	108	2 – 15	Unknown
Pollution Control Plant	Muskogee	108.9	< 2	44:00
N/A	Braggs PSD	129	2 – 15	Unknown
Webbers Falls L&D	--	132.5	< 2	31:15
N/A	Webbers Falls	137.0	2 – 15	Unknown
N/A	Webbers Falls PSD	137.0	2 – 6	Unknown

C.4 Keystone Reservoir Dam

Figure C-5 Keystone Dam Inundation Scenarios

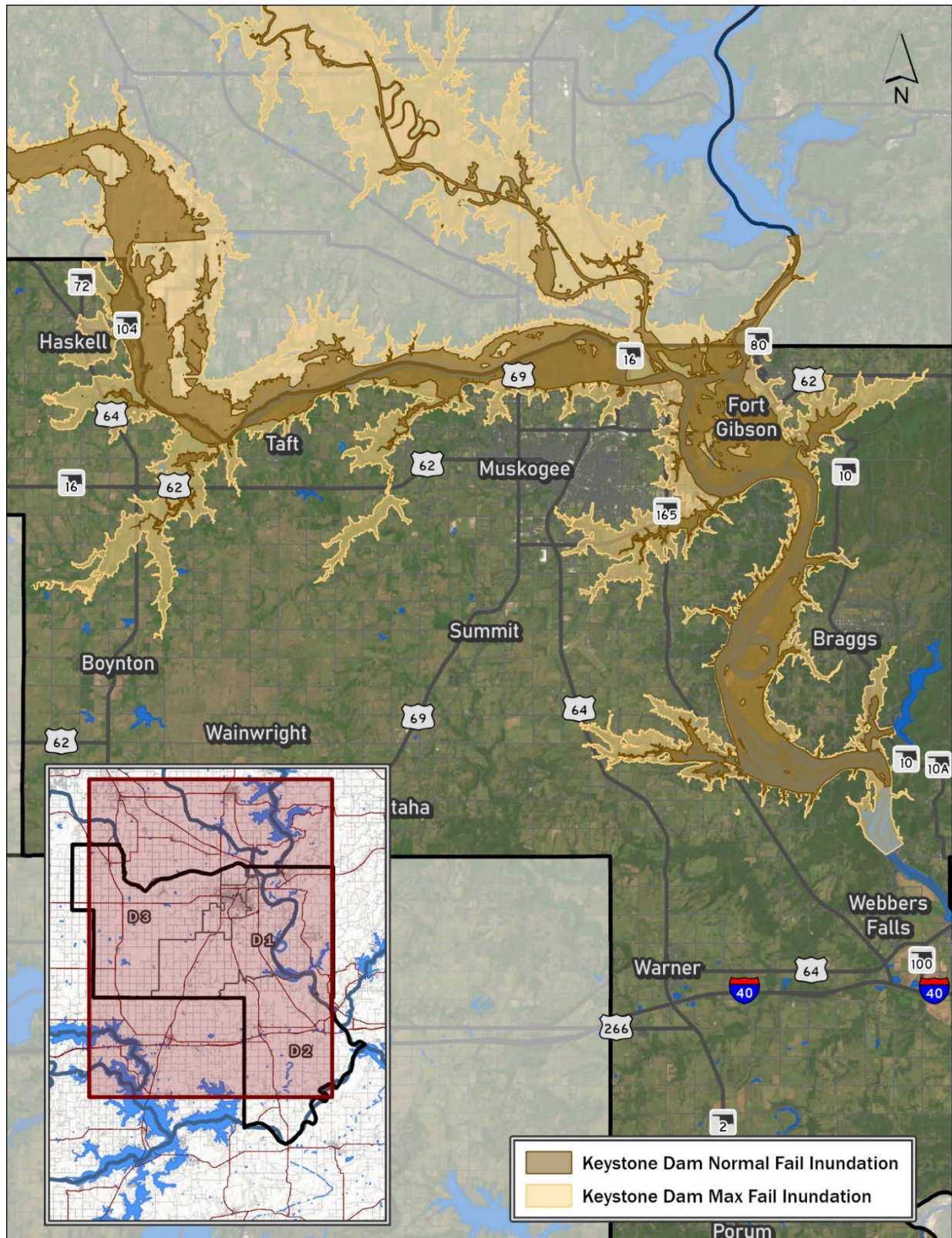


Table C-7 Keystone Dam Sunny Day (Normal) Breach – Times and Water Depths

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (DD:HH:MM)
Haskell Water Treatment Plant	Haskell	54.5	> 15	01:05:00
Port of Muskogee	Muskogee	78.7	2 – 6	01:19:00
Muskogee Pollution Control	Muskogee	82.4	< 2	01:20:00
Electric Sub-Station 118413	Fort Gibson	83.0	6 – 15	N/A
Fort Gibson Water Treatment Plant	Fort Gibson	83.5	< 2	01:20:00
Electric Sub-Station 118414	Fort Gibson	99.9	6 – 15	N/A
Webbers Falls L&D	Muskogee Co. District 2	108	N/A	N/A
Electric Sub-Station #148808	Muskogee Co. District 2	108	N/A	N/A
N/A	Muskogee Co. District 3	52.1	2 – 15	Unknown
N/A	Taft	62.5	2 – 6	Unknown
N/A	Braggs PSD	86.8	2 - 6	Unknown
N/A	Fort Gibson PSD	77.9	2 – 15	Unknown
N/A	Haskell PSD	52.1	2 – 15	Unknown
N/A	Muskogee PSD	67.7	2 – 15	Unknown
N/A	Oktaha PSD	94.2	2 – 15	Unknown
N/A	Warner PSD	96.5	2 – 15	Unknown

Table C-8 Keystone Dam PMF Inundation Arrival Times and Water Depths

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (DD:HH:MM)
Haskell Head Start	Haskell	54.5	< 2	1:05:00
Haskell Water Treatment Plant	Haskell	54.5	> 15	1:05:00
Haskell Care Center	Haskell	54.5	2 – 6	1:05:00
Haskell Police Dept	Haskell	54.5	< 2	1:05:00
Haskell Fire Dept.	Haskell	54.5	2 – 6	1:05:00
Haskell Post Office	Haskell	54.5	6 – 15	1:05:00
Electric Sub-Station 119167	Muskogee	78.0	> 15	01:19:00
Electric Sub-Station 119166	Muskogee	78.0	> 15	01:19:00
Muskogee WTP	Muskogee	78.5	> 15	01:19:00
Port of Muskogee	Muskogee	78.7	> 15	01:19:00
Electric Sub-Station 118411	Fort Gibson	80.2	> 15	N/A
Electric Sub-Station 118412	Fort Gibson	80.3	> 15	N/A
OG&E	Fort Gibson	80.4	> 15	01:20:00

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (DD:HH:MM)
Cedar Village MHP	Muskogee	80.6	> 15	1:05:00
Electric Sub-Station 119089	Muskogee	81.2	6 – 15	N/A
Georgia Pacific	Muskogee	82.0	6 – 15	01:20:00
Muskogee Pollution Control	Muskogee	82.4	> 15	01:20:00
Electric Sub-Station 118413	Fort Gibson	83.0	> 15	N/A
Fort Gibson WTP	Fort Gibson	83.5	> 15	01:20:00
Fort Gibson Middle School	Fort Gibson	83.5	< 2	01:20:00
Fort Gibson Early Learning Center	Fort Gibson	83.5	< 2	01:20:00
Wonderland Preschool	Fort Gibson	83.5	6 – 15	N/A
Fort Gibson MHP 1	Fort Gibson	84.0	2 – 6	01:20:00
Fort Gibson MHP 2	Fort Gibson	84.0	2 – 6	01:20:00
Electric Sub-Station 119091	Muskogee Co. District 1	97.3	2 – 6	01:20:00
Webbers Falls L&D	Muskogee Co. District 2	108	> 15	N/A
Electric Sub-Station #148808	Muskogee Co. District 2	108	> 15	N/A
N/A	Muskogee Co. District 3	52.1	2 – 15	Unknown
N/A	Taft	62.5	2 – 15	Unknown
N/A	Braggs PSD	86.8	2 – 15	Unknown
N/A	Fort Gibson PSD	77.9	2 - 15	Unknown
N/A	Haskell PSD	52.1	2 – 15	Unknown
N/A	Hilldale PSD	90.0	2 – 15	Unknown
N/A	Muskogee PSD	67.7	2 – 15	Unknown
N/A	Oktaha PSD	94.2	2 – 15	Unknown
N/A	Warner PSD	96.5	2 – 15	Unknown

C.5 Oologah Reservoir Dam

Figure C-6 Oologah Lake Normal and PMF Inundation Map

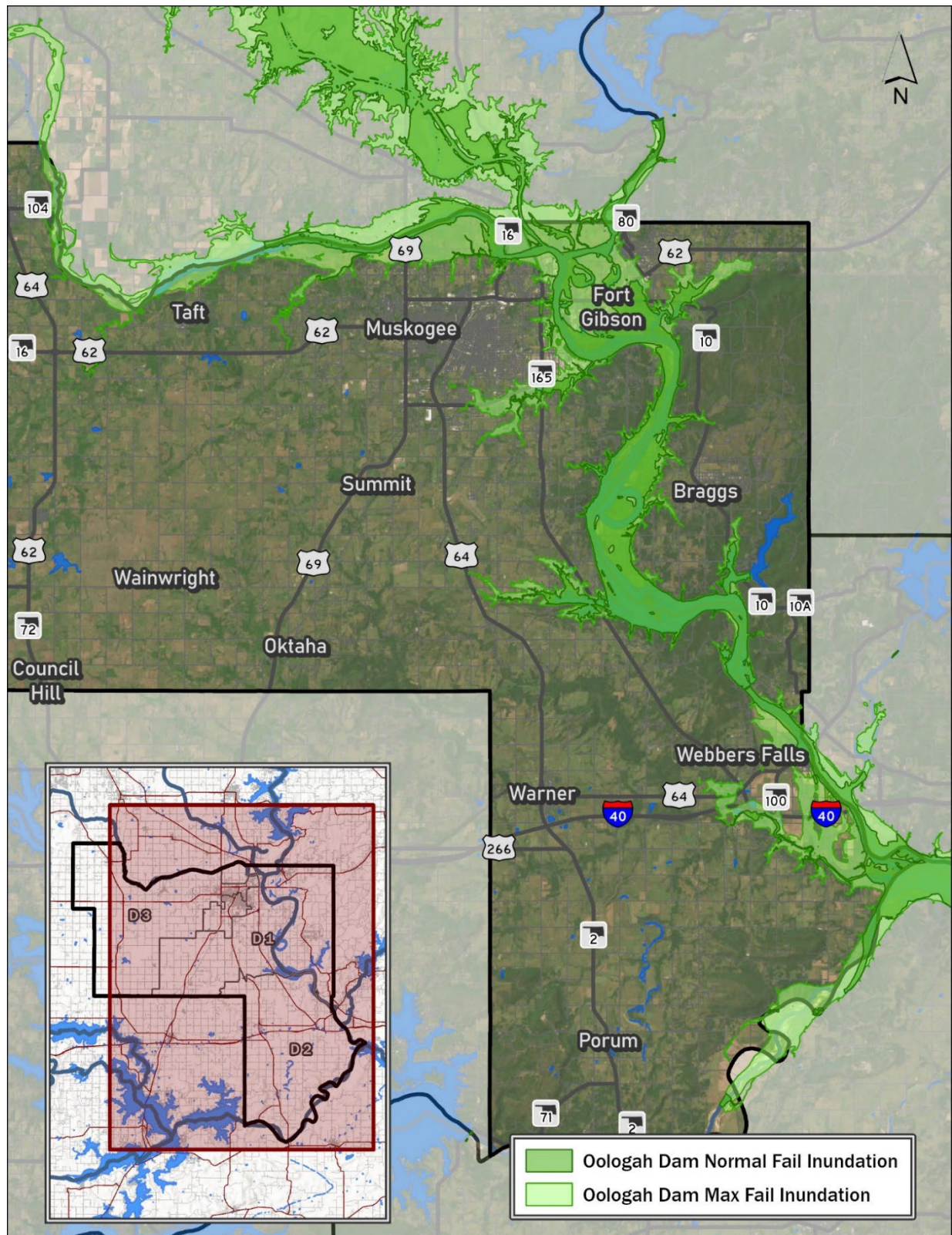


Table C-9 Oologah Lake Sunny Day (Normal) Breach – Times and Water Depths

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
Electrical Sub-Station #118413	Fort Gibson	83.4	6 – 15	Unknown
Webbers Falls L&D	Muskogee Co. District 2	104	< 2	Unknown
Electrical Sub-Station #148808	Muskogee Co. District 2	104	< 2	Unknown
N/A	Muskogee	79.0	2 – 15	Unknown
N/A	Webbers Falls	108.2	2 – 6	Unknown
N/A	Braggs PSD	88.7	2 – 6	Unknown
N/A	Fort Gibson PSD	79.8	2 – 15	Unknown
N/A	Muskogee PSD	78.4	2 – 15	Unknown
N/A	Oktaha PSD	96.1	2 – 15	Unknown
N/A	Warner PSD	98.4	2 – 15	Unknown
N/A	Webbers Falls PSD	100.5	2 – 6	Unknown

Table C-10 Oologah Lake PMF Breach – Times and Water Depths

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
Wonderland Pre-School	Fort Gibson	79.4	2 – 6	Unknown
Water Treatment Plant	Fort Gibson	78.4	> 15	Unknown
Muskogee Water Plant	Muskogee	76.8	6 – 15	Unknown
Port of Muskogee	Muskogee	77	> 15	Unknown
Electrical Sub-Station #119166	Muskogee	77.1	> 15	Unknown
OG&E Power Plant	Fort Gibson	78.3	6 – 15	Unknown
Electrical Sub-Station #118411	Fort Gibson	78.5	6 – 15	Unknown
Bella Vista MHP	Muskogee	78.6	2 – 15	Unknown
Electrical Sub-Station #118412	Fort Gibson	79	6 – 15	Unknown
Electrical Sub-Station #118413	Fort Gibson	80	> 15	Unknown
Electrical Sub-Station #119089	Muskogee	80	2 – 6	Unknown
Georgia Pacific Power Plant	Muskogee	80.5	> 15	Unknown
Pollution Control	Muskogee	80.5	> 15	Unknown
Electrical Sub-Station #118413	Fort Gibson	83.4	> 15	Unknown
Electrical Sub-Station #118414	Muskogee Co. District 2	102	2 – 6	Unknown
Webbers Falls L&D	Muskogee Co. District 2	104	6 – 15	Unknown
Electrical Sub-Station #148808	Muskogee Co. District 2	104	6 – 15	Unknown
Police Department	Webbers Falls	107	< 2	Unknown

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
Emergency Operations Center	Webbers Falls	107	< 2	Unknown
City Hall	Webbers Falls	107	< 2	Unknown
N/A	Taft	94.6	2 – 6	Unknown
N/A	Braggs PSD	88.7	2 – 15	Unknown
N/A	Fort Gibson PSD	79.8	2 – 15	Unknown
N/A	Haskell PSD	91.7	2 - 15	Unknown
N/A	Hilldale PSD	91.9	2 – 15	Unknown
N/A	Muskogee PSD	78.4	2 – 15	Unknown
N/A	Oktaha PSD	96.1	2 - 15	Unknown
N/A	Warner PSD	98.4	2 – 15	Unknown
N/A	Webbers Falls PSD	100.5	2 – 15	Unknown

C.6 Pensacola Dam

Figure C-7 Pensacola Dam Sunny Day (Normal) Breach Inundation Map

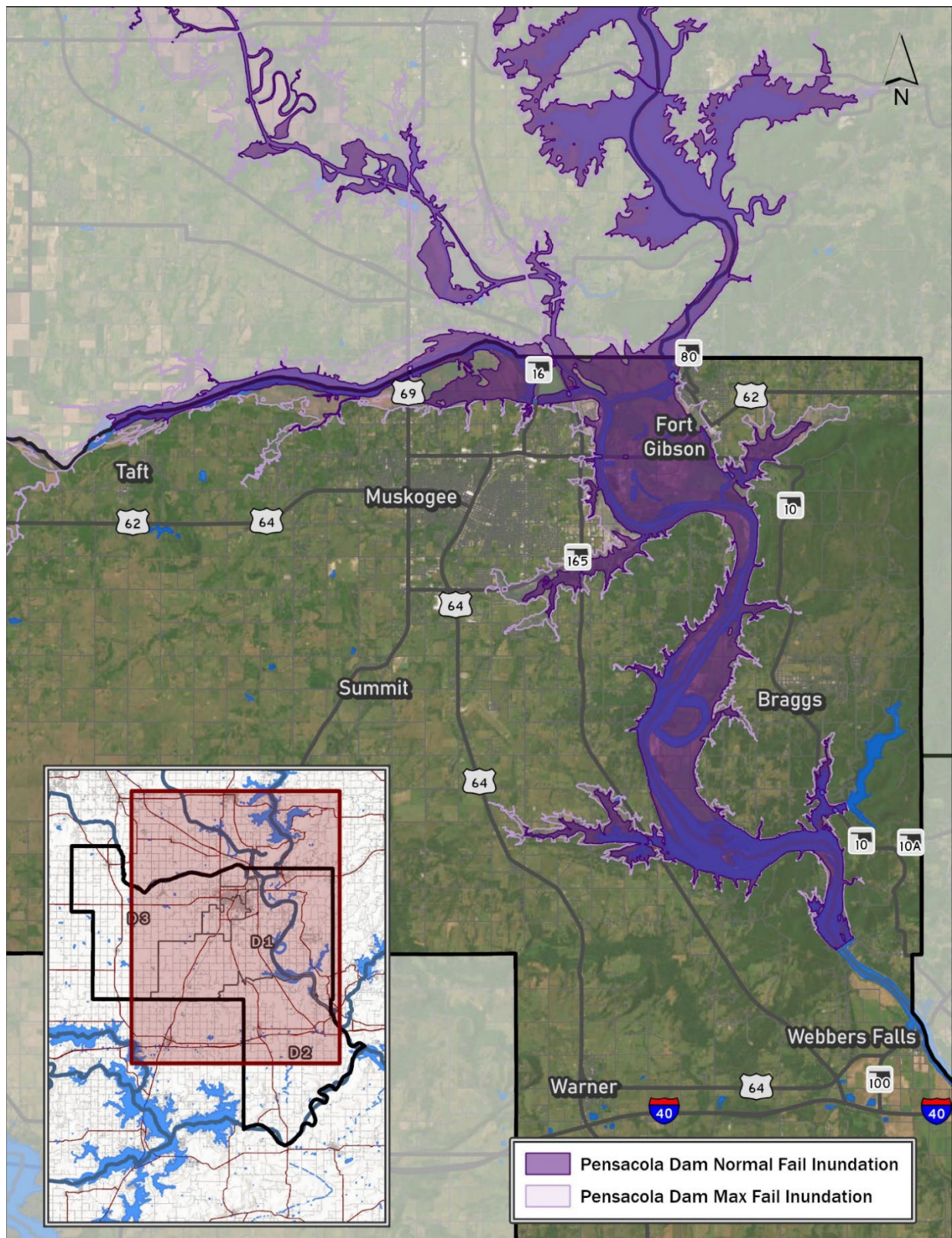


Table C-11 Pensacola Dam Sunny Day (Normal) Breach – Times and Water Depths

Critical Facility	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
Port of Muskogee	Muskogee	73.9	Unknown	Unknown
City Water Plant	Muskogee	73.4	Unknown	Unknown
Webbers Falls L&D	Muskogee Co. District 2	101	Unknown	Unknown
Electrical Sub-Station #148808	Muskogee Co. District 2	101	Unknown	Unknown
N/A	Fort Gibson	74.8	Unknown	Unknown
N/A	Taft	87.8	Unknown	Unknown
N/A	Braggs PSD	81.9	Unknown	Unknown
N/A	Fort Gibson PSD	73.0	Unknown	Unknown
N/A	Hilldale PSD	85.1	Unknown	Unknown
N/A	Muskogee PSD	71.6	Unknown	Unknown
N/A	Oktaha PSD	89.3	Unknown	Unknown

Table C-12 Pensacola Dam PMF Breach – Times and Water Depths

Critical Facility	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
Water Treatment Plant	Fort Gibson	71.6	Unknown	Unknown
Port of Muskogee	Muskogee	73.9	Unknown	Unknown
Electrical Sub-Station #119166	Muskogee	73.4	Unknown	Unknown
Electrical Sub-Station #119167	Muskogee	73.4	Unknown	Unknown
City Water Plant	Muskogee	73.4	Unknown	Unknown
Electrical Sub-Station #118411	Fort Gibson	75.6	Unknown	Unknown
OG&E Power Plant	Fort Gibson	75.7	Unknown	Unknown
Electrical Sub-Station #118412	Fort Gibson	75.7	Unknown	Unknown
Electrical Sub-Station (no name)	Fort Gibson	75.7	Unknown	Unknown
Bella Vista Mobile Home Park	Muskogee	75.7	Unknown	Unknown
Electrical Sub-Station #118413	Fort Gibson	76.3	Unknown	Unknown
Wonderland Preschool & Daycare	Fort Gibson	78.8	Unknown	Unknown
Georgia Pacific Power Plant	Muskogee	77.3	Unknown	Unknown
Pollution Control Plant	Muskogee	77.3	Unknown	Unknown
Webbers Falls L&D	Muskogee Co. District 2	101	Unknown	Unknown
Electrical Sub-Station #148808	Muskogee Co. District 2	101	Unknown	Unknown
N/A	Taft	87.8	Unknown	Unknown
N/A	Webbers Falls	101.4	Unknown	Unknown

Critical Facility	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
N/A	Braggs PSD	81.9	Unknown	Unknown
N/A	Fort Gibson PSD	73.0	Unknown	Unknown
N/A	Haskell PSD	84.9	Unknown	Unknown
N/A	Hilldale PSD	85.1	Unknown	Unknown
N/A	Muskogee PSD	71.6	Unknown	Unknown
N/A	Oktaha PSD	89.3	Unknown	Unknown
N/A	Warner PSD	91.6	Unknown	Unknown
N/A	Webbers Falls PSD	93.7	Unknown	Unknown

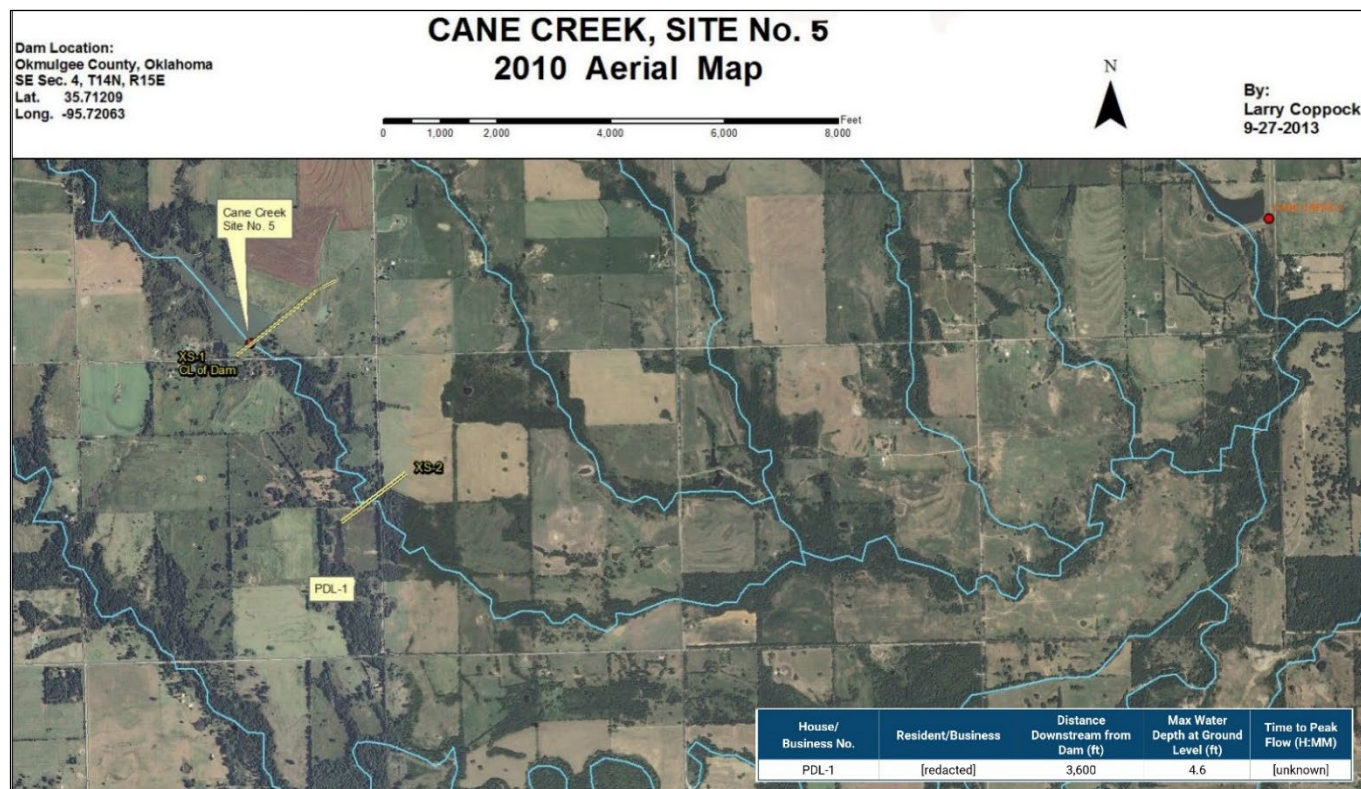
C.7 Robert S. Kerr (Lake Hudson) Dam

Lake Hudson Dam in Mayes County is a GRDA structure rated by OWRB as being a "Significant Hazard". A data deficiency exists with the Lake Hudson Dam's Emergency Action Plan. No formal document was available from the GRDA, and because of this, Action #30 has been added to the 2024 Mitigation Action Items found in Chapter 5. Acquiring the latest EAP will provide helpful information in terms of inundation impacts and arrival times of water as well as water depths in Muskogee County.

C.8 SCS Cane Creek Dam Site 5

In addition to this one residence, four county roads may also become inundated, but to what extent is unknown. Data and scenarios used in the 2014 EAP were extracted using LiDAR data, and no formal inundation study has been performed for this reservoir.

Figure C-8 SCS Cane Creek Dam Site 05 Sunny Day Breach Inundation



C.9 SCS Cane Creek Dam Site 22

Information presented in the SCS Cane Creek Dam Site 22 Emergency Action Plan pertains only to Sunny Day breach scenarios, and to fully understand the extent to which a PMF breach would impact the County, further studies are needed. Furthermore, the EAP used in the assessment of this dam was updated in March 2011. When newer updates are available from OWRB, an examination of inundation impacts would be needed to understand any land use or changes that have occurred since 2011. To account for this data deficiency, an action item has been added to Chapter 5 of this document.

Figure C-9 Cane Creek Dam Site 22 Sunny Day Breach Inundated



C.10 Skiatook Dam

Table C-13 Skiatook Dam Sunny Day (Normal) Inundation Map

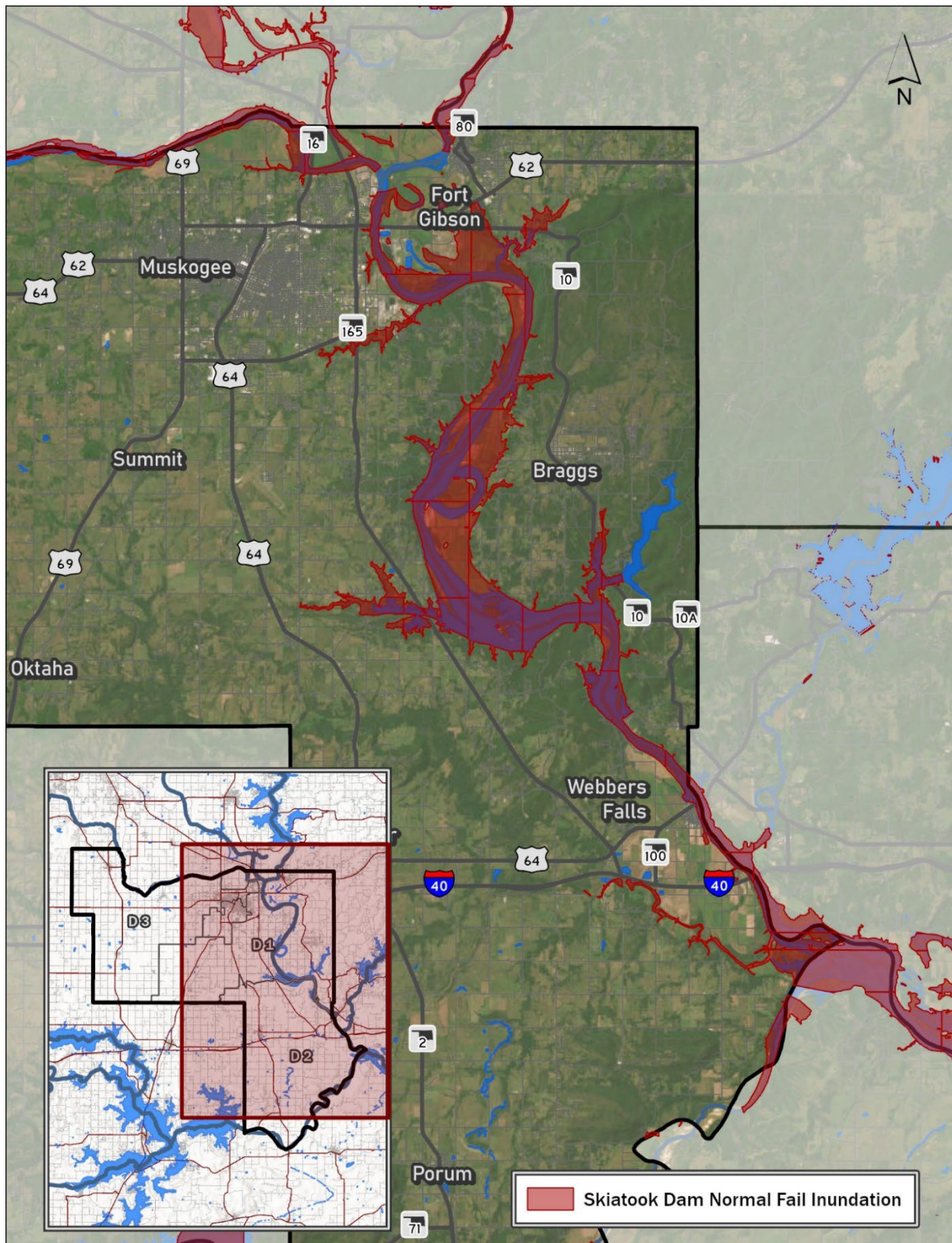


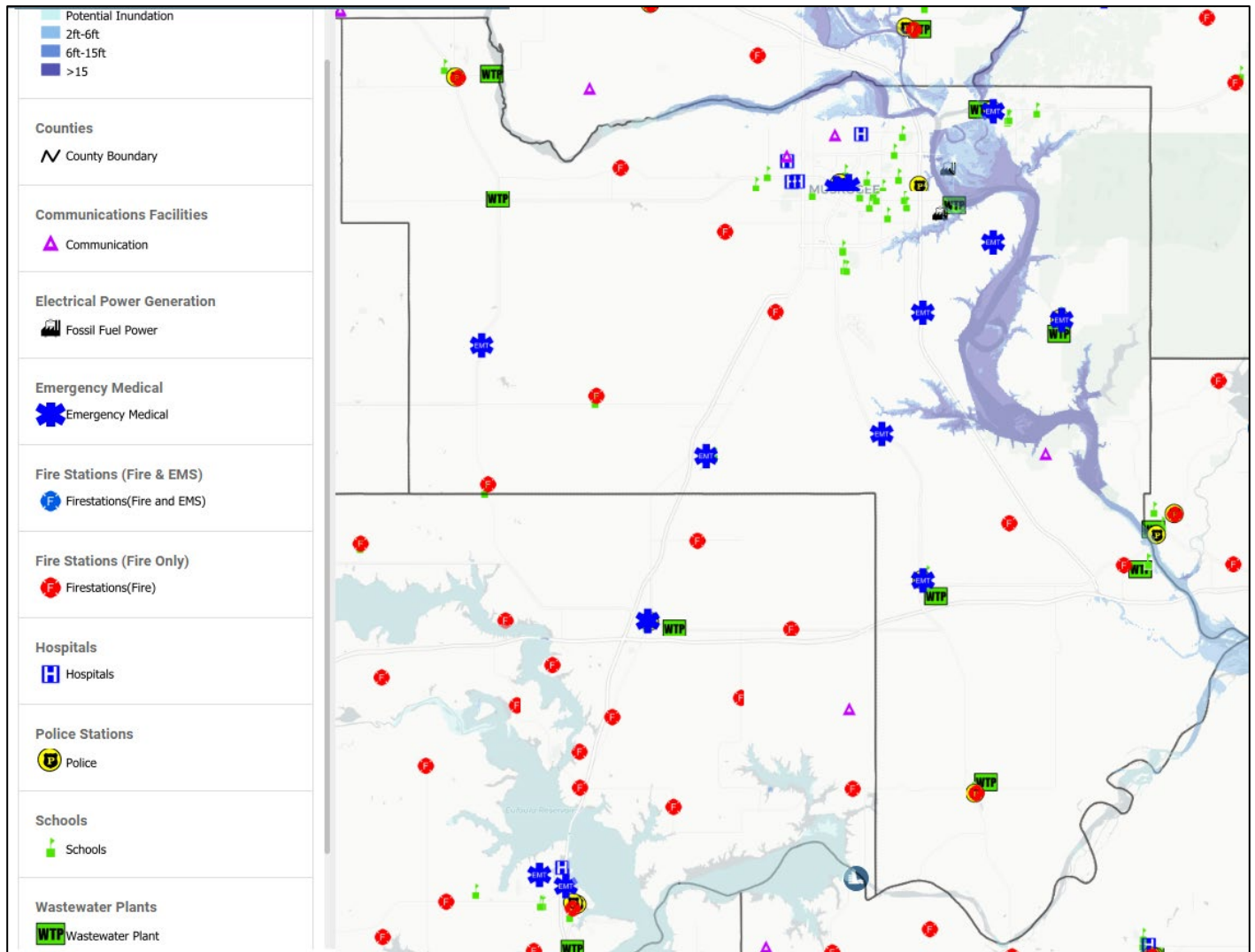
Figure C-10 Skiatook Dam PMF Inundation Map¹¹ <https://nid.sec.usace.army.mil/#/>

Table C-14 Skiatook Dam Sunny Day (Normal) Breach – Times and Water Depths

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
Fort Gibson WTP	Fort Gibson	92.9	Unknown	Unknown
Webbers Falls L&D	Muskogee Co. District 2	122	6 – 15	Unknown
Electrical Sub-Station #148808	Muskogee Co. District 2	122	6 – 15	Unknown
N/A	Muskogee	95.2	2 – 15	Unknown
N/A	Webbers Falls	120.2	2 – 6	Unknown
N/A	Braggs PSD	100.7	2 – 15	Unknown
N/A	Fort Gibson PSD	91.8	2 – 15	Unknown
N/A	Muskogee PSD	90.4	2 – 15	Unknown
N/A	Warner PSD	110.4	2 – 6	Unknown
N/A	Webbers Falls PSD	112.5	6 – 15+	Unknown

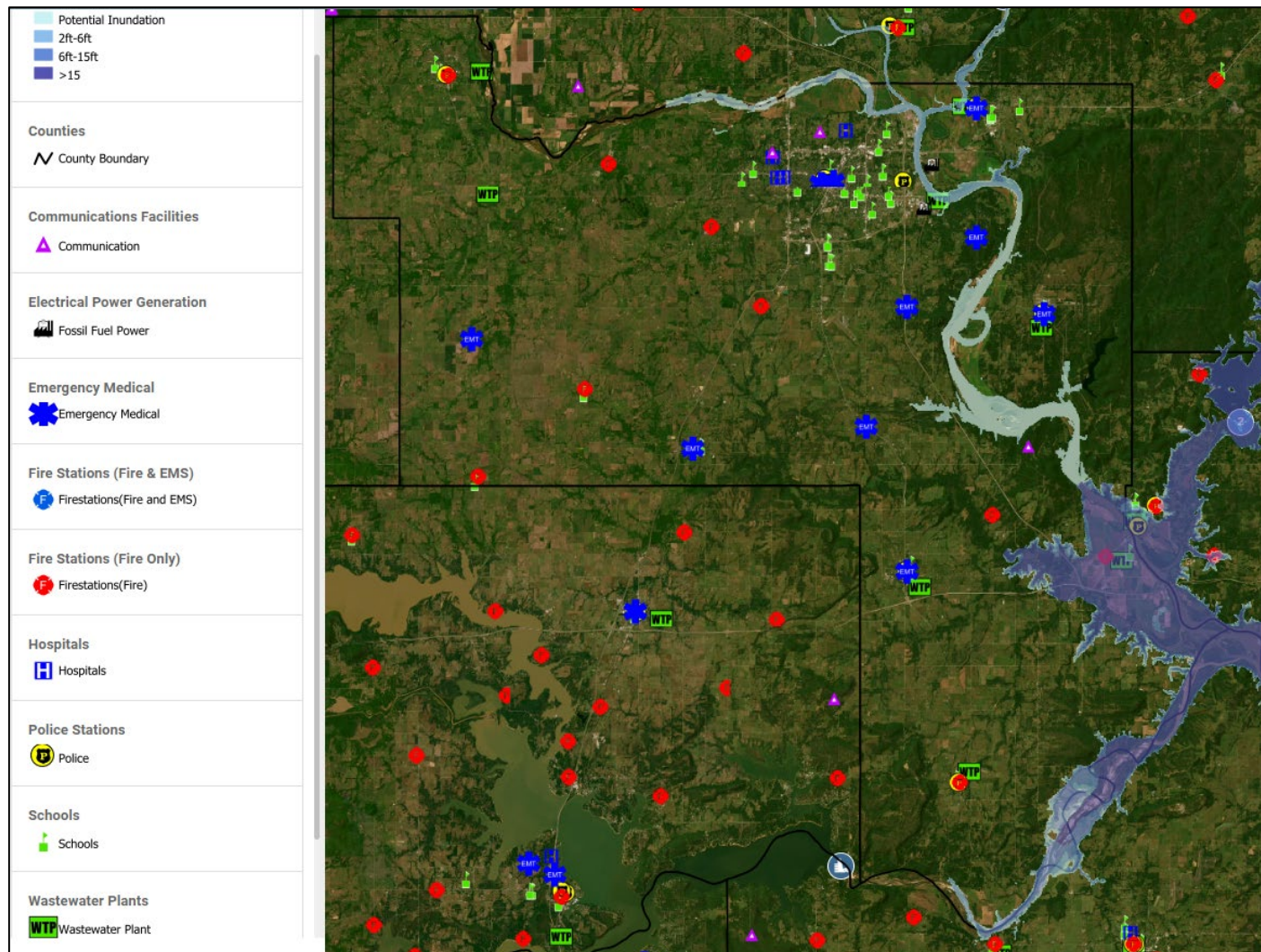
Table C-15 Skiatook PMF (Normal) Breach – Times and Water Depths

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth Above Ground Level (ft)	Time to Peak Flow (H:MM)
Port of Muskogee	Muskogee	91.8	2 – 6	Unknown
Fort Gibson WTP	Fort Gibson	92.9	Unknown	Unknown
Electrical Sub-Station #118411	Fort Gibson	92.9	< 2	Unknown
Electrical Sub-Station #118412	Fort Gibson	92.9	2 – 6	Unknown
OG&E Power Plant	Fort Gibson	93.0	2 – 6	Unknown
Bella Vista Mobile Home Park	Muskogee	93.4	2 – 15	Unknown
Electrical Sub-Station (no name)	Fort Gibson	93.9	6 – 15	Unknown
Electrical Sub-Station #118413	Fort Gibson	93.9	> 15	Unknown
Georgia Pacific Power Plant	Muskogee	95.2	2 – 6	Unknown
Pollution Control	Muskogee	95.2	2 – 15	Unknown
Electrical Sub-Station #118414	Muskogee Co. District 1	97.1	6 – 15	Unknown
Webbers Falls L&D	Muskogee Co. District 2	122	> 15	Unknown
Electrical Sub-Station #148808	Muskogee Co. District 2	122	> 15	Unknown
N/A	Webbers Falls	119.3	2 – 6	Unknown
N/A	Braggs PSD	99.8	2 – 15	Unknown
N/A	Fort Gibson PSD	90.9	2 – 15	Unknown
N/A	Muskogee PSD	89.5	2 – 15	Unknown
N/A	Oktaha PSD	107.2	2 – 15	Unknown
N/A	Warner PSD	109.5	2 – 15	Unknown
N/A	Webbers Falls PSD	111.6	2 – 6	Unknown

*Inundation impacts shown in Table C-15 are inferred from the USACE National Inventory of Dams website.

C.11 Tenkiller Ferry Lake Dam

Figure C-11 Tenkiller Ferry Dam PMF Inundation Map²



² The unavailability of Tenkiller Ferry Dam EAP resulted in inundation maps being extracted from the USACE Dam Inventory GIS Webpage, <https://nid.sec.usace.army.mil/viewer/index.html?version=3.48.1>

Figure C-12 Tenkiller Dam Sunny Day (Normal) Inundation Map

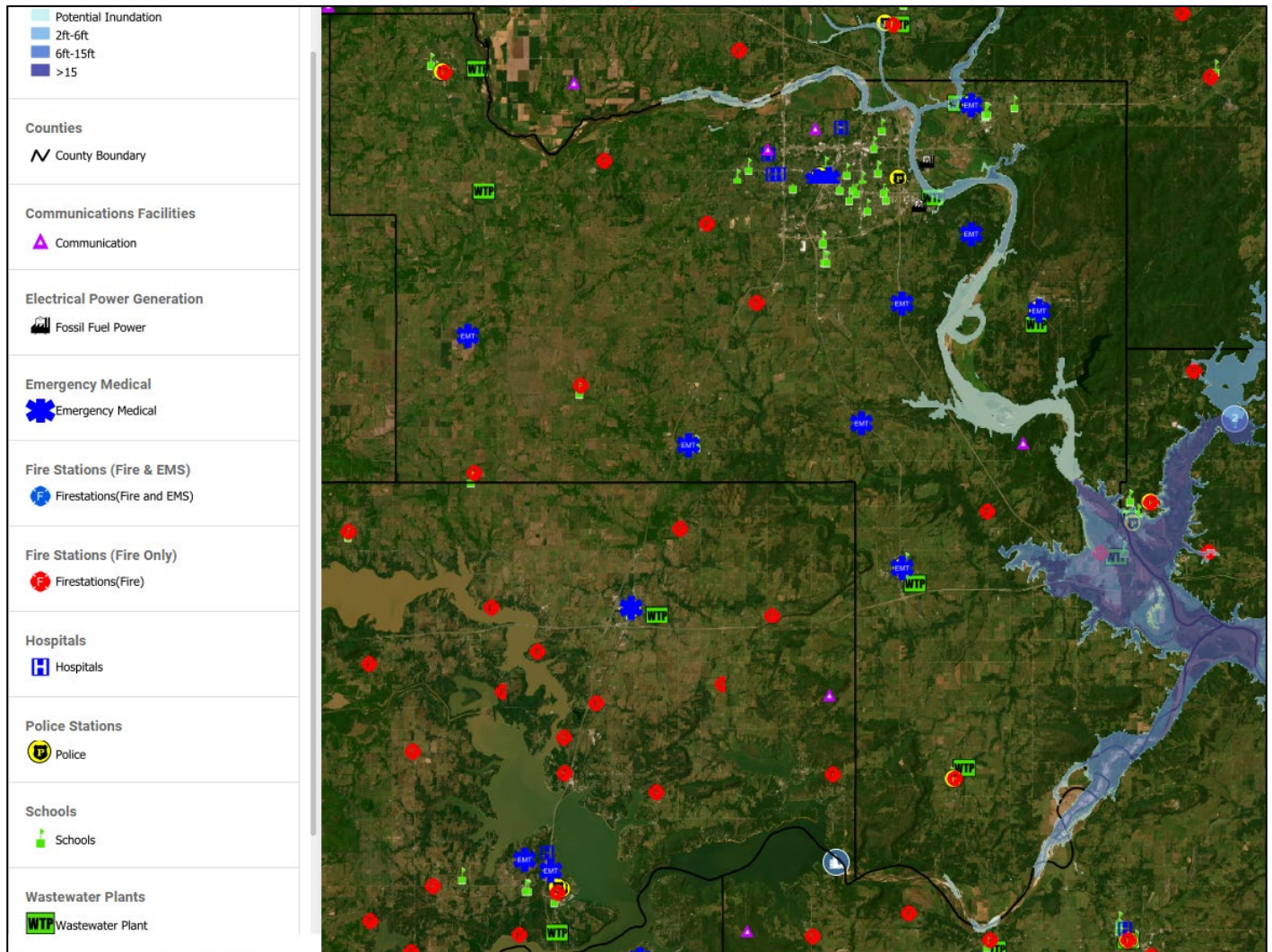


Table C-16 Tenkiller Dam PMF Breach – Times and Water Depths

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth at Ground Level (ft)	Time to Peak Flow (H:MM)
Post Office	Webbers Falls	11.4	> 15	Unknown
Elementary School	Webbers Falls	11.5	> 15	Unknown
High School	Webbers Falls	11.5	> 15	Unknown
Police Department	Webbers Falls	11.7	> 15	Unknown
City Hall	Webbers Falls	11.7	> 15	Unknown
Emergency Operations Center	Webbers Falls	11.7	> 15	Unknown
Volunteer Fire Department	Webbers Falls	12.5	> 15	Unknown
N/A	Muskogee Co. Districts 1 & 2	11.5	2 – 15	Unknown
N/A	Fort Gibson	36.8	< 2	Unknown
N/A	Braggs PSD	20.0	2 – 6	Unknown
N/A	Muskogee PSD	28.3	2 – 6	Unknown
N/A	Fort Gibson PSD	35.7	2 – 15	Unknown
N/A	Oktaha PSD	26.1	< 2	Unknown
N/A	Porum PSD	22.0	2 – 6	Unknown
N/A	Warner PSD	23.0	2 – 15	Unknown
N/A	Webbers Falls PSD	11.5	2 – 15	Unknown

*Requests for EAP from USACE were made. However, no document was made available by the time of this writing. Data deficiency here has been noted in Ch. 5 Action Items.

Table C-17 Tenkiller Dam Sunny Day (Normal) Breach – Times and Water Depths

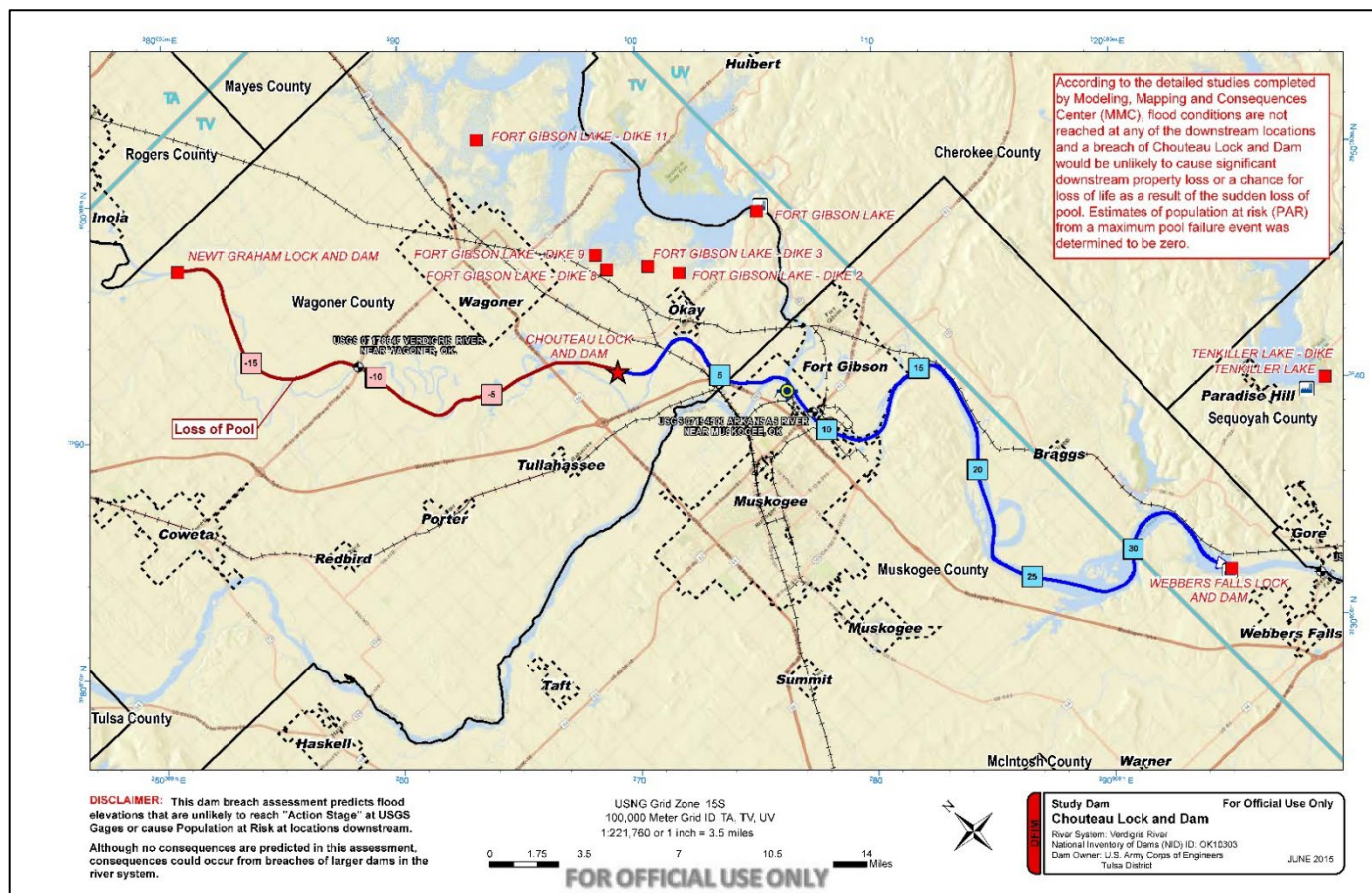
Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth at Ground Level (ft)	Time to Peak Flow (H:MM)
Post Office	Webbers Falls	11.4	> 15	Unknown
Elementary School	Webbers Falls	11.5	6 – 15	Unknown
High School	Webbers Falls	11.5	6 – 15	Unknown
Police Department	Webbers Falls	11.7	6 – 15	Unknown
City Hall	Webbers Falls	11.7	6 – 15	Unknown
Emergency Operations Center	Webbers Falls	11.7	6 – 15	Unknown
Volunteer Fire Department	Webbers Falls	12.5	6 – 15	Unknown
N/A	Muskogee Co. District 1	23	2 – 6	Unknown
N/A	Muskogee Co. District 2	11.5	2 – 15	Unknown
N/A	Fort Gibson	36.8	< 2	Unknown

Critical Facilities	Jurisdiction	Distance Downstream from Dam (mi.)	Max Water Depth at Ground Level (ft)	Time to Peak Flow (H:MM)
N/A	Braggs PSD	20.0	2 – 6	Unknown
N/A	Muskogee PSD	28.3	< 2	Unknown
N/A	Fort Gibson PSD	35.7	< 2	Unknown
N/A	Oktaha PSD	26.1	< 2	Unknown
N/A	Porum PSD	22.0	2 – 15	Unknown
N/A	Warner PSD	23.0	< 2	Unknown
N/A	Webbers Falls PSD	11.5	6 – 15	Unknown

**Requests for EAP from USACE were made, however, no document was made available by the time of this writing. Data deficiency here has been noted in Ch. 5 Action Items.*

C.12 Chouteau Lock and Dam #17

Figure C-13 Inundation Figures from Chouteau Lock and Dam EAP



PURPOSE AND USE

MMC Navigation Dam Screening is a process to evaluate low-head and navigation dams that are unlikely to create downstream consequences in the event of dam failure. It is a quicker, less detailed, and less expensive modeling process to screen potential risks. If the screening process shows potential for any risk, the dam is elevated to a comprehensive MMC study (DFIM). If the dam is determined by the modeler to not create potential consequences, then no further analysis is required within the MMC program. These navigation dam maps support the dam owner and emergency management officials to assist navigation on the river system in the event of a dam failure or flood condition.

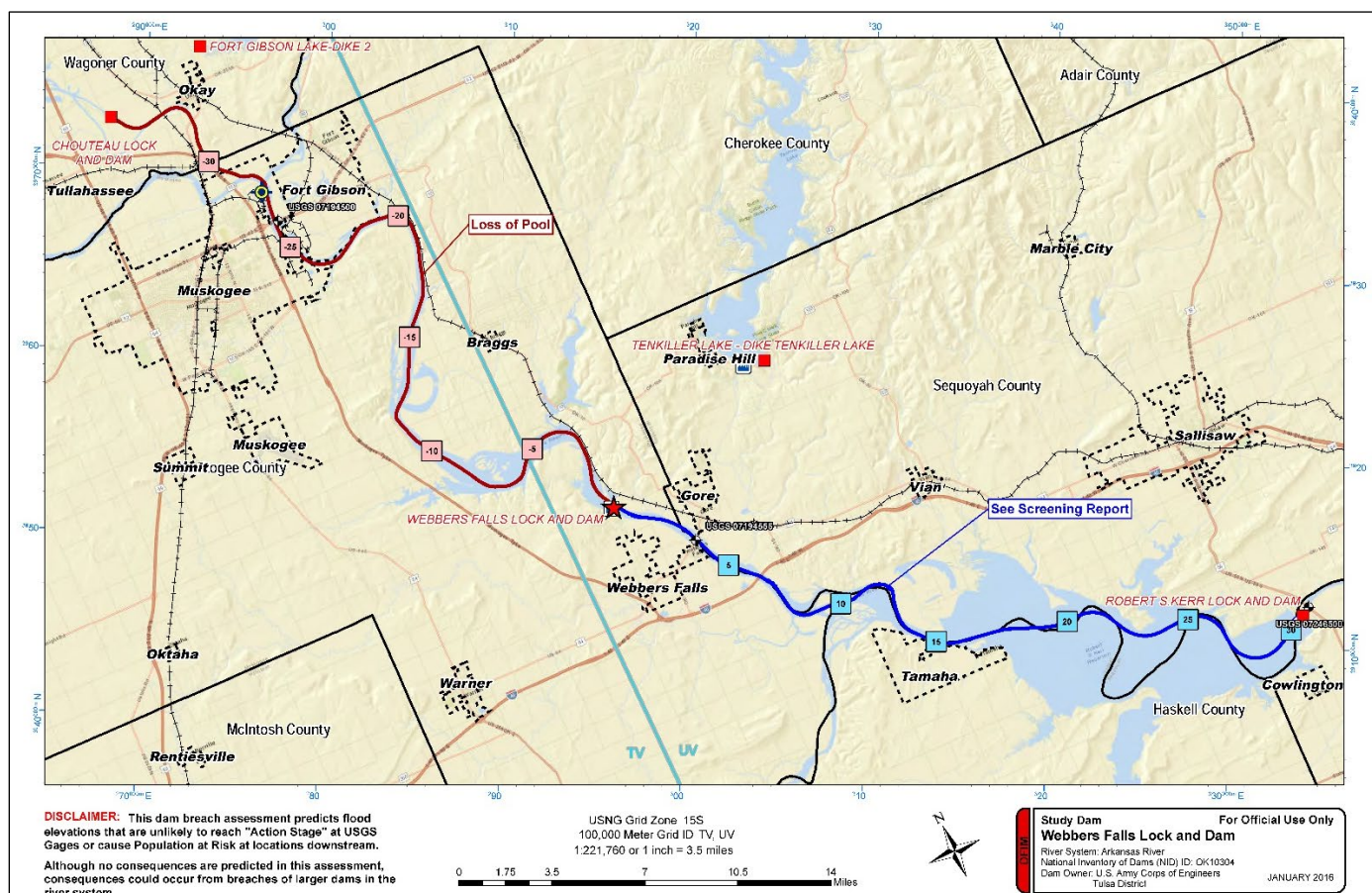
DISCLAIMER

This map has been compiled using the best information available and is believed to be accurate, however, its preparation required many assumptions. Actual conditions during a dam failure may vary from those assumed, so the accuracy cannot be guaranteed. This dam breach assessment predicts flood elevations that are unlikely to reach "Action Stage" at USGS Gages or cause Population at Risk at locations downstream. Although no consequences are predicted in this assessment, consequences could occur from breaches of larger dams in the river system.

C.13 Webbers Falls Lock and Dam #16

The following notes were provided in the Emergency Action Plan for the Webbers Falls L&D.

Figure C-14 Webbers Falls Inundation Graphic from EAP



PURPOSE AND USE

MMC Navigation Dam Screening is a process to evaluate low-head and navigation dams that are unlikely to create downstream consequences in the event of dam failure. It is a quicker, less detailed, and less expensive modeling process to screen potential risks. If the screening process shows potential for any risk, the dam is elevated to a comprehensive MMC study (DFIM). If the dam is determined by the modeler to not create potential consequences, then no further analysis is required within the MMC program. These navigation dam maps support the dam owner and emergency management officials to assist navigation on the river system in the event of a dam failure or flood condition.

DISCLAIMER

This map has been compiled using the best information available and is believed to be accurate, however, its preparation required many assumptions. Actual conditions during a dam failure may vary from those assumed, so the accuracy cannot be guaranteed. This dam breach assessment predicts flood elevations that are unlikely to reach "Action Stage" at USGS Gages or cause Population at Risk at locations downstream. Although no consequences are predicted in this assessment, consequences could occur from breaches of larger dams in the river system.

Appendix D. Sign-in Sheets, Agendas & More

Information contained in this Appendix revolves around the planning process and how participation was won from members of each community. Presented chronologically (see Table 2-1), the figures and tables below depict meeting sign-in sheets, agendas, flyers, and more. Appendix D culminates with a record of jurisdictional participation, similar to the ones presented in Chapter 2 of this plan.

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Table D-1 Participation Schedule & Records	D-20

Figure D-1 Welcome Letter to Stakeholders

2024 Hazard Mitigation Plan Update for Muskogee County, Oklahoma

Welcome!

On behalf of Muskogee County Emergency Management Director, Jeff Smith, welcome to the Muskogee County Hazard Mitigation planning group! Your input and participation are critical in the success of this update, and we hope we can count on your assistance in the development of this plan over the next several months.



Hazard Mitigation Plans (HMPs) are FEMA-approved documents which provide jurisdictional benefits on many fronts, one of which is eligibility for certain funding opportunities over the next five years. To satisfy FEMA requirements, a variety of topics will be discussed over the coming months, many of which will rely on input from stakeholders and community members such as yourself. Beginning this month there will be a series of Stakeholder Workshop meetings and calendar invites will be coming shortly for each gathering. Your attendance at these workshops is critical to providing a complete picture of what hazards have the highest impact on the county and how the County can build a more resilient and sustainable community during future disasters. Development of a Plan begins with stakeholders and local representatives (such as yourself) coming together to identify and discuss natural hazard risks and vulnerabilities in *your* area. In addition to the County, 24 other participating jurisdictions will be involved in the planning process, and they are:

- Town of Boynton
- Town of Braggs
- Town of Council Hill
- Town of Ft Gibson
- Town of Haskell
- City of Muskogee
- Town of Oktaha
- Town of Porum
- Town of Summit
- Town of Taft
- Town of Wainwright
- Town of Warner
- Town of Webbers Falls
- Braggs Public Schools
- Midway Public Schools
- Fort Gibson Public Schools
- Hasell Public Schools
- Muskogee Public Schools
- Hilldale Public Schools
- Oktaha Public Schools
- Porum Public Schools
- Wainwright Public Schools
- Warner Public Schools
- Webbers Falls Public Schools

Meshek & Associates is excited to be partnering with Muskogee County over the coming months, and our collective efforts will help develop a comprehensive multi-jurisdictional, multi-hazard mitigation plan. Calendar invites and reminders will be sent shortly, but below is the tentative schedule for the four Stakeholder Workshops.

Stakeholder Workshop #1	September 21, 2023
Stakeholder Workshop #2	October 19, 2023
Stakeholder Workshop #3	November 16, 2023
Stakeholder Workshop #4	January 11, 2024

We encourage participants to join us in-person for each meeting, but should there be any scheduling conflicts, each meeting will also be held virtually to accommodate everyone's schedules. At Meshek, our aim is to help communities build a stronger tomorrow, and this applies to Muskogee County. Should you have any questions or concerns, please do not hesitate to reach out to the Meshek Planning Department Manager, **Allison Whitsitt** (awhitsitt@meshekengr.com) or the Project Manager, **Mark Stalcup** (mstalcup@meshekengr.com). Thank you for your time, and we look forward to speaking with each of you at our first meeting later this month!



Online Survey

Figure D-2 Muskogee County Online Survey Promo / Flyer



MAKE YOUR VOICE HEARD!

**Community Officials
Seeking Input
for the
2024 Muskogee County
Hazard Mitigation Plan**



Stakeholder Workshop 1

Figure D-3 Stakeholder Workshop #1 Flyer



2024 Muskogee County Hazard Mitigation Plan

STAKEHOLDER INPUT REQUESTED

Muskogee County is updating their Hazard Mitigation Plan (HMP), and your input is needed! Over the next few months, the HMP will be re-assessing risks posed by natural hazards on the people and infrastructure throughout the County, and as stakeholders, your attendance is requested on behalf of the Muskogee County Office of Emergency Management. The goal of the 2024 HMP Update is to identify mitigation strategies that will help protect your community from future disasters. YOUR participation is the foundation to this Plan.

The first Stakeholder Workshop will aim to identify and spotlight areas where hazard mitigation efforts can be improved upon during the HMP's 5-year lifespan. Participating jurisdictions invited to this meeting are representatives from the County as well as the 13 municipalities and 11 Public School Districts (PSD) shown below. Please consider joining your community's leaders – together, we can build a stronger tomorrow. Workshop information is provided below and should you have any further questions, please don't hesitate to reach out to the Meshek team at planning@meshekgm.com. Thank you for your involvement!

Where: Martin Luther King Center
300 W Martin Luther King St.

When: September 21, 2023
1:00pm to 4:00pm



- Boynton
- Braggs
- Council Hill
- Ft. Gibson
- Haskell
- Muskogee
- Oklaaha
- Porum
- Summit
- Tatt
- Wainwright
- Warner
- Webbers Falls

- Braggs PSD
- Ft. Gibson PSD
- Haskell PSD
- Hildale PSD
- Midway PSD
- Muskogee PSD
- Oklaaha PSD
- Porum PSD
- Wainwright PSD
- Warner PSD
- Webbers Falls PSD





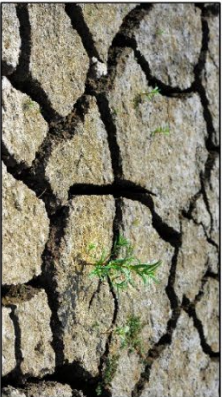



Figure D-4 Stakeholder Workshop #1 Sign-in Sheet



2024 Muskogee County Hazard Mitigation Plan
Stakeholder Workshop #1: Sign-in Sheet
 September 21, 2023 from 1:00pm to 4:00pm
 300 W. Martin Luther King St., Muskogee, OK

Name	Title	Organization	Email
John R Lumpkins	Muskogee water plant	City of Muskogee	jlumpkins@muskogeeonline.org
Scott Fletcher	Muskogee WWTP	City of Muskogee	sfletcher@muskogeeonline.org
Nathan Parker	Ft Gibson Fire	Ft. Gibson	firechief@fortgibson.ms
Jeff Smith	Muskogee Co EM Director	Musk Co EM	jam.the.ready@muskogee.org
Chad Kirkhart	Asst. Supt.	Hilldale	ckirkhart@hilldaleps.org
Chad Bonds	E.M. Tech	MCN EM	cbonds@muscogeneration.com
Tyler Evans	Muskogee E.M.	City of Muskogee	tevans@muskogeeonline.org
Kelly Bolding	Muskogee EM	City of Muskogee	kbolding@muskogeeonline.org
Blake Lyons	Cherokee Nation EM	Cherokee Nation	blake-lyons@cherokee.org
Steve Beauvais	Special Ops officer	Muskogee Fire	sbeauvais@muskogeeofd.org

Meshek & Associates, LLC

Name	Title	Organization	Email
Carrie Wages	Deputy	MCEM	
Jenny Jamison	Exec Director	Lake Area United Way	way.director@lakeareaunderway.org
Abigail Wright	Environmental Tech	City of Muskogee	awright@muskogeeonline.org
Avery Rigney	Asst. PU Director	Conr	arigney@muskogeeonline.org
Jimmy Wood	GIS Specialist	City of Muskogee	jwood@muskogeeonline.org
Kim Jaquez	Outreach Coordin.	Lake Area United Way	outreach@lakeareaunderway.org
Don Hall	Direct Sec	Muskogee Public Safety	don.hall@toughson.org
Jody Moore	MFD Fire Chief	Muskogee Fire	jmoore@muskogeeFD.org

Meshek & Associates, LLC

Figure D-5 Stakeholder Workshop #1 Agenda



2024 Muskogee County Hazard Mitigation Plan Stakeholder Workshop #1 – Agenda

September 21, 2023, 1:00pm - 4:00pm
300 W. Martin Luther King St., Muskogee, OK

1. **Welcome & Introductions**
2. **Hazard Mitigation Planning Process**
 - a. Benefits
 - b. Potential Funding Sources
 - c. Phases & Timeline
3. **Changes in FEMA Guidance for Plans**
4. **Disaster History in Muskogee Co.**
5. **Break**
6. **Capabilities Overview & Discussion**
7. **Muskogee County HMP Survey & GIS Viewer Preview**
8. **Closing Comments / Adjourn**



Core Group Meeting 1

Figure D-6 Core Group Meeting #1 Sign-in Sheet

2024 Muskogee County Hazard Mitigation Plan

Core Group Meeting #1: Sign-in Sheet

October 2, 2023 from 1:00pm to 2:00pm

Virtual Meeting hosted by Microsoft Teams

Name	Organization	Role	Email
Tyler Evans	City of Muskogee	EM Director	tevans@muskogeeonline.org
Carrie Wages	Muskogee County	Deputy EM Director	cwages@readymuskogee.org
Jeff Smith	Muskogee County	EM Director	jsmith@readymuskogee.org
Mark Stalcup	Meshek & Associates	Project Manager	mstalcup@meshekengr.com
Allison Whitsitt	Meshek & Associates	Department Manager	awhitsitt@meshekengr.com
Archie Losey	Meshek & Associates	HM Planner	alosey@meshekengr.com



Figure D-7 Core Group Meeting #1 Agenda

Core Group Meeting 1 Agenda 2024 Muskogee County Hazard Mitigation Plan Update

Monday, October 2, 2023

1:00pm – 2:00pm

1. GIS Web Viewer

- a. Review of current “critical facilities”
- b. Does the County have a GIS portal/account?

