Pawnee Nation of Oklahoma

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Multi-Hazard Mitigation Plan

Funded by the
Federal Emergency Management Agency and the
Pawnee Nation of Oklahoma

Prepared by the Pawnee Nation Division of Natural Resources and Safety
2024
Rev 1.0

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1. CHAPTER ONE - THE PLANNING PROCESS

A.1 Introduction

Floods, tornadoes, winter storms, drought, and other hazardous events are a part of our world, and their natural occurrence is inevitable and cannot be controlled. It is when these natural events intersect the man-made environment that “disasters” occur. Natural hazards cannot be prevented but actions can be taken to reduce their impact upon the human environment so that a disaster is less likely to result.

Applying this knowledge, the Pawnee Nation has prepared a Standard Tribal Hazard Mitigation Plan (hereafter referred to as a Hazard Mitigation Plan [HMP]) that will guide the Tribe toward greater disaster resistance in full accord with the character and needs of the community and federal requirements. The potential hazards identified and assessed in this version of the HMP include Dam failure, Drought, Earthquake, Expansive soils, Extreme heat, Flood, Hailstorm, Severe Winter storm, Tornado, Wildfire and Wind/Thunderstorm. Mitigation actions include a range of specific actions and projects that reduce the effects of each hazard, with particular emphasis on protecting new and existing buildings and infrastructure.

This Pawnee Nation HMP will discuss the planning process, provide background information, a hazard and risk assessment of Pawnee Indian Country, describe mitigation strategies, their implementation, and plan maintenance procedures.

A.2 Plan Adoption

Initially this plan was adopted by resolution by the Pawnee Business Council at their meeting on June 22, 2011. .

The plan will be reviewed and revised within a five-year cycle with the possibility of updating it into a multi-jurisdictional plan should the other counties and municipal governments request this. Municipalities must provide appropriate information for inclusion and be willing to adopt the updated or revised plan.

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I. Figure: Formal Adoption by Local Jurisdictions

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Pawnee Nation of Oklahoma

RESOLUTION 11-65
JUNE 22, 2011

RESOLUTION

Whereas, The Pawnee Business Council is the supreme governing body of the Pawnee Nation and is authorized to conduct business on behalf of the Pawnee Nation in accordance with Articles IV, Sections 1 and 2 of the Pawnee Nation Constitution and By-Laws; and

Whereas, The Pawnee Business Council met in special session on June 22, 2011, at the Pawnee Nation Tribal Administration Building, Conference Room, duly authorized, with a quorum present; and

Whereas, the Pawnee Nation of Oklahoma has historically experienced severe damage from natural and human-caused hazards such as flooding, wildfire, earthquake, drought, thunderstorm/high winds and hazardous materials incidents on many occasions in the past century, resulting in loss of property and life, economic hardship, and treats to public health and safety;

Whereas, the Pawnee Nation of Oklahoma has developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for its Multi-Hazard Mitigation Plan under the requirements of 44 CFR 201.7;

Whereas, the Plan specifically addresses hazard mitigation strategies and plan maintenance procedures for the Pawnee Nation of Oklahoma;

Whereas, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural and human caused hazards that impact Pawnee Nation of Oklahoma, with the effect of protecting people and property from loss associated with those hazards;

Whereas, adoption of this plan will make the Pawnee Nation of Oklahoma eligible for funding to alleviate the future hazards on the Reservation.

NOW, THEREFORE BE IT RESOLVED the Pawnee Business Council hereby approves that;

1. The Plan is hereby adopted as an official plan of the Pawnee Nation of Oklahoma.
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them.
3. Future revisions and Plan maintenance required by 44 CFR 201.7 and FEMA, are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Tribal Council by June 30 of each year.

CERTIFICATION

I, Linda Jestes, Secretary of the Pawnee Business Council, certify that a Special Meeting of the Pawnee Business Council was held on the June 22, 2011 in a Special meeting of the Pawnee Business Council and that the Pawnee Business Council is composed of eight members with one vacancy, of whom _7_were present, comprising a quorum, and the foregoing resolution was duly adopted by a vote of _6_ for, __0__ against, _0__ absent, _0__ abstaining, and __1__ not voting.

Signed this 22nd day of June 2011
ATTEST:

Linda Jestes, Secretary
Pawnee Nation Business Council

Marshall R. Gover, President
Pawnee Nation Business Council

A.2.1 Plan Assurances

The Pawnee Nation assures that it will comply with the all-applicable Federal statutes and regulations during which it receives funding for projects in accordance with 44 CFR 13.11 and OMB Circular A-102. Also, necessary amendments to the plan and procedures will be made to reflect changes in Federal and Tribal laws and Statutes.

A.3. History, Location and Geography

The Pawnee Nation of Oklahoma as a federally recognized, sovereign American Indian Nation is comprised of four distinct bands the Chaui, Kitkehahki, Pitahawirata, and Skidi. The Pawnee's traditional homelands lie in the present-day states of Nebraska and Kansas.

Under three treaties with the United States 1833, 1843, and 1857 - the Pawnee ceded all their lands to the United States Government except a reservation 10 miles wide by 30 miles long along the Loup River in Nebraska. This reservation was sold, and in 1876 the Pawnee Nation was relocated to its present-day location in north central Oklahoma. Today the Pawnee Nation is located within two counties, both the western portion of Pawnee County and eastern third of Payne County (see Map1). By 1893, individual allotments of 60 acres had been made to 821 tribal members. The remaining land, 169,320 acres, was opened for settlement. The Pawnee Nation, today, exercises jurisdiction over a total of 29,951 acres of tribally owned, individually owned, and federal trust lands.

History shows that the Pawnee people were likely to be 20,000-25,000 strong in the early part of the nineteenth century. However, due to warfare (with traditional enemies), disease, and the hardships produced by the relocation to Oklahoma the population underwent a steady decline in the latter part of the nineteenth century. At the start of the twentieth century only 600-700 Pawnee tribal members remained. Tribal membership has subsequently rebounded to a present-day enrollment of 3,190 members.

Today, the Pawnee Nation of Oklahoma operates a modern-day, sovereign tribal government and employs over 100 tribal and non-tribal members in numerous departments and programs. By means of operating from a Tribal Constitution, the supreme governing body is an eight-member council known as the Pawnee Business Council. Executive and Legislative powers are vested in this governing body. A traditional council of Chiefs, the Nasharo Council, is comprised of two chiefs from each of the four bands. These two bodies provide traditional and modern forms of governance for the Pawnee Nation and exercise their jurisdiction over the 684-acre Pawnee Nation reserve and the more than 29,951 acres that comprise our traditional boundaries within Oklahoma.

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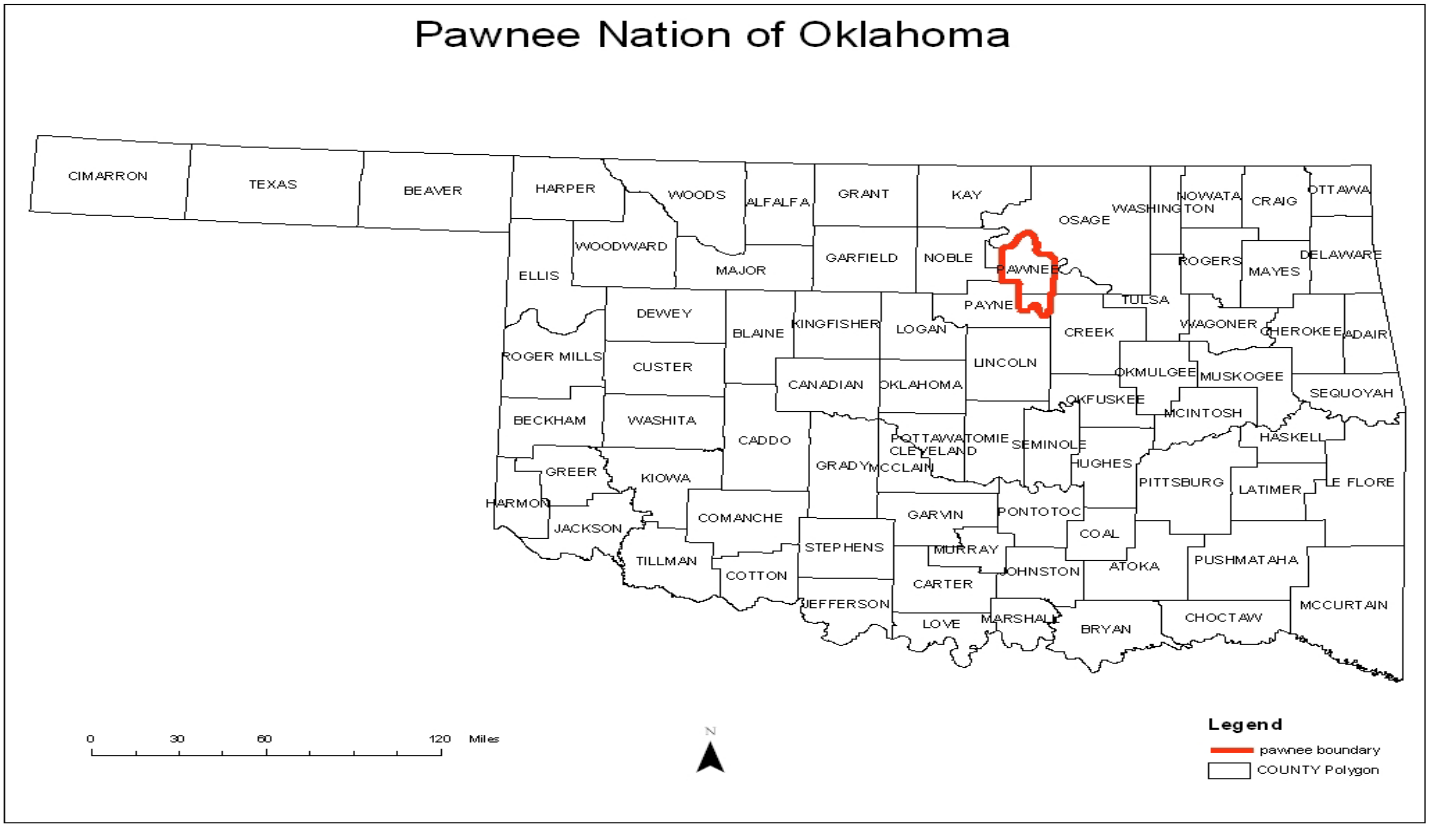
II. Figure. Map of Oklahoma and Pawnee Nation



A.4. Land Use and Development

In 2004, the Pawnee Business Council created the Pawnee Tribal Development Corporation (TDC) to take the lead in making the tribe economically self-sufficient. In establishing a tribally owned and operated smoke shop and convenience store in the late 1990's, this has recently transformed into a casino and café. In the summer of 2004, the tribe built and opened a travel plaza on trust land next to Oklahoma's Cimarron Turnpike. This travel plaza offers gasoline and diesel, showers, and a resting place for weary travelers and truckers. Also, the travel plaza offers a small, franchised restaurant and casino style games for food and entertainment.

In 2004, the Pawnee Nation created the Pawnee Nation College, an institution to provide levels of higher education to the members of the Pawnee Nation and to the local community as well. Since the first enrollment, the College has grown in both enrollment and class offerings. Additionally, through agreements with local Oklahoma Colleges and Universities, quality education and degrees are offered to all those who attend.

Land operations and agreements currently are managed though the Bureau of Indian Affairs. Land Use for the Pawnee Nation includes agriculture activities (cropping and grazing), oil and gas exploration and both residential and commercial development. Specific future development plans have not been finalized at the time of this writing.

A.5. The Hazard Mitigation Planning Process

The Pawnee Nation HMP has been prepared to meet the Federal Emergency Management Agency's (FEMA's) requirements of the Disaster Mitigation Act of 2000 (DMA 2000) and the Interim Final Rule, thus making it eligible for funding and technical assistance from State and Federal hazard mitigation programs. Following each major disaster declaration, the Tribe is required to review and update the mitigation strategy. Additionally, in compliance with FEMA regulations, this HMP must be reviewed, revised if appropriate, and resubmitted for approval every five years so that the Tribe continues to be eligible for various hazard mitigation grant funding sources. This HMP was adopted by the Pawnee Nation on***June 22, 2011,*** reviewed by the Oklahoma Office of Emergency Management, and approved by FEMA.

Hazard mitigation involves recognizing and adapting to natural forces and is defined by the Federal Emergency Management Agency (FEMA) as any sustained action taken to reduce long-term risk to human life and property from natural hazards. Mitigation is the component of emergency management that has the potential to break the cycle of damage and reconstruction that can occur when a community is subjected to repeated natural hazards and therefore should be a high priority.

Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5165, enacted under Section 104 of the DMA 2K, P.L. 106-390 establishes new requirements for local hazard mitigation plans. Tribal and Local governments are required to have a FEMA-approved local hazard mitigation plan to be eligible to receive federal funding through FEMA's Hazard Mitigation Grant Program (HMGP).

This plan was developed by the Pawnee Nation Division of Natural Resources and Safety, through instruction from the Pawnee Business Council. Funding for this plan was provided in part through a grant from FEMA.

A.5.1 Development Process

- **Planning Process:**
    - An open public involvement process was established from the beginning for the public, neighboring communities, regional agencies, businesses, academia, etc to comment on the plan in the drafting stage as well as prior to plan approval. A comprehensive community approach was taken in developing the plan.

- **Perform a Risk Assessment:**

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- An assessment of the hazards apparent to the Pawnee Indian Country and the risks on the current or future built environment was established. The assessment includes the following:
    - The type, location and extent of all hazards that can affect the jurisdiction, both historically and in the future
    - Description of the jurisdictions vulnerability to those hazards including types and numbers of existing and future buildings, infrastructure, and critical facilities in identified hazard areas.
    - Estimate potential dollar losses of those structures considered vulnerable.
    - General description of land use and development trends for future land use decisions.

- **Develop a Mitigation Strategy**:
    - Development of a blueprint for reducing the potential losses identified in the risk assessment, this will include:
        - A description of mitigation goals meant to avoid or reduce long-term vulnerabilities.
        - Identification and analysis of a comprehensive or range of mitigation actions and projects
        - Action Plan describing how the mitigation actions and projects will be prioritized, implemented, and administered.

- **Develop a Plan Maintenance Schedule**:
    - Plans must be monitored, evaluated, and updated on a five-year cycle, including a review on incorporating the mitigation plan into comprehensive or capital improvement plans.

- **Approval:**
    - The plan is submitted to the State Emergency Management Agency for review and coordination. Once accepted, it is forwarded to the FEMA Regional office for formal review and approval pending adoption.

- **Adoption by a Governing Body:**
    - A formal adoption by the Pawnee Business Council to codify the mitigation plan.

A.5.2. Purpose of the Plan

Hazard mitigation planning is a long-term, on-going process. The primary purpose of this plan is to establish and document such a process for areas and assets within the jurisdiction of the Pawnee Nation and, in doing so, fulfill the requirements of the Robert T. Stafford Act and FEMA. The plan will address natural hazards that occur within Pawnee Indian Country. Pawnee Nation hopes to lessen its' vulnerability to disasters caused by natural hazards. The plan is intended to serve as a guide for the Pawnee Nation in coordinating and implementing hazard mitigation policies, programs, and projects.

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A.5.3. The Intent of the Pawnee Nation Mitigation Planning Process

Through this planning process, Pawnee Nation hopes to achieve the following.

- Reduce any repetitive losses from natural hazards in Pawnee Indian Country.
- Facilitate responsible development in Pawnee Indian Country to reduce or eliminate the potential impacts of natural hazards.
- Enhance public awareness and understanding of natural hazard preparedness.
- Develop mitigation measures for specific hazards.

A.5.4. Hazard Mitigation Planning Committee

The Pawnee Nation Hazard Mitigation Planning Committee was formed and integrated into the Pawnee Nation Tribal Emergency Response Committee to provide guidance during the preparation and all updates of this plan. The plan and all updates were completed by the Division of Natural Resources and Safety in conjunction with the Department of Emergency Management. The Update began in January of 2024. Public outreach for comments and suggestions began January of 2025 with any comments received integrated into the plan if appropriate.

Committee Members, along with their affiliation, are listed in Table II. This Committee was Division Directors, Emergency Response personnel and comprised of Tribal citizens and others from various local organizations. Representation was solicited upon recommendations from the Pawnee Business Council; however, no one wishing to participate was excluded from doing so. Contacted people were encouraged to bring interested citizens. The Committee meetings were open to the Tribal Citizens and local community.public. Two meetings were held during the development of this plan. At the first meeting, committee members and other attendees identified and discussed natural hazards most likely to impact the County. The planning process and contacts for plan development were also established.

III. Table: Pawnee Nation Hazard Mitigation Planning Committee Members

Division	Tasks
Pawnee Nation Division of Natural Resource and Safety	• HMGP Chairman • Lead plan developer • Provide information on Environmental and Natural Resources issues • Contributed data on past disasters • Provided expertise on previous mitigation strategies
Pawnee Nation Tribal President	• Provided information on Tribal leadership roles • Contributed data on past disasters • Contributed information on past mitigation strategies • Provided knowledge on future development trends

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	• Reviewed Draft Plan • Coordinated public efforts within his tasked area
Pawnee Nation Executive Director	• Provided information on Tribal Executive and Administrative roles • Contributed data on past disasters • Contributed information on past mitigation strategies • Provided knowledge on future development trends • Reviewed Draft Plan • Coordinated public efforts within his tasked area
Pawnee Nation Fire and Rescue	• Provided information on Fire and rescue issues • Contributed data on past disasters • Contributed expertise on past mitigation strategies • Reviewed draft plan • Contributed plan revisions • Coordinated public efforts within his tasked area
Pawnee Nation Division of Finance	• Provided information on Tribal finance strategies • Contributed data on past disasters • Contributed expertise on past mitigation strategies • Reviewed draft plan • Contributed plan revisions • Coordinated public efforts within his tasked area
Pawnee Nation Division of Health	• Provided information on health representation to citizens • Contributed information on past disasters • Contributed expertise on past mitigation strategies • Reviewed draft plan • Contributed plan revisions • Coordinated public efforts within her tasked area

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Pawnee Nation College	• Provided information on academic efforts to Students and Faculty • Contributed information on past disasters • Contributed expertise on past mitigation strategies • Reviewed draft plan • Contributed plan revisions • Coordinated public efforts within her tasked area
Pawnee Nation Division of Law Enforcement	• Provided information on law enforcement efforts during disasters • Contributed information on past disasters • Contributed expertise on past mitigation strategies • Reviewed draft plan • Contributed plan revisions • Coordinated public efforts within his tasked area
Pawnee Nation Division of Property	• Provided information on Property departments capability to respond to disasters • Contributed information on past disasters • Contributed expertise on past mitigation strategies • Reviewed draft plan • Contributed plan revisions • Coordinated public efforts within his tasked area

A.5.5 Public Involvement in the Planning Process

For the original draft of the plan, Pawnee Nation Members and Citizens were encouraged to attend the planning meetings. Meeting notices were posted per the Pawnee Nation's public meeting policy. Emails and faxes were sent to individuals and private agencies that may wish to be involved. Copies of the plan were available at the Pawnee Nation Fire Department and the Pawnee Nation Administration Offices prior to plan approval. The HMGP was also posted on the Pawnee Nation website for download and review.

A "round table" proved to be the most affective format for generating public and committee input on the project and stimulate "out of the box" problem solving. Due to the fluid nature of the planning process over the planning period, participants were encouraged to make notations on maps as discussion occurred and use other free-flowing processes for documentation of the meeting topics. Discussion included: past occurrences, personal experiences, economic impacts, currently susceptible areas, future development, future economic impacts, and future hazard occurrence predictions.

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All meeting participants received information on the Hazard Mitigation Planning Process and an outline of the plan. This aid contained the following topics which were discussed at the meetings. All meeting attendees were encouraged to share their experiences and suggestions for future mitigation activities.

Public involvement during the drafting of the update included posting a draft of the updated plan on the Pawnee Nation Division of Natural Resources and Safety website with a link to an email address for those to use to provide comments. This email address is a Division email and reviewed daily during the public comment period. All comments received were reviewed and considered for their involvement in the update. A list of comments and responses were posted on the website following the comment period.

A.5.7. Other Interested Party Involvement in the Planning Process

There are many public agencies, private organizations, and businesses that contend with natural hazards. Among the organizations and agencies contacted were the following. Each was asked to contribute information on past and potential hazard threats and comment on the planning process and content.

- ***Federal***
  - Federal Emergency Management Agency (FEMA)
  - US Environmental Protection Agency
  - US Army Corps of Engineers
  - US Department of Agriculture
  - National Weather Service (NWS)
  - Natural Resource Conservation Service (NRCS)
  - US Fish and Wildlife Service
  - US Geological Survey

- ***National Non-Profit***
  - American Red Cross

- ***State***
  - Oklahoma Archeological Survey
  - Oklahoma Historical Society
  - Oklahoma Department of Emergency Management
  - Oklahoma Water Resources Board
  - Oklahoma Science and Rivers Commission
  - Oklahoma Department of Environmental Quality
  - Oklahoma Department of Commerce
  - Oklahoma Conservation Commission
  - Oklahoma Department of Wildlife Conservation
  - Oklahoma Geological Survey

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- ***Regional***
    - Central Oklahoma Economic Development District
    - Area Agency on Aging

- ***County***
    - Pawnee County
    - Payne County
    - Pawnee City/County Health Department
    - Payne City/County Health Department
    - Pawnee County Fire Departments
    - Pawnee Nation Fire Department
    - Payne County Fire Departments
    - Pawnee Nation Police Department
    - Pawnee County Police Departments and Sheriff
    - Payne County Police Departments and Sheriff

- ***Other Communities***

Pawnee and Payne County communities lying within the original boundary of the Pawnee Nation were invited to participate in the planning process and review the plan for comments.

- Pawnee
- Ralston
- Skedee
- Meramec
- Blackburn
- Yale

A draft of the plan was prepared, reviewed, and edited by the committee members. Once edits were accepted and incorporated into the plan the draft was discussed and adopted by the Pawnee Business Council at their regularly scheduled meeting held in compliance with the Pawnee Nation Administrative Procedures Act. Once adopted, this draft was submitted to the Oklahoma Department of Emergency Management for State approval.

A.5.8. Review of Existing Plans

- Capital Improvement Plan
    - Pawnee Nation does not have a CIP.

- Emergency Operations Plan
    - The Emergency Operations Plan (EOP) was completed by Pawnee Nation. The EOP is a response planning manual developed by the tribe in coordination with local and county officials and current emergency management director. The EOP is useful post disaster as a guide to emergency response and rebuilding.

- Permitting
    - Pawnee Nation does not currently have a permitting system in the rural areas.

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- NFIP
    - Pawnee Nation does participate in the National Flood Insurance Program.