GIS LAYER NEEDED?	Y/N
Churches	
Financial Institutions	
Cultural Centers	
Historical Sites	
Flooding Problem Areas	
RV Parks / MHP	
Animal Control	
Natural Gas Facilities	
Federal Facilities, Post Offices	
County Facilities, Court House	
Storm Shelter Locations	

CRITICAL FACILITIES		
Facility Type	Count	Facility Class
EMS	1	Primary
EOC	5	Primary
Fire Department	18	Primary
Hospital	3	Primary
Police Department	10	Primary
Broadcasting Company	2	Secondary
Child Care	26	Secondary
City Facilities	1	Secondary
College/Trade School	4	Secondary
County Facilities	1	Secondary
Electric Substation	29	Secondary
Medical Facilities	5	Secondary
Mobile Home Park	17	Secondary
Nursing Home	13	Secondary
Power Plant	3	Secondary
Private School	6	Secondary
Public School	36	Secondary

2. Online Survey Update

- a. Responses to date, social media flyer (page 2)

3. Scheduling a Public Meeting

- a. When should we schedule this?
- b. What VOAD members can attend?

4. Vulnerable Populations

- a. Who, Where are these groups
- b. Inviting these reps to Stake2

5. Jurisdictional Participation

- a. Do we want to consider joining a School Board/LEPC Meeting?
- b. Missing Contact Information?
 - i. Salvation Army
 - ii. Michael Stewart (City of Muskogee)
 - iii. Georgia Pacific Operations Manager – are reps needed for the 2024 Update?
 - iv. Wal-Mart joined the 2019 committee – are they needed as well?



Stakeholder Workshop 2

Figure D-8 Stakeholder Workshop #2 Sign-in Sheet



2024 Muskogee County Hazard Mitigation Plan

Stakeholder Workshop #2: Sign-in Sheet

October 19, 2023 from 1:00pm to 4:00pm
300 W. Martin Luther King St., Muskogee, OK

Name	Title/Organization	Phone	Email Address
Caleb Brewer	Chief Haskell Fire	918-557-6029	cbrewer@townofhaskell.org
Chad Bonds	MCN EM	918-549-2700	Chbonds@muscogeanation.com
Jeff Moore	Muskogee County EM	918-758-6435	Jeff.moore@okmugreecounty.gov
Kelly Balding	Chief Muskogee EM	918-577-7985	kibalding@muskogeeonline.org
Keri Jaquez	Outreach / Lake Area United Way	918-869-6493	outreach@lakeareaunitedway.org
Came Wages	MCN EM	918-316-8260	cwages@redymuskogee.org
Nathan Parker	FGFD Chief	918-869-6219	Dirchief@fortgibson.net
Jimmy Wood	GIS specialist / City of Muskogee	918-684-6333	jwood@muskogeeonline.org
Allison Whitsitt	Planning Dept. Manager	918-392-5620 ext. 239	awhitt@meshekengr.com
Mark Stalcup	Planning Project Manager	713-391-7324	mstalcup@meshekengr.com
Archie Losey	Planner	918-392-5620 ext. 247	alosey@meshekengr.com *
Gena Barnwell	GIS Specialist	918-392-5620 ext. 257	gbarnwell@meshekengr.com *
Janet Meshek	Principle Engineer	918-392-5620 ext. 204	jmeshek@meshekengr.com *
Chris Hill	GIS Dept. Manager	253-299-4612	chill@meshekengr.com *
Blake Lyons		918-570-9625	blake-lyons@cherokee.org *
(12) Brad Wagon	Coordinator, Cherokee Nation Community Health Preparedness	?	? ? ? ?

*= Virtual attendance
2

Meshek & Associates, LLC

Figure D-9 Stakeholder Workshop #2 Agenda

2024 Muskogee County Hazard Mitigation Plan Stakeholder Workshop 2 Agenda

October 19, 2023, 1:00pm-4:00pm

300 W. Martin Luther King St., Muskogee, OK

- 1. Welcome & Introductions** *Allison Whitsitt*
- 2. Where Things Are in the Planning Process** *Allison Whitsitt*
 - a. Importance of Hazard Mitigation Plans
 - b. Review of Capabilities
- 3. Stakeholder 1 & Survey Results – Prioritizing Hazards** *Mark Stalcup*
- 4. Demonstration of the Muskogee County HMP Viewer** *Gena Barnwell*
- 5. Break**
- 6. Finding the Vulnerabilities: Break-Out Sessions** *Mark Stalcup*
 - a. Severe Weather, Flooding
 - b. Drought, Wildfire, Extreme Heat
 - c. Severe Winter Storms
- 7. New Flood Inundation Mapping from NOAA/NWS** *Mark Stalcup*
- 8. Closing** *Allison Whitsitt*



Core Group Meeting 2

Figure D-10 Core Group Meeting #2 Sign-in Sheet

2024 Muskogee County Hazard Mitigation Plan

Core Group Meeting #2: Sign-in Sheet

October 30, 2023 from 1:00pm to 2:00pm

Virtual Meeting hosted by Microsoft Teams

Name	Organization	Role	Email
Carrie Wages	Muskogee County	Deputy EM Director	cwages@readymuskogee.org
Jeff Smith	Muskogee County	EM Director	jsmith@readymuskogee.org
Mark Stalcup	Meshek & Associates	Project Manager	mstalcup@meshekengr.com
Allison Whitsitt	Meshek & Associates	Department Manager	awhitsitt@meshekengr.com
Archie Losey	Meshek & Associates	HM Planner	alosey@meshekengr.com



Stakeholder Workshop 3

Figure D-11 Stakeholder Workshop #3 Sign-in Sheet

Name	Title & Organization	Phone	Email
Norma Griffith	Town Clerk / ^{Town of} Webbers Falls	918-464-2920	cityclerk@webbersfalls.org
George Kunsman	Facilities / Fort Gibson Public Schools	(918) 781-3481	g-kunsman@fortgibsonigers.org
Kelly Bolding	City EM	918-572-7985	kbolding@muskogeeonline.org
Lisa Tyler	Mayor / Braggs	918-913-1999	Lisetyler2458@gmail.com
Ken Hutchinson	Mayor / Town of Brynthon	918-752-4191	townofbrynthon@windstream.net
Jimmy Wood	GIS Specialist / City of Muskogee	918-864-6333	jwood@muskogeeonline.org
Carrie Wages	MEM	918-316-8260	cwages@readymuskogee.org
Kim Jaquez	Outreach Coordinator / Lake Area United Way	918-869-6493	outreach@lakeareaunitedway.org
Jody Moore	Muskogee Fire Dept.	918-684-6252	JLMOORE@MUSKOGEEFB.ORG
Lannah Moore	Town of Warner / Warner Fire Dept.	918-463-2696	town.of.warner@gmail.com

Meshek & Associates, LLC

Name	Title & Organization	Phone	Email
Caleb Hudson	Warner Fire	918 3604387	warnerfired@hotmail.com

Name*	Title & Organization	Phone	Email
Rod Luellen	Haskell Public Schools		rluellen@haskellps.org
Michael Keene	Haskell FPA	(832) 341-0370	mkeene@townofhaskell.org
Caleb Brewer	Haskell Fire Chief	(918) 557-5029	cbrewer@townofhaskell.org
Blake Lyons	Deputy Sheriff		blake-lyons@cherokee.org
Landon Berry	Porum PS Superintendent		lberry@porum.k12.ok.us
Laura Holt	Oktaha PS Assistant Superintendent		LHolt@oktahaschool.com
Bill Smiley	USACE Emergency Manager		William.e.smiley@usace.army.mil
Mark Stalcup	Meshek Planning Project Manager		mstalcup@meshekengr.com
Wendi Lemons	Meshek Grants Project Manager		wmarcy@meshekengr.com

* Virtual attendance at Stakeholder Workshop #3

Figure D-12 Stakeholder Workshop #3 Agenda

2024 Muskogee County Hazard Mitigation Plan Stakeholder Workshop #3 Agenda

November 16, 2023, 1:00pm-4:00pm
300 W. Martin Luther King St., Muskogee, OK

1. Welcome & Introductions
2. HMP Status Update Allison Whitsitt
3. Review of Community Goals Allison Whitsitt
4. Grant & Funding Opportunities Wendi Lemons
5. Benefits & Costs of Mitigation Allison Whitsitt
6. Prioritization 2019 Actions
7. Mitigation Strategy (what are FEMA Requirements?) Allison Whitsitt
8. Development of 2024 Action Items
9. Preview of Stakeholder Workshop #4, Public Meeting Dates Allison Whitsitt
10. Closing Comments / Adjourn



Core Group Meeting 3

Figure D-13 Core Group Meeting #3 Sign-in Sheet



2024 Muskogee County Hazard Mitigation Plan Core Group Meeting #3 Sign-in Sheet

November 29 from 1:00pm to 2:00pm
Microsoft Teams

Name	Title	Organization	Email
Jeff Smith	Director of Emergency Management	Muskogee County	jsmith@readymuskogee.org
Tyler Evans	Director of Emergency Management	City of Muskogee	tevans@muskogeeonline.org
Allison Whitsitt	Planning Department Manager	Meshek & Associates	awhitsitt@meshekengr.com
Mark Stalcup	Project Manager	Meshek & Associates	mstalcup@meshekengr.com

Figure D-14 Core Group Meeting #3 Agenda



Core Group Meeting 3 Agenda

2024 Muskogee County Hazard Mitigation Plan Update

Thursday, November 29, 2023 from 1:00pm to 2:00pm
Microsoft Teams

1. Review of Mitigation Action Items
2. Address any change/update needed
3. Assign action priorities



Public Meeting

Figure D-15 Public Meeting Invitation / Flyer #1



2024 Muskogee Co. Hazard Mitigation Plan Update

PUBLIC MEETING ANNOUNCEMENT

Muskogee County Office of Emergency Management invites residents from across the County to join them and planners from Meshek & Associates to discuss the 2024 Hazard Mitigation Plan (HMP) Update. Work is nearing completion and before the planning process wraps up, residents and community members County-wide are welcome to join us December 18, 2023.

What is a Hazard Mitigation Plan (HMP)? These documents are FEMA-approved plans developed *specifically* for communities and jurisdictions to help identify what natural disasters can impact your area. They also spotlight how jurisdictions are vulnerable, what impacts they can cause, but most importantly, they describe what ways (or activities) can be done that would help build stronger, more resilient communities. Mitigating hazard impacts is extremely complex and requires input and participation from a variety of individuals, including the public! Feedback has been received from most of the 25 participating jurisdictions, but the plan still lacks *your* input!

Eleven natural hazards are being profiled in the 2024 HMP, and they are: **Dam Incidents, Earthquakes, Droughts, Extreme Heat, Flooding, Hail, High Winds, Lightning, Extreme Winter Storms, Tornadoes, and Wildfires**. Your input at this meeting as well as through the survey will help officials understand what concerns or needs there may be before the next disaster strikes. A brief survey has been developed *specifically* for Muskogee County, and you are encouraged to take part. Scan the QR code below to learn more! Virtual access to the Public Meeting is FREE and open to anyone who wishes to join. Together, we can build a stronger tomorrow.

Participating Jurisdictions

- ♦ Muskogee County
- ♦ Boynton
- ♦ Braggs
- ♦ Council Hill
- ♦ Fort Gibson
- ♦ Haskell
- ♦ Muskogee
- ♦ Oktaha
- ♦ Porum
- ♦ Summit
- ♦ Taft
- ♦ Wainwright
- ♦ Warner
- ♦ Webbers Falls

- ♦ Braggs Public Schools
- ♦ Ft Gibson Public Schools
- ♦ Haskell Public Schools
- ♦ Hilldale Public Schools
- ♦ Midway Public Schools
- ♦ Muskogee Public School
- ♦ Oktaha Public School
- ♦ Porum Public School
- ♦ Wainwright Public Schools
- ♦ Warner Public Schools
- ♦ Webbers Falls Public Schools

Public Survey



https://arcg.is/09I1e1

December 18, 2023
<https://tinyurl.com/Muskogee-County>
5:30 pm - 6:30 pm





Figure D-16 Public Meeting Invitation / Flyer #2



PUBLIC MEETING NOTICE

Natural disasters can produce devastating impacts which can last for months, if not years. To prepare for and mitigate future losses, communities rely on Hazard Mitigation Plans because they identify specific risks and vulnerabilities as well as preparedness activities that can make your area more resilient to natural hazards.

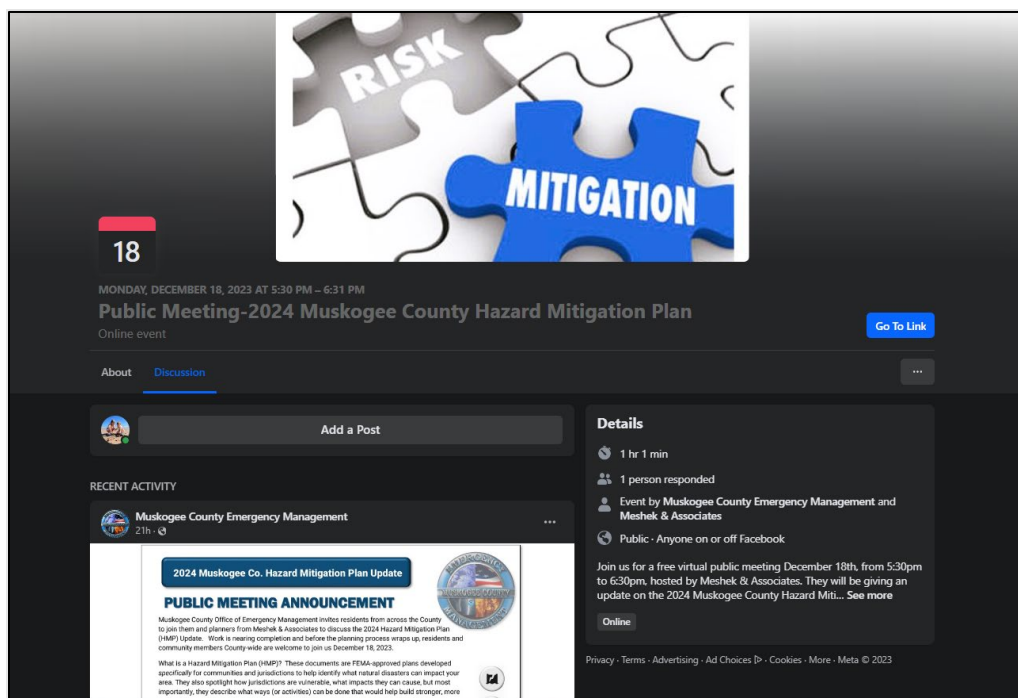
Join us next Monday for a virtual Public Meeting, where planners from Meshek & Associates will showcase the 2024 Plan Update as well as answer any questions or comments you may have. Attendance is free, and all are welcome! To join, simply scan the QR code or visit:

<https://tinyurl.com/Muskogee-County>

December 18, 2023
5:30pm – 6:30pm

MESHEK & ASSOCIATES, LLC *Together, we can build a stronger tomorrow.*

The flyer features a collage of images illustrating natural disasters: a wildfire, a lightning storm, a tornado, and flooded land. The Muskogee County Emergency Management logo is in the top right corner.

Figure D-17 Facebook Invitation for Public Meeting¹


18

MONDAY, DECEMBER 18, 2023 AT 5:30 PM – 6:31 PM

Public Meeting-2024 Muskogee County Hazard Mitigation Plan

Online event

[Go To Link](#)

Details

- 1 hr 1 min
- 1 person responded
- Event by Muskogee County Emergency Management and Meshek & Associates
- Public · Anyone on or off Facebook

Join us for a free virtual public meeting December 18th, from 5:30pm to 6:30pm, hosted by Meshek & Associates. They will be giving an update on the 2024 Muskogee County Hazard Mitigation Plan. See more

[Online](#)

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RECENT ACTIVITY

Muskogee County Emergency Management · 21h · 

2024 Muskogee Co. Hazard Mitigation Plan Update

PUBLIC MEETING ANNOUNCEMENT

Muskogee County Office of Emergency Management invites residents from across the County to join them and planners from Meshek & Associates to discuss the 2024 Hazard Mitigation Plan (HMP) Update. Work is nearing completion and before the planning process wraps up, residents and community members County-wide are welcome to join us December 18, 2023.

What is a Hazard Mitigation Plan (HMP)? These documents are FEMA-approved plans developed specifically for communities and jurisdictions to help identify what natural disasters can impact your area. They also spotlight how jurisdictions are vulnerable, what impacts they can cause, but most importantly, they describe what ways (or activities) can be done that would help build stronger, more resilient communities.

¹ <https://fb.me/e/1JBwkwJvp>

Figure D-18 Public Meeting Sign-in Sheet



2024 Muskogee County Hazard Mitigation Plan Public, VOAD Virtual Meeting Sign-in Sheet

Date December 18 from 5:30pm to 6:30pm
Microsoft Teams

Name	Title	Organization	Email
Tom Stiles	Assistant Superintendent	Fort Gibson Public Schools	T_stiles@fortgibsonigers.org
George Kunsman	Facilities	Fort Gibson Public Schools	G_kunsman@fortgibsonigers.org
Kim Jaquez	Outreach Coordinator	Lake Area United Way	outreach@lakeareaunderdway.org
Blake Lyons	Deputy Sheriff/Coordinator for Community Health Preparedness	Cherokee Nation	blake-lyons@cherokee.org
Laura Holt	Assistant Superintendent	Oktaha Public Schools	lholt@oktahaschool.com
Allison Whitsitt	Planning Department Manager	Meshek & Associates	awhitsitt@meshekengr.com
Mark Stalcup	Project Manager	Meshek & Associates	mstalcup@meshekengr.com
Archie Losey	Hazard Mitigation Planner	Meshek & Associates	alosey@meshekengr.com

Figure D-19 Public Meeting Agenda

2024 Muskogee County Hazard Mitigation Plan Public Meeting Agenda

December 18, 2023, 5:30pm - 6:30pm

1. Welcome and Meshek Introductions
2. Hazard Mitigation Planning Overview *Allison Whitsitt*
3. Benefits and Objectives of Planning *Allison Whitsitt*
 - a. Okay Road
 - b. Muskogee County Advanced Assistance
4. Hazard Risk Assessment & Discussion *Mark Stalcup*
 - a. Social Vulnerabilities
 - b. Muskogee County HUB Page & GIS Viewer
5. Public Survey *Mark Stalcup*
6. Mitigation Strategy & HMP Benefits *Allison Whitsitt*
7. Adoption Process & Timeline *Allison Whitsitt*
8. Closing Remarks

Stakeholder Workshop 4

Figure D-20 Stakeholder Workshop #4 Sign-in Sheet



2024 Muskogee County Hazard Mitigation Plan

Stakeholder Workshop #4: Sign-in Sheet

January 11, 2024 from 1:00pm to 4:00pm
300 W. Martin Luther King St., Muskogee, OK

Name	Title	Organization	Email
Rick Hoos	Superintendent	Braggs Public School	rhoos@braggsschool.com
Blake Lyons*	Coordinator for Community Health Preparedness	Cherokee Nation	blake-lyons@cherokee.org
Hoss Horsley	Chief VFD	Council Hill	councilhillVFD@gmail.com
Nathan Parker*	Fire Chief	Fort Gibson Fire Department	firechief@fortgibson.net
George Kunsman	Grant Administrator	Fort Gibson Public Schools	g_kunsman@fortgibson.tigers.org
Erik Puckett*	Superintendent	Hilldale Schools	epuckett@hilldaleps.org
Allison Whitsitt	Department Manager	Meshek & Associates	awhitsitt@meshekengr.com
Archie Losey*	Hazard Mitigation Planner	Meshek & Associates	alosey@meshekengr.com
Mark Stalcup*	Project Manager	Meshek & Associates	mstalcup@meshekengr.com
Abigail Wright	Environmental Technician	Muskogee	awright@muskogeeonline.org
Jimmy Wood*	GIS	Muskogee	jwood@muskogeeonline.org
Steve Beauvais*	Special Ops Officer – Fire Department	Muskogee	sbeauvais@muskogeedfd.org
Tyler Evans	EM Director	Muskogee	tevens@muskogeeonline.org
Carrie Wages*	Deputy Director EM	Muskogee County	cwages@readymuskogee.org
Lisa Robinson*	Northeast Coordinator	ODEMHS	Lisa.robinson@oem.ok.gov
Jeff Moore*	EM Director	Okmulgee County	Jeff.moore@okmulgeecounty.gov
Jimmy Robinson	Water Superintendent	Porum	water1@crosstel.net
David Vinson	Superintendent	Warner Public School	davidvinson@warner.k12.ok.us
Lori Moore*	Fire Department	Warner	N/A

* denotes those who attended virtually

Figure D-21 Stakeholder Workshop #4 Agenda

2024 Muskogee County Hazard Mitigation Plan

Stakeholder Workshop 4 Agenda

January 11, 2024, 1:00pm-4:00pm
300 W. Martin Luther King St., Muskogee, OK

- 1. Welcome**
- 2. Progress Update/Current Status**
- 3. Mitigation Strategy**
- 4. Plan Maintenance & Integration**
- 5. Plan Implementation & Update**
- 6. Plan Review, Approval, & Adoption Process**
 - ODEMHS Review
 - FEMA Submission
 - Approval Pending Adoption (APA)
- 7. BREAK**
- 8. Presentation of the 2024 Muskogee County HMP (Draft)**
- 9. Public Review & Feedback**
- 10. Closing Comments**



Figure D-22 QR Code for the Muskogee County HUB Webpage



Table D-1 Participation Schedule & Records

S1 = Stakeholder 1**S3** = Stakeholder 3**P** = Public Meeting = Participated**S2** = Stakeholder 2**S4** = Stakeholder 4**S** = Survey = Invited to Participate

Name	Title	Jurisdiction	S1	S2	S3	P	S4	S
Jared Wilson	VFD – Fire Chief	Boynton						
Leanette Hutchinson	FPA							
Kay Lang	Mayor							
Alicia Beasley	Town Clerk	Braggs						
Walter Cohen	VFD – Fire Chief							
Kenneth Richardson	FPA							
Lisa Tyler	Mayor							
Chad Harp	Superintendent	Braggs Public Schools						
Rick Hoos	Superintendent							
Amy Tanner	Director of EM	Cherokee Nation						

Name	Title	Jurisdiction	S1	S2	S3	P	S4	S
Blake Lyons	Deputy Sheriff / Coordinator for Community Health Preparedness							
Brad Wagon	Community Outreach Coordinator							
Mike Underwood	Director of EM	City of Tahlequah / Cherokee Co.						
Eldon Staton	Mayor / County Treasurer	Council Hill						
Hoss Horsley	VFD - Fire Chief							
Brent Williams	VFD - Fire Chief							
Bryan Farmer	Code Enforcement	Fort Gibson						
Nathan Parker	FD - Chief							
James Walters	Town Administrator							
Rob Frazier	Police Chief							
George Kunsman	Grant Administrator	Fort Gibson Public Schools						
Scott Farmer	Superintendent							
Tom Stiles	Assistant Superintendent							
Joy Sloan	Chief Executive Officer	Green Country Behavioral Health Services						
Caleb Brewer	FD - Fire Chief	Haskell						
Dwayne Points	Town Administrator / FPA							
Michael Keene	FPA / Police Chief							
Zach Stephens	Police Chief							
Rod Luellen	Superintendent	Haskell Public Schools						
Chad Kirkhart	Assistant Superintendent	Hilldale Public Schools						
Eric Puckett	Superintendent							
Bruce Douglas	Superintendent	Midway Public Schools						
Bobby Howard	Director of EM	Muscogee (Creek) Nation						
Chad Bonds	Deputy Director of EM							
Avery Rigney	Assistant Public Works Dir.	Muskogee						
Abigail Wright	FPA							
Jody Moore	Fire Chief							

Name	Title	Jurisdiction	S1	S2	S3	P	S4	S
John K. Lumpkins	Muskogee Water Plant	Muskogee County						
Jimmy Wood	GIS Specialist							
Kelly Bolding	Deputy Director of EM							
Mike Miller	City Manager							
Michael Stewart	Director of Public Works							
Steve Beauvais	HazMat Special Ops Officer (FD)							
Scott Fletcher	WWTP Maintenance							
Tyler Evans	Director of EM							
Ron Dean	Muskogee Co. Assessor / MCDRC	Muskogee County						
Ken Doke	District 1 Commissioner							
Carrie Wages	Deputy Dir. of EM / LEPC / MDRC							
Brian DeShazo	District 1 Deputy Commissioner							
Jeff Smith	Director of EM / FPA / ADA Compliance							
Josh Wood	LEPC/Rural Fire Chief							
Keith Hyslop	District 2 Commissioner							
Kenny Payne	District 3 Commissioner							
Ron Dean	Assessor							
Dan Hall	LEPC/Chief of Police	Muskogee Public Schools						
Jarod Mendenhall	Superintendent							
Lisa Robinson	NE Regional Coordinator	ODEMHS						
Rita Echelle	Superintendent	Oklahoma School for the Blind						
Jeff Moore	Director of EM	Okmulgee County						
Levi Hill	FD - Fire Chief	Oktaha						
Sheila Whittle	Town Clerk							
Barbara Tyra	FPA							
Jerry Needham	Superintendent	Oktaha Public Schools						
Laura Holt	Assistant Superintendent							
Trampas Tripp	VFD - Fire Chief	Porum						

Name	Title	Jurisdiction	S1	S2	S3	P	S4	S
Jimmy Robinson	PW Supervisor / FPA / Water Superintendent							
Landon Berry	Superintendent	Porum Public Schools						
Steve Rutherford	Director of EM	Sequoyah County						
Kyle Kuhns	Emergency Manager	St. Francis						
Greg Smith	Mayor / VFD - Fire Chief	Summit						
Elise Ceasar	Mayor	Taft						
Cliff (or Brian?) Lee	VFD – Fire Chief							
Darren Royce	Assistant Fire Chief							
Maya Golden	(receptionist?)							
Jenny Jamison	Executive Director	United Way (Lake Area)						
Kim Jaquez	Outreach Coordinator							
Bill Smiley	Emergency Manager	USACE						
Heath Underwood	Director of EM	Wagoner County						
Jim Ogden	Superintendent	Wainwright Public Schools						
Hannah Moore	Fire Department	Warner						
Johnny Lewis	Town Administrator							
Colby Hyslope	Fire Department							
Lori Moore	Fire Department							
Mike Moore	VFD - Fire Chief							
David Vinson	Superintendent	Warner Public Schools						
Johnny Pollard	Town Clerk	Webbers Falls						
Norma Griffith	Town Clerk / Treasurer							
Wayne Cartwright	Police Chief							
Chris Whelan	Superintendent	Webbers Falls Public Schools						

Appendix E. NFIP Ordinance Information

When a community agrees to participate in NFIP, one of the requirements is that these communities must develop ordinances that regulate development within floodplains¹. FEMA provides these communities at the outset with flood hazard information, or minimum NFIP requirements, upon which floodplain management regulations are based. Communities use this information to build ordinances that meet or exceed these requirements. The primary purpose of such regulations is to ensure that participating communities take into account flood hazards, to the extent which they are known, in official actions relating to land management and use. The exact requirements are coded into 44 CFR 60.3.

In this appendix, ordinances from each community that participates in NFIP are included. Figure E-1 shows each jurisdiction, whether or not they participate in NFIP, and where the NFIP ordinances can be found in this appendix.

Table E-1 NFIP Floodplain Ordinances in Appendix E

Jurisdiction	NFIP Participant (Y/N)	Ordinance Location
Muskogee County	Yes	Figure E-1
Boynton	Yes	Figure E-2
Braggs	Yes	Figure E-3
Council Hill	No	—
Fort Gibson	Yes	Figure E-4
Haskell	Yes	Figure E-5
City of Muskogee	Yes	Figure E-6
Oktaha	Yes	Figure E-7
Porum	Yes	Figure E-8
Summit	No	—
Taft	Yes	Figure E-9
Wainwright	Yes	Unknown
Warner	Yes	Figure E-11
Webbers Falls	Yes	Figure E-12

¹ <https://www.fema.gov/glossary/floodplain-management-ordinances>

Figure E-1 NFIP Ordinances for Muskogee County, OK

**MUSKOGEE COUNTY, OKLAHOMA
FLOODPLAIN BOARD REGULATIONS
EFFECTIVE FEBRUARY 4, 2011**

ARTICLE I

STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND METHODS

SECTION A. STATUTORY AUTHORIZATION

The Legislature of the State of Oklahoma has in 82 O.S. §§ 1601-1618, as amended, delegated the responsibility to local governmental units to adopt regulations designed to minimize flood losses. Therefore, the Muskogee County Floodplain Management Board hereby adopts the following regulations, to become effective on February 4, 2011:

SECTION B. FINDINGS OF FACT

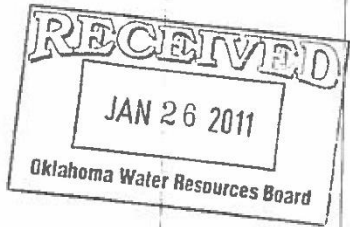
1. The flood hazard areas of Muskogee County, Oklahoma are subject to periodic inundation, which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect the public health, safety and general welfare.

2. These flood losses are created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazards areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, floodproofed or otherwise protected from flood damage.

SECTION C. STATEMENT OF PURPOSE

It is the purpose of these regulations is to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

1. Protect human life and health;
2. Minimize expenditure of public money for costly flood control projects;
3. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
4. Minimize prolonged business interruptions;
5. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains;
6. Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
7. Insure that potential buyers are notified that property is in a flood area.



SECTION D. METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purposes, these regulations use the following methods:

1. Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood heights or velocities;
2. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
3. Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters;
4. Control filling, grading, dredging and other development which may increase flood damage; and
5. Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands.

ARTICLE II

DEFINITIONS

Unless specifically defined below, words or phrases used in these regulations be interpreted to give them the meaning they have in common usage and to give these regulations the most reasonable application.

"Accessory structure" - means a structure which is on the same parcel of property as the principal structure and the use of which is incidental to the use of the principal structure. Examples of accessory structures include but are not limited to garages and storage sheds.

"Area of special flood hazard" - is the land in the floodplain within Muskogee County subject to a one percent or greater chance of flooding in any given year.

"Base flood" - means the flood having a one percent chance of being equaled or exceeded in any given year.

"Base flood elevation" - means the elevation in feet above mean sea level of the base flood or 1% chance flood.

"Basement" - means any area of the building having its floor sub-grade (below ground level) on all sides.

"BFE" - means base flood elevation.

"CFR" - means Code of Federal Regulations.

"Critical feature" - means an integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

"Development" - means any man-made change in improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

"Development Permit" - means a permit issued by the Muskogee County Floodplain Administrator which authorizes development in a special flood hazard area in accordance with these regulations.

"Elevated building" - means a non-basement building built, in the case of a building in Zones AE, A, and X, to have the top of the elevated floor adequately anchored so as not to impair the structural integrity of the building during a flood up to the magnitude of the base flood. In the case of Zones AE, A, and X, "elevated building" also includes a building elevated by means of fill or solid foundation perimeter walls with openings sufficient to facilitate the unimpeded movement of flood waters.

"Existing construction" - means for the purposes of determining rates, structures for which the "start of construction" commenced before the effective date of the FIRM or before January 1, 1975, for FIRMs effective before that date. "Existing construction" may also be referred to as "existing structures."

"Existing manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before the effective date of the Muskogee County Floodplain Board Regulations.

"Expansion to an existing manufactured home park or subdivision"- means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

"FEMA" means the Federal Emergency Management Agency.

"FIRM" means Flood Insurance Rate Map.

"Flood" or "flooding" - means a general and temporary condition of partial or complete inundation of normally dry land areas from:

1. The overflow of inland or tidal waters, or
2. The unusual and rapid accumulation or runoff of surface waters from any source.

"Flood Insurance Rate Map" - means an official map of Muskogee County on which FEMA has delineated both the areas of special flood hazards and the risk premium zones applicable to Muskogee County.

"Flood insurance study" - is the official report provided by FEMA for Muskogee County which contains flood profiles, water surface elevation of the base flood, as well as the floodway width, section area and mean velocity.

"Floodplain Administrator" - means a person accredited by the OWRB and designated by the Muskogee County Floodplain Management Board to administer and implement laws, ordinances and regulations relating to the management of floodplains.

"Floodplain or flood-prone area" - means any land area susceptible to being inundated by water from any source (see definition of flood).

"Floodplain management" - means the operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.

"Floodplain management regulations" or "Flood Damage Prevention Regulations"- mean zoning codes and ordinances, subdivision regulations, building codes, health regulations, special purpose regulations and ordinances (such as floodplain, grading and erosion control regulations and ordinances) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

"Flood protection system" - means those physical structural works for which funds have been authorized, appropriated, and expended and which have been constructed specifically to modify flooding in order to reduce the extent of the areas within Muskogee County subject to a "special

flood hazard" and the extent of the depths of associated flooding. Such a system typically includes hurricane tidal barriers, dams, reservoirs, levees or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

"Floodway" - means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. A floodway is located within areas of special flood hazard established in Article III, Section B. A floodway is an extremely hazardous area due to the velocity of floodwaters that carry debris and potential projectiles.

"Functionally dependent use" - means a use that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

"Highest adjacent grade" - means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

"Historic structure" - means any structure that is:

1. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
2. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
3. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or
4. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
 - a) By an approved state program as determined by the Secretary of the Interior, or
 - b) Directly by the Secretary of the Interior in states without approved programs.

"Levee" - means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

"Levee system" - means a flood protection system which consists of a levee or levees and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

"Lowest floor" - means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking or vehicles, building access or storage in an area other than a basement area is not considered a building's lowest floor;

provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirement of Section 60.3 of Title 44 CFR.

"Manufactured home" - means a structure transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. The term "manufactured home" does not include a "recreational vehicle".

"Manufactured home park or subdivision" - means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

"Mean sea level" - means, for purposes of the National Flood Insurance Program, the North American Vertical Datum (NAVD) of 1988 or other datum, to which base flood elevations shown on the Muskogee County Flood Insurance Rate Map are referenced.

"New construction" - means, for the purpose of determining insurance rates, structures for which the "start of construction" commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, "new construction" means structures for which the "start of construction" commenced on or after the effective date of a floodplain management regulation adopted by the Muskogee County Floodplain Management Board and includes any subsequent improvements to such structures.

"New manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of floodplain management regulations adopted by the Muskogee County Floodplain Management Board.

"OWRB" - means the Oklahoma Water Resources Board.

"Recreational vehicle" - means a vehicle which is:

1. Built on a single chassis;
2. 400 square feet or less when measured at the largest horizontal projections;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

"Start of construction" - (for other than new construction or substantial improvements under the Coastal Barrier Resources Act (Public Law 97-348), includes substantial improvement and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for basement, footings, piers or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main

structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

"Structure" - means a walled and roofed building, including a gas or liquid storage tank that is principally above ground, as well as a manufactured home.

"Substantial damage" - means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"Substantial improvement" - means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before "start of construction" of the improvement. This includes structures that have incurred "substantial damage", regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary conditions, or
2. Any alteration of a "historic structure" provided that the alteration would not preclude the structure's continued designation as a "historic structure."

"Variance" - is a grant of relief by the Muskogee County Floodplain Management Board to a person from the terms of these regulations when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise prohibited by these regulations. (For full requirements see Section 60.6 of Title 44 CFR.)

"Violation" - means the failure of a structure or other development to be fully compliant with the Muskogee County flood damage prevention regulations.

"Water surface elevation" - means the height, in relation to the North American Vertical Datum (NAVD) of 1988 (or other datum, where specified), of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

ARTICLE III

GENERAL PROVISIONS

SECTION A. LANDS TO WHICH THESE REGULATIONS APPLY

These flood damage prevention regulations shall apply to all areas of special flood hazard within the jurisdiction of Muskogee County, Oklahoma.

SECTION B. BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by FEMA in a scientific and engineering report entitled, "The Flood Insurance Study for Muskogee County, Oklahoma and Incorporated Areas" dated February 4, 2011, with the accompanying Flood Insurance Rate Map (FIRM) are hereby adopted by reference and declared to be a part of these regulations which shall become effective on February 4, 2011.

SECTION C. ESTABLISHMENT OF DEVELOPMENT PERMIT

A Development Permit shall be required to ensure conformance with the provisions of these floodplain management regulations.

SECTION D. COMPLIANCE

No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of these regulations and other applicable regulations.

SECTION E. ABROGATION AND GREATER RESTRICTIONS

These regulations are not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where these regulations and any other regulations, easements, covenants, or deed restrictions conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

SECTION F. INTERPRETATION

In the interpretation and application of these regulations, all provisions shall be:

1. Considered as minimum requirements;
2. Liberally construed in favor of the governing body; and
3. Deemed neither to limit nor repeal any other powers granted under State statutes.

SECTION G. WARNING AND DISCLAIMER OR LIABILITY

The degree of flood protection required by these regulations is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by man-made or natural causes. These regulations do not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. These regulations shall not create liability on the part of Muskogee County or any official or employee thereof for any flood damages that result from reliance on these regulations or any administrative decision lawfully made hereunder.

ARTICLE IV

ADMINISTRATION

SECTION A. DESIGNATION OF THE FLOODPLAIN ADMINISTRATOR

The Muskogee County Floodplain Management Board designates the Muskogee County Emergency Management Director as Floodplain Administrator to administer and implement the provisions of these regulations and other appropriate sections of National Flood Insurance Program regulations in Title 44 CFR pertaining to floodplain management.

SECTION B. DUTIES AND RESPONSIBILITIES OF THE FLOODPLAIN ADMINISTRATOR

Duties and responsibilities of the Floodplain Administrator shall include, but not be limited to, the following:

1. Becoming accredited by the OWRB in accordance with Title 82 O.S. §§ 1601-1618, as amended.
2. Reviewing permit applications to determine whether the proposed building sites, including the placement of manufactured homes, will be reasonably safe from flooding.
3. Reviewing, approving or denying all applications for Development Permits required by these regulations.
4. Reviewing proposed development to assure that all necessary permits have been obtained from those Federal, State or local governmental agencies from which prior approval are required.
5. Making the necessary interpretation where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions).
6. Notifying, in riverine situations, adjacent communities and the OWRB prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the FEMA.
7. Assuring that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.
8. Shall require the applicant/developer to provide the proposed and "as built" base flood elevation data on two FEMA Elevation Certificates, on prior to construction and one post construction, and other data as required in order to administer the provisions of Article V.
9. When a floodway has not been designated, the Floodplain Administrator must require that no new construction, substantial improvements, or other development (including fill) be permitted within Zone AE as delineated on the Muskogee County FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface

elevation of the base flood by more than one (1) foot at any point within Zone AE in Muskogee County.

10. After a disaster or other type of damage occurrence to structures in Muskogee County, determining if the residential and non-residential structures and manufactured homes have been substantially damaged, and enforce the substantial improvement requirement.
11. Maintaining a record of all actions involving an appeal from a decision of the Muskogee County Floodplain Management Board.
12. Maintaining and holding open for public inspection all records pertaining to the provisions of these regulations.

SECTION C. PERMIT PROCEDURES

1. An Application for a Development Permit shall be presented to the Floodplain Administrator on forms furnished by the Administrator and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, including the placement of manufactured homes, and the location of the foregoing in relation to areas of special flood hazard. Additionally, the following information is required:
 1. Elevation in relation to mean sea level of the lowest floor (including basement) of all new and substantially improved structures; and
 2. Description of the extent to which any watercourse or natural drainage will be altered or relocated as a result of proposed development.
2. Approval or denial of a Development Permit by the Muskogee County Floodplain Management Board shall be based on all of the provisions of these regulations and the following relevant factors:
 - a. The danger to life and property due to flooding or erosion damage;
 - b. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
 - c. The danger that materials may be swept onto other lands to the injury of others;
 - d. The compatibility of the proposed use with existing and anticipated development;
 - e. The safety of access to the property in times of flood for ordinary and emergency vehicles;
 - f. The costs of providing governmental services during and after flood conditions including maintenance and repair of streets and bridges, and public utilities and facilities such as sewer, gas, electrical and water systems;

- g. The expected heights, velocity, duration, rate of rise and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;
 - h. The necessity to the facility of a waterfront location, where applicable;
 - i. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use; and
 - j. The relationship of the proposed use to the comprehensive plan for that area.
3. The Muskogee County Floodplain Management Board may approve certain development in Zones A or AE delineated on the Muskogee County FIRM which increases the water surface elevation of the base flood by more than one (1) foot, provided that the applicant for the Development Permit in that case first complies with 44 CFR Section 65.12.

SECTION D. VARIANCE PROCEDURES

1. General provisions.

a. The Muskogee County Board of County Commissioners (BOCC) shall serve as the Appeal Board and may grant variances for uses which do not satisfy the requirements of the Oklahoma Floodplain Management Act or these regulations if the applicant for the variance presents adequate proof that (i) compliance with these regulations will result in an arbitrary and unreasonable taking of property without sufficient benefit or advantage to the people and (ii) satisfies the pertinent provisions of this Section D. However, no variance shall be granted where the effect of the variance will be to permit the continuance of a condition which unreasonably creates flooding hazards.

b. Any variance so granted shall not be construed as to relieve any person who receives it from any liability imposed by the Oklahoma Floodplain Management Act or by other laws of the state.

c. In no case shall variances be effective for a period longer than twenty (20) years.

d. Any person seeking a variance shall file a petition with the Muskogee County BOCC.

e. Variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in Section C(2) and provisions of Section D of this Article IV have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.

f. Any person seeking a variance to build a structure below the base flood elevation will be issued a notice signed by the Chairman of the Muskogee County BOCC which states that (i) the cost of flood insurance will be commensurate with the increased risk resulting from permitting the structure to be built lower than the base flood elevation, and (ii) such construction below the base flood level increases risks to life and property.

g. At such time as the official appeals group or board as the case maybe deems the petition ready for notification to the public, the Board of County Commissioners shall schedule a hearing and direct the applicant to publish notice thereof in a newspaper of general circulation in Muskogee County at least thirty (30) days prior to the hearing.

h. The Board of County Commissioners shall conduct the hearing and make determinations in accordance with the applicable provisions of this Section D. The Board of County Commissioners shall exercise wide discretion in weighing the equities involved and the advantages and disadvantages to the applicant and to the public at large when determining whether the variance shall be granted.

i. Variances shall only be issued upon:

- (1) A showing of good and sufficient cause;
- (2) A determination that failure to grant the variance would result in exceptional hardship to the applicant;
- (3) A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws, regulations or ordinances; and
- (4) A determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

j. Upon consideration of the factors stated in this Section D and the intent of these regulations, the official appeals group may attach such conditions to the granting of a variance as it deems necessary to further the purposes and objectives stated in Article I, Section C of these regulations.

k. The Floodplain Administrator shall maintain a record of all variance actions, including justification for their issuance; and a copy of any variance issued by the official appeals group or board as the case maybe shall be sent by the Floodplain Administrator to the OWRB and FEMA within fifteen (15) days after issuance of the variance.

2. Special provisions.

a. Variances may be issued for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in the remainder of these regulations.

b. Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

c. Variances may be issued for the repair or rehabilitation of historic structures upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.

d. Variances may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that:

- (1) The criteria of Section D(1)(e); Section D(1)(i); Section D(2)(b); and Section D(2)(c) of this Article IV are met, and
- (2) The structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

ARTICLE V

PROVISIONS FOR FLOOD HAZARD REDUCTION

SECTION A. GENERAL STANDARDS

In all areas of special flood hazards the following provisions are required for all new construction and substantial improvements:

1. All new construction or substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
2. All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;
3. All new construction or substantial improvements shall be constructed with materials resistant to flood damage;
4. All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
5. All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
6. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharge from the systems into flood waters; and,
7. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

SECTION B. SPECIFIC STANDARDS

In all areas of special flood hazards where base the following provisions are required:

1. **Residential Construction** - new construction and substantial improvement of any residential structure shall have the lowest floor (including basement) elevated at least one foot above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.
2. **Nonresidential Construction** - new construction and substantial improvements of any commercial, industrial or other nonresidential structure shall have the lowest floor (including basement) elevated at least one foot above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.
3. **Enclosures** - new construction and substantial improvements, with fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria:
 - (a) A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided;
 - (b) The bottom of all openings shall be no higher than one foot above grade; and
 - (c) Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.
4. **Manufactured Homes** -

Require that all manufactured homes located anywhere within the unincorporated limits of Muskogee County placed or substantially improved only within Zone A or Zone AE on the Muskogee County FIRM shall be installed using methods and practices that minimize flood damage and have the bottom of the I-beam elevated at least at or above the base flood elevation. For the purposes of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse, or lateral movement. This requirement is in addition to applicable State and local anchoring requirements for resisting wind forces. The home shall be installed by a licensed installer according to Oklahoma state law and compliance herewith shall be certified in writing to the Floodplain Administrator by said installer prior to habitation of the manufactured home.
5. **Recreational Vehicles** - Require that recreational vehicles placed on sites within Zones A and AE on the Muskogee County FIRM either:
 - (a) Be on the site for fewer than 180 consecutive days,
 - (b) Be fully licensed and ready for highway use, or

- (c) Meet the permit requirements of Article IV, Section C, and the elevation and anchoring requirements for "manufactured homes" in paragraph (4) of this section.

A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions.

6. Accessory Structure – Accessory structures to be placed on sites within Zones A and AE on the Muskogee County FIRM shall comply with the following:

- (a) The structure shall be unfinished on the interior;
- (b) The structure shall be used only for parking and limited storage;
- (c) The structure shall not be used for human habitation. Prohibited activities or uses include but are not limited to working, sleeping, living, cooking, or restroom use;
- (d) Service facilities such as electrical and heating equipment must be elevated two feet above the BFE;
- (e) The structure shall be constructed and placed on the building site so as to offer the minimum resistance to the flow of floodwaters;
- (f) The structure shall be designed to have low flood damage potential and constructed with flood resistance materials;
- (g) The structure shall be firmly anchored to prevent flotation, collapse, and lateral movement;
- (h) Floodway requirements must be met in the construction of the structure;
- (i) Openings to relieve hydrostatic pressure during a flood shall be provided below the BFE; and
- (j) The structure shall be located so as not to cause damage to adjacent and nearby structures.

SECTION C. STANDARDS FOR SUBDIVISIONS

1. The applicant for a Development Permit for any subdivision located in Zones A and AE which is 51 or more lots or greater than 5 acres shall generate the base flood elevation data for that subdivision.
2. All subdivisions including the placement of manufactured home parks and subdivisions shall have adequate drainage provided to reduce exposure to flood hazards.
3. All subdivisions including the placement of manufactured home parks and subdivisions shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize or eliminate flood damage.

SECTION D. FLOODWAYS

The following provisions shall apply to floodways:

1. Encroachments, including but not limited to fill, new construction, substantial improvements and other development are prohibited within the adopted floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within Muskogee County during the occurrence of the base flood discharge.
2. If Article V, Section D.1 above is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Article V.
3. The Muskogee County Floodplain Management Board may permit encroachments within the adopted floodway that would result in an increase in base flood elevations, provided that the applicant for the Development Permit complies with all of 44 CFR Section 65.12.

SECTION E. SEVERABILITY

If any section, clause, sentence, or phrase of these regulations is held to be invalid or unconstitutional by any court of competent jurisdiction, then said holding shall in no way affect the validity of the remaining portions of these regulations.

**ARTICLE VI
MUSKOGEE COUNTY FLOODPLAIN BOARD FEE**

The Floodplain Board for Muskogee County establishes a \$100.00 fee to be submitted, either as a personal check or money order, and attached to the application for development in the floodplain. The Board also establishes a \$10 fee for flood zone determinations and if necessary, a \$25.00 inspection fee for any permitted development in the floodplain.

**ARTICLE VII
PENALTIES FOR NONCOMPLIANCE**

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of these regulations and other applicable regulations. A structure or other development without the elevation certificate or other certifications required in these regulations is presumed to be in violation until such time as that documentation is provided. Violation of the provisions of these regulations by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Any person who violates the provisions of these regulations or fails to comply with any of its requirements shall upon conviction thereof be fined not more than \$500.00 or imprisoned for not more than one year or both, for each violation, and in addition shall pay all costs and expenses involved in the case. Nothing herein contained shall prevent the Muskogee County Floodplain Management Board or the Muskogee County District Attorney from taking such other lawful action as is necessary to prevent or remedy any violation.

CERTIFICATION

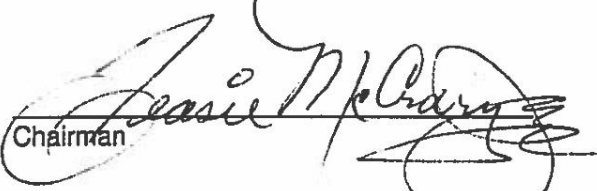
It is hereby found and declared by the Muskogee County Floodplain Management Board that severe flooding has occurred in the past within its jurisdiction and will certainly occur within the future; that flooding is likely to result in infliction of serious personal injury or death, and is likely to result in substantial injury or destruction of property within its jurisdiction; in order to effectively comply with minimum standards for coverage under the National Flood Insurance Program, and in order to effectively remedy the situation described herein, it is necessary that these regulations go into effective on February 4, 2011.

These regulations shall supersede any previous floodplain management regulations or ordinance(s) applicable to the unincorporated limits of Muskogee County.

ADOPTED BY THE MUSKOGEE COUNTY FLOODPLAIN MANAGEMENT BOARD THIS ____ DAY OF _____, 2011.

BOARD

MUSKOGEE COUNTY FLOODPLAIN MANAGEMENT


Chairman

I, Karen Anderson, the undersigned County Clerk of Muskogee County, Oklahoma, hereby certify that the above is a true and correct copy of a flood damage prevention regulations duly adopted by the Muskogee County Floodplain Management Board at its regular meeting duly convened and held on Jan. 18, 2011. I further certify that the Oklahoma Open Meeting Act was complied with in all respects for such meeting.

Karen Anderson
County Clerk
Muskogee County, Oklahoma

(SEAL)

Figure E-2 NFIP Ordinances for the Town of Boynton, OK

**THE TOWN OF BOYNTON, OKLAHOMA
FLOOD DAMAGE PREVENTION ORDINANCE
"DECLARING AN EMERGENCY"**

ARTICLE I

STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND METHODS

SECTION A. STATUTORY AUTHORIZATION

The Legislature of the State of Oklahoma has in 11 O.S. §§ 41-47, as amended, delegated the responsibility to local governmental units to adopt ordinances designed to minimize flood losses. Therefore, the Town of Boynton, Oklahoma, ordains the following, to become effective immediately:

SECTION B. FINDINGS OF FACT

1. The flood hazard areas of the Town of Boynton are subject to periodic inundation, which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect the public health, safety and general welfare.

2. These flood losses are created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazards areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, floodproofed or otherwise protected from flood damage.

SECTION C. STATEMENT OF PURPOSE

It is the purpose of this ordinance to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

1. Protect human life and health;
2. Minimize expenditure of public money for costly flood control projects;
3. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
4. Minimize prolonged business interruptions;
5. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains;
6. Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
7. Insure that potential buyers are notified that property is in a flood area.

RECEIVED
JAN 31 2011
Oklahoma Water Resources Board

SECTION D. METHODS OF REDUCING FLOOD LOSSES -

In order to accomplish its purposes, this ordinance uses the following methods:

1. Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood heights or velocities;
2. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
3. Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters;
4. Control filling, grading, dredging and other development which may increase flood damage; and
5. Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands.

ARTICLE II

DEFINITIONS

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

"Accessory structure" - means a structure which is on the same parcel of property as the principal structure and the use of which is incidental to the use of the principal structure. Examples of accessory structures include but are not limited to garages and storage sheds.

"Area of special flood hazard" - is the land in the floodplain within the The Town of Boynton subject to a one percent or greater chance of flooding in any given year.

"Base flood" - means the flood having a one percent chance of being equaled or exceeded in any given year.

"Base flood elevation" - means the elevation in feet above mean sea level of the base flood or 1% chance flood.

"Basement" - means any area of the building having its floor sub-grade (below ground level) on all sides.

"BFE" - means base flood elevation.

"CFR" - means Code of Federal Regulations.

"Critical feature" - means an integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

"Development" - means any man-made change in improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

"Development Permit" - means a permit issued by the Town of Boynton Floodplain Administrator which authorizes development in a special flood hazard area in accordance with this ordinance.

"Elevated building" - means a non-basement building built, in the case of a building in Zones AE, A, and X, to have the top of the elevated floor adequately anchored so as not to impair the structural integrity of the building during a flood up to the magnitude of the base flood. In the case of Zones AE, A, and X, "elevated building" also includes a building elevated by means of fill or solid foundation perimeter walls with openings sufficient to facilitate the unimpeded movement of flood waters.

"Existing construction" - means for the purposes of determining rates, structures for which the "start of construction" commenced before the effective date of the FIRM or before January 1, 1975, for FIRMs effective before that date. "Existing construction" may also be referred to as "existing structures."

"Existing manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before August 4, 1972.

"Expansion to an existing manufactured home park or subdivision" - means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

"FEMA" means the Federal Emergency Management Agency.

"FIRM" means Flood Insurance Rate Map.

"Flood" or "flooding" - means a general and temporary condition of partial or complete inundation of normally dry land areas from:

1. The overflow of inland or tidal waters, or
2. The unusual and rapid accumulation or runoff of surface waters from any source.

"Flood Insurance Rate Map" - means an official map of the Town of Boynton on which FEMA has delineated both the areas of special flood hazards and the risk premium zones applicable to the Town of Boynton.

"Flood insurance study" - is the official report provided by FEMA for The Town of Boynton which contains flood profiles, water surface elevation of the base flood, as well as the floodway width, section area and mean velocity.

"Floodplain Administrator" - means a person accredited by the OWRB and designated by the Board of Trustees of the Town of Boynton to administer and implement laws, ordinances and regulations relating to the management of floodplains.

"Floodplain or flood-prone area" - means any land area susceptible to being inundated by water from any source (see definition of flood).

"Floodplain management" - means the operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.

"Floodplain management regulations" - this means zoning codes and ordinances, subdivision regulations, building codes, health regulations, special purpose regulations and ordinances (such as floodplain, grading and erosion control regulations and ordinances) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

"Flood protection system" - means those physical structural works for which funds have been authorized, appropriated, and expended and which have been constructed specifically to modify flooding in order to reduce the extent of the areas within The Town of Boynton subject to a

"special flood hazard" and the extent of the depths of associated flooding. Such a system typically includes hurricane tidal barriers, dams, reservoirs, levees or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

"Floodway" - means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. A floodway is located within areas of special flood hazard established in Article III, Section B. A floodway is an extremely hazardous area due to the velocity of floodwaters that carry debris and potential projectiles.

"Functionally dependent use" - means a use that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

"Highest adjacent grade" - means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

"Historic structure" - means any structure that is:

1. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
2. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
3. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or
4. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
 - a) By an approved state program as determined by the Secretary of the Interior, or
 - b) Directly by the Secretary of the Interior in states without approved programs.

"Levee" - means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

"Levee system" - means a flood protection system which consists of a levee or levees and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

"Lowest floor" - means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking or vehicles, building access or storage in an area other than a basement area is not considered a building's lowest floor;

provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirement of Section 60.3 of Title 44 CFR.

"Manufactured home" - means a structure transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. The term "manufactured home" does not include a "recreational vehicle".

"Manufactured home park or subdivision" - means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

"Mean sea level" - means, for purposes of the National Flood Insurance Program, the North American Vertical Datum (NAVD) of 1988 or other datum, to which base flood elevations shown on the Town of Boynton Flood Insurance Rate Map are referenced.

"New construction" - means, for the purpose of determining insurance rates, structures for which the "start of construction" commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, "new construction" means structures for which the "start of construction" commenced on or after the effective date of a floodplain management regulation adopted by the Town of Boynton Board of Trustees and includes any subsequent improvements to such structures.

"New manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of floodplain management regulations adopted by the Town of Boynton Board of Trustees.

"OWRB" - means the Oklahoma Water Resources Board.

"Recreational vehicle" - means a vehicle which is:

1. Built on a single chassis;
2. 400 square feet or less when measured at the largest horizontal projections;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

"Start of construction" - (for other than new construction or substantial improvements under the Coastal Barrier Resources Act (Public Law 97-348), includes substantial improvement and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for basement, footings, piers or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main

structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

"Structure" - means a walled and roofed building, including a gas or liquid storage tank that is principally above ground, as well as a manufactured home.

"Substantial damage" - means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"Substantial improvement" - means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before "start of construction" of the improvement. This includes structures that have incurred "substantial damage", regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary conditions, or
2. Any alteration of a "historic structure" provided that the alteration would not preclude the structure's continued designation as a "historic structure."

"Variance" - is a grant of relief by the Town of Boynton Board of Trustees to a person from the terms of this ordinance when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise prohibited by this ordinance. (For full requirements see Section 60.6 of Title 44 CFR.)

"Violation" - means the failure of a structure or other development to be fully compliant with this flood damage prevention ordinance.

"Water surface elevation" - means the height, in relation to the North American Vertical Datum (NAVD) of 1988 (or other datum, where specified), of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

ARTICLE III
GENERAL PROVISIONS

SECTION A. LANDS TO WHICH THIS ORDINANCE APPLIES

This flood damage prevention ordinance shall apply to all areas of special flood hazard within the jurisdiction of the Town of Boynton, Oklahoma.

SECTION B. BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by FEMA in a scientific and engineering report entitled, "The Flood Insurance Study for Muskogee County, Oklahoma and Incorporated Areas" dated February 4, 2011, with the accompanying Flood Insurance Rate Map (FIRM) are hereby adopted on February 4, 2011, by reference and declared to be a part of this ordinance. However, until this date the current effective flood maps for the Town of Boynton, dated March 4, 1991 for Muskogee County shall be used for this purpose until February 4, 2011.

SECTION C. ESTABLISHMENT OF DEVELOPMENT PERMIT

A Development Permit shall be required to ensure conformance with the provisions of this floodplain management ordinance.

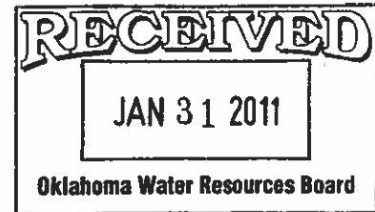
SECTION D. COMPLIANCE

No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of this ordinance and other applicable regulations.

SECTION E. ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and any other ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

JAN 27 2011 9 51 AM

**SECTION F. INTERPRETATION**

In the interpretation and application of this ordinance, all provisions shall be:

1. Considered as minimum requirements;
2. Liberally construed in favor of the governing body; and
3. Deemed neither to limit nor repeal any other powers granted under State statutes.

SECTION G. WARNING AND DISCLAIMER OR LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of the Town of Boynton or any official or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

ARTICLE IV

ADMINISTRATION

SECTION A. DESIGNATION OF THE FLOODPLAIN ADMINISTRATOR

The Board of Trustees of the Town of Boynton designates the Mayor as Floodplain Administrator to administer and implement the provisions of this ordinance and other appropriate sections of National Flood Insurance Program regulations in Title 44 CFR pertaining to floodplain management.

SECTION B. DUTIES AND RESPONSIBILITIES OF THE FLOODPLAIN ADMINISTRATOR

Duties and responsibilities of the Floodplain Administrator shall include, but not be limited to, the following:

1. Become accredited by the OWRB in accordance with Title 82 O.S. §§ 1601-1618, as amended.
2. Reviews permit applications to determine whether the proposed building sites, including the placement of manufactured homes, will be reasonably safe from flooding.
3. Review, approve or deny all applications for Development Permits required by this ordinance.
4. Review proposed development to assure that all necessary permits have been obtained from those Federal, State or local governmental agencies from which prior approval are required.
5. Make the necessary interpretation where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions).
6. Notify, in riverine situations, adjacent communities and the OWRB prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the FEMA.
7. Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.
8. Shall require the developer/applicant to determine and provide the base flood elevation on two FEMA Elevation Certificates, one pre and one post, as well as other data as required in order to administer the provisions of Article V.
9. When a floodway has not been designated, the Floodplain Administrator must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zone AE as delineated on the Muskogee County FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water

surface elevation of the base flood more than one foot at any point within the Town of Boynton.

10. After a disaster or other type of damage occurrence to structures in the Town of Boynton, determine if the residential and non-residential structures and manufactured homes have been substantially damaged, and enforce the substantial improvement requirement.
11. Maintain a record of all actions involving an appeal from a decision of the Board of Trustees.
12. Maintain and hold open for public inspection all records pertaining to the provisions of this ordinance.

SECTION C. PERMIT PROCEDURES

1. An Application for a Development Permit shall be presented to the Floodplain Administrator on forms furnished by him/her and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, including the placement of manufactured homes, and the location of the foregoing in relation to areas of special flood hazard. Additionally, the following information is required:
 - a. Elevation in relation to mean sea level of the lowest floor (including basement) of all new and substantially improved structures; and
 - b. Description of the extent to which any watercourse or natural drainage will be altered or relocated as a result of proposed development.
2. Approval or denial of a Development Permit by the Floodplain Administrator shall be based on all of the provisions of this ordinance and the following relevant factors:
 - a. The danger to life and property due to flooding or erosion damage;
 - b. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
 - c. The danger that materials may be swept onto other lands to the injury of others;
 - d. The compatibility of the proposed use with existing and anticipated development;
 - e. The safety of access to the property in times of flood for ordinary and emergency vehicles;
 - f. The costs of providing governmental services during and after flood conditions including maintenance and repair of streets and bridges, and public utilities and facilities such as sewer, gas, electrical and water systems;
 - g. The expected heights, velocity, duration, rate of rise and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;

- h. The necessity to the facility of a waterfront location, where applicable;
- i. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use; and
- j. The relationship of the proposed use to the comprehensive plan for that area.
3. The Floodplain Administrator or Board of Trustees, as applicable, may approve certain development in Zones A or AE delineated on the Muskogee County FIRM which increases the water surface elevation of the base flood by more than one foot, provided that the applicant for the Development Permit in that case first complies with 44 CFR Section 65.12.

SECTION D. VARIANCES

1. General provisions.

- a. The Board of Trustees and Floodplain Administrator may grant variances for uses which do not satisfy the requirements of the Oklahoma Floodplain Management Act or this ordinance, if the applicant for the variance presents adequate proof that (i) compliance with this ordinance will result in an arbitrary and unreasonable taking of property without sufficient benefit or advantage to the people and (ii) satisfies the pertinent provisions of this Section D. However, no variance shall be granted where the effect of the variance will be to permit the continuance of a condition which unreasonably creates flooding hazards.
- b. Any variance so granted shall not be construed as to relieve any person who receives it from any liability imposed by the Oklahoma Floodplain Management Act or by other laws of the state.
- c. In no case shall variances be effective for a period longer than twenty (20) years.
- d. Any person seeking a variance shall file a petition with the Board of Trustees, accompanied by a filing fee of Twenty-five Dollars (\$25.00).
- e. Variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in Section C(2) and provisions of Section D of this Article IV have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.
- f. Any person seeking a variance to build a structure below the base flood elevation will be issued a notice signed by the Chairman of the Board of Trustees which states that (i) the cost of flood insurance will be commensurate with the increased risk resulting from permitting the structure to be built lower than the base flood elevation, and (ii) such construction below the base flood level increases risks to life and property.
- g. At such time as the Board of Trustees deems the petition ready for notification to the public, the Board of Trustees shall schedule a hearing and direct the applicant to publish

notice thereof in a newspaper of general circulation in Muskogee County at least thirty (30) days prior to the hearing.

h. The Board of Trustees and Floodplain Administrator shall conduct the hearing and make determinations in accordance with the applicable provisions of this Section D. This appeals group shall exercise wide discretion in weighing the equities involved and the advantages and disadvantages to the applicant and to the public at large when determining whether the variance shall be granted.

i. Variances shall only be issued upon:

- (1) A showing of good and sufficient cause;
- (2) A determination that failure to grant the variance would result in exceptional hardship to the applicant;
- (3) A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws, regulations or ordinances; and
- (4) A determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

j. Upon consideration of the factors stated in this Section D and the intent of this ordinance, the Board of Trustees may attach such conditions to the granting of a variance as it deems necessary to further the purposes and objectives stated in Article I, Section C of this ordinance.

k. The Floodplain Administrator shall maintain a record of all variance actions, including justification for their issuance; and a copy of any variance issued by the Board of Trustees and Floodplain Administrator shall be sent by the Floodplain Administrator to the OWRB and FEMA within fifteen (15) days after issuance of the variance.

2. Special provisions.

a. Variances may be issued for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in the remainder of this ordinance.

b. Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

c. Variances may be issued for the repair or rehabilitation of historic structures upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.

d. Variances may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that:

- (1) The criteria of Section D(1)(e); Section D(1)(i); Section D(2)(b); and Section D(2)(c) of this Article IV are met, and
- (2) The structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

ARTICLE V

PROVISIONS FOR FLOOD HAZARD REDUCTION

SECTION A. GENERAL STANDARDS

In all areas of special flood hazards the following provisions are required for all new construction and substantial improvements:

1. All new construction or substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
2. All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;
3. All new construction or substantial improvements shall be constructed with materials resistant to flood damage;
4. All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
5. All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
6. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharge from the systems into flood waters; and,
7. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

SECTION B. SPECIFIC STANDARDS

In all areas of special flood hazards the following provisions are required:

1. **Residential Construction** - new construction and substantial improvement of any residential structure shall have the lowest floor (including basement) elevated at a minimum of one (1) foot above the base flood elevation. A registered professional

engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.

2. Nonresidential Construction - new construction and substantial improvements of any commercial, industrial or other nonresidential structure shall have the lowest floor (including basement) elevated at a minimum one (1) foot above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.

3. Enclosures - new construction and substantial improvements, with fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria:

- (a) A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided;
- (b) The bottom of all openings shall be no higher than one foot above grade; and
- (c) Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

4. Manufactured Homes -

Require that all manufactured homes to be placed anywhere within the Town of Boynton within Zones A and AE on the Town of Boynton FIRM shall be installed using methods and practices that minimize flood damage and have the bottom of the I-beam elevated at or above the BFE. For the purposes of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse, or lateral movement. This requirement is in addition to applicable State and local anchoring requirements for resisting wind forces. The home shall be installed by a licensed installer according to Oklahoma state law and compliance herewith shall be certified in writing to the Floodplain Administrator by said installer prior to habitation of the manufactured home.

5. Recreational Vehicles - Require that recreational vehicles placed on sites within Zones A and AE on the Muskogee County FIRM either:

- (a) Be on the site for fewer than 180 consecutive days.
- (b) Be fully licensed and ready for highway use, or
- (c) Meet the permit requirements of Article IV, Section C, and the elevation and anchoring requirements for "manufactured homes" in paragraph (4) of this section. A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions.

6. Accessory Structure – Accessory structures to be placed on sites within Zones A and AE on the Muskogee County FIRM shall comply with the following:

- (a) The structure shall be unfinished on the interior;
- (b) The structure shall be used only for parking and limited storage;
- (c) The structure shall not be used for human habitation. Prohibited activities or uses include but are not limited to working, sleeping, living, cooking, or restroom use;
- (d) Service facilities such as electrical and heating equipment must be elevated to or above the BFE;
- (e) The structure shall be constructed and placed on the building site so as to offer the minimum resistance to the flow of floodwaters;
- (f) The structure shall be designed to have low flood damage potential and constructed with flood resistance materials;
- (g) The structure shall be firmly anchored to prevent flotation, collapse, and lateral movement;
- (h) Floodway requirements must be met in the construction of the structure;
- (i) Openings to relieve hydrostatic pressure during a flood shall be provided below the BFE; and
- (j) The structure shall be located so as not to cause damage to adjacent and nearby structures.

SECTION C. STANDARDS FOR SUBDIVISIONS

1. The applicant for a Development Permit for any subdivision located in Zones A and AE which is 51 or more lots or greater than 5 acres shall generate the base flood elevation data for that subdivision.
2. All subdivisions including the placement of manufactured home parks and subdivisions shall have adequate drainage provided to reduce exposure to flood hazards.
3. All subdivisions including the placement of manufactured home parks and subdivisions shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize or eliminate flood damage.

SECTION D. FLOODWAYS

The following provisions shall apply to floodways:

1. Encroachments, including but not limited to fill, new construction, substantial improvements and other development are prohibited within the adopted floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the Town of Boynton during the occurrence of the base flood discharge.
2. If Article V, Section D.1 above is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Article V.
3. The Town of Boynton may permit encroachments within the adopted floodway that would result in an increase in base flood elevations, provided that the applicant for the Development Permit complies with all of 44 CFR Section 65.12.

ARTICLE VI**THE TOWN OF BOYNTON FLOODPLAIN MANAGEMENT FEE SCHEDULE**

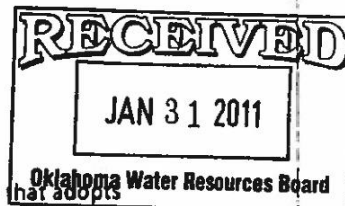
The Town of Boynton Board of Trustees establishes the following fee schedule not to exceed \$500.00 for any one service:

- a. Notice of Intent Fee - \$25.00 maximum
- b. Floodplain Development Permit Application Review - \$100.00
- c. Floodplain Development Permit Fee - \$ 25.00
- d. Inspection Fee-per inspection - \$25.00.

ARTICLE VII**PENALTIES FOR NONCOMPLIANCE**

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. A structure or other development without the elevation certificate or other certifications required in this ordinance is presumed to be in violation until such time as that documentation is provided. Violation of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall upon conviction thereof be subject to a fine of no more than \$500.00 and/or up to one year in jail. Nothing herein contained shall prevent the Board of Trustees of the Town of Boynton or its City Attorney from taking such other lawful action as is necessary to prevent or remedy any violation.

Dec 27 2010 9:53AM

Ordinance No. 2011-1

An ordinance amending the current Town of Boynton Flood Damage Prevention Ordinance that adopts the new Muskogee County Flood Maps dated February 4, 2011; which requires floodplain permits for any new development in the floodplain, sets a penalty and establishes fees and establishes an emergency. This ordinance is required for residents of town to be able to purchase flood insurance in or out of the floodplain.

EMERGENCY CLAUSE

Therefore, an emergency is hereby declared to exist, and this ordinance, being necessary for the immediate preservation of the public peace, health and safety, shall be in full force and effect from and after its passage and approval. The Flood Insurance Study and Flood Insurance Rate Map for Muskogee County and incorporated Areas dated February 4, 2011, shall apply to this ordinance and shall supersede any previous floodplain management ordinance applicable to the Town of Boynton.

WHEREFORE, an emergency is hereby declared to exist and this Ordinance shall be in full force and effect immediately from and after its passage, approval and publication.

PASSED AND APPROVED and the Emergency Clause voted upon separately and passed and approved this 10 day of January 2011.

ADOPTED BY THE BOARD OF TRUSTEES OF THE Town of Boynton THIS 10 DAY OF JANUARY 2011.

BOARD OF TRUSTEES OF TOWN OF BOYNTON

SAM-3, 2011 /s/NAME
James Hobbs Chairman

I, TL the undersigned City Clerk of the Town of Boynton, hereby certify that the above is a true and correct copy of a flood damage prevention ordinance duly adopted by the Board of Trustees of the Town of Boynton at a regular meeting of said Board duly convened and held on January 10 2011. I further certify that the Oklahoma Open Meeting Act was complied with in all respects for such meeting.

/s/name *Tiffany LeBlond*
 City Clerk, Town of Boynton
 (SEAL)

Figure E-3 NFIP Ordinances for the Town of Braggs, OK

TOWN OF BRAGGS, OKLAHOMA FLOOD DAMAGE PREVENTION ORDINANCE "DECLARING AN EMERGENCY" ARTICLE I STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND METHODS SECTION A. <u>STATUTORY AUTHORIZATION</u> The Legislature of the State of Oklahoma has in 11 O.S. §§ 41-47, as amended, delegated the responsibility to local governmental units to adopt ordinances designed to minimize flood losses. Therefore, the Town of Braggs, Oklahoma, ordains the following, to become effective immediately: SECTION B. <u>FINDINGS OF FACT</u> 1. The flood hazard areas of the Town of Braggs are subject to periodic inundation, which result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect the public health, safety and general welfare. 2. These flood losses are created by the cumulative effect of obstructions in floodplains which cause and increase in flood heights and velocities, and by the occupancy of flood hazards areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, floodproofed or otherwise protected from flood damage. SECTION C. <u>STATEMENT OF PURPOSE</u> It is the purpose of this ordinance to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to: 1. Protect human life and health; 2. Minimize expenditure of public money for costly flood control projects; 3. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public; 4. Minimize prolonged business interruptions; 5. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone, and sewer lines, streets and bridges located in floodplains; 6. Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and 7. Insure that potential buyers are notified that property is in a flood area.	RECEIVED JAN 28 2011 Oklahoma Water Resources Board

SECTION D. METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purposes, this ordinance uses the following methods:

1. Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood heights or velocities;
2. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
3. Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters;
4. Control filling, grading, dredging and other development which may increase flood damage; and
5. Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands.

ARTICLE II**DEFINITIONS**

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted to give them the meaning they have in common usage and to give this ordinance it's most reasonable application.

"Accessory structure" – means a structure which is on the same parcel of property as the principal structure and the use of which is incidental to the use of the principal structure. Examples of accessory structures include but are not limited to garages and storage sheds.

"Area of special flood hazard" – is the land in the floodplain within the Town of Braggs subject to a one percent or greater chance of flooding in any given year.

"Base flood" – means the flood having a one percent chance of being equaled or exceeded in any given year.

"Base flood elevations" – means the elevation in feet above mean sea level of the base flood or 1% chance flood.

"Basement" – means any area of the building having its floor sub-grade (below ground level) on all sides.

"BFE" – means base flood elevation.

"CFR" – means Code of Federal Regulations.

"Critical feature" – means an integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

“Development” – means any man-made change in improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

“Development Permit” – means a permit issued by the Town of Braggs Floodplain Administrator which authorized development in a special flood hazard area in accordance with this ordinance.

“Elevated building” – means a non-basement building built, in the case of a building in Zones AE, A, and X, to have the top of the elevated floor adequately anchored so as not to impair the structural integrity of the building during a flood up to the magnitude of the base flood. In the case of Zones AE, A, and X, “elevated building” also includes a building elevated by means of fill or solid foundation perimeter walls with opening sufficient to facilitate the unimpeded movement of flood waters.

“Existing construction” – means for the purposes of determining rates, structures for which the “start of construction” commenced before the effective date of the FIRM or before January 1, 1975, for FIRMS effective before that date. “Existing construction” may also be referred to as “existing structures.”

“Existing manufactured home park or subdivision” – means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before August 4, 1972.

“Expansion to an existing manufactured home park or subdivision” – means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

“FEMA” – means the Federal Emergency Management Agency.

“FIRM” – means Flood Insurance Rate Map.

“Flood” or “Flooding” – means a general and temporary condition of partial or complete inundation of normally dry land areas from:

1. The overflow of inland or tidal waters, or
2. The unusual and rapid accumulation or runoff of surface waters from any source.

“Flood Insurance Rate Map” – means an official map of the Town of Braggs on which FEMA has delineated both the areas of special flood hazards and the risk premium zones applicable to the Town of Braggs.

“Flood Insurance study” – is the official report provided by FEMA for the Town of Braggs which contains flood profiles, water surface elevation of the base flood, as well as the floodway width, section area and mean velocity.

“Floodplain Administrator” – means a person accredited by the OWFB and designated by the Board of Trustees of the Town of Braggs to administer and implement laws, ordinances and regulations relating to the management of floodplains.

“Floodplain or flood-prone area” – means any land area susceptible to being inundated by water from any source (see definition of flood).

“Floodplain management” – means the operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.

“Floodplain management regulations” – this means zoning codes and ordinances, subdivision regulations, building codes, health regulations, special purpose regulations and ordinances (such as floodplain, grading and erosion control regulations and ordinances) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

“Flood protection system” – means those physical structural works for which funds have been authorized, appropriated, and expended and which have been constructed specifically to modify flooding in order to reduce the extent of the areas within the Town of Braggs subject to a “special flood hazard” and the extent of the depths of associated flooding. Such a system typically includes hurricane tidal barriers, dams, reservoirs, levees, or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

“Functionally dependant use” – means a use that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

“Highest adjacent grade” – means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

“Historic structure” – means any structure that is:

1. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
2. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
3. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or
4. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
 - a. By an approved state program as determined by the Secretary of the Interior, or
 - b. Directly by the Secretary of the Interior in states without approved programs.

“Levee” – means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

“Levee system” – means a flood protection system which consists of a levee or levees and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

“Lowest floor” – means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking or vehicles, building access or storage in an area other than a basement area is not considered a building’s lowest floor; provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirement of Section 60.3 of Title 44CFR.

“Manufactured home” – means a structure transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without permanent foundation when connected to the required utilities. The term “manufactured home” does not include a “recreational vehicle”.

“Manufactured home park or subdivision” – means a parcel or (contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

“Mean sea level” – means, for purposes of the National Flood Insurance Program, the North American Vertical Datum (NAVD) of 1988 or other datum, to which base flood elevations shown on the Town of Braggs’ Flood Insurance Rate Map are referenced.

“New construction” – means, for the purpose of determining insurance rates, structures for which the “start of construction” commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, “new construction” means structures for which the “start of construction” commenced on or after the effective date of a floodplain management regulation adopted by the Town of Braggs Board of Trustees and includes any subsequent improvements to such structures.

“New manufacture home park or subdivision” – means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of floodplain management regulations adopted by the Town of Braggs Board of Trustees.

“OWRB” – means the Oklahoma Water Resources Board.

“Recreational vehicle” – means a vehicle which is:

1. Built on a single chassis;
2. 400 square feet or less when measured at the largest horizontal projections;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

“Start of construction” – (for other than new construction or substantial improvements under the Coastal Barrier Resources Act (Public Law 97-348), includes substantial improvement and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvements was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on site, such as the pouring of slab or footing, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the

installation of streets and/or walkways; for does it include excavation for basement, footing, pier or foundations or the erecting of temporary forms; nor does it include the installation on the property of accessory building, such as garages or sheds not occupied as dwelling unit or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

“Structure” – means a walled and roofed building, including a gas or liquid storage tank that is principally above ground, as well as a manufactured home.

“Substantial damage” – means damage of any origin sustained by a structure whereby the cost of restoring the structure to it’s before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

“Substantial improvement” – means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before “start of construction” of the improvement. This includes structures that have incurred “substantial damage”, regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary conditions, or
2. Any alteration of a “historic structure” provided that the alteration would not preclude the structure’s continued designation as a “historic structure”.

“Variance”- is a grant of relief by the Town of Braggs Board of Trustees to a person form the terms of this ordinance when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction of development in a manner otherwise prohibited by this ordinance. (for full requirements see Section 60.6 of Title 44CFR.)

“Water surface elevation” – means the height, in relation to the North American Vertical Datum (NAVD) of 1988 (or other datum, where specified), of floods of various magnitudes and frequencies in the floodplains of costal or riverine areas.

ARTICLE III

GENERAL PROVISIONS

SECTION A. LANDS TO WHICH THIS ORDINANCE APPLIES

This flood damage prevention ordinance shall apply to all areas of special flood hazard within the jurisdiction of the Town of Braggs, Oklahoma.

SECTION B. BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by FEMA in a scientific and engineering report entitled, "The Flood Insurance Study for Muskogee County, Oklahoma and Incorporated Areas" dated February 4, 2011, with the accompany Flood Insurance Rate Map (FIRM) are hereby adopted on February 4, 2011, by reference and declared to be a part of this ordinance. However, until this date the current effective flood maps for the Town of Braggs, dated March 4, 1991 for Muskogee County shall be used for this purpose until February 4, 2011.

SECTION C. ESTABLISHMENT OF DEVELOPMENT PERMIT

A Development Permit shall be required to ensure conformance with the provisions of this floodplain management ordinance.

SECTION D. COMPLIANCE

No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of this ordinance and other applicable regulations.

SECTION E. ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and any other ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

SECTION F. INTERPRETATION

In the interpretation and application of this ordinance, all provisions shall be:

1. Considered as minimum requirements;
2. Liberally construed in favor of the governing body; and
3. Deemed neither to limit nor repeal any other powers granted under State statutes.

SECTION G. WARNING AND DISCLAIMER OR LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of the Town of

Braggs or any official or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

ARTICLE IV

ADMINISTRATION

SECTION A. DESIGNATION OF THE FLOODPLAIN ADMINISTRATOR

The Board of Trustees of the Town of Braggs designates the Mayor or other person, appointed by the Board of Trustees of the Town of Braggs, as Floodplain Administrator to administer and implement the provisions of this ordinance and other appropriate sections of National Flood Insurance Program regulations in Title 44 CFR pertaining to floodplain management.

SECTION B. DUTIES AND RESPONSIBILITIES OF THE FLOODPLAIN ADMINISTRATOR

Duties and responsibilities of the Floodplain Administrator shall include, but not be limited to, the following:

1. Become accredited by the OWRB in accordance with Title 82 O.S. §§ 1601-1618, as amended.
2. Reviews permit applications to determine whether the proposed building sites, including the placement of manufactured homes, will be reasonably safe from flooding.
3. Review, approve, or deny all applications for Development Permits required by this ordinance.
4. Review proposed development to assure that all necessary permits have been obtained from those Federal, State or local governmental agencies from which prior approval are required.
5. Make the necessary interpretation where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions).
6. Notify, in riverine situations, adjacent communities and the OWRB prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the FEMA.
7. Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.
8. Shall require the developer/applicant to determine and provide the base flood elevation on two FEMA elevation Certificates, one pre and one post, as well as other data as required in order to administer the provisions of Article V.
9. When a floodway has not been designated, the Floodplain Administrator must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zone AE as delineated on the Muskogee County FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the Town of Braggs.

10. After a disaster or other type of damage occurrence to structures in the Town of Braggs, determine if the residential and non-residential structures and manufactured homes have been substantially damaged, and enforce the substantial improvement requirement.
11. Maintain a record of all actions involving an appeal from a decision of the Board of Trustees.
12. Maintain and hold open for public inspection all records pertaining to the provisions of this ordinance.

SECTION C. PERMIT PROCEDURES

1. An application for a Development Permit shall be presented to the Floodplain Administrator on forms furnished by him/her and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, including the placement of manufactured homes, and the location of the foregoing in relation to areas of special flood hazard. Additionally, the following information is required:
 - a. Elevation in relation to mean sea level of the lowest floor (including basement) of all new and substantially improved structures; and
 - b. Description of the extent to which any watercourse or natural drainage will be altered or relocated as a result of proposed development.
2. Approval or denial of a Development Permit by the Floodplain Administrator shall be based on all of the provisions of this ordinance and the following relevant factors:
 - a. The danger to life and property due to flooding or erosion damage.
 - b. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
 - c. The danger that materials may be swept onto other lands to the injury of others;
 - d. The compatibility of the proposed use with existing and anticipated development;
 - e. The safety of access to the property in times of flood for ordinary and emergency vehicles;
 - f. The costs of providing governmental services during and after flood conditions including maintenance and repair of streets and bridges, and public utilities and facilities such as sewer, gas, electrical and water systems;
 - g. The expected heights, velocity, duration, rate of rise and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;
 - h. The necessity to the facility of a waterfront location, where applicable;
 - i. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use; and

- j. The relationship of the proposed use to the comprehensive plan for that area.
3. The Floodplain Administrator or Board of Trustees, as applicable, may approve certain development in Zones A or AE delineated on the Muskogee County FIRM which increases the water surface elevation of the base flood by more than one foot, provided that the applicant for the Development Permit in that case first complies with 44 CFR Section 65.12.

SECTION D. VARIANCES

1. General provisions

- a. The Board of Trustees may grant variance for uses which do not satisfy the requirements of the Oklahoma Floodplain Management Act or this ordinance, if the applicant for the variance presents adequate proof that (i) compliance with this ordinance will result in an arbitrary and unreasonable taking of property without sufficient benefit or advantage to the people and (ii) satisfies the pertinent provisions of this Section D. However, no variance shall be granted where the effect of the variance will be to permit the continuance of a condition which unreasonably creates flooding hazards.
- b. Any variance so granted shall not be construed as to relieve any person who receives it from any liability imposed by the Oklahoma Floodplain Management Act or by other laws of the state.
- c. In no case shall variances be effective for a period longer than twenty (20) years.
- d. Any person seeking a variance shall file a petition with the Board of Trustees, accompanied by a filing fee of Twenty-five Dollars (\$25.00).
- e. Variance may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in Section C (2) and provisions of Section D of this Article IV have been full considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.
- f. Any person seeking a variance to build a structure below the base flood elevation will be issued a notice signed by the Chairman of the Board of Trustees which states that (i) the cost of flood insurance will be commensurate with the increased risk resulting from permitting the structure to be built lower than the base flood elevation, and (ii) such construction below the base flood level increases risks to life and property.
- g. At such time as the Board of Trustees deems the petition ready for notification to the public, the Board of Trustees shall schedule a hearing and direct the applicant to publish notice thereof in a newspaper of general circulation in Muskogee County at least thirty (30) days prior to the hearing.

- h. The Board of Trustees shall conduct the hearing and make determinations in accordance with the applicable provisions of this Section D. this appeals group shall exercise wide discretion in weighing the equities involved and the advantages and disadvantages to the applicant and to the public at large when determining whether the variance shall be granted.
- i. Variance shall only be issued upon:
 - (1) A showing of good and sufficient cause;
 - (2) A determination that failure to grant the variance would result in exceptional hardship to the applicant;
 - (3) A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws, regulations or ordinances; and
 - (4) A determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.
- j. Upon consideration of the factors state in this Section D and the intent of this ordinance, the Board of Trustees may attach such condition to the granting of a variance as it deems necessary to further the purposes and objectives stated in Article 1, Section C of this ordinance.
- k. The Floodplain Administrator shall maintain a record of all variance actions, including justification for their issuance; and a copy of any variance issued by the Board of Trustees shall be sent by the Floodplain Administrator to the OWRB and FEMA within fifteen (15) days after issuance of the variance.

2. Special provisions.

- a. Variances may be issued for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Place, without regard to the procedures set forth in the remainder of this ordinance.
- b. Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.
- c. Variances may be issued for the repair or rehabilitation of historic structures upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.
- d. Variance may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that:

- (1) The criteria of Section D(1)(e); Section D(1)(i); Section D(2)(b); and Section D(2)(c) of this Article IV are met, and
- (2) The structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

ARTICLE V

PROVISIONS FOR FLOOD HAZARD REDUCTION

SECTION A. GENERAL STANDARDS

In all areas of special flood hazards the following provisions are required for all new construction and substantial improvements:

1. All new construction or substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
2. All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;
3. All new construction or substantial improvements shall be constructed with materials resistant to flood damage;
4. All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during the conditions of flooding;
5. All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
6. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharge from the systems into flood waters; and
7. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

SECTION B. SPECIFIC STANDARDS

In all areas of special flood hazards the following provisions are required:

1. Residential Construction – new construction or substantial improvement of any residential structure shall have the lowest floor (including basement) elevated at or above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.

2. **Nonresidential Construction** - new construction or substantial improvement of any commercial, industrial or other nonresidential structure shall have the lowest floor (including basement) elevated at or above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.
3. **Enclosures** - new construction or substantial improvements, with fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria:
 - (a) A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided;
 - (b) The bottom of all openings shall be no higher than one foot above grade; and
 - (c) Openings may be equipped with screens, louvers, valves or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.
4. **Manufactured Homes** –

Require that all manufactured homes to be placed anywhere within the Town of Braggs within Zones A and AE on the Town of Braggs FIRM shall be installed using methods and practices that minimize flood damage and have the bottom of the I-beam elevated at or above the BFE. For the purposed of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse, or lateral movement. This requirement is in addition to applicable State and local anchoring requirements for resisting wind forces. The home shall be installed by a licensed installer according to Oklahoma State law and compliance herewith shall be certified in writing to the Floodplain Administrator by said installer prior to habitation of the manufactured home.
5. **Recreational Vehicles** – Require that recreational vehicles placed on sites within Zones A and AE on the Muskogee County FIRM either:
 - (a) Be on a site for fewer than 180 consecutive days,
 - (b) Be fully licensed and ready for highway use, or
 - (c) Meet the permit requirements of Article IV, Section C, and the elevation and anchoring requirements for “manufactured homes” in paragraph (4) of this section. A recreation vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices and has no permanently attached additions.
6. **Accessory Structure** – Accessory structures to be placed on sites within Zones A and AE on the Muskogee County FIRM shall comply with the following:
 - (a) The structure shall be unfinished on the interior;

- (b) The structure shall be used only for parking and limited storage;
- (c) The structure shall not be used for human habitation. Prohibited activities or uses include but are not limited to working, sleeping, living, cooking, or restroom use;
- (d) Service facilities such as electrical and heating equipment must be elevated to or above the BFE;
- (e) The structure shall be constructed and placed on the building site so as to offer the minimum resistance to the flow of floodwaters;
- (f) The structure shall be designed to have low flood damage potential and constructed with flood resistance materials;
- (g) The structure shall be firmly anchored to prevent flotation, collapse, and lateral movement;
- (h) Floodway requirements must be met in the construction of the structure;
- (i) Openings to relieve hydrostatic pressure during a flood shall be provided below the BFE; and
- (j) The structure shall be located so as not to cause damage to adjacent and nearby structures.

SECTION C. STANDARDS FOR SUBDIVISIONS

1. The applicant for a Development Permit for any subdivision located in Zones A and AE which is 51 or more lots or greater than 5 acres shall generate the base flood elevation data for that subdivision.
2. All subdivisions including the placement of manufactured home parks and subdivisions shall have adequate drainage provided to reduce exposure to flood hazards.
3. All subdivisions including the placement of manufactured home parks and subdivisions shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize or eliminate flood damage.

ARTICLE VI

THE TOWN OF BRAGGS FLOODPLAIN MANAGEMENT FEE SCHEDULE

The Town of Braggs Board of Trustees establishes the following fee schedule not to exceed \$500.00 for any one service:

- a. Notice of Intent Fee - \$25.00 maximum
- b. Floodplain Development Permit Application Review - \$100.00
- c. Floodplain Development Permit Fee - \$25.00

- d. Inspection Fee – per inspection - \$25.00

ARTICLE VII

PENALTIES FOR NONCOMPLIANCE

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. A structure or other development without the elevation certificate or other certifications required in this ordinance is presumed to be in violation until such time as that documentation is provided. Violation of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall upon conviction thereof be subject to a fine of no more than \$500.00 and/or up to one year in jail. Nothing herein contained shall prevent the Board of Trustees of the Town of Braggs or its City Attorney from taking such other lawful action as is necessary to prevent or remedy any violation.

CERTIFICATION

It is hereby found and declared by the Board of Trustees of the Town of Braggs that severe flooding has occurred in the past within its jurisdiction and will certainly occur within the future; that flooding is likely to result in infliction of serious injury or death., and is likely to result in substantial injury or destruction of property within its jurisdiction; in order to effectively comply with minimum standards for coverage under the National Flood Insurance Program, and in order to effectively remedy the situation described herein, it is necessary that this ordinance become effective immediately.

This ordinance shall supersede any previous floodplain management regulations or ordinance(s) applicable to the Town of Braggs.

SEVERABILITY

If any section, clause, sentence, or phrase of this ordinance is held to be invalid or unconstitutional by any court of competent jurisdiction, then said holding shall in no way affect the validity of the remaining portions of this ordinance.

EMERGENCY CLAUSE

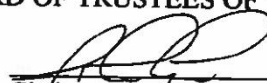
Therefore, an emergency is hereby declared to exist, and this ordinance, being necessary for the immediate preservation of the public peace, health and safety, shall be in full force and effect from and after its passage and approval. The Flood Insurance Study and Flood Insurance Rate Map for Muskogee County and Incorporated Areas dated February 4, 2011, shall apply to this ordinance and shall supersede any previous floodplain management ordinance applicable to the Town of Braggs.

WHEREFORE, an emergency is hereby declared to exist and this Ordinance shall be in full force and effect immediately from and after its passage, approval and publication.

PASSED AND APPROVED and the Emergency Clause voted upon separately and passed and approved this 6th day of January 2011.

ADOPTED BY THE BOARD OF TRUSTEES OF THE TOWN OF BRAGGS THIS 6TH DAY OF January 2011.

BOARD OF TRUSTEES OF THE TOWN OF BRAGGS


Chairman - John Laymon

I, Rebecca J. Smith, the undersigned City Clerk of the Town of Braggs, hereby certify that the above is a true and correct copy of a flood damage prevention ordinance duly adopted by the Board of Trustees of the Town of Braggs at a regular meeting of said Board of Trustees duly convened and held on January 6, 2011. I further certify that the Oklahoma Open Meeting Act was complied with in all respects for such meeting.


City Clerk, Town of Braggs

(SEAL)



Figure E-4 NFIP Ordinances for the Town of Fort Gibson, OK

155.01 Statutory Authorization

The Legislature of the State of Oklahoma has in 11 O.S. §§ 41-47, as amended, delegated the responsibility to local governmental units to adopt ordinances designed to minimize flood losses. Therefore, the town ordains the following, to become effective immediately.

(Ord. 2020-004, Passed 6-22-2020)

155.02 Findings Of Fact

- A. The flood hazard areas of the town are subject to periodic inundation, which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect the public health, safety, and general welfare.
- B. These flood losses are created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazards areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, floodproofed or otherwise protected from flood damage.

(Ord. 2020-004, Passed 6-22-2020)

155.03 Statement Of Purpose

It is the purpose of this chapter to promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

- A. Protect human life and health;
- B. Minimize expenditure of public money for costly flood control projects;

- C. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- D. Minimize prolonged business interruptions;
- E. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone, and sewer lines, streets and bridges located in floodplains;
- F. Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
- G. Ensure that potential buyers are notified that property is in a flood area.

(Ord. 2020-004, Passed 6-22-2020)

155.04 Methods Of Reducing Flood Losses

To accomplish its purposes, this chapter uses the following methods:

- A. Restrict or prohibit uses that are dangerous to health, safety, or property in times of flood, or cause excessive increases in flood heights or velocities;
- B. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
- C. Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters;
- D. Control filling, grading, dredging, and other development which may increase flood damage; and
- E. Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters, or which may increase flood hazards to other lands.

(Ord. 2020-004, Passed 6-22-2020)

155.05 Definitions

For the purpose of this chapter, the following definitions shall apply unless the context clearly indicates or requires a different meaning.

ACCESSORY STRUCTURE. A structure which is on the same parcel of property as the principal structure and the use of which is incidental to the use of the principal structure. Examples of ACCESSORY STRUCTURES include but are not limited to garages and storage sheds.

AREA OF SPECIAL FLOOD HAZARD. The land in the floodplain within the town subject to a 1% or greater chance of flooding in any given year.

BASE FLOOD. The flood having a 1% chance of being equaled or exceeded in any given year.

BASE FLOOD ELEVATION. The elevation in feet above mean sea level of the base flood or 1% chance flood.

BASEMENT. Any area of the building having its floor sub-grade (below ground level) on all sides.

BFE. Base flood elevation.

C.F.R. Code of Federal Regulations.

CRITICAL FEATURE. An integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

DEVELOPMENT. Any man-made change in improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, or drilling operations or storage of equipment or materials.

DEVELOPMENT PERMIT. A permit issued by the Floodplain Administrator which authorizes development in a special flood hazard area in accordance with this chapter.

ELEVATED BUILDING. A non-basement building built, in the case of a building in Zones AE, A, and X, to have the top of the elevated floor adequately anchored so as not to impair the structural integrity of the building during a flood up to the magnitude of the base flood. In the case of Zones AE, A, and X, ELEVATED BUILDING also includes a building elevated by means of fill or solid foundation perimeter walls with openings sufficient to facilitate the unimpeded movement of flood waters.

EXISTING CONSTRUCTION. For the purposes of determining rates, structures for which the start of construction commenced before the effective date of the FIRM or before January 1, 1975, for FIRMs effective before that date. EXISTING CONSTRUCTION may also be referred to as existing structures.

EXISTING MANUFACTURED HOME PARK OR SUBDIVISION. A manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before August 4, 1972.

EXPANSION TO AN EXISTING MANUFACTURED HOME PARK OR SUBDIVISION. The preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

FEMA. The Federal Emergency Management Agency.

FIRM. Flood Insurance Rate Map.

FLOOD or FLOODING. A general and temporary condition of partial or complete inundation of normally dry land areas from:

- A. The overflow of inland or tidal waters; or
- B. The unusual and rapid accumulation or runoff of surface waters from any source.

FLOOD INSURANCE RATE MAP. An official map of the town on which FEMA has delineated both the areas of special flood hazards and the risk premium zones applicable to the town.

FLOOD INSURANCE STUDY. The official report provided by FEMA for the town which contains flood profiles, water surface elevation of the base flood, as well as the floodway width, section area, and mean velocity.

FLOODPLAIN ADMINISTRATOR. A person accredited by the OWRB and designated by the Board of Trustees to administer and implement laws, ordinances, and regulations relating to the management of floodplains.

FLOODPLAIN OR FLOOD-PRONE AREA. Any land area susceptible to being inundated by water from any source. (See definition of FLOOD.)

FLOODPLAIN MANAGEMENT. The operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works, and floodplain management regulations.

FLOODPLAIN MANAGEMENT REGULATIONS. This chapter, zoning code, subdivision regulations, building codes, health regulations, special purpose regulations, and ordinances (such as floodplain, grading and erosion control regulations and ordinances) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

FLOOD PROTECTION SYSTEM. Those physical structural works for which funds have been authorized, appropriated, and expended, and which have been constructed specifically to modify flooding in order to reduce the extent of the areas within the town subject to a special flood hazard and the extent of the depths of associated flooding. Such a system typically includes hurricane tidal barriers, dams, reservoirs, levees, or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

FLOODWAY. The channel of a river or other watercourse and the adjacent land areas that must be reserved to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. A FLOODWAY is located within areas of special flood hazard established in § 155.07 of this chapter. A FLOODWAY is an extremely hazardous area due to the velocity of floodwaters that carry debris and potential projectiles.

FUNCTIONALLY DEPENDENT USE. A use that cannot perform its intended purpose unless it is located or carried out near water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

HIGHEST ADJACENT GRADE. The highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

HISTORIC STRUCTURE. Any structure that is:

- A. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
- B. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
- C. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or
- D. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
 1. By an approved state program as determined by the Secretary of the Interior; or
 2. Directly by the Secretary of the Interior in states without approved programs.

LEVEE. A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water to provide protection from temporary flooding.

LEVEE SYSTEM. A flood protection system which consists of a levee or levees and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

LOWEST FLOOR. The lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking or vehicles, building access or storage in an area other than a basement area is not considered a building's LOWEST FLOOR; provided that such enclosure is not built to render the structure in violation of the applicable non-elevation design requirement of 44 C. F. R. § 60.3.

MANUFACTURED HOME. A structure transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. The term MANUFACTURED HOME does not include a recreational vehicle.

MANUFACTURED HOME PARK OR SUBDIVISION. A parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

MEAN SEA LEVEL. For purposes of the National Flood Insurance Program, the North American Vertical Datum (NAVD) of 1988 or other datum, to which base flood elevations shown on the town's flood insurance rate map are referenced.

NEW CONSTRUCTION. For the purpose of determining insurance rates, structures for which the start of construction commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, "new construction" means structures for which the "start of construction" commenced on or after the effective date of a floodplain management regulation adopted by the Board of Trustees and includes any subsequent improvements to such structures.

NEW MANUFACTURED HOME PARK OR SUBDIVISION. A manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of floodplain management regulations adopted by the Board of Trustees.

OWRB. The Oklahoma Water Resources Board.

RECREATIONAL VEHICLE. A vehicle which is:

- A. Built on a single chassis;
- B. Four hundred square feet or less when measured at the largest horizontal projections;
- C. Designed to be self-propelled or permanently towable by a light duty truck; and
- D. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

START OF CONSTRUCTION. For other than new construction or substantial improvements under the Coastal Barrier Resources Act (Pub. Law. No. 97-348) being 16 U.S.C. §§ 3501 et seq., includes substantial improvement and the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The actual START means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual START OF CONSTRUCTION means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether that alteration affects the external dimensions of the building.

STRUCTURE. A walled and roofed building, including a gas or liquid storage tank that is principally above ground, as well as a manufactured home.

SUBSTANTIAL DAMAGE. Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred.

SUBSTANTIAL IMPROVEMENT. Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure before start of construction of the improvement. This includes structures that have incurred substantial damage, regardless of the actual repair work performed. The term does not, however, include either:

- A. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary conditions; or
- B. Any alteration of a historic structure provided that the alteration would not preclude the structure's continued designation as a historic structure.

VARIANCE. A grant of relief by the Board of Trustees to a person from the terms of this chapter when specific enforcement would result in unnecessary hardship. A VARIANCE, therefore, permits construction or development in a manner otherwise prohibited by this chapter. (For full requirements, see 44 C.F.R. § 60.6.)

VIOLATION. The failure of a structure or other development to be fully compliant with this flood damage prevention chapter.

WATER SURFACE ELEVATION. The height, in relation to the North American Vertical Datum (NAVD) of 1988 (or other datum, where specified), of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

(Ord. 2020-004, passed 6-22-2020)

155.06 Application

This flood damage prevention chapter shall apply to all areas of special flood hazard within the jurisdiction of the town.

(Ord. 2020-004, passed 6-22-2020)

155.07 Basis For Establishing The Areas Of Special Flood Hazard

The areas of special flood hazard identified by FEMA in a scientific and engineering report entitled, *The Flood Insurance Study for Muskogee County, Oklahoma and Incorporated Areas* dated February 4, 2011, with the accompanying flood insurance rate map (FIRM) are hereby adopted on February 4, 2011, by reference and declared to be a part of this chapter, as well as the *Flood Insurance Study for Cherokee County, Oklahoma and Incorporated Areas* dated December 3, 2009, along with the accompanying FIRM.

(Ord. 2020-004, passed 6-22-2020)

155.08 Establishment Of Development Permit

A development permit shall be required to ensure conformance with the provisions of this floodplain management chapter.

(Ord. 2020-004, passed 6-22-2020) Penalty, see § 155.99

155.09 Compliance

No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of this chapter and other applicable regulations.

(Ord. 2020-004, passed 6-22-2020) Penalty, see § 155.99

155.10 Abrogation And Greater Restrictions

- A. This chapter is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions.
- B. However, where this chapter and any other ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

(Ord. 2020-004, passed 6-22-2020)

155.11 Interpretation

In the interpretation and application of this chapter, all provisions shall be:

- A. Considered as minimum requirements;
- B. Liberally construed in favor of the governing body; and
- C. Deemed neither to limit nor repeal any other powers granted under state statutes.

(Ord. 2020-004, passed 6-22-2020)

155.12 Warning And Disclaimer Of Liability

The degree of flood protection required by this chapter is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by human-made or natural causes. This chapter does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This chapter shall not create liability on the part of the town or any official or employee thereof for any flood damages that result from reliance on this chapter or any administrative decision lawfully made hereunder.

(Ord. 2020-004, passed 6-22-2020)

155.25 Designation Of The Floodplain Administrator

The Board of Trustees designates the Code Enforcement Officer as Floodplain Administrator to administer and implement the provisions of this chapter and other appropriate sections of National Flood Insurance Program regulations in 44 C.F.R. pertaining to floodplain management.

(Ord. 2020-004, passed 6-22-2020)

155.26 Duties And Responsibilities Of The Floodplain Administrator

Duties and responsibilities of the Floodplain Administrator shall include, but not be limited to, the following:

- A. Become accredited by the OWRB in accordance with 82 O.S. §§ 1601-1618, as amended;
- B. Review permit applications to determine whether the proposed building sites, including the placement of manufactured homes, will be reasonably safe from flooding;
- C. Review, approve, or deny all applications for development permits required by this chapter;
- D. Review proposed development to assure that all necessary permits have been obtained from those federal, state, or local governmental agencies from which prior approval are required;
- E. Make the necessary interpretation where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions);
- F. Notify, in riverine situations, adjacent communities and the OWRB prior to any alteration or relocation of a watercourse and submit evidence of such notification to the FEMA;
- G. Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained;
- H. Require the developer/applicant to determine and provide the base flood elevation on two FEMA elevation certificates, one pre and one post, as well as other data as required in order to administer the provisions of §§ 155.40 through 155.44;
- I. When a floodway has not been designated, the Floodplain Administrator must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zone AE as delineated on the Muskogee County FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the town;

- J. After a disaster or other type of damage occurrence to structures in the town, determine if the residential and non-residential structures and manufactured homes have been substantially damaged, and enforce the substantial improvement requirement;
- K. Maintain a record of all actions involving an appeal from a decision of the Board of Trustees; and
- L. Maintain and hold open for public inspection all records pertaining to the provisions of this chapter.

(Ord. 2020-004, passed 6-22-2020)

155.27 Permit Procedures

A.

1. An application for a development permit shall be presented to the Floodplain Administrator on forms furnished by him or her and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, including the placement of manufactured homes, and the location of the foregoing in relation to areas of special flood hazard.
2. Additionally, the following information is required:
 - a. Elevation in relation to mean sea level of the lowest floor (including basement) of all new and substantially improved structures; and
 - b. Description of the extent to which any watercourse or natural drainage will be altered or relocated because of proposed development.

B. Approval or denial of a development permit by the Floodplain Administrator shall be based on all the provisions of this chapter and the following relevant factors:

1. The danger to life and property due to flooding or erosion damage;
2. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
3. The danger that materials may be swept onto other lands to the injury of others;
4. The compatibility of the proposed use with existing and anticipated development;
5. The safety of access to the property in times of flood for ordinary and emergency vehicles;
6. The costs of providing governmental services during and after flood conditions including maintenance and repair of streets and bridges, and public utilities and facilities such as sewer, gas, electrical, and water systems;
7. The expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;

8. The necessity to the facility of a waterfront location, where applicable;
9. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use; and
10. The relationship of the proposed use to the comprehensive plan for that area.

C. The Floodplain Administrator or Board of Trustees, as applicable, may approve certain development in Zones A or AE delineated on the Muskogee County FIRM which increases the water surface elevation of the base flood by more than one foot, provided that the applicant for the development permit in that case first complies with 44 C.F.R. § 65.12.

(Ord. 2020-004, passed 6-22-2020) Penalty, see § 155.99

155.28 Variances

A. General provisions.

1. The Board of Adjustment may grant variances for uses which do not satisfy the requirements of the State Floodplain Management Act, being 82 O.S. §§ 1601 et seq. or this chapter, if the applicant for the variance presents adequate proof that compliance with this chapter will result in an arbitrary and unreasonable taking of property without sufficient benefit or advantage to the people and satisfies the pertinent provisions of this section. However, no variance shall be granted where the effect of the variance will be to permit the continuance of a condition which unreasonably creates flooding hazards.
2. Any variance so granted shall not be construed as to relieve any person who receives it from any liability imposed by the State Floodplain Management Act or by other laws of the state.
3. In no case shall variances be effective for a period longer than 20 years.
4. Any person seeking a variance shall file a petition with the Board of Adjustment, accompanied by a filing fee of \$25.
5. Variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in § 155.27(B) and provisions of this section have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.
6. Any person seeking a variance to build a structure below the base flood elevation will be issued a notice signed by the Chairperson of the Board of Adjustment which states that:
 - a. The cost of flood insurance will be commensurate with the increased risk resulting from permitting the structure to be built lower than the base flood elevation; and
 - b. Such construction below the base flood level increases risks to life and property.
7. At such time as the Board of Adjustment deems the petition ready for notification to the public, the Board of Adjustment shall schedule a hearing and direct the applicant to publish notice thereof in a newspaper of general circulation in

Muskogee County at least 30 days prior to the hearing.

8. The Board of Adjustment shall conduct the hearing and make determinations in accordance with the applicable provisions of this section. This appeals group shall exercise wide discretion in weighing the equities involved and the advantages and disadvantages to the applicant and to the public at large when determining whether the variance shall be granted.
9. Variances shall only be issued upon:
 - a. A showing of good and sufficient cause;
 - b. A determination that failure to grant the variance would result in exceptional hardship to the applicant;
 - c. A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws, regulations, or ordinances; and
 - d. A determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.
10. Upon consideration of the factors stated in this section and the intent of this chapter, the Board of Adjustment may attach such conditions to the granting of a variance as it deems necessary to further the purposes and objectives stated in § 155.03 of this chapter.
11. The Floodplain Administrator shall maintain a record of all variance actions, including justification for their issuance; and a copy of any variance issued by the Board of Adjustment shall be sent by the Floodplain Administrator to the OWRB and FEMA within 15 days after issuance of the variance.

B. Special provisions.

1. Variances may be issued for the reconstruction, rehabilitation, or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in the remainder of this chapter.
2. Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.
3. Variances may be issued for the repair or rehabilitation of historic structures upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.
4. Variances may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use; provided that:
 - a. The criteria of divisions (A)(5), (A)(9), and (B)(2) above, and this division (B)(4) are met; and
 - b. The structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

155.40 General Standards

In all areas of special flood hazards, the following provisions are required for all new construction and substantial improvements.

- A. All new construction or substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy.
- B. All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage.
- C. All new construction or substantial improvements shall be constructed with materials resistant to flood damage.
- D. All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
- E. All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.
- F. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharge from the systems into flood waters.
- G. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

(Ord. 2020-004, passed 6-22-2020) Penalty, see § 155.99

155.41 Specific Standards

In all areas of special flood hazards the following provisions are required.

- A. *Residential construction.* New construction and substantial improvement of any residential structure shall have the lowest floor (including basement) elevated at or above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this division (A) is satisfied.
- B. *Nonresidential construction.* New construction and substantial improvements of any commercial, industrial, or other nonresidential structure shall have the lowest floor (including basement) elevated at or above the base flood elevation. A registered professional

engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this division (B) is satisfied.

C. Enclosures.

1. New construction and substantial improvements, with fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access, or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters.
2. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria:
 - a. A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided;
 - b. The bottom of all openings shall be no higher than one foot above grade; and
 - c. Openings may be equipped with screens, louvers, valves, or other coverings or devices if they permit the automatic entry and exit of floodwaters.

D. Manufactured homes. All manufactured homes to be placed anywhere within the town within Zones A and AE on the town FIRM shall be installed using methods and practices that minimize flood damage and have the bottom of the I-beam elevated at or above the BFE. For the purposes of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse, or lateral movement. This requirement is in addition to applicable state and local anchoring requirements for resisting wind forces. The home shall be installed by a licensed installer according to state law and compliance herewith shall be certified in writing to the Floodplain Administrator by said installer prior to habitation of the manufactured home.

E. Recreational vehicles. Recreational vehicles placed on sites within Zones A and AE on the Muskogee County FIRM shall either:

1. Be on the site for fewer than 180 consecutive days;
2. Be fully licensed and ready for highway use; or
3. Meet the permit requirements of § 155.27, and the elevation and anchoring requirements for manufactured homes in division (D) above a recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices and has no permanently attached additions.

F. Accessory structure. Accessory structures to be placed on sites within Zones A and AE on the Muskogee County FIRM shall comply with the following:

1. The structure shall be unfinished on the interior;
2. The structure shall be used only for parking and limited storage;

3. The structure shall not be used for human habitation. Prohibited activities or uses include but are not limited to working, sleeping, living, cooking, or restroom use;
4. Service facilities such as electrical and heating equipment must be elevated to or above the BFE;
5. The structure shall be constructed and placed on the building site so as to offer the minimum resistance to the flow of floodwaters;
6. The structure shall be designed to have low flood damage potential and constructed with flood resistance materials;
7. The structure shall be firmly anchored to prevent flotation, collapse, and lateral movement;
8. Floodway requirements must be met in the construction of the structure;
9. Openings to relieve hydrostatic pressure during a flood shall be provided below the BFE; and
10. The structure shall be located so as not to cause damage to adjacent and nearby structures.

(Ord. 2020-004, passed 6-22-2020) Penalty, see § 155.99

155.42 Standards For Subdivisions

- A. The applicant for a development permit for any subdivision located in Zones A and AE which is 50 or more lots, or greater than five acres, shall generate the base flood elevation data for that subdivision.
- B. All subdivisions including the placement of manufactured home parks and subdivisions shall have adequate drainage provided to reduce exposure to flood hazards.
- C. All subdivisions including the placement of manufactured home parks and subdivisions shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize or eliminate flood damage.

(Ord. 2020-004, passed 6-22-2020) Penalty, see § 155.99

155.43 Floodways

The following provisions shall apply to floodways.

- A. Encroachments, including but not limited to fill, new construction, substantial improvements, and other development are prohibited within the adopted floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the town during the occurrence of the base flood discharge.
- B. If division (A) above is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of this subchapter.

- C. The town may permit encroachments within the adopted floodway that would result in an increase in base flood elevations, provided that the applicant for the development permit complies with all of 44 C.F.R. § 65.12.

(Ord. 2020-004, passed 6-22-2020) Penalty, see § 155.99

155.44 Management Fee Schedule

The Board of Trustees establishes the following fee schedule not to exceed \$500 for any one service:

Floodplain Development Permit Application Review	\$100
Floodplain Development Permit Fee	\$25
Inspection Fee	\$25 per inspection
Notice of Intent Fee	\$25 maximum

(Ord. 2020-004, passed 6-22-2020)

155.99 Penalty

- A. No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this chapter and other applicable regulations. A structure or other development without the elevation certificate or other certifications required in this chapter is presumed to be in violation until such time as that documentation is provided.
- B. Violation of the provisions of this chapter by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Any person who violates this chapter or fails to comply with any of its requirements shall upon conviction thereof be subject to the penalty as delineated in § 10.99 of the code. Nothing herein contained shall prevent the Board of Trustees or the Town Attorney from taking such other lawful action as is necessary to prevent or remedy any violation.

(Ord. 2020-004, passed 6-22-2020)

Figure E-5 NFIP Ordinances for the Town of Haskell, OK

NTH

June 18, 1987

Honorable Delano Hampton
Chairman of the Board
of Trustees
P. O. Drawer 9
Haskell, OK 74436

Dear Chairman Hampton:

This will acknowledge receipt of your recently adopted Floodplain Management Ordinance. Your Ordinance dated May 11, 1987, meets the requirements of the National Flood Insurance Program (NFIP) regulations Section 60.3(d) as revised October 1, 1986. The effective administration and enforcement of your ordinance enables your community to continue participation in the NFIP.

You should keep us advised through the biennial report of any problems or changes associated with the administration of your ordinance and of any variances granted for construction not in accordance with your adopted standards.

We want to thank you for your interest and participation in the NFIP. If you should have any questions or problems concerning the NFIP, please write or call Don Ellison at (817) 898-9156.

Sincerely,

Alton S. Ray
6/19/87

Alton S. Ray, P.E.
Acting Chief
Natural & Technological
Hazards Division

ME
NTH:ELLISON:djl:6-17-87

MINIMUM LAND MANAGEMENT CRITERIA
(Evaluation Sheet)

Locality WASKELLDate 6/10/87ORD # 88 dated MAY 11, 1987Name DON ELLISON

ITEM	60.3d					Reference Section (Ord.)
	a	b	c	d	e	
Basis for establishing the areas of special flood hazard (i.e., date of FHBM, FIRM &/or FIS). 60.3						
In all special flood hazard areas (Zones A, A1-30, V, V1-30, and AO, AH) 60.3						
Definitions: as appropriate 59.1						
1. Require or reference permits for all proposed construction and/or development including placement of prefabricated buildings and manufactured homes. 60.3(a)(1)&(b)(1)						
2. Obtain and maintain records of elevation and floodproofing levels for new construction and substantial improvements, including manufactured homes. 60.3(b)(5)(i)(ii)						
3. Review permits to assure sites are reasonably free from flooding. 60.3(a)(3)						
4. Require that all other State/Federal permits are obtained. 60.3(a)(2)						
5. Notify neighboring communities of watercourse alterations. 60.3(b)(6)						
6. Maintain carrying capacity of altered watercourse. 60.3(b)(7)						
7. In the absence of FEMA base flood elevation data, obtain, review and reasonably utilize any base flood elevation data and floodway data available from a Federal, State or other source as basis for elevating structures to or above bfe for residential and non residential structures. 60.3(b)(4)						
8. Review permits of proposed construction and development and require:						
a. Anchoring (including manufactured homes) to prevent flotation and lateral movement of the structure resulting from hydrodynamic and hydrostatic loads including the effects of buoyancy. 60.3(a)(3)(i)						
b. Construction methods which minimize flood damage. 60.3(a)(3)(iii)						
c. Use of flood resistant materials and utility equipment. 60.3(a)(3)(ii)						
d. Constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding. 60.3(a)(3)(iv)						

Accepted
Muskogee
County
Ordinance

60.3(d)

Revised as of October 1, 1986

FLOOD DAMAGE PREVENTION ORDINANCE**OUTLINE**

	Pg.	Cross Ref. NFIP Regulations
ARTICLE 1 STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND METHODS	1	
SECTION A Statutory Authorization	1	
SECTION B Findings of Fact	1	
SECTION C Statement of Purpose	1	
SECTION D Methods of Reducing Flood Losses	2	
ARTICLE 2 DEFINITIONS	3	59.1
ARTICLE 3 GENERAL PROVISIONS	7	60.(d)(1)
SECTION A Lands to Which This Ordinance Applies	7	60.3(d)
SECTION B Basis for Establishing the Areas of Special Flood Hazard	7	60.3(d)(1)
SECTION C Establishment of Development Permit	7	60.3(d)(1)
SECTION D Compliance	7	
SECTION E Abrogation and Greater Restrictions	7	
SECTION F Interpretation	7	
SECTION G Warning and Disclaimer of Liability	7	
ARTICLE 4 ADMINISTRATION	8	
SECTION A Designation of the Floodplain Administrator	8	60.3(d)(1)
SECTION B Duties and Responsibilities of the Floodplain Administrator	8	60.3(d)(1)
SECTION C Permit Procedures	8	60.3(d)(1)
SECTION D Variance Procedures	9	60.6(a)
ARTICLE 5 PROVISIONS FOR FLOOD HAZARD REDUCTION	11	
SECTION A General Standards	11	60.3(d)(1)
SECTION B Specific Standards	11	60.3(d)(1)
1. Residential Construction	11	60.3(d)(1)
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4. Manufactured Homes	12	60.3(d)(1)
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SECTION D Standards for Areas of Shallow Flooding (AO/AH Zones)	13	60.3(d)(1)
SECTION E Floodways	13	60.3(d)(1-3)
Certification	14	

SECTION D. METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purposes, this ordinance uses the following methods:

- (1) Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood heights or velocities;
- (2) Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
- (3) Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters;
- (4) Control filling, grading, dredging and other development which may increase flood damage;
- (5) Prevent or regulate the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards to other lands.

ARTICLE 2**DEFINITIONS**

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

APPEAL - means a request for a review of the Flood Plain Administrator's interpretation of any provision of this ordinance or a request for a variance.

AREA OF SHALLOW FLOODING - means a designated AO, AH, or VO zone on a community's Flood Insurance Rate Map (FIRM) with a one percent chance or greater annual chance of flooding to an average depth of one to three feet where a clearly defined channel does not exist, where the path of flooding is unpredictable and where velocity flow may be evident. Such flooding is characterized by ponding or sheet flow.

AREA OF SPECIAL FLOOD HAZARD - is the land in the floodplain within a community subject to a one percent or greater chance of flooding in any given year. The area may be designated as Zone A on the Flood Hazard Boundary Map (FHBM). After detailed ratemaking has been completed in preparation for publication of the FIRM, Zone A usually is refined into Zones A, AE, AH, AO, A1-99, VO, V1-30, VE or V.

BASE FLOOD - means the flood having a one percent chance of being equalled or exceeded in any given year.

CRITICAL FEATURE - means an integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

DEVELOPMENT - means any man-made change in improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations.

ELEVATED BUILDING - means a nonbasement building (i) built, in the case of a building in Zones A1-30, AE, A, A99, AO, AH, B, C, X, and D, to have the top of the elevated floor, or in the case of a building in Zones V1-30, VE, or V, to have the bottom of the lowest horizontal structure member of the elevated floor elevated above the ground level by means of pilings, columns (posts and piers), or shear walls parallel to the floor of the water and (ii) adequately anchored so as not to impair the structural integrity of the building during a flood of up to the magnitude of the base flood. In the case of Zones A1-30, AE, A, A99, AO, AH, B, C, X, D, "elevated building" also includes a building elevated by means of fill or solid foundation perimeter walls with openings sufficient to facilitate the the unimpeded movement of flood waters. In the case of Zones V1-30, VE, or V, "elevated building" also includes a building otherwise meeting the definition of "elevated building", even though the lower area is enclosed by means of breakaway walls if the breakaway walls meet the standards of Section 60.3(e)(5) of the National Flood Insurance Program regulations.

EXISTING CONSTRUCTION - means for the purposes of determining rates, structures for which the "start of construction" commenced before the effective date of the FIRM or before January 1, 1975, for FIRMs effective before that date. "Existing construction" may also be referred to as "existing structures."

FLOOD OR FLOODING - means a general and temporary condition of partial or complete inundation of normally dry land areas from:

- (1) the overflow of inland or tidal waters.
- (2) the unusual and rapid accumulation or runoff of surface waters from any source.

FLOOD INSURANCE RATE MAP (FIRM) - means an official map of a community, on which the Federal Emergency Management Agency has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

FLOOD INSURANCE STUDY - is the official report provided by the Federal Emergency Management Agency. The report contains flood profiles, water surface elevation of the base flood, as well as the Flood Boundary-Floodway Map.

FLOODPLAIN OR FLOOD-PRONE AREA - means any land area susceptible to being inundated by water from any source (see definition of flooding).

FLOOD PROTECTION SYSTEM - means those physical structural works for which funds have been authorized, appropriated, and expended and which have been constructed specifically to modify flooding in order to reduce the extent of the areas within a community subject to a "special flood hazard" and the extent of the depths of associated flooding. Such as system typically includes hurricane tidal barriers, dams, reservoirs, levees or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

FLOODWAY (REGULATORY FLOODWAY) - means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

FUNCTIONALLY DEPENDENT USE - means a use which cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

HABITABLE FLOOR - means any floor usable for the following purposes; which includes working, sleeping, eating, cooking or recreation, or a combination thereof. A floor used for storage purposes only is not a "habitable floor."

HIGHEST ADJACENT GRADE - means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

LEVEE - means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

LEVEE SYSTEM - means a flood protection system which consists of a levee, or levees, and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

LOWEST FLOOR - means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area is not considered a building's lowest floor; provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirement of Section 60.3 of the National Flood Insurance Program regulations.

MANUFACTURED HOME - means a structure transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. For flood plain management purposes the term "manufactured home" also includes park trailers, travel trailers, and other similar vehicles placed on a site for greater than 180 consecutive days. For insurance purposes the term "manufactured home" does not include park trailers, travel trailers, and other similar vehicles.

MEAN SEA LEVEL - means, for purposes of the National Flood Insurance Program, the National Geodetic Vertical Datum (NGVD) of 1929 or other datum, to which base flood elevations shown on a community's Flood Insurance Rate Map are referenced.

NEW CONSTRUCTION - means, for flood plain management purposes, structures for which the "start of construction" commenced on or after the effective date of a flood plain management regulation adopted by a community.

START OF CONSTRUCTION - (for other than new construction or substantial improvements under the Coastal Barrier Resources Act (Pub. L. 97-348)), includes substantial improvement and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for basement, footings, piers or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure.

STRUCTURE - means a walled and roofed building, including a gas or liquid storage tank, that is principally above ground, as well as a manufactured home.

SUBSTANTIAL IMPROVEMENT - means any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure either, (1) before the improvement or repair is started, or (2) if the structure has been damaged and is being restored, before the damage occurred. For the purpose of this definition "substantial improvement" is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure. The term does not, however, include either (1) any project for improvement of a structure to comply with existing state or local health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions, or (2) any alteration of a structure listed on the National Register of Historic Places or a State Inventory of Historic Places.

VARIANCE - is a grant of relief to a person from the requirements of this ordinance when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise prohibited by this ordinance. (For full requirements see Section 60.6 of the National Flood Insurance Program regulations.)

VIOLATION - means the failure of a structure or other development to be fully compliant with the community's flood plain management regulations. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance required in Section 60.3(b)(5), (c)(4), (c)(10), (d)(3), (e)(2), (e)(4), or (e)(5) is presumed to be in violation until such time as that documentation is provided.

WATER SURFACE ELEVATION - means the height, in relation to the National Geodetic Vertical Datum (NGVD) of 1929 (or other datum, where specified), of floods of various magnitudes and frequencies in the flood plains of coastal or riverine areas.

ARTICLE 3
GENERAL PROVISIONS

SECTION A. LANDS TO WHICH THIS ORDINANCE APPLIES

The ordinance shall apply to all areas of special flood hazard with the jurisdiction of Haskell, Oklahoma
(local unit)

SECTION B. BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by the Federal Emergency Management Agency in a scientific and engineering report entitled, "The Flood Insurance Study for the Town of Haskell, Oklahoma," dated Dec. 4, 1979, with accompanying Flood Insurance Rate Maps and Flood Boundary-Floodway Maps (FIRM and FBFM) and any revisions thereto are hereby adopted by reference and declared to be a part of this ordinance.

SECTION C. ESTABLISHMENT OF DEVELOPMENT PERMIT

A Development Permit shall be required to ensure conformance with the provisions of this ordinance.

SECTION D. COMPLIANCE

No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of this ordinance and other applicable regulations.

SECTION E. ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and another conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

SECTION F. INTERPRETATION

In the interpretation and application of this ordinance, all provisions shall be; (1) considered as minimum requirements; (2) liberally construed in favor of the governing body; and (3) deemed neither to limit nor repeal any other powers granted under State statutes.

SECTION G. WARNING AND DISCLAIMER OR LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of the community or any official or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made thereunder.

ARTICLE 4**ADMINISTRATION****SECTION A. DESIGNATION OF THE FLOODPLAIN ADMINISTRATOR**

(Comm.)

The Chairman, Jim Joiner of the Zoning is hereby appointed the Floodplain Administrator to administer and implement the provisions of this ordinance and other appropriate sections of 44 CFR (National Flood Insurance Program Regulations) pertaining to flood plain management.

SECTION B. DUTIES & RESPONSIBILITIES OF THE FLOODPLAIN ADMINISTRATOR

Duties and responsibilities of the Floodplain Administrator shall include, but not be limited to, the following:

(1) Maintain and hold open for public inspection all records pertaining to the provisions of this ordinance.

(2) Review permit application to determine whether proposed building site will be reasonable safe from flooding.

(3) Review, approve or deny all applications for development permits required by adoption of this ordinance.

(4) Review permits for proposed development to assure that all necessary permits have been obtained from those Federal, State or local governmental agencies (including Section 404 of the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1334) from which prior approval is required.

(5) Where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions) the Floodplain Administrator shall make the necessary interpretation.

(6) Notify, in riverine situations, adjacent communities and the State Coordinating Agency which is the Oklahoma Water Resources Board, prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Emergency Management Agency.

(7) Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.

(8) When base flood elevation data has not been provided in accordance with Article 3, Section B, the Floodplain Administrator shall obtain, review and reasonably utilize any base flood elevation data and floodway data available from a Federal, State or other source, in order to administer the provisions of Article 5.

(9) When a regulatory floodway has not been designated, the Floodplain Administrator must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zones A1-30 and AE on the community's FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community.

SECTION C. PERMIT PROCEDURES

(1) Application for a Development Permit shall be presented to the Floodplain Administrator on forms furnished by him/her and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, and the location of the foregoing in relation to areas of special flood hazard. Additionally, the following information is required:

a. Elevation (in relation to mean sea level), of the lowest floor (including basement) of all new and substantially improved structures;

b. Elevation in relation to mean sea level to which any nonresidential structure shall be floodproofed;

c. A certificate from a registered professional engineer or architect that the nonresidential floodproofed structure shall meet the floodproofing criteria of Article 5, Section B(2);

d. Description of the extent to which any watercourse or natural drainage will be altered or relocated as a result of proposed development.

e. Maintain a record of all such information in accordance with Article 4, Section (B)(1).

(2) Approval or denial of a Development Permit by the Floodplain Administrator shall be based on all of the provisions of this ordinance and the following relevant factors:

a. The danger to life and property due to flooding or erosion damage;

b. The susceptibility of the proposed facility and its contents, to flood damage and the effect of such damage on the individual owner;

c. The danger that materials may be swept onto other lands to the injury of others;

d. The compatibility of the proposed use with existing and anticipated development;

e. The safety of access to the property in times of flood for ordinary and emergency vehicles;

f. The costs of providing governmental services during and after flood conditions including maintenance and repair of streets and bridges, and public utilities and facilities such as sewer, gas, electrical and water systems;

g. The expected heights, velocity, duration, rate of rise and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;

h. The necessity to the facility of a waterfront location, where applicable;

i. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use;

j. The relationship of the proposed use to the comprehensive plan for that area.

SECTION D. VARIANCE PROCEDURES

(1) The Appeal Board as established by the community shall hear and render judgement on requests for variances from the requirements of this ordinance.

(2) The Appeal Board shall hear and render judgement on an appeal only when it is alleged there is an error in any requirement, decision, or determination made by the Floodplain Administrator in the enforcement or administration of this ordinance.

(3) Any person or persons aggrieved by the decision of the Appeal Board may appeal such decision in the courts of competent jurisdiction.

(4) The Floodplain Administrator shall maintain a record of all actions involving an appeal and shall report variances to the Federal Emergency Management Agency upon request.

(5) Variances may be issued for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in the remainder of this ordinance.

(6) Variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in Section C(2) of this Article have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.

(7) Upon consideration of the factors noted above and the intent of this ordinance, the Appeal Board may attach such conditions to the granting of variances as it deems necessary to further the purpose and objectives of this ordinance (Article I, Section C).

(8) Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

(9) Prerequisites for granting variances:

a. Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

b. Variances shall only be issued upon, (i) showing a good and sufficient cause; (ii) a determination that failure to grant the variance would result in exceptional hardship to the applicant, and (iii) a determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances.

c. Any application to whom a variance is granted shall be given written notice that the structure will be permitted to be built with the lowest floor elevation below the base flood elevation, and that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation.

(10) Variances may be issued by a community for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that (i) the criteria outlined in Article 4, Section D(1)-(9) are met, and (ii) the structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

ARTICLE 5**PROVISIONS FOR FLOOD HAZARD REDUCTION****SECTION A. GENERAL STANDARDS**

In all areas of special flood hazards the following provisions are required for all new construction and substantial improvements;

(1) All new construction or substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;

(2) All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;

(3) All new construction or substantial improvements shall be constructed with materials resistant to flood damage;

(4) All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

(5) All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;

(6) New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharge from the systems into flood waters; and,

(7) On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

SECTION B. SPECIFIC STANDARDS

In all areas of special flood hazards where base flood elevation data has been provided as set forth in (i) Article 3, Section B, (ii) Article 4, Section B(8), or (iii) Article 5, Section C(4); the following provisions are required:

(1) **Residential Construction** - new construction and substantial improvement of any residential structure shall have the lowest floor (including basement), elevated to or above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection as proposed in Article 4, Section C(1)a., is satisfied.