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2. CHAPTER TWO – HAZARD ASSESSMENT

B.1. Identifying Hazards

The first step in developing a hazard mitigation plan is to identify and describe all the natural hazards capable of occurring within the Pawnee Nation Reserve Complex and within Indian Country in addition to the vulnerabilities to each one so that appropriate action can be taken to mitigate the impact of the hazards, minimize the losses and recover as quickly as possible. It is recognized that all the demands of a disaster situation cannot be anticipated, but by being aware of the areas, major facilities and persons that may be vulnerable to each type of hazard, preventive measures, as well as emergency response, can be planned.

The National Climatic Data Center (NCDC) maintains records regarding weather events since 1950. This database, along with information obtained from Pawnee Nation's hazard mitigation meetings, was used to prepare profiles which assess each of the natural hazards capable of occurring within Pawnee Indian Country. Several natural hazards were identified by the Hazard Mitigation Committee members and addressed in this plan. Table III lists these natural hazards and explains how and why each was identified as a hazard to the Pawnee Nation.

Details of each natural hazard and its impact on Indian Country are given in separate profiles for each hazard.

IV. Table: Summary of Natural Hazards

Hazard	How Identified	Why Identified
Dam Failure	• Review past disaster declarations. • OWRB database • Local input • Risk Assessment	• The population and buildings below the dam are very vulnerable in the event of release or dam failure.
Drought	• Review past disaster declarations. • Drought databases • Review NCDC database. • Input from Committee • Public Input	• Drought is common in Indian Country • Drought was one of the costliest past disasters.
Earthquake	• USGS Database • Earthquake databases • Review NCDC database. • Input from Committee • Public Input • HAZUS 99	• The largest earthquake in the continental US centered just east of Oklahoma. • Major faults run through Oklahoma
Expansive Soils	• Review past disaster declarations. • Soil databases • Utility data - recollections • Input from Committee	• Common to area • Affect utilities by breaking underground lines. • Cause foundation damage. • Cause road/street upheavals

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	• Public Input	
Extreme Heat	• Review past disaster declarations. • Heat databases. • Review NCDC database. • Input from Committee • Public Input	• Prolonged temperatures over 100 degrees Fahrenheit are common in summer months. • Heat affects people, animals, and crops
Flood	• Review of FIRMS • Input from Committee • Risk Assessments • Public Input • Review of past disaster declarations • Identification of NFIP repetitive loss properties in the Payne County	• The Pawnee Nation contains many rivers and streams. • Flash Flooding is common
Hailstorm	• Review past disaster declarations. • Hail databases. • Review NCDC database. • Input from Committee • Public Input	• Hail is a major economic hazard to this agricultural region. • Hail occurs each year
Severe Winter Storms	• Review past disaster declarations. • Winter Storm databases • Review NCDC database. • Input from Committee • Public Input	• Occur rarely – which has left the area with little snow removal equipment. • People can be stranded in isolated areas. • Damages to public and private sector caused by heavy snows, etc. • Can result in death. • Humans and property are not prepared for extended periods of cold in this area. • Damage to public and private sector caused by freezing lines. • Ice Storms recently caused extensive damage to area. • Many populations were without power for extended periods. • Damages to public and private sector property
Tornado	• Review past disaster declaration. • Tornado databases • National Weather Service data • Review NCDC database. • Input from Committee • Public Input	• Common to State • Public Concern • Past damages • Damages to public and private sector
Wildfire	• Review past disaster declarations. • Fire databases. • Review NCDC database. • Input from Committee • Public Input	• Common to area • Can occur in conjunction with drought and/or lightning. • Damages to public and private sector
Wind & Thunderstorms	• Review past disaster declarations. • Windstorm databases • Review NCDC database. • Input from Committee • Public Input	• Flat terrain allows high velocity winds to occur. • Damages to public and private sector • Define “Wind” vs. “Tornado” in public mind
Influenza Pandemic	• Review past pandemic declarations. • US department of Health and Human Services • Review CDC database. • Input from Committee	• Occurs rarely in area. • Public Concern • Past Pandemics • Health and survival of public and private sector

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	• Public Input	

B.2. Natural Hazard Assessments

The profiles, found later in this chapter, were prepared for each identified natural hazard and assess the hazard per the following six categories.

1. Description
The description of each hazard describes what the hazard is.

2. Location
The location or geographic area affected by each natural hazard.

3. Extent
Extent describes the hazard's impact in terms of potential severity of impact that the hazard event is capable of inflicting upon the Pawnee Nation. Due to the limited amount of Indian Country-specific documented data, the analysis for determining potential severity was limited to obtaining opinion and information furnished by residents, emergency responders, and the Pawnee and Payne County's Emergency Management Directors.

4. Previous Occurrences
Previous Occurrences describe the hazard in terms of what and where past events have occurred.

5. Probability of Future Events
Probability of Future Events describes the probability that the hazard will occur within the Indian Country. Each hazard is assigned a Probability of Future Events rating based on the criteria and methods described below.

The Probability of Future Events rating was based on the following definitions.
Highly likely = Event probable in next year
Likely = Event probable in next 3 years
Occasional = Event probable in next 5 years
Unlikely = Event probable in next 10 years

Probability of Future Events is quantified as follows.

Highly likely	=Event has 1 in 1 year chance of occurring	1/1 = 1.00
Likely	=Event has 1 in 3 years chance	1/3 = 0.33
Occasional	=Event has 1 in 5 years chance	1/5 = 0.20
Unlikely	=Event has 1 in 10 years chance	1/10 = 0.10

This results in the following ranges of Probability of Future Events.
Highly likely = greater than 0.33
Likely = greater than .020, but less than or equal to 0.33
Occasional = greater than 0.10, but less than or equal to 0.20
Unlikely = 0.10 or less

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Example: Pawnee Indian Country has had 41 tornadoes recorded in the last 53 years
41 / 53 = 0.77 average per year, which would make tornadoes “Highly Likely” to occur within the County.

6. Vulnerability

Vulnerability describes how exposed or susceptible to damage the Pawnee Nation is in terms of why and where the hazard can occur within Indian Country.

7. Secondary Hazards

Lists other hazards often triggered by the identified natural hazard event. Some natural disasters set off other types of catastrophes in a cascade of effects that lead to a highly complex situation. Secondary hazards can be events such as transportation and communications disruptions, fire, hazardous materials dispersion, power outages, and other utilities disruptions. These secondary events are identified along with the associated primary hazard due to how they can dictate the amount of impact a natural hazard event can have on the Pawnee Nation.

8. Overall Summary of Vulnerability and Impacts

This section summarizes the vulnerability of the Pawnee Nation, and the possible impacts of the natural disaster.

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B.3. HAZARD PROFILE - Dam Failure

B.3.1 Description

Dams can fail by several different means. Three general failure models are included.

- Natural disaster related failure, such as when the dam is overtopped by flood waters, which creates a breach through the embankment.
- Intrinsic structural failure, (including foundation problems) either under sunny-day circumstances or during high reservoir levels.
- Failure resulting from an act of terrorism or sabotage.

B.3.2 Location

Three dams exist in Payne County and two in Pawnee County. Two of the dams in Payne County are identified as HIGH risk as is one dam in Pawnee County. These dams are located near the heavily populated area of Stillwater outside of the Pawnee Nation.

V. Table: Pawnee and Payne County Dams

DAM NAME	OWNER	RIVER	NEAREST CITY	YEAR COMPLETED	MAX DISCHARGE	NORMAL STORAGE	HAZARD LEVEL
CARL BLACKWELL LAKE	**OKLAHOMA STATE UNIVERSITY**	**STILLWATER CREEK**	**STILLWATER**	**1937**	**119040.00**	**61500.00**	**HIGH**
SCS-STILLWATER CREEK SITE-46	**PAYNE CO CONS DIST**	**HARRINGTON CREEK**	**STILLWATER**	**1965**	**3522.00**	**346.00**	**HIGH**
SCS-STILLWATER CREEK SITE-01	PAYNE CO CONS DIST	DEER CREEK	RIPLEY	1967	800.00	100.00	LOW
PAWNEE LAKE	**CITYOF PAWNEE**	**SKEDEE CREEK**	**PAWNEE**	**1932**	**18600.0**	**9008.00**	**HIGH**
LONE CHIMNEY LAKE	PAWNEE CO CONS DIST	CAMP CREEK	PAWNEE	1937	6200.00	62000.00	LOW

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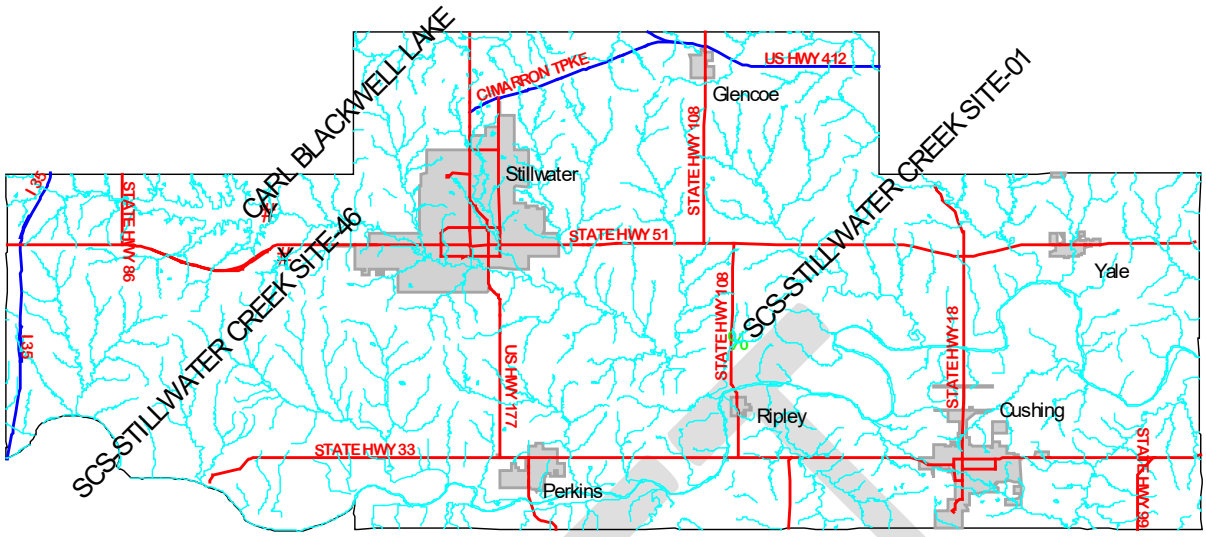
VI. Figure: Locations of Payne County Dams



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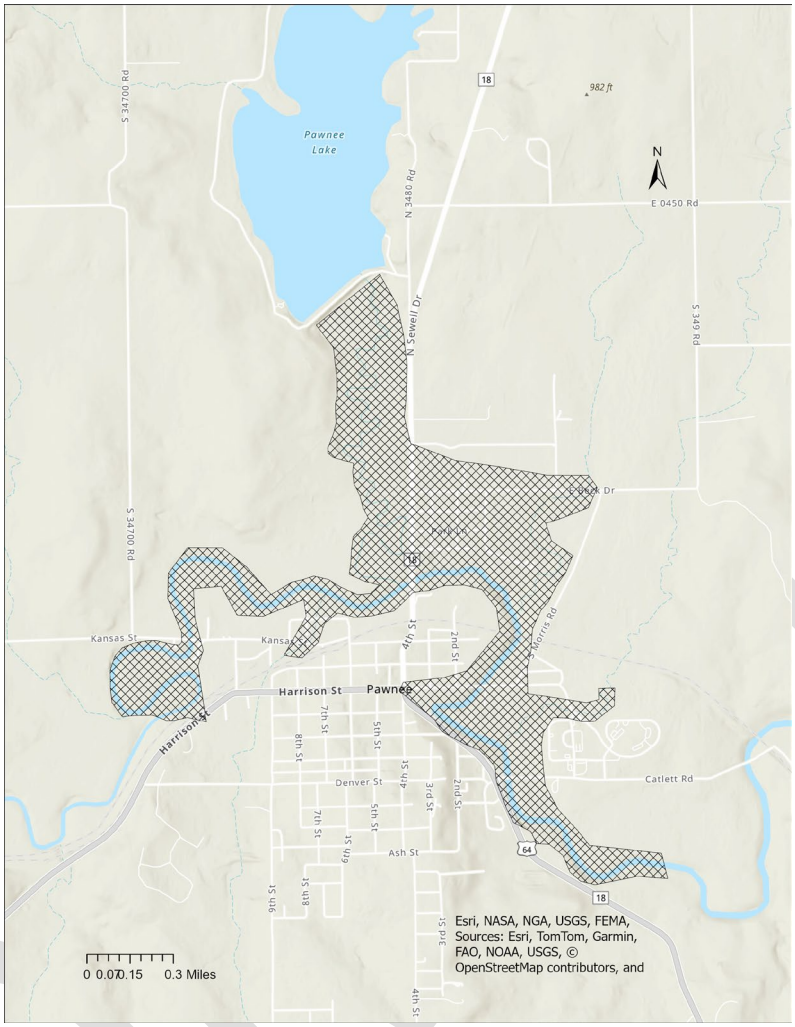

B.3.3. Extent

Dam failures have not occurred in any years between 1954 and 2023

Damages to personal property are estimated at $0.00.

Two dams in Payne County and one in Pawnee County are designated as high risk. Pawnee Lake Dam in Pawnee County could impact Pawnee Nation Property and Citizens if failure was to occur. Payne County Dams would not impact on the Pawnee Nation.

The Oklahoma Water Resources Board (OWRB) coordinates the Oklahoma Dam Safety Program to ensure the safety of the five dams, especially those that could impact downstream life and property.

The program requires inspections every five and three years for low and significant hazard structures, respectively. It requires annual inspection of the three high-hazard dams, so designated due to the presence of occupied dwellings immediately downstream.

Because many of these dams are very old structures and, as a result, require periodic repair, the OWRB requires submittal and subsequent approval of plans and specifications prior to dam modifications. Staff also coordinate periodic training sessions and workshops on dam safety issues and regulations for dam owners and engineers. The Natural Resource Conservation Service offers technical assistance in the construction of small farm ponds and related structures.

B.3.4. Previous Occurrences

There are no previous occurrences of dam failure in Payne or Pawnee County.

B.3.5. Probability of Future Events

Since no dam breaks have occurred the probability of a dam break is rated as unlikely.

B.3.6. Vulnerability

As long as dams exist so does the chance of failure.

B.3.7. Secondary Hazards

Secondary hazards can include transportation disruption and possible dispersion of contaminants. Although hazardous materials and other contaminants are not identified in the area, this may need to be addressed in updates to this plan.

B.3.8. Overall Summary of Vulnerability and Impacts

There is no record of dam failure in the history of Pawnee Indian Country. Only three dams are designated as high hazard.

This designation simply reflects a dam's potential for doing damage downstream if it were to fail and does not mean that a dam needs repair. The areas impacted (swash zones) are delineated using dam breach analysis. However, due to the low population downstream of the dams, the Corps of Engineers have not conducted such analysis.

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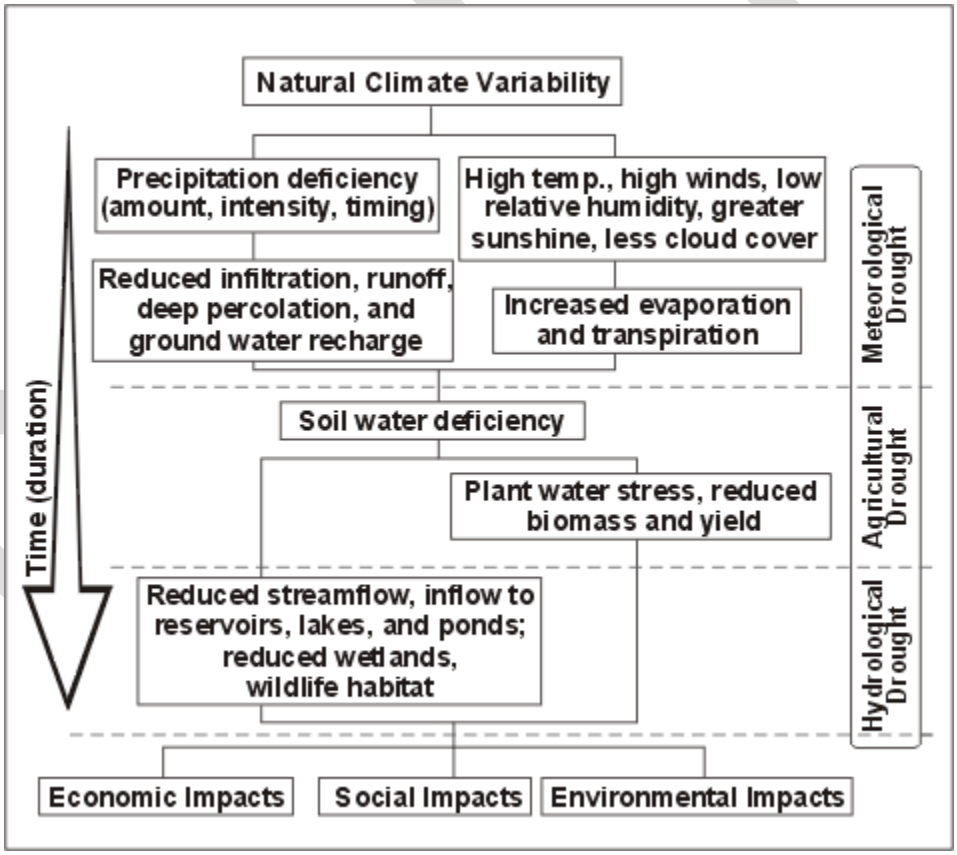
B.4. HAZARD PROFILE - Drought

B.4.1. Description

A drought is a period of abnormally dry weather which persists long enough to produce a serious hydrologic imbalance. There are four ways that drought can be defined.

- Meteorological – a measure of departure of precipitation from normal.
- Agricultural – refers to a situation when the amount of moisture in the soil no longer meets the needs of a particular crop.
- Hydrological – occurs when surface and subsurface water are below normal.
- Socioeconomics – the situation that occurs when physical water shortage begins to affect people.

VII. Figure: Diagram of Drought



B.4.2. Location

All areas of Pawnee Indian Country are equally susceptible to drought.

B.4.3. Extent

Drought impacts in several ways, spanning all regions, and is capable of affecting the economy as well as the environment. Specific impacts can include.

- reduced crops, rangeland.
- increased livestock and wildlife mortality rates.
- reduced income for farmers and agribusiness.
- increased fire hazard.
- reduced water supplies for municipal/industrial, agricultural and power uses.
- damage to fish and wildlife habitat.
- increased consumer prices for food.
- reduced tourism and recreational activities.
- unemployment.
- reduced tax revenues because of reduced expenditures; and
- foreclosures on bank loans to farmers and businesses.

The most direct impact of drought is economic rather than loss of life or immediate destruction of property. While drought impacts in Oklahoma are numerous and often dependent upon the timing and length of individual drought episodes, the greatest impacts of drought are usually experienced in the agricultural community. In addition to the obvious direct losses of both crop and livestock production due to a lack of surface and subsurface water, drought is frequently associated with increases in insect infestations, plant disease, and wind erosion.

Of course, one of the most significant potential impacts of drought relates to public water supply. In metropolitan areas there may be a need to stop washing cars, cease watering the grass and take other water conservation steps. In smaller communities, reduced flow in rivers and streams can have a significant affect on the water amount allowed for municipal use. Hot weather during the summer increases demand and subsequent use of supplies, as well as evaporation. In turn, increased water demand can stress many smaller and/or antiquated delivery and treatment facilities to the point of collapse. Prolonged drought has a much greater impact on rural communities, which usually rely on relatively small watersheds and are especially vulnerable during such periods.

Water shortages can also affect fire fighting capabilities in both urban and rural settings through reduced water flows and pressures. Most droughts dramatically increase the danger of fires on wild land. When wild lands are destroyed by fire, the resulting erosion can cause heavy silting of streams, rivers, and reservoirs. Serious damage to aquatic life, irrigation, and power production then occurs. Although drought can have serious impact during winter months, it is most often associated with extreme heat. Wildlife, pets, livestock, crops, and humans are vulnerable to the high heat that can accompany drought. When temperatures reach 90 degrees and above, people and animals are more likely to suffer sunstroke, heat cramps, and heat exhaustion.

Palmers Drought Severity Index

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	< -4.0	Extreme Drought
	-3.99 to -3.0	Severe Drought
	-2.99 to -2.0	Moderate Drought
	-1.99 to -1.0	Mild Drought
	-0.99 to -0.5	Incipient Drought
	-0.49 to 0.49	Near Normal
	0.5 to 0.99	Incipient Moist Spell
	1.0 to 1.99	Moist Spell
	2.0 to 2.99	Unusual Moist Spell
	3.0 to 3.99	Very Moist Spell
	> 4.0	Extreme Moist Spell

The Pawnee Nation can experience the entire Palmer Drought Scale in the future.

B.4.4. Previous Occurrences

There are four major statewide droughts based on U.S. Geological Survey, Water Supply Paper 2375. The drought years involved include the periods of 1929-1941; 1951-1957; 1961-1972; and 1975-1982. These were determined from stream flow records. Oklahoma had two additional events recorded by the National Climatic Data Center (NCDC); the summers of 2000 and 2001, which were extended periods of high temperatures and low rainfall.

B.4.5. Probability of Future Events

Given that six drought events have occurred in Oklahoma over the past 50 years and those nine notable droughts occurred nationwide in the twentieth century, one may conclude that Oklahoma can expect a drought every decade and that we can expect droughts to occur more frequently here than in the Country as a whole. However, long-term forecasts of droughts are difficult and inexact. The U.S. Corp of Engineers (USACE) is preparing the *National Drought Atlas* to provide information on the magnitude and frequency of minimum precipitation and stream flow for the contiguous United States. On average the July-to-January period is the lowest six-month period of stream flow throughout the U.S. and is used to characterize drought. The mean monthly flow from July to January has a once-in-20 year's chance of falling below a level that would classify it as a drought. In other words, the average occurrence of drought is once every twenty years, with an occurrence most likely lasting for years. In Oklahoma, the risk for drought is highly likely, with 36.5 of the last 72 years classified as drought.

B.4.6. Vulnerability

Oklahoma is in the south-central United States. The primary air masses that bring moisture to the state originate in the Gulf of Mexico. Air masses that come into the state from the west are usually stripped of moisture by the Rocky Mountains, and as a result, mean annual precipitation increases from west to east.

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B.4.7. Secondary Hazards

Drought is considered a secondary hazard brought about by extreme heat and low precipitation. Other hazards associated with drought are wildfire and expansive soil.