(2) **Nonresidential Construction** - new construction and substantial improvements of any commercial, industrial or other nonresidential structure shall either have the lowest floor (including basement) elevated to or above the base flood level or, together with attendant utility and sanitary facilities, be designed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. A registered professional engineer or architect shall develop and/or review structural design, specifications, and plans for the construction, and shall certify that the design and methods of construction are in accordance with accepted standards of practice as outlined in this subsection. A record of such certification which includes the specific elevation (in relation to mean sea level) to which such structures are floodproofed shall be maintained by the Floodplain Administrator.

(3) **Enclosures** - new construction and substantial improvements, with fully enclosed areas below the lowest floor that are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria:

a. A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided.

b. The bottom of all openings shall be no higher than one foot above grade.

c. Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

(4) **Manufactured Homes** -

a. Require that all manufactured homes to be placed within Zone A, shall be installed using methods and practices which minimize flood damage. For the purpose of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse, or lateral movement. Methods of anchoring may include, but are not limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable State and local anchoring requirements for resisting wind forces.

b. All manufactured homes shall be in compliance with Article 5, Section B (1).

c. Require that all manufactured homes to be placed or substantially improved within Zones A1-30, AH and AE on the community's FIRM be elevated on a permanent foundation such that the lowest floor of the manufactured home is at or above the base flood elevation; and be securely anchored to an adequately anchored foundation system in accordance with the provision of Section B(4) of this Article.

SECTION C. STANDARDS FOR SUBDIVISION PROPOSALS

(1) All subdivision proposals including manufactured home parks and subdivisions shall be consistent with Article 1, Sections B, C, and D of this ordinance.

(2) All proposals for the development of subdivisions including manufactured home parks and subdivisions shall meet Development Permit requirements of Article 3, Section C; Article 4, Section C; and the provisions of Article 5 of this ordinance.

(3) Base flood elevation data shall be generated for subdivision proposals and other proposed development including manufactured home parks and subdivisions which is greater than 50 lots or 5 acres, whichever is lesser, if not otherwise provided pursuant to Article 3, Section B or Article 4, Section B (8) of this ordinance.

(4) All subdivision proposals including manufactured home parks and subdivisions shall have adequate drainage provided to reduce exposure to flood hazards.

(5) All subdivision proposals including manufactured home parks and subdivisions shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize or eliminate flood damage.

SECTION D. STANDARDS FOR AREAS OF SHALLOW FLOODING (AO/AH ZONES)

Located within the areas of special flood hazard established in Article 3, Section B, are areas designated as shallow flooding. These areas have special flood hazards associated with base flood depths of 1 to 3 feet where a clearly defined channel does not exist and where the path of flooding is unpredictable and where velocity flow may be evident. Such flooding is characterized by ponding or sheet flow; therefore, the following provisions apply;

(1) All new construction and substantial improvements of residential structures have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as the depth number specified in feet on the community's FIRM (at least two feet if no depth number is specified).

(2) All new construction and substantial improvements of nonresidential structures;

(i) have the lowest floor (including basement) elevated above the highest adjacent grade at least as high as the depth number specified in feet on the community's FIRM (at least two feet if no depth number is specified), or;

(ii) together with attendant utility and sanitary facilities be designed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads of effects of buoyancy.

(3) A registered professional engineer or architect shall submit a certification to the Floodplain Administrator that the standards of this Section, as proposed in Article 4, Section C (1)a., are satisfied.

(4) Require within Zones AH or AO adequate drainage paths around structures on slopes, to guide flood waters around and away from proposed structures.

SECTION E. FLOODWAYS

Floodways - located within areas of special flood hazard established in Article 3, Section B, are areas designated as floodways. Since the floodway is an extremely hazardous area due to the velocity of flood waters which carry debris, potential projectiles and erosion potential, the following provisions shall apply;

(1) Encroachments are prohibited, including fill, new construction, substantial improvements and other development unless certification by a professional registered engineer or architect is provided demonstrating that encroachments shall not result in any increase in flood levels within the community during the occurrence of the base flood discharge.

(2) If Article 5, Section E (1) above is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Article 5.

CERTIFICATION

It is hereby found and declared by Haskell Board of Trustees that
(local unit)
severe flooding has occurred in the past within its jurisdiction and will certainly occur within the future; that flooding is likely to result in infliction of serious personal injury or death, and is likely to result in substantial injury or destruction of property within its jurisdiction; in order to effectively comply with minimum standards for coverage under the National Flood Insurance Program; and in order to effectively remedy the situation described herein, it is necessary that this ordinance become effective immediately.

Therefore, an emergency is hereby declared to exist, and this ordinance, being necessary for the immediate preservation of the public peace, health and safety, shall be in full force and effect from and after its passage and approval.

APPROVED:

Delmar Hampton
(local official)
Chairman of the Board

PASSED:

May 11, 1987
(date)

ATTEST:

Charlene Mosteller
Town Clerk

CERTIFICATE

I, the undersigned, Charlene Mosteller, do hereby certify that the above is a true and correct copy of an ordinance duly adopted by the Haskell Board of Trustees, at a regular meeting duly convened
(local unit)
on May 11, 1987.
(date)

(Secretary or responsible person)
Town Clerk

(SEAL)

Figure E-6 NFIP Ordinances for the City of Muskogee, OK

ORDINANCE NO. 3862-A

AN ORDINANCE AMENDING THE CITY OF MUSKOGEE CODE OF ORDINANCES BY REPEALLING CHAPTER 90, ZONING, ARTICLE XIII, FLOOD DAMAGE PREVENTION, SECTIONS 90-1117 THROUGH 90-1134 AND BY ADDING CHAPTER 64, MUSKOGEE STORM WATER MANAGEMENT REGULATION, ARTICLE III, FLOOD DAMAGE PREVENTION, SECTION 64-60, STATEMENT OF PURPOSE, SECTION 64-61, FINDINGS OF FACT, SECTION 64-62, METHODS OF REDUCING FLOOD LOSS, SECTION 64-63, DEFINITIONS, SECTION 64-64, APPLICABILITY, COMPLIANCE WITH AND INTERPRETATION OF ARTICLE PROVISIONS, SECTION 64-65, BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD, SECTION 64-66, ESTABLISHMENT OF FLOOD PLAIN PERMIT, SECTION 64-67, WARNING AND DISCLAIMER OF LIABILITY, SECTION 64-68, DESIGNATION OF FLOODPLAIN ADMINISTRATOR, SECTION 64-69, DESIGNATION OF FLOODPLAIN PERMIT COMMITTEE, DUTIES AND RESPONSIBILITIES, SECTION 64-70, PERMIT PROCEDURES; APPROVAL OR DENIAL, SECTION 64-71, VARIANCE AND APPEAL, SECTION 64-72, GENERAL STANDARDS FOR FLOOD HAZARD AREAS, SECTION 64-73, SPECIFIC STANDARDS FOR FLOOD HAZARD AREAS, SECTION 64-74, FLOODWAYS, SECTION 64-75, STANDARDS FOR SUBDIVISION PROPOSALS, FLOOD HAZARD AREAS AND SECTION 64-76, PENALTIES FOR NONCOMPLIANCE; BY PROVIDING FOR CODIFICATION, REPEALER. SEVERABILITY AND DECLARING AND EMERGENCY.

NOW THEREFORE BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF MUSKOGEE, OKLAHOMA, AS FOLLOWS:

EMERGENCY ORDINANCE

Section 1. The City of Muskogee Code of Ordinances, Chapter 90, Zoning, Article XIII, Flood Damage Prevention, Sections 90-1117 through 90-1134, are hereby repealed:

Section 2. The City of Muskogee Code of Ordinances, Chapter 64, Flood Damage Prevention, is hereby amended by adding Article III, Flood Damage Prevention, Sections, to read as follows:

ARTICLE III. FLOOD DAMAGE PREVENTION

Sec. 64-60. Statement of purpose.

It is the purpose of this article to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

- (1) Protect human life and health;
- (2) Minimize expenditure of public money for costly flood control projects;
- (3) Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- (4) Minimize prolonged business interruptions;
- (5) Minimize damage to public facilities and utilities, such as water and gas mains, electric, telephone and sewer lines, streets and bridges, located in floodplains;
- (6) Help maintain a stable tax base by providing for the sound use and development of flood prone areas in such a manner as to minimize future flood blight areas;

- (7) Ensure that potential buyers are notified that the property is in a flood area; and
- (8) Ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

Sec. 64-61. Findings of fact.

The flood hazard areas of the city are subject to periodic inundation which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect the public health, safety and general welfare. These flood losses are caused by the cumulative effect of obstructions in floodplains causing increases in flood heights and velocities, and by the occupancy of flood hazard areas by uses vulnerable to floods or hazardous to other lands because they are inadequately elevated, flood proofed, or otherwise protected from flood damage.

Sec. 64-62. Methods of reducing flood losses.

In order to accomplish its purposes, these regulations are established to:

- (1) Restrict or prohibit uses that are dangerous to health, safety or property due to water, water-related or erosion hazards, or that result in damaging increases in erosion or in flood heights, widths or velocities;
- (2) Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage throughout their intended lifespan;
- (3) Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of floodwaters;
- (4) Control filling, grading, excavating, vegetation removal, dredging and other development which may increase flood damage; and
- (5) Prevent or regulate the construction of flood barriers which will unnaturally divert or restrict floodwaters or which may increase flood hazards in other areas, whether adjacent upstream or downstream.

Sec. 64-63. Definitions.

The following words, terms and phrases, when used in this article, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

Appeal means a request for a review of the floodplain administrator's interpretation of any provision of this article or a request for a variance.

Area of special flood hazard means the land in the floodplain within a community subject to a one percent or greater chance of flooding in any given year. The area may be designated as Zone A on the Flood Insurance Rate Map (FIRM). After detailed ratemaking has been completed in preparation for publication of the FIRM, Zone A usually is refined into Zones A or AE.

Base flood means the flood having a one percent chance of being equaled or exceeded in any given year.

Base Flood Elevation (BFE) means the elevation shown on the Flood Insurance Rate Map (FIRM) for Zones that indicate the water surface elevation resulting from a flood that has a one percent chance of equaling or exceeding that level in any given year.

Basement means any area of the building having its floor subgrade (below ground level) on all sides.

Critical feature means an integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

Development means any manmade change in improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

Elevated building means a nonbasement building:

- (1) Built, in Zones AE, A, & X, to have the top of the elevated floor at or above the Base Flood Elevation and, elevated above the ground level by means of pilings, columns (posts and piers), or shear walls parallel to the floor of the water; and
- (2) Adequately anchored so as not to impair the structural integrity of the building during a flood of up to the magnitude of the base flood. In the case of Zones AE, A, or X, elevated building also includes a building elevated by means of fill or solid foundation perimeter walls with openings sufficient to facilitate the unimpeded movement of floodwaters.

Existing construction means, for the purpose of determining rates, structures for which the start of construction commenced before the effective date of the FIRM or before January 1, 1975, for FIRMs effective before that date. Existing construction may also be referred to as "existing structures".

Existing manufactured home park or subdivision means the construction of the facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before the effective date of the floodplain management regulations adopted by a community.

Expansion to an existing manufactured home park or subdivision means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed, including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads.

Flood or flooding means a general and temporary condition of partial or complete inundation of normally dry land areas from:

- (1) The overflow of inland or tidal waters; or
- (2) The unusual and rapid accumulation or runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) means an official map of a community, on which the Federal Emergency Management Agency has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

Flood insurance study means the official report provided by the Federal Emergency Management Agency. The report contains flood profiles, the water surface elevation of the base flood, as well as the flood boundary-floodway map.

Floodplain or flood prone area means any land area susceptible to being inundated by water from any source. See Flood or flooding. *Floodplain Administrator* means a person accredited by the OWRB and designated by the City Council to administer and implement laws, ordinances and regulations relating to the management of floodplains.

Floodplain management means the operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.

Floodplain management regulations means zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as a floodplain, grading, and erosion control ordinance) and other applications of police power. The term "floodplain management

regulations" describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reductions.

Floodplain permit application means the official form used for application to the floodplain permit committee for all proposed development in areas of special flood hazard. A completed and approved floodplain development application is required before any development may be considered for review and approval in the manner prescribed for such development.

Floodplain permit committee means the designated administrative authority for administering the city's floodplain management provisions.

Flood protection system means those physical structural works for which funds have been authorized, appropriated, and expended and which have been constructed specifically to modify flooding in order to reduce the extent of the areas within a community subject to a special flood hazard and the extent of the depths of associated flooding. Such a system typically includes hurricane tidal barriers, dams, reservoirs, levees or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

Floodway or regulatory floodway means the channel of a river, creek, or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

Flood zone(s) defined as:

- (1) Zone A means an area inundated by the 1% annual chance flood, for which no BFEs have been established.
- (2) Zone AE means an area inundated by the 1% annual chance flood, for which BFEs have been determined.
- (3) Zone X means areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

Functionally dependent use means a use which cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term "functionally dependent use" includes only docking facilities, and port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

Habitable floor means any floor usable for living purposes, which includes working, sleeping, eating, cooking or recreation, or a combination thereof. A floor used for storage purposes only is not a habitable floor.

Highest adjacent grade means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

Historical structure means any structure that is:

- (1) Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of Interior as meeting the requirements for individual listing on the National Register of Historic Places;
- (2) Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary of Interior to qualify as a registered historic district;
- (3) Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or

- (4) Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:

- (a) By an approved state program as determined by the Secretary of Interior; or
- (b) Directly by the Secretary of Interior in states without approved programs.

Levee means a manmade structure, usually an earthen embankment designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

Levee system means a flood protection system which consists of a levee and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

Lowest floor means the lowest floor of the lowest enclosed area, including basement. An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area, is not considered a building's lowest floor; provided that such enclosure is not built so as to render the structure in violation of the applicable nonelevation design requirement of 44 CFR 60.3 of the National Flood Insurance Program regulations.

Manufactured home means a structure transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. For floodplain management purposes the term "manufactured home" also includes park trailers, travel trailers, and other similar vehicles placed on a site for greater than 180 consecutive days. The term "manufactured home" does not include a recreational vehicle.

Manufactured home park or subdivision means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

Mean sea level means, for purposes of the National Flood Insurance Program, the current National Geodetic Vertical Datum (NGVD) or other datum, to which base flood elevations shown on a community's flood insurance rate map are referenced.

New construction means, for floodplain management purposes, structures for which the start of construction commenced on or after the effective date of Ordinance No. 1435-A of the city.

New manufactured home park or subdivision means the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of floodplain management regulations adopted by a community.

Recreational vehicle means a vehicle which is:

- (1) Built on a single chassis;
- (2) Four hundred square feet or less when measured at the largest horizontal projections;
- (3) Designed to be self-propelled or permanently towable by a light-duty truck; and
- (4) Designed primarily not for use as a permanent dwelling but, as temporary living quarters for recreational, camping, travel, or seasonal use.

Start of construction includes substantial improvement and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The term "actual start" means either the first placement of permanent construction of a structure on a site,

such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets or walkways; nor does it include excavation for basement, footings, piers or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

Structure means a walled or roofed building, including a gas or liquid storage tank that is principally above ground, as well as a manufactured home.

Substantial damage means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

Substantial improvement.

- (1) The term "substantial improvement" means any repair, reconstruction, rehabilitation, addition, or other improvement of a structure the cost of which equals or exceeds 50 percent of the market value of the structure before start of construction of the improvement. This includes structures which have incurred substantial damage, regardless of the actual repair work performed. The term does not, however, include either:
 - a. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary conditions; or
 - b. Any alteration of a historic structure provided that the alteration will not preclude the structure's continued designation as a historic structure;
- (2) For the purposes of this definition, substantial improvement is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure. The term "substantial improvement" does not, however, include either:
 - a. Any project for improvement of a structure to comply with existing state or local health, sanitary, or safety code specifications which are solely necessary to ensure safe living conditions; or
 - b. Any alteration of a structure listed on the National Register of Historic Places or a state inventory of historic places; and

Use means any actual or anticipated utilization or change in utilization of real property and specifically shall include, but shall not be limited to, any request or application for a zoning change.

Variance means a grant of relief to a person from the requirements of this article when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise prohibited by this article. For full requirements, see 44 CFR 60.6 of the National Flood Insurance Program regulations.

Violation means the failure of a structure, or other development, to be fully compliant with the community's floodplain management regulations. A structure, or other development, without the elevation certificate, other certifications, or other evidence of compliance required in 44 CFR

60.3(b)(5), (c)(4), (c)(10) or (d)(3) of the National Flood Insurance Program Regulations, is presumed to be in violation until such time as that documentation is provided.

Water surface elevation means the height, in relation to the current National Geodetic Vertical Datum (NGVD) or other datum, where specified, of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

Sec. 64-64. Applicability; compliance with and interpretation of article provisions.

- (1) This article shall apply to all areas of special flood hazard within the jurisdiction of the city.
- (2) No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of this article and other applicable regulations.
- (3) This article is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this article and another conflict or overlap, whichever imposes the more stringent restrictions shall prevail.
- (4) In the interpretation and application of this article all provisions shall be:
 - (a) Considered as minimum requirements;
 - (b) Liberally construed in favor of the council; and
 - (c) Deemed neither to limit nor repeal any other powers granted under state statutes.

Sec. 64-65. Basis for establishing the areas of special flood hazard.

The areas of special flood hazard identified by the Federal Emergency Management Agency in a scientific engineering report entitled, The Flood Insurance Study for Muskogee County, Oklahoma, and Incorporated Areas, dated February 4, 2011, with the accompanying Flood Insurance Rate Map (FIRM), are hereby adopted by reference and declared to be a part of these regulations.

Sec. 64-66. Establishment of floodplain permit.

A floodplain permit shall be required to ensure conformance with the provisions of this article. A floodplain permit shall be obtained before any construction, zoning change, change in use, or development begins, or any required drawing approval or building permit is issued within any area of special flood hazard.

Sec. 64-67. Warning and disclaimer of liability.

The degree of flood protection required by this article is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by manmade or natural causes. This article does not imply that land outside the areas of special flood hazards, or uses permitted within such areas, will be free from flooding or flood damages. This article shall not create liability on the part of the city or any officer or employee thereof for any flood damages that result from reliance on this article or any administrative decision lawfully made hereunder.

Sec. 64-68. Designation of Floodplain Administrator.

The Director of Planning is hereby appointed the Floodplain Administrator to administer and implement the provisions of this article and other appropriate sections of 44 CFR (Code of Federal Regulations/National Flood Insurance Program Regulations) pertaining to floodplain management.

Sec. 64-69. Designation of Floodplain Permit Committee; duties and responsibilities.

- (1) The Director of Planning, Director of Public Works and the Assistant Director of Public Works/Utilities are hereby appointed to serve as the Floodplain Permit Committee and are authorized and instructed to implement and administer this article by granting or denying floodplain permit applications in accordance with its provisions.
 - (a) The Director of Planning shall serve as chairman of the committee and shall call meetings of the committee as required to review and pass on floodplain permit applications;
 - (b) A unanimous approval of the committee shall be required to grant a floodplain permit; and
 - (c) The committee may defer action on any floodplain permit application and require the applicant or his engineer or architect to provide such revised or additional information as deemed necessary to render a final decision.
- (2) Duties and responsibilities of the floodplain permit committee shall include, but not be limited to, the following:
 - (a) Maintain and hold open for public inspection all records pertaining to the provisions of this article;
 - (b) Review permit applications to determine whether proposed building sites will be reasonably safe from flooding;
 - (c) Review, approve or deny all applications for development permits required by adoption of this article;
 - (d) Review permits for proposed development to ensure that all necessary permits have been obtained from those federal, state or local governmental agencies (including Section 404 of the Federal Water Pollution Control Act Amendments of 1972, 33 USC 1251 et seq.) from which prior approval is required;
 - (e) Make the necessary interpretation where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be conflict between a mapped boundary and actual field conditions);
 - (f) Notify, in riverine situations, adjacent communities and the State Water Resources Board prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Emergency Management Administration;
 - (g) Ensure that flood carrying capacity within the altered or relocated portion of the watercourse is maintained;
 - (h) When base flood elevation data has not been provided in accordance with Section 64-65, obtain, review, and reasonably utilize any base flood elevation data and floodway data available from a federal, state, or other source, in order to administer the provisions of Sections 64-72 through 64-74;
 - (i) In unnumbered A zones (flood hazard areas without base flood elevations where it is required that you use the best available data), require one of the following actions as a condition of a permit:
 1. Determine an elevation from the nearest benchmark outside of the flood hazard area and require the lowest floor of the structure in the unnumbered A zone to be one foot or more above such elevation;

2. Where flooding history is greater than the elevation specified in Subsection (2)(i)1 of this section, require the lowest floor elevation to be one foot or more above such elevation;
 3. Require elevation of the lowest floor to be two or more feet above the highest adjacent grade next to the building site;
 4. Require that the lowest floor elevation be one foot or more above the base flood elevation which is the elevation of the nearest benchmark outside of the flood hazard area; or
 5. When a regulatory floodway has not been designated, the floodplain permit committee must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zone AE on the community's FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community; and
- (j) Under the provisions of 44 CFR 65.12, of the National Flood Insurance Program regulations, a community may approve certain development in Zone AE on the community's FIRM which increases the water surface elevation of the base flood by more than one foot, provided that the community first applies for a conditional FIRM revision through FEMA; and
- (k) Become accredited by the OWRB in accordance with Title 82 O.S. § 1601-1618, as amended.

Sec. 64-70. Permit procedures; approval or denial.

- (1) Application for a floodplain permit shall be presented to the Floodplain Permit Committee on forms developed by it and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, and the location of the foregoing in relation to areas of special flood hazard. Additionally, the following information is required:
 - (a) Elevation, in relation to mean sea level, of the lowest floor, including basement, of all new and substantially improved structures;
 - (b) A description of the extent to which any watercourse or natural drainage will be altered or relocated as a result of proposed development; and
 - (c) Maintain a record of all such information in accordance with this article.
- (2) Approval or denial of a floodplain permit by the Floodplain Permit Committee shall be based on all of the provisions of this article and the following relevant factors:
 - (a) The danger to life and property due to flooding or erosion damage;
 - (b) The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
 - (c) The danger that materials may be swept onto other lands to the injury of others;
 - (d) The compatibility of the proposed use with existing and anticipated development;
 - (e) The safety of access to the property in times of flood for ordinary and emergency vehicles;

- (f) The costs of providing governmental services during and after flood conditions, including maintenance and repair of streets and bridges, and public utilities and facilities such as sewer, gas, electrical, and water systems;
- (g) The expected heights, velocity, duration, rate of rise and sediment transport of the floodwaters and the effects of wave action, if applicable, expected at the site;
- (h) The necessity to the facility of a waterfront location, where applicable;
- (i) The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use;
- (j) The relationship of the proposed use to the comprehensive plan for that area; and
- (k) Plans shall be sealed by a registered professional engineer registered in the State of Oklahoma, and all survey information shall be sealed by a registered land surveyor registered in the State of Oklahoma.

Sec. 64-71. Variance and Appeal.

- (1) Variances; The City Council, as set out in this article, shall hear and render judgment on requests for variances from the requirements of this article. It shall hear and render judgment on an appeal only when it is alleged there is an error in any requirement, decision, or determination made by the Floodplain Permit Committee in the enforcement or administration of this article. Those aggrieved by the decision of the appeals board may appeal such decision in the courts of competent jurisdiction.
- (2) Variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in Section 64-70(2) have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases. Upon consideration of the factors noted in this section and the intent of this article, the appeals board may attach such conditions to the granting of variances as it deems necessary to further the purpose and objectives of this article.
- (3) Variances; Prerequisites for granting variances include the following:
 - (a) Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief and the applicant for the variance has paid the appropriate fee;
 - (b) Variances shall only be issued upon:
 - 1. A showing of good and sufficient cause;
 - 2. A determination that failure to grant the variance would result in exceptional hardship to the applicant; and
 - 3. A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances.
 - (c) Any applicant to whom a variance is granted shall be given written notice that the structure will be permitted to be built with a lowest floor elevation below the base flood elevation, and that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation.

- (4) Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.
- (5) Variances may be issued for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or the state inventory of historic places, without regard to the procedures set forth in the remainder of this article.
- (6) The city shall maintain a record of all actions involving an appeal and shall report variances to the Federal Emergency Management Agency upon request.
- (7) Variances may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functional dependent use, provided that:
 - (a) The criteria outlined in this section are met; and
 - (b) The structure of other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.
- (8) Procedure for appeal:
 - (a) Any person or persons aggrieved by an alleged error in any requirement, interpretation, decision, or determination made by the Floodplain Permit Committee in the enforcement or administration of this article may appeal such alleged error to the City Council within thirty (30) days after the date of the written decision. The appeal shall be filed in writing with the City Clerk. The City Clerk shall forward the appeal to the Floodplain Administrator.
 - (b) The information required to be submitted by the appellant for the appeal shall be the following:
 - 1. All the information, plans, elevations, and calculations and other material specified in Section 64-70 of this article;
 - 2. Documentation that the request is based upon good and sufficient cause and documentation from a licensed engineer, registered in the State of Oklahoma, that the appeal will not increase the level of the base flood discharge in the regulatory floodway;
 - 3. The appellant must also pay any fee required by the code as provided in the fee schedule.
 - (c) The Floodplain Administrator shall perform the following duties:
 - 1. Docket the appeal on receipt from the clerk;
 - 2. Provide written notice to the appellant of the date, time and place that council will consider the appeal;
 - 3. Present the appeal to the city council within sixty (60) days of receipt of the appeal;
 - 4. Notify the appellant of the decision of the city council on the appeal; and
 - 5. Maintain all records and actions involving an appeal or variance and report to the National Flood Insurance Program Administrator, as required or upon request, with all necessary information concerning the appeal, including justification for any variances to the regulations.

- (d) No permit of any kind will be issued for any development upon any application for a floodplain permit which is the subject of the appeal until a final decision has been made by the city council. (Federal Law Reference – 44 CFR § 60.6)

Sec. 64-72. General standards for flood hazard areas.

In all areas of special flood hazard, the following provisions are required for all new construction and substantial improvements:

- (1) All new construction or substantial improvements shall be designed or modified and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
- (2) All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;
- (3) All new construction or substantial improvements shall be constructed with materials and utility equipment resistant to flood damage;
- (4) All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing and air conditioning equipment and other service facilities that are designed or located so as to prevent water from entering or accumulating within the components during conditions of flooding;
- (5) All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of floodwaters into the system;
- (6) New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters into the system and discharges from the systems into floodwaters; and
- (7) On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

Sec. 64-73. Specific standards for flood hazard areas.

In all areas of special flood hazards the following provisions are required:

- (1) *Residential construction.* New construction or substantial improvement of any residential structure shall have the lowest floor, including basement, elevated to one or more feet above the base flood elevation. A licensed professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Permit Committee that the standard of this subsection, as proposed in Section 64-75, is satisfied.
- (2) *Nonresidential construction.* New construction or substantial improvements of any commercial, industrial or other nonresidential structure shall have the lowest floor, including basement, elevated to one foot or more above the base flood elevation.
- (3) *Enclosures.* New construction and substantial improvements, with fully enclosed areas below the lowest floor that are subject to flooding, shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria:
 - (a) A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided;
 - (b) The bottom of all openings shall be no higher than one foot above grade; or

- (c) Openings may be equipped with screens, louvers, valves, or other coverings or devices, provided that they permit the automatic entry and exit of floodwaters.
- (4) *Manufactured homes.*
 - (a) All manufactured homes to be placed within Zone A shall be installed using methods and practices which minimize flood damage. For the purpose of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse, or lateral movement. Methods of anchoring may include, but are not limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable state and local anchoring requirements for resisting wind forces;
 - (b) Anchoring. All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure. All mobile homes shall be anchored to resist flotation, collapse, or lateral movement by providing over-the-top and frame ties to ground anchors. Special requirements shall be that:
 - 1. Over-the-top ties be provided at each of the four corners of the mobile home, with two additional ties per side at intermediate locations with mobile homes less than 50 feet long requiring one additional tie per side;
 - 2. Frame ties be provided at each corner of the home with five additional ties per side at intermediate points, with mobile homes less than 50 feet long requiring four additional ties per side;
 - 3. All components of the anchoring system be capable of carrying a force of 4,800 pounds; all anchoring must be of a "man earth" type or equal; and
 - 4. Any additions to the mobile home must be similarly anchored.
 - (c) All manufactured homes shall be in compliance with this article; and
 - (d) All manufactured homes to be placed or substantially improved within Zone AE on the community's FIRM shall be elevated on a permanent foundation such that the bottom of the I beam of the manufactured home is at or above the base flood elevation, and shall be securely anchored to an adequately anchored foundation system in accordance with the provisions of this article.
- (5) *Recreational vehicles.* Recreational vehicles on sites within Zone AE and A on the community's FIRM shall either:
 - (a) Be on the site for fewer than 180 days;
 - (b) Be fully licensed and ready for highway use. A recreational vehicle is ready for highway use if it is on its wheels or jacking system or if it is attached to the site only by quick-disconnect-type utilities and security devices and has no permanently attached additions; or
 - (c) Meet the permit requirements and the elevation and anchoring requirements for "manufactured homes" in Subsection (4) of this section.
- (6) *Accessory Structure.* Accessory structures to be placed on sites within Zones A and AE shall comply with the following:
 - (a) The structure shall be unfinished on the interior;
 - (b) The structure shall be used only for parking and limited storage;
 - (c) The structure shall not be used for human habitation. Prohibited activities or uses include but not to working, sleeping, living, cooking or restroom use;

- (d) Service facilities such as electrical and heating equipment must be elevated to or above the BFE;
- (e) The structure shall be constructed and placed on the building site so as to offer the minimum resistance to the flow of floodwaters;
- (f) The structure shall be designed to have low flood damage potential and constructed with flood resistance materials;
- (g) The structure shall be firmly anchored to prevent flotation, collapse and lateral movement;
- (h) Floodway requirements must be met in the construction of the structure;
- (i) Openings to relieve hydrostatic pressure during a flood shall be provided below the BFE; and
- (j) The structure shall be located so as not to cause damage to adjacent and nearby structures.

Sec. 64-74. Floodways.

Floodways located within areas of special flood hazard established in this article are areas designated as floodways. Since the floodway is an extremely hazardous area due to the velocity of floodwaters which carry debris, potential projectiles and erosion potential, the following provisions shall apply:

- (1) Encroachments are prohibited, including fill, new construction, substantial improvements and other developments unless certification by a professional licensed engineer or architect is provided demonstrating that encroachments shall not result in any increase in flood levels within the community during occurrence of the base flood discharge;
- (2) If Subsection (1) of this section is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Sections 64-72; and
- (3) Under the provisions of 44 CFR 65.12, of the National Flood Insurance Regulations, a community may permit encroachments within the adopted regulatory floodway that would result in an increase in base flood elevations, provided that the community first applies for a conditional FIRM and floodway revision through FEMA.

Sec. 64-75. Standards for subdivision proposals, flood hazard areas.

- (1) All subdivision proposals shall be consistent with Sections 64-60 through 64-62 of this Article.
- (2) All proposals for the development of subdivisions including manufactured home parks and subdivisions shall meet floodplain permit requirements of Sections 64-66, 64-70 and 64-72 et seq.
- (3) Base flood elevation data shall be generated for subdivision proposals and other proposed development including manufactured home parks and subdivisions which is greater than 30 lots or three acres, whichever is less, if not otherwise provided pursuant to Sections 64-65 and 64-69.
- (4) All subdivision proposals, including the placement of manufactured home parks and subdivisions, shall have adequate drainage provided to reduce exposure to flood hazards.

- (5) All subdivision proposals including manufactured home parks and subdivisions shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize flood damage.

Sec. 64-76. Penalties for noncompliance.

No structure or land shall hereafter be constructed, located, extended, converted, altered, or changed in use without full compliance with the terms of this article and other applicable regulations. Violation of the provisions of this article by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with condition) shall constitute a misdemeanor and a general nuisance. Any person who violates this article or fails to comply with any of its requirements shall, upon conviction thereof, be punished according to a schedule of fines, as shall be modified from time to time by the council, and made available for public viewing in the office of the clerk of court, as provided in Section 1-14, for each violation, and, in addition, shall pay all costs and expenses involved in the case. Nothing herein contained shall prevent the city from taking such other lawful action as is necessary to prevent or remedy any violation.

Section 3. CODIFICATION. Chapter 64, Article III, Sections 64-60 through 64-76 are hereby codified as Chapter 64, Article III, Section 64-60 through 64-76 of the City of Muskogee, Oklahoma, Code of Ordinances.

Section 4. REPEALER. All other ordinances or parts of ordinances in direct conflict herewith are repealed to the extent of the conflict only.

Section 5. SEVERABILITY. Should any part section, subsection, sentence, provision, clause or phrase hereof be held invalid, void, or unconstitutional for any reason, such holding shall not render invalid, void, or unconstitutional any other section, subsection, sentence, provision, clause, or phrase of this ordinance, and the same are deemed severable for this purpose.

Section 6. EMERGENCY. This ordinance being designated to protect the public health, safety, and welfare of the inhabitants of the City of Muskogee, Oklahoma, and its passage being immediately necessary, an emergency is hereby declared to exist and by reason whereof this ordinance shall take effect immediately upon its passage, approval and publication as provided by law.

PASSED AND APPROVED BY THE CITY COUNCIL OF THE CITY OF MUSKOGEE, OKLAHOMA, THIS ____ DAY OF _____, 2011.

CITY OF MUSKOGEE

JOHN TYLER HAMMONS, MAYOR

ATTEST:

PAMELA S. BATES, CITY CLERK
(seal)

Approved as to form and legality this _____ day of _____,
2011.

JOHN H. VINCENT, CITY ATTORNEY

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ORDINANCE 3948-A

AN ORDINANCE AMENDING THE MUSKOGEE CITY CODE OF ORDINANCES BY REPEALING CHAPTER 90, ZONING REGULATIONS, ARTICLE I, IN GENERAL; ARTICLE II, BOARD OF ADJUSTMENT; ARTICLE III, ZONING DISTRICTS; ARTICLE IV, ADDITIONAL DISTRICT PROVISIONS; ARTICLE V, WIRELESS COMMUNICATION TOWERS AND ANTENNAS; ARTICLE VI, OFF-STREET PARKING REQUIREMENTS; ARTICLE VII, NONCONFORMING USES; ARTICLE VIII, SITE DEVELOPMENT PLAN REQUIREMENTS; ARTICLE IX, ADMINISTRATION AND AMENDMENT; ARTICLE X, SIGN REGULATIONS; ARTICLE XI, AIRPORT HAZARD ZONING REGULATIONS; ARTICLE XII, HISTORIC PRESERVATION; ARTICLE XIII, FLOOD DAMAGE PREVENTION; REPLACING CHAPTER 90, ZONING REGULATIONS BY CREATING THE FOLLOWING ARTICLES: ARTICLE 1, TITLE PURPOSE; ARTICLE 2, BOARD OF ADJUSTMENT; ARTICLE 3, ADMINISTRATION AND AMENDMENT; ARTICLE 4, SITE DEVELOPMENT PLAN REQUIREMENTS; ARTICLE 5, PUD (PLANNED UNIT DEVELOPMENT); ARTICLE 6, ZONING DISTRICTS; ARTICLE 7, AGRIBULTURAL DISTRICT; ARTICLE 8, RESIDENTIAL DISTRICTS; ARTICLE 9, COMMERCIAL DISTRICTS; ARTICLE 10, INDUSTRIAL DISTRICTS; ARTICLE 11, CENTRAL BUSINESS DISTRICT; ARTICLE 12, ON-SITE DEVELOPMENT STANDARDS; ARTICLE 13, USE STANDARDS; ARTICLE 14, OFF-STREET PARKING; ARTICLE 15, LANDSCAPING AND SCREENING; ARTICLE 16, SIGNS; ARTICLE 17, NONCONFORMING USES; ARTICLE 18 DEFINITIONS; ARTILCE 19, WIRELESS COMMUNICATION TOWERS AND ANTENNAS; ARTICLE 20, AIRPORT HAZARD ZONING REGULATIONS; ARTICLE 21, HISTORIC PRESERVATION; ARTICLE 22, FLOOD DAMAGE PREVENTION; PROVIDING FOR CODIFICATION, REPEALER, SEVERABILITY AND DECLARING AND EMERGENCY.

NOW THEREFORE BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF MUSKOGEE, OKLAHOMA, AS FOLLOWS:

EMERGENCY ORDINANCE

Section 1. The City of Muskogee Code of Ordinances, Chapter 90, Zoning, Articles I through XIII, is hereby repealed, and hereby replaced with Articles 1 through 22, as attached hereto.

Section 2. CODIFICATION. Chapter 90, Zoning Regulations, Article 1, Title Purpose; Article 2, Board Of Adjustment; Article 3, Administration And Amendment; Article 4, Site Development Plan Requirements; Article 5, PUD (Planned Unit Development); Article 6, Zoning Districts; Article 7, Agricultural District; Article 8, Residential Districts; Article 9, Commercial Districts; Article 10, Industrial Districts; Article 11, Central Business District; Article 12, On-Site Development Standards; Article 13, Use Standards; Article 14, Off-Street Parking; Article 15, Landscaping And Screening; Article 16, Signs; Article 17, Nonconforming Uses; Article 18 Definitions; Article 19, Wireless Communication Towers And Antennas; Article 20, Airport Hazard Zoning Regulations; Article 21, Historic Preservation; Article 22, Flood Damage Prevention, all in the Muskogee City Code of Ordinances.

Section 3. REPEALER. All other ordinances or parts of ordinances in direct conflict herewith are repealed to the extent of the conflict only.

Section 4. SEVERABILITY. Should any part section, subsection, sentence, provision, clause or phrase hereof be held invalid, void, or unconstitutional for any reason, such holding shall not render invalid, void, or unconstitutional any other section, subsection, sentence, provision, clause, or phrase of this ordinance, and the same are deemed severable for this purpose.

Section 5. EMERGENCY. This ordinance being designated to protect the public health, safety, and welfare of the inhabitants of the City of Muskogee, Oklahoma, and its passage being immediately necessary, an emergency is hereby declared to exist and by reason whereof this ordinance shall take effect immediately upon its passage, approval and publication as provided by law.

PASSED AND APPROVED BY THE CITY COUNCIL OF THE CITY OF MUSKOGEE, OKLAHOMA, THIS 22nd DAY OF SEPTEMBER, 2014.

CITY OF MUSKOGEE

JOHN R. COBURN, MAYOR

ATTEST:

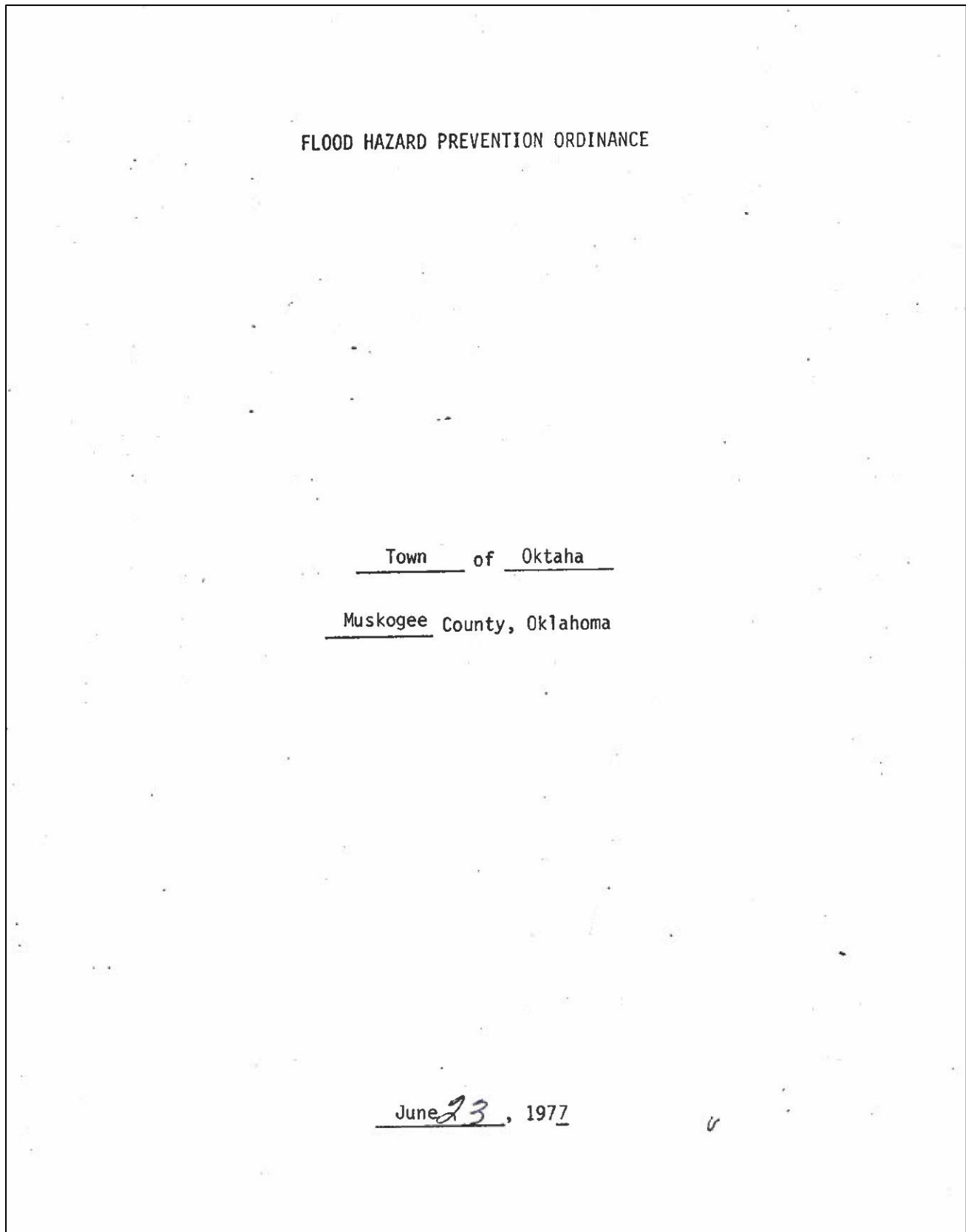
PAMELA S. BATES, CITY CLERK

(seal)

Approved as to form and legality this ____ day of _____, 2014.

ROY D. TUCKER, CITY ATTORNEY

Figure E-7 NFIP Ordinances for the Town of Oktaha, OK



FLOOD HAZARD PREVENTION ORDINANCE

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FLOOD DAMAGE PREVENTION ORDINANCE

ARTICLE I

STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND
OBJECTIVES

SECTION A. STATUTORY AUTHORIZATION

The Legislature of the State of Oklahoma has
in Section 401 O.S. 1971 delegated the responsibility to local
(state)
(statutes)
governmental units to adopt regulations designed to minimize
flood losses. Therefore, be it ordained by the board of
trustees of the Town of Oktaha.

SECTION B. FINDINGS OF FACT

- (1) The flood hazard areas of Oktaha are
(local unit)
subject to periodic inundation which results in loss of
life and property, health and safety hazards, disruption
of commerce and governmental services, and extraordinary
public expenditures for flood protection and relief, all
of which adversely affect the public health, safety and
general welfare.
- (2) These flood losses are created by the cumulative
effect of obstructions in flood plains which cause an
increase in flood heights and velocities, and by the
occupancy of flood hazard areas by uses vulnerable to
floods and hazardous to other lands because they are
inadequately elevated, floodproofed, or otherwise
protected from flood damage.

SECTION C. STATEMENT OF PURPOSE

It is the purpose of this ordinance to promote the public health,
safety and general welfare and to minimize public harm and
private losses in special flood hazard areas with provisions
designed to:

- (1) Restrict or prohibit uses that are dangerous to
health, safety or property in times of flood, or cause
excessive increases in flood heights or velocities;
- (2) Require that uses vulnerable to floods, including
public facilities which serve such uses, be protected
against flood damage at the time of initial construction;
- (3) Control, in the sense of providing authoritative
guidance, the alteration of natural flood plains, their
protective barriers and stream channels;
- (4) Prevent the construction of barriers which will
divert flood waters and subject other lands to greater
flood hazards;

- (5) Control, in the sense of authoritative guidance, development which would cause greater erosion or potential flood damage such as grading, dredging and excavation.

SECTION D. OBJECTIVES

The objectives of this ordinance are:

- (1) To protect human life and property exposed to the hazards of flooding;
- (2) To ensure that potential property owners are notified if property is in a special flood hazard area;
- (3) To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- (4) To minimize prolonged business interruptions;
- (5) To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in special flood hazard areas;
- (6) To minimize expenditure of future public money for costly flood control projects.

ARTICLE 2

DEFINITIONS

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

Appeal--means a request for a review of the Town (local
Clerk Administrator)'s interpretation of any provision of this ordinance or a request for a variance.

Area Of Shallow Flooding--means a designated AO Zone on a community's Flood Insurance Rate Map (FIRM) with base flood depths from one to three feet. This condition occurs where a clearly defined channel does not exist, where the path of flooding is unpredictable and indeterminate, and where velocity flow may be evident.

Area Of Special Flood Hazard--is the land in the flood plain within a community subject to a one percent or greater chance of flooding in any given year.

Base Flood--means the flood having a one percent chance of being equalled or exceeded in any given year.

Development--means any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations.

Existing Mobile Home Park or Mobile Home Subdivision--means a parcel (or contiguous parcels) of land divided into two or more mobile home lots for rent or sale for which the construction of facilities for servicing the lot on which the mobile home is to be affixed (including, at a minimum, the installation of utilities, either final site grading or the pouring of concrete pads, and the construction of streets) is completed before the effective date of this ordinance.

Expansion To An Existing Mobile Home Park Or Mobile Home Subdivision--means the preparation of additional sites by the construction of facilities for servicing the lots on which the mobile homes are to be affixed (including the installation of utilities, either final site grading or pouring of concrete pads, or the construction of streets).

Flood Or Flooding--means a general and temporary condition of partial or complete inundation of normally dry land areas from:

- (1) The overflow of inland or tidal waters.
- (2) The unusual and rapid accumulation or runoff of surface waters from any source.

Flood Hazard Boundary Map (FHBM)--means an official map of a community, issued by the Federal Insurance Administration, where the areas within the boundaries of special flood hazards have been designated as Zone A.

Flood Insurance Rate Map (FIRM)--means an official map of a community, on which the Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

Flood Insurance Study--is the official report provided by the Federal Insurance Administration. The report contains flood profiles, the water surface elevation of the base flood, as well as the Flood Hazard Boundary-Floodway Map.

Floodway--means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

Habitable Floor--means any floor usable for living purposes, which includes working, sleeping, eating, cooking or recreation, or a combination thereof. A floor used for storage purposes only is not a "habitable floor".

Mean Sea Level--means the average height of the sea for all stages of the tide.

Mobile Home--means a structure, transportable in one or more sections, which is built on a permanent chassis and designed to be used with or without a permanent foundation when

connected to the required utilities. It does not include recreational vehicles or travel trailers.

New Mobile Home Park Or Mobile Home Subdivision--means a parcel (or contiguous parcels) of land divided into two or more mobile home lots for rent or sale for which the construction of facilities for servicing the lot on which the mobile home is to be affixed (including, at a minimum, the installation of utilities, either final site grading or the pouring of concrete pads, and the construction of streets) is completed on or after the effective date of this ordinance.

Start Of Construction--means the first placement of permanent construction of a structure (other than a mobile home) on a site, such as the pouring of slabs or footings or any work beyond the stage of excavation. Permanent construction does not include land preparation, such as clearing, grading, and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not as part of the main structure. For a structure (other than a mobile home) without a basement or poured footings, the "start of construction" includes the first permanent framing or assembly of the structure or any part thereof on its piling or foundation. For mobile homes not within a mobile home park or mobile home subdivision, "start of construction" means the affixing of the mobile home to its permanent site. For mobile homes within mobile home parks or mobile home subdivisions, "start of construction" is the date on which the construction of facilities for servicing the site on which the mobile home is to be affixed (including, at a minimum, the construction of streets, either final site grading or the pouring of concrete pads, and installation of utilities) is completed.

Structure--means a walled and roofed building that is principally above ground, as well as a mobile home.

Substantial Improvement--means any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure either, (1) before the improvement or repair is started, or (2) if the structure has been damaged and is being restored, before the damage occurred. For the purposes of this definition "substantial improvement" is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure. The term does not, however, include either (1) any project for improvement of a structure to comply with existing state or local health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions, or (2) any alteration of a structure listed on the National Register of Historic Places or a State Inventory of Historic Places.

Variances--is a grant of relief to a person from the requirements of this ordinance when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise **prohibited** by this ordinance.

ARTICLE 3

GENERAL PROVISIONS

SECTION A. LANDS TO WHICH THIS ORDINANCE APPLIES

This ordinance shall apply to all areas of special flood hazard within the jurisdiction of Oktaha
(local unit)

SECTION B. BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by the Federal Insurance Administration on its Flood Hazard Boundary Map (FHBM), # H 01, dated 11-29-74, and any revisions thereto are hereby adopted by reference and declared to be a part of this ordinance.

SECTION C. ESTABLISHMENT OF DEVELOPMENT PERMIT

A Development Permit shall be required to ensure conformance with the provisions of this ordinance.

SECTION D. COMPLIANCE

No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of this ordinance and other applicable regulations.

SECTION E. ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and another conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

SECTION F. INTERPRETATION

In the interpretation and application of this ordinance, all provisions shall be: (1) considered as minimum requirements; (2) liberally constructed in favor of the governing body; and (3) deemed neither to limit nor repeal any other powers granted under State statutes.

SECTION G. WARNING AND DISCLAIMER OF LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards

or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of Oktaha or any officer or employee (local unit) thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made thereunder.

ARTICLE 4

ADMINISTRATION

SECTION A. DESIGNATION OF Town Clerk (Local Administrator)

The Town Clerk is hereby appointed to (local administrator) administer and implement the provisions of this ordinance.

SECTION B. DUTIES AND RESPONSIBILITIES OF THE Town Clerk (Local administrator)

Duties and responsibilities of the Town Clerk (local administrator) shall include, but not be limited to:

- (1) Maintain and hold open for public inspection all records pertaining to the provisions of this ordinance;
- (2) Review, approve or deny all applications for development permits required by Article 3, Section C of this ordinance;
- (3) Review permits for proposed development to assure that all necessary permits have been obtained from those Federal, State or local governmental agencies from which prior approval is required;
- (4) Where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions) the Town Clerk (local administrator) shall make the necessary interpretation.
- (5) Notify adjacent communities and the Oklahoma Water Resources Board (state) prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Insurance Administration;
- (6) Assure that maintenance is provided within the altered or relocated portion of said watercourse so that the flood carrying capacity is not diminished.

(7) When base flood elevation data has not been provided in accordance with Article 3, Section B, the Town Clerk (local administrator) shall obtain, review, and reasonably utilize any base flood elevation data available from a Federal, State, or other source, in order to administer the provision of Article 5.

SECTION C. PERMIT PROCEDURES

(1) Application for a Development Permit shall be presented to the Town Clerk (local administrator) on forms furnished by him and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, and the location of the foregoing in relation to areas of special flood hazard. Additionally, the following information is required:

- a. Elevation in relation to mean sea level, of the lowest floor (including basement) of all proposed structures;
- b. Elevation in relation to mean sea level to which any non-residential structure shall be floodproofed;
- c. A certificate from a registered professional engineer or architect that the non-residential floodproofed structure shall meet the floodproofing criteria of Article 5, Section B (2);
- d. Description of the extent to which any watercourse or natural drainage will be altered or relocated as a result of proposed development.

(2) Approval or denial of a Development Permit by the Town Clerk (local administrator) shall be based on all of the provisions of this ordinance and the following relevant factors:

- a. The danger to life and property due to flooding or erosion damage;
- b. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
- c. The danger that materials may be swept onto other lands to the injury of others;
- d. The compatibility of the proposed use with existing and anticipated development;
- e. The safety of access to the property in times of flood for ordinary and emergency vehicles;
- f. The costs of providing governmental services during and after flood conditions including maintenance and repair of streets and bridges, and public utilities and

facilities such as sewer, gas, electrical, and water systems.

g. The expected heights, velocity, duration, rate of rise and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;

h. The necessity to the facility of a waterfront location, where applicable;

i. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use;

j. The relationship of the proposed use to the comprehensive plan for that area.

SECTION D. VARIANCES PROCEDURES

(1) The Board of Trustees as established by Oktaha
(appeal board) (local
unit) shall hear and render judgement on requests for variances from the requirements of this ordinance.

(2) The Board of Trustees shall hear and render
(appeal board)
judgement on an appeal only when it is alleged there is an error in any requirement, decision, or determination made by the Town Clerk in the enforcement
(local administrator)
or administration of this ordinance.

(3) Any person or persons aggrieved by the decision of the Board of Trustees may appeal such decision in the
(appeal board)
courts of competent jurisdiction.

(4) The Town Clerk shall maintain a
(local administrator)
record of all actions involving an appeal and shall report variances to the Federal Insurance Administration upon request.

(5) Variances may be issued for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in the remainder of this section.

(6) Generally, variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in Section C (2) of this Article have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.

(7) Upon consideration of the factors noted above and the intent of this ordinance, the Board of Trustees
(appeal board)

may attach such conditions to the granting of variances as it deems necessary to further the purpose and objectives of this ordinance (Article 1, Sections C and D).

(8) Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

(9) Prerequisites for granting variances:

a. Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

b. Variances shall only be issued upon (i) a showing of good and sufficient cause, (ii) a determination that failure to grant the variance would result in exceptional hardship to the applicant, and (iii) a determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances.

c. Any applicant to whom a variance is granted shall be given written notice that the structure will be permitted to be built with a lowest floor elevation two feet below the base flood elevation, and that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation.

ARTICLE 5

PROVISIONS FOR FLOOD HAZARD REDUCTION

SECTION A. GENERAL STANDARDS

In all areas of special flood hazards the following provisions are required:

- (1) All new construction and substantial improvements shall be anchored to prevent flotation, collapse or lateral movement of the structure;
- (2) All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;
- (3) All new construction or substantial improvements shall be constructed with materials and utility equipment resistant to flood damage;
- (4) All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
- (5) New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharges from the systems into flood waters; and,

- (6) On site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

SECTION B. SPECIFIC STANDARDS

In all areas of special flood hazards where base flood elevation data has been provided as set forth in (i) Article 3, Section B, (ii) Article 4, Section B, (7), or (iii) Article 5, Section D, (3) the following provisions are required:

(1) Residential Construction - New Construction or substantial improvement of any residential structure shall have the lowest floor, including basement, elevated to or above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Town Clerk that the (local administrator)

standard of this subsection, as proposed in Article 4, Section C (1) (a), is satisfied.

(2) Non-residential Construction - New Construction or substantial improvement of any commercial, industrial or other non-residential structure shall either have the lowest floor, including basement, elevated to the level of the base flood elevation or, together with attendant utility and sanitary facilities, be floodproofed so that below the base flood level the structure is water tight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. A registered professional engineer or architect shall submit a certification to the Town Clerk that the standards of (local administrator) this subsection as proposed in Article 4, Section C (1) (c), are satisfied.

(3) Mobile Homes -

a. No mobile home shall be placed in a floodway, or if applicable, a coastal high hazard area, except in an existing mobile home park or existing mobile home subdivision.

b. All mobile homes shall be anchored to resist flotation, collapse, or lateral movement. Specific requirements shall be:

(i) over-the-top ties at each of the four corners of the mobile home, with two additional ties per side at intermediate locations and mobile homes less than 50 feet long requiring one additional tie per side;

(ii) frame ties at each corner of the home with five additional ties per side at intermediate points and mobile homes less than 50 feet long requiring four additional ties per side;

(iii) all components of the anchoring system be capable of carrying a force of 4,800 pounds;

(iv) any additions to the mobile home be similarly anchored.

SECTION C. STANDARDS FOR SUBDIVISION PROPOSALS

(1) All subdivision proposals shall be consistent with Article 1, Sections B, C, and D of this ordinance.

(2) All proposals for the development of subdivisions shall meet Development Permit requirements of Article 3, Section C, Article 4, Section C, and the provisions of Article 5 of this ordinance.

(3) Base flood elevation data shall be provided for subdivision proposals and other proposed development which is greater than the lesser of 50 lots or 5 acres, if not otherwise provided pursuant to Article 3, Section B or Article 4, Section B (7) of this ordinance.

(4) All subdivision proposals shall have adequate drainage provided to reduce exposure to flood hazards.

(5) All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize flood damage.

ARTICLE 6
EMERGENCY CLAUSE

SECTION A. DECLARATION OF AN EMERGENCY

It being immediately necessary for the preservation of the public peace, health and safety, an emergency is hereby declared to exist, by reason whereof this ordinance shall be in full force and effect from and after its passage, approval and publication.

Passed and approved this 23 day of June, 1977 by the
Board of Trustees _____ of the Town of Oktaha,
Oklahoma.

Attest: Max L. Walker (Clerk)

Charles Parton

SEAL:

Figure E-8 NFIP Ordinances for the Town of Porum, OK

**THE TOWN OF PORUM, OKLAHOMA
FLOOD DAMAGE PREVENTION ORDINANCE
“DECLARING AN EMERGENCY”**

ARTICLE I

STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND METHODS

SECTION A. STATUTORY AUTHORIZATION

The Legislature of the State of Oklahoma has in 11 O.S. §§ 41-47, as amended, delegated the responsibility to local governmental units to adopt ordinances designed to minimize flood losses. Therefore, the Town of Porum, Oklahoma, ordains the following, to become effective immediately:

SECTION B. FINDINGS OF FACT

1. The flood hazard areas of the Town of Porum are subject to periodic inundation, which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect the public health, safety and general welfare.
2. These flood losses are created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazards areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, floodproofed or otherwise protected from flood damage.

SECTION C. STATEMENT OF PURPOSE

It is the purpose of this ordinance to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

1. Protect human life and health;
2. Minimize expenditure of public money for costly flood control projects;
3. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
4. Minimize prolonged business interruptions;
5. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains;
6. Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
7. Insure that potential buyers are notified that property is in a flood area.

SECTION D. METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purposes, this ordinance uses the following methods:

1. Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood heights or velocities;
2. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
3. Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters;
4. Control filling, grading, dredging and other development which may increase flood damage; and
5. Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands.

ARTICLE II

DEFINITIONS

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

"Accessory structure" - means a structure which is on the same parcel of property as the principal structure and the use of which is incidental to the use of the principal structure. Examples of accessory structures include but are not limited to garages and storage sheds.

"Area of special flood hazard" - is the land in the floodplain within the The Town of Porum subject to a one percent or greater chance of flooding in any given year.

"Base flood" - means the flood having a one percent chance of being equaled or exceeded in any given year.

"Base flood elevation" - means the elevation in feet above mean sea level of the base flood or 1% chance flood.

"Basement" - means any area of the building having its floor sub-grade (below ground level) on all sides.

"BFE" - means base flood elevation.

"CFR" - means Code of Federal Regulations.

"Critical feature" - means an integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

"Development" - means any man-made change in improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

"Development Permit" - means a permit issued by the Town of Porum Floodplain Administrator which authorizes development in a special flood hazard area in accordance with this ordinance.

"Elevated building" - means a non-basement building built, in the case of a building in Zones AE, A, and X, to have the top of the elevated floor adequately anchored so as not to impair the structural integrity of the building during a flood up to the magnitude of the base flood. In the case of Zones AE, A, and X, "elevated building" also includes a building elevated by means of fill or solid foundation perimeter walls with openings sufficient to facilitate the unimpeded movement of flood waters.

"Existing construction" - means for the purposes of determining rates, structures for which the "start of construction" commenced before the effective date of the FIRM or before January 1, 1975, for FIRMs effective before that date. "Existing construction" may also be referred to as "existing structures."

"Existing manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before August 4, 1972.

"Expansion to an existing manufactured home park or subdivision"- means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

"FEMA" means the Federal Emergency Management Agency.

"FIRM" means Flood Insurance Rate Map.

"Flood" or "flooding" - means a general and temporary condition of partial or complete inundation of normally dry land areas from:

1. The overflow of inland or tidal waters, or
2. The unusual and rapid accumulation or runoff of surface waters from any source.

"Flood Insurance Rate Map" - means an official map of the Town of Porum on which FEMA has delineated both the areas of special flood hazards and the risk premium zones applicable to the Town of Porum.

"Flood insurance study" - is the official report provided by FEMA for The Town of Porum which contains flood profiles, water surface elevation of the base flood, as well as the floodway width, section area and mean velocity.

"Floodplain Administrator" – means a person accredited by the OWRB and designated by the Board of Trustees of the Town of Porum to administer and implement laws, ordinances and regulations relating to the management of floodplains.

"Floodplain or flood-prone area" - means any land area susceptible to being inundated by water from any source (see definition of flood).

"Floodplain management" - means the operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.

"Floodplain management regulations" – means zoning codes and ordinances, subdivision regulations, building codes, health regulations, special purpose regulations and ordinances (such as floodplain, grading and erosion control regulations and ordinances) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

"Flood protection system" - means those physical structural works for which funds have been authorized, appropriated, and expended and which have been constructed specifically to modify flooding in order to reduce the extent of the areas within The Town of Porum subject to a

"special flood hazard" and the extent of the depths of associated flooding. Such a system typically includes hurricane tidal barriers, dams, reservoirs, levees or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

"Floodway" - means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. A floodway is located within areas of special flood hazard established in Article III, Section B. A floodway is an extremely hazardous area due to the velocity of floodwaters that carry debris and potential projectiles.

"Functionally dependent use" - means a use that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

"Highest adjacent grade" - means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

"Historic structure" - means any structure that is:

1. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
2. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
3. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or
4. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
 - a) By an approved state program as determined by the Secretary of the Interior, or
 - b) Directly by the Secretary of the Interior in states without approved programs.

"Levee" - means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

"Levee system" - means a flood protection system which consists of a levee or levees and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

"Lowest floor" - means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking or vehicles, building access or storage in an area other than a basement area is not considered a building's lowest floor;

provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirement of Section 60.3 of Title 44 CFR.

"Manufactured home" - means a structure transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. The term "manufactured home" does not include a "recreational vehicle".

"Manufactured home park or subdivision" - means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

"Mean sea level" - means, for purposes of the National Flood Insurance Program, the North American Vertical Datum (NAVD) of 1988 or other datum, to which base flood elevations shown on the Town of Porum Flood Insurance Rate Map are referenced.

"New construction" - means, for the purpose of determining insurance rates, structures for which the "start of construction" commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, "new construction" means structures for which the "start of construction" commenced on or after the effective date of a floodplain management regulation adopted by the Town of Porum Board of Trustees and includes any subsequent improvements to such structures.

"New manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of floodplain management regulations adopted by the Town of Porum Board of Trustees.

"OWRB" - means the Oklahoma Water Resources Board.

"Recreational vehicle" - means a vehicle which is:

1. Built on a single chassis;
2. 400 square feet or less when measured at the largest horizontal projections;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

"Start of construction" - (for other than new construction or substantial improvements under the Coastal Barrier Resources Act (Public Law 97-348), includes substantial improvement and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for basement, footings, piers or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main

structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

"Structure" - means a walled and roofed building, including a gas or liquid storage tank that is principally above ground, as well as a manufactured home.

"Substantial damage" - means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"Substantial improvement" - means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before "start of construction" of the improvement. This includes structures that have incurred "substantial damage", regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary conditions, or
2. Any alteration of a "historic structure" provided that the alteration would not preclude the structure's continued designation as a "historic structure."

"Variance" - is a grant of relief by the Town of Porum Board of Trustees to a person from the terms of this ordinance when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise prohibited by this ordinance. (For full requirements see Section 60.6 of Title 44 CFR.)

"Violation" - means the failure of a structure or other development to be fully compliant with this flood damage prevention ordinance.

"Water surface elevation" - means the height, in relation to the North American Vertical Datum (NAVD) of 1988 (or other datum, where specified), of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

ARTICLE III**GENERAL PROVISIONS****SECTION A. LANDS TO WHICH THIS ORDINANCE APPLIES**

This flood damage prevention ordinance shall apply to all areas of special flood hazard within the jurisdiction of the Town of Porum, Oklahoma.

SECTION B. BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by FEMA in a scientific and engineering report entitled, "The Flood Insurance Study for Muskogee County , Oklahoma and Incorporated Areas" dated February 4, 2011, with the accompanying Flood Insurance Rate Map (FIRM) are hereby adopted on February 4, 2011, by reference and declared to be a part of this ordinance. However, until this date the current effective flood maps for the Town of Porum, dated March 4, 1991 for Muskogee County shall be used for this purpose until February 4, 2011.

SECTION C. ESTABLISHMENT OF DEVELOPMENT PERMIT

A Development Permit shall be required to ensure conformance with the provisions of this floodplain management ordinance.

SECTION D. COMPLIANCE

No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of this ordinance and other applicable regulations.

SECTION E. ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and any other ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

SECTION F. INTERPRETATION

In the interpretation and application of this ordinance, all provisions shall be:

1. Considered as minimum requirements;
2. Liberally construed in favor of the governing body; and
3. Deemed neither to limit nor repeal any other powers granted under State statutes.

SECTION G. WARNING AND DISCLAIMER OR LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of the Town of Porum or any official or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

ARTICLE IV**ADMINISTRATION****SECTION A. DESIGNATION OF THE FLOODPLAIN ADMINISTRATOR**

The Board of Trustees of the Town of Porum designates the Water Superintendent as Floodplain Administrator to administer and implement the provisions of this ordinance and other appropriate sections of National Flood Insurance Program regulations in Title 44 CFR pertaining to floodplain management.

SECTION B. DUTIES AND RESPONSIBILITIES OF THE FLOODPLAIN ADMINISTRATOR

Duties and responsibilities of the Floodplain Administrator shall include, but not be limited to, the following:

1. Become accredited by the OWRB in accordance with Title 82 O.S. §§ 1601-1618, as amended.
2. Reviews permit applications to determine whether the proposed building sites, including the placement of manufactured homes, will be reasonably safe from flooding.
3. Review, approve or deny all applications for Development Permits required by this ordinance.
4. Review proposed development to assure that all necessary permits have been obtained from those Federal, State or local governmental agencies from which prior approval are required.
5. Make the necessary interpretation where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions).
6. Notify, in riverine situations, adjacent communities and the OWRB prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the FEMA.
7. Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.
8. Shall require the developer/applicant to determine and provide the base flood elevation on two FEMA Elevation Certificates, one pre and one post, as well as other data as required in order to administer the provisions of Article V.
9. When a floodway has not been designated, the Floodplain Administrator must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zone AE as delineated on the Muskogee County FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water

surface elevation of the base flood more than one foot at any point within the Town of Porum.

10. After a disaster or other type of damage occurrence to structures in the Town of Porum, determine if the residential and non-residential structures and manufactured homes have been substantially damaged, and enforce the substantial improvement requirement.
11. Maintain a record of all actions involving an appeal from a decision of the Board of Trustees.
12. Maintain and hold open for public inspection all records pertaining to the provisions of this ordinance.

SECTION C. PERMIT PROCEDURES

1. An Application for a Development Permit shall be presented to the Floodplain Administrator on forms furnished by him/her and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, including the placement of manufactured homes, and the location of the foregoing in relation to areas of special flood hazard. Additionally, the following information is required:
 - a. Elevation in relation to mean sea level of the lowest floor (including basement) of all new and substantially improved structures; and
 - b. Description of the extent to which any watercourse or natural drainage will be altered or relocated as a result of proposed development.
2. Approval or denial of a Development Permit by the Floodplain Administrator shall be based on all of the provisions of this ordinance and the following relevant factors:
 - a. The danger to life and property due to flooding or erosion damage;
 - b. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
 - c. The danger that materials may be swept onto other lands to the injury of others;
 - d. The compatibility of the proposed use with existing and anticipated development;
 - e. The safety of access to the property in times of flood for ordinary and emergency vehicles;
 - f. The costs of providing governmental services during and after flood conditions including maintenance and repair of streets and bridges, and public utilities and facilities such as sewer, gas, electrical and water systems;
 - g. The expected heights, velocity, duration, rate of rise and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;

- h. The necessity to the facility of a waterfront location, where applicable;
 - i. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use; and
 - j. The relationship of the proposed use to the comprehensive plan for that area.
- 3. The Floodplain Administrator or Board of Trustees, as applicable, may approve certain development in Zones A or AE delineated on the Muskogee County FIRM which increases the water surface elevation of the base flood by more than one foot, provided that the applicant for the Development Permit in that case first complies with 44 CFR Section 65.12.

SECTION D. VARIANCES

1. General provisions.

a. The Board of Trustees and Floodplain Administrator may grant variances for uses which do not satisfy the requirements of the Oklahoma Floodplain Management Act or this ordinance, if the applicant for the variance presents adequate proof that (i) compliance with this ordinance will result in an arbitrary and unreasonable taking of property without sufficient benefit or advantage to the people and (ii) satisfies the pertinent provisions of this Section D. However, no variance shall be granted where the effect of the variance will be to permit the continuance of a condition which unreasonably creates flooding hazards.

b. Any variance so granted shall not be construed as to relieve any person who receives it from any liability imposed by the Oklahoma Floodplain Management Act or by other laws of the state.

c. In no case shall variances be effective for a period longer than twenty (20) years.

d. Any person seeking a variance shall file a petition with the Board of Trustees, accompanied by a filing fee of Twenty-five Dollars (\$25.00).

e. Variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in Section C(2) and provisions of Section D of this Article IV have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.

f. Any person seeking a variance to build a structure below the base flood elevation will be issued a notice signed by the Chairman of the Board of Trustees and Floodplain Administrator which states that (i) the cost of flood insurance will be commensurate with the increased risk resulting from permitting the structure to be built lower than the base flood elevation, and (ii) such construction below the base flood level increases risks to life and property.

g. At such time as the Board of Trustees and Floodplain Administrator deems the petition ready for notification to the public, the Board of Trustees shall schedule a hearing and direct the applicant to publish notice thereof in a newspaper of general circulation in Muskogee County at least thirty (30) days prior to the hearing.

h. The Board of Trustees and Floodplain Administrator shall conduct the hearing and make determinations in accordance with the applicable provisions of this Section D. This appeals group shall exercise wide discretion in weighing the equities involved and the advantages and disadvantages to the applicant and to the public at large when determining whether the variance shall be granted.

i. Variances shall only be issued upon:

- (1) A showing of good and sufficient cause;
- (2) A determination that failure to grant the variance would result in exceptional hardship to the applicant;
- (3) A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws, regulations or ordinances; and
- (4) A determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

j. Upon consideration of the factors stated in this Section D and the intent of this ordinance, the Board of Trustees and Floodplain Administrator may attach such conditions to the granting of a variance as it deems necessary to further the purposes and objectives stated in Article I, Section C of this ordinance.

k. The Floodplain Administrator shall maintain a record of all variance actions, including justification for their issuance; and a copy of any variance issued by the Board of Trustees and Floodplain Administrator shall be sent by the Floodplain Administrator to the OWRB and FEMA within fifteen (15) days after issuance of the variance.

2. Special provisions.

a. Variances may be issued for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in the remainder of this ordinance.

b. Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

c. Variances may be issued for the repair or rehabilitation of historic structures upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.

d. Variances may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that:

- (1) The criteria of Section D(1)(e); Section D(1)(i); Section D(2)(b); and Section D(2)(c) of this Article IV are met, and
- (2) The structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

ARTICLE V

PROVISIONS FOR FLOOD HAZARD REDUCTION

SECTION A. GENERAL STANDARDS

In all areas of special flood hazards the following provisions are required for all new construction and substantial improvements:

1. All new construction or substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
2. All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;
3. All new construction or substantial improvements shall be constructed with materials resistant to flood damage;
4. All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
5. All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
6. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharge from the systems into flood waters; and,
7. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

SECTION B. SPECIFIC STANDARDS

In all areas of special flood hazards the following provisions are required:

1. **Residential Construction** - new construction and substantial improvement of any residential structure shall have the lowest floor (including basement) elevated at a minimum of two (2) feet above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.

2. **Nonresidential Construction** - new construction and substantial improvements of any commercial, industrial or other nonresidential structure shall have the lowest floor (including basement) elevated at a minimum two (2) feet above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.

3. **Enclosures** - new construction and substantial improvements, with fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria:

- (a) A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided;
- (b) The bottom of all openings shall be no higher than one foot above grade; and
- (c) Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

4. **Manufactured Homes** -

Require that all manufactured homes to be placed anywhere within the Town of Porum within Zones A and AE on the Town of Porum FIRM shall be installed using methods and practices that minimize flood damage and have the bottom of the I-beam elevated at or above the BFE. For the purposes of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse, or lateral movement. This requirement is in addition to applicable State and local anchoring requirements for resisting wind forces. The home shall be installed by a licensed installer according to Oklahoma state law and compliance herewith shall be certified in writing to the Floodplain Administrator by said installer prior to habitation of the manufactured home.

5. **Recreational Vehicles** - Require that recreational vehicles placed on sites within Zones A and AE on the Muskogee County FIRM either:

- (a) Be on the site for fewer than 180 consecutive days,
- (b) Be fully licensed and ready for highway use, or
- (c) Meet the permit requirements of Article IV, Section C, and the elevation and anchoring requirements for "manufactured homes" in paragraph (4) of this section. A recreational vehicle is ready for highway use if it is on its wheels or jacking

system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions.

6. Accessory Structure – Accessory structures to be placed on sites within Zones A and AE on the Muskogee County FIRM shall comply with the following:

- (a) The structure shall be unfinished on the interior;
- (b) The structure shall be used only for parking and limited storage;
- (c) The structure shall not be used for human habitation. Prohibited activities or uses include but are not limited to working, sleeping, living, cooking, or restroom use;
- (d) Service facilities such as electrical and heating equipment must be elevated to or above the BFE;
- (e) The structure shall be constructed and placed on the building site so as to offer the minimum resistance to the flow of floodwaters;
- (f) The structure shall be designed to have low flood damage potential and constructed with flood resistance materials;
- (g) The structure shall be firmly anchored to prevent flotation, collapse, and lateral movement;
- (h) Floodway requirements must be met in the construction of the structure;
- (i) Openings to relieve hydrostatic pressure during a flood shall be provided below the BFE; and
- (j) The structure shall be located so as not to cause damage to adjacent and nearby structures.

SECTION C. STANDARDS FOR SUBDIVISIONS

- 1. The applicant for a Development Permit for any subdivision located in Zones A and AE which is 51 or more lots or greater than 5 acres shall generate the base flood elevation data for that subdivision.
- 2. All subdivisions including the placement of manufactured home parks and subdivisions shall have adequate drainage provided to reduce exposure to flood hazards.
- 3. All subdivisions including the placement of manufactured home parks and subdivisions shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize or eliminate flood damage.

SECTION D. FLOODWAYS

The following provisions shall apply to floodways:

1. Encroachments, including but not limited to fill, new construction, substantial improvements and other development are prohibited within the adopted floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the Town of Porum during the occurrence of the base flood discharge.
2. If Article V, Section D.1 above is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Article V.
3. The Town of Porum may permit encroachments within the adopted floodway that would result in an increase in base flood elevations, provided that the applicant for the Development Permit complies with all of 44 CFR Section 65.12.

ARTICLE VI**THE TOWN OF PORUM FLOODPLAIN MANAGEMENT FEE SCHEDULE**

The Town of Porum Board of Trustees establishes the following fee schedule not to exceed \$500.00 for any one service:

- a. Notice of Intent Fee - \$25.00 maximum
- b. Floodplain Development Permit Application Review - \$100.00
- c. Floodplain Development Permit Fee - \$ 25.00
- d. Inspection Fee-per inspection - \$25.00.

ARTICLE VII**PENALTIES FOR NONCOMPLIANCE**

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. A structure or other development without the elevation certificate or other certifications required in this ordinance is presumed to be in violation until such time as that documentation is provided. Violation of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall upon conviction thereof be subject to a fine of no more than

\$120.00 and up to 30 days in jail. Nothing herein contained shall prevent the Board of Trustees of the Town of Porum or its City Attorney from taking such other lawful action as is necessary to prevent or remedy any violation.

CERTIFICATION

It is hereby found and declared by the Board of Trustees of the Town of Porum that severe flooding has occurred in the past within its jurisdiction and will certainly occur within the future; that flooding is likely to result in infliction of serious injury or death., and is likely to result in substantial injury or destruction of property within its jurisdiction; in order to effectively comply with minimum standards for coverage under the National Flood Insurance Program, and in order to effectively remedy the situation described herein, it is necessary that this ordinance become effective immediately.

This ordinance shall supersede any previous floodplain management regulations or ordinance(s) applicable to the Town of Porum.

SEVERABILITY

If any section, clause, sentence, or phrase of this ordinance is held to be invalid or unconstitutional by any court of competent jurisdiction, then said holding shall in no way affect the validity of the remaining portions of this ordinance.

EMERGENCY CLAUSE

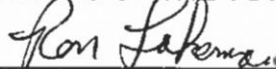
Therefore, an emergency is hereby declared to exist, and this ordinance, being necessary for the immediate preservation of the public peace, health and safety, shall be in full force and effect from and after its passage and approval. The Flood Insurance Study and Flood Insurance Rate Map for Muskogee County and Incorporated Areas dated February 4, 2011, shall apply to this ordinance and shall supersede any previous floodplain management ordinance applicable to the Town of Porum.

WHEREFORE, an emergency is hereby declared to exist and this Ordinance shall be in full force and effect immediately from and after its passage, approval and publication.

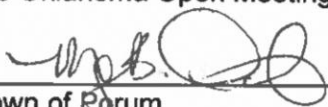
PASSED AND APPROVED and the Emergency Clause voted upon separately and passed and approved this 4th day of January 2011.

ADOPTED BY THE BOARD OF TRUSTEES OF THE TOWN OF PORUM THIS 4th DAY OF January 2011.

BOARD OF TRUSTEES OF THE TOWN OF PORUM

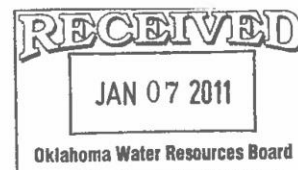

Chairman

I, May B. Daniel, the undersigned City Clerk of the Town of Porum, hereby certify that the above is a true and correct copy of a flood damage prevention ordinance duly adopted by the Board of Trustees of the Town of Porum at a regular meeting of said Board of Trustees duly convened and held on January 4, 2011. I further certify that the Oklahoma Open Meeting Act was complied with in all respects for such meeting.



City Clerk, Town of Porum



**ORDINANCE NO. 05-0104**

An ordinance establishing and/or amending the current Town of Porum Flood Damage Prevention Ordinance that adopts the new Muskogee County Flood Maps dated February 4, 2011; which requires floodplain, sets a penalty and establishes fees and establishes an emergency. This ordinance is required for residents of town to be able to purchase flood insurance in or out of the floodplain.

EMERGENCY CLAUSE

Therefore, an emergency is hereby declared to exist, and this ordinance, being necessary for the immediate preservation of the public peace, health and safety, shall be in full force and effect from and after its passage and approval. The Flood Insurance Study and Flood Insurance Rate Map for Muskogee County and Incorporated Areas dated February 4, 2011, shall apply to this ordinance and shall supersede any previous floodplain management ordinance applicable to the Town of Porum.

WHEREFORE, an emergency is hereby declared to exist and this Ordinance shall be in full force and effect immediately from and after its passage, approval and publication.

PASSED AND APPROVED and the Emergency Clause voted upon separately and passed and approved this 4th day of January 2011.

ADOPTED BY THE BOARD OF TRUSTEES OF THE 'TOWN of PORUM
THIS 4th DAY OF JANUARY 2011.

BOARD OF TRUSTEES OF TOWN of PORUM

/s/ Ron Lakeman
Ron Lakeman, Chairman

I, May B. Daniel, the undersigned City Clerk/Treasurer of the Town of Porum, hereby certify that the above is a true and correct copy of a flood damage prevention ordinance duly adopted by the Board of Trustees of the Town of Porum at a regular meeting of said Board duly convened and held on 4th day of January, 2011. I further certify that the Oklahoma Open Meeting Act was complied with in all respects for such meeting.

/s/ May B. Daniel
Clerk/Treasurer, Town of Porum



Figure E-9 NFIP Ordinances for the Town of Taft, OK

**THE TOWN OF TAFT, OKLAHOMA
FLOOD DAMAGE PREVENTION ORDINANCE
“DECLARING AN EMERGENCY”**

ARTICLE I

STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND METHODS

SECTION A. STATUTORY AUTHORIZATION

The Legislature of the State of Oklahoma has in 11 O.S. §§ 41-47, as amended, delegated the responsibility to local governmental units to adopt ordinances designed to minimize flood losses. Therefore, the Town of Taft, Oklahoma, ordains the following, to become effective immediately:

SECTION B. FINDINGS OF FACT

1. The flood hazard areas of the Town of Taft are subject to periodic inundation, which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect the public health, safety and general welfare.
2. These flood losses are created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazards areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, floodproofed or otherwise protected from flood damage.

SECTION C. STATEMENT OF PURPOSE

It is the purpose of this ordinance to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

1. Protect human life and health;
2. Minimize expenditure of public money for costly flood control projects;
3. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
4. Minimize prolonged business interruptions;
5. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains;
6. Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
7. Insure that potential buyers are notified that property is in a flood area.

SECTION D. METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purposes, this ordinance uses the following methods:

1. Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood heights or velocities;
2. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
3. Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters;
4. Control filling, grading, dredging and other development which may increase flood damage; and
5. Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands.

ARTICLE II

DEFINITIONS

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

"Accessory structure" - means a structure which is on the same parcel of property as the principal structure and the use of which is incidental to the use of the principal structure. Examples of accessory structures include but are not limited to garages and storage sheds.

"Area of special flood hazard" - is the land in the floodplain within the The Town of Taft subject to a one percent or greater chance of flooding in any given year.

"Base flood" - means the flood having a one percent chance of being equaled or exceeded in any given year.

"Base flood elevation" - means the elevation in feet above mean sea level of the base flood or 1% chance flood.

"Basement" - means any area of the building having its floor sub-grade (below ground level) on all sides.

"BFE" - means base flood elevation.

"CFR" - means Code of Federal Regulations.

"Critical feature" - means an integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

"Development" - means any man-made change in improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

"Development Permit" - means a permit issued by the Town of Taft Floodplain Administrator which authorizes development in a special flood hazard area in accordance with this ordinance.

"Elevated building" - means a non-basement building built, in the case of a building in Zones AE, A, and X, to have the top of the elevated floor adequately anchored so as not to impair the structural integrity of the building during a flood up to the magnitude of the base flood. In the case of Zones AE, A, and X, "elevated building" also includes a building elevated by means of fill or solid foundation perimeter walls with openings sufficient to facilitate the unimpeded movement of flood waters.

"Existing construction" - means for the purposes of determining rates, structures for which the "start of construction" commenced before the effective date of the FIRM or before January 1, 1975, for FIRMs effective before that date. "Existing construction" may also be referred to as "existing structures."

"Existing manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before August 4, 1972.

"Expansion to an existing manufactured home park or subdivision"- means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

"FEMA" means the Federal Emergency Management Agency.

"FIRM" means Flood Insurance Rate Map.

"Flood" or "flooding" - means a general and temporary condition of partial or complete inundation of normally dry land areas from:

1. The overflow of inland or tidal waters, or
2. The unusual and rapid accumulation or runoff of surface waters from any source.

"Flood Insurance Rate Map" - means an official map of the Town of Taft on which FEMA has delineated both the areas of special flood hazards and the risk premium zones applicable to the Town of Taft.

"Flood insurance study" - is the official report provided by FEMA for The Town of Taft which contains flood profiles, water surface elevation of the base flood, as well as the floodway width, section area and mean velocity.

"Floodplain Administrator" – means a person accredited by the OWRB and designated by the Board of Trustees of the Town of Taft to administer and implement laws, ordinances and regulations relating to the management of floodplains.

"Floodplain or flood-prone area" - means any land area susceptible to being inundated by water from any source (see definition of flood).

"Floodplain management" - means the operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.

"Floodplain management regulations" – this means zoning codes and ordinances, subdivision regulations, building codes, health regulations, special purpose regulations and ordinances (such as floodplain, grading and erosion control regulations and ordinances) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

"Flood protection system" - means those physical structural works for which funds have been authorized, appropriated, and expended and which have been constructed specifically to modify flooding in order to reduce the extent of the areas within The Town of Taft subject to a "special

flood hazard" and the extent of the depths of associated flooding. Such a system typically includes hurricane tidal barriers, dams, reservoirs, levees or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

"Floodway" - means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. A floodway is located within areas of special flood hazard established in Article III, Section B. A floodway is an extremely hazardous area due to the velocity of floodwaters that carry debris and potential projectiles.

"Functionally dependent use" - means a use that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

"Highest adjacent grade" - means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

"Historic structure" - means any structure that is:

1. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
2. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
3. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or
4. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
 - a) By an approved state program as determined by the Secretary of the Interior, or
 - b) Directly by the Secretary of the Interior in states without approved programs.

"Levee" - means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

"Levee system" - means a flood protection system which consists of a levee or levees and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

"Lowest floor" - means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking or vehicles, building access or storage in an area other than a basement area is not considered a building's lowest floor;

provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirement of Section 60.3 of Title 44 CFR.

"Manufactured home" - means a structure transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. The term "manufactured home" does not include a "recreational vehicle".

"Manufactured home park or subdivision" - means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

"Mean sea level" - means, for purposes of the National Flood Insurance Program, the North American Vertical Datum (NAVD) of 1988 or other datum, to which base flood elevations shown on the Town of Taft Flood Insurance Rate Map are referenced.

"New construction" - means, for the purpose of determining insurance rates, structures for which the "start of construction" commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, "new construction" means structures for which the "start of construction" commenced on or after the effective date of a floodplain management regulation adopted by the Town of Taft Board of Trustees and includes any subsequent improvements to such structures.

"New manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of floodplain management regulations adopted by the Town of Taft Board of Trustees.

"OWRB" – means the Oklahoma Water Resources Board.

"Recreational vehicle" - means a vehicle which is:

1. Built on a single chassis;
2. 400 square feet or less when measured at the largest horizontal projections;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

"Start of construction" - (for other than new construction or substantial improvements under the Coastal Barrier Resources Act (Public Law 97-348), includes substantial improvement and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for basement, footings, piers or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main

structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

"Structure" - means a walled and roofed building, including a gas or liquid storage tank that is principally above ground, as well as a manufactured home.

"Substantial damage" - means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"Substantial improvement" - means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before "start of construction" of the improvement. This includes structures that have incurred "substantial damage", regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary conditions, or
2. Any alteration of a "historic structure" provided that the alteration would not preclude the structure's continued designation as a "historic structure."

"Variance" - is a grant of relief by the Town of Taft Board of Trustees to a person from the terms of this ordinance when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise prohibited by this ordinance. (For full requirements see Section 60.6 of Title 44 CFR.)

"Violation" - means the failure of a structure or other development to be fully compliant with this flood damage prevention ordinance.

"Water surface elevation" - means the height, in relation to the North American Vertical Datum (NAVD) of 1988 (or other datum, where specified), of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

ARTICLE III**GENERAL PROVISIONS****SECTION A. LANDS TO WHICH THIS ORDINANCE APPLIES**

This flood damage prevention ordinance shall apply to all areas of special flood hazard within the jurisdiction of the Town of Taft, Oklahoma.

SECTION B. BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by FEMA in a scientific and engineering report entitled, "The Flood Insurance Study for Muskogee County , Oklahoma and Incorporated Areas" dated February 4, 2011, with the accompanying Flood Insurance Rate Map (FIRM) are hereby adopted on February 4, 2011, by reference and declared to be a part of this ordinance. However, until this date the current effective flood maps for the Town of Taft, dated March 4, 1991 for Muskogee County shall be used for this purpose until February 4, 2011.

SECTION C. ESTABLISHMENT OF DEVELOPMENT PERMIT

A Development Permit shall be required to ensure conformance with the provisions of this floodplain management ordinance.

SECTION D. COMPLIANCE

No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of this ordinance and other applicable regulations.

SECTION E. ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and any other ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

SECTION F. INTERPRETATION

In the interpretation and application of this ordinance, all provisions shall be:

1. Considered as minimum requirements;
2. Liberally construed in favor of the governing body; and
3. Deemed neither to limit nor repeal any other powers granted under State statutes.

SECTION G. WARNING AND DISCLAIMER OR LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of the Town of Taft or any official or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

ARTICLE IV**ADMINISTRATION****SECTION A. DESIGNATION OF THE FLOODPLAIN ADMINISTRATOR**

The Board of Trustees of the Town of Taft designates the Billing Clerk as Floodplain Administrator to administer and implement the provisions of this ordinance and other appropriate sections of National Flood Insurance Program regulations in Title 44 CFR pertaining to floodplain management.

SECTION B. DUTIES AND RESPONSIBILITIES OF THE FLOODPLAIN ADMINISTRATOR

Duties and responsibilities of the Floodplain Administrator shall include, but not be limited to, the following:

1. Become accredited by the OWRB in accordance with Title 82 O.S. §§ 1601-1618, as amended.
2. Reviews permit applications to determine whether the proposed building sites, including the placement of manufactured homes, will be reasonably safe from flooding.
3. Review, approve or deny all applications for Development Permits required by this ordinance.
4. Review proposed development to assure that all necessary permits have been obtained from those Federal, State or local governmental agencies from which prior approval are required.
5. Make the necessary interpretation where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions).
6. Notify, in riverine situations, adjacent communities and the OWRB prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the FEMA.
7. Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.
8. Shall require the developer/applicant to determine and provide the base flood elevation on two FEMA Elevation Certificates, one pre and one post, as well as other data as required in order to administer the provisions of Article V.
9. When a floodway has not been designated, the Floodplain Administrator must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zone AE as delineated on the Muskogee County FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water

surface elevation of the base flood more than one foot at any point within the Town of Taft.

10. After a disaster or other type of damage occurrence to structures in the Town of Taft, determine if the residential and non-residential structures and manufactured homes have been substantially damaged, and enforce the substantial improvement requirement.
11. Maintain a record of all actions involving an appeal from a decision of the Board of Trustees.
12. Maintain and hold open for public inspection all records pertaining to the provisions of this ordinance.

SECTION C. PERMIT PROCEDURES

1. An Application for a Development Permit shall be presented to the Floodplain Administrator on forms furnished by him/her and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, including the placement of manufactured homes, and the location of the foregoing in relation to areas of special flood hazard. Additionally, the following information is required:
 - a. Elevation in relation to mean sea level of the lowest floor (including basement) of all new and substantially improved structures; and
 - b. Description of the extent to which any watercourse or natural drainage will be altered or relocated as a result of proposed development.
2. Approval or denial of a Development Permit by the Floodplain Administrator shall be based on all of the provisions of this ordinance and the following relevant factors:
 - a. The danger to life and property due to flooding or erosion damage;
 - b. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
 - c. The danger that materials may be swept onto other lands to the injury of others;
 - d. The compatibility of the proposed use with existing and anticipated development;
 - e. The safety of access to the property in times of flood for ordinary and emergency vehicles;
 - f. The costs of providing governmental services during and after flood conditions including maintenance and repair of streets and bridges, and public utilities and facilities such as sewer, gas, electrical and water systems;
 - g. The expected heights, velocity, duration, rate of rise and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;

- h. The necessity to the facility of a waterfront location, where applicable;
 - i. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use; and
 - j. The relationship of the proposed use to the comprehensive plan for that area.
- 3. The Floodplain Administrator or Board of Trustees, as applicable, may approve certain development in Zones A or AE delineated on the Muskogee County FIRM which increases the water surface elevation of the base flood by more than one foot, provided that the applicant for the Development Permit in that case first complies with 44 CFR Section 65.12.

SECTION D. VARIANCES

1. General provisions.

a. The Board of Trustees may grant variances for uses which do not satisfy the requirements of the Oklahoma Floodplain Management Act or this ordinance, if the applicant for the variance presents adequate proof that (i) compliance with this ordinance will result in an arbitrary and unreasonable taking of property without sufficient benefit or advantage to the people and (ii) satisfies the pertinent provisions of this Section D. However, no variance shall be granted where the effect of the variance will be to permit the continuance of a condition which unreasonably creates flooding hazards.

b. Any variance so granted shall not be construed as to relieve any person who receives it from any liability imposed by the Oklahoma Floodplain Management Act or by other laws of the state.

c. In no case shall variances be effective for a period longer than twenty (20) years.

d. Any person seeking a variance shall file a petition with the Board of Trustees, accompanied by a filing fee of Twenty-five Dollars (\$25.00).

e. Variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in Section C(2) and provisions of Section D of this Article IV have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.

f. Any person seeking a variance to build a structure below the base flood elevation will be issued a notice signed by the Chairman of the Board of Trustees which states that (i) the cost of flood insurance will be commensurate with the increased risk resulting from permitting the structure to be built lower than the base flood elevation, and (ii) such construction below the base flood level increases risks to life and property.

g. At such time as the Board of Trustees deems the petition ready for notification to the public, the Board of Trustees shall schedule a hearing and direct the applicant to publish

notice thereof in a newspaper of general circulation in Muskogee County at least thirty (30) days prior to the hearing.

h. The Board of Trustees shall conduct the hearing and make determinations in accordance with the applicable provisions of this Section D. This appeals group shall exercise wide discretion in weighing the equities involved and the advantages and disadvantages to the applicant and to the public at large when determining whether the variance shall be granted.

i. Variances shall only be issued upon:

- (1) A showing of good and sufficient cause;
- (2) A determination that failure to grant the variance would result in exceptional hardship to the applicant;
- (3) A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws, regulations or ordinances; and
- (4) A determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

j. Upon consideration of the factors stated in this Section D and the intent of this ordinance, the Board of Trustees may attach such conditions to the granting of a variance as it deems necessary to further the purposes and objectives stated in Article I, Section C of this ordinance.

k. The Floodplain Administrator shall maintain a record of all variance actions, including justification for their issuance; and a copy of any variance issued by the Board of Trustees shall be sent by the Floodplain Administrator to the OWRB and FEMA within fifteen (15) days after issuance of the variance.

2. Special provisions.

a. Variances may be issued for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in the remainder of this ordinance.

b. Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

c. Variances may be issued for the repair or rehabilitation of historic structures upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.

d. Variances may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that:

- (1) The criteria of Section D(1)(e); Section D(1)(i); Section D(2)(b); and Section

D(2)(c) of this Article IV are met, and

- (2) The structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

ARTICLE V

PROVISIONS FOR FLOOD HAZARD REDUCTION

SECTION A. GENERAL STANDARDS

In all areas of special flood hazards the following provisions are required for all new construction and substantial improvements:

1. All new construction or substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
2. All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;
3. All new construction or substantial improvements shall be constructed with materials resistant to flood damage;
4. All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
5. All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
6. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharge from the systems into flood waters; and,
7. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

SECTION B. SPECIFIC STANDARDS

In all areas of special flood hazards the following provisions are required:

1. **Residential Construction** - new construction and substantial improvement of any residential structure shall have the lowest floor (including basement) elevated at a minimum of one (1) foot above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.

SECTION D. FLOODWAYS

The following provisions shall apply to floodways:

1. Encroachments, including but not limited to fill, new construction, substantial improvements and other development are prohibited within the adopted floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the Town of Taft during the occurrence of the base flood discharge.
2. If Article V, Section D.1 above is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Article V.
3. The Town of Taft may permit encroachments within the adopted floodway that would result in an increase in base flood elevations, provided that the applicant for the Development Permit complies with all of 44 CFR Section 65.12.

ARTICLE VI**THE TOWN OF TAFT FLOODPLAIN MANAGEMENT FEE SCHEDULE**

The Town of Taft Board of Trustees establishes the following fee schedule not to exceed \$500.00 for any one service:

- a. Notice of Intent Fee - \$25.00 maximum
- b. Floodplain Development Permit Application Review - \$100.00
- c. Floodplain Development Permit Fee - \$ 25.00
- d. Inspection Fee-per inspection - \$25.00.

ARTICLE VII**PENALTIES FOR NONCOMPLIANCE**

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. A structure or other development without the elevation certificate or other certifications required in this ordinance is presumed to be in violation until such time as that documentation is provided. Violation of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall upon conviction thereof be subject to a fine of no more than \$500.00 and up to one year in jail. Nothing herein contained shall prevent the Board of Trustees of the Town of Taft or its City Attorney from taking such other lawful action as is necessary to prevent or remedy any violation.

CERTIFICATION

It is hereby found and declared by the Board of Trustees of the Town of Taft that severe flooding has occurred in the past within its jurisdiction and will certainly occur within the future; that flooding is likely to result in infliction of serious injury or death, and is likely to result in substantial injury or destruction of property within its jurisdiction; in order to effectively comply with minimum standards for coverage under the National Flood Insurance Program, and in order to effectively remedy the situation described herein, it is necessary that this ordinance become effective immediately.

This ordinance shall supersede any previous floodplain management regulations or ordinance(s) applicable to the Town of Taft.

SEVERABILITY

If any section, clause, sentence, or phrase of this ordinance is held to be invalid or unconstitutional by any court of competent jurisdiction, then said holding shall in no way affect the validity of the remaining portions of this ordinance.

EMERGENCY CLAUSE

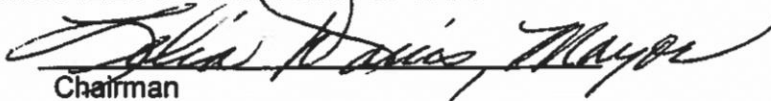
Therefore, an emergency is hereby declared to exist, and this ordinance, being necessary for the immediate preservation of the public peace, health and safety, shall be in full force and effect from and after its passage and approval. The Flood Insurance Study and Flood Insurance Rate Map for Muskogee County and Incorporated Areas dated February 4, 2011, shall apply to this ordinance and shall supersede any previous floodplain management ordinance applicable to the Town of Taft.

WHEREFORE, an emergency is hereby declared to exist and this Ordinance shall be in full force and effect immediately from and after its passage, approval and publication.

PASSED AND APPROVED and the Emergency Clause voted upon separately and passed and approved this 3rd day of January 2011.

ADOPTED BY THE BOARD OF TRUSTEES OF THE TOWN OF TAFT THIS 3rd DAY OF January 2011.

BOARD OF TRUSTEES OF THE TOWN OF TAFT


Chairman

I, Alicia Sourie, the undersigned City Clerk of the Town of Taft, hereby certify that the above is a true and correct copy of a flood damage prevention ordinance duly adopted by the Board of Trustees of the Town of Taft at a regular meeting of said Board of Trustees duly convened and held on January 3rd, 2011. I further certify that the Oklahoma Open Meeting Act was complied with in all respects for such meeting.

Theresa Louis

City Clerk, Town of Taft

(SEAL)

Figure E-10 NFIP Ordinances for the Town of Wainwright, OK

No response was received from officials in the Town of Wainwright after multiple contact attempts.

Figure E-11 NFIP Ordinances for the Town of Warner, OK

**THE TOWN OF WARNER, OKLAHOMA
FLOOD DAMAGE PREVENTION ORDINANCE
“DECLARING AN EMERGENCY”**

ARTICLE I

STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND METHODS

SECTION A. STATUTORY AUTHORIZATION

The Legislature of the State of Oklahoma has in 11 O.S. §§ 41-47, as amended, delegated the responsibility to local governmental units to adopt ordinances designed to minimize flood losses. Therefore, the Town of Warner, Oklahoma, ordains the following, to become effective immediately:

SECTION B. FINDINGS OF FACT

1. The flood hazard areas of the Town of Warner are subject to periodic inundation, which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect the public health, safety and general welfare.
2. These flood losses are created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazards areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, floodproofed or otherwise protected from flood damage.

SECTION C. STATEMENT OF PURPOSE

It is the purpose of this ordinance to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

1. Protect human life and health;
2. Minimize expenditure of public money for costly flood control projects;
3. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
4. Minimize prolonged business interruptions;
5. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains;
6. Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
7. Insure that potential buyers are notified that property is in a flood area.

SECTION D. METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purposes, this ordinance uses the following methods:

1. Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood heights or velocities;
2. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
3. Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters;
4. Control filling, grading, dredging and other development which may increase flood damage; and
5. Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands.

ARTICLE II

DEFINITIONS

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

"Accessory structure" - means a structure which is on the same parcel of property as the principal structure and the use of which is incidental to the use of the principal structure. Examples of accessory structures include but are not limited to garages and storage sheds.

"Area of special flood hazard" - is the land in the floodplain within the The Town of Warner subject to a one percent or greater chance of flooding in any given year.

"Base flood" - means the flood having a one percent chance of being equaled or exceeded in any given year.

"Base flood elevation" – means the elevation in feet above mean sea level of the base flood or 1% chance flood.

"Basement" - means any area of the building having its floor sub-grade (below ground level) on all sides.

"BFE" - means base flood elevation.

"CFR" - means Code of Federal Regulations.

"Critical feature" - means an integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

"Development" - means any man-made change in improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

"Development Permit" - means a permit issued by the Town of Warner Floodplain Administrator which authorizes development in a special flood hazard area in accordance with this ordinance.

"Elevated building" - means a non-basement building built, in the case of a building in Zones AE, A, and X, to have the top of the elevated floor adequately anchored so as not to impair the structural integrity of the building during a flood up to the magnitude of the base flood. In the case of Zones AE, A, and X, "elevated building" also includes a building elevated by means of fill or solid foundation perimeter walls with openings sufficient to facilitate the unimpeded movement of flood waters.

"Existing construction" - means for the purposes of determining rates, structures for which the "start of construction" commenced before the effective date of the FIRM or before January 1, 1975, for FIRMs effective before that date. "Existing construction" may also be referred to as "existing structures."

"Existing manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before August 4, 1972.

"Expansion to an existing manufactured home park or subdivision"- means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

"FEMA" means the Federal Emergency Management Agency.

"FIRM" means Flood Insurance Rate Map.

"Flood" or "flooding" - means a general and temporary condition of partial or complete inundation of normally dry land areas from:

1. The overflow of inland or tidal waters, or
2. The unusual and rapid accumulation or runoff of surface waters from any source.

"Flood Insurance Rate Map" - means an official map of the Town of Warner on which FEMA has delineated both the areas of special flood hazards and the risk premium zones applicable to the Town of Warner.

"Flood insurance study" - is the official report provided by FEMA for The Town of Warner which contains flood profiles, water surface elevation of the base flood, as well as the floodway width, section area and mean velocity.

"Floodplain Administrator" – means a person accredited by the OWRB and designated by the Board of Trustees of the Town of Warner to administer and implement laws, ordinances and regulations relating to the management of floodplains.

"Floodplain or flood-prone area" - means any land area susceptible to being inundated by water from any source (see definition of flood).

"Floodplain management" - means the operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.

"Floodplain management regulations" – this means zoning codes and ordinances, subdivision regulations, building codes, health regulations, special purpose regulations and ordinances (such as floodplain, grading and erosion control regulations and ordinances) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

"Flood protection system" - means those physical structural works for which funds have been authorized, appropriated, and expended and which have been constructed specifically to modify flooding in order to reduce the extent of the areas within The Town of Warner subject to a

"special flood hazard" and the extent of the depths of associated flooding. Such a system typically includes hurricane tidal barriers, dams, reservoirs, levees or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

"Floodway" - means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. A floodway is located within areas of special flood hazard established in Article III, Section B. A floodway is an extremely hazardous area due to the velocity of floodwaters that carry debris and potential projectiles.

"Functionally dependent use" - means a use that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

"Highest adjacent grade" - means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

"Historic structure" - means any structure that is:

1. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
2. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
3. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or
4. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
 - a) By an approved state program as determined by the Secretary of the Interior, or
 - b) Directly by the Secretary of the Interior in states without approved programs.

"Levee" - means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

"Levee system" - means a flood protection system which consists of a levee or levees and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

"Lowest floor" - means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking or vehicles, building access or storage in an area other than a basement area is not considered a building's lowest floor;

provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirement of Section 60.3 of Title 44 CFR.

"Manufactured home" - means a structure transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. The term "manufactured home" does not include a "recreational vehicle".

"Manufactured home park or subdivision" - means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

"Mean sea level" - means, for purposes of the National Flood Insurance Program, the North American Vertical Datum (NAVD) of 1988 or other datum, to which base flood elevations shown on the Town of Warner' Flood Insurance Rate Map are referenced.

"New construction" - means, for the purpose of determining insurance rates, structures for which the "start of construction" commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, "new construction" means structures for which the "start of construction" commenced on or after the effective date of a floodplain management regulation adopted by the Town of Warner Board of Trustees and includes any subsequent improvements to such structures.

"New manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of floodplain management regulations adopted by the Town of Warner Board of Trustees.

"OWRB" – means the Oklahoma Water Resources Board.

"Recreational vehicle" - means a vehicle which is:

1. Built on a single chassis;
2. 400 square feet or less when measured at the largest horizontal projections;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

"Start of construction" - (for other than new construction or substantial improvements under the Coastal Barrier Resources Act (Public Law 97-348), includes substantial improvement and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for basement, footings, piers or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main

structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

"Structure" - means a walled and roofed building, including a gas or liquid storage tank that is principally above ground, as well as a manufactured home.

"Substantial damage" - means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"Substantial improvement" - means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before "start of construction" of the improvement. This includes structures that have incurred "substantial damage", regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary conditions, or
2. Any alteration of a "historic structure" provided that the alteration would not preclude the structure's continued designation as a "historic structure."

"Variance" - is a grant of relief by the Town of Warner Board of Trustees to a person from the terms of this ordinance when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise prohibited by this ordinance. (For full requirements see Section 60.6 of Title 44 CFR.)

"Violation" - means the failure of a structure or other development to be fully compliant with this flood damage prevention ordinance.

"Water surface elevation" - means the height, in relation to the North American Vertical Datum (NAVD) of 1988 (or other datum, where specified), of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

ARTICLE III

GENERAL PROVISIONS

SECTION A. LANDS TO WHICH THIS ORDINANCE APPLIES

This flood damage prevention ordinance shall apply to all areas of special flood hazard within the jurisdiction of the Town of Warner, Oklahoma.

SECTION B. BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by FEMA in a scientific and engineering report entitled, "The Flood Insurance Study for Muskogee County , Oklahoma and Incorporated Areas" dated February 4, 2011, with the accompanying Flood Insurance Rate Map (FIRM) are hereby adopted on February 4, 2011, by reference and declared to be a part of this ordinance. However, until this date the current effective flood maps for the Town of Warner, dated March 4, 1991 for Muskogee County shall be used for this purpose until February 4, 2011.

SECTION C. ESTABLISHMENT OF DEVELOPMENT PERMIT

A Development Permit shall be required to ensure conformance with the provisions of this floodplain management ordinance.

SECTION D. COMPLIANCE

No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of this ordinance and other applicable regulations.

SECTION E. ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and any other ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

SECTION F. INTERPRETATION

In the interpretation and application of this ordinance, all provisions shall be:

1. Considered as minimum requirements;
2. Liberally construed in favor of the governing body; and
3. Deemed neither to limit nor repeal any other powers granted under State statutes.

SECTION G. WARNING AND DISCLAIMER OR LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of the Town of Warner or any official or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

ARTICLE IV**ADMINISTRATION****SECTION A. DESIGNATION OF THE FLOODPLAIN ADMINISTRATOR**

The Board of Trustees of the Town of Warner designates Paula Girty as Floodplain Administrator to administer and implement the provisions of this ordinance and other appropriate sections of National Flood Insurance Program regulations in Title 44 CFR pertaining to floodplain management.

SECTION B. DUTIES AND RESPONSIBILITIES OF THE FLOODPLAIN ADMINISTRATOR

Duties and responsibilities of the Floodplain Administrator shall include, but not be limited to, the following:

1. Become accredited by the OWRB in accordance with Title 82 O.S. §§ 1601-1618, as amended.
2. Reviews permit applications to determine whether the proposed building sites, including the placement of manufactured homes, will be reasonably safe from flooding.
3. Review, approve or deny all applications for Development Permits required by this ordinance.
4. Review proposed development to assure that all necessary permits have been obtained from those Federal, State or local governmental agencies from which prior approval are required.
5. Make the necessary interpretation where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions).
6. Notify, in riverine situations, adjacent communities and the OWRB prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the FEMA.
7. Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.
8. Shall require the developer/applicant to determine and provide the base flood elevation on two FEMA Elevation Certificates, one pre and one post, as well as other data as required in order to administer the provisions of Article V.
9. When a floodway has not been designated, the Floodplain Administrator must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zone AE as delineated on the Muskogee County FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water

surface elevation of the base flood more than one foot at any point within the Town of Warner.

10. After a disaster or other type of damage occurrence to structures in the Town of Warner, determine if the residential and non-residential structures and manufactured homes have been substantially damaged, and enforce the substantial improvement requirement.
11. Maintain a record of all actions involving an appeal from a decision of the Board of Trustees.
12. Maintain and hold open for public inspection all records pertaining to the provisions of this ordinance.

SECTION C. PERMIT PROCEDURES

1. An Application for a Development Permit shall be presented to the Floodplain Administrator on forms furnished by him/her and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, including the placement of manufactured homes, and the location of the foregoing in relation to areas of special flood hazard. Additionally, the following information is required:
 - a. Elevation in relation to mean sea level of the lowest floor (including basement) of all new and substantially improved structures; and
 - b. Description of the extent to which any watercourse or natural drainage will be altered or relocated as a result of proposed development.
2. Approval or denial of a Development Permit by the Floodplain Administrator shall be based on all of the provisions of this ordinance and the following relevant factors:
 - a. The danger to life and property due to flooding or erosion damage;
 - b. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
 - c. The danger that materials may be swept onto other lands to the injury of others;
 - d. The compatibility of the proposed use with existing and anticipated development;
 - e. The safety of access to the property in times of flood for ordinary and emergency vehicles;
 - f. The costs of providing governmental services during and after flood conditions including maintenance and repair of streets and bridges, and public utilities and facilities such as sewer, gas, electrical and water systems;
 - g. The expected heights, velocity, duration, rate of rise and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;

- h. The necessity to the facility of a waterfront location, where applicable;
 - i. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use; and
 - j. The relationship of the proposed use to the comprehensive plan for that area.
- 3. The Floodplain Administrator or Board of Trustees, as applicable, may approve certain development in Zones A or AE delineated on the Muskogee County FIRM which increases the water surface elevation of the base flood by more than one foot, provided that the applicant for the Development Permit in that case first complies with 44 CFR Section 65.12.

SECTION D. VARIANCES

1. General provisions.

a. The Board of Trustees may grant variances for uses which do not satisfy the requirements of the Oklahoma Floodplain Management Act or this ordinance, if the applicant for the variance presents adequate proof that (i) compliance with this ordinance will result in an arbitrary and unreasonable taking of property without sufficient benefit or advantage to the people and (ii) satisfies the pertinent provisions of this Section D. However, no variance shall be granted where the effect of the variance will be to permit the continuance of a condition which unreasonably creates flooding hazards.

b. Any variance so granted shall not be construed as to relieve any person who receives it from any liability imposed by the Oklahoma Floodplain Management Act or by other laws of the state.

c. In no case shall variances be effective for a period longer than twenty (20) years.

d. Any person seeking a variance shall file a petition with the Board of Trustees, accompanied by a filing fee of Twenty-five Dollars (\$25.00).

e. Variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in Section C(2) and provisions of Section D of this Article IV have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.

f. Any person seeking a variance to build a structure below the base flood elevation will be issued a notice signed by the Chairman of the Board of Trustees which states that (i) the cost of flood insurance will be commensurate with the increased risk resulting from permitting the structure to be built lower than the base flood elevation, and (ii) such construction below the base flood level increases risks to life and property.

g. At such time as the Board of Trustees deems the petition ready for notification to the public, the Board of Trustees shall schedule a hearing and direct the applicant to publish

notice thereof in a newspaper of general circulation in Muskogee County at least thirty (30) days prior to the hearing.

h. The Board of Trustees shall conduct the hearing and make determinations in accordance with the applicable provisions of this Section D. This appeals group shall exercise wide discretion in weighing the equities involved and the advantages and disadvantages to the applicant and to the public at large when determining whether the variance shall be granted.

i. Variances shall only be issued upon:

- (1) A showing of good and sufficient cause;
- (2) A determination that failure to grant the variance would result in exceptional hardship to the applicant;
- (3) A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws, regulations or ordinances; and
- (4) A determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

j. Upon consideration of the factors stated in this Section D and the intent of this ordinance, the Board of Trustees may attach such conditions to the granting of a variance as it deems necessary to further the purposes and objectives stated in Article I, Section C of this ordinance.

k. The Floodplain Administrator shall maintain a record of all variance actions, including justification for their issuance; and a copy of any variance issued by the Board of Trustees shall be sent by the Floodplain Administrator to the OWRB and FEMA within fifteen (15) days after issuance of the variance.

2. Special provisions.

a. Variances may be issued for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in the remainder of this ordinance.

b. Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

c. Variances may be issued for the repair or rehabilitation of historic structures upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.

d. Variances may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that:

- (1) The criteria of Section D(1)(e); Section D(1)(i); Section D(2)(b); and Section

D(2)(c) of this Article IV are met, and

- (2) The structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

ARTICLE V

PROVISIONS FOR FLOOD HAZARD REDUCTION

SECTION A. GENERAL STANDARDS

In all areas of special flood hazards the following provisions are required for all new construction and substantial improvements:

1. All new construction or substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
2. All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;
3. All new construction or substantial improvements shall be constructed with materials resistant to flood damage;
4. All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
5. All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
6. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharge from the systems into flood waters; and,
7. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

SECTION B. SPECIFIC STANDARDS

In all areas of special flood hazards the following provisions are required:

1. **Residential Construction** - new construction and substantial improvement of any residential structure shall have the lowest floor (including basement) elevated at a minimum of one (1) foot above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.

2. Nonresidential Construction - new construction and substantial improvements of any commercial, industrial or other nonresidential structure shall have the lowest floor (including basement) elevated at a minimum one (1) foot above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.

3. Enclosures - new construction and substantial improvements, with fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria:

- (a) A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided;
- (b) The bottom of all openings shall be no higher than one foot above grade; and
- (c) Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

4. Manufactured Homes -

Require that all manufactured homes to be placed anywhere within the Town of Warner within Zones A and AE on the Town of Warner FIRM shall be installed using methods and practices that minimize flood damage and have the bottom of the I-beam elevated at or above the BFE. For the purposes of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse, or lateral movement. This requirement is in addition to applicable State and local anchoring requirements for resisting wind forces. The home shall be installed by a licensed installer according to Oklahoma state law and compliance herewith shall be certified in writing to the Floodplain Administrator by said installer prior to habitation of the manufactured home.

5. Recreational Vehicles - Require that recreational vehicles placed on sites within Zones A and AE on the Muskogee County FIRM either:

- (a) Be on the site for fewer than 180 consecutive days,
- (b) Be fully licensed and ready for highway use, or
- (c) Meet the permit requirements of Article IV, Section C, and the elevation and anchoring requirements for "manufactured homes" in paragraph (4) of this section. A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions.

6. Accessory Structure – Accessory structures to be placed on sites within Zones A and AE on the Muskogee County FIRM shall comply with the following:

- (a) The structure shall be unfinished on the interior;
- (b) The structure shall be used only for parking and limited storage;
- (c) The structure shall not be used for human habitation. Prohibited activities or uses include but are not limited to working, sleeping, living, cooking, or restroom use;
- (d) Service facilities such as electrical and heating equipment must be elevated to or above the BFE;
- (e) The structure shall be constructed and placed on the building site so as to offer the minimum resistance to the flow of floodwaters;
- (f) The structure shall be designed to have low flood damage potential and constructed with flood resistance materials;
- (g) The structure shall be firmly anchored to prevent flotation, collapse, and lateral movement;
- (h) Floodway requirements must be met in the construction of the structure;
- (i) Openings to relieve hydrostatic pressure during a flood shall be provided below the BFE; and
- (j) The structure shall be located so as not to cause damage to adjacent and nearby structures.

SECTION C. STANDARDS FOR SUBDIVISIONS

1. The applicant for a Development Permit for any subdivision located in Zones A and AE which is 51 or more lots or greater than 5 acres shall generate the base flood elevation data for that subdivision.
2. All subdivisions including the placement of manufactured home parks and subdivisions shall have adequate drainage provided to reduce exposure to flood hazards.
3. All subdivisions including the placement of manufactured home parks and subdivisions shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize or eliminate flood damage.

SECTION D. FLOODWAYS

The following provisions shall apply to floodways:

1. Encroachments, including but not limited to fill, new construction, substantial improvements and other development are prohibited within the adopted floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the Town of Warner during the occurrence of the base flood discharge.
2. If Article V, Section D.1 above is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Article V.
3. The Town of Warner may permit encroachments within the adopted floodway that would result in an increase in base flood elevations, provided that the applicant for the Development Permit complies with all of 44 CFR Section 65.12.

ARTICLE VI**THE TOWN OF WARNER FLOODPLAIN MANAGEMENT FEE SCHEDULE**

The Town of Warner Board of Trustees establishes the following fee schedule not to exceed \$500.00 for any one service:

- a. Notice of Intent Fee - \$25.00 maximum
- b. Floodplain Development Permit Application Review - \$100.00
- c. Floodplain Development Permit Fee - \$ 25.00
- d. Inspection Fee-per inspection - \$25.00.

ARTICLE VII**PENALTIES FOR NONCOMPLIANCE**

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. A structure or other development without the elevation certificate or other certifications required in this ordinance is presumed to be in violation until such time as that documentation is provided. Violation of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall upon conviction thereof be subject to a fine of no more than \$500.00 and up to one year in jail. Nothing herein contained shall prevent the Board of Trustees of the Town of Warner or its City Attorney from taking such other lawful action as is necessary to prevent or remedy any violation.

CERTIFICATION

It is hereby found and declared by the Board of Trustees of the Town of Warner that severe flooding has occurred in the past within its jurisdiction and will certainly occur within the future; that flooding is likely to result in infliction of serious injury or death., and is likely to result in substantial injury or destruction of property within its jurisdiction; in order to effectively comply with minimum standards for coverage under the National Flood Insurance Program, and in order to effectively remedy the situation described herein, it is necessary that this ordinance become effective immediately.

This ordinance shall supersede any previous floodplain management regulations or ordinance(s) applicable to the Town of Warner.

SEVERABILITY

If any section, clause, sentence, or phrase of this ordinance is held to be invalid or unconstitutional by any court of competent jurisdiction, then said holding shall in no way affect the validity of the remaining portions of this ordinance.

EMERGENCY CLAUSE

Therefore, an emergency is hereby declared to exist, and this ordinance, being necessary for the immediate preservation of the public peace, health and safety, shall be in full force and effect from and after its passage and approval. The Flood Insurance Study and Flood Insurance Rate Map for Muskogee County and Incorporated Areas dated February 4, 2011, shall apply to this ordinance and shall supersede any previous floodplain management ordinance applicable to the Town of Warner.

WHEREFORE, an emergency is hereby declared to exist and this Ordinance shall be in full force and effect immediately from and after its passage, approval and publication.

PASSED AND APPROVED and the Emergency Clause voted upon separately and passed and approved this 12 day of January 2011.

ADOPTED BY THE BOARD OF TRUSTEES OF THE TOWN OF WARNER THIS 12 DAY OF January 2011.

BOARD OF TRUSTEES OF THE TOWN OF WARNER


Chairman

I, Connie Hiseley, the undersigned City Clerk of the Town of Warner, hereby certify that the above is a true and correct copy of a flood damage prevention ordinance duly adopted by the Board of Trustees of the Town of Warner at a regular meeting of said Board of Trustees duly convened and held on January

Warner at a regular meeting of said Board of Trustees duly convened and held on January 12, 2011. I further certify that the Oklahoma Open Meeting Act was complied with in all respects for such meeting.



City Clerk, Town of Warner

(SEAL)



Figure E-12 NFIP Ordinances for the Town of Webbers Falls, OK

**THE TOWN OF WEBBERS FALLS, OKLAHOMA
FLOOD DAMAGE PREVENTION ORDINANCE
"DECLARING AN EMERGENCY"**

ARTICLE I

STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND METHODS

SECTION A. STATUTORY AUTHORIZATION

The Legislature of the State of Oklahoma has in 11 O.S. §§ 41-47, as amended, delegated the responsibility to local governmental units to adopt ordinances designed to minimize flood losses. Therefore, the Town of Webbers Falls, Oklahoma, ordains the following, to become effective immediately:

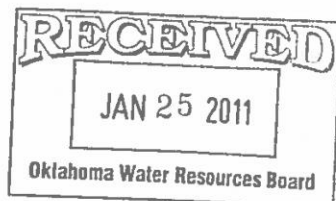
SECTION B. FINDINGS OF FACT

1. The flood hazard areas of the Town of Webbers Falls are subject to periodic inundation, which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, all of which adversely affect the public health, safety and general welfare.
2. These flood losses are created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazards areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, floodproofed or otherwise protected from flood damage.

SECTION C. STATEMENT OF PURPOSE

It is the purpose of this ordinance to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

1. Protect human life and health;
2. Minimize expenditure of public money for costly flood control projects;
3. Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
4. Minimize prolonged business interruptions;
5. Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains;
6. Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
7. Insure that potential buyers are notified that property is in a flood area.



SECTION D. METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purposes, this ordinance uses the following methods:

1. Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood heights or velocities;
2. Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
3. Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of flood waters;
4. Control filling, grading, dredging and other development which may increase flood damage; and
5. Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands.

ARTICLE II

DEFINITIONS

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

"Accessory structure" - means a structure which is on the same parcel of property as the principal structure and the use of which is incidental to the use of the principal structure. Examples of accessory structures include but are not limited to garages and storage sheds.

"Area of special flood hazard" - is the land in the floodplain within the The Town of Webbers Falls subject to a one percent or greater chance of flooding in any given year.

"Base flood" - means the flood having a one percent chance of being equaled or exceeded in any given year.

"Base flood elevation" – means the elevation in feet above mean sea level of the base flood or 1% chance flood.

"Basement" - means any area of the building having its floor sub-grade (below ground level) on all sides.

"BFE" - means base flood elevation.

"CFR" - means Code of Federal Regulations.

"Critical feature" - means an integral and readily identifiable part of a flood protection system, without which the flood protection provided by the entire system would be compromised.

"Development" - means any man-made change in improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

"Development Permit" - means a permit issued by the Town of Webbers Falls Floodplain Administrator which authorizes development in a special flood hazard area in accordance with this ordinance.

"Elevated building" - means a non-basement building built, in the case of a building in Zones AE, A, and X, to have the top of the elevated floor adequately anchored so as not to impair the structural integrity of the building during a flood up to the magnitude of the base flood. In the case of Zones AE, A, and X, "elevated building" also includes a building elevated by means of fill or solid foundation perimeter walls with openings sufficient to facilitate the unimpeded movement of flood waters.

"Existing construction" - means for the purposes of determining rates, structures for which the "start of construction" commenced before the effective date of the FIRM or before January 1, 1975, for FIRMs effective before that date. "Existing construction" may also be referred to as "existing structures."

"Existing manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before August 4, 1972.

"Expansion to an existing manufactured home park or subdivision" - means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

"FEMA" means the Federal Emergency Management Agency.

"FIRM" means Flood Insurance Rate Map.

"Flood" or "flooding" - means a general and temporary condition of partial or complete inundation of normally dry land areas from:

1. The overflow of inland or tidal waters, or
2. The unusual and rapid accumulation or runoff of surface waters from any source.

"Flood Insurance Rate Map" - means an official map of the Town of Webbers Falls on which FEMA has delineated both the areas of special flood hazards and the risk premium zones applicable to the Town of Webbers Falls.

"Flood insurance study" - is the official report provided by FEMA for The Town of Webbers Falls which contains flood profiles, water surface elevation of the base flood, as well as the floodway width, section area and mean velocity.

"Floodplain Administrator" – means a person accredited by the OWRB and designated by the Board of Trustees of the Town of Webbers Falls to administer and implement laws, ordinances and regulations relating to the management of floodplains.

"Floodplain or flood-prone area" - means any land area susceptible to being inundated by water from any source (see definition of flood).

"Floodplain management" - means the operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.

"Floodplain management regulations" – this means zoning codes and ordinances, subdivision regulations, building codes, health regulations, special purpose regulations and ordinances (such as floodplain, grading and erosion control regulations and ordinances) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

"Flood protection system" - means those physical structural works for which funds have been authorized, appropriated, and expended and which have been constructed specifically to modify flooding in order to reduce the extent of the areas within The Town of Webbers Falls subject to

a "special flood hazard" and the extent of the depths of associated flooding. Such a system typically includes hurricane tidal barriers, dams, reservoirs, levees or dikes. These specialized flood modifying works are those constructed in conformance with sound engineering standards.

"Floodway" - means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. A floodway is located within areas of special flood hazard established in Article III, Section B. A floodway is an extremely hazardous area due to the velocity of floodwaters that carry debris and potential projectiles.

"Functionally dependent use" - means a use that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

"Highest adjacent grade" - means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

"Historic structure" - means any structure that is:

1. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
2. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
3. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or
4. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
 - a) By an approved state program as determined by the Secretary of the Interior, or
 - b) Directly by the Secretary of the Interior in states without approved programs.

"Levee" - means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

"Levee system" - means a flood protection system which consists of a levee or levees and associated structures, such as closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

"Lowest floor" - means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking or vehicles, building access or storage in an area other than a basement area is not considered a building's lowest floor;

provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirement of Section 60.3 of Title 44 CFR.

"Manufactured home" - means a structure transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. The term "manufactured home" does not include a "recreational vehicle".

"Manufactured home park or subdivision" - means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

"Mean sea level" - means, for purposes of the National Flood Insurance Program, the North American Vertical Datum (NAVD) of 1988 or other datum, to which base flood elevations shown on the Town of Webbers Falls' Flood Insurance Rate Map are referenced.

"New construction" - means, for the purpose of determining insurance rates, structures for which the "start of construction" commenced on or after the effective date of an initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, "new construction" means structures for which the "start of construction" commenced on or after the effective date of a floodplain management regulation adopted by the Town of Webbers Falls Board of Trustees and includes any subsequent improvements to such structures.

"New manufactured home park or subdivision" - means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of floodplain management regulations adopted by the Town of Webbers Falls Board of Trustees.

"OWRB" – means the Oklahoma Water Resources Board.

"Recreational vehicle" - means a vehicle which is:

1. Built on a single chassis;
2. 400 square feet or less when measured at the largest horizontal projections;
3. Designed to be self-propelled or permanently towable by a light duty truck; and
4. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

"Start of construction" - (for other than new construction or substantial improvements under the Coastal Barrier Resources Act (Public Law 97-348), includes substantial improvement and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for basement, footings, piers or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main

structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

"Structure" - means a walled and roofed building, including a gas or liquid storage tank that is principally above ground, as well as a manufactured home.

"Substantial damage" - means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"Substantial improvement" - means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before "start of construction" of the improvement. This includes structures that have incurred "substantial damage", regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary conditions, or
2. Any alteration of a "historic structure" provided that the alteration would not preclude the structure's continued designation as a "historic structure."

"Variance" - is a grant of relief by the Town of Webbers Falls Board of Trustees to a person from the terms of this ordinance when specific enforcement would result in unnecessary hardship. A variance, therefore, permits construction or development in a manner otherwise prohibited by this ordinance. (For full requirements see Section 60.6 of Title 44 CFR.)

"Violation" - means the failure of a structure or other development to be fully compliant with this flood damage prevention ordinance.

"Water surface elevation" - means the height, in relation to the North American Vertical Datum (NAVD) of 1988 (or other datum, where specified), of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

ARTICLE III**GENERAL PROVISIONS****SECTION A. LANDS TO WHICH THIS ORDINANCE APPLIES**

This flood damage prevention ordinance shall apply to all areas of special flood hazard within the jurisdiction of the Town of Webbers Falls, Oklahoma.

SECTION B. BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by FEMA in a scientific and engineering report entitled, "The Flood Insurance Study for Muskogee County, Oklahoma and Incorporated Areas" dated February 4, 2011, with the accompanying Flood Insurance Rate Map (FIRM) are hereby adopted on February 4, 2011, by reference and declared to be a part of this ordinance. However, until this date the current effective flood maps for the Town of Webbers Falls, dated March 4, 1991 for Muskogee County shall be used for this purpose until February 4, 2011.

SECTION C. ESTABLISHMENT OF DEVELOPMENT PERMIT

A Development Permit shall be required to ensure conformance with the provisions of this floodplain management ordinance.

SECTION D. COMPLIANCE

No structure or land shall hereafter be located, altered, or have its use changed without full compliance with the terms of this ordinance and other applicable regulations.

SECTION E. ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and any other ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

SECTION F. INTERPRETATION

In the interpretation and application of this ordinance, all provisions shall be:

1. Considered as minimum requirements;
2. Liberally construed in favor of the governing body; and
3. Deemed neither to limit nor repeal any other powers granted under State statutes.

SECTION G. WARNING AND DISCLAIMER OR LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions greater floods can and will occur and flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of the Town of Webbers Falls or any official or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

ARTICLE IV

ADMINISTRATION

SECTION A. DESIGNATION OF THE FLOODPLAIN ADMINISTRATOR

The Board of Trustees of the Town of Webbers Falls designates the Chief of Police as Floodplain Administrator to administer and implement the provisions of this ordinance and other appropriate sections of National Flood Insurance Program regulations in Title 44 CFR pertaining to floodplain management.

SECTION B. DUTIES AND RESPONSIBILITIES OF THE FLOODPLAIN ADMINISTRATOR

Duties and responsibilities of the Floodplain Administrator shall include, but not be limited to, the following:

1. Become accredited by the OWRB in accordance with Title 82 O.S. §§ 1601-1618, as amended.
2. Reviews permit applications to determine whether the proposed building sites, including the placement of manufactured homes, will be reasonably safe from flooding.
3. Review, approve or deny all applications for Development Permits required by this ordinance.
4. Review proposed development to assure that all necessary permits have been obtained from those Federal, State or local governmental agencies from which prior approval are required.
5. Make the necessary interpretation where interpretation is needed as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions).
6. Notify, in riverine situations, adjacent communities and the OWRB prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the FEMA.
7. Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.
8. Shall require the developer/applicant to determine and provide the base flood elevation on two FEMA Elevation Certificates, one pre and one post, as well as other data as required in order to administer the provisions of Article V.
9. When a floodway has not been designated, the Floodplain Administrator must require that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zone AE as delineated on the Muskogee County FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water

surface elevation of the base flood more than one foot at any point within the Town of Webbers Falls.

10. After a disaster or other type of damage occurrence to structures in the Town of Webbers Falls, determine if the residential and non-residential structures and manufactured homes have been substantially damaged, and enforce the substantial improvement requirement.
11. Maintain a record of all actions involving an appeal from a decision of the Board of Trustees.
12. Maintain and hold open for public inspection all records pertaining to the provisions of this ordinance.

SECTION C. PERMIT PROCEDURES

1. An Application for a Development Permit shall be presented to the Floodplain Administrator on forms furnished by him/her and may include, but not be limited to, plans in duplicate drawn to scale showing the location, dimensions, and elevation of proposed landscape alterations, existing and proposed structures, including the placement of manufactured homes, and the location of the foregoing in relation to areas of special flood hazard. Additionally, the following information is required:
 - a. Elevation in relation to mean sea level of the lowest floor (including basement) of all new and substantially improved structures; and
 - b. Description of the extent to which any watercourse or natural drainage will be altered or relocated as a result of proposed development.
2. Approval or denial of a Development Permit by the Floodplain Administrator shall be based on all of the provisions of this ordinance and the following relevant factors:
 - a. The danger to life and property due to flooding or erosion damage;
 - b. The susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
 - c. The danger that materials may be swept onto other lands to the injury of others;
 - d. The compatibility of the proposed use with existing and anticipated development;
 - e. The safety of access to the property in times of flood for ordinary and emergency vehicles;
 - f. The costs of providing governmental services during and after flood conditions including maintenance and repair of streets and bridges, and public utilities and facilities such as sewer, gas, electrical and water systems;
 - g. The expected heights, velocity, duration, rate of rise and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;

- h. The necessity to the facility of a waterfront location, where applicable;
 - i. The availability of alternative locations, not subject to flooding or erosion damage, for the proposed use; and
 - j. The relationship of the proposed use to the comprehensive plan for that area.
- 3. The Floodplain Administrator or Board of Trustees, as applicable, may approve certain development in Zones A or AE delineated on the Muskogee County FIRM which increases the water surface elevation of the base flood by more than one foot, provided that the applicant for the Development Permit in that case first complies with 44 CFR Section 65.12.