B.4.8. Overall Summary of Vulnerability and Impacts

It is difficult to predict drought probabilities for the near future because of the nature and complexity of the hazard. Drought evolves over time as certain conditions are met and are spread over a large geographical area. Drought severity depends on its duration, intensity, geographic extent, and the regional water supply demands made by human activities and vegetation. The impact of hazards such as Extreme Heat, Expansive Soils, and Wildfires can be intensified during times of drought. Otherwise, the most direct impact of drought is economic rather than loss of life or immediate destruction of property.

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B.5. HAZARD PROFILE - Earthquake

B.5.1. Description

An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. This sudden motion or trembling is caused by a release of strain accumulated within or along the edge of earth's tectonic plates.

B.5.2. Location

All Pawnee Indian Country is equally susceptible to earthquake. Earthquakes are not limited to certain areas or certain communities. It is regional in nature, covering vast expanses of the country. An extremely devastating earthquake begun several states away could affect the Pawnee Nation. With this characteristic in mind, all buildings and structures are equally susceptible to earthquakes and their destruction.

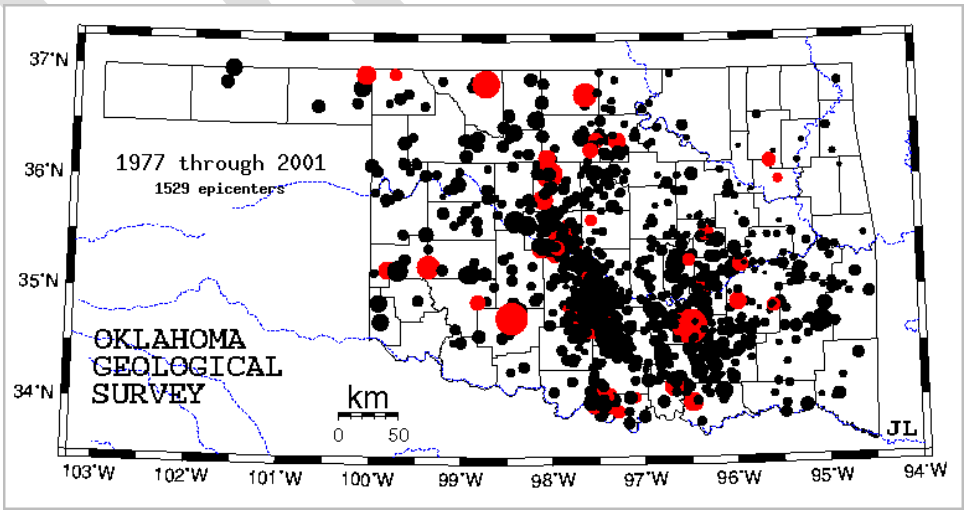
B.5.3. Extent

Pawnee Nation has several petroleum and chemical refineries. There are also countless pipelines producing oil and gas wells, and large buildings that are not constructed to earthquake codes. This creates the possibility of a major catastrophe in the event of a major earthquake.

B.5.4. Previous Occurrences

Earthquakes centered within Indian Country are rare. The few events that have been recorded are largely unfelt and are seismically rated at or below level 2. Records maintained by the Oklahoma Geological Survey and dating back to 1897 indicate that six occurrences of seismic activity have been recorded in Payne County. On April 9, 1952, a large earthquake centered near El Reno (in Canadian County) affected most of Oklahoma and extending as far north as Iowa.

VIII. Figure: Seismographic History of Oklahoma 1897 - 2003



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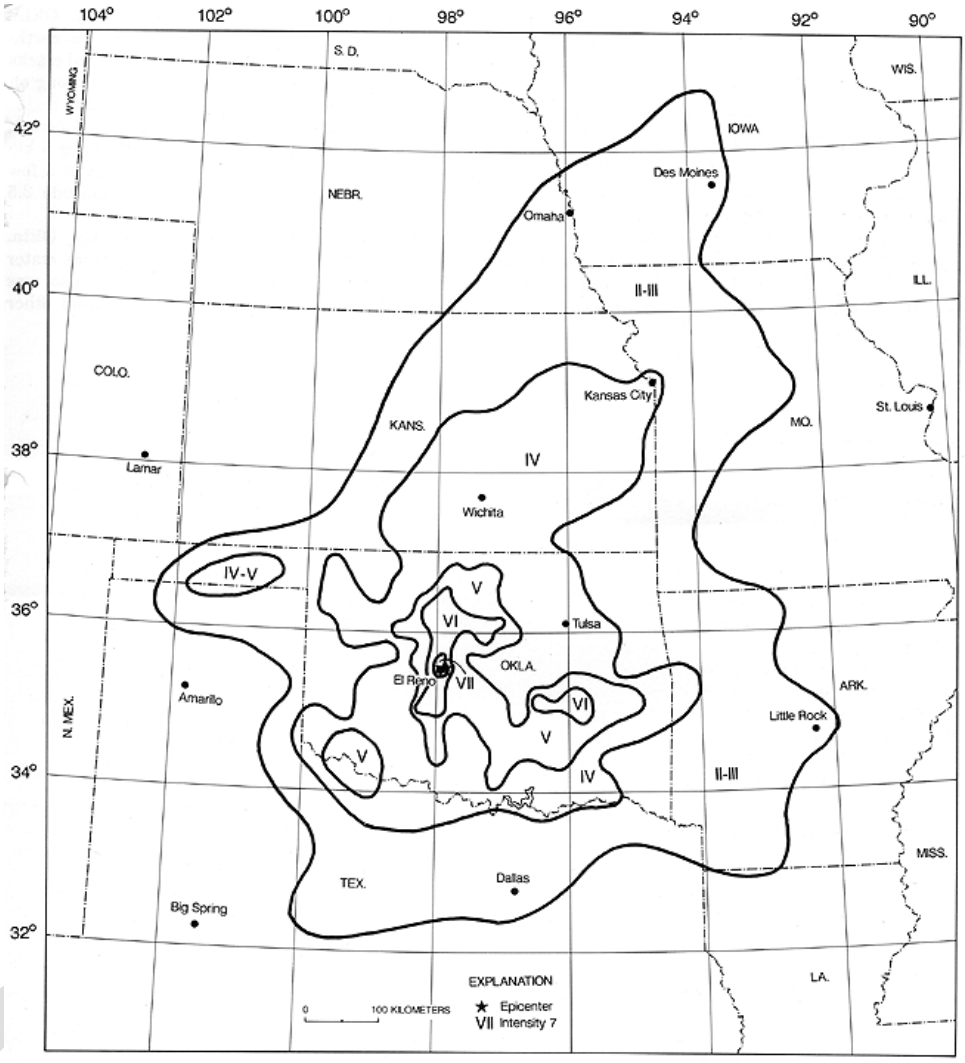
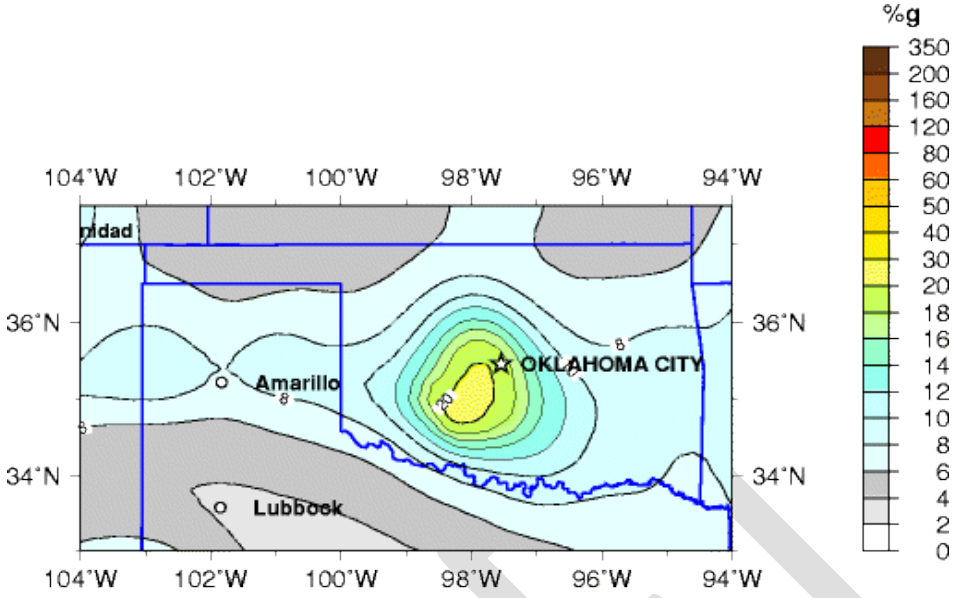
IX. Figure: Diagram of 1957 El Reno Earthquake



B.5.5. Probability of Future Events

The Pawnee Nation has a Peak Ground Acceleration (PGA) value of 2 with 10% probability of exceedance in 50 years. This earthquake measure indicates that there is a probability (10% chance in 50 years) of an earthquake at the severity level of 2 occurring within the Indian Country. With this rating, and since records dating back to 1897 indicate that six occurrences of seismic activity have been recorded, the probability of an earthquake occurring within the Indian Country is low.

X. Figure: Probability of Exceedance in 50 Years



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
site: NEHRP B-C boundary
National Seismic Hazard Mapping Project

B.5.6. Vulnerability

Pawnee Nation has beneath its surface the Nemaha Ridge which connects with the New Madrid fault, one of the nation's most seismic active zones. The installation of a statewide earthquake-station network of seismograph stations greatly improved earthquake detection and location. Oklahoma has experienced, on average, 50 earthquakes each year since records have been kept by the Oklahoma Geological Survey. Most of these earthquakes are so small that people do not feel them. However, according to Kathleen Shingledecker, Earthquake Project Manager with the Oklahoma Department of Emergency Management, these unfelt earthquakes could adversely affect the integrity of the infrastructure and lifelines within the impacted areas.

B.5.7. Secondary Hazards

Secondary hazards can include fire, explosions, collapse or structural failure of bridges, overpasses, roads, and disruption of economic activity across the region. Dispersion of contaminants could also occur. Hazardous materials and other contaminants were not identified in the area but may need to be addressed in updates of this plan.

Ground movement during an earthquake is seldom the direct cause of death or injury. Most earthquake-related injuries result from collapsing walls, flying glass, and falling objects because of the ground shaking, or people trying to move more than a few feet during the shaking.

B.5.8. Overall Summary of Vulnerability and Impacts

As the Earth's crust moves and bends, stresses are built up, sometimes for years, before suddenly breaking or slipping. This abrupt release of accumulated tension can be

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devastating to human communities. The destructiveness of an earthquake depends upon the magnitude of the tremor, direction of the fault, distance from the epicenter, regional geology, local soils, and the design characteristics of buildings and infrastructure. Earthquakes centered in Pawnee Indian Country are rare and the few events that have occurred were largely unfelt. There is concern as to what the long term affects of the unfelt earthquakes have on the integrity and infrastructure of the numerous pipelines associated with the oil and gas industries located within Indian Country.

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B.6. HAZARD PROFILE - Expansive Soils

B.6.1. Description

Expansive soils are soils with a relatively high percentage of clay minerals that are subject to changes in volume as they swell and shrink with changing moisture conditions. These volume changes can impact the integrity of structures built on, or within, the surface of such soils.

B.6.2. Location

The entire Pawnee Nation is affected by Expansive Soils.

B.6.3. Extent

The most extensive damage from expansive soil can occur to highways and streets. Homes, buildings, and other structures can have extensive damage resulting in sticking doors, uneven floors and cracks in the foundation, floors, walls, and ceilings. The greatest damage occurs when structures are constructed when clays are dry (such as during a drought) and then subsequent soaking rains swell the clay. Damage can become so severe that the cost of repair can exceed the value of the building.

Both public and private structures can develop extreme foundation problems during times of shrink-swell events. The most common signs of damage are cracks in foundations, brick exteriors, drywall interiors, sidewalks, and other concrete structures within the building.

Sewer and water lines are also affected by shrinking swell soils. The action of the movement of the soil can snap water and sewer lines, producing a minimum of area discomfort, and a maximum of a serious health and welfare risk. Pawnee Nation is in the Moderate Swell Class.

Classification of Shrink Swell Potential

Shrink-Swell Class	Linear Extensibility Percent (LEP)	Coefficient of Linear Extent (COLE)
Low	< 3	< 0.03
Moderate	3 – 6	0.03 – 0.06
High	6 – 9	0.06 – 0.09
Very High	≥ 9	≥ 0.09

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B.6.4. Previous Occurrences

Since this hazard develops gradually and seldom presents a threat to life, problems may not be recognized as being related to expansive soils or may be considered only nuisances and therefore never repaired or reported. No records of specific incidences of structure loss due to expansive soils in Pawnee Nation.

B.6.5. Probability of Future Events

Since no records of specific incidences of loss associated with expansive soils were found and no specific areas of expansive soils were identified, Probability of Future Events cannot be determined at this time. However, according to public opinion, the probability of future events of loss due to expansive soils is possible.

B.6.6. Vulnerability

The effects of expansive soils are most prevalent in regions of moderate to high precipitation. Prolonged periods of drought are followed by long periods of rainfall. Other cases of damage result from increases in moisture volume from such sources as broken or leaking water and sewer lines. Dry clays are capable of absorbing water and will increase in volume in an amount proportional to the amount of water absorbed. Areas capable of these changes in soil volume present a hazard to buildings, slabs, concrete, asphalt and other structures built over them and to the pipelines buried in them. Houses and one-story commercial buildings are more apt to be damaged by the expansion of swelling clays than are multi-story buildings, which are usually heavy enough to counter swelling pressures. However, if constructed on wet clay, multi-story buildings may also be damaged by clay shrinkage when moisture levels are substantially reduced.

B.6.7. Secondary Hazards

Depending on the use of the pipeline, contamination of soils and groundwater could occur should buried pipelines become damaged by expansive soils.

B.6.8. Overall Summary of Vulnerability and Impacts

Changes in soil volume present a hazard primarily to structures built on top of expansive soils. Damages occur as clay moisture content expands or shrinks the soil volume causing different parts of the structure to move at different rates and distances. Houses and one-story commercial buildings are more apt to be damaged since they are usually not heavy enough to counter swelling pressures. However, multi-story buildings may be damaged by clay shrinkage when moisture levels are substantially reduced. There are no records of specific incidences of loss within Indian Country due to expansive soils. For large areas of the United States, little information is reported other than field observations of the physical characteristics of clay in a particular stratigraphic unit. As a result, fixed criteria for determining the swelling potential have not been devised.

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B.7. HAZARD PROFILE - Extreme Heat

B.7.1. Description

Temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks are defined as extreme heat. Humid or muggy conditions, which add to the discomfort of high temperature, occur when a “dome” of high atmospheric pressure traps hazy, damp air near the ground.

B.7.2. Location

Extreme Heat events are regional in nature. The entire Pawnee Nation is equally affected by extreme heat.

B.7.3. Extent

The severity of the extreme heat is dependent on a combination of temperature and humidity. High temperatures, when combined with high humidity can put an area in the “Extreme Danger” category on the National Weather Service Heat Index scale. When extreme heat is combined with drought, results can include not only excessively dry hot conditions that contribute to a high risk of life-threatening heat related illnesses but can also provoke dust storms with low visibility.

Heat kills by pushing the human body beyond its limits. Under normal conditions, the body's internal thermostat produces perspiration that evaporates and cools the body. However, in extreme heat and high humidity, evaporation is slowed, and the body must work extra hard to maintain a normal temperature.

Most heat disorders occur because the victim has been overexposed to heat or has over exercised for his or her age and physical condition. Other conditions that can induce heat-related illnesses include stagnant atmospheric conditions and poor air quality.

A prolonged drought can have a serious economic impact on a community. Increased demand for water and electricity may result in shortages of resources. Moreover, food shortages may occur if agricultural production is damaged or destroyed by a loss of crops or livestock.

The Pawnee Nation expects to see the entirety of the heat index scale in the future.

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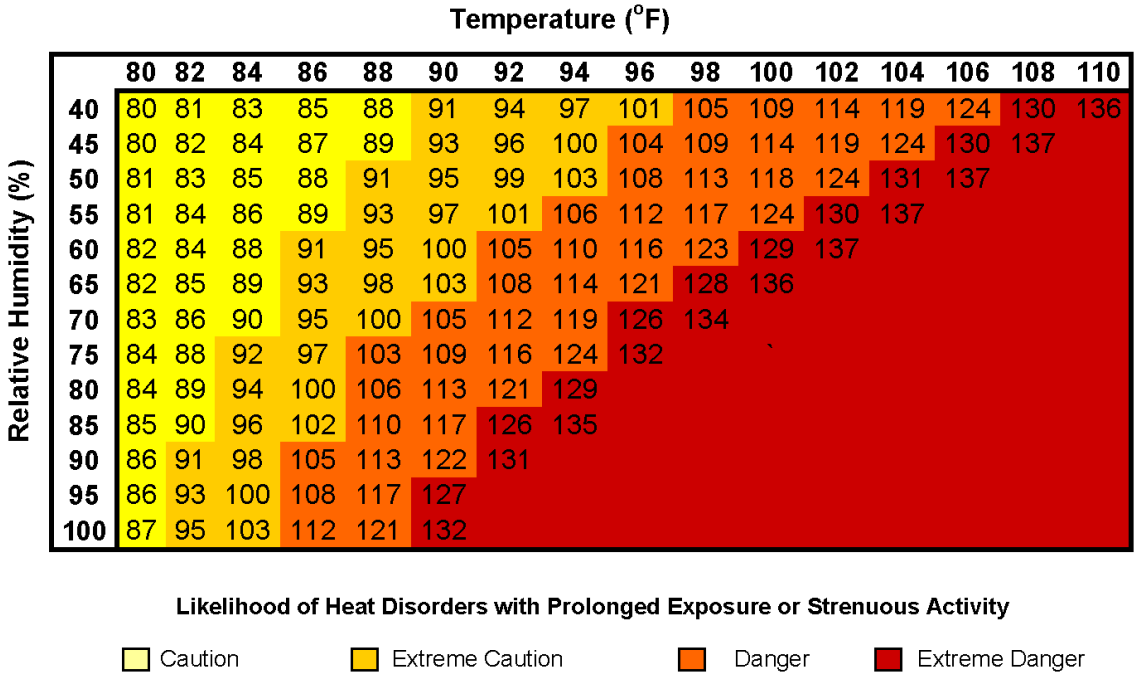

B.7.4. Previous Occurrences

In a normal year, approximately 175 Americans die from extreme heat. Between 1936 and 1975, nearly 20,000 people succumbed to the effects of heat and solar radiation. From 1979-1999, excessive heat exposure caused 8,015 deaths in the United States. On average approximately 400 people die each year from exposure to heat. In Oklahoma, July is generally the hottest month of the year, followed by August. A few incidences of recent extreme heat in Payne County and Pawnee are listed in Appendix B.

B.7.5. Probability of Future Events

According to the data collected from the Oklahoma Climatological Survey, the Pawnee Nation averages 10 – 20 days per year of daytime high temperatures greater than 100° F. Therefore, extreme temperatures are highly likely to occur within the Pawnee Nation.

B.7.6. Vulnerability

Young children, elderly people, and those who are sick or overweight are more likely to become victims to extreme heat. Other conditions that can limit the ability to regulate temperature include fever, dehydration, heart disease, mental illness, poor circulation, sunburn, prescription drug use, and alcohol use. Another segment of the population at risk is those whose jobs consist of strenuous labor outside. Livestock and crops can also become stressed, decreasing in quality or in production, during times of extreme heat.

B.7.7. Secondary Hazards

Extreme high temperatures can cause water shortages, increase fire danger, and prompt excessive demands for energy. Damage to property during extreme heat can be related to

expanding and contracting soil, which is covered in the section, “Expansive Soils.” Another secondary hazard is air pollution in summer months resulting from consistent high temperatures and stagnant airflows.

B.7.8. Overall Summary of Vulnerability and Impacts

The Pawnee Nation can expect to experience extreme heat every summer and is most likely to occur during the months of July and August. The severity of the extreme heat is dependent on temperature and humidity. High temperatures and high humidity can result in dangerous conditions that expose people to an increased risk of heat stroke and other heat related illnesses. The most vulnerable population is the elderly, young children, and those who are sick, overweight, or who work outside. Extreme heat can also cause stress on livestock and other agricultural productions.

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B.8. HAZARD PROFILE - Flood

B.8.1. Description

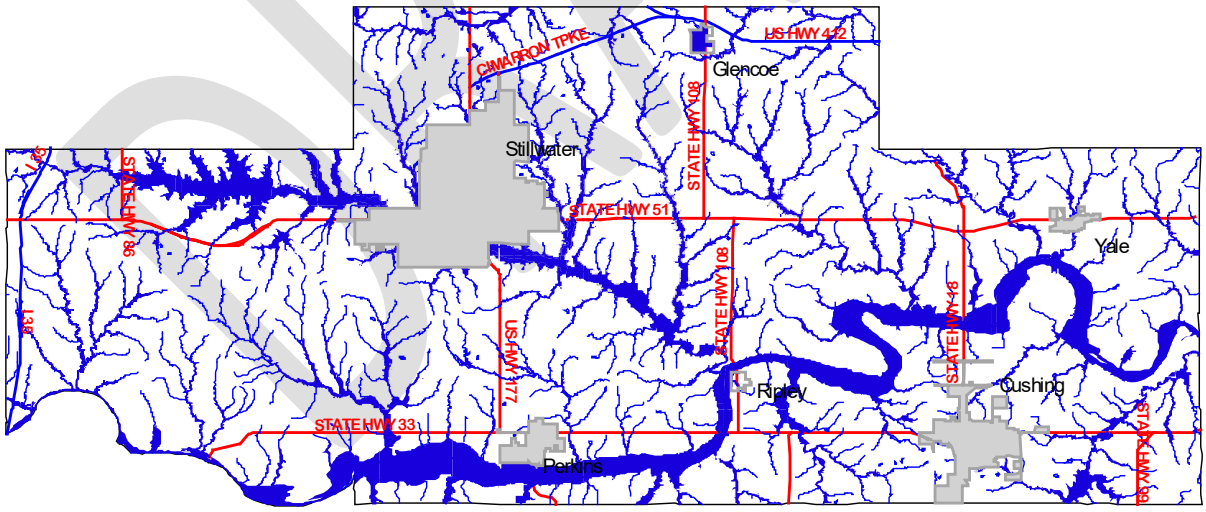
Flooding is the most prevalent and costly disaster in the United States. Flooding occurs any time dam failures, rain, or melting snows exceed the absorptive capacity of the soil and the flow capacity of rivers, streams, or coastal areas. At the point the water concentration hyper extends the capacity of the flood way, the water enters the floodplain. Floods are most common in seasons of rain and thunderstorms. Floods can be associated with other natural phenomena such as rainstorms, thunderstorms, hurricanes, earthquakes, tsunamis, and rapidly melting snow.