SECTION D. VARIANCES

1. General provisions.

a. The Board of Trustees may grant variances for uses which do not satisfy the requirements of the Oklahoma Floodplain Management Act or this ordinance, if the applicant for the variance presents adequate proof that (i) compliance with this ordinance will result in an arbitrary and unreasonable taking of property without sufficient benefit or advantage to the people and (ii) satisfies the pertinent provisions of this Section D. However, no variance shall be granted where the effect of the variance will be to permit the continuance of a condition which unreasonably creates flooding hazards.

b. Any variance so granted shall not be construed as to relieve any person who receives it from any liability imposed by the Oklahoma Floodplain Management Act or by other laws of the state.

c. In no case shall variances be effective for a period longer than twenty (20) years.

d. Any person seeking a variance shall file a petition with the Board of Trustees, accompanied by a filing fee of Twenty-five Dollars (\$25.00).

e. Variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing the relevant factors in Section C(2) and provisions of Section D of this Article IV have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.

f. Any person seeking a variance to build a structure below the base flood elevation will be issued a notice signed by the Chairman of the Board of Trustees which states that (i) the cost of flood insurance will be commensurate with the increased risk resulting from permitting the structure to be built lower than the base flood elevation, and (ii) such construction below the base flood level increases risks to life and property.

g. At such time as the Board of Trustees deems the petition ready for notification to the public, the Board of Trustees shall schedule a hearing and direct the applicant to publish

notice thereof in a newspaper of general circulation in Muskogee County at least thirty (30) days prior to the hearing.

h. The Board of Trustees shall conduct the hearing and make determinations in accordance with the applicable provisions of this Section D. This appeals group shall exercise wide discretion in weighing the equities involved and the advantages and disadvantages to the applicant and to the public at large when determining whether the variance shall be granted.

i. Variances shall only be issued upon:

- (1) A showing of good and sufficient cause;
- (2) A determination that failure to grant the variance would result in exceptional hardship to the applicant;
- (3) A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws, regulations or ordinances; and
- (4) A determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

j. Upon consideration of the factors stated in this Section D and the intent of this ordinance, the Board of Trustees may attach such conditions to the granting of a variance as it deems necessary to further the purposes and objectives stated in Article I, Section C of this ordinance.

k. The Floodplain Administrator shall maintain a record of all variance actions, including justification for their issuance; and a copy of any variance issued by the Board of Trustees shall be sent by the Floodplain Administrator to the OWRB and FEMA within fifteen (15) days after issuance of the variance.

2. Special provisions.

a. Variances may be issued for the reconstruction, rehabilitation or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in the remainder of this ordinance.

b. Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

c. Variances may be issued for the repair or rehabilitation of historic structures upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.

d. Variances may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that:

- (1) The criteria of Section D(1)(e); Section D(1)(i); Section D(2)(b); and Section

D(2)(c) of this Article IV are met, and

- (2) The structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

ARTICLE V

PROVISIONS FOR FLOOD HAZARD REDUCTION

SECTION A. GENERAL STANDARDS

In all areas of special flood hazards the following provisions are required for all new construction and substantial improvements:

1. All new construction or substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
2. All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;
3. All new construction or substantial improvements shall be constructed with materials resistant to flood damage;
4. All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
5. All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
6. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharge from the systems into flood waters; and,
7. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

SECTION B. SPECIFIC STANDARDS

In all areas of special flood hazards the following provisions are required:

1. **Residential Construction** - new construction and substantial improvement of any residential structure shall have the lowest floor (including basement) elevated at or above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.

2. Nonresidential Construction - new construction and substantial improvements of any commercial, industrial or other nonresidential structure shall have the lowest floor (including basement) elevated at or above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection is satisfied.

3. Enclosures - new construction and substantial improvements, with fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria:

- (a) A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided;
- (b) The bottom of all openings shall be no higher than one foot above grade; and
- (c) Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

4. Manufactured Homes -

Require that all manufactured homes to be placed anywhere within the Town of Webbers Falls within Zones A and AE on the Town of Webbers Falls FIRM shall be installed using methods and practices that minimize flood damage and have the bottom of the I-beam elevated at or above the BFE. For the purposes of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse, or lateral movement. This requirement is in addition to applicable State and local anchoring requirements for resisting wind forces. The home shall be installed by a licensed installer according to Oklahoma state law and compliance herewith shall be certified in writing to the Floodplain Administrator by said installer prior to habitation of the manufactured home.

5. Recreational Vehicles - Require that recreational vehicles placed on sites within Zones A and AE on the Muskogee County FIRM either:

- (a) Be on the site for fewer than 180 consecutive days,
- (b) Be fully licensed and ready for highway use, or
- (c) Meet the permit requirements of Article IV, Section C, and the elevation and anchoring requirements for "manufactured homes" in paragraph (4) of this section. A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions.

6. Accessory Structure – Accessory structures to be placed on sites within Zones A and AE on the Muskogee County FIRM shall comply with the following:

- (a) The structure shall be unfinished on the interior;
- (b) The structure shall be used only for parking and limited storage;
- (c) The structure shall not be used for human habitation. Prohibited activities or uses include but are not limited to working, sleeping, living, cooking, or restroom use;
- (d) Service facilities such as electrical and heating equipment must be elevated to or above the BFE;
- (e) The structure shall be constructed and placed on the building site so as to offer the minimum resistance to the flow of floodwaters;
- (f) The structure shall be designed to have low flood damage potential and constructed with flood resistance materials;
- (g) The structure shall be firmly anchored to prevent flotation, collapse, and lateral movement;
- (h) Floodway requirements must be met in the construction of the structure;
- (i) Openings to relieve hydrostatic pressure during a flood shall be provided below the BFE; and
- (j) The structure shall be located so as not to cause damage to adjacent and nearby structures.

SECTION C. STANDARDS FOR SUBDIVISIONS

1. The applicant for a Development Permit for any subdivision located in Zones A and AE which is 51 or more lots or greater than 5 acres shall generate the base flood elevation data for that subdivision.
2. All subdivisions including the placement of manufactured home parks and subdivisions shall have adequate drainage provided to reduce exposure to flood hazards.
3. All subdivisions including the placement of manufactured home parks and subdivisions shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize or eliminate flood damage.

CERTIFICATION

It is hereby found and declared by the Board of Trustees of the Town of Webbers Falls that severe flooding has occurred in the past within its jurisdiction and will certainly occur within the future; that flooding is likely to result in infliction of serious injury or death., and is likely to result in substantial injury or destruction of property within its jurisdiction; in order to effectively comply with minimum standards for coverage under the National Flood Insurance Program, and in order to effectively remedy the situation described herein, it is necessary that this ordinance become effective immediately.

This ordinance shall supersede any previous floodplain management regulations or ordinance(s) applicable to the Town of Webbers Falls.

SEVERABILITY

If any section, clause, sentence, or phrase of this ordinance is held to be invalid or unconstitutional by any court of competent jurisdiction, then said holding shall in no way affect the validity of the remaining portions of this ordinance.

EMERGENCY CLAUSE

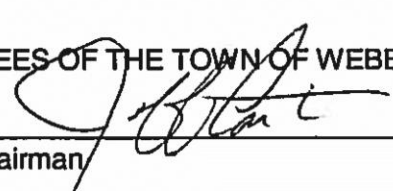
Therefore, an emergency is hereby declared to exist, and this ordinance, being necessary for the immediate preservation of the public peace, health and safety, shall be in full force and effect from and after its passage and approval. The Flood Insurance Study and Flood Insurance Rate Map for Muskogee County and Incorporated Areas dated February 4, 2011, shall apply to this ordinance and shall superseded any previous floodplain management ordinance applicable to the Town of Webbers Falls.

WHEREFORE, an emergency is hereby declared to exist and this Ordinance shall be in full force and effect immediately from and after its passage, approval and publication.

PASSED AND APPROVED and the Emergency Clause voted upon separately and passed and approved this 18TH day of January 2011.

ADOPTED BY THE BOARD OF TRUSTEES OF THE TOWN OF WEBBERS FALLS THIS
18TH **DAY OF** January 2011.

BOARD OF TRUSTEES OF THE TOWN OF WEBBERS FALLS

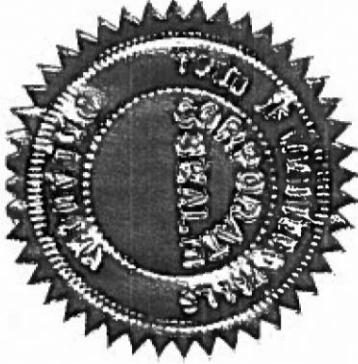

Chairman

I, TONI COX, the undersigned City Clerk of the Town of Webbers Falls, hereby certify that the above is a true and correct copy of a flood damage prevention ordinance duly adopted by the Board of Trustees of the Town of Webbers Falls at a regular meeting of said Board of Trustees duly convened and held on January 18,

2011. I further certify that the Oklahoma Open Meeting Act was complied with in all respects for such meeting.

Toni Cox
City Clerk, Town of Webbers Falls

(SEAL)



Appendix F. Adoption Resolution Letters

Below are signed adoption resolution letters provided by each participating jurisdiction. These formal adoption papers signal the intent of each jurisdiction to uphold and work together towards building a more resilient Muskogee County over the next five years. Letters are grouped by jurisdiction type, beginning with the County.

Ordinance Directory

Muskogee County, OK.....	F-2
Boynton, OK	F-3
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Council Hill, OK	F-5
Fort Gibson, OK.....	F-6
Haskell, OK.....	F-7
Muskogee, OK.....	F-8
Oktaha, OK	F-9
Porum, OK.....	F-10
Summit, OK	F-11
Taft, OK	F-12
Wainwright, OK.....	F-13
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Muskogee County, OK

PLACEHOLDER

Boynton, OK

PLACEHOLDER

Braggs, OK

PLACEHOLDER

Council Hill, OK

PLACEHOLDER

Fort Gibson, OK

PLACEHOLDER

Haskell, OK

PLACEHOLDER

Muskogee, OK

PLACEHOLDER

Oktaha, OK

PLACEHOLDER

Porum, OK

PLACEHOLDER

Summit, OK

PLACEHOLDER

Taft, OK

PLACEHOLDER

Wainwright, OK

PLACEHOLDER

Warner, OK

PLACEHOLDER

Webbers Falls, OK

PLACEHOLDER

Braggs Public School District

PLACEHOLDER

Fort Gibson Public School District

ADOPTION RESOLUTION
Fort Gibson Public Schools
School Board

RESOLUTION

WHEREAS, the 2024 Muskogee County Multi-Hazard Mitigation Plan Update has been prepared in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS, the School Board is a local unit of government that has afforded the citizens an opportunity to comment and provide input in the Plan and the actions in the Plan; and

WHEREAS, the School Board has reviewed the Plan and affirms that the Plan will be updated no less than every five years;

NOW THEREFORE, BE IT RESOLVED by the School Board that Fort Gibson Public Schools adopts this Plan as this jurisdiction's FEMA Natural Hazard Mitigation Plan.

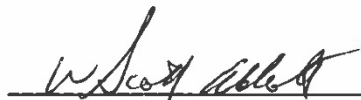
ADOPTION

ADOPTED 02/12/2024 (Date)

At the meeting of the Fort Gibson Board of Education



(Commissioner), (Mayor), (Superintendent) or (Elected Official)



(Clerk) or (Other witness; please list title)

Haskell Public School District

PLACEHOLDER

Hilldale Public School District

PLACEHOLDER

Midway Public School District

PLACEHOLDER

Muskogee Public School District

PLACEHOLDER

Oktaha Public School District

PLACEHOLDER

Porum Public School District

PLACEHOLDER

Wainwright Public School District

PLACEHOLDER

Warner Public School District

PLACEHOLDER

Webbers Falls Public School District

PLACEHOLDER

Appendix G. Additional Hazard Risk Figures

Figures and maps contained in this Appendix are ones that were carried over from the Hazard Risk Assessment in Chapter 4. Flooding and Wildfire maps have been tailored for each jurisdiction participating in this plan, and each can be located by using the hyperlinks embedded in the Table of Contents below.

Wildfire Risk for Incorporated Areas G-3

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Muskogee, OK.....	G-5
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Porum, OK	G-6
Summit, OK	G-7
Taft, OK.....	G-7
Wainwright, OK	G-8
Warner, OK	G-8
Webbers Falls, OK.....	G-9

Wildfire Risk for Public School Districts G-9

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Haskell Public Schools.....	G-10
Hilldale Public Schools.....	G-10
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Oktaha Public Schools	G-11
Porum Public Schools	G-12
Wainwright Public School	G-12
Warner Public Schools	G-12
Webbers Falls Public Schools	G-13

Historic Flooding G-13

Flood Zones for Incorporated Areas G-14

Boynton, OK.....	G-14
Braggs, OK.....	G-15
Council Hill, OK	G-16
Fort Gibson, OK.....	G-17
Haskell, OK.....	G-18
Muskogee, OK.....	G-19
Oktaha, OK	G-20
Porum, OK	G-21
Summit, OK	G-22
Taft, OK.....	G-23
Wainwright, OK	G-24
Warner, OK	G-25
Webbers Falls, OK.....	G-26

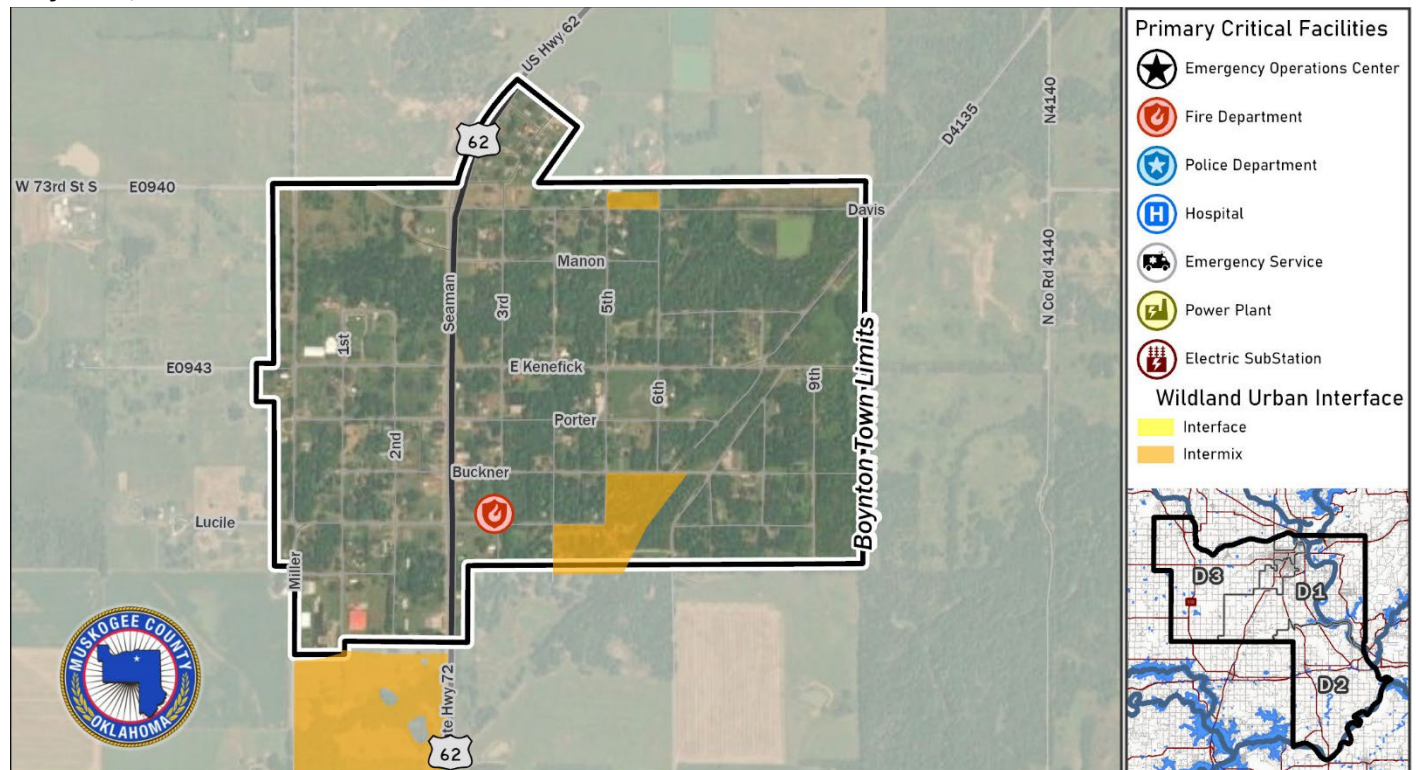
Flooding Maps for Public School Districts G-27

Braggs Public Schools	G-27
Fort Gibson Public Schools.....	G-27
Haskell Public Schools.....	G-27
Hilldale Public Schools.....	G-28
Midway Public School	G-28
Muskogee Public Schools.....	G-28
Oktaha Public Schools	G-29
Porum Public Schools	G-29
Wainwright Public School	G-29
Warner Public Schools	G-30
Webbers Falls Public Schools	G-30

Flooding Reports from ODEMHS G-30

G.1.1 Wildfire Risk for Incorporated Areas

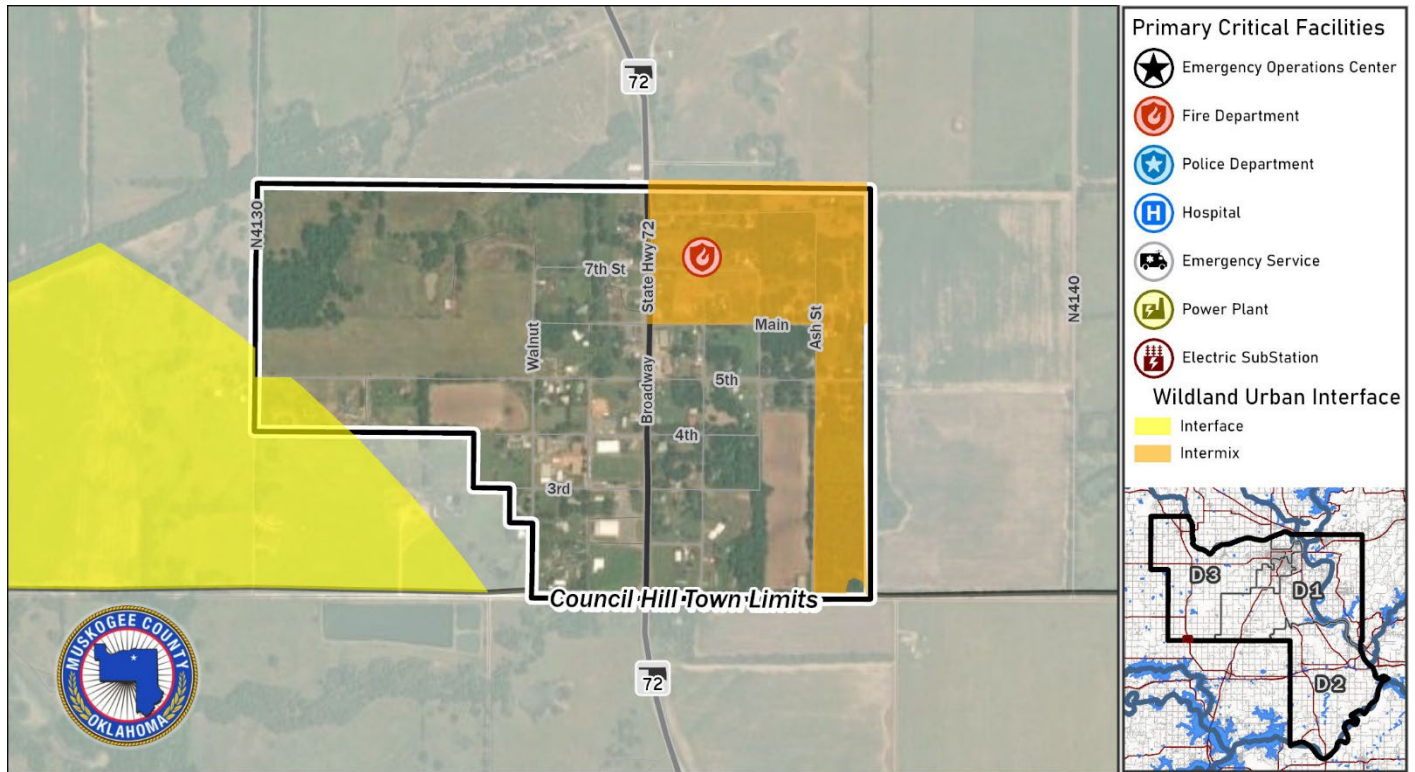
Boynton, OK



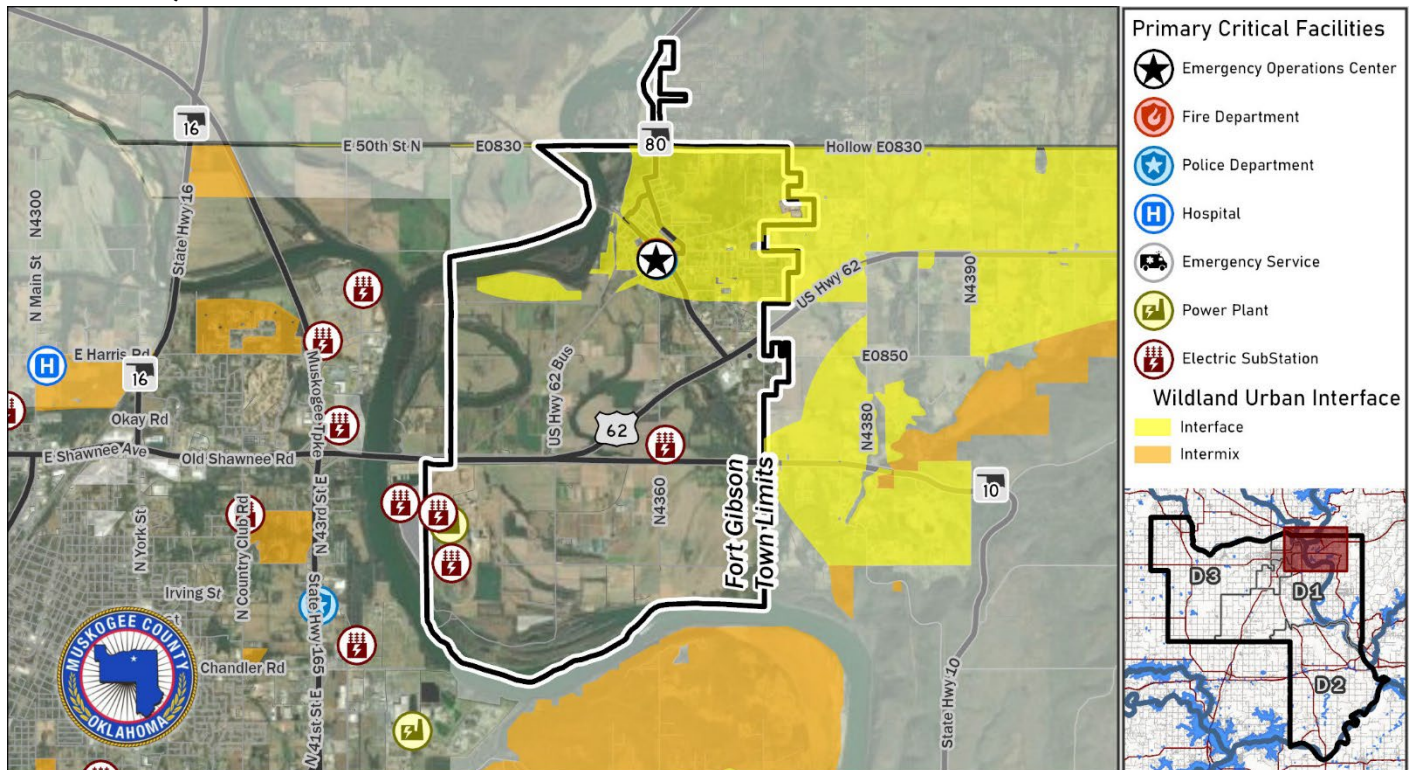
Braggs, OK



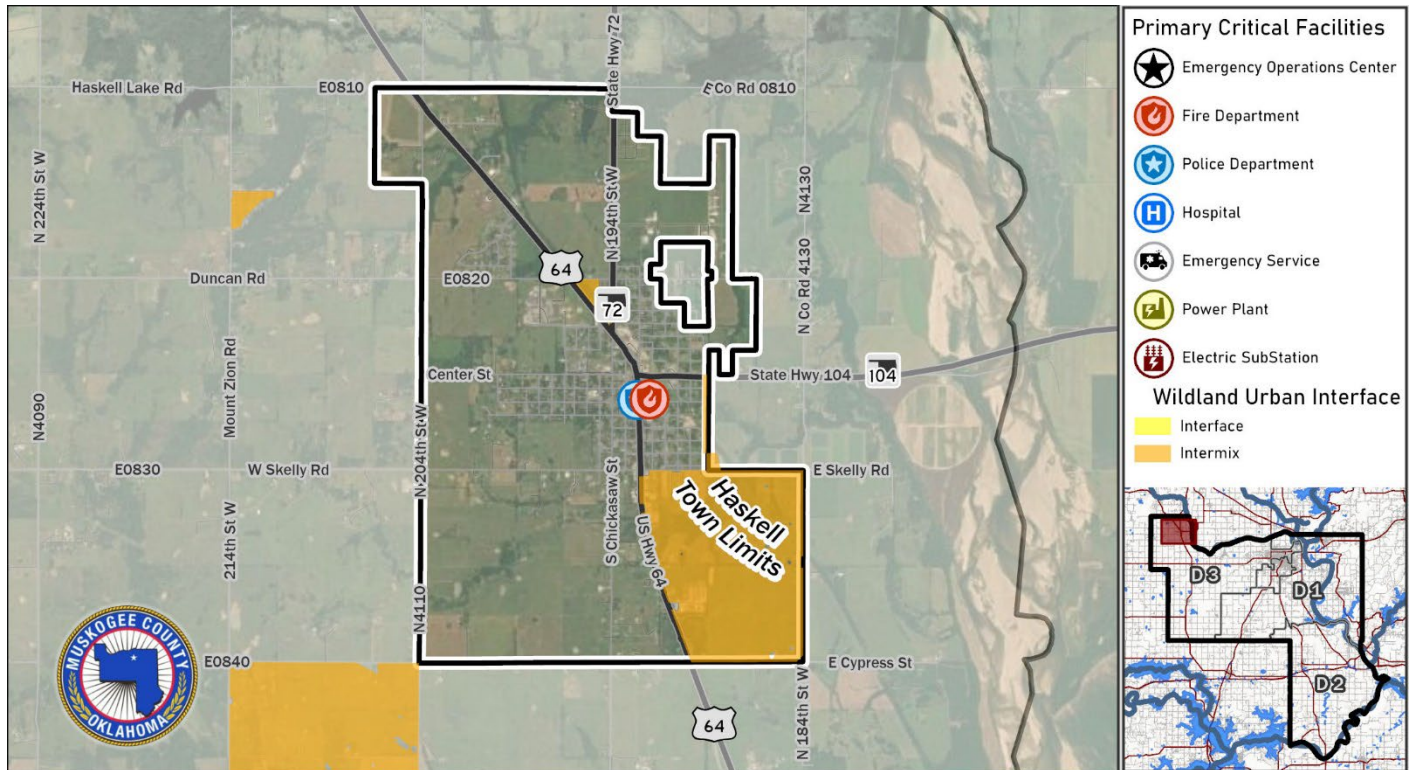
Council Hill, OK



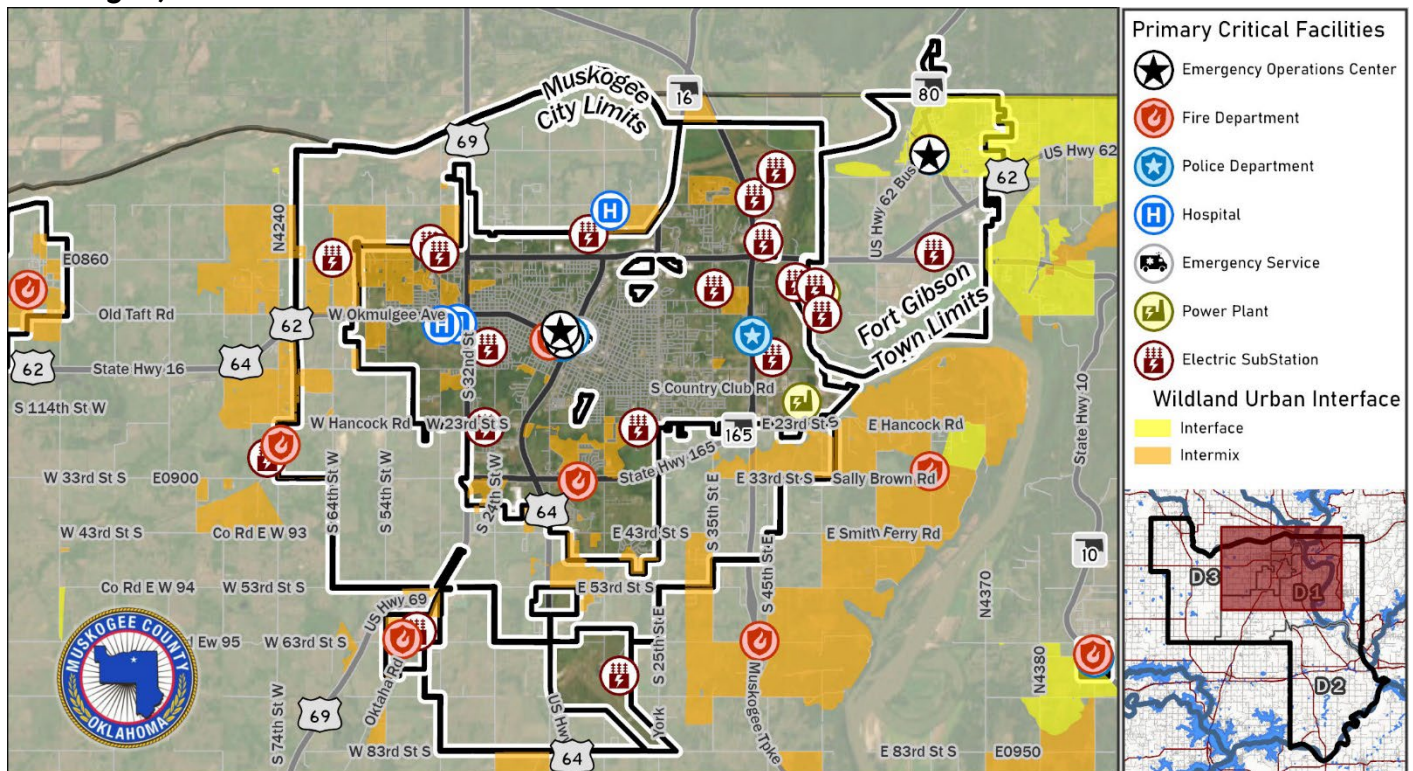
Fort Gibson, OK



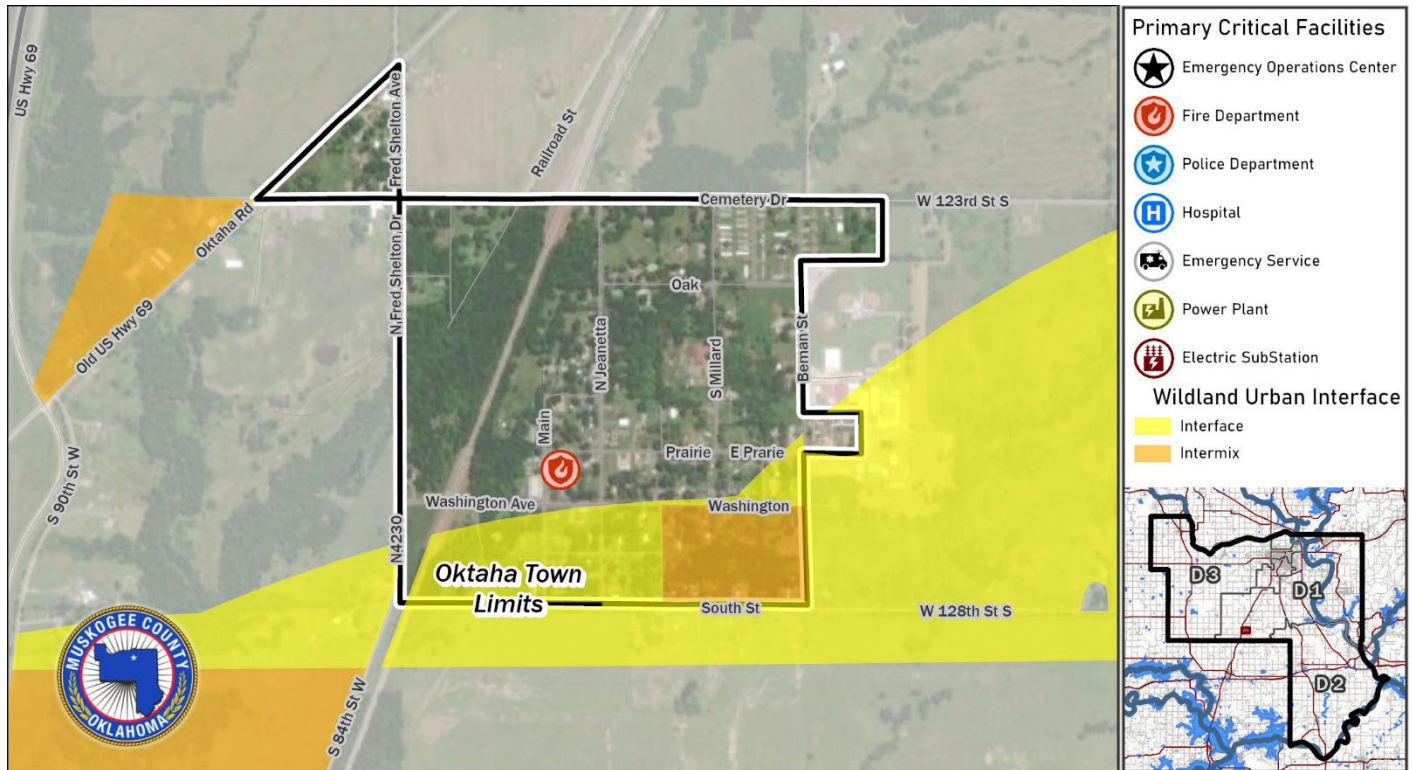
Haskell, OK



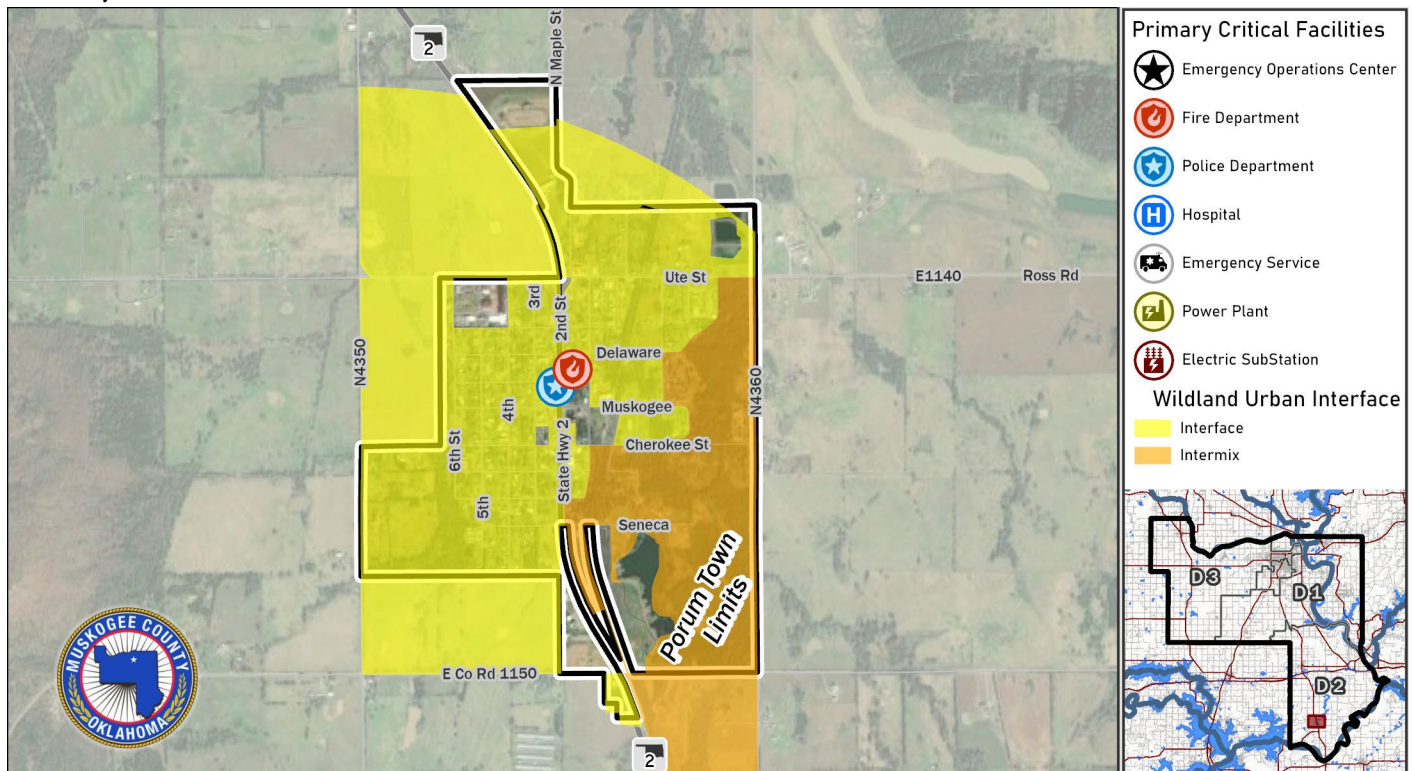
Muskogee, OK



Oktaha, OK



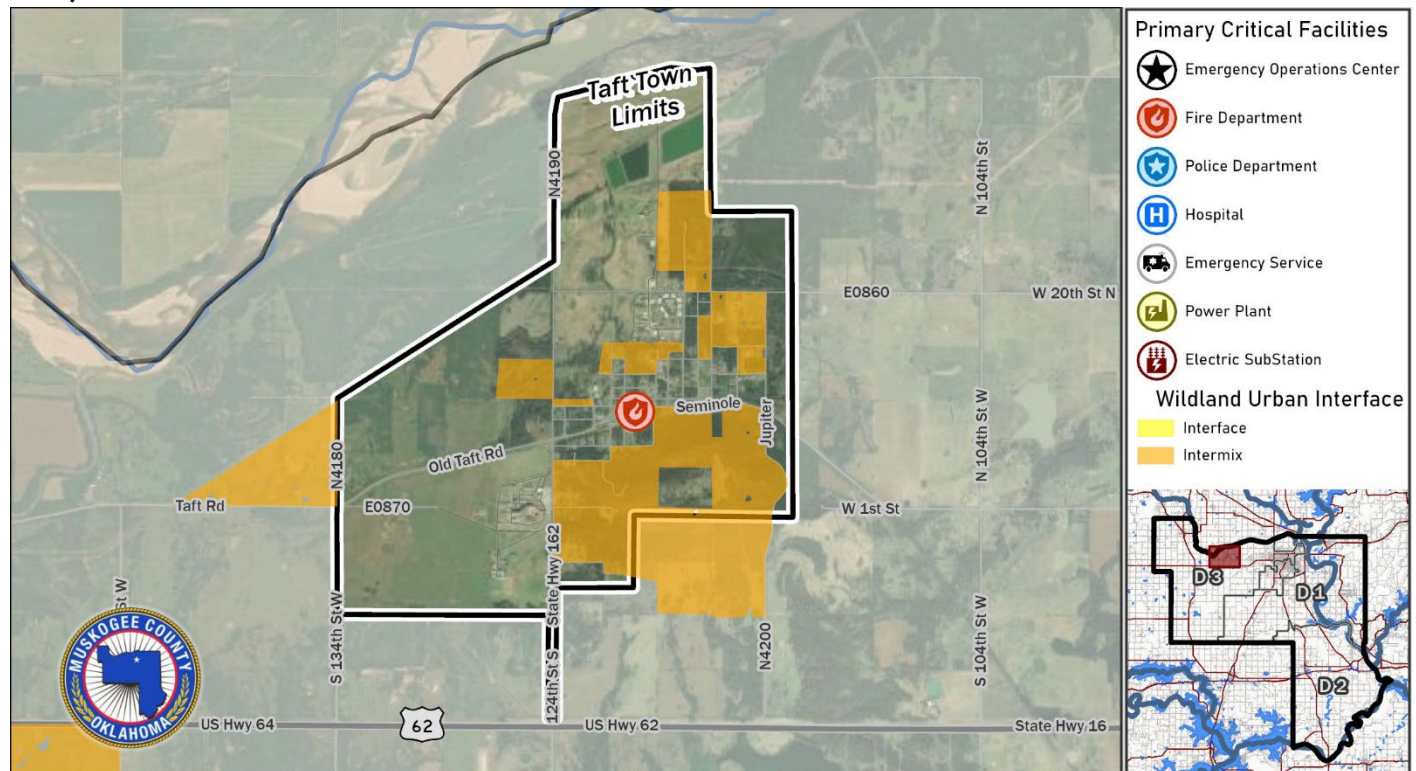
Porum, OK



Summit, OK



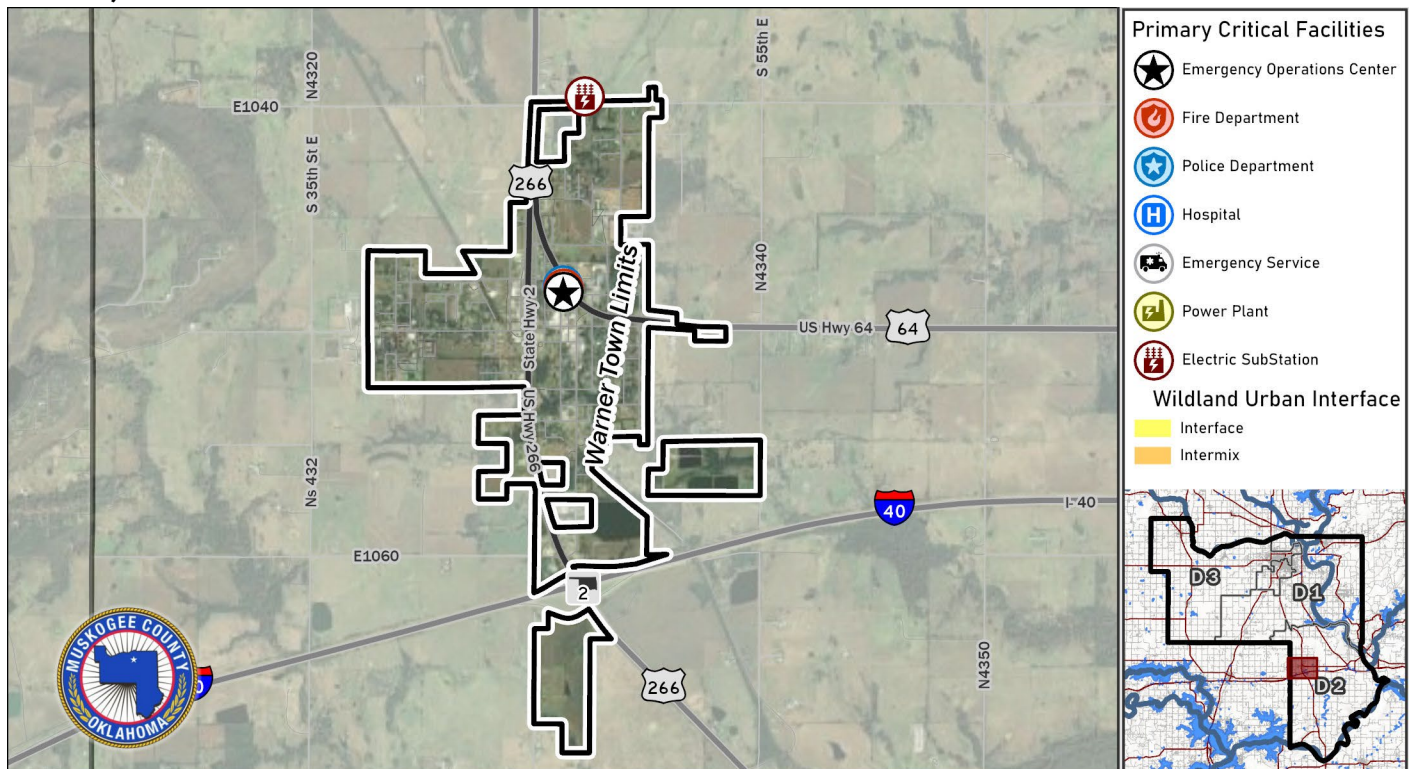
Taft, OK



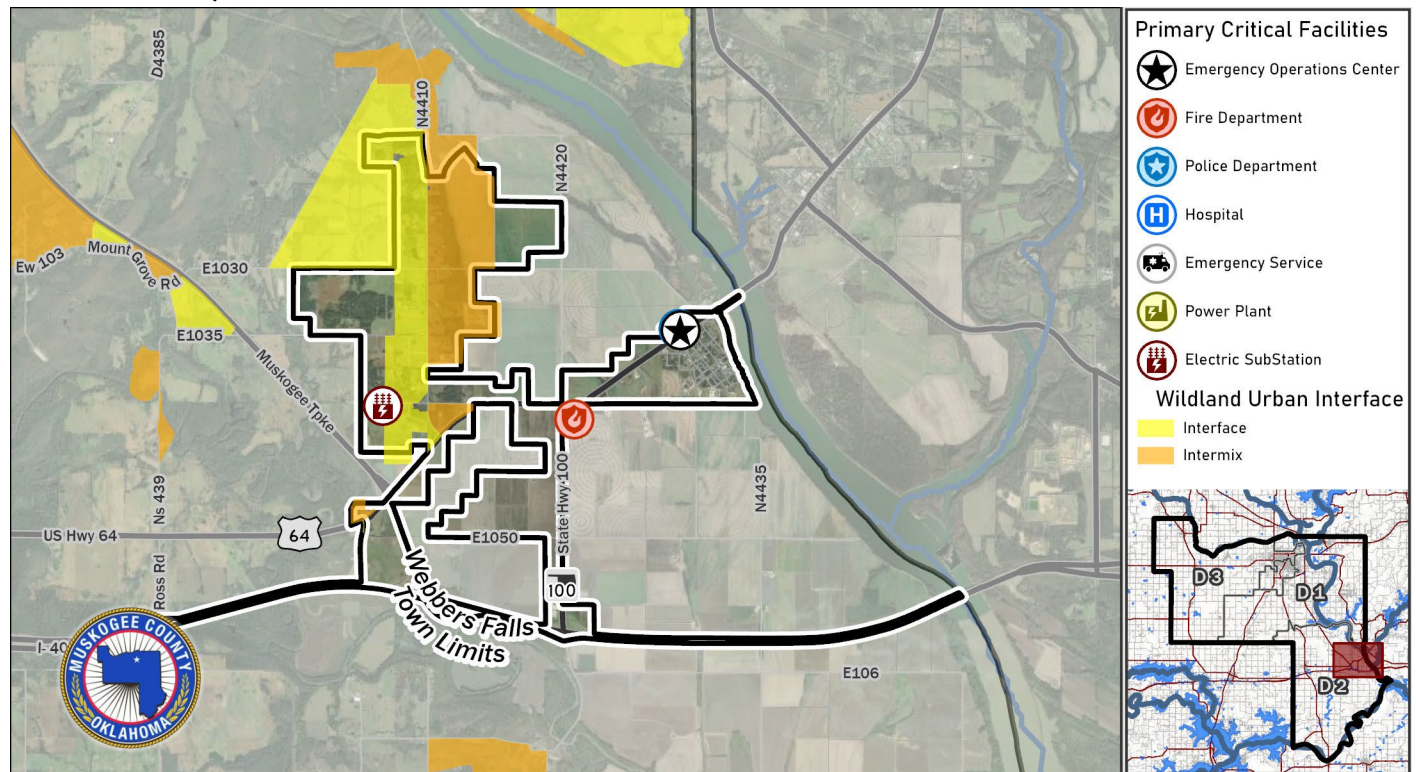
Wainwright, OK



Warner, OK



Webbers Falls, OK

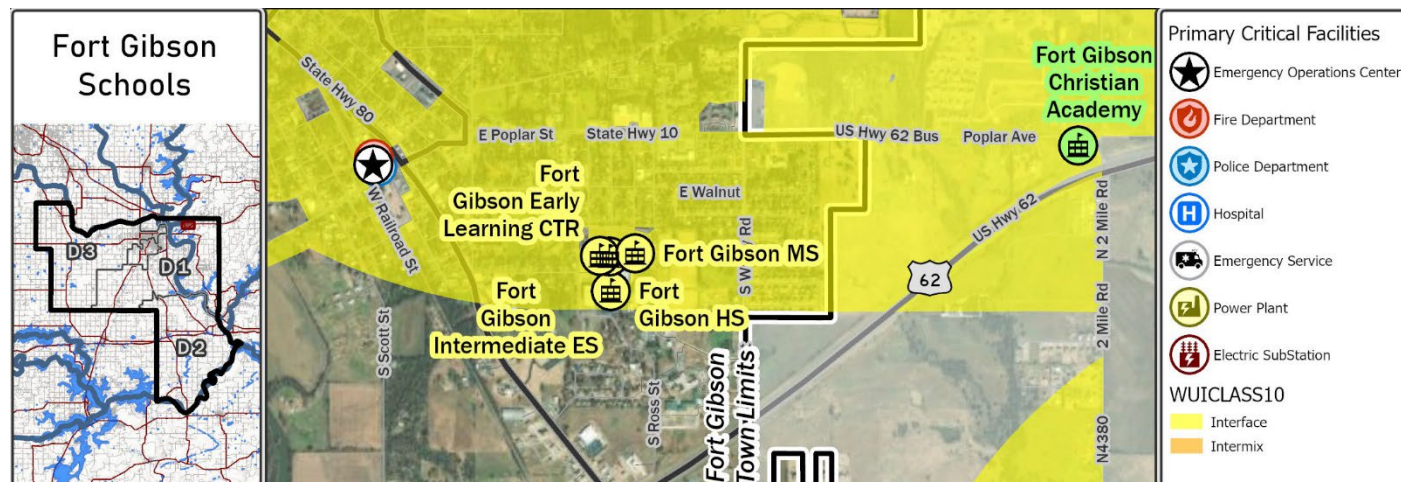


G.1.2 Wildfire Risk for Public School Districts

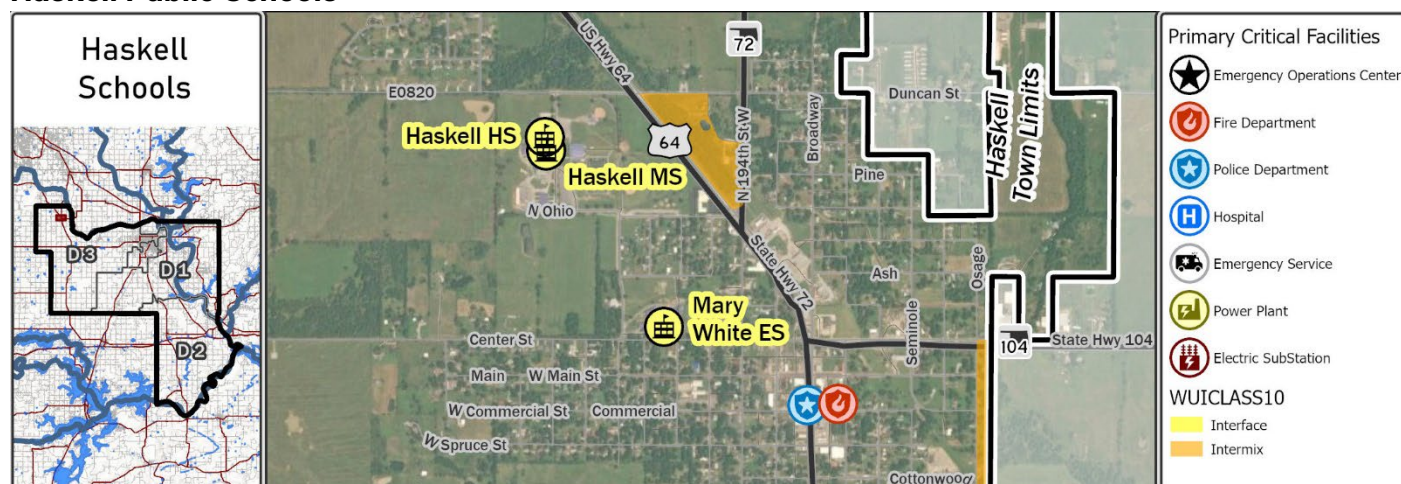
Braggs Public Schools



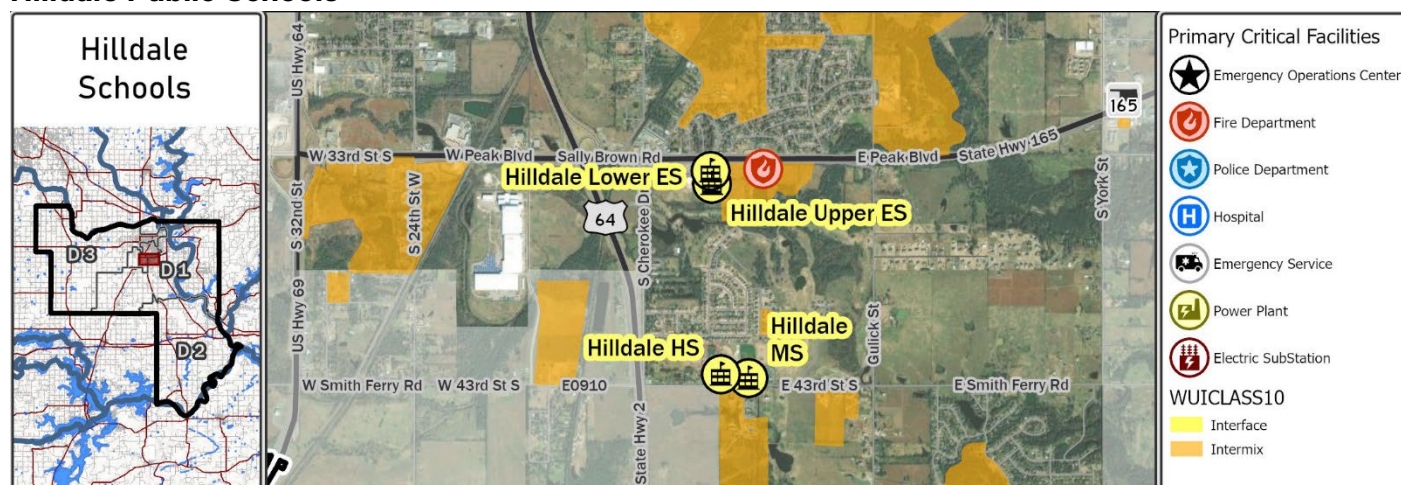
Fort Gibson Public Schools



Haskell Public Schools



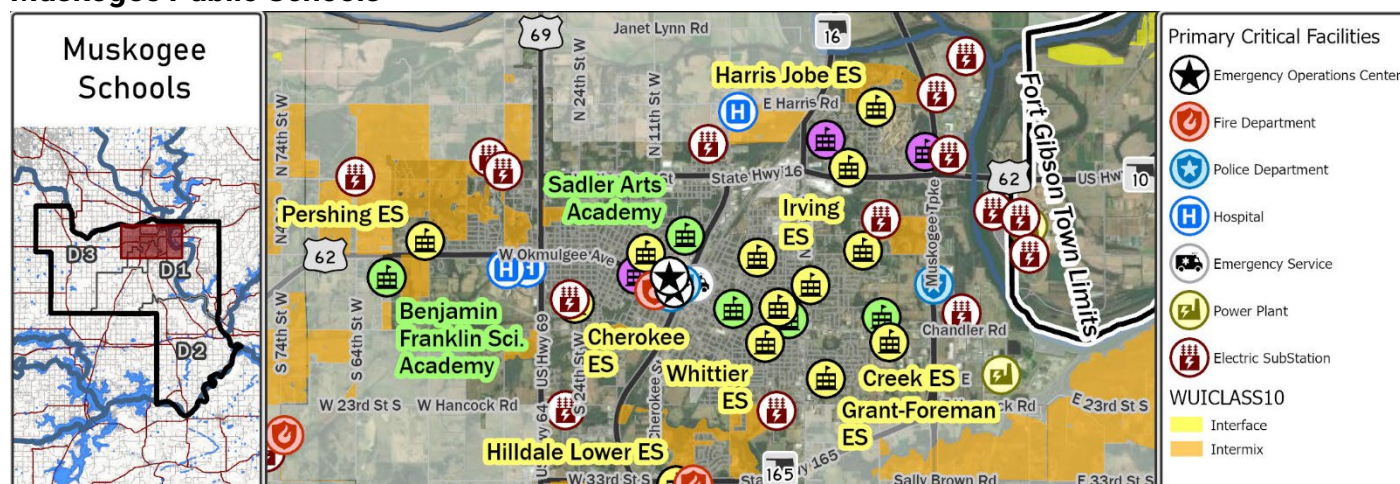
Hilldale Public Schools



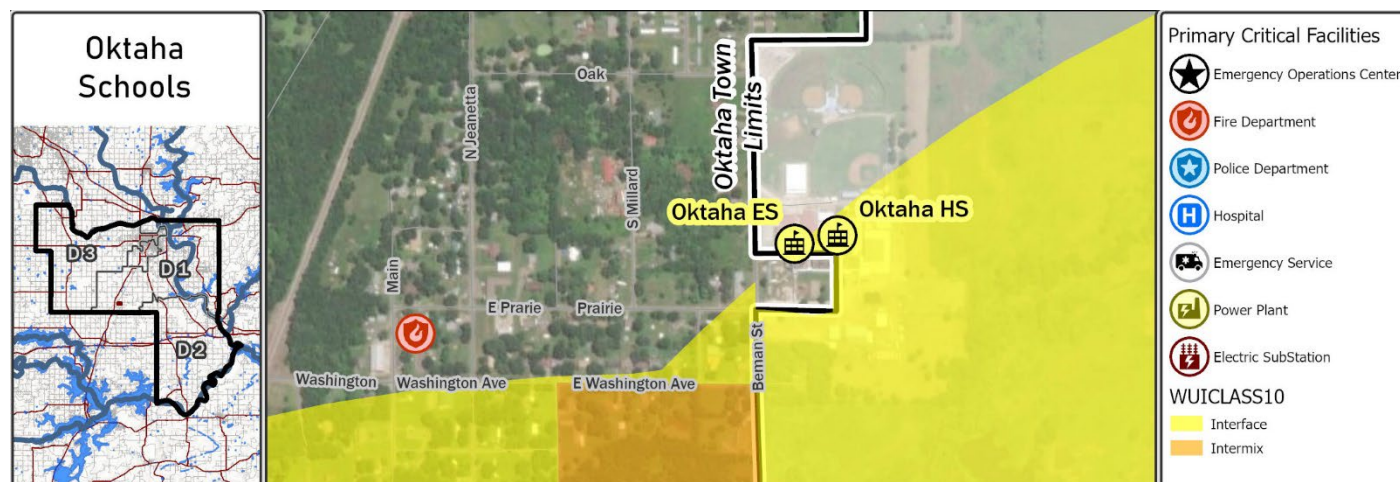
Midway Public School



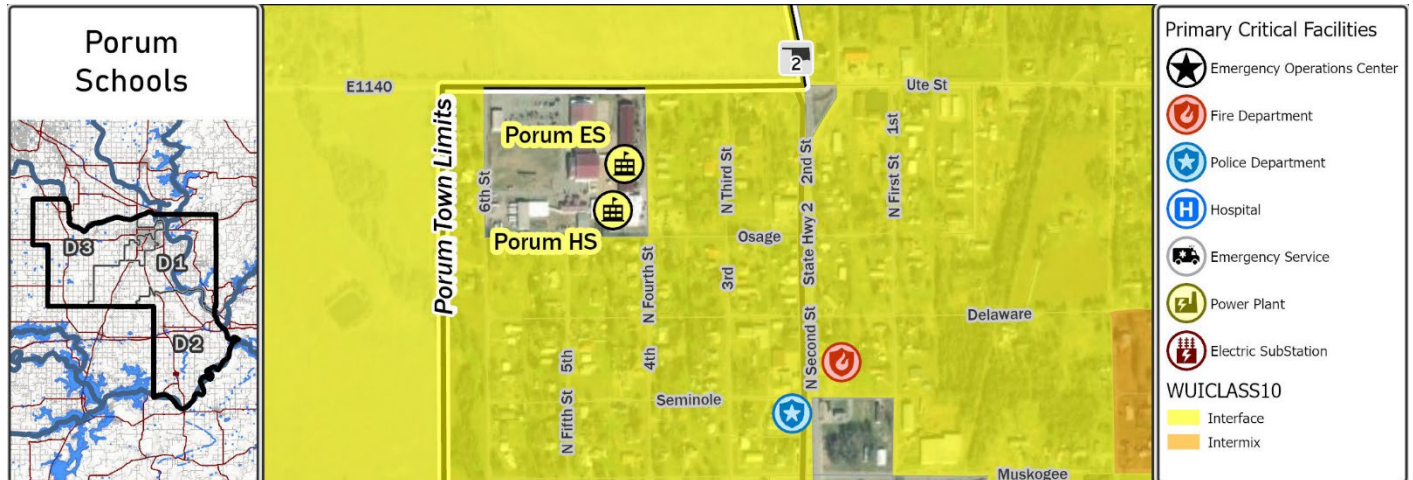
Muskogee Public Schools



Oktaha Public Schools



Porum Public Schools



Wainwright Public School



Warner Public Schools



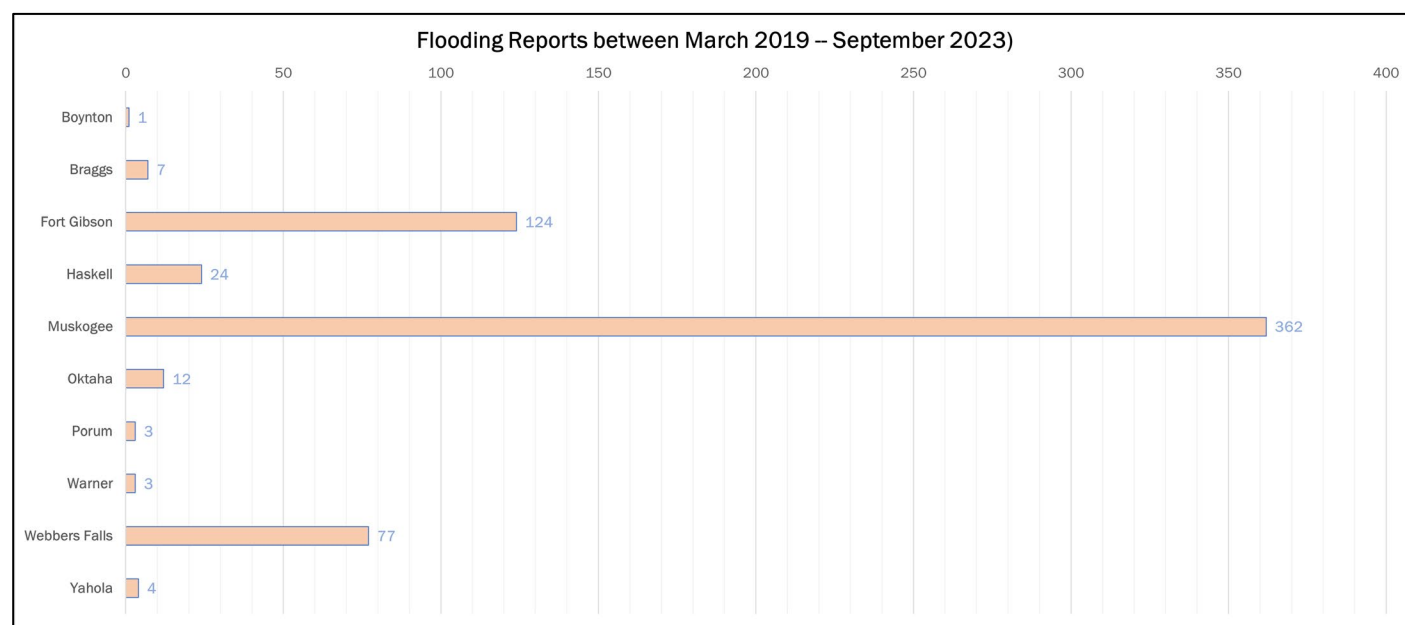
Webbers Falls Public Schools



G.1.3 Historic Flooding

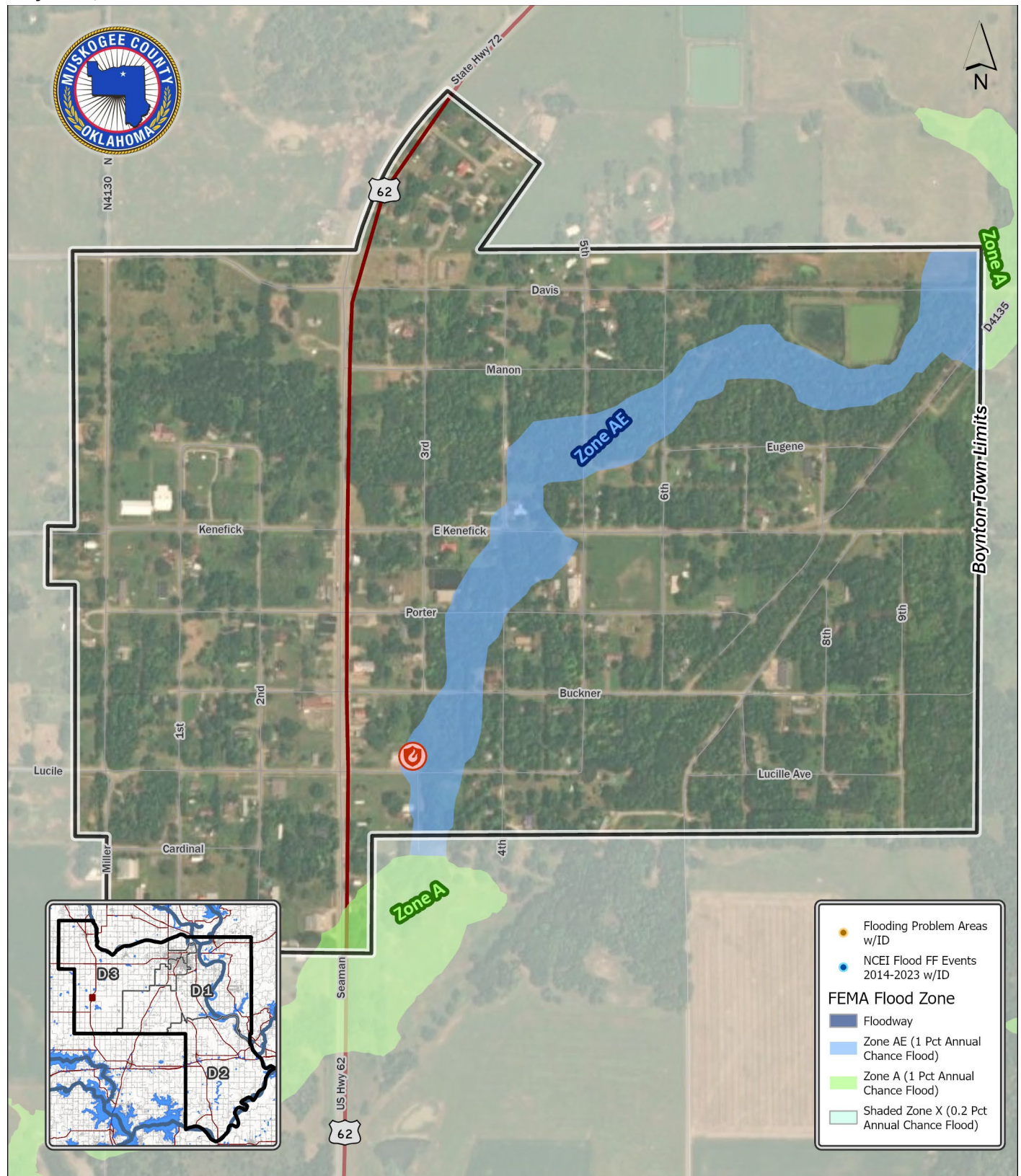
The graphic shown below describes specific flooding areas reported to ODEMHS during recent disasters. Collected via Survey123, this data provides specific information as to the location, cause, depth of water, and more. Table G-1 serves as a legend for the community-specific flooding maps found throughout this Appendix. While flooding reports were labeled and grouped according to jurisdiction, sensitive information associated with each report has been redacted for privacy purposes. In all, there were 617 flooding reports across the County, and Figure G-1 shows a distribution of reports across the planning area. Data shown in Table G-1 reveals the most extensive flood depth of reported water was a staggering 30 feet in Muskogee (M-225) in 2019, which is located just west of the Muskogee Golf Club.