There are two types of floods, both which can occur in Indian Country. First, flash floods, which result in heavy rainfall. Flash floods occur rapidly with little warning. Dam failures are a unique form of flash flood. Flash flooding is the most common cause of death by natural disaster in the United States. Second, riverine floods, occur after extended periods of rain over several days or weeks. Riverine floods generally can be forecast in advance, and proper precautions taken to save lives, and mitigate some though certainly not all property losses.

B.8.2. Location

Below is a map of Payne County flood zones, Pawnee Nation is not mapped currently.

XI. Figure: Flood Zones of Payne County



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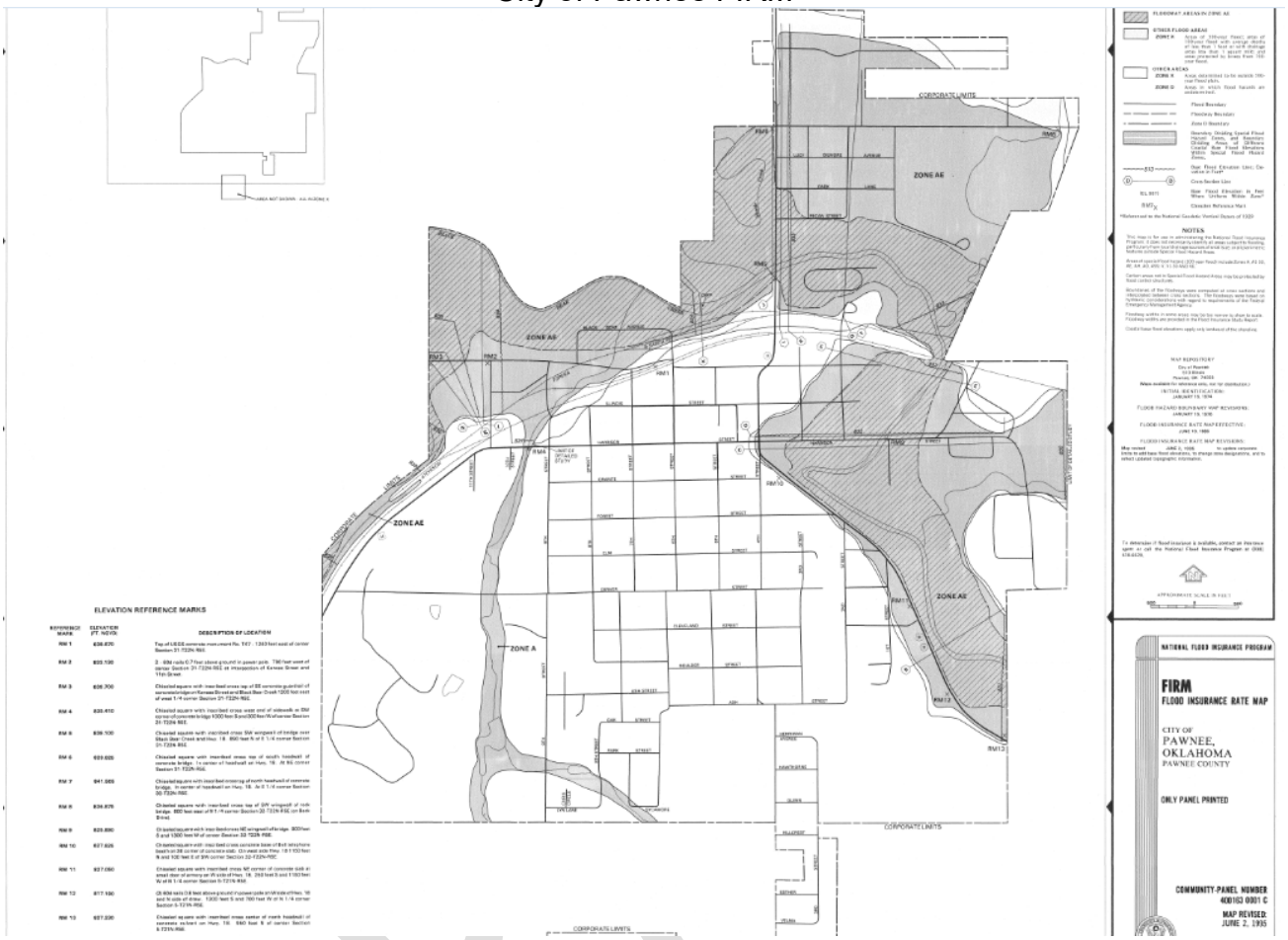
City of Pawnee FIRM



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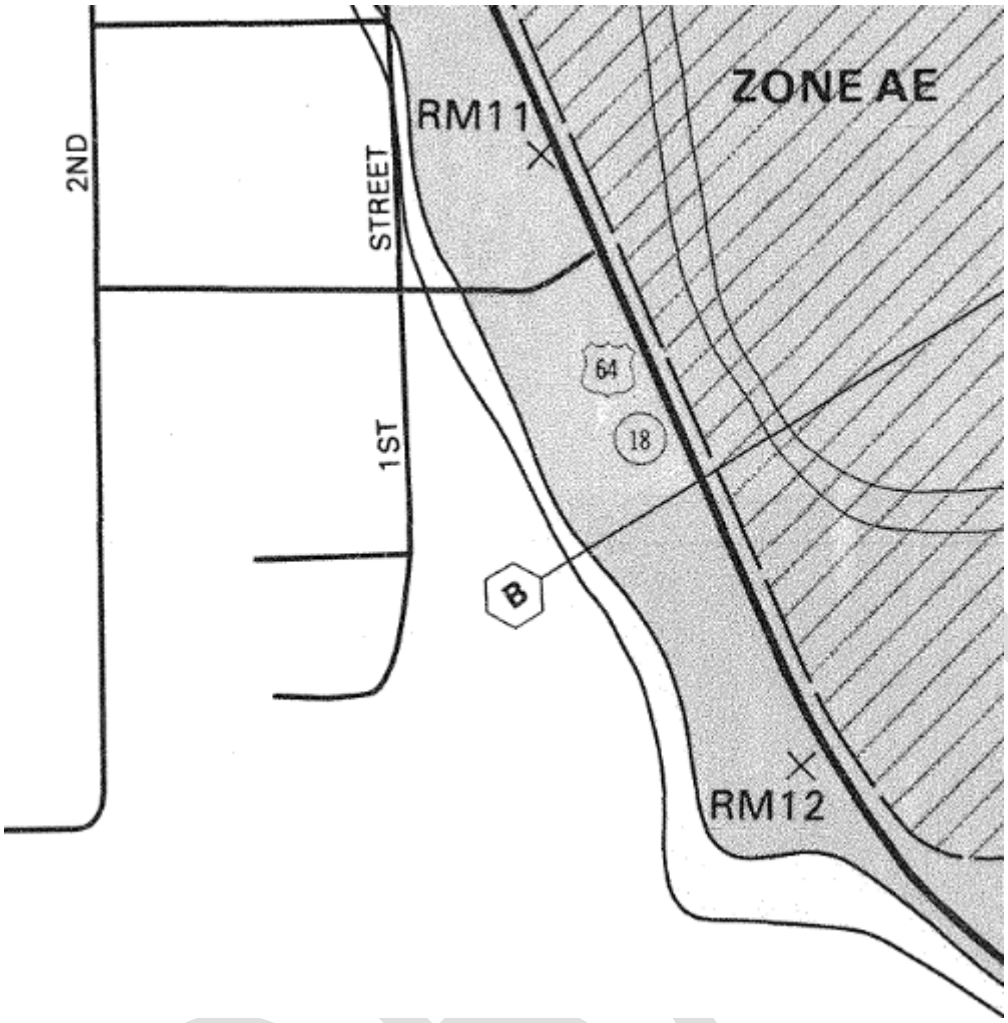
ZONE AE
RM11
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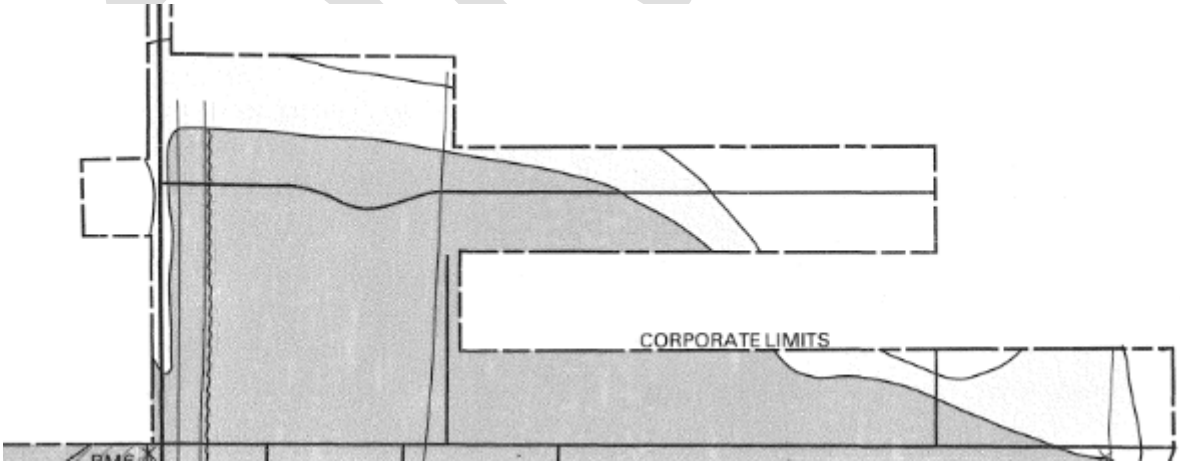
RM12


CORPORATE LIMITS

B.8.3. Extent

Severity of flooding is determined by several factors including rainfall intensity, duration, and location. Flash floods are most dangerous since they can occur suddenly and begin before the rain stops. A maximum flood threat could result if soil is saturated and wide spread heavy rains begin to fall. Such an event could cause all streams and rivers within Indian Country to rise. Responders have rescued citizens from flood waters in previous events.

Vulnerable housing on 1st street is very limited . The Yellowhorse addition on the north side of Pawne is mainly impacted with street flooding as houses are on elevated yards above the street.

B.8.4. Previous Occurrences

Floods occurred in the years 1993, 1995, 1998, 1999, 2000, 2001 and 2019. Damages to personal property are estimated at $11,957,000.

Past flood events for Pawnee and Payne Counties are summarized in Appendix B. while nine of the 24 events in Payne County occurred outside of the Pawnee Nation Reservation

B.8.5. Probability of Future Events

The Pawnee Nation receives abundant rainfall mainly in the spring and fall. Consequently, rivers and creeks overflow their banks during these seasons. Many of these floods are of small consequence; however, the number of major floods in the last 100 years warrants a likely probability rating.

B.8.6. Vulnerability

Within the Pawnee Nation, Payne County has a county-wide flood plain ordinance which regulates the issuing of building permits within flood zones, conversely neither Pawnee County nor the Pawnee Nation have a flood plain ordinance. Pawnee Nation's GIS department has worked with Pawnee and Payne County to gather their information to plan and map Tribal lands in reference to flooding. Since improvements in the Payne County portion of the Pawnee Nation have been directed away from flood plains, an estimated population of 3400 people was found to live in flood zones outside municipalities within the area. Geographic Information Software (GIS) was used to help associate population and housing with flood zones to obtain this estimate.

Pawnee Nation Emergency Management concludes that citizens who live in affected areas are aware of the dangers, thus resulting in a low human casualty rate. With early warning from the National Weather Service, the Pawnee Nation and other local jurisdictions are

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able to activate response personnel in a timely manner to prevent loss of life with minimal loss to property.

B.8.7. Secondary Hazards

Secondary hazards include transportation disruptions, Dam failure, dispersion of contaminants, and threatened water supplies. Hazardous materials, and other possible sources of contaminants, are not identified in the area, but may need to be addressed in updates to this plan.

B.8.8. Overall Summary of Vulnerability and Impacts

Spring and fall rains can result in a rise in the Pawnee Nation's rivers and creeks resulting in floods that vary in intensity. Severity of flooding is determined by several factors including rainfall intensity, duration, and location. Flash floods are most likely to close small roads and some major highways. Payne County's flood-plain ordinance has limited the growth within the flood plains and as a result it is estimated that less than 1% of that County's population live in a flood zone. Pawnee Nation has no structures that are designated as repetitive loss structures. The roadways, bridges, and some farmlands remain most vulnerable to floods.

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B.9. HAZARD PROFILE - Hailstorm

B.9.1. Description

Due to Oklahoma's rapidly changing climate, large scale hail is especially prevalent. Hail is formed by the actions of wind and rain at freezing temperatures which cause water particles to become frozen and condense into particles ranging from very small to grapefruit size. Hailstones may be spherical, conical, or irregular in shape. The size and shape of hailstones is determined by the strength of wind within the storm cell. Each lifting, falling, recoating cycle produces a larger hailstone until finally the weight of the stone causes it to fall to earth.

Hail is associated with severe thunderstorms. Powerful updrafts produce cumulonimbus clouds that tower tens of thousands of feet above the ground. The air temperature in the upper levels of these clouds may be -50°F or below. Hailstones grow as ice pellets, are lifted by updrafts, and collect supercooled water droplets. As they grow, hailstones become heavier and begin to fall. Sometimes, they are caught by successively stronger updrafts and are circulated through the cloud again and again; growing larger each time the cycle is repeated. Eventually, the updrafts can no longer support the weight of the hailstones. As hailstones fall to the ground, they produce a hail streak that may be more than a mile wide and a few miles long. A single thunderstorm can produce several hairstreaks.

Note that although hail is associated with thunderstorms, this plan profiles hail equal to or larger than 1.50" in diameter as a separate natural hazard event. Based on previous occurrences, when hail gets this large, it can be particularly damaging to cars, roofs, and windows, but can also hurt people.

B.9.2. Location

All parts of Pawnee Nation are equally vulnerable to hailstorms.

B.9.3. Extent

The severity of damage caused by hailstorms depends on the hailstone sizes (average and maximum), number of hailstones per unit area, and associated winds. Storms that produce high winds in addition to hail are most damaging and can result in numerous broken windows and damaged siding.

Hailstorms can cause extensive property damage affecting both urban and rural landscapes. Fortunately, most hailstorms produce marble-size or smaller hailstones. These can cause damage to crop, but they normally do not damage buildings or automobiles. Larger hailstones can destroy crops, livestock, and wildlife and can cause extensive damage to buildings, including roofs, windows, and outside walls. Vehicles can be total losses. When hail breaks windows, water damage from accompanying rains can also be significant. A major hailstorm can easily cause damage running into the millions of dollars. Nationwide hail is responsible for over $1 billion in property and crop damage per year.

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B.9.4. Previous Occurrences

The National Climatic Data Center documented a total of 296 hail events occurring in Payne County and 227 events in Pawnee County between 1950 and 2009. Of those, 71 Payne County and 41 Pawnee County events had large hail equal to or greater than 1.50" in diameter. The largest recorded hail stones were 4.0" in diameter which fell in April 1984. There were no reported deaths from hail events within the Pawnee Nation.

Hail events have been documented every year from 1955 to 2009. All structures are equally acceptable to hail damage. Crops are especially vulnerable to hail damage.

B.9.5. Probability of Future Events

Based on the Previous Occurrences of 112 large-hail events recorded in the last 59 years, an average of 1.89 events occurs per year. Therefore, the probability of large-hail (equal to or greater than 1.50 inches diameter) occurring within the Pawnee Nation each year is highly likely.

B.9.6. Vulnerability

Vulnerability is difficult to evaluate since hail occurs in random locations and creates relatively narrow paths of destruction. Hail can cause considerable damage to crop, buildings, and vehicles, and occasionally death to farm animals. Hail can also strip leaves and small limbs from non-evergreen trees. While large hail poses a threat to people caught outside in a storm, it seldom causes loss of human life.

- Costs and losses to agricultural and livestock producers
- Reduced yields and crop loss
- Injuries or loss of livestock
- Damage to barns and other farm buildings.
- Damage to farm machinery.
- Damage to wood fences.
- Loss from timber production
- Damage to trees resulting in increased susceptibility to disease.
- Urban, residential, and commercial
- Damage to and destruction of buildings.
- Roofs
- Windows
- Siding, stucco, brick, and other exterior building materials
- Loss of trees and landscaping
- Damage to automobiles, trucks, trains, airplanes, etc.
- Disruptions to local utilities and services
- Power
- Communications
- Transportation
- Health
- Injuries
- Fatalities

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- Mental and physical stress
- General economic effects
- Revenue loss from lost production in business and industry
- Negative impact of economic multipliers
- Environmental Impacts
- Damage to trees and bushes resulting in increased susceptibility to disease.
- Losses of wildlife, with particular emphasis on birds

B.9.7. Secondary Hazards

Deep hail can easily worsen a flash flood situation by clogging drainage paths, culverts, and grates.

B.9.8. Overall Summary of Vulnerability and Impacts

Hail can occur in any strong thunderstorm. However, the size of the hailstones is a direct function of the severity and size of the storm. Hail, larger than 1.5“, can cause serious damage to cars, roofs, walls, windows, and inflict serious bodily injury as well. All of Oklahoma has significant exposure to hailstorms, and virtually all buildings and automobiles are at risk. Crops are also at risk since the peak periods for hailstorms occur during early spring and late fall, which coincide with critical agricultural seasons.

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B.10. HAZARD PROFILE – Severe Winter Storm

B.10.1 Description

This plan defines a winter storm as a single or combination of the following winter weather types occurring over a wide area of Indian Country.

- Ice storm. Described by the National Weather Service (NWS), as an occasion when damaging accumulations of ice are expected during freezing rain situations. Significant ice accumulations are usually accumulations of 0.25 inches or greater.
- Heavy snow. Defined as either a snowfall accumulating to 4 inches in depth in 12 hours or less, or snowfall accumulation to 6 inches or more in depth in 24 hours or less.
- Freezing rain or freezing drizzle. An occasion when rain or drizzle freezes on surfaces such as trees, power lines, highways, etc.
- Extreme Cold. Cold temperatures for extended periods of time.

B.10.2. Location

All parts of Pawnee Nation are susceptible to severe winter storms.

B.10.3. Extent

Based on past occurrences, Pawnee Nation winter storms have not been shown to have significant impact on agricultural and loss of life, but there has been property and economic damage.

Winter storms such as blizzards can strike unexpectedly and can create hazardous travel conditions and utility outages. Dangerous driving conditions can play roles in both community, economic, and social hardships.

Fortunately, the Pawnee Nation is not affected by blizzards as often as other parts of the state. Damages usually occur in loss of water due to frozen water lines, loss in agricultural revenue due to loss of livestock. During times of more than average accumulation, structures can collapse due to the added weight of snow and ice. Ice dams can cause additional roof damage.

Extremely cold temperatures can cause property damages and death. Pawnee Nation is not well equipped for extended periods of below freezing and colder temperatures. Water pipes can freeze and crack. Individuals may not be prepared with proper clothing. These individuals can underestimate the wind chill or can become trapped in cold temperatures due to car failure or other unexpected events.

Pawnee Nation can anticipate SPIA levels for ice up Level 2; for snow we anticipate levels up to 2-3 inches and extreme cold can be 20-25 degrees for several days.

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SPIA Index Parameters			
Index	Radial Ice Accumulation (Inches)	Wind (mph)	Damage and Impact Descriptions
1	0.10 – 0.25	15 – 25	Some local utility interruptions possible...typically lasting a few hours.
	0.25 – 0.50	> 15	
2	0.10 – 0.25	25 – 35	Scattered utility interruptions possible...typically lasting less than 12 hours.
	0.25 – 0.50	15 – 25	
	0.50 – 0.75	< 15	
3	0.10 – 0.25	≥35	Numerous utility interruptions possible...lasting up to 5 days. Damage to some main feeder lines possible.
	0.25 – 0.50	25 – 35	
	0.50 – 0.75	15 – 25	
	0.75 – 1.00	< 15	
4	0.25 – 0.50	≥ 35	Prolonged and widespread utility interruptions possible. Damage to many main feeder lines possible. Utility outages lasting up to 10 days possible.
	0.50 – 0.75	25 – 35	
	0.75 – 1.00	15 – 25	
	1.00 – 1.50	< 15	
5	0.50 – 0.75	≥ 35	Catastrophic damage to exposed utility systems possible. Outages lasting several weeks possible in some areas.
	0.75 – 1.00	≥ 25	
	1.00 – 1.50	≥ 15	
	> 1.50	Any	
The Damage and Impact Descriptions are based upon: (1) researched weather parameters and utility impacts and (2) the combination of **forecast** parameters including radial ice accumulation, wind and temperatures.			

B.10.4. Previous Occurrences

Over the past 59 years (1950 – early 2009), the National Climatic Data Center has recorded that Payne and Pawnee Counties has experienced 67 significant winter storm events. Some examples of past winter storm events in Payne and Pawnee County are listed in Appendix B

B.10.5. Probability of Future Events

Based on Previous Occurrences, some 34 snow and/or ice events have occurred in the last 56 years. This would indicate that the probability of a winter storm occurring within the Indian Country is highly likely.

B.10.6. Vulnerability

Cold waves pose a variety of threats to individuals and communities. These threats are sometimes compounded by accumulations of ice or snow. The delivery of public services and maintenance of infrastructure are often disrupted by cold waves. Frozen and burst water lines are a common problem. Increased consumption of heating fuel can lead to

energy shortages and higher prices. People and animals are subject to health risks from extended exposure to cold air. The list below summarizes some of the most common impacts of cold waves.

- Costs and losses to livestock producers
    - Loss of livestock due to exposure
    - Greater mortality due to Increased vulnerability to disease
    - Increased feed costs
    - Reduced milk production
    - Cost of supplemental water for livestock if onsite ponds and streams are frozen.
    - Machinery and farm vehicles will not operate in cold weather.
- Urban, residential, and commercial impacts
    - Availability of water for municipal use due to frozen and burst water lines.
    - Homes with alternative energy sources
    - House fires from overburdened chimneys
    - Carbon monoxide poisoning from exhaust produced by heaters and generators.
    - Vehicles that will not operate in cold weather.
    - Cost of keeping transportation lines clear of ice and snow
- Health
    - Mental and physical stress in the form of "cabin fever"
    - Frostbite and hypothermia.
    - Disruption of services
    - Government offices and schools closed.
    - Garbage collection halted.
- General economic effects
    - Revenue loss from lost production in business and industry
    - Negative impact of economic multipliers
    - Higher energy costs
    - Damage to animal species.
    - Loss of wildlife, particularly if cold wave is coupled with prolonged snow cover that makes sources of food unavailable.
    - Greater mortality due to Increased vulnerability to disease
    - Loss of trees and woody shrubs that are not hardy enough to survive prolonged exposure to cold temperatures, especially when soil moisture is low.
    - Pollution from increased energy production

A major winter storm can be lethal. Preparing for cold weather conditions and responding to them effectively can reduce the dangers caused by winter storms.

Mitigating ice storm damage must be a joint effort by tribal, county and city workers, private landowners, and corporate entities. Pawnee Nation, Pawnee County and Payne County workers simply do not have the available resources to maintain all the wire systems in Indian Country. Ordinances that require the maintenance of trees and shrubs surrounding

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the area of electric and telephone wires are a first step toward mitigating ice storm damage. Aggressive public education programs must be in place to alert people to the possible damages to their and other's property if trees and shrubs are not regularly maintained in the Location and Extent Requirement 201.6(c)(2)(i). Large corporations such as OG&E and Indian Electric do not have the man-power or financial resources to maintain all their lines. Regular trimming by all levels of participants can substantially reduce the damage caused by future episodes.

B.10.7. Secondary Hazards

Secondary hazards can include traffic accidents due to snow- and ice-covered roads, and death from hypothermia due to prolonged exposure to cold. Wind-driven snow can result in "whiteout" conditions which can also make driving extremely dangerous. House fires and resulting deaths tend to occur more frequently from increased and improper use of alternate heating sources. Fires during winter storms also present a greater danger because water supplies may freeze and impede firefighting efforts.

B.10.8. Overall Summary of Vulnerability and Impacts

A winter storm can range from accumulating snow and/or ice over a few hours to blizzard conditions with blinding, wind-driven snow lasting several days. In latitudes like Oklahoma's, where moist Gulf air collides with artic temperatures from the Canadian Shield, winter storms - particularly ice storms - have the potential to cause significant property damage, transportation problems, and utility service failure over large areas of the State. The aftermath of a winter storm can continue to impact a region for weeks, and even months.

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B.11. HAZARD PROFILE - Tornado

B.11.1. Description

A tornado is a violent whirling wind, characteristically accompanied by a funnel-shaped cloud. Tornadoes are the result of great instability in the atmosphere and are often associated with severe thunderstorms or in advance of cold fronts. Note that although tornadoes are associated with thunderstorms, tornadoes are profiled in this plan as a separate event.

Tornado intensity is rated using the Fujita Scale (or F-scale) of F0 to F5. The scale described below is based on wind speed and type of damage done

XII. Figure and Table: Enhanced Fujita Scale

EF SCALE	
EF Rating	**3 Second Gust (mph)**
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200
Source: National Weather Service, Weather.gov/oun/efscale	

B.11.2. Location

All Pawnee Nation is equally susceptible to tornado damages. Due to the area wide probability of tornado, throughout the Indian Country, every structure has equal probability to be struck by an F0 tornado or higher.

According to NOAA data, this area of the United States is the most tornado-prone in the country. The area has a reported concentration of more than 11 tornadoes per 1000 square miles.

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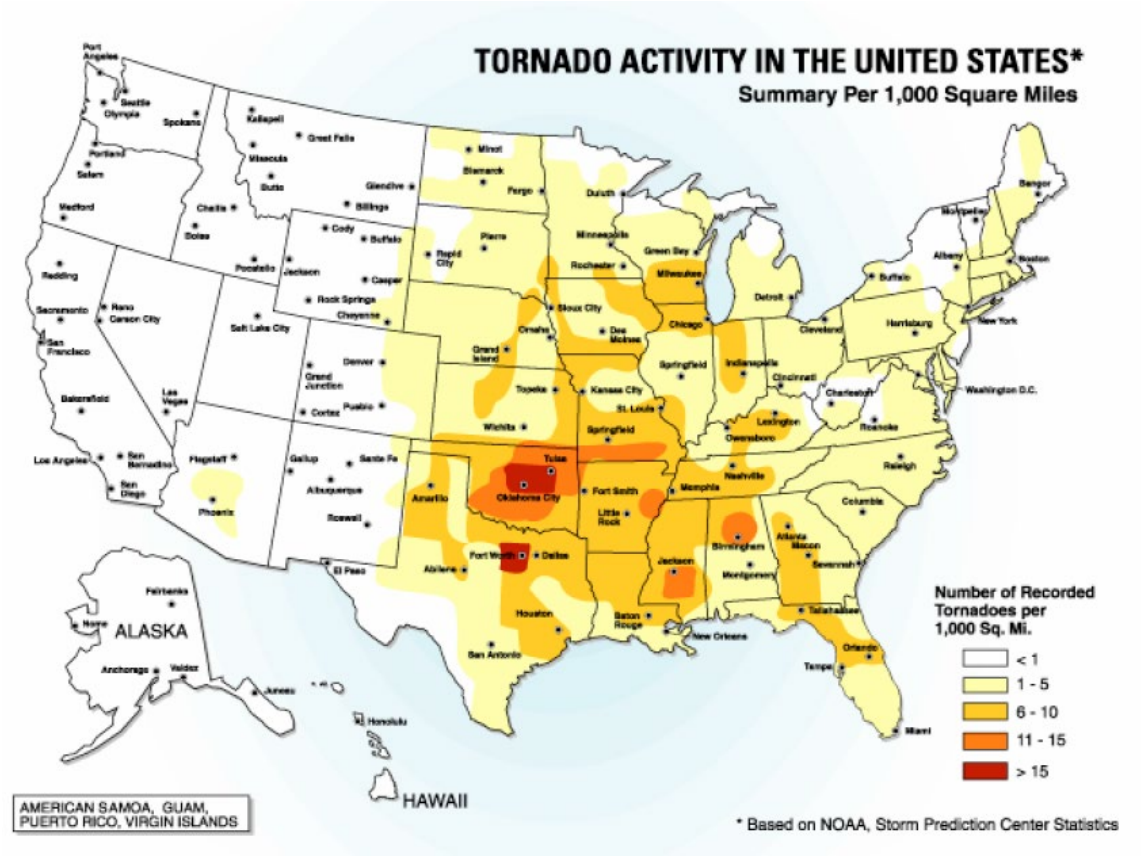
XIII. Figure: Tornado Activity in the United States



B.11.3. Extent

The most severe impact by a tornado would be the result of a EF5 tornado moving through the area and hitting several communities.

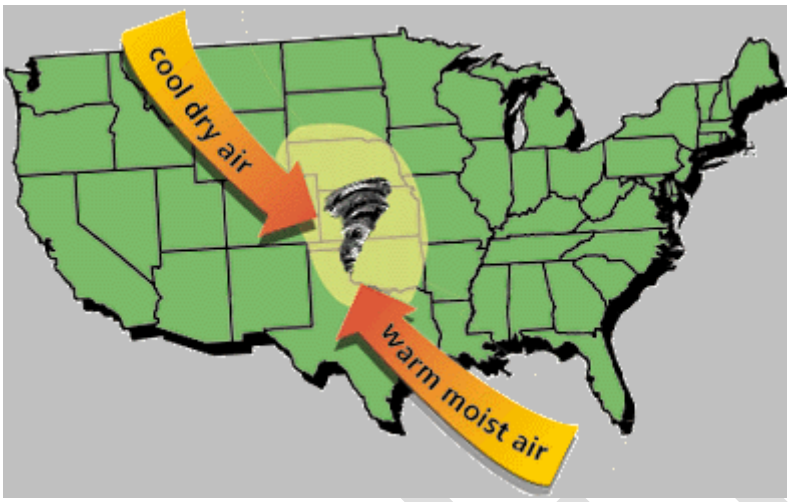
Tornadoes, which drop in areas of low development, cause little to no damage. Conversely, tornadoes which drop in heavily populated areas can cause extreme loss of property and loss of human life. Winds of such velocity can lift even the most solidly built structure. Mature trees can be uprooted and flung across fields or into homes or businesses. Cars and automobiles can be lifted and projected into other structures. Smaller projectiles made of glass shards, splintered lumber, or metal have been documented to pierce trees, homes, and other property. Death can result from any debris source at this speed.

B.11.4. Previous Occurrences

Oklahoma, Texas and Kansas are the most common areas for tornado formation, though they can occur anywhere on the world. The Unites States has more large and intense tornadoes than any other country. Tornadoes have occurred in every state of the union.

Nearly 900 occur each year. In the last fifty years nine thousand deaths have been caused by tornadoes.

XIV. Figure: Tornado Alley



Tornadoes are most common on the Great Plains and in the part of the United States often called *Tornado Alley.* According to NOAA data, this area of the United States is the most tornado prone in the country. The area has a reported concentration of more than 11 tornadoes per 1000 square miles.

In Oklahoma, Pawnee Nation is located within this area and tornadoes have a history of development and destruction throughout the area. Tornadoes occur most often in spring during the late afternoon or early evening. Based on records kept by the National Climatic Data Center (NCDC) since 1950, a total of 44 tornadoes were recorded in Payne County and 32 recorded in Pawnee County.

May to August is the predominate tornado season, though again, they can occur any time of year. Over 80% of tornadoes occur between noon and midnight, one quarter from 4:00 to 6:00 pm. Tornadoes within the area have varied in intensity from F0 to F5 on the Fujita Scale. Out of the 76 total, none were rated F5, 5 were rated as F4, 5 as F3, and 14 were rated as F2, and 52 were F1 and under or not rated at all. Examples of other tornado events are listed in Appendix B.

B.11.5. Probability of Future Events

In the last 59 years Pawnee and Payne Counties have had 76 tornadoes, resulting in an average of 1.28 tornadoes per year. Therefore, the probability of a tornado occurring within Indian Country each year is highly likely.

B.11.6. Vulnerability

Located in the central part of Oklahoma, Pawnee Nation is in an active part of tornado alley and has a designated wind speed rating of a Zone IV. Zone IV is associated with 250 mph wind speeds. Historically the average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. Consequently, vulnerability of humans and property is difficult to evaluate since tornadoes form at different strengths, in random locations, and create relatively narrow paths of destruction. Residents most vulnerable to tornadoes are those living in mobile homes.

Education about and preparedness for this threat is a perpetual process, and many County residents are aware that they live in tornado alleys and take appropriate precautions during tornado warnings. Warning systems, as well as trained spotters, exist are limited in all areas of the Indian Country. With peak tornado season in the spring there is a slight risk of crop loss in the tornado path.

Advances in meteorology and the use of Doppler radar allow efficient prediction of tornado formation before they occur. A network of storm watchers attempts to identify funnel clouds and report to various networks to alert the population. Even though these advances have significantly improved the available response time, tornadoes can still occur unexpectedly and without warning.

The use of better building techniques and the availability of affordable home storm shelters have helped to mitigate losses in Indian Country. The growing popularity of mobile/manufactured homes and structures without basements contraindicate any advances. The rapid urbanization of rural areas also intensifies the probability of being affected by a tornado.

B.11.7. Secondary Hazards

Secondary hazards can include fire, power outages, communications disruption, and failure of municipal services. Peripheral damage can occur caused by the accompanying thunder/rainstorm activity. Lighting can cause fire. Rain can cause flooding. Tornadoes often affect areas not directly struck by the tornadic event. Loss of power and telephone service due to downed lines within the system can lead to a wide range of problems. Debris can cause damage ranging from minor inconvenience to major transportation problems. The resulting “building rush” following a major event can lead to material shortages and price increases.

B.11.8. Overall Summary of Vulnerability and Impacts

Located in “Tornado Alley”, Oklahoma is hit by more tornadoes each year, on average, than any other state except Texas. Texas has twice as many tornadoes, but it also is more than twice the size of Oklahoma. Oklahoma has experienced an average of 60 tornadoes per year over the past 50 years. They are most likely to occur between March and June within the afternoon hours of 3:00 to 7:00pm. A tornado can generate winds exceeding 300 mph. The path width of a tornado is generally less than a half-mile, but path length can vary from a few hundred yards to dozens of miles. Therefore, the impact on human life and property can be substantial. Based on wind speed and type of damage done, tornado

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intensity is rated using the Fujita Scale of F0 to F5. In the last 59 years Payne County and Pawnee County have experienced tornadoes of various intensities, with 66 tornadoes rated as an F2 or under and 10 tornadoes rated as F3 or F4.

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B.12. HAZARD PROFILE - Wildfire

B.12.1. Description

Wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed and spread quickly and are usually signaled by dense smoke that fills the air for miles around. A “Wild Land” fire is a fire in an area in which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities. An “Urban-Wild Land Interface” fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wild land or vegetative fuels.

B.12.2. Location

Wildfires can occur throughout Oklahoma and Pawnee Nation due to the combination of dry burnable ground cover and lightning storms.

B.12.3. Extent

Dry conditions, high temperatures, low humidity, and high winds can increase the potential and severity of a wildfire. In such conditions, wildfires can spread quickly, affecting large areas in a short amount of time. A worst-case scenario would be multiple wildfires started simultaneously by lightning during dry thunderstorms that move across an area experiencing drought conditions.

On average, fires kill nearly 5,500 Americans each year. Over 30,000 people are injured in fires annually. In the United States, someone dies in a fire every 40 minutes. Most often, victims are children or the elderly. Nearly 25 percent of the fires that kill young children are started by children playing with fire. Approximately 1,300 senior citizens die in fires annually. Approximately three-quarters of all fire fatalities occur in residential dwellings.

Each year in the US, fire causes over $2 billion worth of damage to homes.

Pawnee Nation can experience the entire scale below.

Wildfire (http://www.southernwildfirerisk.com/map/index/public)

	1	Lowest Intensity	Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment.
	1.5		
	2	Lowest Intensity	Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools.
	2.5		
	3	Moderate	Flames up to 8 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines,

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			but dozer and plows are generally effective. Increasing potential for harm or damage to life and property.
	3.5		
	4	High	Large Flames, up to 30 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property.
	4.5		
	5	Highest	Very large flames up to 150 feet in length; profuse short-range spotting, frequent long-range spotting; strong fire-induced winds. Indirect attack marginally effective at the head of the fire. Great potential for harm or damage to life and property.

B.12.4. Previous Occurrences

Wildfires occur every year. People start more than four out of every five wildfires, usually as debris burns, arson, or carelessness. Lightning strikes are another leading cause of wildfires. Other sources of ignition include railroads, catalytic converters on automobiles, and spontaneous ignition of hay bales. Wildfires that do not encounter a human population are difficult to calculate damages. Homes and businesses that are burned in naturally occurring fires are usually privately owned. No data exists on the non-incorporated Pawnee Nation level. Although no data exists on the NCDC database, Oklahoma, and the Pawnee Nation in 2006 were under severe fire danger for most of the year. Fire personnel and apparatus were ordered into the state from around the country. The Bureau of Indians Affairs initiated a command center and staging area at the Pawnee Nation Fire Department for those fires that were on or threatened Indian Lands. An action item will be created to rectify the data deficiency.

B.12.5. Probability of Future Events

Although the number of incidences indicates that wildfires are likely to occur, most wildfires are small and contained by local resources through mutual aid agreements and a command system that allows the request for additional resources. Also, growth within the wild land/urban interface has been limited in parts of the area but not all Tribal lands have been serviced with a consistent urban interface program to eliminate or reduce the risk of personal property loss. Therefore, firefighters within Pawnee Indian Country do consider wildfire to be a major threat.

B.12.6. Vulnerability

Periods of drought, dry conditions, high temperatures, and low humidity set the stage for wildfires. Areas along railroads and people whose homes are in woodland settings (especially cedar woodlands) in rural areas have an increased risk of wildfire. The sparsely populated tall, grassed range lands, can experience large sweeping fires. Ironically, fire suppression can create larger fire hazards, because live and dead vegetation is allowed to accumulate in areas where fire has been excluded. The especially large accumulations of

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deadfall throughout Indian Country resulting from the severe ice storms of 2000, 2002 and 2007, is becoming a concern to firefighters.

B.12.7. Secondary Hazards

The loss of groundcover from fire makes areas more susceptible to soil erosion from rainstorms. Water quality can also deteriorate as runoff from burned areas carries mud, agriculture-related chemicals, and other debris into waterways.

B.12.8. Overall Summary of Vulnerability and Impacts

Wildfires can be caused by arson, debris burns, lightning strikes, railroads, catalytic converters on autos, and carelessness. Growth in rural areas within the area is low therefore wildfires are not a major threat to homes. However, fire can increase erosion and result in a deterioration of soil and water quality. Fortunately, most wildfires are small and quickly contained by the local fire departments.

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B.13. HAZARD PROFILE – Wind & Thunderstorm

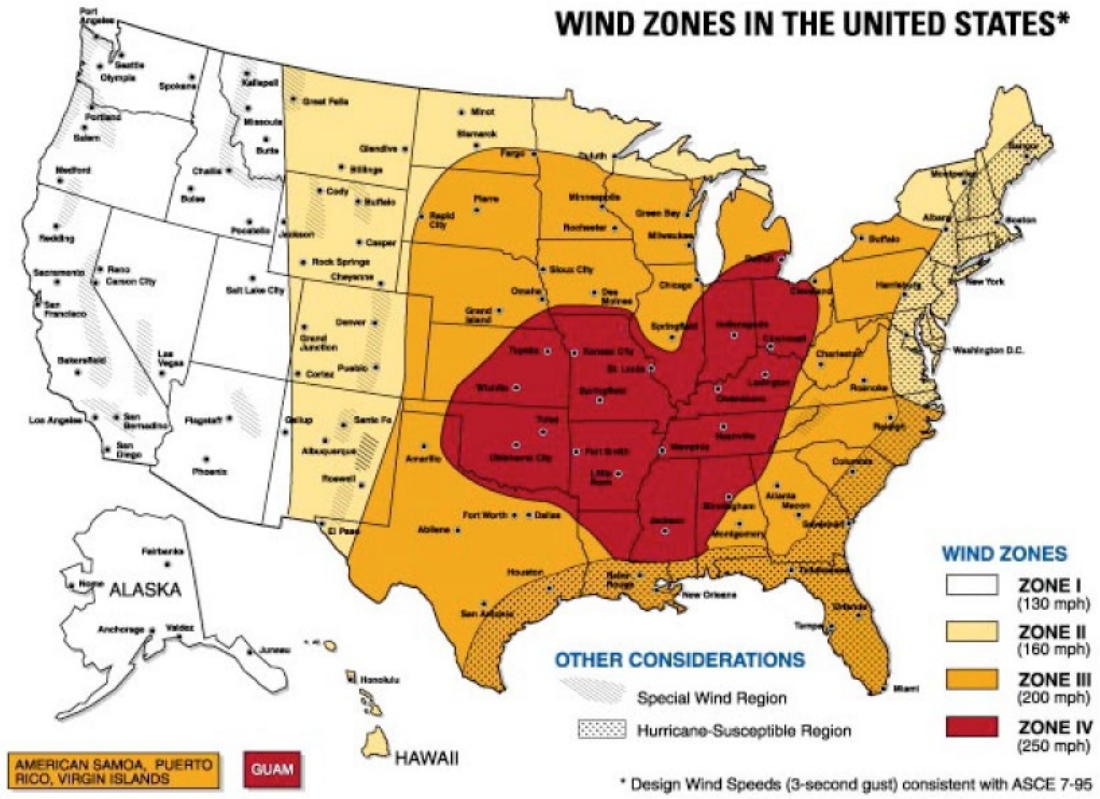
B.13.1 Description

Produced by a cumulonimbus cloud, a thunderstorm is an atmospheric disturbance with lightning and thunder. Lightning is generated by the buildup of charged ions in a thundercloud. When that buildup interacts with the best conducting object or surface on the ground, the result is a discharge of a lightning bolt. Thunder is the sound of the shock wave produced by the rapid heating and cooling of the air near the lightning bolt. A typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes and may also be accompanied by high winds, rain, and hail. A thunderstorm is considered severe if it produces hail at least ¾ inch in diameter, or high damaging winds 58mph or greater. The high winds may be in the form of straight-line winds or microbursts. While thunderstorms can produce tornados, hail, and rain causing floods, this Hazard Mitigation plan profiles these events as separate natural hazards.

B.13.2. Location

All parts of Pawnee Nation are at risk for wind and thunderstorms. Pawnee Nation can anticipate winds up to 250 mph.

XV. Figure: Wind Zones in the United States



B.13.3. Extent

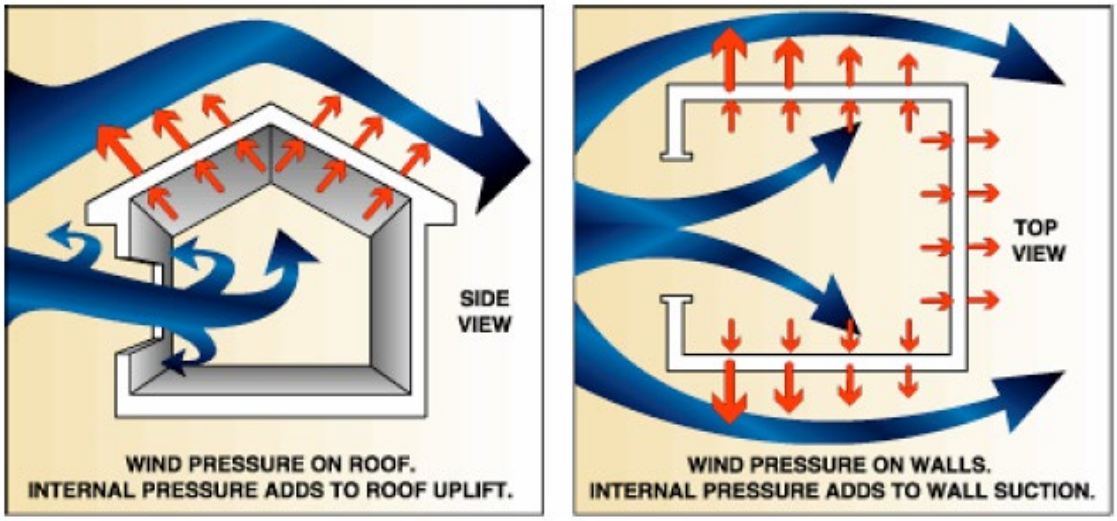
A worst-case scenario involving thunderstorms would be a solid or redeveloping line, of severe thunderstorms that move through the entire area. These storms can result in heavy rains causing widespread flooding and road closures. Large economic loss to agriculture and/or major damage to buildings and other property can result if such storms are accompanied by hail and high winds. High winds and lightning associated with such storms can also down trees and highline poles and result in power outages capable of affecting large areas of Indian Country.

Extreme winds can cause several kinds of damage to a building. The figure below shows how extreme winds affect a building and helps explain why these winds cause buildings to fail.

Wind speeds, even in these extreme wind events, rapidly increase and decrease. An obstruction, such as a house, in the path of the wind causes the wind to change direction. This change in wind direction increases pressure on parts of the house. The combination of

increased pressures and fluctuating wind speeds creates stress on the house that frequently causes connections between building components to fail. For example, the roof or siding can be pulled off or the windows can be pushed in.

XVI. Figure: Diagram of Windstorm Effects



Buildings that fail under the effects of extreme winds often appear to have exploded, giving rise to the misconception that the damage is caused by unequal wind pressures inside and outside the building. This misconception has led to the myth that during an extreme wind event, the windows and doors in a building should be opened to equalize the pressure. In fact, opening a window or door allows wind to enter a building and increases the risk of building failure.

Damage can also be caused by flying debris (referred to as windborne missiles). If wind speeds are high enough, missiles can be thrown at a building with enough force to penetrate windows, walls, or the roof. For example, an object such as a 2” x 4” wood stud weighing 15 pounds, when carried by a 250-mph wind, can have a horizontal speed of 100 mph and enough force to penetrate most common building materials used in houses today. Even a reinforced masonry wall will be penetrated unless it has been designed and constructed to resist debris impact during extreme winds. Because missiles can severely damage and even penetrate walls and roofs, they threaten not only buildings but the occupants as well.

During thunderstorms, Pawnee Nation can experience 1-5 on the scale below.

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Lightning Activity Level (LAL)
Is a scale which describes lightning activity. Values are labeled 1-6:

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 then 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.

B.13.4. Previous Occurrences

Since 1956 the National Climatic Data Center (NCDC) recorded 374 thunderstorm events in Pawnee and Payne County. Due to the rural nature of the Indian Country, most reports of thunderstorms, and any associated damage, are from cities and towns.

B.13.5. Probability of Future Events

Considering the previous occurrences and the high number of recorded thunderstorms, the probability that at least one severe thunderstorm event will occur within the Pawnee Nation each year is highly likely.

B.13.6. Vulnerability

Vulnerability is difficult to evaluate since thunderstorms can occur at different levels of strength, in random locations, and create relatively narrow paths of destruction. Due to the randomness of this event, the entire population of the Pawnee Nation, Pawnee and Payne Counties remains vulnerable to possible injury and/or property loss from lightning and strong winds associated with severe thunderstorms. Mobile homes are thought most vulnerable to strong winds. All structures are vulnerable to lightning. Lightning can strike ten miles out from the rain column, enabling injurious lightning strikes to people to occur under a clear sky ahead of the storm, as they tend to wait to seek shelter until the last minute.

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B.13.7. Secondary Hazards

Secondary hazards can include fires and power failures. Hail, flooding, and tornadoes, although associated with thunderstorms, are profiled as separate events with their own secondary hazards.

B.13.8. Overall Summary of Vulnerability and Impacts

All of Oklahoma has significant exposure to thunderstorms. In addition to high damaging winds and lightning, thunderstorms can produce tornadoes, hail, and rain causing floods. This plan profiles high winds and lightning with thunderstorms. Damage like that caused by tornadoes can result from high winds such as straight-line and microburst winds associated with thunderstorms. Within Indian Country, inferior construction, mobile homes, and crop land are most vulnerable to high winds. Overall, lightning is the most constant and widespread threat to people and property during the thunderstorm season.

B.14. HAZARD PROFILE –Pandemic

B.14.1. Description

An Influenza Pandemic is a worldwide outbreak of flu disease that occurs when a new type of influenza virus appears that people have not been exposed to before (or have not been exposed to in a long time). The pandemic virus can cause serious illness because individuals do not have immunity to the new virus. Pandemics are different from seasonal outbreaks of influenza in that seasonal influenza is caused by influenza virus types to which people have already been exposed. Its impact on society is less severe than a pandemic, and influenza vaccines are available to help prevent the widespread illness from seasonal flu.

B.14.2. Location

All parts of Pawnee Nation are at risk for an influenza pandemic.

B.14.3. Extent

A worst-case scenario involving an influenza pandemic is millions of deaths due to the illness. Millions could get sick and even die. History tells us of endemics and pandemics alike. Our awareness and preparation of the people will be our first line of defense. A pandemic could strike at any point in the Pawnee Nation. The exact numbers cannot be firmly estimated.

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B.14.4. Previous Occurrences

In the last century there were four influenza pandemics. All of them were called pandemics because of their worldwide spread and because they were caused by a new influenza virus. The 1918 pandemic was especially severe.

B.14.5. Probability of Future Events

Considering the previous occurrences and the number of recorded pandemics and endemics, the probability of a future event is likely.

B.14.6. Vulnerability

Vulnerability is difficult to evaluate since the initial health and preparedness of the citizens is a primary factor to the spread. The availability of a vaccine of the new strain of virus will only be manufactured after the virus has been identified and its genetic makeup determined. Person to person contact will most likely be the vector of spreading the virus. Isolation and quarantine will most likely be instituted worldwide.

B.14.7. Secondary Hazards

Secondary hazards can include loss of first responders and health care workers to assist those infected will be a hazard in that the lack of personnel could lead to larger numbers of deaths.

B.14.8. Overall Summary of Vulnerability and Impacts

All of Oklahoma has a significant risk of exposure to the influenza pandemic. No one age group, race or nationality will be completely immune. A pandemic means a worldwide occurrence of illness and death. As the nation’s health departments and the world health organization coordinate efforts to stay ahead of any pandemic events the threat is still not to be taken lightly it is going to happen only the determination of when and what strain of virus is the question.

We must plan for the disruption of normal governmental services and day-to-day services including retail operations, telephone services and banks and post offices. Stores may have limited supplies or even close. Public transportation may be disrupted due to lack of personnel. Public gatherings, such as volunteer meetings and church services, may be canceled to limit the spread or due to the number of ill.

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C.1. CHAPTER THREE – ASSESSING VULNERABILITY

C.1. Hazard Summary

This summary identifies the major natural hazards that could occur and includes previous occurrences and probability of future events of them occurring, within Pawnee Nation.

XVII. Hazard Summary, Occurrence and Probability

Hazard	Previous Occurrences	Probability of Future Events
Dam Failure	No record of this occurring.	Unlikely
Drought	6 events *in State* since 1929.	Likely
Earthquake	6 recorded since 1897.	Unlikely
Expansive Soils	Due to limited or non-existent data, no specific occurrences could be found documented.	Occasional
Extreme Heat	3 Events since 1950	Unlikely
Flood	21 events between 1950 and 2003.	Highly Likely
Hailstorm	64 large-hail events recorded since 1950.	Highly Likely
Severe Winter Storm	26 snow and/or ice events since 1953.	Highly Likely
Tornado	41 events recorded since 1950.	Highly Likely
Wildfire	Wild land fires occur numerous times per year.	Highly Likely
Wind & Thunderstorm	155 thunderstorm events recorded since 1950.	Highly Likely
Pandemic	4 Pandemics in recorded history	Likely

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XVIII. Table: Critical Facilities Located in Pawnee Nation

Name	Type	Flood Zone
Administration Building #64	Tribal Gvt	X
Tribal Courthouse	Tribal Gvt	X
Pawnee Nation Police/Fire Station	Tribal Gvt	X
Tribal Development Corporation Building	Tribal Gvt	X
BIA Building	Tribal Gvt/leased federal	X
Pawnee Indian Health Center	Tribal Gvt	X
Multipurpose Building	Tribal Gvt	X
RoamChief Building	Tribal Gvt	X
Fitness/Daycare Center	Tribal Gvt	X
Old IHS Hospital	Tribal Gvt	X
Albin Leading fox Bldg/PN College	Tribal College	X
Staff Quarters Bldg/PN College	Tribal College	X

C.2. Identifying Assets

The Pawnee Nation Hazard Mitigation plan identifies critical facilities located within the Pawnee Nation and the hazards to which these facilities are susceptible. It does not, however, address local government buildings and critical facilities in the local communities. Located within Pawnee Indian Country. These facilities are addressed within the community's Hazard Mitigation Plans.

A critical facility is defined as a facility that provides essential products or services to Tribal members and the public and is necessary to the preservation of the welfare and quality of life in Pawnee Indian Country. In this initial Tribal plan, the Hazard Mitigation Committee agreed that the following basic facilities should be considered critical: police and fire stations, hospitals, airports, the Tribal Administration Building, and other Tribal buildings. In future updates of this plan, other facilities may be added.

Committee members and others helped locate the facilities. GIS software was used to map the facilities and determine which are most likely to be affected by hazards. According to the guidelines in the FEMA document "Understanding Your Risks Identifying Hazards and Estimating Losses" the use of a truncated inventory with cost estimates of critical facilities and residential properties is sufficient for providing a very broad picture of the potential extent of damage likely from a hazard event. Therefore, since time, money, and resources were limited, truncated inventories were prepared to estimate the proportion of buildings, the value of buildings and the population that are in hazard areas in the entire area.

C.3. Estimating Potential Dollar Loss

Potential dollar loss was estimated for each hazard based on losses recorded from previous natural hazard events. The total recorded loss was divided by the number of

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events to obtain an average potential dollar loss per event. An attempt was made to estimate losses for all hazards profiled in this plan, however due to limited resources, detailed data for estimating Tribal-specific potential dollar loss for some of the natural hazards was not available.

C.3.1. Potential Dollar Loss for Each Hazard

- **Dam Failure**
  There is no record of dam failure occurring within Pawnee Indian Country and although the Pawnee Nation has three high hazard dams, no swash zone studies exist. Therefore, potential dollar loss for Dam failure was not estimated.

- **Drought**
  In the entire state of Oklahoma, six drought events have been reported since 1929 and resulted in an estimated total of $900 million in crop damages. Dollar losses do not necessarily reflect total loss since damages resulting from drought are not often fully compensated. Therefore, potential dollar loss is difficult to estimate.

- **Earthquake**
  There is only a 10% chance in 50 years that an earthquake at the severity level of 2 will occur within Pawnee Indian Country. There are no significant past damages recorded, therefore potential dollar loss was not estimated.

- **Expansive Soils**
  No records of specific incidences of structure losses due to expansive soils within the Pawnee Indian Country were found. Therefore, potential dollar loss could not be estimated.

- **Extreme Heat**
  Pawnee Nation-specific data pertaining to dollar loss resulting from Extreme Heat was not found. Therefore, estimates for potential loss could not be given. Such loss is likely to include livestock and crop damage, but it is most likely to be associated with drought, rather than extreme heat.

- **Flood**
  According to the National Climatic Data Center (NCDC), Pawnee Nation (Payne and Pawnee County), along with other Counties and Tribal Nations in Central Oklahoma have experienced 12 flood events that resulted in approximately $11,957,000 in flood damages since 1950. Therefore, the average potential dollar loss is estimated at $239,140 per year, or $996,412 per event, within this region. Dollar loss specific to flood damage experienced in Pawnee Nation *outside municipalities* was not found.

- **Hail**
  According to the NCDC, Pawnee Nation (Payne and Pawnee County) experienced 112 large-hail events (>= 1.50”) since 1950, with a total of more than $105,000 in damages recorded. However, this total is suspect since much hail damage is

believed to go unreported. It must also be noted that dollar loss specific to hail damages recorded for areas *outside municipalities* within the Pawnee Nation was not available, therefore crop damage due to hail may not be accurately recorded in the NCDC, and thus, not accurately reflected in the estimated potential dollar loss per event.

- **Thunderstorms (includes High Winds & Lightning)**
  It was found documented that Pawnee Nation (Payne and Pawnee County) had 374 thunderstorm/high wind events recorded with damages totaling $1,988,000. Although this dollar loss, recorded by NCDC, includes damages that resulted in loss occurring within municipalities, these values were used to estimate loss for the Pawnee Nation. Therefore, based on these values, it is concluded that the Pawnee Nation can experience an estimated potential dollar loss of $5,935 for each thunderstorm event that includes high wind and/or lightning.

- **Tornadoes**
  Overall, in the state of Oklahoma, the average cost in tornado damage per year is $23,221,264. According to the National Climatic Data Center, Pawnee Nation (Payne County) and its communities have experienced 108 tornado events that resulted in approximately $68,326,000 in damages in the last 59 years. Therefore, the average potential dollar loss per event is estimated to be approximately $632,648 dollars per event.

  Since this plan covers only the Pawnee Nation, a tornado scenario is not appropriate. Most damage caused by tornadoes is incurred when their path intersects a densely populated area. Tornadoes setting down in unincorporated Pawnee Indian Country would have a relatively small monetary impact.

- **Wildfire**
  According the 2002 Annual report by the OK State Fire Marshall, in the State of Oklahoma, there were a total of 1,427 wild land fires reported, which burned approximately 25,804 acres, and resulted in total estimated dollar losses of $25,804,000.

- **Winter Storms**
  The Pawnee Nation has experienced many winter storms of varied intensities that consisted of snow and/or ice. Snow blocked and ice-covered roads not only make travel dangerous, but the removal and clearing of snow and ice can be costly. Downed electrical lines and the resulting loss of power to homes, businesses, and water systems not only increase hardships and hinder recovery but can also increase potential dollar losses during and after winter storm events.

- **Pandemic**
  The Pawnee Nation has faced historical diseases that have severely impacted the survival of the people. A dollar amount is difficult to place on the impact that a pandemic or endemic would have on the people of the Pawnee Nation.

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C.4. Development Trends

An analysis of the statistics provided by the Oklahoma Department of Commerce (ODOC) indicates that there is a slight but constant increase in residents expected over the next 30 years. Most of the residential development is expected to occur in the already developed areas outside the 100-year floodplain.

XIX. Population Projections

Population Projections	2000	2005	2010	2015	2020	2025	2030
Payne County	68,190	73,200	77,500	80,800	83,400	86,300	89,600
Pawnee County	16,612	17,300	18,200	19,200	20,200	21,100	22,000
Pawnee City	2,230	2,320	2,440	2,580	2,710	2,830	2,950
Meramec Town	104	110	110	120	130	130	140
Skedee Town	102	110	110	120	120	130	140
Ralston Town	355	370	390	410	430	450	470
Yale city	1,342	1,440	1,530	1,590	1,640	1,700	1,760
Quay Town	47	50	50	50	50	60	70
Remainder of Pawnee County	9,454	9,850	10,360	10,930	11,500	12,010	12,520
Remainder of Payne County	16,027	17,200	18,220	18,990	19,600	20,280	21,060

Payne County is projected to have a 24% increase in population over the next thirty years, while a 25% increase in population is expected over the next thirty years for Pawnee County. Data from Oklahoma Department of Commerce.

The Pawnee Nation is centrally located in the State and is largely rural. Most of the land use is designated as agricultural/farmland. The largest city and county seat, Pawnee is located near the central part of the original reservation. Yale, the second largest city, is in the southern section of the original reservation. Ralston is the third largest City and is located on the northern boundary. The land uses within the Pawnee nation consist of; industrial and commercial areas, located in and around Pawnee and the Pawnee Nation Reserve Complex, Yale, and Ralston; residential areas, located in and around these main communities; ranch land, which is most of the Indian Country; and specialized land use designations (institutional, mixed-use) located primarily in the Cities.

All areas of Pawnee Nation and the surrounding areas have been affected by the closing of manufacturing plants in the area. This outflux of jobs has impacted on the current economic conditions. Building and development have slowed due to the availability of resale homes and businesses in both the incorporated and rural areas.

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Stillwater, located outside the reservation boundaries and the county seat of Payne County is the home of Oklahoma State University. The large university is a major hub of economic stimulus for the city, County, and region of Oklahoma. It is also a vast resource for the Pawnee Nation in planning and development.

The Pawnee Nation is not expected to undergo development pressure and does not anticipate any changes in land use within the next 5 years. The potential relocation of a major employee to the area would alter the land use patterns surrounding that area. This development cannot be forecasted at this time. Potential businesses and location information are not available currently.

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D. CHAPTER FOUR – MITIGATION STRATEGY

D.1. Hazard Mitigation Goals

Our goals and objectives for Hazard Mitigation are many folds; the obvious benefits to individuals both financially and emotionally following a disaster, the benefits to government both financially and politically, and the benefits to private business.

- **Eliminate Loss of Life from Natural Disaster**
- **Eliminate Flood Damages**
- **Reduce Damages from All Hazards**

This goal was developed by the Pawnee Nation from review of other hazard mitigation plans, planning team meetings, and discussions with committee members. The goal was presented, discussed, and a consensus reached during the hazard mitigation strategy meeting of the Pawnee Nation Hazard Mitigation Planning Committee.

D.2. Comprehensive Range of Mitigation Actions

To meet the Pawnee Nation's overall goals, the following objectives, as they relate to specific natural hazards, were developed through discussions and a consensus reached at the public meetings that included the Hazard Mitigation Committee members and any other interested parties.

XX. Table: Mitigation Actions or Projects

Hazards	Actions or Projects	Objectives
Severe Winter Storms, Extreme Heat, Tornadoes, Dam Failures, Floods, Hailstorms, and Wind & Thunderstorms.	Provide NOAA Radios to Citizens as funding becomes available. Encourage local merchants to offer discounts on weather radios.	Expansion and/or continuance of ODEM NOAA radio program to provide early warning radios to residents not being warned by sirens.
Severe Winter Storms, Tornadoes, Hailstorms, Wind & Thunderstorms, Earthquakes, Floods and Wildfires.	Install Auxiliary Power Sources for Critical Facilities including medical facilities, Tribal governmental centers, and emergency operations centers. The location and types of Auxiliary Power facilities could change over time with changing priorities. Funding for facilities will be considered in the Tribal budget process each year.	Provide for greater continuity of electrical power to critical facilities and governmental operations during times of disaster or crisis.
Extreme Heat, Severe Winter Storms, Drought, Hailstorms, Tornados, Dam Failures, Floods, Expansive Soils, Wind & Thunderstorms, Wildfires and Earthquakes.	Continue Public Education Programs regarding safe activities and practices. • Taking Shelter from Hazards. • Protection of property from hazardous events. • What to do after a disaster.	Reduce loss of life and property.
Dam Failure/Flooding	Clear Channels	Keep drainage channels open to allow water to flow freely.
Drought	Develop Drought Information & Assessment • Conduct Inventories of Data Availability & Establish New Collection Networks Continue to develop criteria for triggers for drought-related actions. • Develop early warning system to give citizens earlier indicators of impending water shortages and secondary hazards	Better manage resources to reduce negative effects of drought hazards.
Drought	Encourage installation and transition to low flow fixtures.	Initiate public programs to reduce

		drought impacts on local water supply
Earthquake	Work with the National Earthquake Hazards Reduction Program (NEHRP) to develop and implement seismic design and construction standards and techniques	Reduce earthquake impacts.
Expansive Soils	Provide guidance on building practices to reduce shrink-swell damage.	Reduce economic impact of shrink-swell soils.
Extreme Heat	Provide information on prevention of heat related health problems.	Mitigate adverse effects of hot weather on human life and wellbeing.
Flood	Obtain funding assistance and provide technical guidance for elevating or flood proofing structures in flood prone areas.	Reduce losses due to flooding of existing structures in flood prone areas.
Flood	Obtain funding to move structures out of the flood plain and reserve flood prone areas for open space, recreational & agricultural uses.	Eliminate flood losses to structures.
Hailstorm	Work with Tribal Housing and building supply centers to encourage hail resistant shingles and building materials.	Reduce hail losses to structures.
Hailstorm	Install window protection film on critical facilities and governmental buildings.	Reduce hail losses to critical facilities and government buildings
Severe Winter Storm	Coordinate efforts between the Tribe, local county, power companies and private citizens to remove the limbs around power lines	Reduce losses caused by downed power lines
Tornado	Encourage building of tornado shelters by funding assistance and/or reimbursement	Reduce loss of life due to tornadoes
Tornado	Adopt Tribal Building Codes to provide for greater structural resistance to Wind.	Minimize structure losses due to strong winds.
Tornado	Adopt Manufactured Housing Protective Policies and Ordinances.	Reduce losses in manufactured homes by implementing safety policies and procedures.
Wildfire	Initiate Controlled Burns of Grasslands	Reduce wildfire hazards
Wildfire	Work with Bureau of Indian Affairs, State Forestry and NRCS to survey Cedar populations and develop incentives for reducing cedar populations.	Reduce cedar populations
Wildfire	Coordinate with Bureau of Indian Affairs, Local County, Local Fire Chiefs, COEDD Rural Fire Coordinator and State Forestry Department to obtain more fire training and firefighting equipment	Providing additional resources for fighting wildfires
Wildfire	Coordinate with Bureau of Indian Affairs, Local County, Local Fire Chiefs to gather previous occurrence for wildfire specific to Pawnee Nation	Data Deficiency To analyze wildfire occurrence and address deficiency of data for better management of resources for response and minimize life and property loss.
Wind & Thunderstorms	Adopt Tribal Building Codes to provide for greater structural resistance to Wind.	Reduce losses from wind and thunderstorms
Wind & Thunderstorms	Work with Tribal Housing to provide anchoring of mobile homes of Tribal members	Reduce losses from wind and thunder storms
Influenza Pandemic	Continue Public Education Programs regarding influenza and sanitary procedures.	Reduce losses due to illness
Influenza Pandemic	Work with Indian Health Services, Oklahoma Department of Health, and Tribal Community Health Representatives to establish vaccination schedule and procedures.	Reduce losses due to illness

D.2.1. Addressing New and Existing Buildings and Infrastructure

While most people perceive the threat of natural hazards, people are often unaware of actions that can be taken to mitigate disasters when they occur. However, today more than ever before, individuals and communities can reduce their risk by developing and implementing strategies to mitigate disasters when they occur. FEMA's Project Impact stresses a variety of risk management strategies to mitigate natural hazards. These include

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creating and enforcing effective building codes and zoning laws. Their Building Performance Assessment Team works to assess the vulnerability of buildings and infrastructure to hazards and strives to develop technologies for building disaster resistant structures, such as tornado safe rooms. Tribal and Local governments and their planning commissions have the responsibility to organize and implement programs to mitigate natural hazards.

D.3. Implementation of Mitigation Actions

D.3.1. Prioritization

Once mitigation actions and projects were recommended by the Mitigation Team, they were organized by hazard in Table XVIII. Each Action was discussed publicly and with the Hazard Mitigation Committee. After considering the public's input and other opinions, the Hazard Mitigation Committee members selected and prioritized the actions in the order (#1 being the highest priority ranking) that they felt the actions should be implemented should they receive funding. These actions are summarized into Table XIX which includes their priority and a schedule of when the Action(s) may begin. The categories of cost, citizens served, Probability of Future Events, and # of hazards mitigated by the Action were considered when prioritizing rank of the Actions. Note that these priorities are subject to change. It is also important to note that additional mitigation actions will be included as more of the public, and other entities within the Pawnee Nation, become involved and as the plan is updated and as funding becomes available.

In Table XXI and XXII, the following scales were used for each category.

- Cost
  Cost was ranked, starting with the value of 1 to indicate the MOST expensive Action
  Example 1 = Most expensive Action
  2 = Next expensive Action
  3 = Next…. etc.

- Citizens Potentially Served
  1 = A few individuals (less than 24%)
  2 = A fourth of the Community (25%-49%)
  3 = Half the Community (50%-99%)
  4 = Entire Community (100%)

- Probability of Future Events of Natural Hazard that Requires the Action
  1 = Unlikely
  2 = Occasional
  3 = Likely
  4 = Highly likely

- # of Natural Hazards Mitigated by the Action
  The value assigned for this category simply represented the number of natural hazards mitigated with the Action.

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XXI. Table: Summary of categories and scales used to determine priority ranking of Mitigation Actions.

The higher the TOTAL, the higher the PRIORITY.

Actions or Projects	Cost	Cost Rank	Citizens Served	Probability of Future Events	# of hazards mitigated	TOTAL	PRIORITY
Provide NOAA Radios to Citizens	$175,000	4	4	4	12	24	6
Install Auxiliary Power Sources for Critical Facilities	$70,000	7	4	4	12	27	1
Public Education Programs	$100,000	6	4	4	12	26	2
Clear Channels	$150,000	5	1	3	2	11	12
Drought Assessment	$25,000	18	4	3	1	26	4
Changes to Legislative and Public Policy	$55,000	10	4	4	1	19	9
Development and implementation of seismic design and construction standards and techniques	$20,000	19	4	1	1	25	5
Develop a shrink-swell soils policy	$50,000	12	4	2	1	19	9
Work with existing floodplain owners to elevate or flood proof their structures, including obtaining funding assistance and technical guidance	$45,000	13	1	3	1	18	10
Elevation, Relocation and Acquisition Projects	$39,900	15	1	3	1	20	8
Work with Tribal Housing and building supply centers to demonstrate hail resistant shingles and building materials. Work with the local OSU extension to demonstrate hail resistant crops.	$35,000	16	4	4	1	25	5
Install window protection film on critical facilities and government buildings	$25,000	17	1	4	3	25	5
Coordinate efforts between the tribe, county, power companies and private citizens to remove the limbs around power lines	$200,000	3	4	3	1	11	12
Provide funding for private shelter building and/or reimbursement	$1,000,000	2	4	4	1	11	12
Establish Tribal Building Codes to Provide the Greatest Wind Resistance	$42,000	14	4	4	2	24	6
Initiate Manufactured Housing Protective Ordinances and Education	$60,000	9	2	4	4	19	9
Manage Controlled Burns of Grasslands	$68,000	8	2	4	1	15	11
Provide educational materials and incentives for individuals to reduce cedar populations	$15,000	20	2	4	1	27	3
Work with Tribal Housing to provide anchoring of mobile homes of tribal members	$50,000	11	2	4	2	19	9
Coordinate with Bureau of Indian Affairs, Local County, Fire Chiefs and Rural Fire Coordinator to insure more fire training and additional equipment purchases	$1,250,000	1	4	4	12	21	7
Coordinate with Bureau of Indian Affairs, Local County, Local Fire Chiefs to gather previous occurrence for wildfire specific to Pawnee Nation	$25,000	21	4	4	1	30	12

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D.3.2. Implementation and Administration

Following prioritization of the hazard actions and projects, the Pawnee Nation next determined possible sources of funding and finally initialized an implementation schedule.

XXII. Table: Summary of selected actions and their priority ranking.

Actions or Projects	Cost	Funding Sources	Who will Implement Action	Schedule	PRIORITY
Install Auxiliary Power Sources for Critical Facilities that may be impacted by Severe Winter Storms, Tornados, Hailstorms, Wind & Thunderstorms, Earthquakes, Floods and Wildfires	$70,000	FEMA Tribe	PN DEM PN Fire Dept.	As funding becomes available.	1
Provide public education programs concerning Extreme Heat, Severe Winter Storms, Drought, Wildfires, Hailstorms, Tornados, Dam Failures, Floods, Expansive Soils, Earthquakes & Wind & Thunderstorms	$100,000	FEMA Tribe	PN DEM	Ongoing	2
Provide educational materials and incentives for individuals to reduce cedar populations	$15,000	FEMA Tribe	PN DEM PN Fire Dept.	Ongoing	3
Drought Assessment	$25,000	FEMA Tribe OSU	PN DEM	As funding becomes available.	4
Work with Tribal Housing and building supply centers to demonstrate hail resistant shingles and building materials. Work with the local OSU extension to demonstrate hail resistant crops.	$35,000	FEMA Tribe OSU	PN DEM	Ongoing	5
Development and implementation of seismic design and construction standards and techniques	$20,000	FEMA Tribe OU	PN DEM	As funding becomes available.	5
Install window film on critical facilities and government buildings	$25,000	FEMA Tribe	PN DEM	As funding becomes available.	5
Establish County	$42,000	FEMA	PN DEM	Ongoing	6

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Building Codes to Provide the Greatest Wind Resistance		Tribe			
Provide NOAA Radios to advise Citizens of hazards associated with Hailstorms, Severe Winter Storms, Wind & Thunderstorms, Extreme Heat, Tornados, Floods and Dam Failures.	$550,000	FEMA	PN DEM	As funding becomes available.	6
Coordinate with Bureau of Indian Affairs, Local County, Fire Chiefs and Rural Fire Coordinator to insure more fire training and additional equipment purchases	$1,250,000	FEMA Forestry Tribe BIA	PN Fire Dept.	Ongoing	7
Elevation, Relocation and Acquisition Projects	$39,900	FEMA OWRB	PN DEM	As funding becomes available.	8
Changes to Legislative and Public Policy	$55,000	FEMA Tribe	PN DEM	Ongoing	9
Initiate Manufactured Housing Protective Ordinances and Education	$60,000	FEMA Tribe	PN DEM	Ongoing	9
Work with Tribal Housing to provide anchoring of mobile homes of tribal members	$50,000	FEMA Tribe	PN DEM PN Housing Authority	As funding becomes available.	9
Develop a shrink-swell soils policy	$50,000	FEMA Tribe	PN DEM	Ongoing	9
Work with existing floodplain owners to elevate or flood proof their structures, including obtaining funding assistance and technical guidance	$45,000	FEMA OWRB Tribe	PN DEM	As funding becomes available.	10
Manage Controlled Burns of Grasslands	$68,000	FEMA BIA Tribe	PN Fire Dept.	Ongoing	11
Clear Channels	$150,000	FEMA EPA Tribe	PN DEM	As funding becomes available.	12
Coordinate efforts between the Tribe, Local County, power companies and private citizens to remove the limbs around power lines	$287,000	FEMA Tribe County/City Private Business	PN DEM	Ongoing	12

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Provide funding for private shelter building and/or reimbursement	$1,000,000	FEMA Tribe	PN DEM	As funding becomes available.	12

D.3.3. Cost-Benefit Review

Cost-Benefit review for natural disaster projects is extremely difficult. Since the exact damage or even path of destruction cannot be planned in advance, there is little to no way of calculating an expenditure of $x.xx would lead to potential savings of $x.xx. Less tangible mitigation strategies such as public education or improvements in the Pawnee Nation's codes cost relatively little to implement. There is no way to quantify the number of more informed decisions, and hence the number of dollars in reduced losses that could occur following these types of programs.

For example, a mother driving home with her children reaches a flooded roadway. She contemplates just going through, the water doesn't look that deep, or turning around and going the long way home. She recalls seeing an ad in the local paper that said, "turn around, don't drown." Her ten-year-old son has just had flood awareness at school and asks her to take the other way home. The mother turns around and goes the long way home.

Was the money spent worth the investment? Maybe the family would have driven right through and made it home safe and sound. A net economic loss of $0.00. Maybe the water was moving a little faster than she thought, and the family vehicle washed down river, resulting in at least damage to the vehicle, and more likely a rescue scenario involving several agencies and expense at a cost of approximately $45,000. The extreme end to our scenario would have the family drown. Quantifying the loss of human life, especially children, has been and will continue to be a fiercely heated legal debate. For this discussion, the loss of life is $500,000, the emergency responders attempted rescue and retrieval at a cost of $45,000.

Quantify the results using our public education budget of $100,000 for Priority #2.

Education cost the Tribe $100,000. The Tribe may have saved no dollars, at a cost of $100,000. The Tribe may have saved $45,000, with a net cost of $55,000. The Tribe may have saved $545,000, for a net benefit of $445,000 which includes several human lives.

Another example would be implementing better building codes in an area that is then never hit by strong winds, tornado, or large hail. Was the money spent to reinforce the structure well spent since no economic losses would have occurred at that location?

A detailed probability study of how human decisions are made is beyond the scope of this project. Natural disasters are unpredictable and may occur in the same location several times, or never occur in a particular location. Therefore, a breakdown of possible costs and benefits are included in this plan as a guide project implementation.

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XXIII. Install Auxiliary Power Sources for Critical Facilities

Actions or Projects	Cost	Funding Sources	Who will Implement Action	Schedule	PRIORITY
Install Auxiliary Power Sources for Critical Facilities	$70,000	Forestry Grant FEMA	County DEM Rural Fire Chiefs County Commissioners	As funding becomes available.	1

Priority #1 would provide auxiliary power sources following disasters. The generators would be tied into two critical facilities of the Pawnee Nation.

This priority would be best mandated and administered by the Pawnee Nation Department of Emergency Management, and Pawnee Nation Fire Department. Each of these groups could provide a fair and balanced review of the priority for placement. The property department would be responsible for testing and maintenance of the equipment, which for convenience could be scheduled during standard property department equipment testing.

- Economic Costs of the Proposal
  - Cost to purchase the auxiliary power source equipment.
  - Cost to house the equipment.
  - Cost of regular maintenance on the equipment
  - Cost to train equipment maintainers

- Social Costs of Proposal
  - Possible conflict if major disaster accedes number of available powers. generators

- Economic Benefits of Proposal
  - Critical services can continue.
  - Heat and air conditioning will be available for vulnerable populations.
  - Heat available to reduce broken pipes during extreme cold.

- Social Benefits of Proposal
  - Citizens have confidence that critical services will be available.

- Economic Analysis
  - The exact dollar amount of costs and benefits is nearly impossible to determine without vast amounts of study. However, comparing the types of costs vs. the types of benefits from this proposal, it seems likely that the economic benefits would far exceed the economic costs.

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XXIV. Public Education Programs

Actions or Projects	Cost	Funding Sources	Who will Implement Action	Schedule	PRIORITY
Public Education Programs	$100,000	FEMA Tribe	PN DEM	Ongoing	2

Priority #2 would provide education and information to tribal members and citizens to make better pre and post disaster decisions.

This priority would be best mandated and administered by the Pawnee Nation DEM. It would be the EM's duty to coordinate activities between the State, County, Cities, Towns, and local school districts to make the most use of the funding available. Coordination of volunteers would expedite the storm safety message. Presentations to Tribal and local civic groups would also be a good source of information dissemination. Pamphlets and handouts could be arranged in a booth at local fairs and gatherings. Some stores would allow a small display on storm safety.

- Economic Costs of the Proposal
  - Cost to purchase pamphlets and handouts.
  - Cost of employee time

- Social Costs of Proposal
  - None

- Economic Benefits of Proposal
  - Possible reduced losses from all disasters
  - Possible saving of human life

- Social Benefits of Proposal
  - Increased citizens awareness
  - Increased confidence in Government's concerns and capabilities

- Economic Analysis
  - The exact dollar amount of costs and benefits is nearly impossible to determine without vast amounts of study. However, comparing the types of costs vs. the types of benefits from this proposal, it seems likely that the economic benefits would far exceed the economic costs.

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XXV.

Actions or Projects	Cost	Funding Sources	Who will Implement Action	Schedule	PRIORITY
Provide educational materials and incentives for individuals to reduce cedar populations	$15,000	FEMA Tribe	PN DEM PN Fire Department	Ongoing	3

Priority #3 would provide education and information to citizens to make help reduce the cedar population in Pawnee Indian Country. Cedars are dangerously combustible, especially when coupled with high winds or dry ground cover.

This priority would be best mandated and administered by the Pawnee Nation Fire Department. Activities would include information distribution. Incentives for controlling the cedar populations would be provided as funding became available.

- Economic Costs of the Proposal
  - Cost to purchase pamphlets and handouts.
  - Cost of employee time
  - Incentive funding

- Social Costs of Proposal
  - Some environmentalists have believed the cedar should spread naturally through the ecosystem but are recognizing their destructive consequences.

- Economic Benefits of Proposal
  - Reduction in fire losses
  - Possible economic outlet for cut cedars.

- Social Benefits of Proposal
  - Increased safety in the wild land/urban interface

- Economic Analysis
  - The exact dollar amount of costs and benefits is nearly impossible to determine without vast amounts of study. However, comparing the types of costs vs. the types of benefits from this proposal, it seems likely that the economic benefits would far exceed the economic costs. An economic outlet for the wild cedars, such as cedar chips, might be an incentive for the reduction and pay for associated education materials.

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XXVI. Drought Assessment

Actions or Projects	Cost	Funding Sources	Who will Implement Action	Schedule	PRIORITY
Drought Assessment	$25,000	FEMA Tribe OSU	PN DEM	As funding becomes available.	4

Priority #4a would conduct a study of drought, drought indicators, secondary hazards, and suggest strategies to ward off or significantly reduce the impact of drought on the area.

This priority would be best administered by the Pawnee Nation DEM. Planning would include a preemptive strategy for drought resistance, strategies to reduce losses to agriculture, and preplanned alternatives for commercial/industrial water usage.

- Economic Costs of the Proposal
  - Cost to hire an expert drought consultant or
  - Train current staff on drought measures

- Social Costs of Proposal
  - Suggested actions on private lands.

- Economic Benefits of Proposal
  - Commercial/Industrial alternatives during water rationing
  - Reduced losses to agriculture

- Social Benefits of Proposal
  - Network of drought contacts for related supplies (example: hay was brought in from other states during the last drought episode)

- Economic Analysis
  - The exact dollar amount of costs and benefits is nearly impossible to determine without vast amounts of study. However, comparing the types of costs vs. the types of benefits from this proposal, it seems likely that the economic benefits would far exceed the economic costs.

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XXVII. Establish Codes to Provide Wind Resistance

Actions or Projects	Cost	Funding Sources	Who will Implement Action	Schedule	PRIORITY
Work with Tribal Housing and building supply centers to demonstrate hail resistant shingles and building materials. Work with the local OSU extension to demonstrate hail resistant crops.	$35,000	FEMA Tribe OSU	PN DEM	Ongoing	5

Priority #4b establishes building codes and education to provide the greatest hail resistance. Building better structures lessens losses caused by most natural hazards.

This priority would be administered by the Pawnee Nation DEM. Planning would involve strategies to study the better building practices and work with local construction companies, insurance agents and building centers to build compliant buildings. Public education would be a key component.

- Economic Costs of the Proposal
  - Cost to hire an expert hail consultant or
  - Train current staff on wind disasters
  - Greater building costs for citizens
  - Hire or Train building inspector.

- Social Costs of Proposal
  - Suggested actions on private property.
  - Government infringement in rural areas

- Economic Benefits of Proposal
  - Reduced losses due to many natural hazards

- Social Benefits of Proposal
  - Better building practices could lead to increased resales and customer satisfaction.
  - Citizens would know their structure is sound.

- Economic Analysis
  - The exact dollar amount of costs and benefits is nearly impossible to determine without vast amounts of study. However, comparing the types of costs vs. the types of benefits from this proposal, it seems likely that the economic benefits would far exceed the economic costs.

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E. CHAPTER FIVE – CAPABILITY ASSESSMENT

The capability assessment section of this document describes a discussion of its financial, legal, and programmatic ability to carry out mitigation actions in the pre and post disaster setting to achieve its mitigation objectives and ultimately its goals. The Pawnee Nation currently supports pre and post disaster mitigation through regulations, plans, and programs. During a re-organization of the Tribal departments the Division of Natural Resources and Safety was established by the integration of several existing departments. Currently the Department of Environmental Conservation and Safety, Fire Department, Department of Emergency Management and Department of Transportation are managed under the Division. Within each department are multiple programs that accomplish the goals of the Division. Many plans and regulations as well as tribal law govern the action of departments. Table XXVIII summarizes the plans, regulations and programs demonstrating capability of administering a hazard mitigation plan.

XXVIII. Legal and Regulatory Resources Available for Hazard Mitigation.

Type of Mitigation	Regulatory Tool	Name/Type	Evaluation of Regulatory Tool on Hazard Mitigation
Pre-Disaster Mitigation	Plans	Emergency Response Plan	Developed by the TERC to establish a plan for continuity of government and serving at-risk members.
		Building Codes	Implemented throughout Pawnee Indian Country on trust lands. Adopted the International Building Code.
		Permit and Inspection	To be required under building codes.
	Programs	Geographical Information Systems	The Tribal GIS coordinator currently manages mapping processes for the Tribe such as land-use, flood zoning and watersheds as well as transportation routes.
		Utilities	Tribal Utility Commission manages drinking water resources and well protection measures. Also manages wastewater and lagoon system.
Post- Disaster Mitigation	Plans	Emergency Operations Plan/Center	Developed by TERC to establish the Emergency Operations
		Mutual Aid Agreements	The Pawnee Nation has mutual aid agreements for Fire response and law enforcement agencies in the surrounding communities.
	Programs/ Departments	Fire Department	The Pawnee Nation has an operating Fire response department as well as Hazardous Materials and Medical First Responders.
		Law Enforcement	The Pawnee Nation always operates a full-time law enforcement department with officers on duty.
		Department of Environmental Conservation and Safety	The Pawnee Nation has an Environmental Conservation Department to respond to natural resource and environmental disasters and emergencies. The department employees full-time Rangers and Environmental Scientists/Specialists.

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The evaluation of the Pawnee Nation's policies related to development in hazard prone areas are limited to the current building codes and planning.

E.1. Funding Sources

The fiscal capability assessment lists specific financial and budgetary tools that are currently available, as well as potentially available to the Pawnee Nation for Hazard Mitigation planning and actions. These capabilities include sources from USEPA – water quality monitoring program and general assistance, FEMA assistance for the development of the Hazard Mitigation Plan, Tribal budget for Operations and Property Department as well as ICDBG Program opportunities for development. Potential Sources include Federal Highway/Indian Reservation Roads funding, Administration for Native Americans (ANA) Grant Programs, and Assistance to Firefighters Grant Program, National Flood Insurance Program and FEMA Hazard Mitigation Grant Program.

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F. CHAPTER SIX - PLAN MAINTENANCE PROCESS

The plan maintenance section of this document describes the formal process that will ensure that the Pawnee Nation Hazard Mitigation Plan remains an active and relevant document with continued public participation. The plan maintenance process will be driven by the Division of Natural Resources and Safety to include annual evaluations, revisions, or updates, as needed by the Pawnee Nation. The plan will be resubmitted for Federal review every five years. Pawnee Nation Tribal Emergency Response Committee (TERC), along with the Hazard Mitigation Committee will be responsible for reviewing the drafts, evaluating and updating the plan. Plan updates or revisions will be submitted to the Pawnee Nation Business Council for adoption.

F.1. Plan Monitoring

The Pawnee Nation TERC Chairmanwill be responsible for monitoring the plan. The chairman may request the assignment of this task to the Department of Emergency Management if it is deemed necessary. A monitoring report will be written and submitted to the Committee Members on a yearly basis. The Committee Members may request a quarterly report following a period of rapid growth or another unexpected event.

The Chairman or Coordinator will perform any necessary site visits monthly. He or she will also be the lead contact for phone calls and scheduling meetings.

F.2. Plan To Evaluate

The TERC Chairman and the Pawnee Nation's Hazard Mitigation Committee will evaluate the Hazard Mitigation Plan every year to determine the effectiveness and/or progress of mitigation actions and the implementation of other actions.

Plan evaluation should address the following questions.

- Do objectives address current and expected hazardous conditions?
- Has the nature or magnitude of risks changed?
- Are the current resources appropriate for implementing mitigation actions?
- Are there any implementation problems, such as technical, political, legal, or coordination issues with other agencies?
- Did the outcome of mitigation actions occur as expected?

The Committee and TERC Chairman will have three months, from the date of the evaluation meeting, to update the plan with any changes needed. The Pawnee Nation will resubmit the plan for Federal review every five years.

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F.3. Plan To Update

The plan will be kept on record at the Pawnee Nation Administration Building in Pawnee, OK.

The plan will be updated every five years as funding is available. Any interested party may request a copy of the plan via the Executive Director's Secretary.

At least 6 months prior to the expiration, the Emergency Manager will conduct meetings with the TERC and the Business Council to review the hazards and the strategy to ensure no priorities have changed. Once confirmed the entire plan will be reviewed and updated with any revisions necessary and submitted to FEMA prior to the plan expiration.

F.4. Incorporation into Existing Planning Mechanisms

The Pawnee Nation currently utilizes a planning department to guide future planning and development. After the Pawnee Nation officially adopts the Hazard Mitigation Plan, these existing mechanisms will have hazard mitigation strategies integrated into them.

After adoption of the Mitigation Plan, the Pawnee Nation will suggest that other local municipalities address natural hazards in their respective planning processes. Specifically, one of the goals in the Mitigation Plan directs the Pawnee Nation and local governments to protect life and property from natural disasters and hazards. The Tribal Emergency Response Committee will conduct a periodic review of the Tribe's amendments and provide technical assistance to other local municipalities in implementing these requirements.

The capital improvement planning that occurs in the future will also contribute to the goals in the Hazard Mitigation Plan. The respective TERC Chairman will work with the capital improvement planners to secure high-hazard areas for low risk uses.

Incorporating goals of other planning activities into the Hazard Mitigation Plan will occur as each of these plans is updated.

Within six months of the formal adoption of the Mitigation Plan, the policies listed above will be incorporated into the process of existing planning mechanisms.

F.5. Continued Public Participation

While the Hazard Mitigation Committee represents the public to some extent, the public will be able to directly comment on and provide feedback about the plan. The Pawnee Nation is dedicated to generating public interest in the updates of the Tribe's Hazard Mitigation Plan. Efforts to do so may include:

- Distributing information about the existence and purpose of the Hazard Mitigation Plan to community groups, units of Tribal and County government, and other public gatherings.

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- Questionnaires periodically being made available to the public to collect information on what mitigation activities the tribal members would like to see implemented.

- Posting information about the Hazard Mitigation Plan on the Pawnee Nation's Web page, along with an email address for questions and input.

Listed below is the address and phone number of the Hazard Mitigation Committee Chairman who is responsible for keeping track of public comments on the plan. Copies of the plan will be kept at the Pawnee Nation Fire Department and at the Pawnee Nation Administration Building, where the public can review the plan. The public will also be invited to, and included in, the Hazard Mitigation Committee's annual evaluation of the plan. This meeting will provide the public with a forum for which they can express their concerns, opinions, or ideas about the plan.

Pawnee Nation Fire Department
301 Agency Road
Pawnee, OK 74058

918-762-3655

Pawnee Nation Administration Building 64
881 Little Dee Drive
Pawnee, OK 74058

918-762-3621

F.6. Mitigation Measures and Closeouts

Each department and agency listed in Table XXII will be responsible for monitoring the mitigation project implementation and closeout. If more than one department or agency is listed, then the Department of Emergency Management will be the lead department. The status of the project implementation and closeout will be included with each review. In addition, each of these agencies and departments will be required to submit a closeout report at the conclusion of any mitigation project.

Progress review on achievement of goals and implementation of activities and projects of the Mitigation Strategy will also be accomplished during the annual review process. During each annual review, the department and or agency currently administering a mitigation project will submit a progress report to the Emergency Manager and TERC. The report will include the status of the mitigation project, including any changes made to the project, the identification of implementation problems and appropriate strategies to overcome them, and whether the project has helped to achieve the appropriate goals identified in the plan. Project management, i.e. procurement compliance, audits and reconciliation of financial components will be coordinated through the Division responsible for the implementation of the mitigation measure and the Tribe's Division of Finance and Grants and Contracts

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departments. This is the process and procedures implemented for all grants managed by the Pawnee Nation.

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3. APPENDIX B. Storm listings

WINTER STORMS

27 Winter Storm event(s) were reported in Pawnee County, Oklahoma between 01/01/1950 and 03/31/2009.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
Eastern Oklahoma	3/08/1994	06:00	Heavy Snow	N/A	0	0	1K	0
Heavy snow fell in northeast and east-central Oklahoma on March 8th. Thunderstorms accompanied the snow in many areas, which added to the snow accumulations. Snowfall amounts across northeast and east-central Oklahoma ranged from 4 to 18 inches, with the heaviest amounts across southern Osage, Pawnee, northern Creek, Tulsa, Wagoner, and eastern Delaware Counties. The town of Pawnee had the greatest official snowfall accumulation with 15 inches, but unofficial amounts of up to 18 inches were reported in eastern Delaware County. The 12.9 inches of snow which fell at the Tulsa International Airport was a record snowfall. The previous record of 11.5 inches occurred on March 20th, 1924. Numerous accidents occurred because of the snowfall, and several power outages also occurred. A propane tank truck overturned on icy roads near Pawhuska which resulted in the evacuation of a small area, but no injuries were reported. A convenient store in Checotah had its gas island canopy collapse under the weight of the snow.								
Begin Location: Not Known End Location: Not Known	Begin: 12-08-2007 End: 12-10-2007	Begin: 23:00 PM End: 21:00 PM	Ice Storm	N/A	0	0	$50.0M	0
One to two inches of ice accumulated on trees, power lines and other exposed surfaces. 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 could be the costliest weather-related disaster in Oklahoma history. A few 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.								

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Not Known	12/25/2000	07:00 AM	Ice Storm	N/A	0	0	0	0
Summary of winter weather events for December 25-27, 2000. A slow-moving winter storm moved across the State Christmas day bringing heavy freezing rain and dangerous ice accumulations. While all of Eastern Oklahoma received significant ice accumulations, East Central and Southeast Oklahoma were hardest hit. One to two inches of ice accumulation were common in these areas with locally higher amounts. Over 500 power poles were downed during the event and over 200,000 Oklahomans were without power. The heavy ice accumulations also left thousands without telephone and water service. Some locations in Southeast Oklahoma were without utility services for more than a week. Numerous shelters and feeding sites were established across Southeast Oklahoma to provide water, food and a warm place to sleep. Thousands of trees were damaged across Southeast Oklahoma including 7 State parks where damage was estimated at over 1 million dollars. Numerous reports of trees downing on vehicles and homes were reported across Southeast Oklahoma. Some of the areas that experienced the most damage was in Pittsburg, Latimer and LeFlore counties. While damage estimates were not finalized as of late February, a preliminary total for the state was $168.9 million.								
Totals	0	0	0	51.522M	0			

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

40 WINTER STORM event(s) were reported in Payne County, Oklahoma between 01/01/1950 and 03/31/2009.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
Begin Location: Not Known End Location: Not Known	02/01/1996 02/02/1996	06:00PM 08:00AM	Heavy Snow	N/A	0	0	0	0
Description: Dry snow fell across most of western and central Oklahoma from midday February 1st through the morning of the 2nd. A band of heavy snow extended west to east across northern Oklahoma from Dewey County to Payne County. In Payne County, 8 inches fell in Stillwater.								
Begin Location: Not Known End Location: Not Known	12/03/2002 12/04/2002	06:00PM 03:00AM	Ice Storm	N/A	0	0	0	0
Description: A winter storm affected the northwest half of Oklahoma during the afternoon and evening of the 3rd, and early morning of the 4th. Southeast of this area, a mixture of freezing rain, sleet, and snow fell, with ice accumulations ranging from a trace to one half inch, and snow accumulations between two and three inches. The greatest amount of ice fell from about Stillwater (Payne County), southwestward to about Guthrie (Logan County), Bethany (Oklahoma County), Weatherford (Custer County), and Elk City (Beckham County). Nearly 50,000 residences were without power during the peak of the winter storm.								
Begin Location: Not Known End Location: Not Known	12-09-2007 12-11-2007	01:00AM 06:00 AM	Ice Storm	N/A	0	0	150.0 M	0
Description: In addition to the above-mentioned damage, all but the gym burned at Jones High School. Seven deaths were reported across the county due to the ice storm. The total estimated monetary damage listed is for the entire event that occurred in the National Weather Service County Warning Area. A devastating ice storm affected a large swath of Oklahoma beginning on the 9th and continuing through the 11th over parts of the area. The storm left behind a trail of severe damage to trees and power lines, which in turn led to the worst power outage in Oklahoma history (in terms of the number of people impacted). This was because the worst of the ice storm affected the urban corridor from near Lawton to Oklahoma City, to Tulsa, and northeast into Missouri. The storm began with a strong cold front that moved through the northern half of Oklahoma on the 8th, and then moved south through the rest of the state during the day on the 9th. South of the front, an almost tropical airmass was in place with temperatures in the 60s and 70s. Showers and thunderstorms were ongoing over central and southwest Oklahoma early on the 9th but were developing and moving above a layer of freezing air at the surface. However, as the cold front moved south, the cold air undercut the thunderstorms, which became the start of many waves of freezing showers and thunderstorms. The very moist airmass south of the front continued to move over top of the shallow cold airmass through 11th. This classic setup created one of the costliest ice storms in Oklahoma history. By the time the storm had ended, over one inch of ice had accumulated over a good portion of Oklahoma. The governor								

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declared a State of Emergency for all 77 Oklahoma counties. At least 27 deaths were reported statewide, mainly due to hundreds of automobile accidents, although some were due to prolonged cold air exposure or carbon monoxide poisoning. Most of the December 12th morning flights in and out of Will Rogers World Airport were canceled because of icy runways. Trees, power line and power pole damage was widespread statewide, which resulted in hundreds of thousands without power. Some of the trees that had to be cut back or cut down altogether were over 100 years old. At the peak of the event, more than 641,000 electric customers were without power (the actual number of people was likely much larger). Due to the magnitude of the outage, electrical crews from dozens of states worked 12-hour shifts daily to restore power. Even with this huge relief effort, more than 150,000 residents were still without power one week later. Even city water and sewage plants were without power, making them unable to pump water for a short time. Fallen power lines created another hazard as the broken lines sparked structure fires. Fire departments responded to over 100 structure fires in all. Other fires were caused by portable heating sources inside the home. Schools, churches, and local businesses had to close, some for several days due to the power outages. Christmas parades and area sporting events had to be rescheduled or canceled all together. Final exams at area colleges were also postponed. The local economy took a huge hit as the ice storm hit during a key weekend for holiday sales. The pecan crop loss alone was estimated at $25 million statewide. Shelters were opened across the state for people who did not have electricity, which many took advantage of. The storm cleanup was estimated to cost at least $200 million statewide. Cities were expected to remove over 750,000 cubic yards of debris.								
Begin Location: Not Known End Location: Not Known	01/18/1996 01/20/1996	02:00AM 12:00PM	Cold - Extreme	N/A	2	0	0	0
Description: A strong arctic air mass settled in across Oklahoma early in the morning of the 18th, and remained over the state through the 20th, resulting in two deaths. Low temperatures fell into the single digits and high temperatures rose only to around 20 degrees on the 19th. Wind chill values fell as low as 35 to 40 degrees below zero. A fifty-one-year-old man died of hypothermia overnight after apparently sitting down against a north-facing wall in Midwest City early on the 18th. A fifty-six-year-old man also died of hypothermia on the 20th when he took refuge in an unheated shack in Oklahoma City.								
TOTALS:	0	2	452.085M	0				

EXTREME TEMPERATURES

8 TEMPERATURE EXTREMES event(s) were reported in Payne County, Oklahoma between 01/01/1950 and 03/31/2007.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Western and Central O	06/27/1994	1200	Excessive Heat	N/A	0	0	0	0
2 OKZ004>053	01/18/1996	02:00 AM	Extreme Cold	N/A	2	0	0	0
3 OKZ004>053	02/01/1996	12:00 AM	Extreme Cold	N/A	0	0	0	0
4 OKZ010 - 020 - 025>026 - 046	07/01/1996	03:00 PM	Excessive Heat	N/A	7	0	0	0
5 OKZ004>048 - 050>052	07/04/2001	12:00 AM	Excessive Heat	N/A	8	0	0	0
6 OKZ020	06/18/2006	05:45 PM	Heat	N/A	0	0	0	0
7 OKZ004>048 - 050>052	07/16/2006	12:00 PM	Heat	N/A	10	100	0	0
8 OKZ004>048 - 050>052	08/01/2006	12:00 AM	Heat	N/A	8	0	10K	0
			TOTALS:		35	100	10K	0

6 TEMPERATURE EXTREMES event(s) were reported in Pawnee County,

Mag: Magnitude

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Oklahoma between 01/01/1950 and 03/31/2007.

Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma								
Location or County	**Date**	**Time**	**Type**	**Mag**	**Dth**	**Inj**	**PrD**	**CrD**
1 OKZ054>055 - 059>060 - 064	07/16/2001	12:00 PM	Excessive Heat	N/A	1	0	0	0
2 OKZ049 - 053>076	07/17/2006	03:00 PM	Excessive Heat	N/A	3	0	0	0
3 OKZ049 - 053>076	07/29/2006	04:00 PM	Excessive Heat	N/A	0	0	0	0
4 OKZ049 - 053>076	08/01/2006	12:00 AM	Excessive Heat	N/A	0	0	0	0
5 OKZ049 - 053>076	08/09/2006	11:00 AM	Excessive Heat	N/A	1	0	0	0
6 okz054>072 – 074 -076	08-06-2007	08:00AM	Excessive Heat	N/A	0	0	0	0
				TOTALS:	5	0	0	0

FLOOD EVENTS
24 FLOOD event(s) were reported in **Payne County, Oklahoma** between **01/01/1950** and **03/31/2009**.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damag
CrD: Crop Damage

Oklahoma							
Location or County	**Date**	**Time**	**Type**	**Mag**	**Dth**	**Inj**	**PrD**
1 Sw Stillwater	04/28/1993	2100	Flash Flood	N/A	0	0	500K
2 Countywide	05/08/1993	1530	Flash Flood	N/A	0	0	5.0M
3 Countywide	05/09/1993	0430	Flash Flood	N/A	0	0	5.0M
4 Coyle	06/09/1995	1030	Flash Flood	N/A	0	0	0
5 Stillwater	08/01/1995	0700	Flash Flood	N/A	0	0	0
6 Nrn Stillwater	08/01/1995	1900	Flash Flood	N/A	0	0	500K
7 Countywide	10/05/1998	04:00 AM	Flood	N/A	0	0	0K
8 Countywide	11/01/1998	12:00 AM	Flood	N/A	0	0	0

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9 21 Counties OKZ007>008 - 012>013 - 018>020 - 024>028 - 030>032 - 040>043 - 046>047	04/23/1999	11:00 PM	Flood	N/A	0	0	932K	0
10 Countywide	06/24/1999	11:00 AM	Flash Flood	N/A	0	0	10K	0
11 Glencoe	07/03/2000	05:55 AM	Flash Flood	N/A	0	0	0	0
12 Stillwater	06/30/2001	01:30 AM	Urban/sml Stream Fld	N/A	0	0	15K	0
13 17 Counties OKZ004>008 - 010 - 012 - 017>020 - 023>024 - 026 - 034>035 - 037	03/04/2004	04:30 PM	Flood	N/A	0	3	1.0M	250K
14 4 Counties OKZ018 - 020 - 030>031	06/22/2004	09:50 AM	Flood	N/A	0	0	0	0
15 Countywide	08/23/2005	06:00 AM	Flood	N/A	0	0	0	0
				TOTALS:	0	3	12.957M	250K

33 FLOOD event(s) were reported in **Pawnee County, Oklahoma** between **01/01/1950** and **03/31/2007**.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 PAWNEE	05/08/1993	1600	Flash Flood	N/A	0	0	500K	0
2 PAWNEE	05/09/1993	0600	Flash Flood	N/A	0	0	500K	0
3 PAWNEE	07/12/1994	1845	Flash Flood	N/A	0	0	0	0
4 Terlton	04/17/1995	2200	Flash Flood	N/A	0	0	0	0
5 Skedee-Blackburn	04/29/1995	0330	Flash Flood	N/A	0	0	0	0
6 Cleveland	05/07/1995	1530	Flash Flood	N/A	0	0	0	0
7 PAWNEE	06/04/1995	0230	Flash Flood	N/A	0	0	0	0
8 PAWNEE	06/09/1995	0000	Flash Flood	N/A	0	0	0	0

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9 PAWNEE	06/09/1995	1000	Flash Flood	N/A	0	0	0	0
10 Nr Maramec	05/07/1997	10:30 PM	Flash Flood	N/A	0	0	0	0
11 W. Pawnee County	07/17/1997	08:00 PM	Flash Flood	N/A	0	0	0	0
12 Cleveland	07/21/1997	06:30 PM	Flash Flood	N/A	0	0	0	0
13 Countywide	04/27/1998	04:00 AM	Flash Flood	N/A	0	0	0	0
14 East Portion	10/04/1998	11:00 PM	Flash Flood	N/A	0	0	38K	0
15 Pawnee	10/05/1998	03:00 AM	Flood	N/A	0	0	0	0
16 Pawnee/Osage	11/02/1998	01:00 PM	Flood	N/A	0	0	0	0
17 Western Pawnee	04/25/1999	12:00 PM	Flood	N/A	0	0	0	0
18 Pawnee	06/24/1999	09:00 AM	Flash Flood	N/A	0	0	15K	0
19 East Portion	05/06/2000	04:00 AM	Flash Flood	N/A	0	0	100K	0
20 Pawnee	05/26/2000	03:00 AM	Flash Flood	N/A	0	0	0	0
21 Cleveland	05/16/2002	10:30 PM	Flash Flood	N/A	0	0	0	0
22 Pawnee	08/13/2002	08:30 PM	Flash Flood	N/A	0	0	0	0
23 Countywide	03/04/2004	04:00 PM	Flash Flood	N/A	0	0	25K	0
24 Pawnee	03/04/2004	08:00 PM	Flood	N/A	0	0	0	0
25 Pawnee	03/06/2004	01:00 AM	Flood	N/A	0	0	0	0
26 Ralston	05/07/2007	06:30 AM	Flash Flood	N/A	0	0	350K	0
27 Cleveland	06/01/2007	18:00 PM	Flash Flood	N/A	0	0	0	0
28 Ralston	6/28/2007	15:20	Flash Flood	N/A	0	0	0	0

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		PM						
29 Pawnee	03/31/2008	04:30 AM	Flash Flood	N/A	0	0	0	0
30 Pawnee	04/10/2008	00:30 AM	Flash Flood	N/A	0	0	100K	0
31 Cleveland	06/01/2008	09:15 AM	Flash Flood	N/A	0	0	0	0
32 Terlton	06/09/2008	03:00 AM	Flash Flood	N/A	0	0	25K	0
33 Pawnee	2/10/2009	19:30 PM	Flash Flood	N/A	0	0	0	0
				TOTALS:	0	0	1.653M	0

TORNADO

32 Tornadoes were reported in **Pawnee County, Oklahoma** between **01/01/1950** and **03/31/2009**.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 PAWNEE	05/01/1954	1742	Tornado	F2	0	0	25K	0
2 PAWNEE	04/12/1955	0200	Tornado	F0	0	0	0K	0
3 PAWNEE	04/02/1956	2130	Tornado	F2	0	1	25K	0
4 PAWNEE	05/20/1957	1700	Tornado	F0	0	0	0K	0
5 PAWNEE	05/22/1957	0858	Tornado	F0	0	0	0K	0
6 PAWNEE	03/31/1959	1700	Tornado	F1	0	1	0K	0
7 PAWNEE	11/22/1963	0210	Tornado	F1	0	0	0K	0
8 PAWNEE	06/11/1970	1410	Tornado	F3	0	0	250K	0
9 PAWNEE	04/26/1971	2000	Tornado	F0	0	0	25K	0
10 PAWNEE	05/10/1971	2000	Tornado	F1	0	0	25K	0
11 PAWNEE	07/02/1976	1645	Tornado	F1	0	0	0K	0

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12 PAWNEE	03/17/1977	1651	Tornado	F1	0	0	0K	0
13 PAWNEE	08/21/1979	1840	Tornado	F0	0	0	0K	0
14 PAWNEE	04/27/1983	2000	Tornado	F2	0	0	25K	0
15 PAWNEE	04/26/1984	1932	Tornado	F0	0	0	0K	0
16 PAWNEE	04/26/1984	2210	Tornado	F4	0	0	2.5M	0
17 PAWNEE	04/26/1984	2212	Tornado	F4	3	37	2.5M	0
18 PAWNEE	04/29/1984	0925	Tornado	F4	0	5	25.0M	0
19 PAWNEE	04/29/1984	0932	Tornado	F4	0	15	25.0M	0
20 PAWNEE	06/21/1990	1730	Tornado	F0	0	0	0K	0
21 PAWNEE	06/21/1990	1812	Tornado	F0	0	0	0K	0
22 PAWNEE	06/21/1990	1838	Tornado	F1	0	0	0K	0
23 PAWNEE	04/26/1991	1910	Tornado	F4	1	5	2.5M	0
24 PAWNEE	06/18/1992	1455	Tornado	F0	0	0	0K	0
25 Ralston	09/08/1997	04:20 PM	Tornado	F0	0	0	0	0
26 Pawnee	10/04/1998	06:38 PM	Tornado	F1	0	0	800K	0
27 Ralston	04/19/2003	04:04 PM	Tornado	F0	0	0	0	0
28 Pawnee	05/26/2004	06:40 PM	Tornado	F0	0	0	0	0
29 Pawnee	05/01/2008	19:18 PM	Tornado	F0	0	0	0K	0K
30 Skedee	05/01/2008	19:25 PM	Tornado	F1	0	0	20K	0K
31 Pawnee	02/10/2009	16:35 PM	Tornado	F0	0	0	30K	0K
32 Pawnee	03/24/2009	00:29 AM	Tornado	F0	0	0	30K	0K
				TOTALS:	4	64	58.756M	0

44 TORNADOES(s) were reported in **Payne County, Oklahoma** between **01/01/1950** and **03/31/2009**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 PAYNE	05/07/1950	2300	Tornado	F1	0	0	3K	0
2 PAYNE	05/23/1952	0400	Tornado	F1	0	0	3K	0
3 PAYNE	05/01/1954	1742	Tornado	F2	0	7	25K	0
4 PAYNE	06/12/1954	1550	Tornado	F1	0	0	0K	0
5 PAYNE	07/23/1954	1845	Tornado	F2	0	1	3K	0

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6 PAYNE	05/26/1955	0400	Tornado	F0	0	0	0K	0
7 PAYNE	04/08/1956	2330	Tornado	F1	0	0	250K	0
8 PAYNE	06/12/1957	0455	Tornado	F1	0	0	3K	0
9 PAYNE	04/18/1959	1635	Tornado	F0	0	0	0K	0
10 PAYNE	05/02/1959	1630	Tornado	F1	0	0	3K	0
11 PAYNE	05/02/1959	1650	Tornado	F1	0	0	3K	0
12 PAYNE	05/21/1961	1615	Tornado	F2	0	0	0K	0
13 PAYNE	05/21/1961	1615	Tornado	F2	0	0	3K	0
14 PAYNE	05/21/1961	1615	Tornado	F3	0	0	25K	0
15 PAYNE	05/21/1961	1615	Tornado	F3	0	0	25K	0
16 PAYNE	05/26/1963	0130	Tornado	F1	0	0	3K	0
17 PAYNE	08/09/1963	1720	Tornado	F2	0	0	25K	0
18 PAYNE	06/23/1969	1850	Tornado	F2	0	0	250K	0
19 PAYNE	04/30/1970	0200	Tornado	F2	0	0	2.5M	0
20 PAYNE	04/30/1970	0245	Tornado	F1	0	2	25K	0
21 PAYNE	06/19/1972	2125	Tornado	F2	0	0	0K	0
22 PAYNE	09/03/1973	1720	Tornado	F1	0	0	3K	0
23 PAYNE	06/13/1975	1733	Tornado	F3	0	8	2.5M	0
24 PAYNE	07/03/1976	1410	Tornado	F1	0	0	0K	0
25 PAYNE	03/17/1977	1640	Tornado	F1	0	0	0K	0
26 PAYNE	05/02/1979	1913	Tornado	F1	0	0	25K	0
27 PAYNE	04/26/1984	1835	Tornado	F0	0	0	250K	0
28 PAYNE	04/26/1984	1835	Tornado	F1	0	0	250K	0
29 PAYNE	04/26/1984	2120	Tornado	F2	0	8	250K	0
30 PAYNE	03/03/1985	1900	Tornado	F1	0	0	250K	0
31 PAYNE	09/15/1987	1713	Tornado	F0	0	0	0K	0
32 PAYNE	03/28/1988	1715	Tornado	F0	0	0	3K	0
33 PAYNE	06/26/1988	1900	Tornado	F1	0	0	25K	0
34 PAYNE	05/15/1990	1841	Tornado	F3	1	12	2.5M	0
35 PAYNE	04/26/1991	1838	Tornado	F2	0	0	250K	0
36 PAYNE	06/19/1992	2009	Tornado	F0	0	0	0K	0
37 Yale	05/06/1994	2050	Tornado	F0	0	0	0	0
38 Ripley	05/06/1994	2112	Tornado	F0	0	0	0	0
39 Stillwater	10/04/1998	05:47 PM	Tornado	F0	0	0	5K	0

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40 Cushing	11/29/1998	08:10 PM	Tornado	F0	0	0	20K	0
41 Stillwater	05/03/1999	09:20 PM	Tornado	F2	1	3	100K	0
42 Ripley	05/16/2003	01:20 PM	Tornado	F0	0	0	0	0
43 Glencoe	05/01/2008	18:42 PM	Tornado	F0	0	0	0K	0K
44 Perkins	02/10/2009	15:39 PM	Tornado	F1	0	0	0K	0K
				TOTALS:	2	41	9.576M	0

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