Figure G-1 Flooding Reports Collected by ODEMHS in Muskogee County

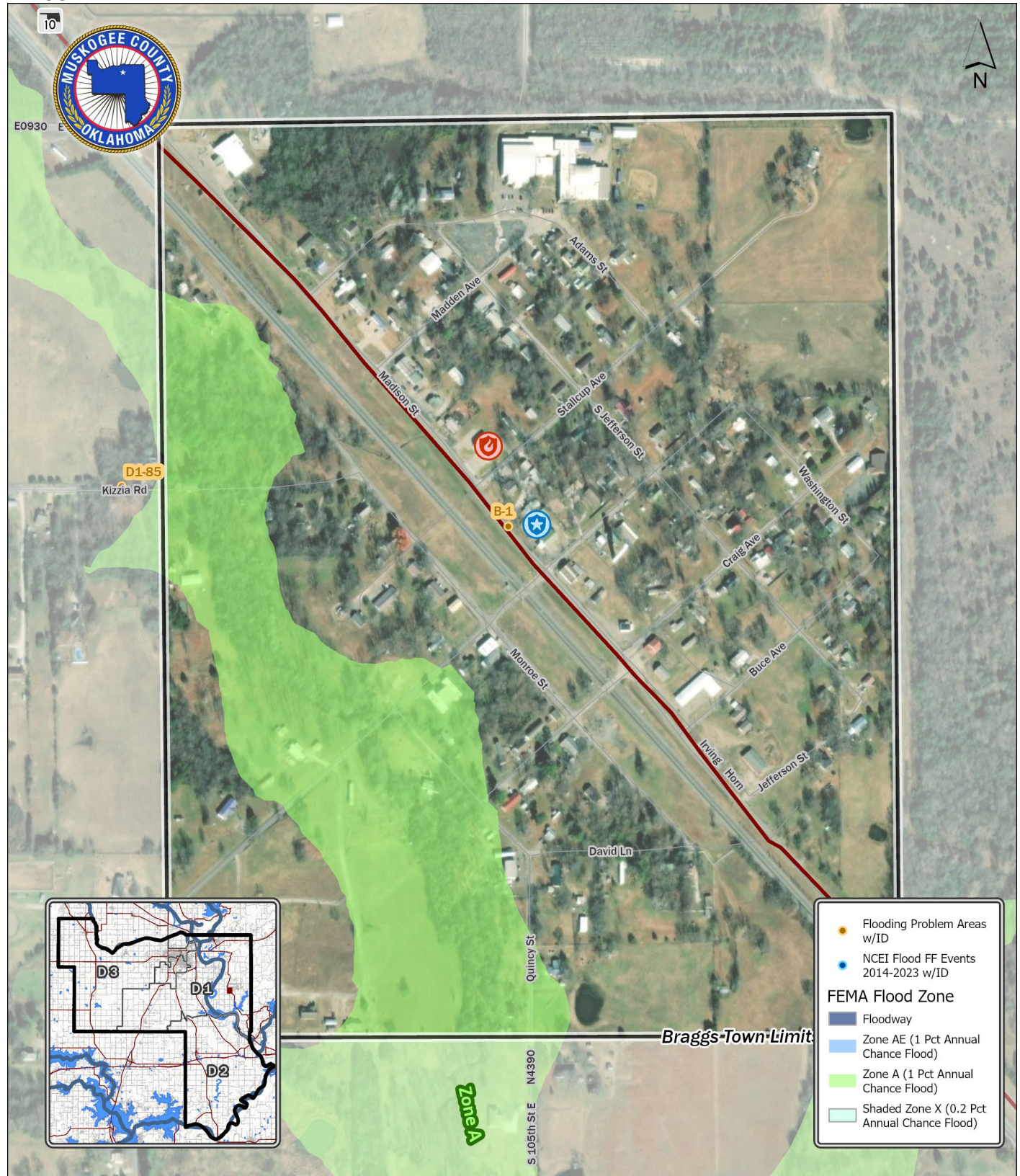


G.1.4 Flood Zones for Incorporated Areas

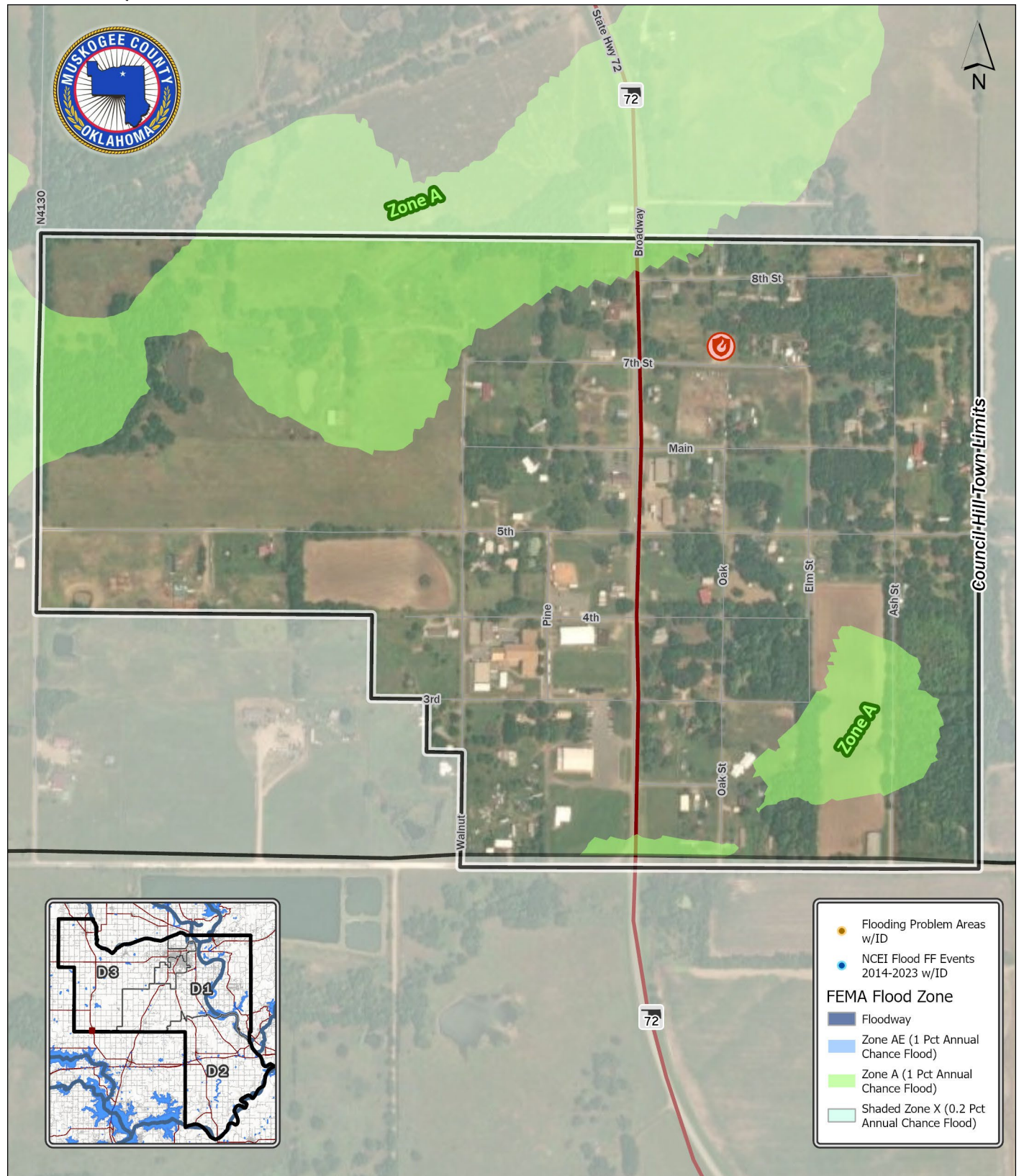
Boynton, OK



Braggs, OK

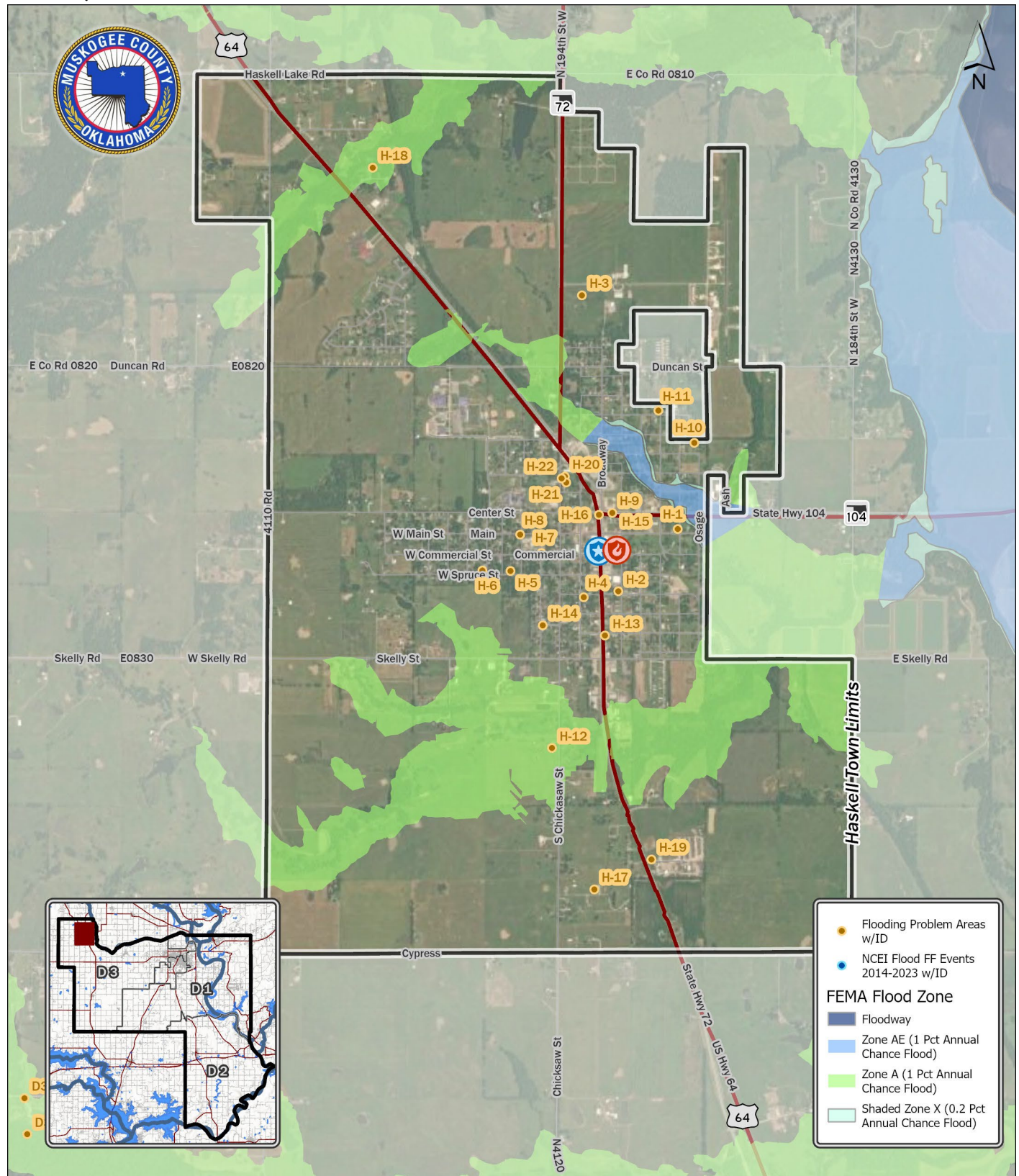


Council Hill, OK

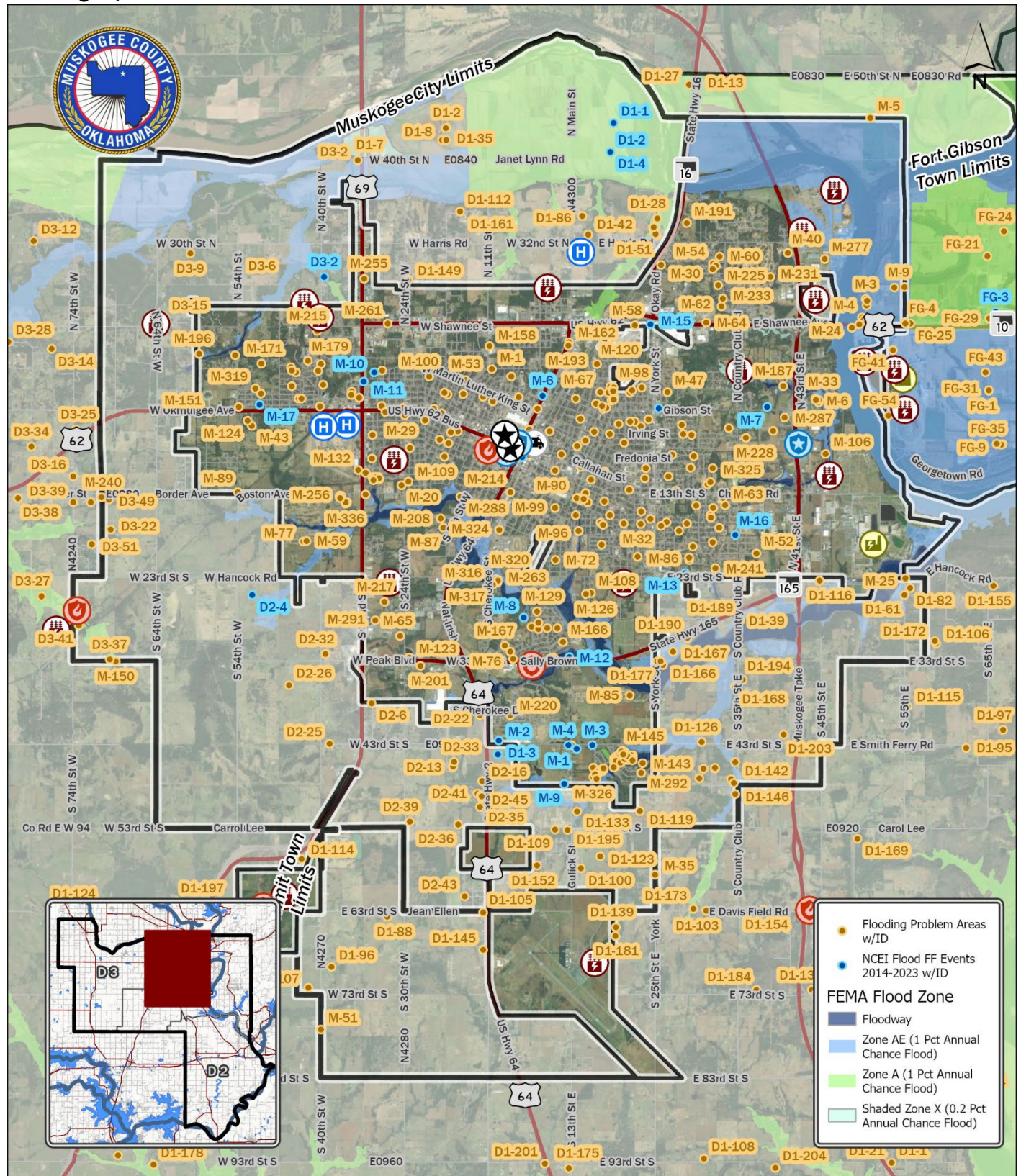


[illegible]

Haskell, OK



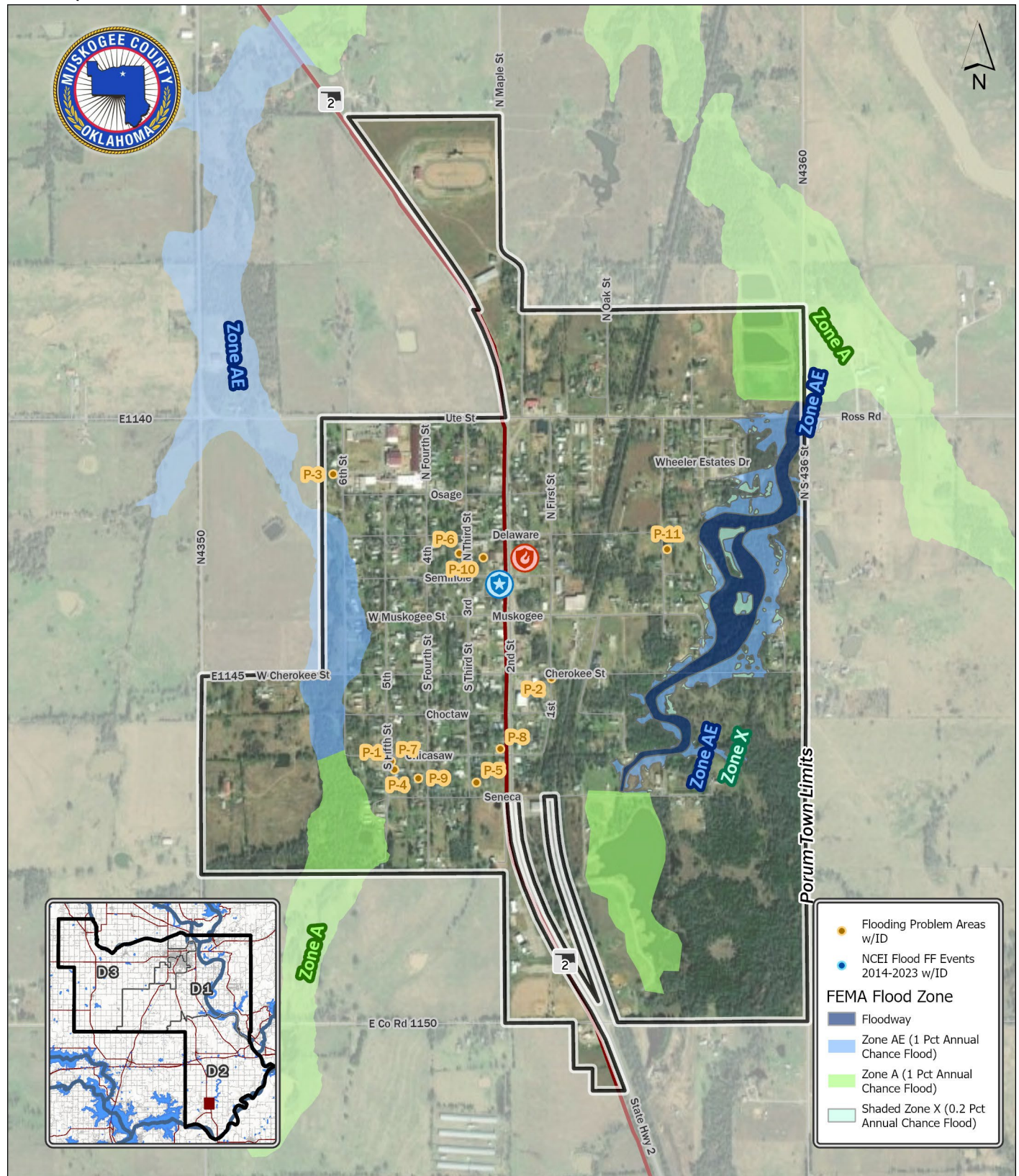
Muskogee, OK



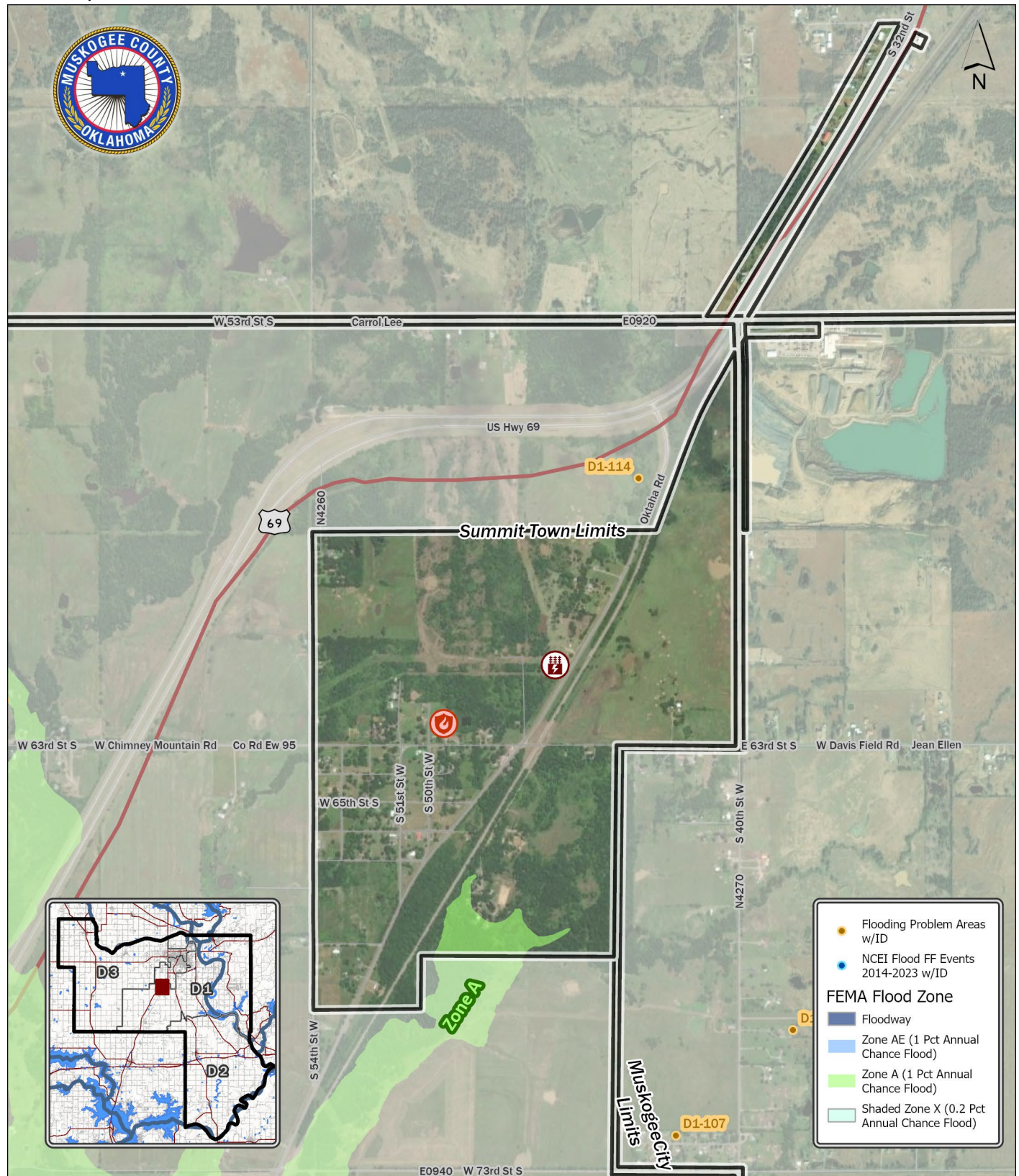
Oktaha, OK



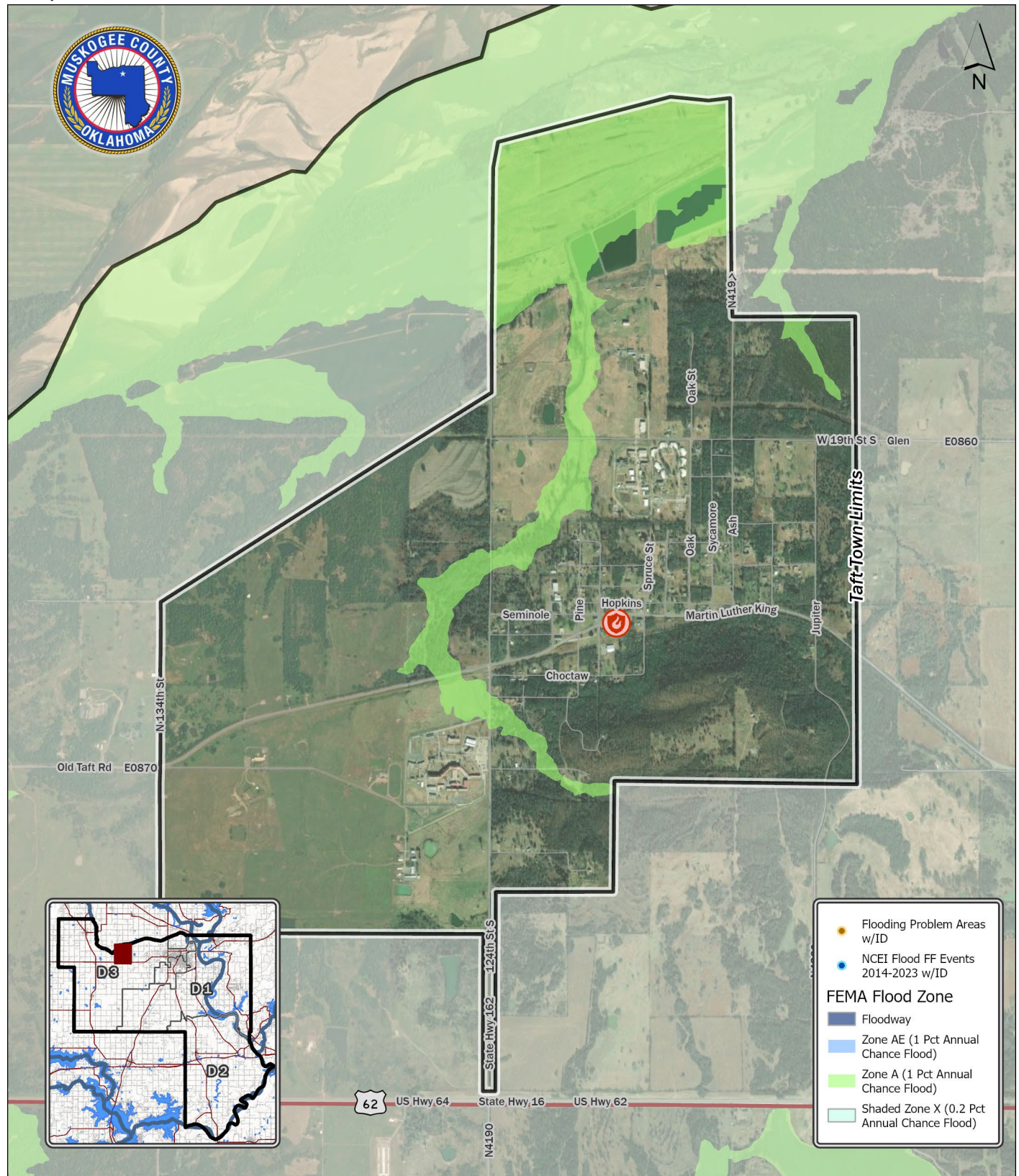
Porum, OK



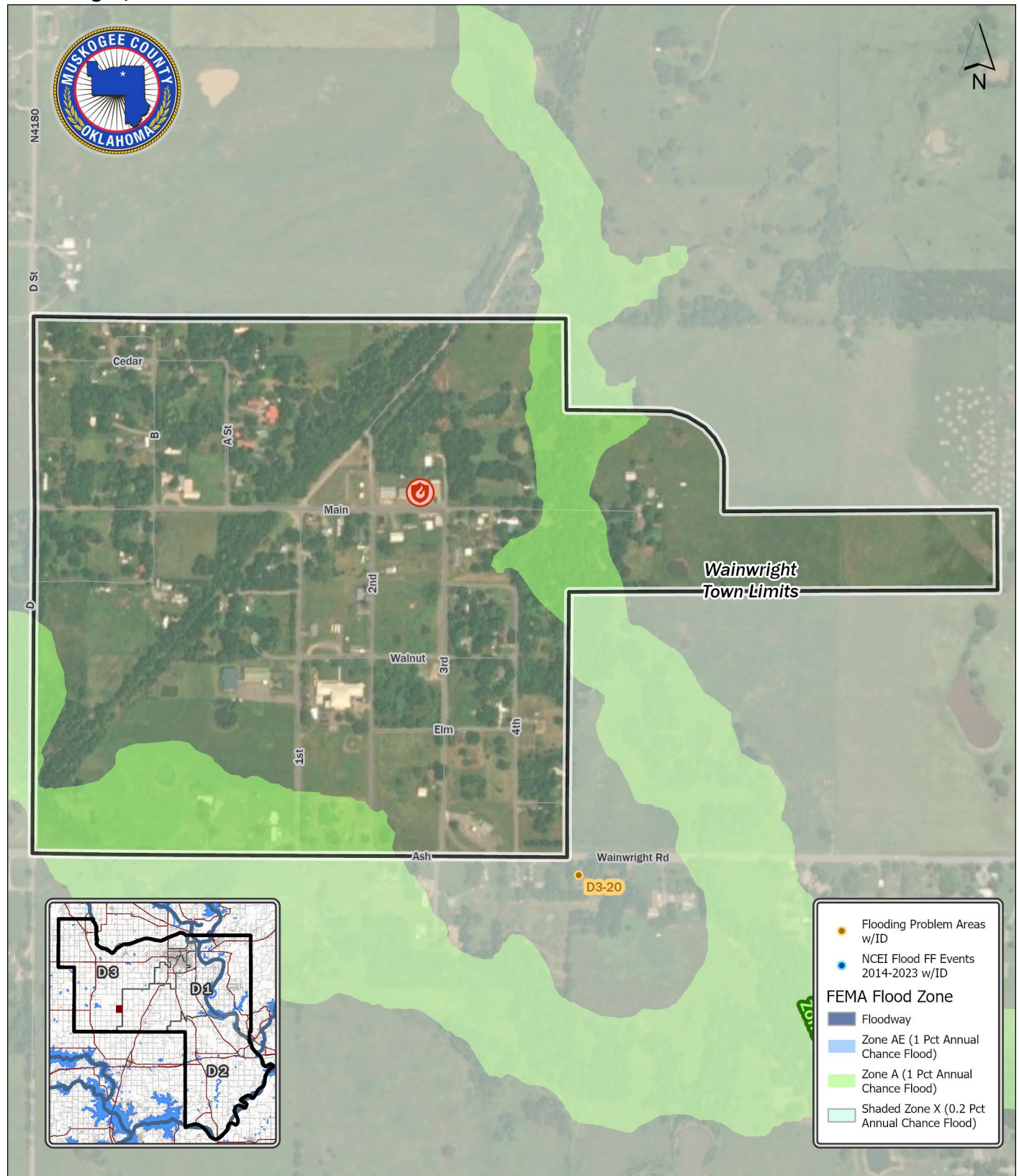
Summit, OK



Taft, OK



Wainwright, OK



Muskogee County, Oklahoma

FEMA Flood Zone

- Floodway
- Zone AE (1 Pct Annual Chance Flood)
- Zone A (1 Pct Annual Chance Flood)
- Shaded Zone X (0.2 Pct Annual Chance Flood)

Flooding Problem Areas w/ID

NCEI Flood FF Events 2014-2023 w/ID

Webbers Falls Town Limits

Legend:

- Flooding Problem Areas w/ID
- NCEI Flood FF Events 2014-2023 w/ID

Map Labels:

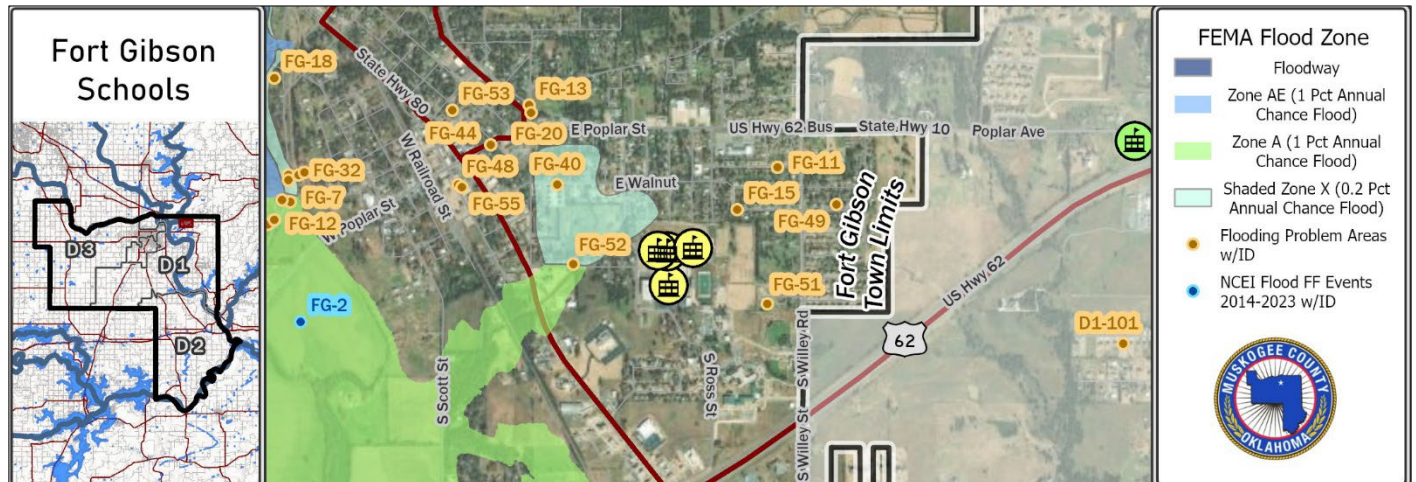
- D1-93, D1-91, D1-92, D2-37, WF-66, WF-51, WF-19, WF-77, WF-37, D2-1, WF-59, WF-13, WF-20, WF-9, WF-3, WF-40, D1-5
- E1035, E1030, E1040, E1050, E106
- N4410, N4415, N4420, N4425, N4435, N4440, N4445
- US Hwy 64, State Hwy 100, State Hwy 10
- I-40, Ross Rd, Muskogee Tpke, Lock and Dam Rd

G.1.5 Flooding Maps for Public School Districts

Braggs Public Schools



Fort Gibson Public Schools



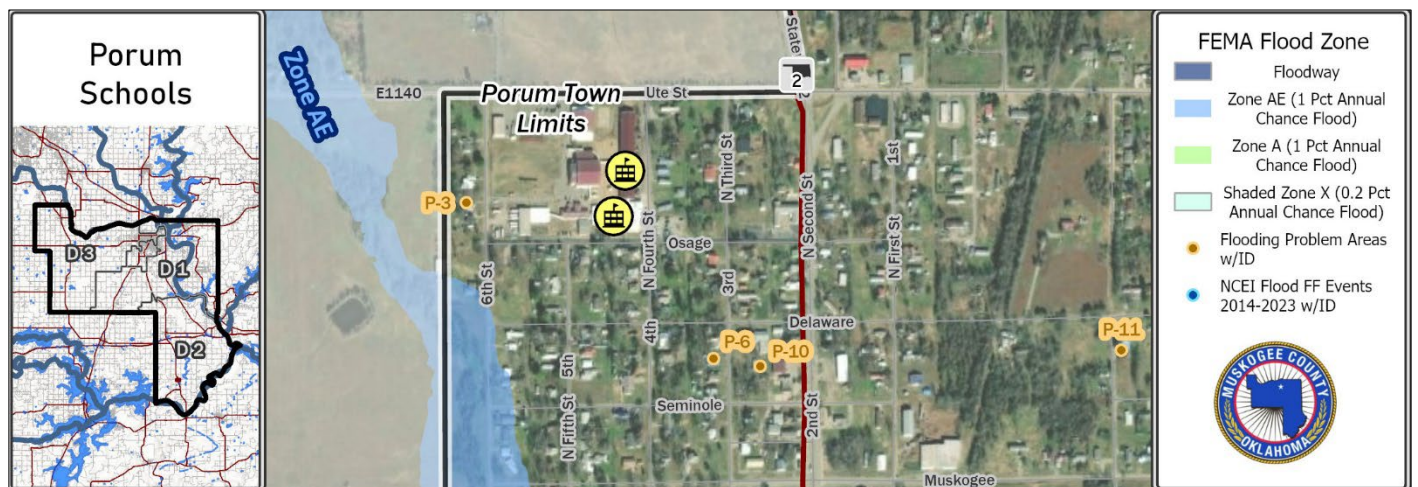
Haskell Public Schools



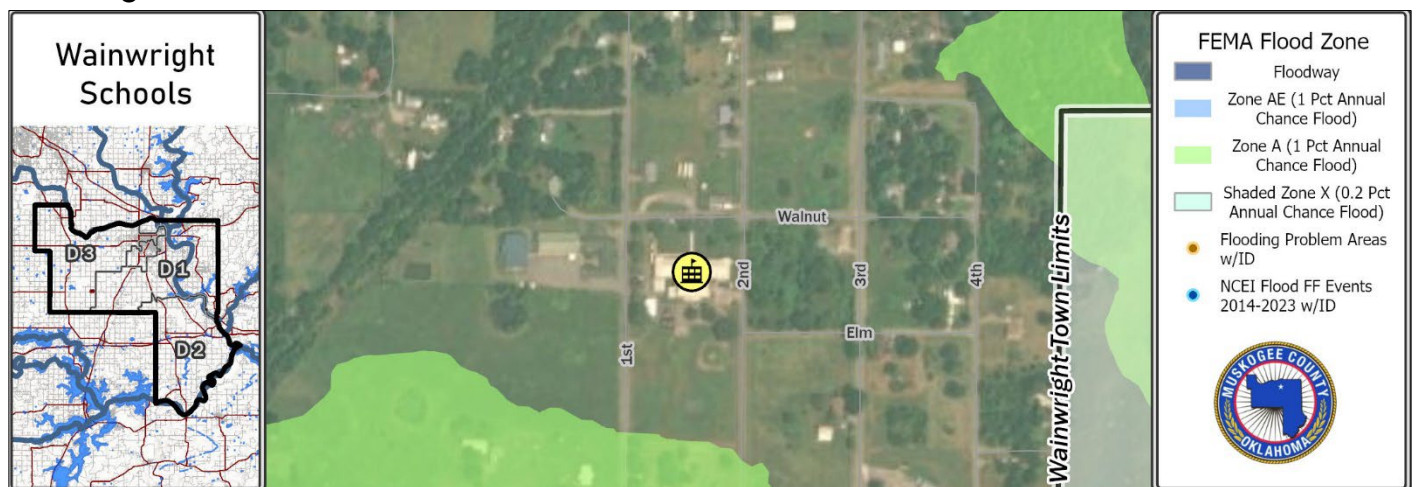
Oktaha Public Schools



Porum Public Schools



Wainwright Public School



Warner Public Schools



Webbers Falls Public Schools



G.1.6 Flooding Reports from ODEMHS

The table below serves as a legend and reference point for all flooding locations shown on the maps above. Locations are organized alphabetically by Flood Area ID.

Table G-1 Reported Flooding Locations in Muskogee County (ODEMHS)

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
B-1	Braggs	DR-4657	3	agriculture	5/4/2022
D1-10	Fort Gibson	DR-4438	132	business	5/21/2019
D1-106	Muskogee	DR-4587	2	home	2/16/2021
D1-11	Fort Gibson	DR-4438	0	home	5/21/2019
D1-114	Muskogee	DR-4587	2	business	2/21/2021
D1-117	Muskogee	DR-4657	6	home	5/4/2022
D1-118	Muskogee	DR-4657	6	home	5/4/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
D1-119	Muskogee	DR-4657	0	home	5/4/2022
D1-12	Fort Gibson	DR-4438	72	home	5/21/2019
D1-120	Muskogee	DR-4657	0	home	5/4/2022
D1-121	Oktaha	DR-4657	1	home	5/4/2022
D1-122	Muskogee	DR-4657	0	home	5/4/2022
D1-123	Muskogee	DR-4657	0	home	5/4/2022
D1-124	Muskogee	DR-4657	0	home	5/4/2022
D1-125	Fort Gibson	DR-4657	5	agriculture	5/4/2022
D1-126	Muskogee	DR-4657	2	home	5/4/2022
D1-127	Oktaha	DR-4657	48	home	5/4/2022
D1-128	Braggs	DR-4657	0	home	5/4/2022
D1-129	Muskogee	DR-4657	3	home	5/4/2022
D1-13	Muskogee	DR-4438	100	home	5/21/2019
D1-130	Fort Gibson	DR-4657	8	home	5/4/2022
D1-131	Muskogee	DR-4657	6	home	5/4/2022
D1-132	Muskogee	DR-4657	6	home	5/4/2022
D1-133	Muskogee	DR-4657	2	home	5/4/2022
D1-134	Muskogee	DR-4657	3	home	5/4/2022
D1-135	Fort Gibson	DR-4657	6	home	5/4/2022
D1-136	Muskogee	DR-4657	5	home	5/4/2022
D1-137	Fort Gibson	DR-4657	0	agriculture	5/4/2022
D1-138	Muskogee	DR-4657	3	home	5/4/2022
D1-139	Muskogee	DR-4657	1	home	5/4/2022
D1-14	Fort Gibson	DR-4438	84	home	5/21/2019
D1-140	Braggs	DR-4657	48	home	5/4/2022
D1-141	Muskogee	DR-4657	6	home	5/4/2022
D1-142	Muskogee	DR-4657	8	home	5/4/2022
D1-143	Oktaha	DR-4657	1	home	5/4/2022
D1-144	Muskogee	DR-4657	6	home	5/4/2022
D1-145	Muskogee	DR-4657	4	home	5/4/2022
D1-146	Muskogee	DR-4657	6	home	5/4/2022
D1-147	Muskogee	DR-4657	0	home	5/4/2022
D1-148	Fort Gibson	DR-4657	36	home	5/4/2022
D1-149	Muskogee	DR-4657		home	5/4/2022
D1-15	Muskogee	DR-4438	50	home	5/21/2019
D1-150	Fort Gibson	DR-4657	1	home	5/4/2022
D1-151	Muskogee	DR-4657	1	home	5/4/2022
D1-152	Muskogee	DR-4657	7	home	5/4/2022
D1-153	Muskogee	DR-4657	0	home	5/4/2022
D1-154	Muskogee	DR-4657	8	business	5/4/2022
D1-155	Muskogee	DR-4657	4	home	5/4/2022
D1-156	Oktaha	DR-4657	48	agriculture	5/4/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
D1-157	Muskogee	DR-4657	1	home	5/4/2022
D1-158	Oktaha	DR-4657	72	agriculture	5/4/2022
D1-159	Muskogee	DR-4657	5	home	5/4/2022
D1-16	Muskogee	DR-4438	0	home	5/21/2019
D1-160	Muskogee	DR-4657	2	home	5/4/2022
D1-161	Muskogee	DR-4657		home	5/4/2022
D1-162	Muskogee	DR-4657	0	home	5/4/2022
D1-163	Fort Gibson	DR-4657	8	agriculture	5/4/2022
D1-164	Braggs	DR-4657	24	home	5/4/2022
D1-165	Fort Gibson	DR-4657	108	agriculture	5/4/2022
D1-166	Muskogee	DR-4657	60	home	5/4/2022
D1-167	Muskogee	DR-4657	60	home	5/4/2022
D1-168	Muskogee	DR-4657	60	agriculture	5/4/2022
D1-169	Muskogee	DR-4657	60	agriculture	5/4/2022
D1-17	Fort Gibson	DR-4438	84	home	5/21/2019
D1-170	Oktaha	DR-4657	0	home	5/4/2022
D1-171	Fort Gibson	DR-4657	0	agriculture	5/4/2022
D1-172	Muskogee	DR-4657		home	5/4/2022
D1-173	Muskogee	DR-4657	36	home	5/4/2022
D1-174	Oktaha	DR-4657	1	business	5/4/2022
D1-175	Muskogee	DR-4657		home	5/4/2022
D1-176	Fort Gibson	DR-4657	0	home	5/4/2022
D1-177	Muskogee	DR-4657	38	home	5/4/2022
D1-178	Oktaha	DR-4657	48	home	5/4/2022
D1-179	Oktaha	DR-4657	48	home	5/4/2022
D1-180	Muskogee	DR-4657		home	5/4/2022
D1-181	Muskogee	DR-4657	3	home	5/4/2022
D1-182	Muskogee	DR-4657	6	home	5/4/2022
D1-183	Muskogee	DR-4657	4	agriculture	5/4/2022
D1-184	Muskogee	DR-4657	0	home	5/4/2022
D1-185	Oktaha	DR-4657	48	home	5/4/2022
D1-186	Muskogee	DR-4657	0	home	5/4/2022
D1-187	Muskogee	DR-4657	0	business	5/4/2022
D1-188	Muskogee	DR-4657	1	home	5/4/2022
D1-189	Muskogee	DR-4657	11	home	5/4/2022
D1-19	Fort Gibson	DR-4438	108	home	5/21/2019
D1-190	Muskogee	DR-4657	50	home	5/4/2022
D1-191	Muskogee	DR-4657	38	home	5/4/2022
D1-192	Braggs	<Null>	0	home	5/4/2022
D1-193	<Null>	<Null>	48	home	5/4/2022
D1-194	Muskogee	DR-4657		home	5/5/2022
D1-195	Muskogee	DR-4657	40	home	5/5/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
D1-196	Muskogee	DR-4657	9	home	5/5/2022
D1-197	Muskogee	DR-4657	29	home	5/5/2022
D1-198	Muskogee	DR-4657	6	home	5/5/2022
D1-199	Braggs	DR-4657	0	home	5/14/2022
D1-2	Muskogee	DR-4438	8	home	5/20/2019
D1-20	Fort Gibson	DR-4438	6	home	5/22/2019
D1-200	Fort Gibson	DR-4657	4	home	6/1/2022
D1-201	Muskogee			home	6/16/2022
D1-21	Muskogee	DR-4438	24	home	5/22/2019
D1-22	Muskogee	DR-4438	0	home	5/22/2019
D1-23	Fort Gibson	DR-4438		Unspecified	5/22/2019
D1-24	Fort Gibson	DR-4438	60	home	5/22/2019
D1-25	Fort Gibson	DR-4438	48	home	5/22/2019
D1-26	Fort Gibson	DR-4438	60	home	5/22/2019
D1-27	Muskogee	DR-4438	0	home	5/22/2019
D1-28	Muskogee	DR-4438	24	home	5/22/2019
D1-29	Fort Gibson	DR-4438	72	home	5/22/2019
D1-3	Fort Gibson	DR-4438	48	home	5/21/2019
D1-30	Fort Gibson	DR-4438	84	home	5/22/2019
D1-31	Fort Gibson	DR-4438	192	home	5/22/2019
D1-32	Fort Gibson	DR-4438	108	home	5/22/2019
D1-33	Muskogee	DR-4438	0	home	5/22/2019
D1-34	Fort Gibson	DR-4438	96	home	5/22/2019
D1-35	Muskogee	DR-4438	8	home	5/22/2019
D1-36	Fort Gibson	DR-4438	96	home	5/22/2019
D1-37	Fort Gibson	DR-4438	108	home	5/22/2019
D1-38	Fort Gibson	DR-4438	96	home	5/22/2019
D1-39	Muskogee	DR-4438	15	home	5/22/2019
D1-4	Fort Gibson	DR-4438	48	business	5/21/2019
D1-40	Fort Gibson	DR-4438	144	home	5/22/2019
D1-41	Braggs	DR-4438	96	agriculture	5/23/2019
D1-42	Muskogee	DR-4438	0	agriculture	5/23/2019
D1-43	Fort Gibson	DR-4438	72	home	5/23/2019
D1-44	Fort Gibson	DR-4438	4	home	5/23/2019
D1-45	Fort Gibson	DR-4438	72	home	5/23/2019
D1-46	Fort Gibson	DR-4438	300	home	5/23/2019
D1-47	Fort Gibson	DR-4438	80	home	5/23/2019
D1-48	Fort Gibson	DR-4438	96	home	5/23/2019
D1-49	Muskogee	DR-4438	0	agriculture	5/23/2019
D1-5	Fort Gibson	DR-4438	120	home	5/21/2019
D1-50	Muskogee	DR-4438	60	home	5/23/2019
D1-51	Muskogee	DR-4438	0	home	5/23/2019

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
D1-52	Fort Gibson	DR-4438	96	home	5/23/2019
D1-53	Fort Gibson	DR-4438	120	home	5/23/2019
D1-54	Muskogee	DR-4438	60	home	5/23/2019
D1-55	Fort Gibson	DR-4438	48	home	5/23/2019
D1-56	MUSKOGEE	DR-4438	5	home	5/23/2019
D1-57	Fort Gibson	DR-4438	72	home	5/23/2019
D1-58	Fort Gibson	DR-4438	180	home	5/23/2019
D1-59	Fort Gibson	DR-4438	96	home	5/23/2019
D1-6	Fort Gibson	DR-4438	60	home	5/21/2019
D1-60	Webbers Falls	DR-4438	48	home	5/23/2019
D1-61	Muskogee	DR-4438	108	home	5/23/2019
D1-62	Fort Gibson	DR-4438		home	5/24/2019
D1-63	Fort Gibson	DR-4438	48	home	5/24/2019
D1-64	Fort Gibson	DR-4438	84	business	5/24/2019
D1-65	Fort Gibson	DR-4438	48	home	5/24/2019
D1-66	Fort Gibson	DR-4438	48	home	5/24/2019
D1-67	Fort Gibson	DR-4438	216	home	5/24/2019
D1-68	Fort Gibson	DR-4438	27	home	5/24/2019
D1-69	Fort Gibson	DR-4438	48	home	5/24/2019
D1-7	Muskogee	DR-4438	4	business	5/21/2019
D1-70	Fort Gibson	DR-4438	132	home	5/24/2019
D1-71	Fort Gibson	DR-4438	36	home	5/24/2019
D1-72	Muskogee	DR-4438	48	home	5/24/2019
D1-73	Fort Gibson	DR-4438	48	home	5/24/2019
D1-74	Muskogee	DR-4438	0	home	5/24/2019
D1-75	Fort Gibson	DR-4438	120	home	5/24/2019
D1-76	Fort Gibson	DR-4438	120	home	5/24/2019
D1-77	Muskogee	DR-4438	72	agriculture	5/24/2019
D1-78	Muskogee	DR-4438	0	home	5/27/2019
D1-79	Fort Gibson	DR-4438	120	home	5/27/2019
D1-8	Muskogee	DR-4438	8	Unspecified	5/21/2019
D1-80	Fort Gibson	DR-4438	96	home	6/20/2019
D1-81	Fort Gibson	DR-4438	0	home	6/28/2019
D1-9	Fort Gibson	DR-4438	132	home	5/21/2019
D2-1	Webbers Falls	DR-4438	60	agriculture	5/23/2019
D2-2	Porum	DR-4438	24	agriculture	5/24/2019
D2-26	Muskogee	DR-4587	3	home	2/21/2021
D2-3	Webbers Falls	DR-4438	48	agriculture	5/25/2019
D2-31	Muskogee	DR-4657		home	5/4/2022
D2-32	Muskogee	DR-4657	36	business	5/4/2022
D2-33	Muskogee	DR-4657	8	home	5/4/2022
D2-34	Muskogee	DR-4657	0	home	5/4/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
D2-35	Muskogee	DR-4657	0	business	5/4/2022
D2-36	Muskogee	DR-4657	2	home	5/4/2022
D2-37	Muskogee	DR-4657	180	agriculture	5/4/2022
D2-38	Muskogee	DR-4657	1	home	5/4/2022
D2-39	Muskogee	DR-4657		home	5/4/2022
D2-40	Muskogee	DR-4657	12	home	5/4/2022
D2-41	Muskogee	DR-4657	60	home	5/4/2022
D2-42	Muskogee	DR-4657	72	home	5/4/2022
D2-43	Muskogee	DR-4657	0	home	5/4/2022
D2-44	Warner	DR-4657	0	home	5/4/2022
D2-45	Muskogee	DR-4657	72	home	5/4/2022
D2-46	Muskogee	DR-4657	72	home	5/4/2022
D3-1	Haskell	DR-4438	18	home	5/21/2019
D3-12	Muskogee	DR-4587	2	business	2/19/2021
D3-13	Muskogee	DR-4657	48	home	5/4/2022
D3-14	Muskogee	DR-4657	4	home	5/4/2022
D3-15	Muskogee	DR-4657	2	home	5/4/2022
D3-16	Muskogee	DR-4657	2	home	5/4/2022
D3-17	Muskogee	DR-4657	0	agriculture	5/4/2022
D3-18	Muskogee	DR-4657	84	agriculture	5/4/2022
D3-19	Oktaha	DR-4657	7	home	5/4/2022
D3-2	Muskogee	DR-4438	60	home	6/27/2019
D3-20	Oktaha	DR-4657		home	5/4/2022
D3-21	Muskogee	DR-4657	3	home	5/4/2022
D3-22	Muskogee	DR-4657	2	home	5/4/2022
D3-23	Haskell	DR-4657	48	home	5/4/2022
D3-24	Haskell	DR-4657	36	home	5/4/2022
D3-25	Muskogee	DR-4657	1	home	5/4/2022
D3-26	Muskogee	DR-4657		home	5/4/2022
D3-27	Muskogee	DR-4657		agriculture	5/4/2022
D3-28	Muskogee	DR-4657	72	home	5/4/2022
D3-29	Haskell	DR-4657	4	agriculture	5/4/2022
D3-30	Haskell	DR-4657	7	home	5/4/2022
D3-31	Haskell	DR-4657	6	home	5/4/2022
D3-32	Haskell	DR-4657	0	home	5/4/2022
D3-33	Haskell	DR-4657	26	home	5/4/2022
D3-34	Muskogee	DR-4657	0	home	5/4/2022
D3-35	Haskell	DR-4657	36	home	5/4/2022
D3-36	Boynton	DR-4657	120	agriculture	5/4/2022
D3-37	Muskogee	DR-4657	0	agriculture	5/4/2022
D3-38	Muskogee	DR-4657		home	5/4/2022
D3-39	Muskogee	DR-4657	36	home	5/4/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
D3-40	Muskogee	DR-4657	18	home	5/4/2022
D3-41	Muskogee	DR-4657	15	home	5/4/2022
D3-42	Yahola	DR-4657		home	5/4/2022
D3-43	Muskogee	DR-4657		home	5/4/2022
D3-44	Yahola	DR-4657		home	5/4/2022
D3-45	Yahola	DR-4657	24	home	5/4/2022
D3-46	Yahola	DR-4657	48	home	5/4/2022
D3-47	Haskell	DR-4657		home	5/4/2022
D3-48	Haskell	DR-4657		home	5/4/2022
D3-49	Muskogee	DR-4657	24	home	5/5/2022
D3-50	Haskell	DR-4657	96	home	5/5/2022
D3-51	Muskogee	DR-4657	0	home	5/5/2022
FG-1	Fort Gibson	DR-4438	180	home	5/7/2019
FG-10	Fort Gibson	DR-4438	72	home	5/21/2019
FG-11	Fort Gibson	DR-4438	0	home	5/22/2019
FG-12	Fort Gibson	DR-4438	120	home	5/22/2019
FG-13	Fort Gibson	DR-4438	60	home	5/22/2019
FG-14	Fort Gibson	DR-4438	36	business	5/22/2019
FG-15	Fort Gibson	DR-4438	0	home	5/22/2019
FG-16	Fort Gibson	DR-4438	54	home	5/22/2019
FG-17	Fort Gibson	DR-4438	54	home	5/22/2019
FG-18	Fort Gibson	DR-4438	115	home	5/22/2019
FG-19	Fort Gibson	DR-4438	72	business	5/22/2019
FG-2	Fort Gibson	DR-4438	72	home	5/20/2019
FG-20	Fort Gibson	DR-4438	96	home	5/22/2019
FG-21	Fort Gibson	DR-4438	12	home	5/22/2019
FG-22	Fort Gibson	DR-4438	120	home	5/22/2019
FG-23	Fort Gibson	DR-4438	120	home	5/22/2019
FG-24	Fort Gibson	DR-4438	72	home	5/22/2019
FG-25	Fort Gibson	DR-4438	144	home	5/22/2019
FG-26	Fort Gibson	DR-4438	5	home	5/22/2019
FG-27	Fort Gibson	DR-4438	5	business	5/22/2019
FG-28	Fort Gibson	DR-4438	48	Unspecified	5/22/2019
FG-29	Fort Gibson	DR-4438	96	business	5/22/2019
FG-3	Fort Gibson	DR-4438	60	home	5/20/2019
FG-30	Fort Gibson	DR-4438	0	home	5/22/2019
FG-31	Fort Gibson	DR-4438	0	home	5/23/2019
FG-32	Fort Gibson	DR-4438	72	home	5/23/2019
FG-33	Fort Gibson	DR-4438	144	home	5/23/2019
FG-34	Fort Gibson	DR-4438	5	home	5/23/2019
FG-35	Fort Gibson	DR-4438	24	home	5/23/2019
FG-36	FORT GIBSON	DR-4438	36	business	5/23/2019

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
FG-37	Fort Gibson	DR-4438	28	business	5/23/2019
FG-38	Muskogee	DR-4438	48	home	5/23/2019
FG-39	Muskogee	DR-4438	0	home	5/23/2019
FG-4	Fort Gibson	DR-4438	300	home	5/21/2019
FG-41	Muskogee	DR-4438	120	Unspecified	5/25/2019
FG-42	Fort Gibson	DR-4438	240	business	5/25/2019
FG-43	Fort Gibson	DR-4438	72	home	5/25/2019
FG-44	Fort Gibson	DR-4438	0	business	5/29/2019
FG-45	Fort Gibson	DR-4438	36	business	5/30/2019
FG-46	FORT GIBSON	DR-4438	11	home	6/22/2019
FG-48	Fort Gibson	DR-4657	1	business	5/4/2022
FG-49	Fort Gibson	DR-4657	8	home	5/4/2022
FG-5	Fort Gibson	DR-4438	192	home	5/21/2019
FG-50	Fort Gibson	DR-4657	3	home	5/4/2022
FG-51	Fort Gibson	DR-4657	2	home	5/4/2022
FG-52	Fort Gibson	DR-4657	12	home	5/4/2022
FG-53	Fort Gibson	DR-4657		home	5/4/2022
FG-54	Muskogee	DR-4657		home	5/4/2022
FG-55	Fort Gibson	DR-4657	3	business	5/5/2022
FG-6	Fort Gibson	DR-4438	96	home	5/21/2019
FG-7	Fort Gibson	DR-4438	12	home	5/21/2019
FG-8	Fort Gibson	DR-4438	12	home	5/21/2019
FG-9	Fort Gibson	DR-4438	15	home	5/21/2019
H-11	Haskell	DR-4657		agriculture	5/4/2022
H-12	Haskell	DR-4657	24	home	5/4/2022
H-13	Haskell	DR-4657	11	business	5/4/2022
H-14	Haskell	DR-4657	12	home	5/4/2022
H-15	Haskell	DR-4657	48	agriculture	5/4/2022
H-16	Haskell	DR-4657	3	business	5/4/2022
H-17	Haskell	DR-4657	3	home	5/4/2022
H-18	Haskell	DR-4657	4	home	5/4/2022
H-19	Haskell	DR-4657	48	agriculture	5/4/2022
H-20	Haskell	DR-4657	23	home	5/4/2022
H-21	Haskell	DR-4657	23	home	5/4/2022
H-22	Haskell	DR-4657	23	home	5/4/2022
M-10	Muskogee	DR-4438	245	home	5/22/2019
M-103	Muskogee	DR-4587	3	business	2/18/2021
M-109	Muskogee	DR-4587	2	business	2/19/2021
M-11	Fort Gibson	DR-4438	240	home	5/22/2019
M-12	Fort Gibson	DR-4438	150	home	5/22/2019
M-123	Muskogee	DR-4657	40	business	5/4/2022
M-124	Muskogee	DR-4657	2	home	5/4/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
M-125	Muskogee	DR-4657	10	home	5/4/2022
M-126	Muskogee	DR-4657		home	5/4/2022
M-127	Muskogee	DR-4657		home	5/4/2022
M-128	Muskogee	DR-4657		home	5/4/2022
M-129	Muskogee	DR-4657	3	home	5/4/2022
M-13	Fort Gibson	DR-4438	144	home	5/22/2019
M-130	Muskogee	DR-4657		home	5/4/2022
M-131	Muskogee	DR-4657		home	5/4/2022
M-132	Muskogee	DR-4657	3	business	5/4/2022
M-133	Muskogee	DR-4657	0	agriculture	5/4/2022
M-134	Muskogee	DR-4657	38	home	5/4/2022
M-135	Muskogee	DR-4657	24	home	5/4/2022
M-136	Muskogee	DR-4657	30	home	5/4/2022
M-137	Muskogee	DR-4657	36	home	5/4/2022
M-138	Muskogee	DR-4657	8	home	5/4/2022
M-139	Muskogee	DR-4657	3	home	5/4/2022
M-14	Muskogee	DR-4438	96	home	5/22/2019
M-140	Muskogee	DR-4657	2	home	5/4/2022
M-141	Muskogee	DR-4657	12	home	5/4/2022
M-142	Muskogee	DR-4657	12	home	5/4/2022
M-143	Muskogee	DR-4657	0	home	5/4/2022
M-144	Muskogee	DR-4657	24	home	5/4/2022
M-145	Muskogee	DR-4657	0	home	5/4/2022
M-146	Muskogee	DR-4657	0	home	5/4/2022
M-147	Muskogee	DR-4657	7	home	5/4/2022
M-148	Muskogee	DR-4657	24	home	5/4/2022
M-149	Muskogee	DR-4657	2	home	5/4/2022
M-15	Muskogee	DR-4438	72	home	5/22/2019
M-150	Muskogee	DR-4657	0	home	5/4/2022
M-151	Muskogee	DR-4657	4	home	5/4/2022
M-152	Muskogee	DR-4657	3	home	5/4/2022
M-153	Muskogee	DR-4657	30	home	5/4/2022
M-154	Muskogee	DR-4657	10	home	5/4/2022
M-155	Muskogee	DR-4657		home	5/4/2022
M-156	Muskogee	DR-4657	12	home	5/4/2022
M-157	Muskogee	DR-4657	1	home	5/4/2022
M-158	Muskogee	DR-4657		business	5/4/2022
M-159	Muskogee	DR-4657	7	home	5/4/2022
M-16	Fort Gibson	DR-4438	120	business	5/22/2019
M-160	Muskogee	DR-4657	1	home	5/4/2022
M-161	Muskogee	DR-4657		agriculture	5/4/2022
M-162	Muskogee	DR-4657	36	business	5/4/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
M-163	Muskogee	DR-4657	4	home	5/4/2022
M-164	Muskogee	DR-4657	6	home	5/4/2022
M-165	Muskogee	DR-4657	60	home	5/4/2022
M-166	Muskogee	DR-4657	4	home	5/4/2022
M-167	Muskogee	DR-4657	7	home	5/4/2022
M-168	Muskogee	DR-4657	36	home	5/4/2022
M-169	Muskogee	DR-4657	29	home	5/4/2022
M-17	Muskogee	DR-4438	0	home	5/22/2019
M-170	Muskogee	DR-4657	13	home	5/4/2022
M-171	Muskogee	DR-4657	3	home	5/4/2022
M-172	Muskogee	DR-4657	6	home	5/4/2022
M-173	Muskogee	DR-4657	5	home	5/4/2022
M-174	Muskogee	DR-4657	60	agriculture	5/4/2022
M-175	Muskogee	DR-4657	0	home	5/4/2022
M-176	Muskogee	DR-4657	2	home	5/4/2022
M-177	Muskogee	DR-4657		home	5/4/2022
M-178	Muskogee	DR-4657	0	home	5/4/2022
M-179	Muskogee	DR-4657	1	home	5/4/2022
M-18	Fort Gibson	DR-4438	180	home	5/22/2019
M-180	Muskogee	DR-4657		home	5/4/2022
M-181	Muskogee	DR-4657	36	home	5/4/2022
M-182	Muskogee	DR-4657	54	home	5/4/2022
M-183	Muskogee	DR-4657	1	home	5/4/2022
M-184	Muskogee	DR-4657	2	home	5/4/2022
M-185	Muskogee	DR-4657	48	home	5/4/2022
M-186	Muskogee	DR-4657	3	home	5/4/2022
M-187	Muskogee	DR-4657	2	home	5/4/2022
M-188	Muskogee	DR-4657	3	home	5/4/2022
M-189	Muskogee	DR-4657	5	home	5/4/2022
M-19	Muskogee	DR-4438	27	home	5/23/2019
M-190	Muskogee	DR-4657	6	home	5/4/2022
M-191	Muskogee	DR-4657	2	business	5/4/2022
M-192	Muskogee	DR-4657	18	home	5/4/2022
M-193	Muskogee	DR-4657	24	business	5/4/2022
M-194	Muskogee	DR-4657	4	home	5/4/2022
M-195	Muskogee	DR-4657	6	home	5/4/2022
M-196	Muskogee	DR-4657	0	home	5/4/2022
M-197	Muskogee	DR-4657	7	home	5/4/2022
M-198	Muskogee	DR-4657	2	business	5/4/2022
M-199	Muskogee	DR-4657	24	home	5/4/2022
M-2	Muskogee	DR-4438	95	business	5/21/2019
M-200	Muskogee	DR-4657	3	business	5/4/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
M-201	Muskogee	DR-4657	10	business	5/4/2022
M-202	Muskogee	DR-4657	2	home	5/4/2022
M-203	Muskogee	DR-4657	29	home	5/4/2022
M-204	Muskogee	DR-4657	1	home	5/4/2022
M-205	Muskogee	DR-4657	12	home	5/4/2022
M-206	Muskogee	DR-4657	2	home	5/4/2022
M-207	Muskogee	DR-4657	44	home	5/4/2022
M-208	Muskogee	DR-4657	6	business	5/4/2022
M-209	Muskogee	DR-4657	8	home	5/4/2022
M-21	Muskogee	DR-4438	24	business	5/23/2019
M-210	Muskogee	DR-4657	16	home	5/4/2022
M-211	Muskogee	DR-4657	18	home	5/4/2022
M-212	Muskogee	DR-4657	14	home	5/4/2022
M-213	Muskogee	DR-4657	8	home	5/4/2022
M-214	Muskogee	DR-4657	0	home	5/4/2022
M-215	Muskogee	DR-4657	5	home	5/4/2022
M-216	Muskogee	DR-4657	0	home	5/4/2022
M-217	Muskogee	DR-4657	6	home	5/4/2022
M-218	Muskogee	DR-4657	1	home	5/4/2022
M-219	Muskogee	DR-4657	2	home	5/4/2022
M-22	Muskogee	DR-4438	6	home	5/23/2019
M-220	Muskogee	DR-4657	6	home	5/4/2022
M-221	Muskogee	DR-4657	5	home	5/4/2022
M-222	Muskogee	DR-4657	36	home	5/4/2022
M-223	Muskogee	DR-4657	0	home	5/4/2022
M-224	Muskogee	DR-4657	48	home	5/4/2022
M-225	Muskogee	DR-4657	360	business	5/4/2022
M-226	Muskogee	DR-4657	7	home	5/4/2022
M-227	Muskogee	DR-4657	15	home	5/4/2022
M-228	Muskogee	DR-4657		home	5/4/2022
M-229	Muskogee	DR-4657	4	home	5/4/2022
M-23	Muskogee	DR-4438	40	home	5/23/2019
M-230	Muskogee	DR-4657		home	5/4/2022
M-231	Muskogee	DR-4657		home	5/4/2022
M-232	Muskogee	DR-4657	3	home	5/4/2022
M-233	Muskogee	DR-4657	1	home	5/4/2022
M-234	Muskogee	DR-4657	36	home	5/4/2022
M-235	Muskogee	DR-4657	1	business	5/4/2022
M-236	Muskogee	DR-4657	2	home	5/4/2022
M-237	Muskogee	DR-4657	8	home	5/4/2022
M-238	Muskogee	DR-4657	24	home	5/4/2022
M-239	Muskogee	DR-4657	3	business	5/4/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
M-24	Fort Gibson	DR-4438	60	home	5/23/2019
M-240	Muskogee	DR-4657	5	home	5/4/2022
M-241	Muskogee	DR-4657	14	business	5/4/2022
M-242	Muskogee	DR-4657	14	business	5/4/2022
M-243	Muskogee	DR-4657	2	business	5/4/2022
M-244	Muskogee	DR-4657	2	business	5/4/2022
M-245	Muskogee	DR-4657	48	home	5/4/2022
M-246	Muskogee	DR-4657		home	5/4/2022
M-247	Muskogee	DR-4657	36	home	5/4/2022
M-248	Muskogee	DR-4657	2	home	5/4/2022
M-249	Muskogee	DR-4657		home	5/4/2022
M-25	Muskogee	DR-4438	60	home	5/23/2019
M-250	Muskogee	DR-4657	12	home	5/4/2022
M-251	Muskogee	DR-4657	20	home	5/4/2022
M-252	Muskogee	DR-4657	7	home	5/4/2022
M-253	Muskogee	DR-4657	3	home	5/4/2022
M-254	Muskogee	DR-4657	6	home	5/4/2022
M-255	Muskogee	DR-4657	1	business	5/4/2022
M-256	Muskogee	DR-4657	8	home	5/4/2022
M-257	Muskogee	DR-4657	0	home	5/4/2022
M-258	Muskogee	DR-4657	14	home	5/4/2022
M-259	Muskogee	DR-4657		home	5/4/2022
M-26	Fort Gibson	DR-4438	36	business	5/23/2019
M-260	Muskogee	DR-4657	48	home	5/4/2022
M-261	Muskogee	DR-4657	12	home	5/4/2022
M-262	Muskogee	DR-4657	24	home	5/4/2022
M-263	Muskogee	DR-4657	96	home	5/4/2022
M-264	Muskogee	DR-4657	0	home	5/4/2022
M-265	Muskogee	DR-4657	2	home	5/4/2022
M-266	Muskogee	DR-4657	0	agriculture	5/4/2022
M-267	Muskogee	DR-4657	1	home	5/4/2022
M-268	Muskogee	DR-4657	36	home	5/4/2022
M-269	Muskogee	DR-4657	48	home	5/4/2022
M-27	Muskogee	DR-4438	70	home	5/24/2019
M-270	Muskogee	DR-4657	0	home	5/4/2022
M-271	Muskogee	DR-4657	18	home	5/4/2022
M-272	Muskogee	DR-4657		home	5/4/2022
M-273	Muskogee	DR-4657	4	home	5/4/2022
M-274	Muskogee	DR-4657	8	home	5/4/2022
M-275	Muskogee	DR-4657	10	home	5/4/2022
M-276	Muskogee	DR-4657	18	home	5/4/2022
M-277	Muskogee	DR-4657	0	home	5/4/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
M-278	Muskogee	DR-4657		home	5/4/2022
M-279	Muskogee	DR-4657	12	home	5/4/2022
M-28	Muskogee	DR-4438	0	home	5/24/2019
M-280	Muskogee	DR-4657	12	home	5/4/2022
M-281	Muskogee	DR-4657	12	home	5/4/2022
M-282	Muskogee	DR-4657	36	agriculture	5/4/2022
M-283	Muskogee	DR-4657	72	agriculture	5/4/2022
M-284	Muskogee	DR-4657	18	home	5/4/2022
M-285	Muskogee	DR-4657	3	home	5/4/2022
M-286	Muskogee	DR-4657	24	business	5/4/2022
M-287	Muskogee	DR-4657		business	5/4/2022
M-288	Muskogee	DR-4657	20	home	5/4/2022
M-289	Muskogee	DR-4657	8	home	5/4/2022
M-29	Muskogee	DR-4438	0	home	5/24/2019
M-290	Muskogee	DR-4657	2	home	5/4/2022
M-291	Muskogee	DR-4657	0	home	5/4/2022
M-292	Muskogee	DR-4657	3	home	5/4/2022
M-293	Muskogee	DR-4657	0	home	5/4/2022
M-294	Muskogee	DR-4657		home	5/4/2022
M-295	Muskogee	DR-4657		home	5/4/2022
M-296	Muskogee	DR-4657		home	5/4/2022
M-297	Muskogee	DR-4657		home	5/4/2022
M-298	Muskogee	DR-4657		home	5/4/2022
M-299	Muskogee	DR-4657		home	5/4/2022
M-3	Fort Gibson	DR-4438	50	home	5/21/2019
M-30	MUSKOGEE	DR-4438	48	agriculture	5/24/2019
M-300	Muskogee	DR-4657	24	home	5/4/2022
M-301	Muskogee	DR-4657	24	home	5/4/2022
M-302	Muskogee	DR-4657	24	home	5/4/2022
M-303	Muskogee	DR-4657	24	home	5/4/2022
M-304	Muskogee	DR-4657	24	home	5/4/2022
M-305	Muskogee	DR-4657	24	home	5/4/2022
M-306	Muskogee	DR-4657	24	home	5/4/2022
M-307	Muskogee	DR-4657		home	5/4/2022
M-308	Muskogee	DR-4657		home	5/4/2022
M-309	Muskogee	DR-4657	24	home	5/4/2022
M-31	Muskogee	DR-4438	6	home	5/24/2019
M-310	Muskogee	DR-4657		home	5/4/2022
M-311	Muskogee	DR-4657		home	5/4/2022
M-312	Muskogee	DR-4657		home	5/4/2022
M-313	Muskogee	DR-4657		home	5/4/2022
M-314	Muskogee	DR-4657		home	5/4/2022

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
M-315	Muskogee	DR-4657		home	5/4/2022
M-316	Muskogee	DR-4657		home	5/4/2022
M-317	Muskogee	DR-4657		home	5/4/2022
M-318	Muskogee	DR-4657		home	5/4/2022
M-319	MUSKOGEE	DR-4657	3	home	5/4/2022
M-320	Muskogee	DR-4657	22	home	5/5/2022
M-321	Muskogee	DR-4657	4	home	5/5/2022
M-323	Muskogee	DR-4657	22	home	5/5/2022
M-324	Muskogee	DR-4657	12	business	5/5/2022
M-325	Muskogee	DR-4657	0	home	5/5/2022
M-326	Muskogee	DR-4657	36	home	5/5/2022
M-327	Muskogee	DR-4657	24	home	5/5/2022
M-328	Muskogee	DR-4657	4	home	5/5/2022
M-329	Muskogee	DR-4657	28	home	5/5/2022
M-33	Muskogee	DR-4438	100	home	5/27/2019
M-330	Muskogee	DR-4657	8	home	5/6/2022
M-331	Muskogee	DR-4657	2	home	5/10/2022
M-34	Muskogee	DR-4438	36	home	6/22/2019
M-340	Muskogee	DR-4657	4	home	<Null>
M-4	Fort Gibson	DR-4438	10	home	5/21/2019
M-48	Muskogee	DR-4587	0	home	2/15/2021
M-5	Fort Gibson	DR-4438	20	agriculture	5/21/2019
M-54	Muskogee	DR-4587	1	home	2/15/2021
M-6	Muskogee	DR-4438	8	Unspecified	5/21/2019
M-7	Muskogee	DR-4438	120	home	5/21/2019
M-71	Muskogee	DR-4587		home	2/16/2021
M-73	Muskogee	DR-4587	36	home	2/16/2021
M-8	Muskogee	DR-4438	84	home	5/21/2019
M-9	Fort Gibson	DR-4438	96	home	5/22/2019
P-1	Porum	DR-4438	48	home	5/24/2019
P-11	Porum	DR-4657	4	home	5/4/2022
W-15	Warner	DR-4657		home	5/4/2022
W-16	Warner	DR-4657	5	home	5/4/2022
WF-1	Webbers Falls	DR-4438	36	home	5/7/2019
WF-10	Webbers Falls	DR-4438	150	home	5/21/2019
WF-11	Webbers falls	DR-4438	72	home	5/21/2019
WF-12	Webbers Falls	DR-4438	36	home	5/21/2019
WF-13	Webbers Falls	DR-4438	38	home	5/21/2019
WF-14	Webbers Falls	DR-4438	36	home	5/21/2019
WF-15	Webbers Falls	DR-4438	0	home	5/21/2019
WF-16	Webbers Falls	DR-4438	14	home	5/21/2019
WF-17	Webbers Falls	DR-4438	14	home	5/21/2019

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
WF-18	Webbers Falls	DR-4438	180	home	5/21/2019
WF-19	Webbers Falls	DR-4438	48	home	5/21/2019
WF-2	Webbers Falls	DR-4438	0	home	5/20/2019
WF-20	Webbers Falls	DR-4438	36	home	5/22/2019
WF-21	Webbers Falls	DR-4438	96	home	5/22/2019
WF-22	Webbers Falls	DR-4438	336	home	5/22/2019
WF-23	Webbers falls	DR-4438	0	home	5/22/2019
WF-24	Webbers Falls	DR-4438	8	home	5/22/2019
WF-25	Webbers Falls	DR-4438	84	home	5/22/2019
WF-26	Webbers Falls	DR-4438	80	home	5/22/2019
WF-27	Webbers Falls	DR-4438	94	home	5/22/2019
WF-28	Webbers Falls	DR-4438	60	home	5/22/2019
WF-29	Webbers Falls	DR-4438	6	home	5/22/2019
WF-3	Webbers Falls	DR-4438	48	home	5/20/2019
WF-30	Webbers Falls	DR-4438	3	home	5/22/2019
WF-31	Webbers Falls	DR-4438	6	home	5/22/2019
WF-32	Webbers Falls	DR-4438	36	home	5/22/2019
WF-33	Webbers Falls	DR-4438	36	home	5/22/2019
WF-34	Webbers Falls	DR-4438	18	home	5/22/2019
WF-35	Webbers Falls	DR-4438	48	home	5/22/2019
WF-36	Webbers Falls	DR-4438	6	home	5/22/2019
WF-37	Webbers Falls	DR-4438	36	home	5/22/2019
WF-38	Webbers Falls	DR-4438	72	home	5/22/2019
WF-39	Webbers Falls	DR-4438	36	home	5/22/2019
WF-4	Webbers Falls	DR-4438	36	home	5/20/2019
WF-40	Webbers Falls	DR-4438	36	home	5/22/2019
WF-41	Webbers Falls	DR-4438	54	home	5/22/2019
WF-42	Webbers Falls	DR-4438	60	home	5/23/2019
WF-43	Webbers Falls	DR-4438	48	home	5/23/2019
WF-44	Webbers Falls	DR-4438	48	home	5/23/2019
WF-45	Webbers Falls	DR-4438	60	home	5/23/2019
WF-46	Webbers Falls	DR-4438		home	5/23/2019
WF-47	Webbers Falls	DR-4438	60	home	5/23/2019
WF-48	Webbers Falls	DR-4438	60	home	5/23/2019
WF-49	Webbers Falls	DR-4438	4	home	5/23/2019
WF-5	Webbers Falls	DR-4438	0	home	5/20/2019
WF-50	Webbers Falls	DR-4438	84	home	5/23/2019
WF-51	Webbers Falls	DR-4438	0	Unspecified	5/23/2019
WF-52	Webbers Falls	DR-4438	48	home	5/23/2019
WF-53	Webbers Falls	DR-4438	36	home	5/24/2019
WF-54	Webbers Falls	DR-4438	72	home	5/24/2019
WF-55	Webbers Falls	DR-4438	60	home	5/24/2019

Flood Area ID	City	FEMA Disaster	Water Depth (in)	Property Type	Date of Disaster
WF-56	Webbers Falls	DR-4438	72	home	5/24/2019
WF-57	Webbers Falls	DR-4438	36	home	5/24/2019
WF-58	Webbers Falls	DR-4438	3	home	5/24/2019
WF-59	Webbers Falls	DR-4438	3	home	5/24/2019
WF-6	Webbers Falls	DR-4438	48	home	5/21/2019
WF-60	Webbers Falls	DR-4438	36	home	5/24/2019
WF-61	Webbers Falls	DR-4438	60	home	5/24/2019
WF-62	Webbers Falls	DR-4438	48	home	5/24/2019
WF-63	Webbers Falls	DR-4438	60	home	5/25/2019
WF-64	Webbers Falls	DR-4438	36	home	5/25/2019
WF-65	Webbers Falls	DR-4438	6	home	5/25/2019
WF-67	Webbers Falls	DR-4438	12	home	5/26/2019
WF-68	Webbers Falls	DR-4438	20	home	5/27/2019
WF-69	Webbers Falls	DR-4438	36	home	5/27/2019
WF-7	Webbers Falls	DR-4438	60	home	5/21/2019
WF-70	Webbers Falls	DR-4438	36	home	5/27/2019
WF-71	Webbers Falls	DR-4438	48	home	5/27/2019
WF-72	Webbers Falls	DR-4438	0	home	5/27/2019
WF-73	Webbers Falls	DR-4438	3	home	5/28/2019
WF-74	Webbers Falls	DR-4438	24	home	5/29/2019
WF-75	Webbers Falls	DR-4438	60	business	5/30/2019
WF-8	Webbers Falls	DR-4438	24	home	5/21/2019
WF-9	Webbers Falls	DR-4438	150	home	5/21/2019

Appendix H. Survey Responses

Survey questions were made available early in the planning process to help gather stakeholder input and community feedback regarding how natural hazards impact the planning area. The digital survey was structured so that respondents could choose whether they represented school districts or incorporated areas. Those representing school districts received a slightly different line of questioning compared to those who represented municipalities in Muskogee County. Below, survey responses are grouped accordingly. If neither was selected, the general public was provided a basic information question that helped the planning team in their assessments in the 2024 Muskogee County Hazard Mitigation Plan Update

School Administration Questions

Question	Hilldale PS	Fort Gibson PS	Porum PS	Oktaha PS
School Capabilities				
What is your role within the school district?	<i>Superintendent</i>	<i>Emergency Manager</i>	<i>Superintendent</i>	<i>Assistant Superintendent</i>
Does the school have a designated safe room, shelter, or place of refuge for students?	Yes	Yes	Yes	No
What is the shelter capacity?	<i>We have three, one located at each school site. elementary could house 1250, middle school could house 600, and high school could house 600</i>	2,000+	550	
How does the school receive emergency alerts or warnings during emergency events?	<i>TV, Radio, text messages</i>	<i>Mobile Devices and Direct Contact</i>	—	<i>Social media</i>
Does the school have an Emergency Operations Plan (EOP) during severe weather events?	Yes	Yes	Yes	No
Which natural hazard(s) does/do the schools routinely prepare for?	<i>Extreme Heat, High Winds, Lightning, Severe Winter Storm, Tornado</i>	—	<i>High Winds, Severe Winter Storms, Tornadoes</i>	<i>Earthquake, Tornado</i>
Does the school have a backup power generator in place?	Yes	No	No	No
Does the school offer virtual connectivity options?	Yes	Yes	Yes	Yes

Question	Hilldale PS	Fort Gibson PS	Porum PS	Oktaha PS
How can teaching be done virtually?	<i>We learned how to do virtual learning during COVID. All students and staff have devices that can be taken home for usage if needed and staff can connect with students to correspond for instruction.</i>	<i>Students are provided with computers and can participate at school or home.</i>	<i>Distance Learning</i>	<i>We use Google Classroom</i>
Does the school provide free meals to students?	No	Yes	Yes	No
What percentage of students utilize bus transportation?	50%	Approx 50-60%	70%	Around 40%
Are there "problem areas" on local bus routes during times of inclement weather?	<i>Yes, bridges and neighborhoods we know have regular issues during heavy rain periods.</i>	<i>Issues on several country roads.</i>	<i>Low-water crossings and bridges</i>	Yes
Does the district have covered parking for school buses?	No	No	No	Yes
Does the school have lightning detection capabilities or alerts to notify those who are outdoors?	No	Yes	Unsure	No
Vulnerabilities & Impacts				
How is your school district vulnerable to DAM INCIDENTS?	<i>Parts of our district are in the floodplain and path if dams had a failure. We would have to evacuate many families in our district and cause a major disruption to learning</i>	<i>We have several areas that are vulnerable to dams during emergency water releases</i>	—	<i>I do not believe we are</i>
What specific impacts have there been from DAM INCIDENTS/FAILURES in the past?	None	<i>Widespread flooding in 2019</i>	—	<i>None that I'm aware of</i>
In what ways is your school district vulnerable to DROUGHT events?	<i>Drought affects our building foundations and structures such as roofs.</i>	<i>No current concerns</i>	—	<i>I do not believe we are</i>
What specific impacts have there been from DROUGHT in the past?	<i>Building and maintenance feel the major impact of drought.</i>	<i>None known</i>	—	<i>None that I'm aware of</i>
How is your school district vulnerable to EARTHQUAKE events?	<i>We have not. yet.</i>	<i>Not currently an issue</i>	—	<i>I do not know but several of our buildings are old and would not hold up to an earthquake.</i>

Question	Hilldale PS	Fort Gibson PS	Porum PS	Oktaha PS
What specific impacts have there been from EARTHQUAKES in the past?	None	None known	—	None so far
In what ways is your school district vulnerable when it comes to EXTREME HEAT events?	Building and maintenance, technology, transportation, and grounds are obviously affected by extreme heat, but we also worry about student and staff safety in the heat	Possible interruption of utility service (electricity)	—	Extreme heat would cause our students to stay inside with no recess during the school day
What specific impacts have there been from EXTREME HEAT in the past?	Wear and tear on facilities, technology, and student/staff safety.	Loss of power during the last flood	—	As mentioned above, our students have spent many days inside without free-time physical activity
How is your school district vulnerable during FLOODING events?	We have many areas of our district that flood during heavy rain events.	We are above the floodplain and don't have issue of water flooding our buildings	—	We are not close to any waterways that would cause us to see flooding events although we do have water in our building due to draining issues
What specific impacts have there been from FLOODING in the past?	Neighborhood and road flooding has closed schools at times. We have major flooding on the road in front of our high and middle school which makes traffic dangerous during any rain event.	We lost power during a flood due to power lines and transformers being flooded	—	We have had water in our buildings due to drainage issues when we get a lot of rain in a short period
How is your school district vulnerable during HAIL events?	Damage to roofs, transportation, and facilities.	Roof damage and damage to HVAC units.	—	Hail damage to all of our buildings
What specific impacts have there been from HAIL in the past?	Damage to facilities and transportation	During past hail events, several of the condenser fan blades were damaged as well as the condensing coils.	—	We have had hail damage due to large amounts of hail. roofs, windows, etc.
How is your school district vulnerable during HIGH WIND events?	Damage to buildings and facilities. danger in driving school vehicles	Building damage.	—	We have mostly metal buildings and if high wind comes in, it could cause damage.
What specific impacts have there been from HIGH WINDS in the past?	Damage to building and grounds	We have lost HVAC equipment blown off roofs and roof damage from a possible tornado event.	—	We have had equipment outside blown away during storms. Track and field high jump mats/pole vault mats that aren't tied down. Trees down.

Question	Hilldale PS	Fort Gibson PS	Porum PS	Oktaha PS
How is your school district vulnerable to LIGHTNING strikes?	<i>During any storm event, lightning leaves all aspects of the school vulnerable. From technology to drop off and pick up of students and everything in between.</i>	<i>Buildings, security equipment, internet, HVAC control systems.</i>	—	<i>Lightning can cause some of our electrical equipment to quit working.</i>
What specific impacts have there been from LIGHTNING in the past?	<i>Technology, Instruction, Transportation, Drop off and pick up, any outside activity</i>	<i>A lightning strike damaged an elementary school's EMS controls and thermostats.</i>	—	<i>Computers, TVs, Chromebooks, telephones, internet have all been affected by lightning in the past.</i>
What vulnerabilities are there when SEVERE WINTER STORMS (ice, extreme cold, blizzard, etc.) impact your school district?	<i>School closures and maintenance/ facility issues</i>	<i>Loss of utilities could lead to damaged plumbing leading to water damage in the building.</i>	—	<i>School closings, equipment to stop working, frozen pipes that can cause flooding in the buildings, high electric bills, etc.</i>
What specific impacts have there been from SEVERE WINTER STORMS in the past?	<i>Closed School for instruction, Pipes busted numerous times, employee and student safety walking in and out of the building.</i>	<i>Sprinkler system failure due to frozen pipes in our student center. Extensive damage</i>	—	<i>All of the above things have happened in our district. School closings, equipment to stop working, frozen pipes that can cause flooding in the buildings, high electric bills, etc.</i>
How is your school district vulnerable to TORNADOES?	<i>Facility and loss of life in extreme situations</i>	<i>All of our infrastructure.</i>	—	<i>We have an underground shelter that will only hold around 350 students. Our population is around 650 plus 100 employees. The shelter currently floods so it's not the safest to be in. Our buildings and equipment could be destroyed.</i>
What specific impacts have there been from TORNADOES in the past?	<i>None to date, thank you, Lord!</i>	<i>Roof and HVAC equipment damage</i>	—	<i>I am not aware of a tornado hitting our school but have been close.</i>
How is your school district vulnerable to WILDFIRES?	<i>Facilities and school closure</i>	<i>None known</i>	—	<i>I think we are in a place that could have wildfires. We have a volunteer fire department so that would help. Like everything else, it would cause total loss and damage to our facilities.</i>
What specific impacts have there been from WILDFIRES in the past?	<i>None at this time</i>	<i>N/A</i>	—	<i>None that I know of.</i>

Question	Hilldale PS	Fort Gibson PS	Porum PS	Oktaha PS
What future mitigation projects/actions can help lessen a disaster's impact? Are there areas that can be enhanced or built upon?	—	—	—	New bridges, EOC, and community storm shelter
Please rank the following 11 natural hazards as being the most impactful and most important (1) to the least impactful, and least relevant (11).	1. Tornado 2. Lightning 3. Severe Winter Storm 4. Flooding 5. High Winds 6. Extreme Heat 7. Hail 8. Drought 9. Dam Incidents 10. Earthquake 11. Wildfire	1. Tornado 2. Lightning 3. Severe Winter Storm 4. Flooding 5. High Winds 6. Extreme Heat 7. Hail 8. Drought 9. Dam Incidents 10. Earthquake 11. Wildfire	1. Tornado 2. Dam Incidents 3. Drought 4. Earthquake 5. Extreme Heat 6. Flooding 7. Hail 8. High Winds 9. Lightning 10. Severe Winter Storm 11. Wildfire	1. Tornado 2. Wildfire 3. Earthquake 4. Flooding 5. High Winds 6. Severe Winter Storm 7. Hail 8. Lightning 9. Extreme Heat 10. Drought 11. Dam Incidents
In the last 10 years, what natural hazards have directly impacted you? Please select all that apply.	• Extreme Heat • Flooding • Hail • High Winds • Lightning • Severe Winter Storm	• Dam Incidents • Flooding • Hail • High Winds • Lightning • Severe Winter Storm • Tornado	• High Winds	• Flooding • High Winds • Severe Winter Storm
What zip code is your place of residence?	74403	74434	Unsure	74403
Is your place of residence in an identified FEMA flood zone	No	No	No	No
Do you have flood insurance through FEMA's National Flood Insurance Program (NFIP)?	No	Yes	No	No
Have you had previous flood damage?	No	No	No	No
Describe any past flood damage to your property.	—	—	—	Pipes froze and ruined our gymnasium floor and other room floors.
Do you have a safe room in your home?	Yes	No	No	No
How are natural hazard threats, and preparedness guidelines communicated to you and your home?	• Facebook • Schools • Mobile App • weather radio	• Radio • Fire Department • Law Enforcement • Mobile App	• Radio • Mobile App	• Facebook • Radio/Television • Mobile App
Are there any public events/programs that promote public awareness of natural hazards?	Unsure	Yes	Unsure	Unsure

Question	Hilldale PS	Fort Gibson PS	Porum PS	Oktaha PS
Please describe the public events/programs.	—	<i>Social Media</i>	—	—
Are there any projects or public awareness campaigns that would better prepare you for future disasters?	<i>None that I am aware of</i>	<i>More public education and information</i>	<i>Not sure</i>	<i>Unsure</i>
If you could choose one action to reduce the impacts of natural hazards, what would it be?	<i>More money to deal with flooding</i>	—	—	<i>Knowledge of how to prepare for natural disasters.</i>
What future mitigation projects/actions can help lessen a disaster's impact? Are there areas that can be enhanced or built upon?	<i>Communication is always key, preparation of how we access resources after events,</i>	—		<i>I would say the most important thing is to get a good plan in place so we know what our options are and how to face things as they come our way.</i>
Provide any additional comments below.				

City/Town Representatives

Question	Braggs	Muskogee	Porum	Taft
City/Town Capabilities				
What best describes your current occupation?	<i>Mayor</i>	<i>GIS Specialist</i>	<i>Water Superintendent</i>	<i>Billing Clerk</i>
What zip code is your place of residence?	<i>74423</i>	<i>74403</i>	<i>Unsure</i>	<i>74436</i>
Does your town have adopted building codes?	<i>Unsure</i>	<i>Yes</i>	<i>Yes</i>	<i>No</i>
Are there any community shelters in your municipality?	<i>No</i>	<i>No</i>	<i>Yes</i>	<i>No</i>
Are there storm sirens in place?	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>No</i>
Who controls the storm siren?	<i>Fire Chief</i>	<i>Emergency Management</i>	<i>Firefighters, water superintendent, cops</i>	<i>—</i>
What are the critical facilities in your town/city?	<i>Water plant/ wastewater treatment plant/ city hall</i>	<i>Police & Fire Stations, City Hall, Pollution Control, Water Plant, Water Towers, Cell Towers, Sub Stations, Gas Stations, Groceries Stores, Power Plant</i>	<i>Water Plant, Fire Station, Police Department</i>	<i>—</i>
Where are the backup power generators in place?	<i>Water plant/ city hall/ wastewater treatment plant</i>	<i>Public Works, City Hall, Pollution Control, Schools</i>	<i>We have none</i>	<i>—</i>
Who are the electrical providers for your town?	<i>OG&E, Lake Region</i>	<i>OG&E</i>	<i>OG&E</i>	<i>OG&E</i>
Do these companies provide tree-trimming services along the power lines?	<i>Yes</i>	<i>Yes</i>	<i>No</i>	<i>Yes</i>
Who are the water utility providers for your town?	<i>We provide our own water</i>	<i>City of Muskogee</i>	<i>Town of Porum</i>	<i>Muskogee</i>
In your city/town, are there socially disadvantaged populations? Where are they located?	<i>Throughout the community</i>	• Several locations for the Elderly, that being apartments & also assisted living locations. • Several Apt locations for lower income. • The city does have areas where there are congregates of African Americans and more Hispanic areas.	<i>Yes, all over</i>	<i>—</i>

Question	Braggs	Muskogee	Porum	Taft
Does the town communicate hazard risks/preparedness information to residents?	Yes	Yes	No	No
Please explain how the town communicates hazard risks and preparedness to the citizens.	The town's Facebook page and other social media outlets. It's also posted on the window at the city hall.	We do have someone tasked with communicating with the public through social media who also handles news-TV situations and City website-related news and events, which can involve Hazardous Situations and Events. news-TV may interview city officials.	—	—
Vulnerabilities & Impacts				
How is your City/Town vulnerable to DAM INCIDENTS/ FAILURES?	No immediate danger	We are 7-8 miles from the dam outflow and in the direction of River flow from the Fort Gibson Lake Dam	We have Eufaula dam and I'm not sure what would happen if it broke.	—
What specific impacts have there been from DAM INCIDENTS/ FAILURES in the past?	N/A	Critical damn levels because the lake was so full. In turn, difficult situations during the Arkansas River flooding event in 2019. With the River so swollen and unable to take on any more water.	None	—
In what ways is your City/Town vulnerable to DROUGHT events?	We're a farming community and we also have underground water wells	Possible issues with the city water supply depend upon the severity of the drought. Agricultural needs near or around the city. Livestock vulnerability. Wildfire Hazards with gusty wind situations or lightning storms, power lines.	Water Supply	—
What specific impacts have there been from DROUGHT in the past?	People lost their crops. And the water gets low. We can't service the people with water. Low water pressure	Serious wildfires in the county. It came up in one of the workshops. The highway was blocked off.	None	—
How is your City/Town vulnerable to EARTHQUAKE events?	N/A	Possible cracking of the streets, sidewalks, and building structures. water lines breaks	Buildings are not built to earthquake standards.	—

Question	Braggs	Muskogee	Porum	Taft
What specific impacts have there been from EARTHQUAKES in the past?	N/A	Unsure what has been documented.	None	—
In what ways is your City/Town vulnerable when it comes to EXTREME HEAT events?	With extreme heat, our water wells can't keep up with the demand of our customers	Strains on electrical grid. Folks without A/C with nowhere to go. Unhealthy populations are susceptible to heat-related illness. Infrastructure water and electrical demands. Infrastructure water line breaks.	Elderly and other houses don't have air conditioners. The electrical grid may not be enough.	—
What specific impacts have there been from EXTREME HEAT in the past?	The town of Braggs has had to get water from Camp Gruber and we also handed out bottled water to customers	Unsure what has been documented.	none	—
How is your City/Town vulnerable during FLOODING events?	We're closed in. IE the flood of 2019	Certain neighborhoods flood. Certain roads become unpassable. Some storm systems become compromised. Clogged ditches can cause issues.	Some of the town was in floodplains.	—
What specific impacts have there been from FLOODING in the past?	Lost homes, lost livestock, and people couldn't leave their homes. Food and medical supplies had to be brought in by boat and train.	Several flood events have caused the whole neighborhood to flood (meadows subdivision). The Arkansas River flooding event hit areas that never really experienced flooding.	Some houses have flooded.	—
How is your City/Town vulnerable during HAIL events?	N/A	Roof damage to buildings and homes and vehicle damage. Possible physical injury depending on hail size.	We have a lot of hail storms.	—
What specific impacts have there been from HAIL in the past?	N/A	Unsure what has been documented	Property damage, automobile damage	—
How is your City/Town vulnerable during HIGH WIND events?	Electricity Loss	This year's (2023) derecho caused significant tree and limb damage.	We have a lot of high winds and storms in our area.	—

Question	Braggs	Muskogee	Porum	Taft
What specific impacts have there been from HIGH WINDS in the past?	Electricity Loss	Same as stated in the previous question. The City spent a significant time dealing with tree limb damage, and tree limb piles throughout the City. The City had to clean up or stuck cleaning up other contractors' messes.	Property, structure, vehicle, and vegetation damage	—
How is your City/Town vulnerable to LIGHTNING strikes?	N/A	If there is a drought, wildfires.	We have lots of storms	—
What specific impacts have there been from LIGHTNING in the past?	N/A	Unsure	Damage to houses, damage to electrical equipment	—
What vulnerabilities are there when SEVERE WINTER STORMS (ice, extreme cold, blizzard, etc.) impact your City or Town?	Can't go anywhere	Severe ice storm, tree and limb damage. Power outage & damage to electrical poles and assets. Driving conditions always. Water line breaks. Sudden severe temperature drops this year. Blizzard conditions a couple of times.	The elderly, young, and all houses are affected.	—
What specific impacts have there been from SEVERE WINTER STORMS in the past?	Loss of water loss of electricity	Severe ice storm around 2005 or 2006. Also another one less severe a few years later. Blizzard conditions a couple of times. A couple of severely cold events. The first one some buildings suffered water damage from water line breaks, which also was a snowy event.	Houses without power and water. When power and water were restored there were leaks to houses. Food in freezers and ice boxes spoiling.	—
How is your City/Town vulnerable to TORNADOES?	We don't have a community shelter	Building, tree, electrical damage. Potential human loss of life.	We live in Tornado Alley.	—
What specific impacts have there been from TORNADOES in the past?	Destruction of property	Building damage I believe.	Property damage	—
How is your City/Town vulnerable to WILDFIRES?	A lot of wooded areas and vegetation	If it happens during a high wind event it could be serious.	Outside the city is wooded land	—
What specific impacts have there been from WILDFIRES in the past?	N/A	Unsure of any.	Outside of city limits has had land burnt and houses compromised.	—

Question	Braggs	Muskogee	Porum	Taft
What future mitigation projects/actions can help lessen a disaster's impact? Are there areas that can be enhanced or built upon?	—	Unsure exactly. But I'm sure keeping up with the latest equipment, training, and procedures and making sure the right systems are in place goes a long way. Maintaining and improving infrastructure.	—	—
Please rank the following 11 natural hazards as being the most impactful and most important (1) to the least impactful, least relevant (11)	1. Flooding 2. Dam Incident 3. Drought 4. Earthquake 5. Extreme Heat 6. Hail 7. High Winds 8. Lightning 9. Severe Winter Storm 10. Tornado 11. Wildfire	1. Severe Winter Storm 2. Flooding 3. High Winds 4. Extreme Heat 5. Tornado 6. Drought 7. Hail 8. Earthquake 9. Dam Incidents 10. Lightning 11. Wildfire	1. Severe Winter Storm 2. Tornado 3. High Winds 4. Lightning 5. Flooding 6. Hail 7. Wildfire 8. Drought 9. Extreme Heat 10. Dam Incidents 11. Earthquake	1. Lightning 2. Flooding 3. Extreme Heat 4. High Winds 5. Dam Incidents 6. Drought 7. Earthquake 8. Hail 9. Severe Winter Storm 10. Tornado Wildfire
In the last 10 years, what natural hazards have directly impacted you?	• Drought • Flooding • Severe Winter Storm • Tornado	• Extreme Heat • Flooding • High Winds • Severe Winter Storm	• Drought • Flooding • Hail • High Winds • Lightning • Severe Winter Storm • Tornado	• Drought • Extreme Heat • Flooding • Hail • High Winds • Lightning • Severe Winter Storm
Is your place of residence in an identified FEMA flood zone?	Unsure	No	Yes	Unsure
Do you have flood insurance through FEMA's National Flood Insurance Program (NFIP)?	Unsure	No	No	Unsure
Have you had previous flood damage?	Yes	Yes	Yes	Yes
Describe any past flood damage to your property.	None	Area drainage problems	Flooding inside of a house	Turning down roads
Do you have a safe room in your home?	Yes	No	No	No
How are natural hazard threats, and preparedness guidelines communicated to you and your home?	• Other Social Media • Radio • Fire Department	• Radio • Mobile App • Internet • YouTube	• Other Social Media • Radio • Fire Department • Law Enforcement • Weather Radio	• Twitter • Other Social Media • Fire Department
Are there any public events/programs that promote public awareness of natural hazards?	Unsure	Unsure	No	No
Please describe the public events/programs.	—	—	—	—

Question	Braggs	Muskogee	Porum	Taft
Are there any projects or public awareness campaigns that would better prepare you for future disasters?	No	Committing to better awareness with up-to-date sites with helpful tips, resources, and service information.	I don't know	Not at the moment
If you could choose one action to reduce the impacts of natural hazards, what would it be?	Community Shelters	Preparedness	—	Sirens and shelters
Provide any additional comments below.	—	- Paying attention to weather events and situations - Having access to or Accessing the necessary resources - Knowing what to do when the events are presented.	Come to the smaller communities and talk to the residents	—

Additional Public Feedback

Other respondents suggested the following projects, public awareness campaigns that could potentially better prepare them for future disasters.

Other respondents suggested the following projects, public awareness campaigns that could potentially better prepare them for future disasters.
There probably are some that I'm not aware of. Our Women United group invited EM to speak and they shared some great information with us!
Neighborhood watch programs for emergency
Maybe an app?
Affordable safe room options or registering a safe room
Probably post information promptly on the town's Facebook or other social media.
Quicker coverage of everything
Mobile App for both Apple/Android.

If you could choose one action to reduce the impacts of natural hazards, what would it be?
More funding for mitigation and preparedness.
To have a recovery system that includes volunteers trained on how and where to access resources.
The County should review ice/snow mitigation systems and processes for effectiveness.
Warning systems
Better land management practices to reduce fire risk.
More public awareness/engagement. Less booth fairs more hands-on creativity.
Fix the flood problems!



Communities need trusted
partners to safeguard today
and build a stronger tomorrow
— it's why we exist.

MESHEK
& ASSOCIATES, LLC

Tulsa | OKC | Springdale

1988 35 Years of Serving Communities 2023

REPORT TO: CITY COUNCIL

MEETING DATE: SEPTEMBER 23, 2024



Agenda Item:	3.d. CC-24-113
Previous/Related Action:	• CC-18-114, October 1, 2018: Stormwater Capital Project Needs • CC-19-133, September 16, 2019: Bid Recommendation for Master Plan • CC 19-199, December 16, 2019: Application for FEMA Pre-Disaster Mitigation (PDM) Grant • CC-21-126, July 12, 2021: Budget Amendment for FEMA Pre-Disaster Mitigation City Match • CC-23-149, September 25, 2023 – Stormwater Rate Study
Background/Issue:	• On September 25, 2023, staff presented a proposed rate increase for the Drainage Fee; the rate increase was later adopted by City Council. • Staff have a long-term goal of improving stormwater detention, creeks and channels throughout the City utilizing funds from the Drainage Fee. • A CIP covering a portion of the City's drainage area was completed by Meshek & Associates under the Boomer Creek Master Drainage Plan, funded in part by the FEMA PDM. • In order to identify the most beneficial stormwater projects and their timing, a prioritized Capital Improvement Plan for the entire City is essential.
Proposal/Solution:	• Staff have negotiated with Meshek & Associates for a scope amendment that will build upon the partial CIP to produce a expended CIP that covers the stormwater need for all areas within City Limits. • The CIP will be completed in approximately nine months from the Notice to Proceed. Although the fee for the additional CIP work is \$91,055, unexpended funds in the amount of \$43,724.65 from the original contract will be reassigned to the CIP effort and will reduce the overall impact to the Stormwater Fund.

Financial Source/Impact:	Adequate funds are available in the Stormwater Fund.
Related Strategic Priority:	#3 SAFE COMMUNITY
Recommended Action/Motion:	Staff recommends a motion to: • Approve Amendment No. 2 to the Professional Services Agreement with Meshek & Associates for a Stormwater CIP; • Authorize the City Manager to sign the amendment; and • Approve the budget amendment appropriating \$56,435 for the project, which includes a contingency.
Prepared By:	Zack Henson
Reviewed By:	Candy Staring Brady Moore Teresa Kadavy
Submitted By:	Kimberly Meek, City Manager

Attachments

1. 19TR09 Amendment No.2
2. Engineering - CIP Stormwater - 9.23.2024 - Expenditure

This is **EXHIBIT K**, consisting of 2 pages, referred to in and part of the **Agreement between Owner and Engineer for Professional Services** dated October 25, 2019

AMENDMENT TO OWNER-ENGINEER AGREEMENT
Amendment No. 2

The Effective Date of this Amendment is: _____.

Background Data

Effective Date of Owner-Engineer Agreement: October 25, 2019

Owner: City of Stillwater

Engineer: Meshek & Associates, LLC

Project: 19TR09 Stillwater Creek Watershed Management Plan

Nature of Amendment: [Check those that are applicable and delete those that are inapplicable.]

- ☒ Additional Services to be performed by Engineer
- ☐ Modifications to services of Engineer
- ☐ Modifications to responsibilities of Owner
- ☒ Modifications of payment to Engineer
- ☒ Modifications to time(s) for rendering services
- ☐ Modifications to other terms and conditions of the Agreement

Description of Modifications:

This amendment adds the specific scope, fee, and time needed to complete the Capital Improvement Plan. This scope, fee, and time will be in addition to the original scope, fee, and time presented in the original Exhibit A and Exhibit C. The detailed scope/fee/schedule additions are included in Attachment 1. This amendment assigns all unused funds from the original scope, totaling \$43,725.65, to be used in the development of the Capital Improvement Plan.

Agreement Summary:

Original agreement amount:	\$ 675,163.00
Net change for prior amendments:	\$ 490,989.10
This amendment amount:	\$ 47,329.35
Adjusted Agreement amount:	\$ 1,213,481.45

Change in time for services (days or date, as applicable): Within 9 months of Notice to Proceed.

The foregoing Agreement Summary is for reference only and does not alter the terms of the Agreement, including those set forth in Exhibit C.

Owner and Engineer hereby agree to modify the above-referenced Agreement as set forth in this Amendment. All provisions of the Agreement not modified by this or previous Amendments remain in effect.

OWNER:

ENGINEER:

City of Stillwater

Meshek & Associates, LLC

By: _____

By:  _____

Print

Print

name: Kimberley Meek

name: Chris Duncan

Title: City Manager

Title: Principal

Date Signed: _____

Date Signed: 09/04/2024

Attachment 1

Amendment # 2 to 19TR09

Scope Additions: 10-Year Capital Improvement Plan

Define a Capital Improvements to Include

- Infrastructure Improvements, maintenance needs, operations, equipment, future planning & engineering studies.

Gather Background Information

- Conduct staff interviews to determine known needs.
- Compile existing studies/reports.
- Compile existing tangible assets/equipment.

Prioritization

- Review and finalize prioritization criteria. The priority matrix developed during the Boomer Creek Master Drainage will be used to prioritize identified Capital Improvements.

Identify Projects

- Studies: potential master drainage plans for sub-watersheds, additional stormwater infrastructure studies/assessments, water quality assessments, and MS4 needs.
- Projects: aerial/topography collection needs, existing list of infrastructure improvement needs, project concepts and estimates in watersheds that have yet to be studied, review infrastructure condition assessment results and determine critical needs.
- Capital equipment/maintenance: review existing equipment list and estimate future needs for replacement and new purchases, provide guidance for maintenance of existing infrastructure and estimate future expenditures.
- Project summaries: prepare one page summary of the major capital improvement projects with pertinent details of each project for use with future funding discussions.
- Analyze condition assessment findings and develop a list of operation and maintenance actions in order of priority.

Evaluate Funding Options

- Stormwater Utility Fee
- Available grants
- Provide synopsis of funding option that may be available for future capital projects.

Prepare a CIP Report

- Develop preliminary planning-level opinions of probable cost for design and construction of recommended projects.
- Incorporate the recommended projects identified in the Boomer Creek Master Drainage Plan.
- Present the prioritized list of projects in a tabular format, including opinions of probable construction, rehabilitation, and repair costs.

- Prepare a summary report that provides the basis of the analysis and the results of the stormwater capital improvement plan.
- Present recommendations as a 10-year capital improvement plan which identifies the prioritized plan for improvements.

Exclusions

- Additional H&H analysis
- Public Meetings

Fee Additions

The scope additions will be billed monthly on a percent complete basis with a total fee not-to-exceed \$91,055.

Define Capital Improvement & Gather Background Information	\$15,840
Prioritization	\$ 4,525
Identify Projects	\$28,170
Funding Options	\$ 6,990
CIP Report	\$35,530
Total	\$91,055

The following scope items from Exhibit A are considered complete and the remaining unused funds will be reallocated to the services included in this amendment:

Project Management:	\$8,202.42
Public Information:	\$2,732.67
Document Review:	\$30,090.56
<u>Final Report:</u>	<u>\$2,700.00</u>
Total Reallocation	\$43,725.65

Additional funding in the amount of \$47,329.35 will be required to complete the additional scope additions.

Schedule Modification

The project is anticipated to be completed within 9 months of the Notice to Proceed.

Budget Amendment Request

For Budget Year 2025

Department of Finance
723 S. Lewis Street/P.O. Box 1449
Stillwater, OK 74076-1449

Office: 405.372.0025
Web: stillwater.org

Date: 09/06/2024

Department: Transportation

Requested by: Candy Staring

Explanation:

Expenditures:
Appropriate funds for the CIP phase of the stormwater master plan. Project funded from the Stormwater Fund.

	Account Name	Account Number (xxxxxxx-xxxxx)	Project Number	Current Budget Amount	Amount of Change	New Budget Amount
Increase:	Professional Services	2104011 - 53069		\$ 0	\$ 56,435	\$ 56,435
		-				\$ 0
		-				\$ 0
		-				\$ 0
		-				\$ 0
Decrease:		-				\$ 0
		-				\$ 0
		-				\$ 0
		-				\$ 0
		-				\$ 0

Net Change: (will usually result in a total increase or decrease)

\$ 56,435

Reviewed by Department Manager: _____

Date: _____

Reviewed by Finance: _____

Date: _____

Approved by CMO: _____

Date: _____

Approved by City Council: ☐ Yes ☐ No

Date: _____

Processed by Finance: _____

Date: _____

Set ID: _____

Date Sent to SA&I: _____

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REPORT TO: CITY COUNCIL

MEETING DATE: SEPTEMBER 23, 2024



Agenda Item:	3.e. CC-24-114
Previous/Related Action:	
Background/Issue:	The library received \$23,100 from the Friends of the Library for FY25 programming and \$263 from Stillwater Frontier Rotary Club for the purchase of children's books.
Proposal/Solution:	Use the donated funds for programming for all ages throughout the year and for the purchase of children's books.
Financial Source/Impact:	The budget amendments reflect an increase to the donations account by \$23,363 and a corresponding increase to projects in the donation expenditure account.
Related Strategic Priority:	#1 EFFECTIVE SERVICES & ACCOUNTABLE GOVERNMENT
Recommended Action/Motion:	Motion to approve budget amendments reflecting receipt and appropriation of \$23,363 in donations to the Stillwater Public Library.
Prepared By:	Stacy Delano, Library Director
Reviewed By:	Stacy Delano Christy Driskel Teresa Kadavy
Submitted By:	Kimberly Meek, City Manager

Attachments

1. BA donations 9.23.24 signed



Budget Amendment Request

For Budget Year 2025

Department of Finance
723 S. Lewis Street/P.O. Box 1449
Stillwater, OK 74076-1449
Office: 405.372.0025
Web: stillwater.org

Date: 09/15/2024

Department: Library

Requested by: Stacy Delano, library director

Explanation:

Donation REVENUE
The library received \$23,100 in donations from Friends of the Library for children's, teen, adult, and Lexicon programming.
The library also received \$262.78 from Stillwater Frontier Rotary Club for the purchase of children's books.

Account Name	Account Number (xxxxxx-xxxx)	Project Number	Current Budget Amount	Amount of Change	New Budget Amount
FOL Children/Donations	1015510 - 48701	20LB04101	\$ 0	\$ 14,000	\$ 14,000
FOL Teens/Donations	1015510 - 48701	20LB02101	\$ 0	\$ 3,600	\$ 3,600
FOL Adult/Donations	1015510 - 48701	20LB03101	\$ 0	\$ 3,000	\$ 3,000
Designated Donat / Donations	1015510 - 48701	21LB07101	\$ 0	\$ 2,763	\$ 2,763
					\$ 0

Decrease:	-				\$ 0
	-				\$ 0
	-				\$ 0
	-				\$ 0
	-				\$ 0
	-				\$ 0

Net Change: (will usually result in a total increase or decrease)

\$ 23,363

Reviewed by Department Manager:

Date: 09/15/2024

Reviewed by Finance:

Date:

Approved by CMO:

Date:

Approved by City Council:

Date:

Processed by Finance:

Date:

Set ID:

Date Sent to SA&I:

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Budget Amendment Request

For Budget Year 2025

Department of Finance
723 S. Lewis Street/P.O. Box 1449
Stillwater, OK 74076-1449
Office: 405.372.0025
Web: stillwater.org

Date: 09/15/2024

Department: Library

Requested by: Stacy Delano, library director

Explanation:

Donation EXPENDITURE
The library received \$23,100 in donations from Friends of the Library for children's, teen, adult, and LexiCon programming.
The library also received \$262.78 from Stillwater Frontier Rotary Club for the purchase of children's books.

Account Name	Account Number (xxxxxx-xxxxx)	Project Number	Current Budget Amount	Amount of Change	New Budget Amount
FOL Children/Donations	1015510 -53041	20LB04101	\$ 5,802	\$ 14,000	\$ 19,802
FOL Teens/Donations	1015510 -53041	20LB02101	\$ 3,117	\$ 3,600	\$ 6,717
FOL Adult/Donations	1015510 -53041	20LB03101	\$ 3,919	\$ 3,000	\$ 6,919
Designated Donat / Donations	1015510 -53041	21LB07101	\$ 8,396	\$ 2,763	\$ 11,159
					\$ 0

Decrease:

	-				\$ 0
	-				\$ 0
	-				\$ 0
	-				\$ 0
	-				\$ 0
	-				\$ 0

Net Change: (will usually result in a total increase or decrease)

\$ 23,363

Reviewed by Department Manager:

Date: 09/15/2024

Reviewed by Finance:

Date:

Approved by CMO:

Date:

Approved by City Council:

☐ Yes

☐ No

Date:

Processed by Finance:

Date:

Set ID:

Date Sent to SA&I:

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RESOLUTION NO. CC-2024-28

A RESOLUTION AUTHORIZING THE CITY OF STILLWATER TO SUBMIT A GRANT APPLICATION FOR THE FEMA HAZARD MITIGATION GRANT PROGRAM (HMGP) ADMINISTERED BY THE OKLAHOMA DEPARTMENT OF EMERGENCY MANAGEMENT AND FEMA FOR THE PURPOSE OF ASSISTING IN IMPLEMENTATION OF LONG-TERM HAZARD MITIGATION PLANNING; AUTHORIZING MESHEK & ASSOCIATES, LLC TO SUBMIT THE GRANT APPLICATION ON BEHALF OF THE CITY OF STILLWATER IN CONNECTION WITH ITS GRANT ADMINISTRATION SERVICES; APPROVING THE ASSOCIATED BUDGET AMENDMENT; AND AUTHORIZING THE MAYOR OR VICE-MAYOR TO SIGN GRANT APPLICATION DOCUMENTS

WHEREAS, the City of Stillwater is required to update its existing Hazard Mitigation Plan in accordance with the requirements of the Stafford Act and 44 C.F.R. § 201.6; and

WHEREAS, FEMA's Hazard Mitigation Grant Program provides funding to local governments so they can develop hazard mitigation plans in a way that reduces, or mitigates, future disaster losses in their communities; and

WHEREAS, the City has entered into an agreement with Meshek & Associates, LLC to perform professional services in connection with the city's hazard mitigation plan update project which includes grant administration; and

WHEREAS, the estimated total project cost is \$182,345.98; and

WHEREAS, the anticipated cost share is FEMA HMGP grant funds up to 75% of the total project cost on a reimbursable basis and local match required of 25% of total project cost (FEMA HMGP \$136,759.49; Local Match \$45,586.50);

WHEREAS, application for grant funds to assist in updating and implementing the hazard mitigation plan is in the best interest of the city.

NOW THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF STILLWATER, OKLAHOMA THAT THE FOLLOWING IS HEREBY APPROVED:

Section 1. The City of Stillwater is hereby authorized to submit a FEMA HMGP grant application for the purpose of funding assistance for the review and update of the City's Hazard Mitigation Plan.

Section 2. The City's consultant, Meshek & Associates, LLC, is hereby authorized to apply for said grant on behalf of the City of Stillwater in connection with its responsibility to provide grant administration for the City of Stillwater for this project.

Section 3. The attached Budget Amendment appropriating funds for the hazard mitigation plan project in the amount of \$182,346 is hereby approved.

Section 4. The Mayor or Vice-Mayor is hereby authorized to execute all necessary application documents as may be required to secure grant funding for the hazard mitigation plan project.

PASSED AND APPROVED by the City Council of Stillwater, Oklahoma, and signed this 23rd day of September, 2024.

CITY OF STILLWATER, OKLAHOMA
a Municipal Corporation

WILLIAM H. JOYCE, MAYOR

(SEAL)
ATTEST:

TERESA KADAVY, CITY CLERK

APPROVED AS TO FORM AND LEGALITY THIS 23rd DAY OF SEPTEMBER, 2024.

KIMBERLY CARNLEY, CITY ATTORNEY



Budget Amendment Request

For Budget Year 2025

Department of Finance
723 S. Lewis Street/P.O. Box 1449
Stillwater, OK 74076-1449

Office: 405.372.0025
Web: stillwater.org

Date: 09/16/2024

Department: Emergency Management

Requested by: Rob Hill

Explanation:

To appropriate funds for hazard mitigation plan update.

Increase:

Account Name	Account Number (xxxxxxx-xxxxx)	Project Number	Current Budget Amount	Amount of Change	New Budget Amount
Hazard Mitigation Plan Update	1056026 - 54010	25EM01105	\$ 0	\$ 182,346	\$ 182,346
	-				\$ 0
	-				\$ 0
	-				\$ 0
	-				\$ 0
	-				\$ 0

Decrease:

Net Change: (will usually result in a total increase or decrease)

\$ 182,346

Reviewed by Department Manager: Rob Hill

Date: 9/16/2024

Reviewed by Finance: [Signature]

Date: 9/16/2024

Approved by CMO: _____

Date: _____

Approved by City Council: _____

☐ Yes

☐ No

Date: _____

Processed by Finance: _____

Date: _____

Set ID: _____

Date Sent to SA&I: _____

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REPORT TO: CITY COUNCIL

MEETING DATE: SEPTEMBER 23, 2024



Agenda Item:	7.b. CC-24-115
Previous/Related Action:	
Background/Issue:	Stillwater Fire Department offers a rural fire service contract for customers within our response district that are located outside our corporate city limits. The current annual fee for the contract is \$100.00. The contract sets a maximum charge of \$2,000.00 charged per incident, and a minimum charge of \$500.00 per incident. The program also establishes hourly rates for apparatus and personnel. The contract fee and hourly rates were established in 2008. General prices of goods and services have increased over 45% since 2008, and we have seen even higher rates of inflation regarding fire apparatus and equipment in that time frame. With the rising costs of personnel and equipment, Stillwater Fire Administration strongly believed it was time to take an in-depth look at our current hourly rates and contract fees for rural fire protection. In the fall of 2022, Stillwater Fire Department hired NewGen Strategies and Solutions to conduct an independent review of our rural fire contract fee, and hourly rates for apparatus and personnel. Dave Yanke, the owner of NewGen Strategies and Solutions, presented his findings and recommendations to the City Council on February 26th, 2024. Methods used by NewGen Strategies and Solutions • NewGen conducted a Benchmarking analysis of ten communities that also provide fire service outside their city limits. • Hourly apparatus rates were determined by using a combination of capital expenditures and construction trade standards, along with a 5% yearly inflation rate. • Hourly labor rates were determined by utilizing minimum, maximum, and average hourly rates for each position. NewGen also utilized a fully loaded rate, to include benefits and education pay.

- According to NewGen's findings, we are recovering approximately 40% of current personnel costs, and 56% of apparatus costs.

Proposal/Solution:

After an in-depth analysis of NewGen's report and recommendations, staff recommended increasing the annual contract fee to \$200.00, and updating hourly rates for personnel and equipment. These increases will enable us to recover a reasonable amount of costs for providing fire protection to customers in our rural fire district. This approach helps ensure that the financial burden for these services is shared more equitably.

The table below lists the current fees and our recommendation for increases.

Equipment	Current Rate	Proposed Rate
Hazardous Materials Unit	\$650	\$650
Ladder Truck	\$550	\$1,000
Engine/Heavy Rescue	\$350	\$650
Technical Rescue	\$250	\$400
Brush Unit	\$125	\$200
Battalion Chief	\$30	\$60
Vehicle		
Other Staff Vehicle	\$25	\$55
Personnel	Current Rate	Proposed Rate
Line Personnel	\$28	\$60
Company Officers	\$30	\$67.50
Command Officers	\$35	\$105

Financial Source/Impact:

It is anticipated that this will increase available funding to help recover costs for service in the rural areas, and provide additional revenue for apparatus, training, and operations.

Related Strategic Priority:

#3 SAFE COMMUNITY
 #1 EFFECTIVE SERVICES & ACCOUNTABLE GOVERNMENT
 #2 MOTIVATED MANAGEMENT
 #6 ENGAGED & INVESTED RESIDENTS

Recommended Action/Motion:

Motion to authorize an increase of \$100.00 to the rural fire contract for a total of \$200.00 annual membership fee. Also, to authorize an increase in equipment and personnel hourly rates as listed in table 1, and authorize the City Manager to sign related

documents.

Prepared By:

Terry Essary, Fire Chief

Reviewed By:

Terry Essary

Teresa Kadavy

Submitted By:

Kimberly Meek, City Manager

Attachments

1. CC-2024-29 Fire Service Fees - Rate Schedule resolution
2. 2024-29 EXHIBIT A - Fire Service Fees Rate Schedule This is Correct Copy

RESOLUTION CC-2024-29

A RESOLUTION ADOPTING A REVISED RATE SCHEDULE FOR FIRE SERVICE FEES PURSUANT TO THE STILLWATER CITY CODE CHAPTER 20, FIRE PREVENTION AND PROTECTION, ARTICLE II, FIRE DEPARTMENT, SECTION 20-30, FIRE SERVICE FEES.

WHEREAS, the Stillwater City Code, Chapter 20, Fire Prevention and Protection, Article II, Fire Department, Section 20-30, Fire service fees authorizes the City Council to establish a rate schedule for fire services delivered outside the corporate limits of the City of Stillwater by resolution; and

WHEREAS, the City of Stillwater has conducted a rate study with a consultant to review the existing rate schedule and finds that revisions to the rate schedule is necessary and appropriate.

NOW THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF STILLWATER, OKLAHOMA THAT:

- 1. The revised Rate Schedule attached hereto as "Exhibit A" is hereby adopted and shall have an effective date of January 1, 2025.
- 2. The City Attorney is hereby authorized and directed to bring any necessary action at law or equity to affect recovery for non-payment for services rendered under Stillwater City Code, Chapter 20, Fire Prevention and Protection, Article II, Fire Department, Section 20-30, Fire service fees and this resolution.

PASSED, APPROVED, AND ADOPTED this 23rd day of September 2024.

WILLIAM H. JOYCE, MAYOR

(SEAL)
ATTEST:

TERESA KADAVY, CITY CLERK

APPROVED AS TO FORM AND LEGALITY this 23rd day of September 2024.

KIMBERLY CARNLEY, CITY ATTORNEY



**STILLWATER FIRE DEPARTMENT
FIRE SERVICE FEES
RATE SCHEDULE**

EQUIPMENT CHARGES (hourly rate)	
Hazardous Materials Unit	\$ 650.00
Ladder Truck	\$ 1,000.00
Engine/Heavy Rescue	\$ 650.00
Tech Rescue	\$ 400.00
Brush Unit	\$ 200.00
Battalion Chief Vehicle	\$ 60.00
Other Staff Vehicles	\$ 55.00
PERSONNEL RATES (hourly rate)	
Line Personnel	\$ 60.00
Company Officers	\$ 67.50
Command Officers	\$ 105.00

ORDINANCE NO. 3545

AN ORDINANCE AMENDING THE STILLWATER CITY CODE BY AMENDING CHAPTER 20, FIRE PREVENTION AND PROTECTION, ARTICLE II, FIRE DEPARTMENT, BY AMENDING SECTION 20-30, FIRE SERVICE FEES BY DESIGNATING HOW FUNDS COLLECTED ARE TO BE USED AND BY INCREASING THE RURAL FIRE SERVICES CONTRACT ANNUAL FEE; REPEALING ALL ORDINANCES TO THE CONTRARY; AND PROVIDING FOR SEVERABILITY.

(AMENDMENTS HIGHLIGHTED BY STRIKETHROUGH AND UNDERLINING)

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF STILLWATER, OKLAHOMA:

SECTION 1: That the Stillwater City Code, Chapter 20, Fire Prevention and Protection, Article II, Fire Department, Section 20-30, Fire service fees, be amended to read as follows:

Sec. 20-30. Fire service fees.

There shall be a fee charged by the city for any fire services delivered outside the corporate limits of the city. The fee for services authorized herein shall be established by city council resolution.

(1) The fee, which shall be collected by the director of finance, shall be levied and charged against the property owner or lessee upon whose property the fire department provides fire and/or rescue services. Fees collected pursuant to this section shall be placed in a designated Fire Fund and utilized to support the operations of the Stillwater Fire Department.

(2) Owners or lessees of real property located in unincorporated areas of the county may contract with the city for fire services authorized under this article, provided the property to be served:

- (a) lies within ten road miles of the nearest fire station;
- (b) does not lie within the jurisdiction of another fire service entity;
- (c) is not owned by a federal, state, county or other local government entity;
- (d) is not primarily used for the storage, distribution, sale, transportation and/or disposal of flammable liquids and/or gases, or hazardous, dangerous, and/or other materials or activities regulated by federal or state law; and
- (e) the property owner or lessee pays a two hundred dollar (\$200.00) ~~one hundred dollar (\$100.00)~~ annual fee.

If the annual fee described in subsection (2)(e) above has been paid and the fire department provides services as provided in this article, the maximum fee charged for such services shall be capped at two thousand dollars (\$2,000.00) ~~one thousand dollars (\$1,000.00)~~ per run for the period beginning January 1, 2025 ~~2009 and ending December 31, 2009, and thereafter at two thousand dollars (\$2,000.00) per run. If the fee described in subsection (2)(e) above is not paid prior to the time service is rendered, the fee assessed for a response by the fire department shall be subject to the provisions of subsection (3) below.~~

(3) If the property owner or lessee either does not qualify to contract for service, or if qualified to contract elects not to contract, the full cost any service

rendered by the fire department shall be billed to the property owner or lessee in accordance with the rate schedule resolution authorized by subsection (1).

SECTION 2: REPEALER. All ordinances or parts of ordinances conflicting or inconsistent with the provisions of this ordinance are hereby repealed.

SECTION 3: SEVERABILITY. If any section, subsection, clause, phrase, or portion of this Ordinance is for any reason held invalid or unconstitutional by a Court of competent jurisdiction, such portion shall be deemed a separate, distinct, and independent provision and such holding shall not affect the validity of the remaining portion of this Ordinance.

Passed, approved, and adopted this ____ day of October, 2024.

William H. Joyce, Mayor

(SEAL)
ATTEST:

Teresa Kadavy, City Clerk

Approved as to form and legality, this ____ day of October, 2024.

Kimberly Carnley, City Attorney

First Reading: 9/23/2024
Second Reading: