City of Tulsa, Oklahoma

Multi-Hazard Mitigation Plan

November 25, 2002

R.D. Flanagan & Associates
Planning Consultants

Meshek & Associates, Inc.
Engineering Consultants

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PUBLIC WORKS
DEPARTMENT

CITY OF TULSA OKLAHOMA

2317 SOUTH JACKSON • TULSA, OKLAHOMA • 74107

December 23, 2002

Ms. Connie Dill, State Hazard Mitigation Officer
Oklahoma Department of Civil Emergency Management
P.O. Box 53365
Oklahoma City, OK 73152

RE: Multi-Hazard Mitigation

Dear Ms. Dill:

We are pleased to submit this *City of Tulsa Multi-Hazard Mitigation Plan-2002*, as fulfillment of the requirements of the Hazard Mitigation Grant (FEMA-1355-DR-OK).

This Multi-Hazard Mitigation Plan, prepared in accordance with State and Federal guidance, addresses floodplain management, dam and levee failures, tornadoes, high winds, hailstorms, lightning, winter storms, extreme heat, drought, expansive soils, urban and wild fires, earthquakes, and hazardous materials events.

We look forward to implementing this plan to enhance protection of the lives and property of our citizens from natural hazards and hazard materials incidents. If we can answer any questions or be of further assistance, please do not hesitate to contact me at 918.596.9608, or Mr. Ken Hill at 918.596.9240.

Sincerely,

Charles L. Hardt, P.E., Director
City of Tulsa Department of Public Works

City of Tulsa, Oklahoma

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Acknowledgements

The Tulsa Multi-Hazard Mitigation Plan, October, 2002, was prepared by the City of Tulsa, Oklahoma, under the direction of the Department of Public Works.

City of Tulsa Elected Officials

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	Susan Savage (1990-2002)
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City Council District 2	Randi Miller
City Council District 3	David Patrick
	Roscoe Turner (1999 -2002)
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City Council District 7	Randy Sullivan
	Clay Bird (2000-2002)
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	Todd Huston (2000-2002)
City Council District 9	Susan Neal
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Tulsa Hazard Mitigation Citizen Advisory Board

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J. D. Metcalfe	Royce Bentley
John Westmoreland	June Mustari
Neal McNeal	Nancy Kincaid-Deacon
Bob Roberts	David Kollman

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Ann Patton	Director, Project Impact
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Executive Summary

In the early 1980s Tulsa was identified in a national study as one of the nation's most disaster-prone areas, having been declared a federal disaster area nine times in only fifteen years. Oklahoma's location at the intersection of the hot arid zone to the west, the temperate zone to the northeast, and the hot humid zone to the southeast makes it subject to a wide variety of potentially violent weather and natural hazards.

This Tulsa Multi-Hazard Mitigation Plan is an update of the Flood and Stormwater Management Plan, 1999–2014 and the City of Tulsa Community Ratings System (CRS) Plan. This plan was developed in fulfillment of a Hazard Mitigation Grant Program (HMGP) grant from the Federal Emergency Management Agency (FEMA) and the Oklahoma Department of Civil Emergency Management (ODCEM).

Citizen Advisory Committee meeting at Tulsa City Hall

Background

Virtually every area of the city is vulnerable to natural and man-made hazards. The Tulsa Hazard Mitigation Citizen Advisory Committee (THMCAC) has identified 15 hazards affecting the City of Tulsa, including floods, tornadoes, high winds, lightning, hailstorms, severe winter storms, extreme heat, drought, expansive soils, urban fires, wildfires, earthquakes, hazardous materials events, dam failures, and levee failures.

Purpose

The purpose of this plan is to:

- Assess the ongoing mitigation activities in the community
- Identify and assess the hazards that pose a threat to citizens and property
- Evaluate additional mitigation measures that should be undertaken
- Outline a strategy for implementation of mitigation projects

The objective of this plan is to provide guidance for community activities for the next five years. It will ensure that the city and other partners implement activities that are most effective and appropriate for mitigating natural hazards and hazardous materials incidents.

Hazard Mitigation Citizens Advisory Committee

Citizens and professionals active in disasters provided important input in the development of the plan and recommended goals and objectives, mitigation measures, and priorities for actions. The THMCAC is comprised of ten members: Dwayne Wilkerson, June Mustari, Royce Bentley, Nancy Kincaid-Deacon, David Kollman, Sandy Cox, J.D. Metcalfe, John Westmoreland, Neal McNeill, and Bob Roberts.

Each year Oklahoma has more tornado events per square mile than any other state

The Planning Process

The development of Tulsa's Multi-Hazard Mitigation Plan followed a ten-step process, based on guidance and requirements of FEMA:

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

Plan Summary

The City of Tulsa Multi-Hazard Mitigation Plan provides guidance to help Tulsans protect life and property from natural hazards. The plan identifies the hazards that are most likely to strike Tulsa, provides a profile and risk assessment of each hazard, identifies mitigation measures for each hazard, and presents an action plan for the implementation of the mitigation measures.

Chapter 1 provides a profile of the City of Tulsa that includes a community description and regulatory framework, a discussion of existing hazard mitigation programs, and detailed information on the planning process.

Chapter 2 presents a flood profile, the history of Tulsa's flooding, an assessment of Tulsa's flooding problems, reviews the actions taken to solve them, and identifies the vulnerable populations, buildings, and infrastructure, including critical facilities.

Chapter 3 provides an assessment of 14 additional natural hazards and hazardous materials events. Each assessment includes a hazard profile, describes the historical events, identifies vulnerable populations and properties at risk, and summarizes the findings for each hazard with a conclusion. A bibliography and list of sources is included at the end of each hazard section.

Chapter 4 presents the goals adopted by the Tulsa Hazard Mitigation Citizen Advisory Committee and organizes proposed mitigation strategies under six mitigation categories: public information and education, preventive activities, structural projects, property protection, emergency services, and natural resource protection. The prioritized mitigation measures for each hazard are summarized in a table at the end of each category section.

Tulsa Hazard Mitigation Workshop

Chapter 5 details the action plan for implementation of top ten high priority mitigation projects, including a description of the project, identification of the lead agency, estimated project cost, funding sources, timelines for implementation, and a description of the work product or expected project outcome. A complete prioritized list of the THMCAC's recommended mitigation measures is presented at the end of the Action Plan.

Chapter 6 provides a discussion of the plan maintenance process, and documentation of the adoption. Plan maintenance includes monitoring, evaluating, and updating the plan, with involvement of the public. The resolutions forming the Tulsa Hazard Mitigation Citizen Advisory Committee, the Tulsa Metropolitan Area Planning Commission's adoption resolution, and the resolution of the Tulsa City Council are included.

Appendix A: Glossary of Hazard Mitigation Terms provides a glossary of terms commonly used in disaster management and hazard mitigation.

Appendix B: Stormwater Capital Improvements Projects lists City of Tulsa's prioritized Flood and Stormwater Management Capital Improvements Projects (CIP), as identified in the several Master Drainage Plans, and city-wide Flood and Stormwater Management Plan 1999-2014.

Appendix C: Hazard Mitigation Capital Improvements Projects lists City of Tulsa's approved Capital Improvements Projects that accomplish hazard mitigation objectives, and implement the goals and objectives, and mitigation measures recommended by the THMCAC.

Appendix D: Critical Facilities provides a comprehensive list of Critical Facilities within the City of Tulsa, including addresses and telephone numbers.

Appendix E: City of Tulsa Buildings lists City of Tulsa government buildings, including addresses, telephone numbers, and contacts.

Appendix F: Hazard Mitigation Committee Meeting Agendas provides the agendas from THMCAC meetings and supporting staff meetings held during the planning process.

Appendix G: Repetitive Loss Plan presents City of Tulsa's plan for the NFIP identified Repetitive Loss Properties.

Appendix H: Acquisition Candidates provides a list of floodplain buildings identified by the basin-wide master drainage plans for acquisition as the most cost-effective solution to their flooding problems.

Appendix I is purposely omitted for page numbering and referencing reasons.

Appendix J: Overtopped Bridges provides a list of public infrastructure bridges and culverts that are overtopped by the 100-year regulatory flood, and are recommended by the city-wide Flood and Stormwater Management Plan 1999-2014 for replacement.

Appendix K: Hazardous Materials Sites is a table of Tier 2 Hazardous Materials Sites within the City of Tulsa, including facility name and address. For purposes of this report, toxics, chemicals, and hazardous materials at each site have been suppressed.

Appendix L: Public Comments Survey is a opinion survey conducted by the Department of Public Works, soliciting comments from the public.

Mitigation Measures

The following are the high priority mitigation measures defined by the Tulsa Hazard Mitigation Citizens Advisory Committee:

General

- Examine optimum methods of implementing public information and education objectives.
- Evaluate and upgrade warning systems.
- Provide new facilities for the 911 Center and the Emergency Operations Center.
- Update GIS data to include public utility infrastructure.

Floods

- Implement structural and non-structural flood mitigation measures for flood-prone properties.
- Acquire and remove Repetitive Loss Properties and repeated flooded properties where appropriate.

Extreme Heat

- Obtain funding for distribution of public information and education materials to vulnerable populations.

Winter Storms

- Continue the city's aggressive snow and ice removal plan.

Drought

- Build a third flow line to the Lake Hudson reservoir for additional water supply by 2020.

Expansive Soils

- Investigate codes and incentives for the construction of new foundations to avoid expansive soil problems.

Hazardous Materials Events

- Continue the city's Household Pollutant Collection program and build a year-round site for collection.

Dam Failures

- Develop a computer mapping program for results of the Arkansas River's Keystone Dam release rates of 250, 350, and 450 thousand cubic feet per second.

Mitigation Action Plan

The mitigation action plan includes strategies for implementing the mitigation measures, including information on the responsible agency, time frame, cost estimate, funding sources, and a statement of the measurable results.

For further information, contact:

Kenneth Hill, P.E.
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Chapter 1:

Introduction

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1.1 About the Plan

This document is the first phase of a multi-hazard mitigation plan for the City of Tulsa. It is a strategic planning guide to be presented in fulfillment of requirements of the Hazard Mitigation Grant Program for the Federal Emergency Management Agency (FEMA), according to the Stafford Disaster Relief and Emergency Assistance Act. This act provides federal assistance to state and local governments to alleviate suffering and damage from disasters. It broadens existing relief programs to encourage disaster preparedness plans and programs, coordination and responsiveness, insurance coverage, and hazard mitigation measures.

This plan fulfills requirements for the following programs:

1. Hazard Mitigation Grant Program (HMGP)
2. National Flood Insurance Program's Community Rating System (CRS)
3. Flood Mitigation Assistance Program (FMA)

Since there is an immediate need to coordinate the various flooding programs with those for other hazards, the first phase is limited to natural hazards and hazardous materials events. In the future, the City will initiate additional studies to address technological and man-made hazards, such as water quality emergencies, power failures, civil unrest, riot, and terrorism.

Start date for the Tulsa Multi-Hazard Mitigation Plan was October 31, 2001. The Oklahoma Department of Civil Emergency Management (ODCEM) approved the application for the plan on January 1, 2002.

1.1.1 Purpose

The purpose of this plan is to:

- Assess the ongoing hazard mitigation activities in the Tulsa community (Chapter 1)
- Identify and assess the hazards that pose a threat to citizens and property (Chapters 2 and 3)
- Evaluate additional mitigation measures that should be undertaken (Chapter 4)
- Outline a strategy for implementation of mitigation measures (Chapter 5)

The objective of this plan is to provide guidance for community activities for the next five years. It will ensure that the City and other partners implement activities that are most effective and appropriate for mitigating natural hazards and hazardous materials incidents.

1.1.2 Scope

The scope of the City of Tulsa Multi-Hazard Mitigation Plan is citywide. It addresses all natural hazards deemed to be a threat to citizens of Tulsa, along with hazardous materials events. Both short-term and long-term hazard mitigation opportunities are addressed, and go beyond existing federal, state and local funding programs.

1.1.3 Authority

Section 409 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288, as amended), Title 44 CFR, as amended by Section 102 of the Disaster Mitigation Act of 2000, provides the framework for State and Local governments to evaluate and mitigate all hazards as a condition of receiving Federal disaster assistance. A major requirement of the law is the development of a local hazard mitigation plan.

1.1.4 Funding

Funding for the City of Tulsa Multi-Hazard Mitigation Plan (first phase) was provided by a 75 percent HMGP grant from FEMA, through the Oklahoma Department of Civil Emergency Management (ODCEM). The local share, 25 percent, was provided by the City of Tulsa.

Federal share	75 %	$70,500
Local share	25%	23,500
Total cost		$94,000

1.1.5 Goals

National Mitigation Strategy and Goal

FEMA has developed ten fundamental principles for the nation's mitigation strategy:

1. Risk reduction measures must ensure long-term economic success for the community as a whole, rather than short-term benefits for special interests.
2. Risk reduction measures for one natural hazard must be compatible with risk reduction measures for other natural hazards.
3. Risk reduction measures must be evaluated to achieve the best mix for a given location.
4. Risk reduction measures for natural hazards must be compatible with risk reduction measures for technological hazards and vice versa.
5. All mitigation is local.

6. Emphasizing proactive mitigation before emergency response can reduce disaster costs and the impacts of natural hazards. Both pre-disaster (preventive) and post-disaster (corrective) mitigation is needed.
7. Hazard identification and risk assessment are the cornerstones of mitigation.
8. Building new federal-state-local partnerships and public-private partnerships is the most effective means of implementing measures to reduce the impacts of natural hazards.
9. Those who knowingly choose to assume greater risk must accept responsibility for that choice.
10. Risk reduction measures for natural hazards must be compatible with the protection of natural and cultural resources.

FEMA's goal is to:

1. Substantially increase public awareness of natural hazard risk so that the public demands safer communities in which to live and work
2. Significantly reduce the risk of loss of life, injuries, economic costs, and destruction of natural and cultural resources that result from natural hazards

State of Oklahoma Mitigation Strategy and Goals

The State of Oklahoma has developed a *Strategic All-Hazards Mitigation Plan* to guide all levels of government, business, and the public to reduce or eliminate the effects of natural, technological and man-made disasters. The goals and objectives are:

- Improve government recovery capability.
- Provide pre- and post-disaster recovery guidance.
- Protect public health and safety.
- Reduce losses and damage to property and infrastructure.
- Preserve natural and cultural resources in vulnerable areas.
- Preserve the environment.
- Focus only on those mitigation measures that are cost effective and provide the best benefit to communities.

The key measures to implement these goals include:

- Enhance communication between state and federal agencies and local governments to facilitate post-disaster recovery, and both pre- and post-disaster mitigation.
- Coordinate Federal, State, Local, and private resources to enhance the preparedness and mitigation process.
- Ensure consistency between Federal and State regulations.
- Provide protection from hazards for critical facilities.
- Support legislation that protects hazardous areas from being developed.

City of Tulsa Core Goal

To create a disaster-resistant community and improve the safety and well-being of Tulsans by reducing deaths, injuries, property damage, and environmental and other losses from natural and technological hazards in a manner that advances community goals, quality of life, and results in a more livable, viable, and sustainable community. A detailed description of mitigation goals is presented in Chapter 4.

1.1.6 Definition of Terms

A glossary of terms that are commonly used in hazard mitigation are included in Appendix A.

1.1.7 Point of Contact

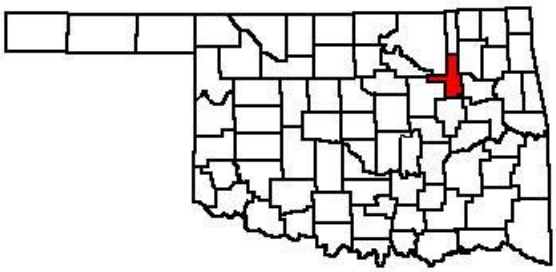
The primary point of contact for information regarding this plan is:

Charles Hardt
Director of Public Works
City of Tulsa
2000 Civic Center
Tulsa, OK 74103
(918) 596-9608

The secondary point of contact is:

Paul Zachary
Deputy Director for Engineering, Public Works
City of Tulsa
2317 South Jackson
Tulsa, OK 74107
(918) 596-9565

1.2 Community Description



Tulsa is faced with a variety of hazards, both natural and man-made. Although in recent years winter storms, tornadoes, and dam releases and floods in Tulsa and northeastern Oklahoma have made national headlines, in fact, any part of the city can be impacted by high winds, drought, hail, lightning, fire, hazardous materials events and other threats. In some cases, such as flooding and dam failure, the areas most at risk have been mapped and delineated. A map of the City of Tulsa with its major streets and highways is shown in Figure 1–1 on the following page.

1.2.1 Geography

Latitude: 36.203 **FIPS:** 040143

Longitude: 95.90

The City of Tulsa is located in northeastern Oklahoma on the Arkansas River on lands that were once part of the Creek and Cherokee nations. Tulsa is Oklahoma's second largest city and the county seat for Tulsa County. It is surrounded by a rapidly growing ring of suburban cities, including Broken Arrow, Bixby, Jenks, Owasso, and Sand Springs. Beyond those suburbs are quiet, backwoods areas.

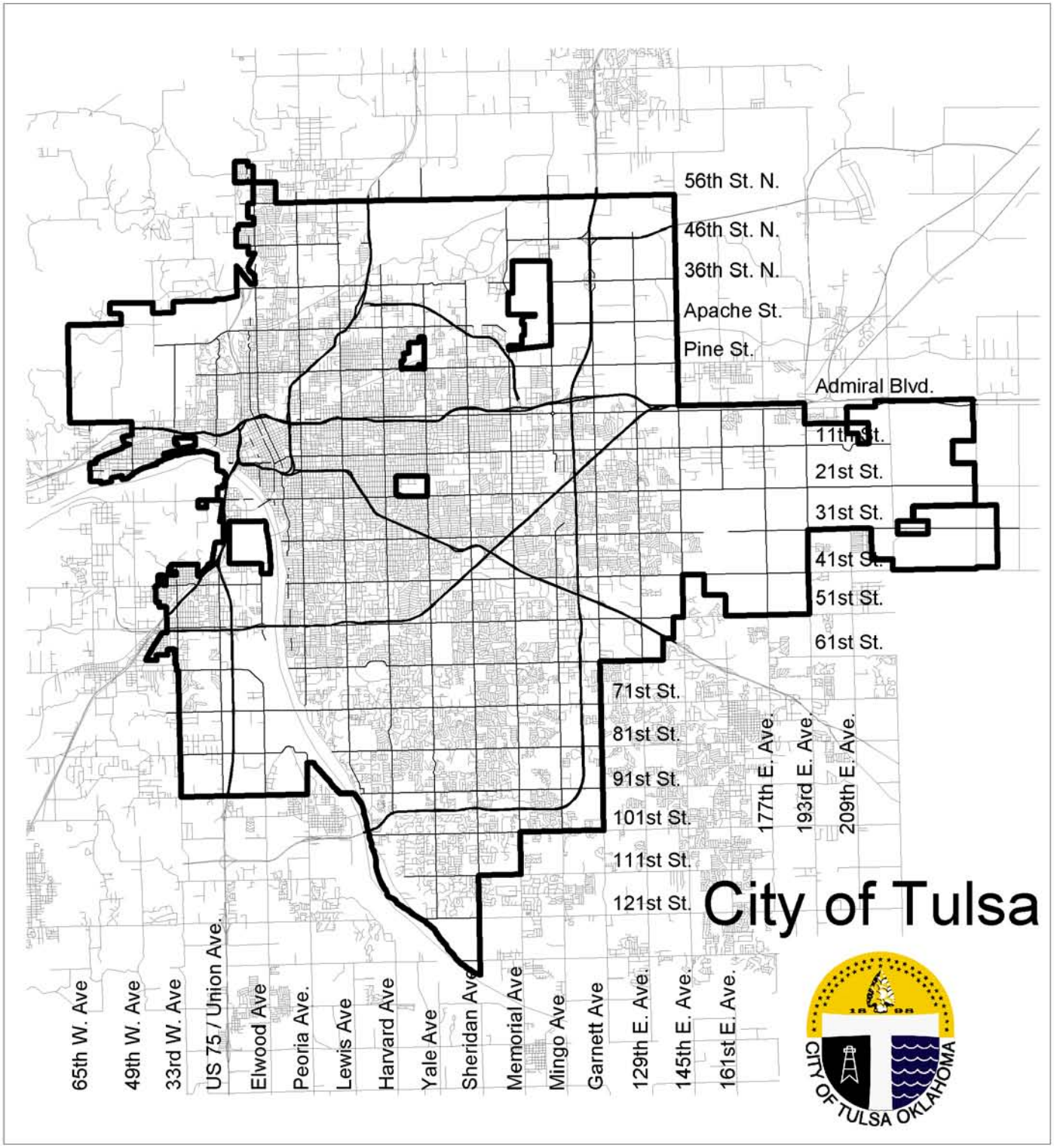
The Tulsa area is part hills and bluffs and part wide prairie, marking the dividing line between the ridges of the Ozarks in the East and the broad plains of the West. The city rests against the southward bend in the Arkansas River. Cattle and horse ranches and rich farmland lie almost within the shadow of urban buildings.

1.2.2 Climate

Tulsa lies at an elevation of 700 feet above sea level, and is far enough south in latitude to miss the extreme cold of winter. The climate is essentially continental, characterized by rapid changes in temperature. The winter months are usually mild. Temperatures occasionally drop below zero, but only for a short time. Temperatures of 100 degrees or higher are often experienced from late July to early September. January's average temperature is 40.6 degrees Fahrenheit and July's average is 79.6 degrees Fahrenheit.

Annual precipitation totals range from a low of 23.24 inches in 1956 to 69.88 inches in 1973. The Tulsa area will receive a wide variety of precipitation (rain, sleet, hail, and snow) throughout any given year and averages 40.68 inches of rainfall each year.

April, May, and June account for 55 percent of all severe weather during a typical year, with 77 percent of the severe weather occurring between the months of March and July. June is the most active month of the year for hail, wind, floods, and tornadoes.



Legend

- Highway
- Interstate
- Main Streets
- Tulsa City Limits

Miles: 1 0.5 0 1 2

R.D. Flanagan & Associates

Figure 1-1
City of Tulsa
Major Streets
and Highways

1.2.3 History

The city now known as Tulsa was first settled by the Lockapoka Creek Indians between 1828 and 1836. Driven from their native Alabama by the forced removal of Indians from southeastern states, the Lockapokas established a new home at a site near Cheyenne and 18th Street. Under a large oak tree, they rekindled their ceremonial fire. This site was abandoned and destroyed during the Civil War, but afterwards the Lockapoka Creeks returned to their home along the Arkansas and relit the council fire.

In 1848, Lewis Perryman, a prominent Creek rancher, opened a cattle ranch and the first trading post near the Lockapoka settlement. His son George built a large white ranch house here, and in March 1878, a mail station was established at the Perryman store. The community served by the station was officially designated as "Tulsa."

The big oil strike at Glenpool in 1905, just 15 miles south of Tulsa, made Oklahoma and Indian Territory the center of oil speculation and exploration. At the time of statehood in 1907, Tulsa's population was 7,298.

By 1920, Tulsa had grown to a city of 72,000, primarily due to oil discoveries. During the 1930s and 1940s, the U.S. Army Corps of Engineers built levees along the Arkansas River, primarily to protect the critical oil refineries during the Second World War. During the war, Tulsa grew in importance as an aviation center, with the Spartan School of Aeronautics and the mile-long Douglas Aircraft plant, which produced bombers. Years later, McDonnell-Douglas and Rockwell International would contribute to the nation's space program and national defense.

The 1950s and 60s saw Tulsa's growth to the south and east, and into the watersheds of Mingo and Joe Creeks. Flooding on the inland creeks and along the Arkansas River became increasing problems as the town continued to expand. The Corps of Engineers completed the Keystone Dam, on the Arkansas River, in 1964. A more detailed discussion of Tulsa's flood history is presented in Chapter 2.

Tulsa enjoyed a period of economic prosperity during the 1970s and early 80s, but with the oil bust of the mid 1980s, Tulsa's economy took a downturn. City leaders searched for opportunities to diversify and to continue to improve the quality of life in one of America's most livable cities. In the year 2000, the focus of community leaders has turned to inner-city redevelopment, sustainable growth, and safety from natural and man-made hazards.

1.2.4 Population and Demographics

Tulsa has a 2000 Census population of 393,049 and a 2002 population of 396,781, which accounts for 48.6 percent of the population in the Tulsa Metropolitan Statistical Area (MSA). The density of Tulsa is 2000 people per square mile, compared with the population density of Tulsa County at 882.6 persons per square mile. The population center is 36th Street South and Pittsburg Avenue. The location of population over age 65 is shown in Figure 1–2, and areas of poverty are shown on the map in Figure 1–3.

Table 1–1: City of Tulsa Population Data

Subject	*Number*
Total Population	393,049
65 years and older	50,508
Poverty Status in 1999 (individuals)	54,121
Language spoken at home (speaks English less than "very well")	
Spanish	13,333
Other Indo-European languages	1,486
Asian and Pacific Island languages	2,461

According to the 2000 Census, the City of Tulsa has a total of 179,491 housing units. Census data and Tulsa County Assessor's Office data are structured differently and do not necessarily agree, so they are shown in separate tables, 1–2 and 1–3.

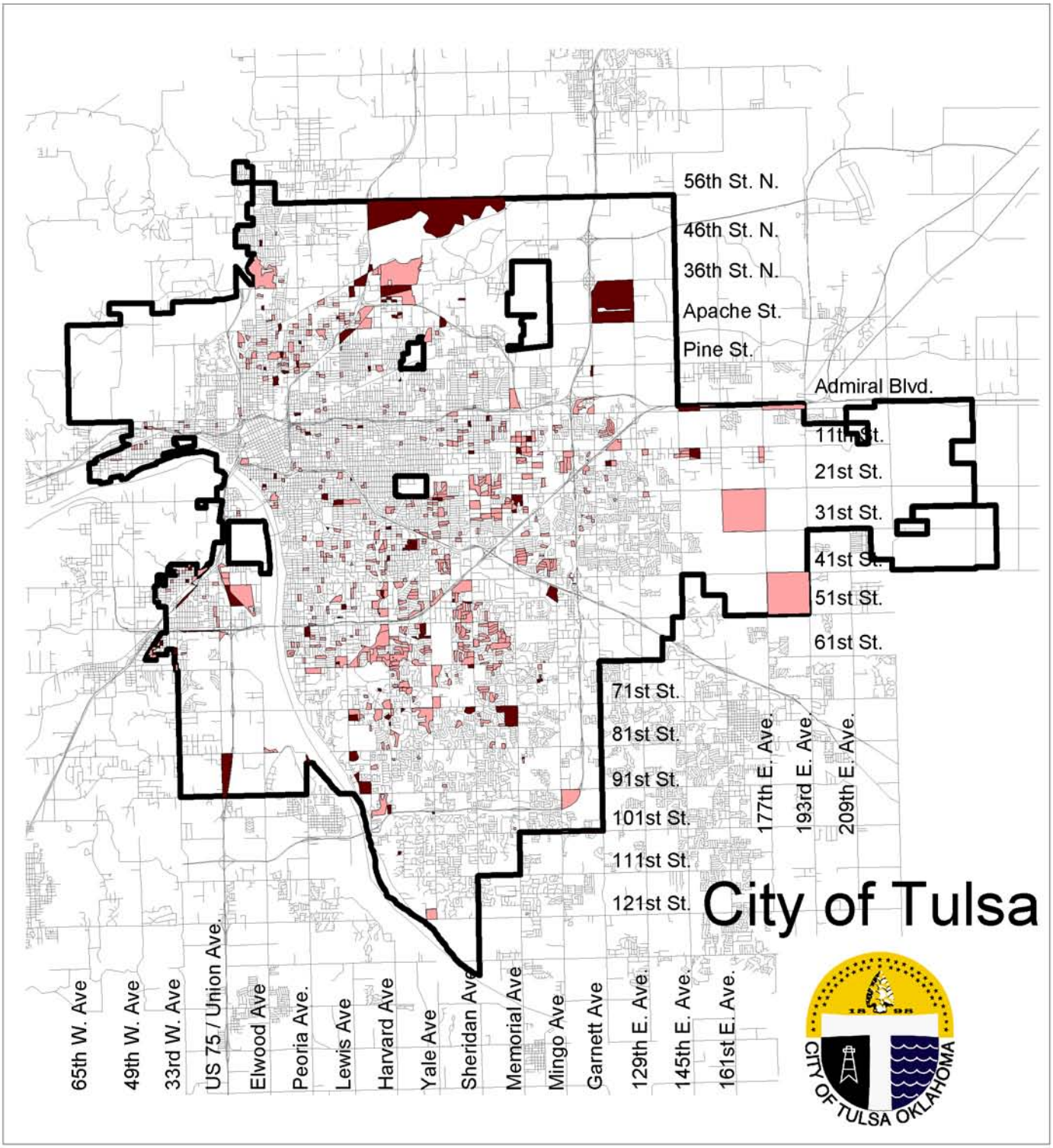
Table 1–2: City of Tulsa Housing Units, By Type (Census)

Housing Unit Type	*Number*
Single-family	117,600
Multi-family	59,050
Mobile homes	2,626
Boat, RV, van, etc.	215
Total housing units	**179,491**

According to the Tulsa County Assessor's Office, there are 129,794 properties with improvements within the City of Tulsa, with a total value, adjusted for fair market value of $17,235,107,007. Numbers of properties with improvements (buildings, garages, pools, storage, and so forth) and improvement values, by type, are shown in the table below. No land values are included. The locations of mobile homes and mobile home parks are shown on the map in Figure 1–4.

Table 1–3: City of Tulsa Properties and Values, By Improvement Type (Assessor)

Improvement Type on Property	*Number of Properties*	*Total Value*
Single-family	115,791	$10,888,265,645
Multi-family	3,499	1,514,814,899
Residential mobile home	2,626	2,099,689
Commercial	3,122	1,306,767,476
Industrial	2,753	1,126,311,308
Other	2,003	2,396,847,990
Total	**129,794**	**$17,235,107,007**



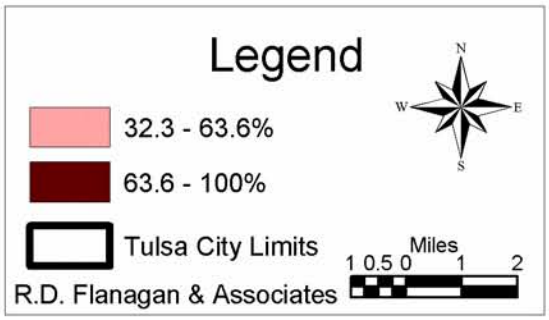
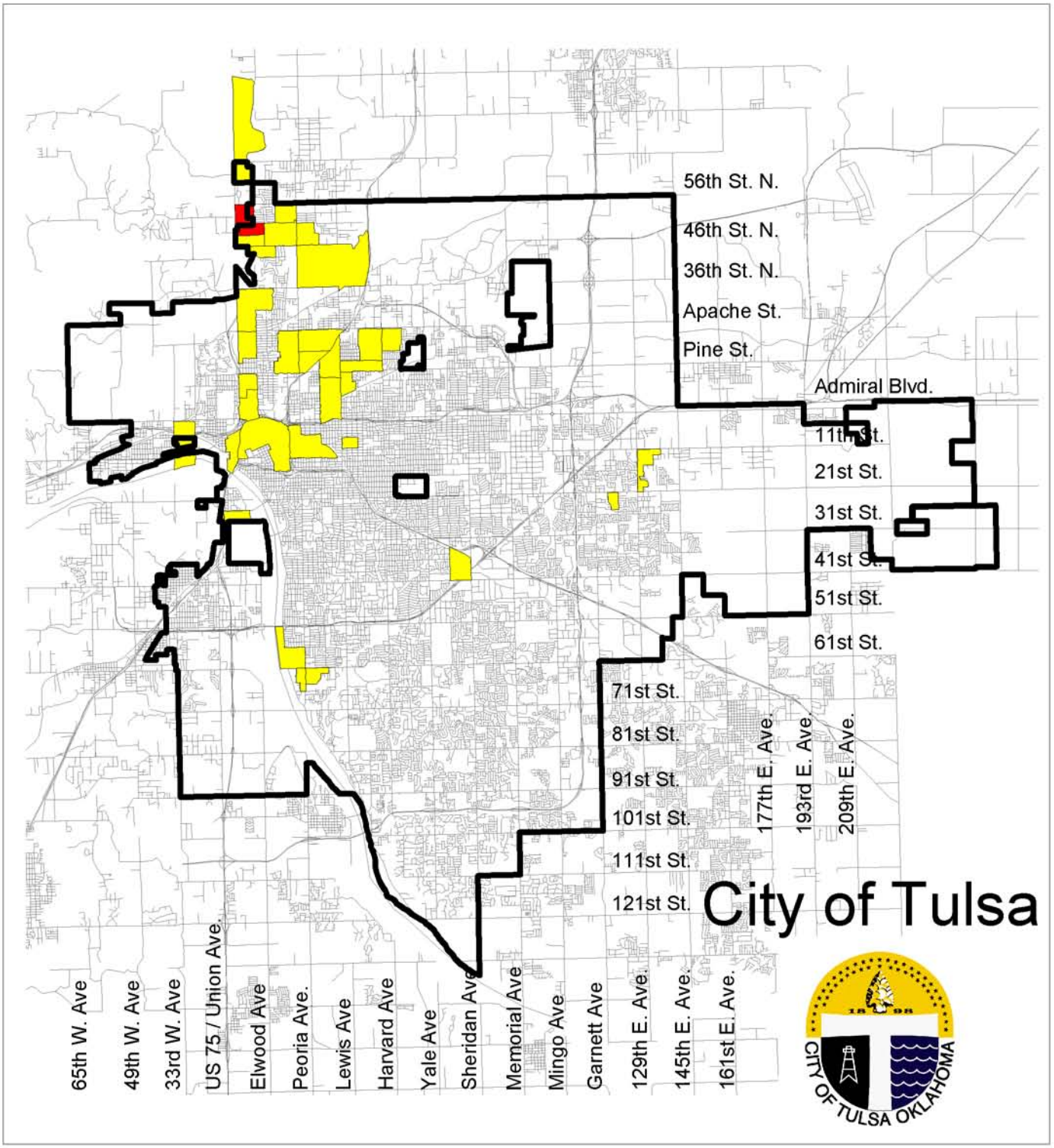


Figure 1-2
City of Tulsa
Population
Age 65 & Older



Legend

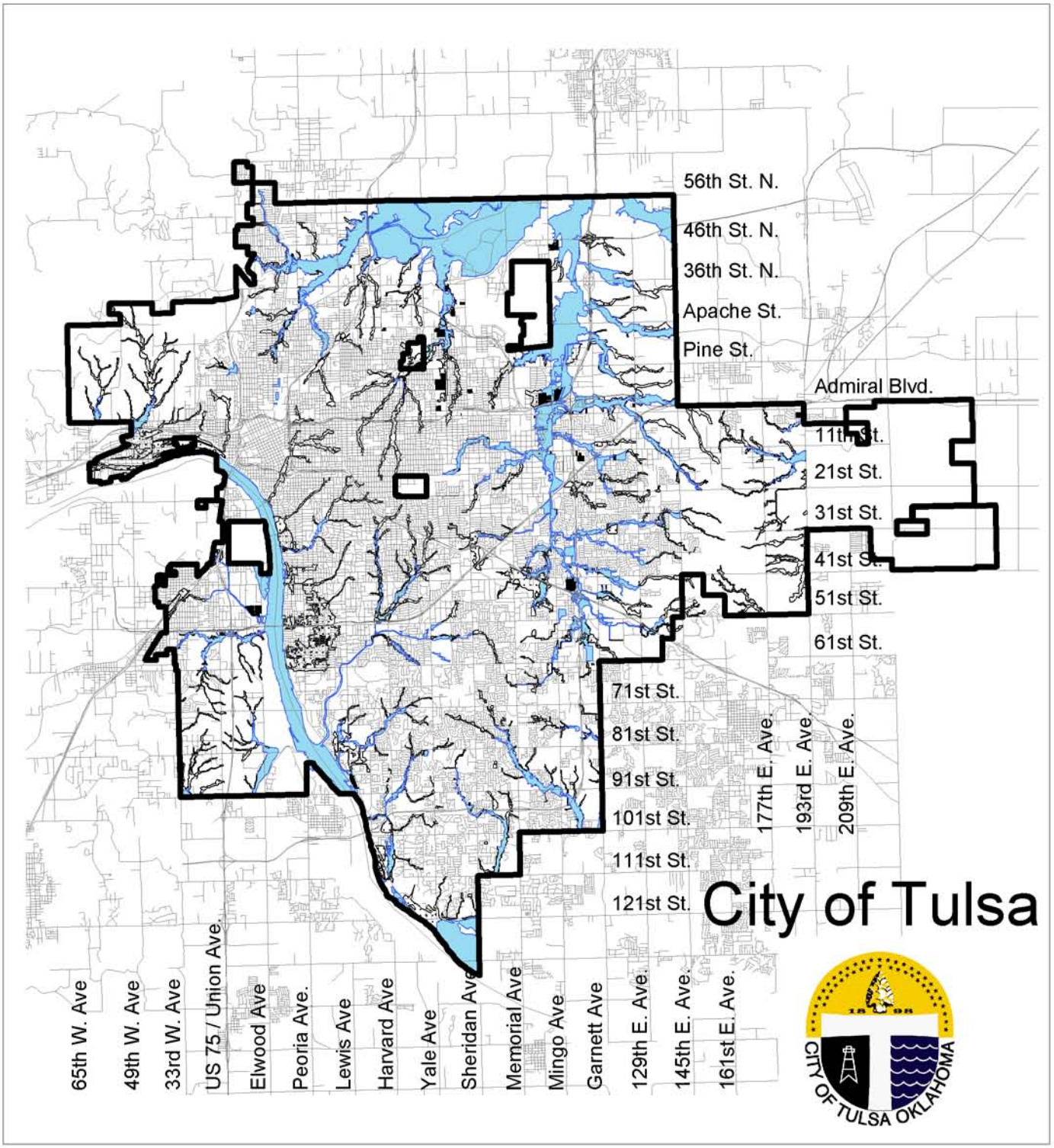
- 30.88% - 55.2%
- 55.2% - 151.72%
- Tulsa City Limits

Miles: 1 0.5 0 1 2

R.D. Flanagan & Associates

Figure 1-3

City of Tulsa
Poverty Levels



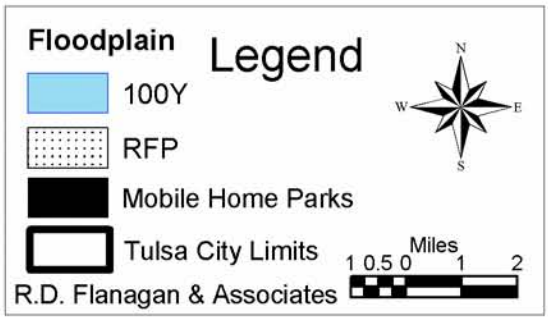


Figure 1-4
City of Tulsa
Mobile Home
Park Properties

1.2.5 Local Utilities—Lifelines

Lifelines are defined as those infrastructure facilities that are essential to the function of the community and the well-being of its residents. They generally include transportation and utility systems. Transportation systems include interstate, US, and state highways, railways, waterways, ports and harbors, and airports. Utility systems include electric power, gas and liquid fuels, telecommunications, water, and wastewater.

The following is a list of companies or entities that supply utilities for the City of Tulsa.

Electric:	AEP Public Service Company of Oklahoma
Water:	City of Tulsa
Sewage:	City of Tulsa
Natural Gas:	Oklahoma Natural Gas
Telephone:	Southwestern Bell Telephone Company and Valor

1.2.6 Economy

According to Dunn & Bradstreet, the City of Tulsa had 24,148 businesses in June 2002 with a combined corporate income of $127.5 billion, 94.6 percent of the corporate income in the Tulsa MSA. The Tulsa MSA accounts for 32 percent of the state's gross domestic product, but only 23.4 percent of the population.

Corporate income in the Tulsa MSA was $134.8 billion in June 2002, up over 10 percent from June the previous year. The number of jobs increased 13.1 percent (47,274 jobs) in the past five years, or 2.6 percent annually. Approximately 28.6 percent of all jobs in the Tulsa MSA are in wealth producing industries such as mining, construction, manufacturing, transportation, communication, and utilities. This compares favorably to the national average of 25.2 percent.

The local inflation rate of 3.0 percent in 2001 was slightly above the national inflation rate. Tulsa's cost of living and quality of life compare favorably to other cities. The average cost of living in the Tulsa MSA in 2001 was 94.1 percent of the national average.

1.2.7 Industry

Petroleum refining and airplane manufacturing are leading industries in the Tulsa area. The largest sub-industry is business services (1,953 businesses), wholesale trade (1,380 businesses), and engineering, accounting, research, and management services (1,341 businesses).

1.2.8 Future Development

Tulsa's population growth rate is 0.7 percent annually. The Tulsa MSA is growing at 1.3 percent, the same as the national growth rate. Comparatively, the State of Oklahoma is growing at 1 percent annually.

Although the obvious direction of Tulsa's growth is south and east, there is great interest among city leaders in redeveloping Downtown Tulsa as the center of culture and the historical heart of the city. The vision of Tulsa's future is already evident in such projects as the Brady District, the Blue Dome District (around Second Street and Detroit Avenue), the Sixth Street Project (which includes the Village at Central Park), the Tribune Lofts at Main and Archer streets, and the Renaissance Uptown Apartments at Tenth Street and Denver Avenue.

One of the keys to the future development of Downtown Tulsa is making use of the structures already in place. In January 2002 Tulsa adopted the International Existing Building Code (IEBC), which makes it possible for entrepreneurs and property owners to use existing structures without being required to make major changes that would be prohibitively expensive.

Another key to future development, mentioned at the Mayor's Vision Summit 2002 (July 9, 2002), is regional coordination. Tulsa' leaders believe the City should expand its vision of development to include those surrounding jurisdictions whose futures are inextricably connected to Tulsa's. These could include Bixby, Broken Arrow, Jenks, Glenpool, Sapulpa, Sand Springs, Owasso, Claremore, and Bartlesville.

Growth Trends

The planning team examined Tulsa's existing city limits, fenceline, and capital improvements plans to determine areas of future growth and expansion. The team examined the Tulsa Metropolitan Area Planning Commission's Comprehensive Plan and detailed District Plans to establish planned future land use, densities, and policies. Areas of future growth include infill and urban redevelopment of the central and older section of the city, the northwest part of Tulsa in Osage County, east of 145th East Avenue between Admiral Boulevard and 51st Street, the newly annexed 13 square miles in Wagoner County, and the southwest section of the city in the Mooser/Hager Creek basin.

Vacant available areas that are not expected to experience much growth pressure include north Tulsa County and the industrial area east of the Tulsa International Airport.

The City of Tulsa has about 61 square miles of vacant, developable land within its city limits, and another 40 square miles within its fencelines designated for future development. A "fenceline" is a narrow strip of annexed land around the perimeter of an area of un-annexed land that a community identifies and claims for future growth to protect the area for annexation.

Northwest-Osage County includes about 10 square miles of undeveloped annexed land, and another 12.5 square miles of undeveloped land within Tulsa's fenceline. The west

loop of the Gilcrease Expressway is being extended to serve this area. The extension of other municipal utilities into the area, such as water and sanitary sewer, is expected to spur development. Due to the rugged nature of the terrain, development will most likely be residential.

North Tulsa County includes 26 square miles around which Tulsa has placed a fenceline. The Comprehensive Plan designates the area primarily as industrial and highway-oriented commercial. The wide expanses of the Bird Creek floodplain are set aside for open space.

Airport Industrial Area, from Tulsa International Airport east to the Rogers County line, encompasses some 14 square miles and is designated for industrial development. This area is served by U.S. Highway 169, the Mingo Valley Expressway. Because it is underlain by massive limestone deposits, it has been difficult and expensive to develop.

East Tulsa, between 145th East Avenue and the Tulsa-Wagoner County line and between Admiral Place and East 51st Street, includes 14 square miles of land planned for mixed uses, primarily residential. The area has been slow to develop due to its limestone outcroppings.

Newly Annexed Wagoner County Area consists of 13 square miles of Fair Oaks. The area is designated for mixed uses, and is served by the recently completed East Creek Turnpike.

The Mooser/Hager Creek Basins, located in southwest Tulsa, include about 10 square miles of scenic, rugged woodland. The area is served by U.S. Highway 75, and is experiencing some recent development activity. The highway corridor is expected to develop with commercial/business park and higher density residential uses, while the balance of the basin is expected to consist of mixed uses, primarily lower-density residential.

The floodplains of the future growth areas have been or are being identified and mapped, and new development will be regulated. The City's ordinances prohibit development and fill in the floodplains. Stormwater detention requirements ensure that no adverse stormwater impact will result from new development. Tulsa's stringent stormwater and floodplain management ordinances and development regulations require that new development occur outside of the 100-year floodplain, and not be damaged or damage other properties due to flooding. In addition, any new critical facilities will be protected to the 500-year flood level. Roadways and bridges are required to pass the 100-year regulatory flood.

The growth areas will all continue to be subject to non-site specific natural hazards, such as tornadoes, lightning, hail, winter storms, extreme heat, drought, expansive soils, urban fires, wildfires, earthquakes, and hazardous materials events. Dam and levee failures are not a problem for these future growth areas. The multi-hazard mitigation measures identified and recommended in this plan should lessen the impacts of natural and man-made hazards on future development and population of the community.

1.3 Regulatory Framework

This section contains the current City of Tulsa ordinances for land use, zoning, subdivision, stormwater management, stream management, and erosion management. It also lists the current building codes and fire insurance rating.

1.3.1 Comprehensive Planning and Zoning

Tulsa's Comprehensive Plan defines policies for providing guidance and direction of the city's physical development. It covers ordinances for land use, zoning and subdivision, and the development of standards for transportation and public facilities. The original plan, adopted in 1924, contained Tulsa's first zoning ordinances. It was revised in 1960, and again in 1976, when a land use plan was added.

The City's zoning ordinances and subdivision regulations are in Title 42, Tulsa Revised Ordinances, "The Tulsa Zoning Code" (1/1/1997) Zoning and Property Restrictions.

1.3.2 Floodplain and Stormwater Management

Tulsa has been a National Flood Insurance Program community since August 3, 1971, number 405381. Tulsa has also been a Class 3 CRS community since October 1, 2000. Refer to the section, "Community Rating System (CRS)" on page 1–16.

Stormwater management, stream management, floodplain management, and erosion control are regulated by Title 11-A, Tulsa Revised Ordinances, "Stormwater Drainage" Chapter 3 (1/1/1997), Watershed Development Regulations.

- Elevation certificates are maintained.
- The City uses a freeboard of one (1) foot.

Tulsa has 29 master drainage plans, developed from 1978 to the present, that cover all floodplains in the City except the recently annexed area referred to as Fair Oaks. See "Flood and Stormwater Management Plans" on page 1–17, below, and Chapter 2, "Floods" for in-depth discussions of flooding.

1.3.3 Building Codes

- Code for existing buildings—ICC International Existing Building Code (11/13/2001), August 2001.
- Building code—Title 51 Building Code (1/1/1998) BOCA National Building Code, 13th Edition, 1996.

1.3.4 Fire Insurance

Tulsa has a Public Protection Class rating of 3 as of June 1, 1994. The City is no longer rated by ISO.

1.4 Existing Hazard Mitigation Programs

To counter pertinent hazards, Tulsa has a host of programs that range from informing people about protection measures, warning the public of impending threats, requiring protection measures to be incorporated in new buildings, acquiring and clearing properties in high hazard areas, and constructing flood control projects. All efforts to mitigate the impact of hazards have helped, but they have not eliminated all potential problems.

The City is currently participating in several programs that address one or more hazards. These programs are described in the following sections.

1.4.1 Community Rating System (CRS)

The CRS is a part of the National Flood Insurance Program that helps coordinate all flood-related activities of the City. Tulsa has participated in the National Flood Insurance Program (NFIP) since 1971 and in the CRS since 1991. The City takes part in the following CRS activities:

- Public information activities
- Mapping and regulatory activities
- Flood damage reduction activities
- Flood preparedness activities

Tulsa advanced from a Class 5 to a Class 3 community in 2000, making the City's flood insurance rates the lowest in the country. The Class 3 rating allows Tulsa's floodplain residents a 35 percent reduction in their flood insurance premium rates.

Tulsa has had 2,431 flood insurance claims totaling $37,422,249 since 1978.

1.4.2 Project Impact / Mayor's Citizen Corps

Project Impact was launched by FEMA in 1998 with a goal of building disaster-resistant communities that will work together to prevent damage and loss of life from disasters. The Tulsa area Project Impact is both a public and private effort that has more than 350 partners. It is an all-hazards program that organizes and promotes voluntary preparedness and mitigation measures. Tulsa was invited to become a Disaster-Resistant Community with Project Impact on June 3, 1998, and was awarded the 1998 "Most Outstanding Model Community."

The Tulsa area Project Impact/Mayor's Citizen Corps is involved in the following activities:

- Risk assessment
- Geographic Information Systems (GIS) development

1.4.3 Flood and Stormwater Management Plans

The first citywide master drainage plan was the *Flood and Stormwater Management Plan 1990–2005*. This plan prioritizes and coordinates the flood protection projects that are detailed in the city's 29 master drainage plans. The last revision of the plan was September 7, 2001. (Refer to Table 2–1, Master Drainage Plans and Basins, in Chapter 2.) The plan oversees the following:

- Capital Improvement Program (see next section)
- Non-Structural Mitigation/Acquisition Priority List

The City later developed the *Flood and Stormwater Management Plan 1999-2014*, published on September 10, 1998. It was developed in accordance with planning criteria from the Community Rating System (CRS), Flood Mitigation Assistance (FMA), and Hazard Mitigation Grant Program (HMGP). Although the 1999-2014 plan primarily dealt with flooding, it also addressed other natural hazards. The *Flood and Stormwater Management Plan* recommended stormwater capital improvements projects. The prioritized list of recommended stormwater projects is located in Appendix B.

1.4.4 Capital Improvements Plan

The City of Tulsa's Capital Improvements Plan lists approved street, building, water, sewer, and stormwater capital improvement needs, their costs, priority, and 5-year funding schedule. Capital improvements projects identified for hazard mitigation purposes—such as flood, tornadoes, high winds, and drought—are listed in Appendix C.

1.4.5 Emergency Operations Plan

The Tulsa Emergency Management Agency's *Emergency Operations Plan* contains a hazard analysis for eight potential disasters. This strategic planning guide coordinates the City's preparedness and response to an emergency or disaster. While it is constantly kept updated, two new parts are planned:

- Public Works Department internal procedures
- Post-disaster mitigation procedures

The warning siren coverage for the City of Tulsa is shown on the map in Figure 1–5.

1.4.6 Critical Facilities

Critical facilities are defined differently by different organizations and agencies, but are usually classified as those facilities that, if put out of operation by any cause, would have a broadly adverse impact on the community as a whole.

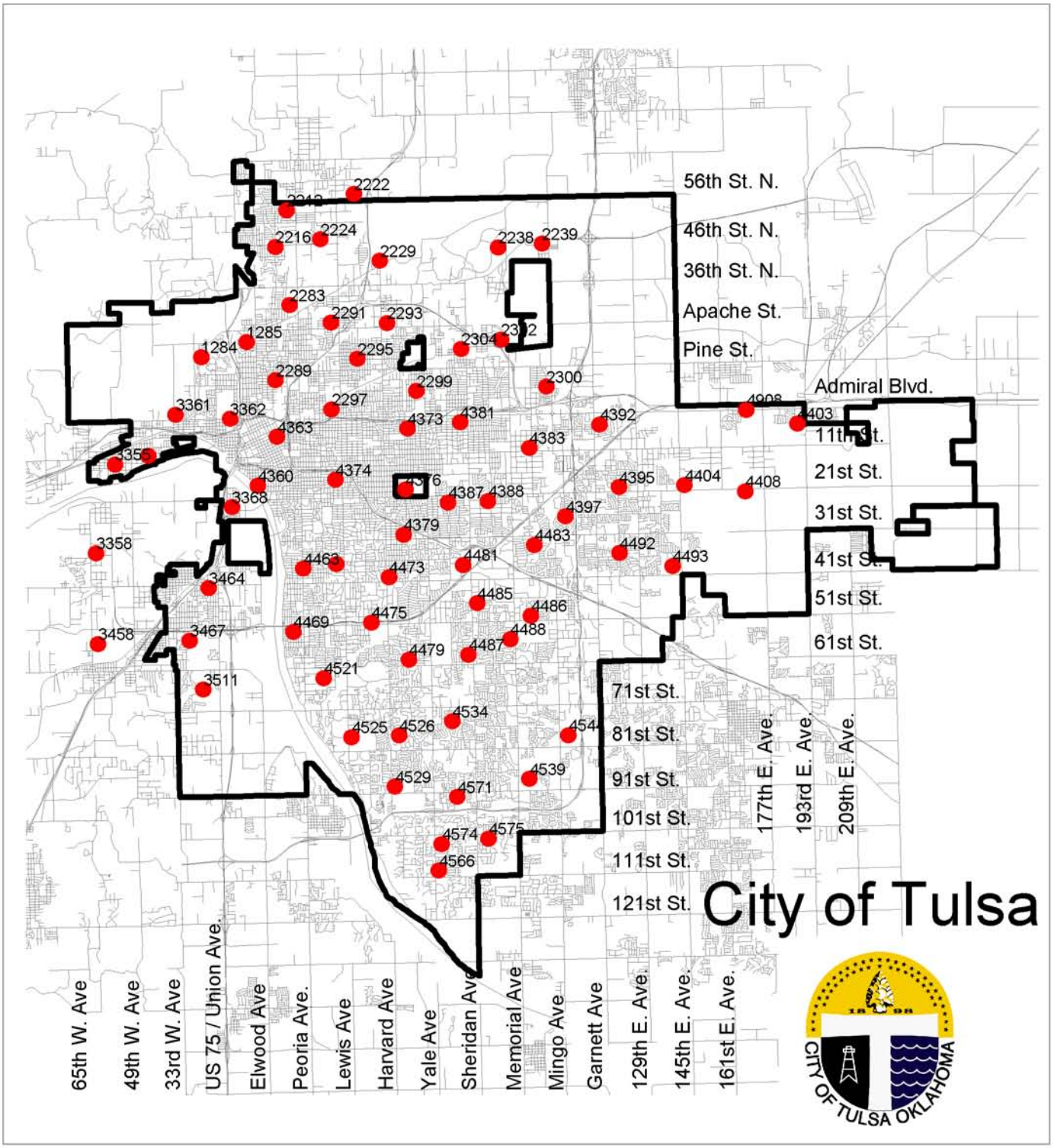
FEMA's definition includes shelters, police and fire stations, schools, childcare centers, senior citizen centers, hospitals, disability centers, vehicle and equipment storage facilities, emergency operations centers, and city halls. Since 9/11, FEMA has added banks and financial institutions to their critical facilities list. Tulsa's critical facilities are listed in Appendix D and shown in Figure 1–6.

FEMA generally separates critical buildings and facilities into five categories:

- **Essential facilities** are essential to the health and welfare of the entire population and are especially important following hazard events. The potential consequences of losing them are so great that they should be carefully inventoried. They include hospitals and other medical facilities, police and fire stations, emergency operations centers, and schools.
- **Transportation systems** include airways (airports), highways (bridges, overpasses, and roadbeds), railways (trackage, bridges, rail yards, and depots), and waterways (canals, locks, and ports).
- **Lifeline utility systems** include potable water, wastewater, oil, natural gas, electric power, and communication systems.
- **High potential loss facilities** are those that would have high financial costs associated with their loss, such as power plants, dams, and military installations.
- **Hazardous materials facilities** include facilities housing industrial and hazardous materials, such as corrosives, explosives, flammable materials, radioactive materials, and toxins.

1.4.7 City of Tulsa Buildings

The City has identified priority facilities, owned and operated by the City, essential to maintaining critical services during an emergency or disaster period. Initial vulnerability assessments have been conducted for the selected buildings/facilities to identify potential problem areas or risks that could impact City operations or business functions. City buildings are listed in Appendix E.



Legend

Sirens

Tulsa City Limits

10.50 1 2 Miles

R.D. Flanagan & Associates

Figure 1-5

City of Tulsa Warning Sirens

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For more information, contact information can be located on page xviii.

1.5 The Planning Process

Because several of the hazard mitigation programs were developing or revising plans or activities during the year, it was determined that a coordinated, multi-hazard planning process was needed.

The *Multi-Hazard Mitigation Plan* updates and expands the *Flood and Stormwater Management Plan* (see "Flood and Stormwater Management Plan" on page 1–17 for information). The City of Tulsa Department of Public Works is responsible for this plan, with assistance and participation of the Indian Nations Council of Governments (INCOG), the regional planning agency, and the Tulsa Area Emergency Management Agency (TAEMA).

Simply stated, a mitigation plan is the product of a rational thought process that reviews the hazards, measures their impacts on the community, identifies alternative mitigation measures, and selects and designs those that will work best for the community.

This plan addresses the following hazards:

Floods	Expansive Soils
Tornadoes	Urban Fires
High Winds	Wildfires
Lightning	Earthquakes
Hailstorms	Hazardous Materials Events
Severe Winter Storms	Dam Failures
Extreme Heat	Levee Failures
Drought	

The planning for Tulsa followed a ten-step process, based on guidance and requirements of FEMA. The ten steps are described below.

1.5.1 Step One: Organize to Prepare the Plan

(October 2001-November 2001)
Citizens and professionals active in disaster planning, response, and mitigation provided important input in the development of the plan and recommended goals and objectives, mitigation measures, and priorities for actions.

The planning process was formally created by resolution of the City Council, which established the Tulsa Hazard Mitigation Citizens Advisory Committee (THMCAC) to oversee the planning effort.

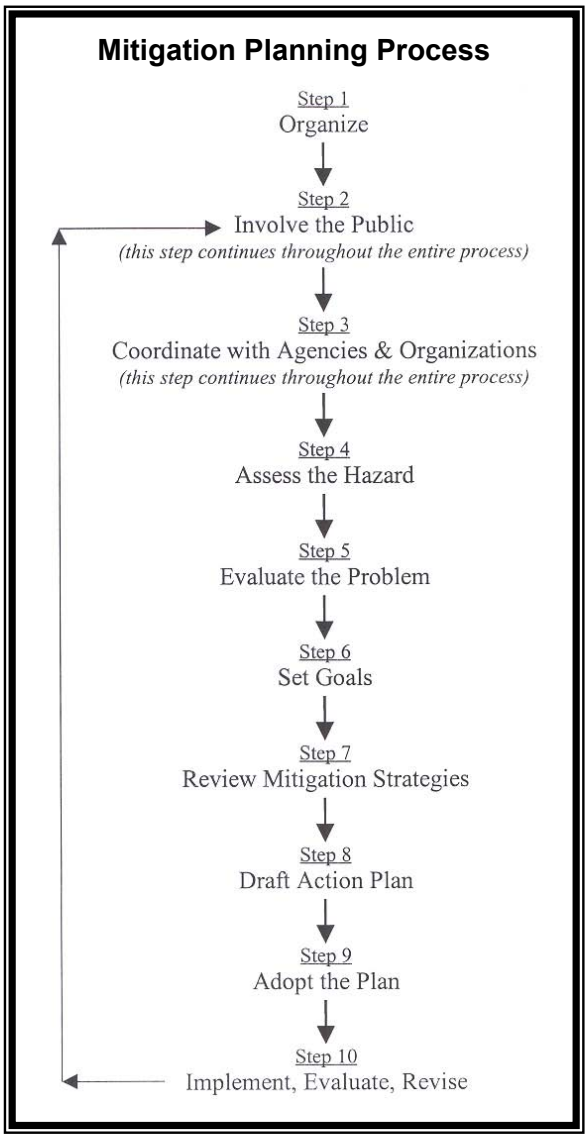
The Committee consists of the five members of the Stormwater Drainage Advisory Board and the five members of the Project Impact Executive Committee. The THMCAC members are:

Stormwater Drainage Advisory Board

- Dwayne Wilkerson, Chairman
- June Mustari, Board Member
- Royce Bentley, Board Member
- Nancy Kincaid-Deacon, floodplain resident, citizen leader-activist
- David Kollman, Board Member

Project Impact Advisory Board

- Sandy Cox, Chair, Project Impact and Mayor's Citizens Corps
- J.D. Metcalfe, former City Commissioner, member Utility Board, Board of Directors, Project Impact
- John Westmoreland, Retired Vice-President, State Farm Insurance, Vice-Chair, Project Impact
- Neal McNeill, former Tulsa City Attorney
- Bob Roberts, American Red Cross



Supporting the Committee is the Tulsa Staff Technical Advisory Committee (TSTAC), which includes representatives of every city department that has a role in hazards protection, along with TAEMA and INCOG. Most of the detail work was done by a management team of the following staff and consultants:

- Mike L. Buchert, P.E., Team Leader, Assistant Director, Public Works
- Kenneth Hill, Manager, Planning and Coordination
- Brent Stout, Senior Engineer
- Ann Patton, Executive Director, Tulsa Project Impact
- Pat Hoggard, City Council Liaison
- Laureen Gibson Gilroy, Community Affairs and Planning
- Ron Flanagan, CFM, Principal Planner, R.D. Flanagan & Associates

- Janet Meshek, P.E., CFM, President, Meshek Engineering, Inc.
- Gaylon Pinc, P.E., Manager, Environmental Engineering, INCOG

The expanded TSTAC met with the THMCAC four times during the year's planning process. This included:

- Charles L. Hardt, P.E., Director, Public Works, and Chief Operations Officer, City of Tulsa
- Paul D. Zachary, P.E., CFM, Deputy Director for Engineering Services
- Mike McCool, Director, Tulsa Area Emergency Management Agency
- Jack Page, P.E., CFM, City of Tulsa Floodplain Administrator & Deputy Director for Development Services
- Deborah K. Stowers, P.E., CFM, Manager, Stormwater Design
- Ray Jordan, P.E., Tulsa County Engineer
- Kim MacLeod, Community Affairs & Planning
- Clayton Edwards, Deputy Director for Environmental Operations
- Larry Bottoms, Deputy Director for Public Facilities Maintenance
- Greg Warren, ASLA, Park Department
- Roger Sharp, Tulsa Fire Department
- Rick Myscofski, Tulsa City-County Health Department
- Brett Bailey, Tulsa Police Department
- Charlie Jackson, Tulsa Police Department
- Pat Treadway, Urban Development Department

Consultants:

- Janet K. Meshek, P.E., CFM, President, Meshek Engineering, Inc.
- Ronald D. Flanagan, CFM, Principal Planner, R.D. Flanagan & Associates
- French Wetmore, CFM, Senior Planner, French & Associates, Ltd.

The THMCAC met monthly at City Hall during the planning process to review progress, identify issues, receive task assignments, and advise the staff. Table 1–4 on the next page shows a list of THMCAC meetings and dates. See Appendix F for meeting agendas.

Table 1–4: Tulsa Hazard Mitigation Citizens Advisory Committee Meetings and Activities

Date	***Activity***
Oct. 31, 2001	Initial Tulsa Staff Technical Advisory Committee (TSTAC) meeting to overview the planning process, timelines, and meeting schedules, draft a resolution, and identify hazards. Tulsa Hazard Mitigation Citizens Advisory Committee (THMCAC) meeting
Nov. 13, 2001	TSTAC meeting
Dec. 11, 2001	TSTAC meeting
Dec. 19, 2001	THMCAC meeting: Overview of planning process, timelines, meeting schedule, draft resolution, and hazards identification.
Jan. 8, 2002	TSTAC meeting
Jan. 16, 2002	THMCAC meeting: Draft resolution and review planning process.
Feb. 12, 2002	TSTAC meeting
Feb. 20, 2002	THMCAC meeting: Identify mitigation measures and goals and discuss hazards workshop.
March 12, 2002	TSTAC meeting
March 20, 2002	THMCAC meeting: Identify hazards and agencies.
April 9, 2002	TSTAC meeting
April 10, 2002	TSTAC and Agency Workshop planning meeting
April 17, 2002	THMCAC meeting: Convened at HM Workshop, 4/23/02
April 23, 2002	Regional Multi-Hazard Mitigation Workshop, Tulsa Garden Center
May 7, 2002	TSTAC meeting
May 15, 2002	THMCAC meeting: Review hazards and mitigation measures.
June 11, 2002	TSTAC meeting
June 13, 2002	Regional Hazard Mitigation Measures Workshop, Tulsa Homebuilders Association
June 19, 2002	THMCAC meeting: Review workshop mitigation measures and review recommended Capital Improvements Projects.
July 10, 2002	TSTAC meeting
July 17, 2002	THMCAC meeting
July 18, 2002	Tulsa Stormwater Drainage Advisory Board meeting: Hazard Mitigation Report
July 19, 2002	Tulsa All-City/Agency Public Information Officer meeting
Aug. 1, 2002	TSTAC public forum planning/project status meeting
Aug. 9, 2002	T Staff/Agency public forum planning meeting
Aug. 20, 2002	Public meeting at Union High School: Review recommended mitigation measures and hazard mitigation action plan
Aug. 21, 2002	THMCAC meeting, City Hall: Review public meeting
Sept. 10, 2002	TSTAC meeting, City Hall
Sept. 18, 2002	THMCAC meeting, City Hall: Review final plan recommendations, time schedule

Date	Activity
Oct. 8, 2002	TSTAC meeting: Review final plan draft
Oct. 16, 2002	THMCAC meeting, City Hall: Review Safe and Secure Plan
Oct. 23, 2002	Tulsa Metropolitan Area Planning Commission committee work session: Tulsa Multi-Hazard Mitigation Plan overview/orientation
Oct. 30, 2002	THMCAC meeting: Review/approval of Tulsa Multi-Hazard Mitigation Plan
Nov. 5, 2002	City Council Public Works Committee, Review of Tulsa Multi-Hazard Mitigation Plan, consider resolution.
Nov. 6, 2002	THMCAC Meeting, City Hall; Review, recommend approval of Final Plan document
Nov. 12, 2002	City Council Public Works Committee review of HM Plan
Nov. 13, 2002	Tulsa Metropolitan Area Planning Commission: Tulsa Multi-Hazard Mitigation Plan presentation, adoption, and recommendation
Nov. 21, 2002	City Council Public hearing on Multi-Hazard Mitigation Plan (continued 12/05/02)
Dec. 3, 2002	City Council Public Works Committee review of Tulsa Multi-Hazard Mitigation Plan
Dec. 5, 2002	City Council public hearing on Tulsa Multi-Hazard Mitigation Plan: Approval and adoption
Dec. 10, 2002	City Council Public Works Committee, Resolution amending the Tulsa Metropolitan Area Comprehensive Plan, adopting the Tulsa Multi-Hazard Mitigation Plan
Dec. 12, 2002	Approval of Tulsa Multi-Hazard Mitigation Plan by Mayor, submission to Oklahoma Department of Civil Emergency Management

1.5.2 Step Two: Involve the Public

(November 2001 – October 2002)
The THMCAC and the TSTAC management team undertook a number of initiatives to inform the public of this effort and to solicit their input. These activities included news releases, articles in *City Life*, public meetings, progress reports on the City's web site, speaker's bureau talks, and maximum use of the Project Impact committees and partners. A Public Works comment form and a Flooding and Drainage Problem comment form were distributed.

All meetings of the THMCAC were publicly posted, as required by ordinance. Public meetings were held at the beginning of the planning process. Workshops were used to review the hazards and to identify and develop mitigation measures. These workshops were held at the Tulsa Garden Center on April 23, 2002, and at the Tulsa Metropolitan Area Homebuilder's Association, June 13, 2002. A public meeting was held on August 20, 2002, at Union High School to review the final draft.

1.5.3 Step Three: Coordinate with Other Agencies and Organizations

(November 2001 – August 2002)
There are many public agencies, private organizations, and businesses that contend with natural hazards. Management team members contacted them to collect information on the hazards, and determine how their programs could best support the City's mitigation program.

The Public Works Department, with input and assistance from other agencies and organizations, manages the CRS, Project Impact, and the stormwater management planning process. The Emergency Operations Plan is administered under the Tulsa Area Emergency Management Agency (TAEMA), but the Public Works Department plays a key role during most emergencies and is the Incident Commander during certain events, including flooding. The CRS and Stormwater Plan are flood- and stormwater-oriented, while Project Impact and the Emergency Operations Plan deal with multiple hazards.

Among the organizations and agencies contacted were:

Federal

Federal Emergency Management Agency (FEMA)
US Army Corps of Engineers
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 Department of Civil Emergency Management

Oklahoma Water Resources Board

- State National Flood Insurance Program (NFIP) Coordinator
- State Dam Safety Coordinator

Oklahoma Conservation Commission
Oklahoma Department of Wildlife Conservation
Oklahoma Department of Labor
Oklahoma Geological Survey
Oklahoma Department of Environmental Quality

Regional

Indian Nation Council of Governments

County

Tulsa County
Tulsa City/County Health Department
Tulsa Area Emergency Management Agency

Tulsa

Tulsa Project Impact
Mayor's Citizen Corps
Mayor's Office for Neighborhoods, Mayor's Good Neighbor Alliance
Community Service Council
Tulsa Area Agency on Aging
Tulsa Fire Department
Tulsa Police Department

Other Communities

The planning process also actively involved the adjacent jurisdictions and communities. A multi-jurisdictional plan was developed for the Polecat Creek watershed, some 370 square miles, and individual plans were developed for Creek County, Washington County, and the cities of Bartlesville, Sapulpa, Glenpool, Bixby, and Jenks. Each community had staff technical advisory committees and citizen advisory committees appointed by the local governing bodies and designated by official resolution. These communities were invited to participate in Tulsa's planning process, and many staff and Citizen Advisory Committee members attended Tulsa-sponsored committee and public meetings and hazard mitigation workshops.

1.5.4 Step Four: Assess the Hazard

(November 2001 – December 2001)

In 1998, Tulsa's Project Impact began identifying natural and man-made hazards that affect Tulsa. Project Impact assembled community leaders and disaster professionals from throughout the community to identify those hazards to which Tulsa's citizens and property were most vulnerable. A comprehensive list of over 20 natural and man-made hazards were initially considered for investigation:

Natural Hazards Considered:

Dam Break
Earthquake
Flood
Hail
Winter/Ice Storm
Summer Heat
Drought
Lightning
Tornado
Wildfire

Man-Made Hazards Considered:

Bioterrorism Incident
Chemical Terrorism
Civil Disturbance/Riot
Cyber Terrorism
Fixed Facility Hazardous Materials
Transportation Hazardous Materials
Infectious Pandemic
Utility Outage
Nuclear Incident

The Project Impact Citizens Advisory Committee, disaster staff professionals, and the Indian Nations Council of Governments (INCOG), reduced this list to the seven hazards most likely to impact the Tulsa area. The hazards to be initially assessed included: floods, dam breaks, hail, snow and ice storms, summer drought and heat, tornadoes, and hazardous materials releases.

The results of the initial Project Impact/INCOG assessment were mapped in GIS, and published, *Community Risk Assessment, City of Tulsa and Tulsa County,* November 2001. The analysis of these seven hazards included their impacts upon critical facilities, on society, the environment, the economy, and on future development.

City of Tulsa Multi-Hazard Mitigation Plan

In 2001, the City of Tulsa applied to the Oklahoma Department of Civil Emergency Management and FEMA for a Hazard Mitigation Grant Program (HMGP) project to further develop and refine Tulsa's multi-hazard mitigation planning process and plan. The State approved Tulsa's HMGP application to develop a multi-hazard mitigation plan in conformance with the Oklahoma Strategic All-Hazards Mitigation Plan. The State Plan identified 10 hazards which should be addressed by the local plans, including: floods, dam failures, tornadoes, severe thunderstorm winds and hail, earthquakes, winter storms, urban and wildfires, hazardous materials incidents, drought, and terrorism.

The Tulsa Hazard Mitigation Citizens Advisory Committee reviewed the natural and man-made hazards that could potentially impact the Tulsa area and selected and prioritized the hazards to be included in the study. The management team collected data on the hazards from available sources, including historical incidents and disaster declarations, records from the National Climatic Data Center, input from federal and state emergency management agencies, the National Weather Service, local governmental entities, and community service organizations, such as the Red Cross. No new engineering studies were undertaken, except for floodplain management data collection and analysis. The hazard assessment justification and methodology are included in Chapters 2 and 3, with the discussion of each hazard.

The Tulsa Multi-Hazard Mitigation Plan addresses 15 hazards. These are listed in Table 1–5, below, along with how they were identified and why they were included in the Plan.

Table 1–5: How and Why these Hazards were Selected

Hazard	*How Identified*	*Why Identified*
Floods	• Review of FEMA and City floodplain maps • Review of Disaster Declarations • 8,690 buildings in the floodplains • 123 NFIP Repetitive Loss Properties • Historical floods and damages (detailed in Chapter 2)	• 10% of City land is located in floodplains • 1984 flood caused $180 million in damage • 1984 flood killed 14 people • Flood damage occurs every year • Over $1 billion of property at risk

Hazard	*How Identified*	*Why Identified*
Tornadoes	• Review of recent disaster declarations • Input from Emergency Manager • Input from citizens' questionnaires • Consensus of Hazard Mitigation Citizens Advisory Committee • Review of data from the National Climatic Data Center	• Tulsa is located in "Tornado Alley" • An average of 52 tornadoes per year strike Oklahoma • Recent disaster events and damage • Oklahoma City tornado of 1999 killed 42 people and destroyed 899 buildings • All citizens and buildings are at risk • 8 deaths, and over $350 million in property damage in 50 years in Tulsa County
High Winds	• National Weather Service data • Loss information provided by national Insurance Companies	• 147 high wind-related events in Tulsa County in the last 5 years, and over $400,000 in damage
Lightning	• National Climatic Data Center information and statistics	• Oklahoma ranks 15th in lightning related casualties • 88 deaths and 243 injuries over 36 years due to lightning
Hailstorms	• National Climatic Data Center and State Disaster Declarations	• 33 hail damage events in Tulsa over the last 5 years • Over $3 million in property damage
Severe Winter Storms	• Review of past disaster declarations • Input from Tulsa Area Emergency Management Agency (TAEMA) • Input from Tulsa Department of Public Works • Input from area utility companies	• Severe winter storms are an annual event in the Tulsa area • Wide-spread economic disruption • Massive public utility outages • Two winter storm-related Federal Disaster Declarations in the past 2 years, requiring over $330 million in Federal assistance
Extreme Heat	• Review of number of heat-related deaths and injuries during hot Oklahoma summers • Review of data from National Climatic Data Center and National Center for Disease Control	• TAEMA and local community service organizations have made heat-related deaths a high priority • High percentage of poor and elderly populations at risk • 44 heat-related deaths in Oklahoma in the last 5 years
Drought	• Historical vulnerability to drought, the "Dust Bowl" era • Recent (2002) drought and water shortages in Bartlesville • Input from Tulsa Utility Board and Department of Public Works	• Continuing mid-west and western drought and impacts on Oklahoma communities, including neighboring Bartlesville • Acute awareness of Oklahoma's population to the severe results of drought • Need to ensure adequate long-

Hazard	*How Identified*	*Why Identified*
		term-water resources for Tulsa's metropolitan area population
Expansive Soils	• Input from INCOG • Input from City Building Inspections Department • Review of Soil Conservation data • Input from Oklahoma Department of Transportation	• Expansive soils are prevalent in the Tulsa area • Damage to buildings from expansive soils can be mitigated with public information and building code provision
Urban Fires	• Data and input from the Tulsa Fire Department	• Older, deteriorating frame homes with substandard heating • Severe winter storms • Continuing loss of life and property due to house fires
Wildfires	• Input from Tulsa Fire Department • Input from area Rural Fire Depts. • Input from surrounding county & community fire departments • Input from State Fire Marshal	• Fires of the urban/rural interface threaten Tulsa properties • Hundreds of miles of Tulsa's perimeter are exposed and vulnerable to wildfires
Earthquakes	• Historic records of area earthquakes • Input from Oklahoma Geological Survey • Input from USGS	• Tulsa area has a history of mild earthquakes • Tulsa County has experienced earthquakes on the average of once every 5 years
Hazardous Materials Events	• Input from Local Emergency Planning Committee (LEPC) • Input from TAEMA • Input from Oklahoma Dept. of Environmental Quality • Input from Emergency First Responders (Tulsa Fire and Police Departments)	• Many hazardous materials sites scattered throughout the community • Major trafficways expose large populations to potential trafficway haz-mat incidents
Dam Failures	• Keystone Dam 15 miles upstream from Tulsa • Dam releases and floods in 1986 and 1989 • Input from US Army Corps of Engineers (USACE) • Input from Okla. Water Resources Board, (OWRB), Dam Safety Division • Input from Tulsa Hazard Mitigation Citizens Advisory Committee (THMCAC)	• Population and buildings below dam are very vulnerable in event of release or dam failure • Dam break/release contingency plan needs updating • Warning systems need to be updated and refined • Various dam release rates, i.e., 250, 350, 450 cfs should be GIS mapped, and properties at risk identified
Levee Failures	• Historic flooding behind levees • Input from Dept. of Public Works • Input from USACE	• City considering redevelopment options for areas behind levees

1.5.5 Step Five: Assess the Problem

(November 2001 – February 2002)
The hazard data were analyzed in light of what it means to public safety, health, buildings, transportation, infrastructure, critical facilities, and the economy. Much of the initial work for Steps 4 and 5 had already been done by INCOG as a Project Impact assignment. INCOG prepared several analyses using its geographic information system (GIS). The City used GIS modeling and historical data to estimate potential losses from the various hazards. The discussion of the problem and vulnerability assessment for each hazard is presented for floods in Chapter 2, and other hazards in Chapter 3.

1.5.6 Step Six: Set Goals

(February 2002 –March 2002)
Project and community hazard mitigation goals and objectives for Tulsa were set by the THMCAC to guide the development of the Plan. The goals, in the national and state context are discussed in Chapter 1, and individual hazard goals and the goals-setting process are described in Chapter 4.

1.5.7 Step Seven: Review Possible Mitigation Measures

(March 2002 – July 2002)
A wide variety of mitigation measures that can affect hazards or the damage from hazards were examined. These mitigation activities are organized under the following six categories (see Chapter 4, "Mitigation Strategies," for a more detailed description of each category):

1. **Public Information and Education—**Outreach projects and technical assistance
2. **Preventive Activities**—Zoning, building codes, stormwater ordinances
3. **Structural Projects**—Levees, reservoirs, channel improvements, safe rooms
4. **Property Protection**—Acquisition, retrofitting, insurance
5. **Emergency Services**—Warning, sandbagging, evacuation
6. **Natural Resource Protection**—Wetlands protection, best management practices

1.5.8 Step Eight: Draft an Action Plan

(July 2002 – October 2002)
The results of the mitigation activities review are summarized in the Action Plan. The Action Plan specifies what will be done, by what office, and by what deadline. The draft Action Plan was widely circulated for comment and reviewed at public meetings. It is presented in Chapter 5.

1.5.9 Step Nine: Adopt the Plan

(November 2002 –December 2002)
After the public review, the THMCAC settled on the Final Plan and submitted it to the Mayor and City Council for action. It was also submitted through the Tulsa Metropolitan Area Planning Commission and adopted as a part of the City's Comprehensive Plan.

1.5.10 Step Ten: Implement, Evaluate, and Revise

(January 2003 – 2008)

The City's adoption of the Multi-Hazard Mitigation Plan is only the beginning of this effort. City offices, other agencies, and private partners will implement the Plan's activities. The THMCAC will monitor implementation progress, evaluate the effectiveness of the actions, and periodically recommend revisions to the action items. Progress in the implementation of the Plan and the recommended action/mitigation measures will be assessed annually. The Plan will be updated every five years.

Chapter 2:

Floods

Chapter 2: Floods

Flooding is defined as the accumulation of water within a waterbody and the overflow of excess water onto adjacent floodplain lands. Floodplains are the lands adjoining the channel of a river, stream, ocean, lake, or other watercourse or waterbody that are susceptible to flooding.

2.1 Hazard Profile

Floods are the most common and widespread of all natural disasters in the United States—except fire.

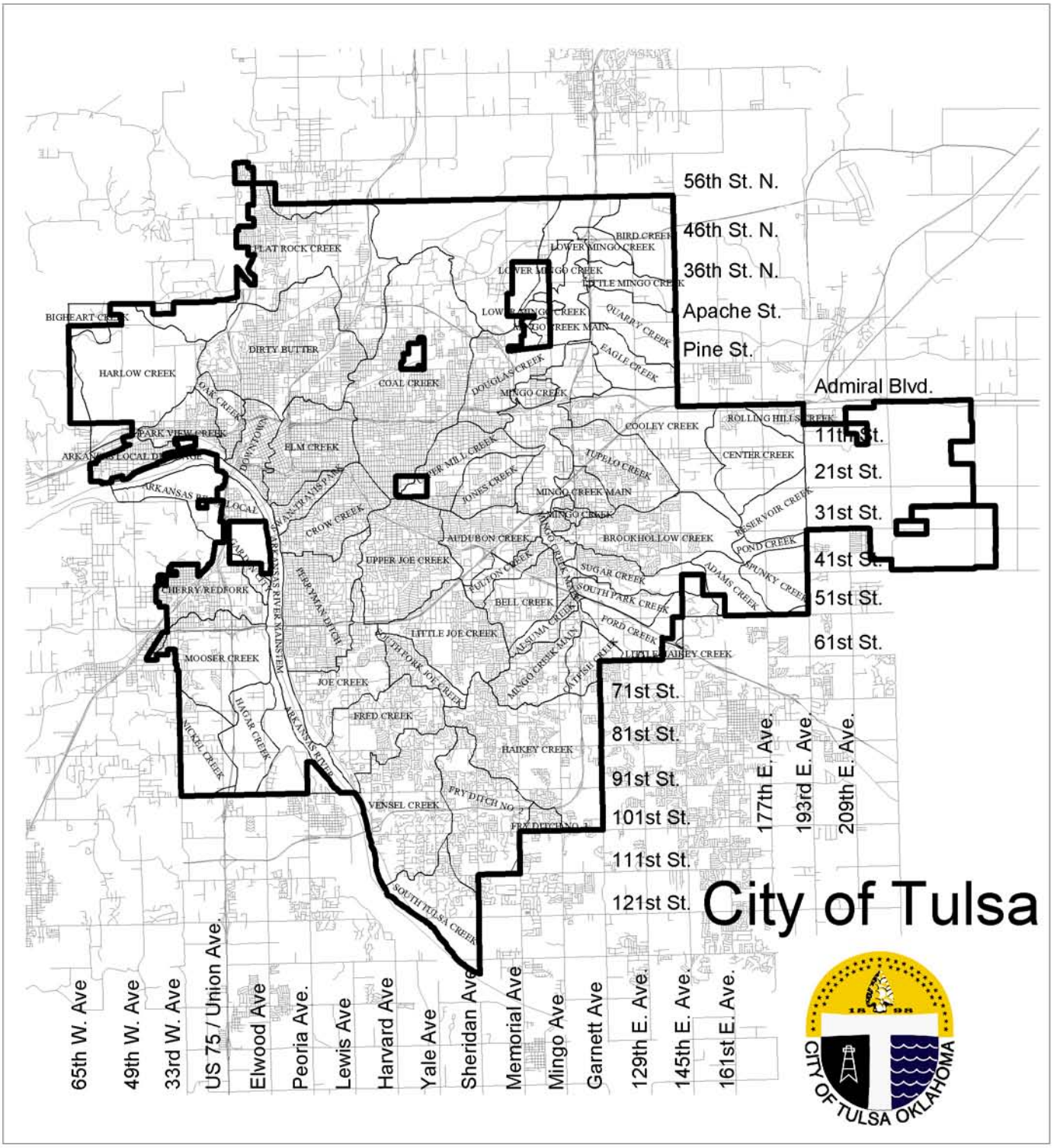
Floods have been Tulsa's most common and most costly natural hazard

- Flooding has caused the deaths of more than 10,000 people since 1900.
- United States property damage from flooding now totals over $1 billion each year.
- In 1987 FEMA concluded that over 9 million households and $390 billion in property are at risk from the 1-percent-annual-chance flood.
- In most years flooding is involved in three quarters of Federal Disaster declarations.
- Floods claim about 140 lives each year, making them the most deadly hazard in the United States.
- Floods are also responsible for more damage to property each year than any other type of weather hazard.

Flash floods usually result from intense storms dropping large amounts of rain within a brief period. The two key elements are rainfall intensity and duration, but topography, soil conditions, and ground cover also play important roles.

Flash floods occur with little or no warning and can reach peak flow within a few minutes. Waters from flash floods move with great force and velocity and can roll boulders, tear out trees, destroy buildings, and sweep away bridges. These walls of water can reach heights of 10 to 30 feet and generally carry large amounts of debris. Most flood deaths are due to flash floods.

The City of Tulsa's 213 square miles contain 56 creeks and watersheds that drain to the Arkansas River or Bird Creek, a tributary to the Verdigris River (see Figure 2-1 for Tulsa's drainage basins). Although rainfall averages 36 inches per year, because of Tulsa's geographical location, thunderstorms can, and have, dumped up to 15 inches of rain on the city in a few hours causing widespread flooding and devastating flash floods.



Legend

Drainage Basins

Tulsa City Limits

Miles

1 0.5 0 1 2

R.D. Flanagan & Associates

Figure 2-1

City of Tulsa
Drainage Basins

2.2 History of Tulsa's Flooding Problems

Tulsa has grown up with flooding. Many of the causes are related to Tulsa's geographical location. The city is set on a wide river, in a zone of violent spring and autumn storms, and on a frontier where people believed they had a right to do as they wished with their land.

Like most American communities located on waterways, Tulsa has a long history of flooding. In 1908, only a year after statehood, flooding on the Arkansas River caused $250,000 in damages ($14.73 million in 1997 dollars).

By 1920, Tulsa had grown to a city of 72,000, primarily due to oil discoveries. In June 1923, the Arkansas River flooded Tulsa's Water Treatment Plant, causing $500,000 in damages ($13.37 million in 1997 dollars) and leaving 4,000 homeless. City fathers responded by moving the critical facility to higher ground, and acquiring 2,800 acres of floodplain for park, recreation and open-space purposes.

2.2.1 The Structural Era of Flood Control

Meanwhile, around the nation, the 1920s ushered in what has been called the Structural Era of Flood Control (approximately 1928 to 1968). In response to the Great Mississippi River Flood of 1927, Congress passed the Lower Mississippi Flood Control Act of 1928 authorizing the U.S. Army Corps of Engineers to construct dams and levees to control flooding.

During the 1930s and 1940s, the U.S. Army Corps of Engineers built levees along the Arkansas River, primarily to protect the oil refineries during the war years. In the post-war years, Tulsa's growing population spread into the floodplains of inland streams, such as Coal, Mingo, and Joe Creeks. Major floods occurred in 1957 and 1959 on the Arkansas and inland creeks, spurring demand for major flood control on the Arkansas River. Floods in May and July of 1961 caused citizens to demand a halt to building in areas subject to flood hazard. However, a Tulsa City attorney's legal opinion issued in 1962 stated that the city could not block land development based on susceptibility to flooding. The Arkansas River's Keystone Dam above Tulsa was completed by the U.S. Army Corps of Engineers in 1964.

2.2.2 The Regulatory Era of Floodplain Management

Nationally, flood losses continued to rise despite billions of dollars in federal flood control projects. The dilemma prompted a decade of actions that could be called the Regulatory Era of Floodplain Management, generally from 1968 to 1978.

Flood control structures offered spot protection, but sometimes caused offsite problems, and produced a false sense of security that lured more development into floodplains. To compound this problem, the value of the induced growth was counted as a benefit in project evaluations.

In the 1960s, this problem was illuminated in the landmark House Document 465, the Unified National Program for Managing Flood Losses. In response, the late 1960s brought Presidential Executive Order 11296 encouraging floodplain management, and the National Flood Insurance Act of 1968, which made federally subsidized flood insurance available to communities that agreed to adopt minimum floodplain regulations to stem future losses.

Emergency workers prepare a rescue line for people trapped by Little Joe Creek in 1968

Tulsa's progress in addressing flood problems usually followed in the wake of serious flood events. After the 1970 Mother's Day flood left $1 million in damages, Tulsa entered the new National Flood Insurance Program (NFIP). Floods on Bird, Flat Rock, and Haikey Creeks damaged Tulsa and many suburban communities in September and December 1971, and Bird Creek again in 1973.

Year of the Floods, 1974

The Year of the Floods, 1974, brought April and May floods that left $744,000 in damages ($2.11 million in 1994 dollars) on Bird Creek. After another flood on June 8, 1974, caused $18 million in damage, Tulsa began a fundamental reassessment of its approach to floodplain management. More flooding in September and November 1974 heightened the intensity of the debate. In October, Congress authorized the U.S. Army Corps of Engineers to perform an urban floodplain study of the Tulsa area, and in November 1974, Mingo and Joe Creeks flooded again, and the Keystone Dam filled to capacity.

Angry citizens and flood victims demanded that the City enforce NFIP regulations, and that all development that contributed to flooding be halted until Tulsa's existing problems were solved. Developers objected strenuously.

The 1976 Memorial Day Flood

The Memorial Day Flood of 1976 killed three people and caused $34 million in damages. In the aftermath, the City developed basic floodplain management goals and objectives to guide the planning process, drafted comprehensive drainage regulations, and began a pilot master drainage planning program for the newly developing Vensel Creek basin in south Tulsa. Floodplain policies were accepted, and detention storage of urban stormwater runoff for new developments was instituted amid much controversy.

2.2.3 The Nonstructural Era of Stormwater Management

The Nonstructural Era, a third major phase of stormwater management, began with the President's 1978 Water Policy Initiative. It recognized the need to place nonstructural techniques on a par with flood-control structures and the importance of preserving the natural values of floodplains and wetlands.

To curb continuing losses, in the early 1980s the federal government developed the Federal Inter-Agency Hazard Mitigation process. In the days after disasters, federal teams were dispatched to identify hazard mitigation opportunities—basically ways to make the response to each disaster reduce the scope of the next one. The mitigation concept focused on correcting the causes of losses, including removing, raising, or flood-proofing the most vulnerable of the damaged buildings.

The 1984 Memorial Day Flood

The 1984 Memorial Day Flood, the worst in the city's history, was Tulsa's watershed point. After a muggy Sunday afternoon, a stalled cool front produced some 15 inches of midnight rain, centered over Mingo Creek but also extending across most of the city. The results were disastrous.

The Memorial Day Flood of 1984 killed 14 people and caused $180 million in damages, and reenergized Tulsa's commitment to floodplain management. The City responded by enacting a rebuilding and repair moratorium, acquiring 300 flood-prone properties, and a 228-lot mobile home park. A 1987 General Obligation Bond Issue, approved by the voters, allocated $1.4 million for continuation of the basin-wide floodplain master drainage planning process. Thirteen additional watersheds were authorized for master planning.

Flash flooding on Mingo Creek killed 14 people on Memorial Day 1984

A Unified Program

A Unified Program was created after the 1984 flood. The work didn't end with the initial flood response and recovery. In fact, that was only the first step in a long and continuing journey to make Tulsa safe from floods. The 1984 flood persuaded Tulsans that a coordinated, comprehensive stormwater management program was needed that reached from the rooftop to the river.

A citizens advisory committee, the Stormwater Drainage Advisory Board, was established in 1985 by the City Commission to oversee the floodplain management planning process, and continues to function to date. Also in 1985, the Department of Stormwater Management centralized responsibility for all city flood, drainage, and stormwater programs.

A stormwater utility fee was established by ordinance in 1986 to operate the program. The utility fee ensures stable funds for maintenance and management, independent of shifting political winds. The ordinance allocates the entire fee exclusively for floodplain and stormwater management activities.

The 1986 Arkansas River Flood

The 1986 Arkansas River Flood was a first test of the new stormwater management program. It also served as a reminder of the limited protection provided by Keystone Dam. Between September and October 1986, Keystone Reservoir filled to capacity, forcing the U.S. Army Corps of Engineers to release water at the rate of 310,000 cubic feet per second. Downstream flooding was inevitable. At Tulsa, a private west bank levee failed, causing $1.3 million in damages to 64 buildings. The city fielded its hazard mitigation team and cleared 13 substantially damaged structures.

Forced releases at Keystone Dam have resulted in a private levee failure and flooding in Tulsa

Institutionalization and Acceptance

In the 1990s Tulsans approved a change in city government from the mayor-commission form to the mayor-council form. A new Department of Public Works consolidated all public works services. Stormwater management was reintegrated and finally institutionalized into the city structure. Today, storm drainage management is an accepted part of the city's services.

Tulsa's system has not been tested by a catastrophic rainfall since 1986, but the system has handled smaller rains well. Leaders believe improved maintenance, continuing capital projects, stringent regulations, and aggressive citizen awareness programs will reduce, but cannot entirely eliminate, future flood losses.

The greatest testimony to the program is that, since comprehensive regulations were adopted in 1977, the city has no record of flood damages to any building that complies with those regulations.

In the early 1990s, FEMA ranked Tulsa first in the nation for its floodplain management program, allowing Tulsans to enjoy the nation's lowest flood insurance rates. The program was also honored with FEMA's 1992 Outstanding Public Service Award and the Association of State Floodplain Managers has twice given Tulsa its Local Award for Excellence.

Leaders consider the Tulsa program still in progress. They know that much remains to be done, and that there is an inevitable flood ahead. The program continues to evolve.

2.2.4 The Watershed Era of Comprehensive Management

The Great Midwest Floods on the Mississippi and other heartland rivers in 1993 caused more than $10 billion in damages to 72,000 structures and, in some cases, entire communities.

According to Dr. Gilbert F. White, a leader in national floodplain management for the past 50 years, and Larry Larson, Executive Director of the Association of State Floodplain Managers, the 1993 floods launched a fourth era in the nation's attempts to stem disaster losses--the era of ”Comprehensive Management.” Although Tulsa was not directly affected, local leaders took advantage of the lessons that the nation was learning.

This new era looks above and beyond the floodplains, beyond response to a specific disaster, and takes a longer and broader view.

According to White, comprehensive management “examines in an integrated fashion the whole regional floodplain environment…and takes into account the human values, the local resource decisions, the whole pattern of local community management, as it is related to flood hazard and the floodplain."

"Until this year," says Larson, "the government mostly helped people rebuild at risk of the next flood. A monumental change has occurred in federal attitudes and programs that assist people and communities in flood recovery."

Part of this change involves communities taking greater responsibility for disaster preparedness and mitigation.

Over the past 50 years most Americans have come to expect that when flood disasters strike, the federal government will come rushing in to take charge of rescue efforts and pay the bills. The increasing number of disaster declarations and their mounting costs, make it doubtful this practice can continue indefinitely. This is particularly true with floods, since many such events can be viewed as the result of a community’s own risky development practices and lack of foresight. To qualify for future federal funding, communities are required to prepare hazard mitigation plans aimed at preventing disasters before they happen, or limiting damages if they do occur.

Another new guideline for floodplain management that is gaining acceptance among government officials and planning professionals is that development shall create "no adverse impact." This strategy requires that any development activity be evaluated for the impacts it will have on flood stages, velocity, flows, and erosion or sedimentation anywhere in the present and future watershed. If adopted, this standard would reduce flooding and help ensure that future development activity both in and out of the floodplain is part of a locally adopted management plan. It would also measurably strengthen local management, planning and mitigation activities.

2.3 Regulation

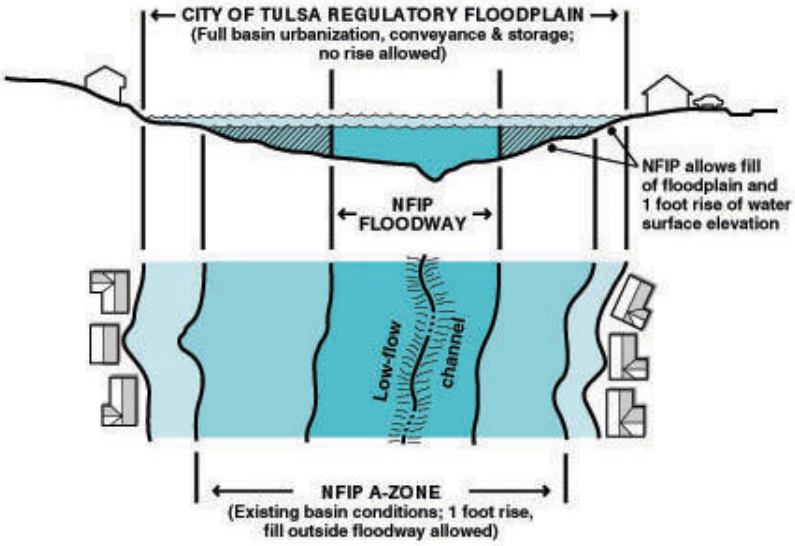
Experience showed that the National Flood Insurance Program's minimum standard is insufficient for Tulsa. Therefore, the city's regulations exceed NFIP standard in several important ways, highlighted below.

2.3.1 Ultimate Watershed Urbanization

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

Insurance purposes require that NFIP floodplain maps must be based on existing watershed development, but unless plans and regulations are based on future watershed urbanization, development permitted today may flood tomorrow as uphill urbanization increases runoff.

Tulsa enforces the NFIP minimum regulations and maps to retain eligibility for federal flood insurance, and also enforces its own more extensive maps and regulations, based on ultimate watershed urbanization as forecast in the comprehensive plan.



Tulsa welcomes growth, so long as it does not flood or cause flooding elsewhere

2.3.2 Watershed-Wide Regulation

Floodplains are only part of flood-management considerations. Water gathers and drains throughout entire watersheds, from uplands to lowlands. Each watershed is an interactive element of the whole. A change at one place can cause changes elsewhere, whether planned or inadvertent.

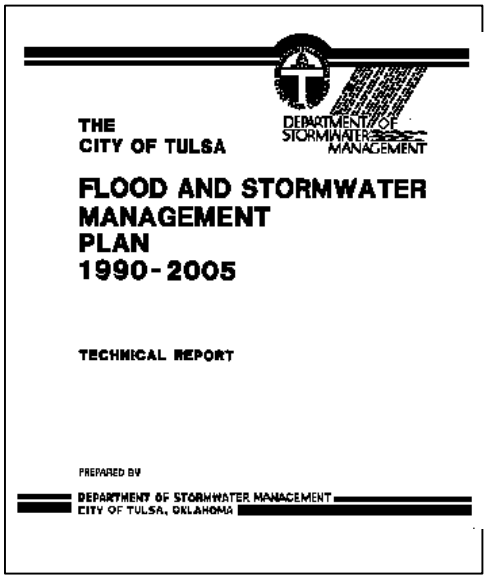
2.4 Master Drainage Planning

The backbone of Tulsa's stormwater management system is its master drainage planning. The planning process involves extensive citizen participation, including hundreds of public meetings over the past decade.

2.4.1 Master Drainage Plans

Tulsa has completed master drainage plans for virtually all drainage basins. Each plan is a comprehensive, watershed-wide study that documents existing floodplain information and recommends solutions for flooding and drainage problems.

A master drainage plan (MDP) is developed within the context of the community and, therefore, takes into account community values, existing conditions, goals and objectives, and future plans. The master drainage plan process recognizes that a watershed is an interrelated unit, and that any change in one component affects the entire drainage system. The result is a plan for actions and projects with defined costs and benefits.


THE
CITY OF TULSA

DEPARTMENT OF STORMWATER MANAGEMENT

FLOOD AND STORMWATER MANAGEMENT PLAN 1990-2005

TECHNICAL REPORT

PREPARED BY

DEPARTMENT OF STORMWATER MANAGEMENT
CITY OF TULSA, OKLAHOMA

Tulsa has comprehensive drainage plans for each watershed

The following is a summary of the primary components of the MDP:

- Applicable laws and regulations
- Basin resource inventory
- Basin hydrology-quantification of stormwater run-off amounts
- Basin hydraulics and delineation and determination of floodplain boundaries
- Flooding problems and damages
- Evaluation and presentation of the most cost-effective approaches for addressing the identified flooding and drainage problems

The plans contain regulatory floodplain maps superimposed on aerial photo topography. Recent plans provide lists of all buildings located in the floodplain, their finished floor elevations, base flood elevations, and depth of flooding. The development of each master drainage plan involved extensive citizen participation. Public meetings were advertised, public input sought, and review sessions held at key points throughout the planning process for each basin plan.

Over $1.4 million for watershed-wide master drainage planning studies was submitted to the citizens of Tulsa, and approved in the 1986 General Obligation Bond issue. The bond

issue financed the development of comprehensive master drainage plans for the Coal, Dirty Butter, Flat Rock, Southwest (Mooser, Nickle, Hager), Elm, Upper Mingo,

Table 2–1: Master Drainage Plans and Basins

Plan Name	*Creeks Watersheds*	*Year Completed*
Bird	Bird	1993
Cherry/Red Fork	Cherry Red Fork	1982
Coal	Coal	1987
Crow	Crow Swan Travis Park	1989
Dirty Butter	Dirty Butter	1987
Downtown	Central Bus. Dist.	1993
Elm	Elm	1988
Flatrock	Flatrock Valley View	1987
Fred	Fred	1988
Fry Ditch #2	Fry Ditch #2	1989
Garden City	Garden City	1987
Haikey	Haikey Little Haikey	1989
Joe Mainstem	Mainstem, Joe No Study	
Joe, East & West	Upper Joe, E/W	1989
Little Joe	Little Joe (Upper)	1992
South Fork Joe	Joe, South Fork	1982
Mingo Creek	Mainstem (USACE)	No MDP
Cooley	Cooley	1980
Lower Mingo	Little Quarry Eagle Douglas	1991
Lower Mid Mingo	Tupelo Mill Jones	1980
Mingo Creek Upper Mill/Jones (Update)	Upper Mill Upper Jones Upper Audubon	1993
Upper Mid Mingo	Audubon Bell Brookhollow Fulton SouthPark Sugar	1981
Upper Tup/Brook (Update)	Upper Tupelo Upper Brookhollow	1994
Upper Mingo	Alsuma Catfish Ford Mainstem	1988
Northwest	Bigheart Harlow Parkview Oak Lower Basin	1989
Perryman	Perryman	1988
South Tulsa Basin	South Tulsa	1992
Southwest	Mooser Nickel Hager	1988
Spunky Adams	Adams Center Pond Reservoir Spunky	1989
Vensel	Vensel	1978
Vensel (Update)	Vensel	1994

Northwest (Oak, Harlow, Bigheart, Parkview), Spunky-Adams, Crow, Fred, Fry Ditch #2, Haikey, and the East and West Branches of Joe Creek. The plans for the drainage basins were developed with full citizen participation, in part because the City realized that the citizens would have to approve any subsequent funding packages for program implementation.

Tulsa has 56 identified creek and drainage basins, which have been studied and planned in 29 basin-wide master drainage plans and updates. Master drainage plans and the dates they were completed are listed in Table 2-1, on the previous page.

2.4.2 Mingo Creek Project

The 61-square-mile Mingo watershed drains the eastern one-third of the city but has accounted for two-thirds of Tulsa's flood damages in recent years. The U.S. Army Corps of Engineers and the City of Tulsa worked together in the late 1970s to develop a plan for Mingo flood control, which Congress authorized for construction in 1986.

The Corps estimates that the completed $143 million project will prevent $32 million in average annual flood damages. With an average annual cost of about $16 million, the Mingo project has a benefit-to-cost ratio of 2 to 1.

The local cooperation agreement signed by the City helped forge new legislation written into the Water Resources Development Act of 1986, which also gives communities credit for past construction projects. The federal government recognized that, before 1986, Tulsa had constructed some Mingo channels and detention basins that were compatible with the Corps project. The federal government agreed to give the Tulsa credit toward its local share plus reimbursement for the federal share of prior expenditures that pertain to the project.

2.4.3 Flood and Stormwater Management Plan, 1990-2005

Institutionalization and acceptance of the stormwater management program continued in the 1990s after Tulsans approved a change from the mayor-commission to the mayor-council form of government. Stormwater management programs and activities were consolidated into the new Department of Public Works, along with all other public works services.

Tulsa's citizens have been involved in every stage of stormwater management planning

Beginning in 1989, an effort was made to bring the results of the existing 22 basin-wide master drainage plans together into a single, comprehensive city-wide document:

The City of Tulsa *Flood and Stormwater Management Plan, 1990-2005*. The planning process took several years to complete, and required extensive public involvement and participation. This citywide plan ranks and prioritizes hundreds of recommended projects, to guide capital scheduling.

The process was supervised by the Stormwater Drainage Advisory Board, and public meetings were held throughout the city to obtain citizen input and to disseminate information about the plan and the planning process. The Mayor and City Council adopted the plan when it was completed.

Since the completion of the *Flood and Stormwater Management Plan, 1990-2005*, additional master drainage plans for Lower Mingo, Little Joe, South Tulsa, Bird, and Downtown have been completed. In addition, the original plans for Upper Mill, Upper Audubon, Upper Jones, Upper Tupelo, Upper Brookhollow, and Vensel Creeks, now over 15 years old, were updated. The City had also developed a planning process for acquiring repetitive-loss, floodway, and substantially damaged properties, and buildings recommended for acquisition and removal from the floodplain in the master drainage plans. Many of the projects proposed in the plan have been funded and completed.

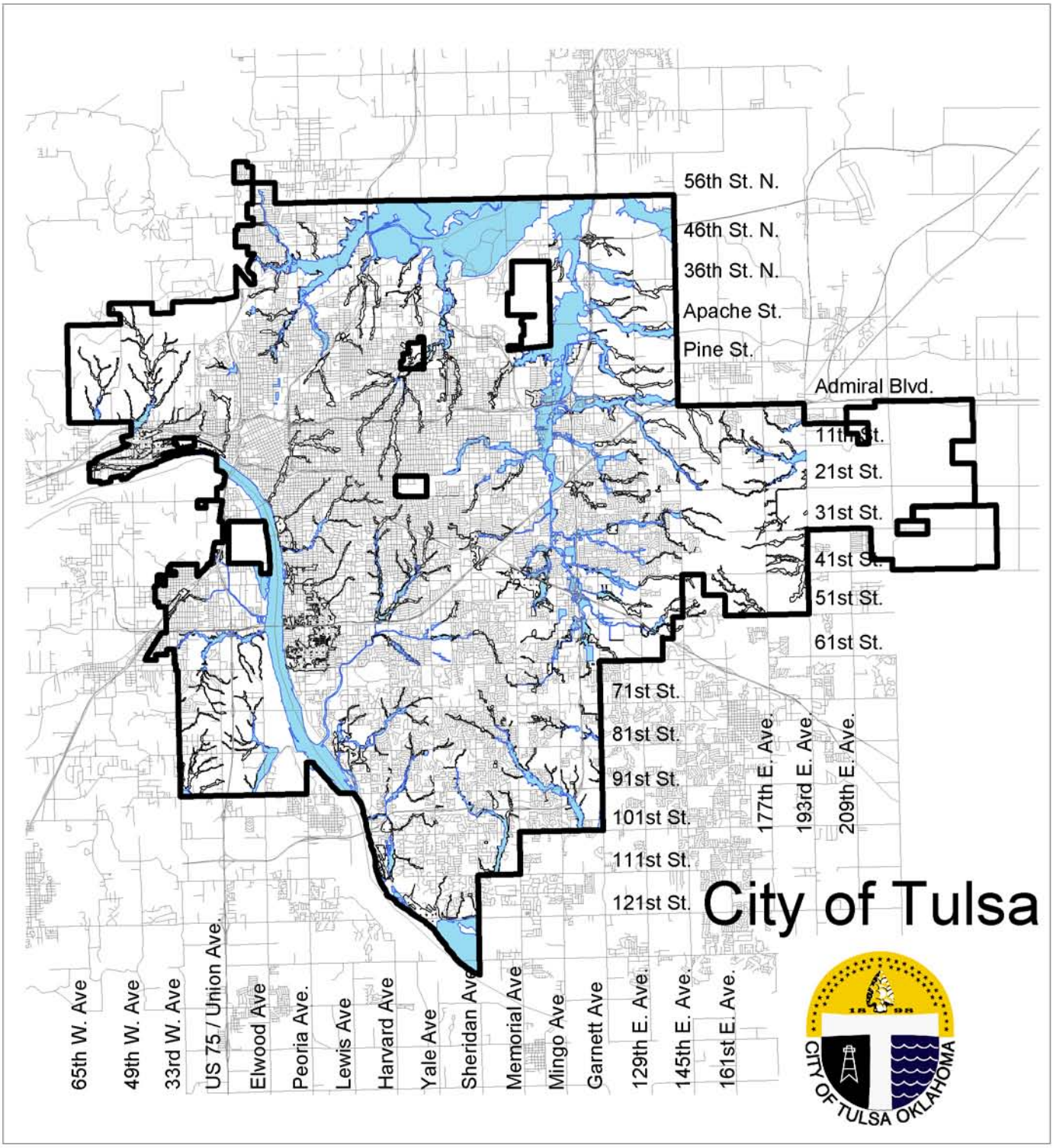
2.4.4 Flood and Stormwater Management Plan (Update), 1999-2014

The *Flood and Stormwater Management Plan, 1999-2014* reviewed the various stormwater-related plans in light of new floodplain management perspectives, and recommended areas for restudy and project reprioritization. The 1999 Update was based on the best available information, including the 29 basin studies and 56 creeks and watersheds within the jurisdiction of the City of Tulsa, along with the floodplain notification database, the Non-Structural Hazard Mitigation Plan, the 1997 Urban Infrastructure Inventory, and the Repetitive Loss Plan. The regulatory floodplains of the City of Tulsa are shown in Figure 2–2.

2.4.5 Community Rating System

The City of Tulsa joined FEMA's Community Rating System (CRS) on October 1, 1991. Tulsa has taken its participation in the CRS program very seriously and rapidly progressed to a rating of 5, and in 2000 was awarded a rating of 3, the highest rating awarded in the country. As a result of Tulsa's Comprehensive Stormwater Management Program, its citizens enjoy the lowest flood insurance rates in the nation.

In 1997, when the City was updating its stormwater plan, the CRS program revised its planning process requirements, as described in Activity 510 - Floodplain Management Planning. Since Tulsa's planning procedures were modeled on the CRS process, it was decided the new city-wide *Flood and Stormwater Management Plan 1999-2014* would follow the CRS guidelines.



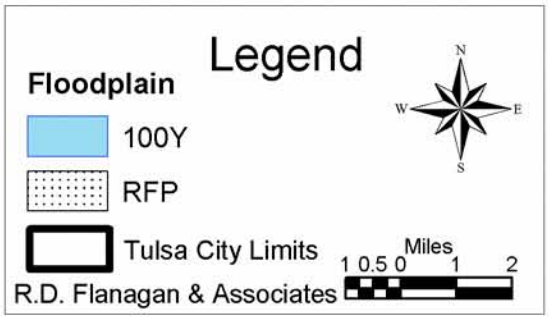


Figure 2-2

City of Tulsa
Regulatory Floodplain

Acquisition and Relocation

Over the past 15 years, Tulsa has cleared more than 900 buildings from its floodplains. The largest clearance came after the 1984 flood, when more than 300 single-family homes and 228 mobile homes pads were acquired and removed. The City's floodplain program is gradually reducing its inventory of thousands of flood-prone buildings, and has revised its post-flood mitigation plan to include acquisition and relocation recommendations for before, during, and after a flood. Tulsa's Non-Structural Mitigation (Acquisition) list, included in Appendix H, identifies 455 flood-prone properties recommended for acquisition and removal from the floodplain as the most cost-effective means of protection. As funds and opportunities become available, the most vulnerable properties are given the opportunity to participate in Tulsa's voluntary flood acquisition program.

The City of Tulsa, as of August 18, 2002, has two Hazard Mitigation Grant Program applications in process with the Oklahoma Department of Civil Emergency Management and the Federal Emergency Management Agency for the acquisition and removal of 28 high-priority repetitive loss and repeatedly flooded properties.

Repetitive Loss Plan

A repetitive loss property is defined by FEMA as "a property for which two or more National Flood Insurance Program losses of at least $1,000 each have been paid within any 10-year period."

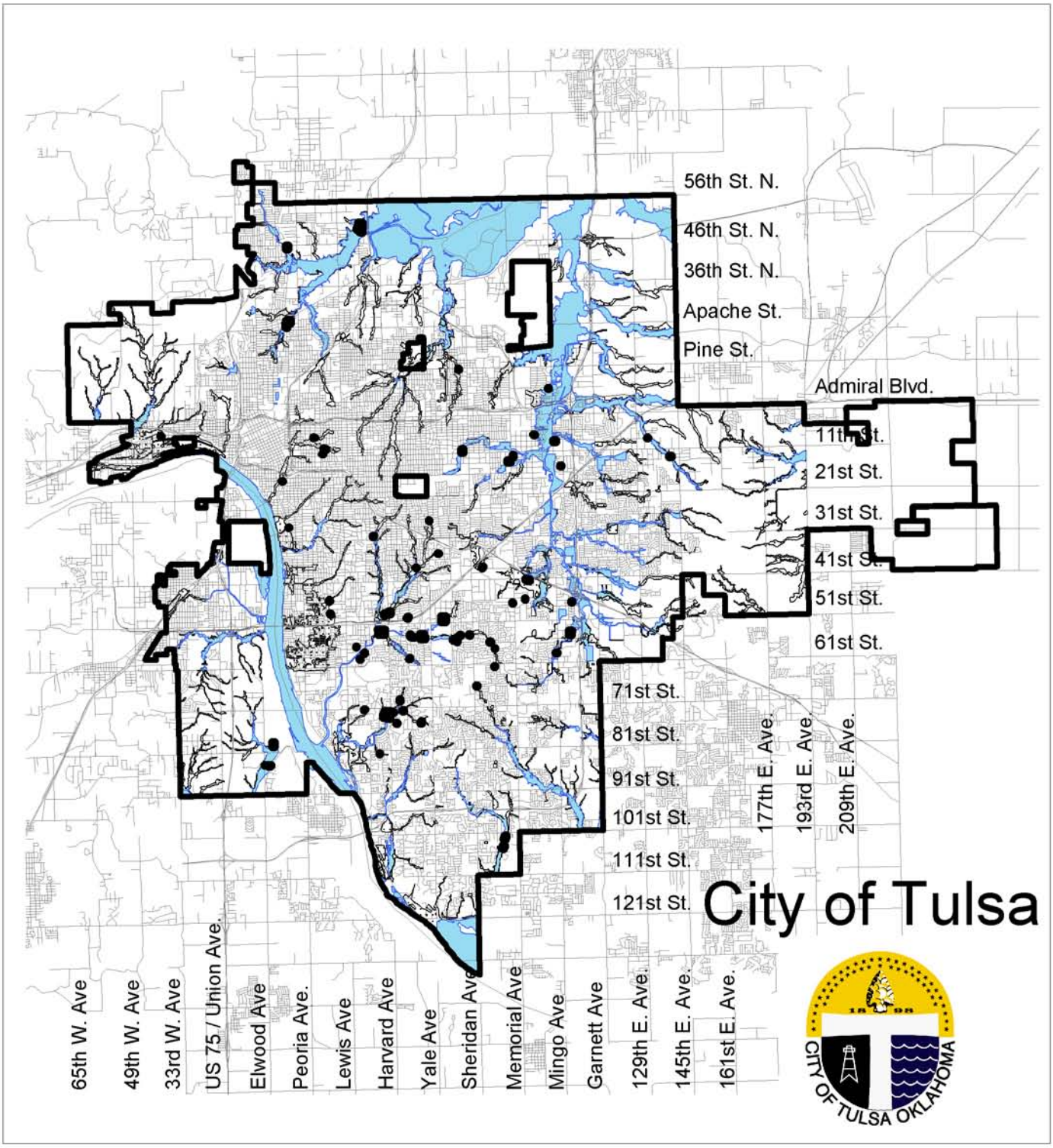
The City of Tulsa currently has 123 properties on its FEMA Repetitive Loss list. Tulsa has developed a Repetitive Loss Plan that recommends the measures needed to solve the flooding problem of each repetitive loss property. Tulsa's strategies include:

- Construction of flood protection projects, such as channel improvements and stormwater detention ponds
- Construction of small local projects, such as storm sewers, culvert replacements, and drainage ditches
- Acquisition of the property and removal and demolition of the building

The locations of Tulsa's repetitive loss properties are shown on the map in Figure 2–3 and are listed by status category in Appendix G.

Critical Facilities

Critical Facilities located in the floodplains pose a problem for the community. In the event of a flood, they have impacts beyond the flooding of the facility. If flooded, Police and Fire stations cannot perform their first responder duties. During the 1984 flood, hundreds of police cars parked in the floodplain were flooded and unavailable for use in responding to Tulsa's worst natural disaster. Critical facilities located in the floodplain are listed in Table 2–2 and shown on the map in Figure 2–4.



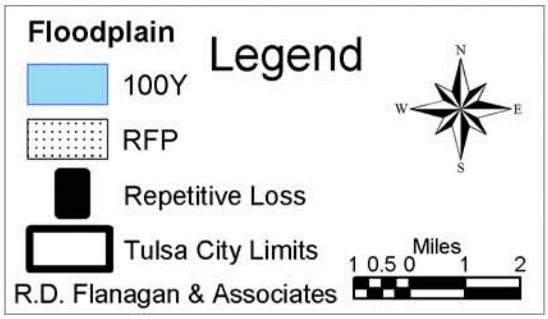


Figure 2-3

City of Tulsa Repetitive Loss Properties

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2.4.6 City Stormwater Programs

The City of Tulsa's extensive stormwater management program is comprehensive in scale and includes every aspect of flood and stormwater management. This section provides a discussion of each program element.

Maintenance and Operations

City leaders clearly saw the need for better maintenance when the 1984 flood swamped neglected pump stations, debris-choked creeks and channels, and clogged and collapsed sewers. The resulting public and private costs were enormous.

The flood triggered a search for stable, continual maintenance funding. The answer came in 1986, when city leaders approved a stormwater drainage utility fee. Now maintenance is an essential element of Tulsa's program. The contrast is telling:

- In 1980, the city spent about $400,000 on stormwater maintenance.
- In 1993, the city was able to spend about $6 million on stormwater maintenance.

The difference was the stormwater drainage utility fee.

The maintenance program's first goal is to keep systems operating at full capacity. These systems include hundreds of miles of surface channels and floodplains, thousands of miles of underground sewers, public detention basins, pump stations, roadside ditches, bridges, and the curbs and inlets along the street system.

The list of duties continues to expand, extending through turf control and tree planting, debris removal, emergency response during storms, and management of maintenance trails along drainageways.

Response

Emergency response is triggered by the possibility of severe weather anywhere in the community. Response teams are guided by detailed plans and protocols, training, and their extensive field experience from other emergencies. The plans also identify critical facilities with hazardous materials, vulnerable occupants, and essential community functions.

Recovery and Mitigation

Traditionally, flood recovery has meant rebuilding as fast as possible. But recurring disasters have taught Tulsans that rebuilding in kind can mean investing in another disaster. Today, Tulsa emphasizes mitigation projects, which seek to make the response to each disaster reduce future losses. For example, hundreds of flooded homes have been relocated to dry sites. In addition, the city is updating its flood-hazard mitigation plans to include actions to be taken before, during, and after a flood.

Hazardous Materials Sites

Hazardous materials sites, discussed in Chapter 3, section 3.12, also present special problems when located in the floodplain. When flooded, hazardous materials may react with water and become volatile, or contaminate areas and flooded buildings for miles downstream. Tulsa’s hazardous materials facilities located in the floodplain are listed in Table 2–3 and they are shown on the map in Figure 2–5.

Emergency Management

Capricious climate makes Tulsa vulnerable to weather emergencies, particularly tornadoes, violent thunderstorms, and floods. As with flooding, Tulsa's emergency management goal is to reduce the hazard and damage before, during, and after the event.

Overall responsibility during emergencies lies with the City-County Tulsa Area Emergency Management Agency. For flood management, however, TAEMA shares the leadership role with Tulsa's Public Works Department.

Forecasting and Warning

Flash floods require the earliest possible warnings. Tulsa's warning system works in cooperation with the National Weather Service, news media, and TAEMA. A computerized ALERT system includes 39 rain, 19 stream, and seven detention gauges that report changes as they happen. The system is based on detailed basin inventories and includes a hydrologic program that develops stream and flood forecasts, which are released for appropriate action before flooding occurs. Siren locations are shown in Chapter 1, Figure 1–5.

Public Awareness

The City places great emphasis on public information and involvement to keep citizens aware that floods are frequent in Tulsa and require prudent preparation.

Informational tools include flood maps, brochures, news releases, fact sheets, reports, slide shows, videos, direct mailings, displays, speeches and presentations, roadway signs, and individual contacts—anything and everything available to help keep the public informed. For example, the City sends out periodic notices to floodplain occupants, warning them of hazards, offering them flood preparedness tips, and urging them to buy flood insurance. Also, Tulsa's stormwater ordinances require that full information about flood hazards be provided to prospective buyers by property sellers, and to tenants by landlords.

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2.5 Vulnerability

All buildings in the City of Tulsa, regardless of location, are at some risk of suffering riverine flooding or local surface water drainage damage.

FEMA has identified those areas within the community that have a one percent chance of flooding in any given year. These areas, commonly referred to as the 100-year floodplain, are designated as the Special Flood Hazard Area (SFHA) on FEMA's Flood Insurance Rate Maps (FIRM). The SFHA identifies the National Flood Insurance Program's (NFIP) minimum national standard, and reflects existing development conditions at the time of the study.

The City of Tulsa's Regulatory Floodplains are mapped to a higher standard than FEMA's Special Flood Hazard Area (SFHA), and reflect the 100-year floodplain limits based upon total anticipated urbanization of the watershed, and allowing for no floodplain fill.

The City of Tulsa has a total of 12,483 properties that are touched by the floodplains that have buildings on them. The buildings on the properties are not necessarily located inside the floodplain. The number of buildings by type, fair market value of the improvements, estimated value of the contents, and total value are shown in Table 2-4.

Table 2–4: Floodplain Property Value

Type	*Number of Buildings*	*Building Value*	*Contents Value*	*Total Value*
Single-Family	9,130	$697,890,741	$348,945,370	$1,046,836,111
Multi-Family	2,460	165,007,351	82,503,675	247,511,026
Mobile Home Properties	16	1,931,407	965,703	2,897,110
Commercial	312	72,337,635	72,337,635	144,675,270
Hotel/Motels	12	17,572,100	8,786,050	26,358,150
Offices	80	87,259,130	87,259,130	174,518,260
Industrial	441	124,940,273	187,410,409	312,350,682
Critical Facilities	32	99,310,213	100,435,029	199,745,242
Total	**12,483**	**$1,266,248,850**	**$888,643,001**	**$2,154,891,851**

Table 2–5 on the next page shows statistics about the vulnerability of Tulsa's floodplain properties, including number, value, flood damage, flood insurance policies, and actual losses. There are 2,622 buildings located within the FEMA Special Flood Hazard Area, and another 6,068 buildings in the City of Tulsa's Regulatory Floodplain, for a total of 8,690 buildings being physically located inside of Tulsa's floodplains. Total value of improvements and contents of buildings located inside of the floodplains is estimated to be $1.494 billion. Damage to buildings and their contents, from the 100-year flood event, is estimated to be $316 million.

Table 2–5: Floodplain Building Vulnerability

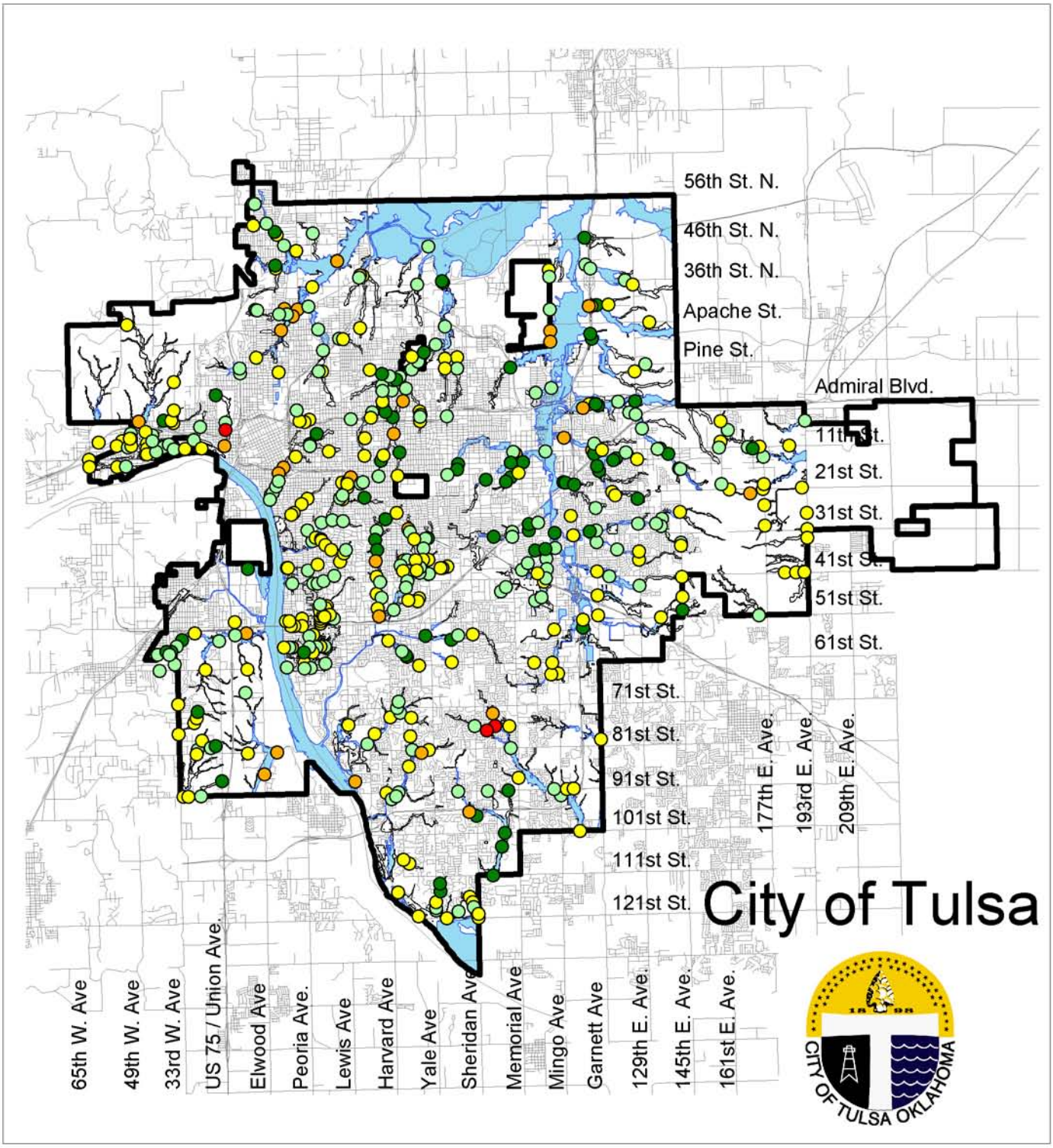
Structures in the Floodplains	*Number or Value*
FEMA SFHA	2,622
Tulsa Regulatory Floodplain	6,068
Total Floodplain Buildings	8,690
Value of Floodplain Buildings	$877,690,000
Value of Contents	$616,990,000
Total Value of Buildings Located in the Floodplain	**$1,494,680,000**
Damage to Buildings from 100-Year Flood	$131,653,000
Damage to Contents from 100-Year Flood	$185,097,000
Total Damage from the 100-Year Flood	**$316,750,000**
Flood Insurance - Jan 1, 1978 to Dec 31, 2001 ***(Source: FEMA)***	
Policies in Force	2,303
$ Insurance in Force	$289,606,000
Paid Premiums	$898,326
Total Losses Paid	2,431
Loss Payments	$37,422,249

Critical Facilities located in the floodplains, their type, number, value of improvements and contents, and total value are shown in Table 2-6.

Table 2–6: Critical Facilities in the Floodplain

Type	*Number of Buildings*	*Building Value*	*Contents Value*	*Total Value*
Schools	8	$79,754,896	$79,754,896	$159,509,792
Daycare	16	1,648,032	824,016	2,472,048
Nursing Homes	1	623,000	311,500	934,500
Tulsa Zoo	1	11,033,620	11,033,620	22,067,240
YWCA	1	865,000	432,500	1,297,500
Fire Department	4	3,010,665	4,515,997	7,526,662
Medical Buildings	1	2,375,000	3,562,500	5,937,500
Total	**32**	**$99,310,213**	**$100,435,029**	**$199,745,242**

Overtopped bridges in the city are shown in Figure 2–6 and listed in Appendix J. The depth of flooding listed for each bridge in Appendix J is the potential depth of water above the road surface, based on the 100-year flood (the 1 percent flood).



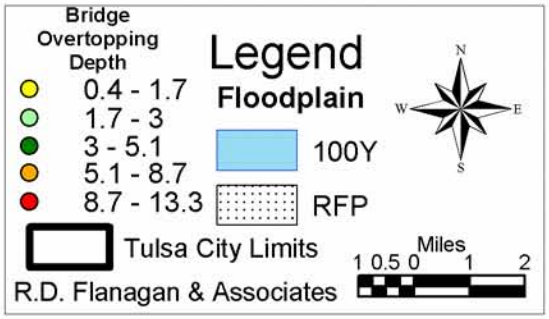


Figure 2-6

City of Tulsa
Overtopped Bridges

2.6 Conclusion

Over the past twenty years, Tulsa has made great progress in protecting its citizens' lives and property from flooding. In 1978, the City was cited as the nation's most disaster-prone community. By 1990, Tulsa's floodplain management program was receiving national awards, and in 2000, just 16 years after the devastating 1984 flood, the City was awarded the Community Rating System's Class 3, the best in the nation, and affording Tulsa's citizens the lowest flood insurance rates in the country.

Much work remains to be done to make Tulsa safe from flooding. Over 8,500 buildings remain in the city's regulatory floodplains. An additional 3,200 buildings are subject to areas of shallow flooding along the Perryman Ditch and in the Arkansas River floodplain. Over 3,000 of these structures are located in the Parkview/Charles Page Boulevard drainage area, protected by levees along the Arkansas River.

To protect citizens at risk from flooding, Tulsa's *Flood and Stormwater Management Plan 1999-2014* (a summary of 29 individual basin-wide master drainage plans) and *Capital Improvements Plan* have identified over $500 million in needed stormwater projects. These include bridge replacements, channel improvements, and stormwater detention ponds, and acquisition and removal of several hundred flood-prone properties.

Chapter 3:

Additional Hazards

Chapter 3: Additional Hazards

Introduction

Natural weather-related events, such as floods, tornadoes, severe drought, extreme heat, high winds, wildfires, and lightning only become disasters when people and their developments are located in nature's path. When there is human occupation in high-risk areas, many disaster-related losses can be predicted. These predictions can be used to create proactive measures for mitigating the impacts of natural hazard events, and significantly reducing or eliminating them.

Each natural hazard has its own characteristics, time of year and geographic area of probable occurrence, severity, and risk level. Although natural hazards may be individually identified and categorized, many are interrelated, and a natural hazard event may involve multiple hazards. For example, severe thunderstorms may spawn high winds, lightning, hailstorms, tornadoes, and flooding.

It is often difficult to identify individual hazards in multi-hazard events and attribute damages and costs. Attempts to do so will inevitably be sketchy and incomplete. However, risk assessment will grow in accuracy as new technology is developed and refined.

This chapter contains the risk identification and assessment of 14 additional hazards. The natural hazards addressed, for purposes of this study, are those deemed most likely to impact Northeastern Oklahoma. The hazards include:

1. Tornadoes
2. High Winds
3. Lightning
4. Hail
5. Severe Winter Storms
6. Extreme Heat
7. Drought
8. Expansive Soils
9. Urban Fires
10. Wildfires
11. Earthquakes
12. Hazardous Materials Events
13. Dam Failures
14. Levee Failures

As discussed earlier, the hazards addressed in this Multi-Hazard Mitigation Plan were identified by researching local archives and libraries, newspapers and web databases, by interviewing local officials involved in emergency and disaster management, through a two-year screening process by Project Impact, and by input from Tulsa Hazard Mitigation Citizen Advisory Committee members.

Each hazard section includes the following information:

- **Hazard Profile** – Causes, effects, normal frequency (how often it is likely to occur at a particular location), and available measurement scales or methods of the severity of the events, if any; the geographical extent of the hazards; and the identification of any topographic or geological conditions that would make a particular area prone to a hazard.
- **Historical Events** – Notable past occurrences of the hazard, including national, state, and local examples, if any. Where available, cost of damage, in terms of lives and property are included.
- **Vulnerable Population** – The people, geographic locations, and types of property subject to the particular hazard are identified. For each hazard with a specific geographic location, such as floodplains, dam break path, levee failure, the number, types, value of building and contents, and vulnerable populations are identified.

  The planning team used data from the Tulsa County Assessor's Office, INCOG, used GIS modeling, and FEMA methodology recommended in FEMA 386-2, to estimate the potential dollar losses from the hazards most likely to impact the Tulsa area.
- **Conclusion** – The information provided on each of the hazards is condensed into a brief summary/conclusion statement.

3.1 Tornadoes

A tornado is a rapidly rotating vortex or funnel of air extending to the ground from a cumulonimbus cloud. When the lower tip of a vortex touches earth, the tornado becomes a force of destruction. The path width of a tornado is generally less than a half-mile, but the path length can vary from a few hundred yards to dozens of miles. A tornado moves at speeds from 30 to 125 mph, but can generate winds exceeding 300 mph.

3.1.1 Hazard Profile

Severe thunderstorms produce about 1,000 tornadoes each year in the United States. FEMA reports that 106 federal disaster declarations over the past 20 years have included tornado damage.

Each year Oklahoma has more tornado events per square mile than any other state

Effects

The path width of a tornado averages about 200 yards and therefore can have a substantial impact on human life and property. Damage from the average tornado includes roof surfaces, mobile homes pushed off of their foundations, and automobiles pushed off of the road. More severe tornadoes can lift 300-ton objects and toss homes more than 300 feet.

Normal Frequency

Oklahoma, along with Texas, Arkansas, Missouri, and Kansas, is located in "Tornado Alley," the most tornado-prone area of the nation. Oklahoma has experienced an average of 60 tornadoes per year over the past 50 years. Between 1975 and 1995 there were eight federal tornado-related disaster declarations in the state. Oklahoma is hit by more tornadoes each year, on average, than any other state except Texas. Texas has twice as many tornadoes, but is also more than twice the size of Oklahoma.

Tornadoes are most likely to occur between March 15 and June 15, and over half strike in the afternoon between the hours of 3:00 and 7:00 PM.

Tulsa County has been hit by 61 tornadoes in the last 52 years. This equates to a frequency of 1.17 per year. Tulsa can expect a tornado on the average of at least once each year. More recent data shows that Tulsa County had 11 reported tornadoes from 1995 to 2001, or about 1.6 per year. Figure 3–1 shows historic tornado paths from 1950 to 2000 in the Tulsa area, which demonstrates the random nature of tornado strikes.

Tulsa has been hit less frequently than other locations in "Tornado Alley." According to a Native American legend, Tulsa is protected from "devil winds" by the mountains on the west side of the river, the direction from which most tornadoes approach.

Measurements

Almost 70% of all tornadoes are measured F0 and F1 on the Fujita Tornado Scale (see below), causing light to moderate damage, with wind speeds between 40 and 112 miles per hour. F4 and F5 tornadoes are considerably less frequent, but are the big killers. Sixty-seven percent of all tornado deaths were caused by F4 and F5 storms, which represent only 1% of all tornadoes.

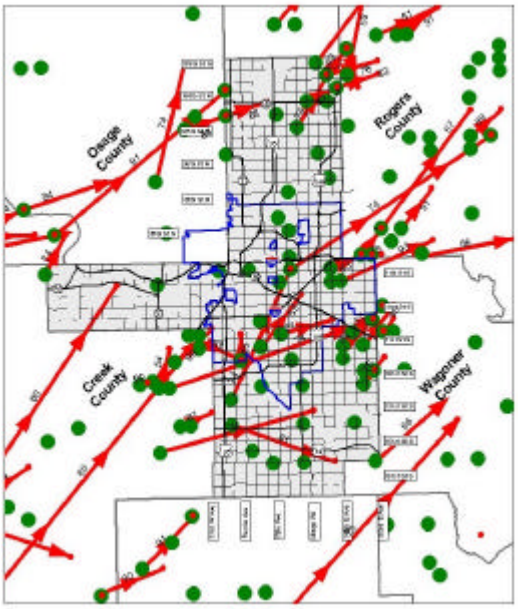


Figure 3–1: Historical Tornado Paths in Tulsa County

Table 3–1: Fujita Scale

Category	*Wind Speed (mph)*	*Damage*
F0	Gale tornado (40-72)	**Light:** Damage to chimneys, tree branches, shallow-root trees, sign boards
F1	Moderate tornado (73-112)	**Moderate:** Lower limit is beginning of hurricane wind speed—surfaces peeled off roofs, mobile homes pushed off foundations or overturned, cars pushed off roads
F2	Significant tornado (113-157)	**Considerable:** Roofs torn off frame houses, mobile homes demolished, boxcars pushed over, large trees snapped or uprooted, light-object missiles generated
F3	Severe tornado (158-206)	**Severe:** Roofs and some walls torn off well-constructed houses, trains overturned, most trees in forest uprooted, cars lifted off the ground and thrown
F4	Devastating tornado (207-260)	**Devastating:** Well-constructed houses leveled, structures with weak foundations blown off some distance, cars thrown and large missiles generated
F5	Incredible tornado (261-318)	**Incredible:** Strong frame houses lifted off foundations and carried considerable distance to disintegrate, automobile-sized missiles fly through the air in excess of 100 yards, trees debarked

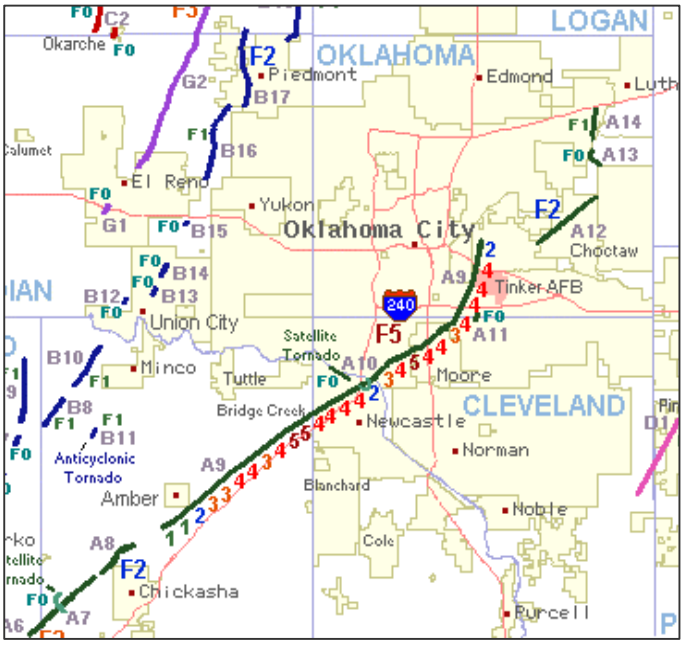
3.1.2 Historical Events

In Oklahoma since 1950, there have been over 200 fatalities and over 2,000 injuries from tornadoes. According to the National Climatic Data Center, there were 45 tornado-related fatalities from 1995 to the year 2000, and 42 of those occurred in 1999 during the worst

tornado incident in recent Oklahoma history. (The Oklahoma Department of Civil Emergency Management states in their All-Hazards Mitigation Plan that there were 46 fatalities from tornadoes in 1999.)

This incident occurred on May 3 when a series of severe thunderstorms swept out of the southwest. These storms produced many tornadoes that greatly intensified as they moved across the state. The map to the right shows tornado touchdowns, paths, and direction of movement. The visual representation makes it clear that this incident was indeed a huge outbreak.

One of the tornadoes in the outbreak was an F5, which occurred southwest of Oklahoma City, stayed on the ground about four hours, and left a path approximately thirty-eight miles long. This storm was the first F5 tornado to ever hit metropolitan Oklahoma City. The path included 6.5 miles of continuous F4 damage as well as several areas of F5 level destruction. Several homes were completely removed from their slabs.



The worst tornado in recent Oklahoma history hit Mulhall and Oklahoma City in May 1999, causing over $1 billion in damage

Approximately 10,000 homes and businesses were affected by the storms, with total losses exceeding $1 billion. In Oklahoma, at least 899 structures were destroyed, including 645 in Oklahoma City and 95 percent of the town of Mulhall. Federal disaster areas were declared in 16 Oklahoma counties.

The table below compares Tulsa County with Oklahoma for tornado frequency and impact data in two time periods, reported by the National Climatic Data Center.

Table 3–2: Tornadoes in Oklahoma and in Tulsa County Since 1950 and Since 1995

Oklahoma	*Events*	*Deaths*	*Injuries*	*Property Damage*
1950-2000	3525	305	4659	$3,958,447,000
1995-2000	534	45	751	$1,138,000,000
Tulsa County				
1950-2000	61	8	227	$369,197,000
1995-2000	11	0	0	$2,226,000

3.1.3 Vulnerable Population

The National Weather Service advises that tornadoes strike at random, and therefore all areas within the community are equally at risk. However, tornadoes follow the path of least resistance. People living in valleys, which normally are the most highly developed areas, have the greatest exposure.

Damage is a factor of both storm or wind severity and what is in the path of the tornado. An F4 tornado in a densely populated area will do enormous damage, as in the recent Oklahoma City area storm.

The characteristics of a structure can make it more or less vulnerable to tornado damage, and its occupants more or less safe from injury if the building is hit. For example, mobile homes can be more easily damaged than permanent structures, buildings with crawl spaces are more susceptible to lift, and foundation and roof type can increase or decrease the structure's vulnerability. (A mobile home is defined by Florida's Department of Highway Safety and Motor Vehicles as a dwelling that is built on an integral chassis, in a factory, transportable in one or more sections, and eight feet or more in width.)

The table below shows the numbers of tornado-related fatalities in the United States for each year from 1995 to 2000, and where the deaths occurred. It illustrates that those who live in mobile homes are significantly more vulnerable to the effects of a tornado than any other identifiable population. While the number of mobile homes is a small fraction of total residential dwellings, more people who lived in mobile homes died from tornado strikes than did those who lived in permanent or conventional homes. In fact, nearly 44% of all tornado deaths during this time period occurred in mobile homes.

Table 3–3: Tornado Fatalities in the United States

Year	*Vehicle*	*Permanent Home*	*Mobile Home*	*In the Open*	*Other*	*Total for Year*
1995	4	15	8	0	3	30
1996	2	8	14	0	1	25
1997	3	38	15	0	11	67
1998	16	46	64	0	4	130
1999	6	39	36	0	13	94
2000	3	6	18	0	2	29
Totals	34	152	155	0	34	375

3.1.4 Tornado Scenario

Tulsa County has experienced an average of 1.2 tornadoes per year over the last 50 years, from 1950 to 2000, and an average of 2.2 tornadoes per year during the 5 year period from 1995 to 2000, as shown on chart in Table 3–2.

The entire community, as illustrated on the map in Figure 3–1, is subject to random tornado events. A typical tornado path is, however, reported to be approximately 600 ft. in width, and 2.5 miles in length. The typical path, in Tulsa County, tends to be generally from southwest to northeast.

Oklahoma experiences, on the average, about 60 tornadoes per year. About 70% are F0 and F1 magnitude events. Only about 1% of tornadoes are killers of F4 and F5 strength, with wind speeds from 207-318 mph.

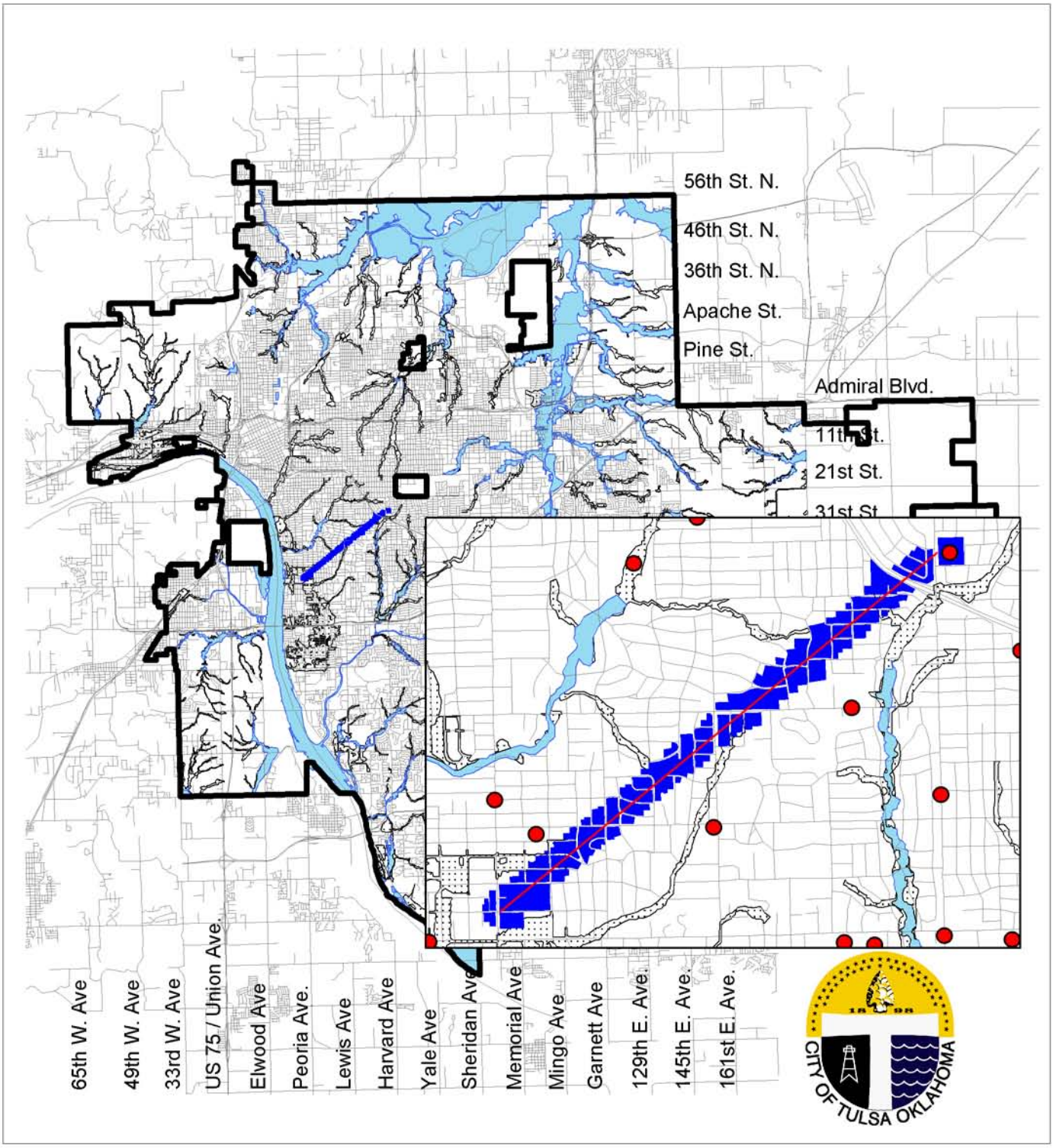
The path of an average tornado is about 600 ft. in width by 2 ½ miles in length. The area of destruction is about 181 acres per event. About 16 square miles of Oklahoma's 69,919 square miles are impacted by tornadoes each year. In Oklahoma, the chances of a tornado hitting any one area in any given year is about .0002, and for an F4 or F5, about .0000024. Bigger and more devastating tornadoes can and do occur, as evidenced by the 1999 Oklahoma City tornado, which stayed on the ground for 38 miles.

Typical Tulsa Tornado Scenario

A hypothetical tornado path, based on the typical event discussed above, was randomly placed through the center of the community, touching down in the 41st and South Peoria Avenue area, with a path of destruction northeast to the 26th and South Harvard area.

The typical tornado as presented in this scenario affects 827 buildings, including Doctor's Hospital, 765 single-family residences, 46 apartment units, and 15 commercial businesses. Total assets in the tornado path, including buildings and contents totals $163 million. The path of the hypothetical tornado is shown on the map in Figure 3–2. The damage, by building type, contents, and percent damage to each building is summarized in Table 3–4.

The typical tornado, according to this hypothetical scenario, could destroy 191 residences, 11 apartment units, and 4 businesses, and damage an additional 574 residences, 35 apartment units, 11 businesses, and a hospital. Damage to buildings would approximate $56 million, and $29 million to contents, for a total damage estimate of $85 million.



Floodplain

100Y

RFP

Tornado Damage Path

Critical Facilities

Tulsa City Limits

Legend

N W E S

Miles

1 0.5 0 1 2

R.D. Flanagan & Associates

Figure 3-2

City of Tulsa
Tornado Damage
Scenario

Table 3–4: Tornado Scenario

Total Buildings In Tornado Scenario Path				
Type	***Number***	***Building Value***	***Contents Value***	***Total Value***
Single-Family	765	$99,970,000	$49,985,000	$149,955,000
Multi-Family	46	793,260	396,360	1,189,620
Commercial	15	6,392,000	6,392,000	12,784,000
Hospital	1	-		
Total	**827**	**$107,155,260**	**$56,773,360**	**$163,928,620**
Destroyed				
Type	***Number***	***Building Damage***	***Contents Damage***	***Total Damage***
Single-Family	191	$24,992,500	$12,496,250	$37,488,750
Multi-Family	11	198,315	99,157	297,472
Commercial	4	1,598,000	1,598,000	3,196,000
Total	**206**	**$26,788,815**	**$14,193,407**	**$40,982,222**
50% Damage				
Single-Family	267	$17,494,750	$8,747,375	$26,242,125
Multi-Family	16	138,820	69,410	208,230
Commercial	5	1,118,600	1,118,600	2,237,200
Hospital	1			
Total	**289**	**$18,752,170**	**$9,935,385**	**$28,687,555**
25% Damage				
Single-Family	307	$9,997,000	$4,998,500	$14,995,500
Multi-Family	19	79,326	39,663	118,989
Commercial	6	639,200	639,200	1,278,400
Total	**332**	**$10,715,526**	**$5,677,363**	**$16,392,889**
Total Damages, Tornado Scenario				
Single-Family	765	$52,484,250	$26,242,125	$78,726,375
Multi-Family	46	416,461	208,230	624,691
Commercial	15	3,355,800	3,355,800	6,711,600
Hospital	1			
Total	**827**	**$56,256,511**	**$29,806,155**	**$86,062,666**

3.1.5 Conclusion

Depending on the severity of the tornado, damage can range from light damage to trees and roofs (Fujita Category F0) to destruction of well-built houses (Fujita Category F4 and F5). Mobile homes and houses with crawl spaces are more susceptible to lift and therefore at the greatest risk of damage.

Oklahoma is located in "Tornado Alley," the most tornado-prone area of the United States. In the last 50 years, there have been over 300 fatalities and over 4,600 injuries from tornadoes.

While Tulsa has not been hit by the most violent storms, F3 tornadoes have killed 7 people and injured 201 since 1950.

3.1.6 Sources

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3.2 High Winds

Wind is defined as the motion of air relative to the earth's surface. Extreme windstorm events are associated with cyclones, severe thunderstorms, and accompanying phenomena such as tornadoes and downbursts. Winds vary from zero at ground level to 200 mph in the upper atmospheric jet steam, 6 to 8 miles above the earth.

The mean annual wind speed in the mainland United States is reported by FEMA to be 8 to 12 mph, with frequent speeds of 50 mph and occasional wind speeds of greater than 70 mph. Tropical cyclone winds along coastal areas from Texas to Maine may exceed 100 mph.

3.2.1 Hazard Profile

The entire United States is at risk from damaging winds. Winds are always part of severe storms such as hurricanes, tornadoes, and blizzards but do not have to accompany a storm to be dangerous. Down-slope windstorms, straight-line winds, and microbursts can all cause death, injury, and property and crop damage.

High winds generated by Oklahoma's huge spring and autumn storms can be devastating to older homes and trailers

Property damage and loss of life from windstorms are increasing due to a variety of factors. Use of manufactured housing is on an upward trend, and this type of structure provides less resistance to wind than conventional construction. All states do not have uniform building codes for wind-resistant construction. Inferior construction practices result in buildings particularly susceptible to high winds.

Effects

The deteriorating condition of older homes and the increased use of aluminum-clad mobile homes will likely cause the impacts of wind hazards to increase. The general design and construction of buildings in many high wind zones do not fully consider wind resistance and its importance to survival. Near-surface winds and associated pressure effects exert pressure on structure walls, doors, windows, and roofs, causing the structural components to fail.

Debris carried by extreme winds can directly contribute to loss of life and indirectly to the failure of protective building envelope components. (The building envelope consists of the walls, foundation, doors, windows, and roof—all surfaces that make up the barrier between the indoors and the outdoors.) Upon impact, wind-driven debris can rupture a building.

Measurements

Various wind scales and resultant damages include the Beaufort, Saffir-Simpson, and the Fujita measurement scales. The tables below containing the Beaufort and Saffir-Simpson scales show that there is little consensus as to what wind speeds produce various damages. (The Fujita Scale is shown in the section, "Tornadoes.")

Table 3–5: Beaufort Scale of Wind Strength

Force	*Wind Speed (mph)*	*Damages*
9	47-54	**Strong gale:** Chimneys blown down, slate and tiles torn from roofs
10	55-63	**Whole gale:** Trees broken or uprooted
11	64-75	**Storm:** Trees Uprooted, cars overturned
12	75+	**Severe Storm:** Devastation is widespread, buildings destroyed

Table 3–6: Saffir-Simpson Scale

Category	*Wind Speed (mph)*	*Storm Surge (feet)*	*Damages*
1	74-95	4-5	**Minimal:** Trees, shrubbery, unanchored mobile homes, and some signs damaged, no real damage to structures
2	96-110	6-8	**Moderate:** Some trees toppled, some roof coverings damaged, major damage to mobile homes
3	111-130	9-12	**Extensive:** Large trees are toppled, some structural damage to roofs, mobile homes destroyed, structural damage to small homes and utility buildings
4	131-155	13-18	**Extreme:** Extensive damage to roofs, windows, and doors, roof systems on small buildings completely fail, some curtain walls fall
5	155+	18+	**Catastrophic:** Roof damage is considerable and widespread, window and door damage is severe, extensive glass failure, entire buildings could fall

3.2.2 Historical Events

Over the past 20 years, 193 Federal disaster declarations have involved wind-induced damage. From 1975 to 1994 in the United States, there were a total of 649 deaths and 6,670 injuries from disastrous winds. Wind is the fourth-leading cause of property damage.

In that 20-year period, deaths from winds in the United States were highest in 1975 with 103 deaths, 31 of them occurring on November 10 in Michigan. The second highest number was in 1983 with 98 deaths. There was also the highest number of wind-related injuries in 1983, totaling 622.

From 1981 to 1990, the insurance industry spent nearly $23 billion on wind-related catastrophic events. Out of the primary sources of high winds (hurricanes, tropical storms, severe thunderstorms, and winter storms), severe local windstorms accounted for 51.3% of the expenditures.

Table 3–7: Fatalities and Property Damage Caused by High Winds From 1995 to 2000

Location	*Events*	*Deaths*	*Damage*
Tulsa County	147	No data	$415,000
Tulsa	58	0	$270,000
Oklahoma		2	$112,009,000
United States		193	$3,351,800,000

3.2.3 Vulnerable Population

The highest wind speeds other than tornadoes occur in coastal regions, because of hurricane-related windstorms. However, the Midwest is also at risk from high winds because of the powerful thunderstorms that frequent the region.

The people most vulnerable to high wind-related deaths, injuries, and property damage are those residing in mobile homes and deteriorating or poorly constructed homes. Refer to Figure 1–4: Mobile Home Park Locations, in Chapter 1.

3.2.4 Conclusion

Almost the entire United States has some risk of high wind events, but the factors that contribute most to wind-related deaths, injuries, and property damage are the structure type, quality of construction, and the state of deterioration of the buildings where people reside. Mobile homes, older homes, and poorly designed and constructed buildings are the most vulnerable.

Uniform building codes for wind-resistant construction and demand for better quality construction practices would result in buildings being less susceptible to high winds.

3.2.5 Sources

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3.3 Lightning

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. The air in the channel of a lightning strike reaches temperatures higher than 50,000 degrees Fahrenheit.

3.3.1 Hazard Profile

Lightning is deadlier than tornadoes and hurricanes combined. Only the combined weather casualty totals from flash floods and river floods exceed fatalities caused by lightning strikes. Lightning is the most constant and widespread threat to people and property during the thunderstorm season. Lightning-caused casualty and damage events are less variable from year to year than other weather causes.

Lightning is one of the deadliest natural hazards, and can strike 10 miles out in front of an advancing rain column

Lightning can strike ten miles out from the rain column, and lightning deaths often occur under a clear sky ahead of the storm. This is because people wait until the last minute to seek shelter—hoping to finish the game, the painting, the lawn mowing, and so on.

Effects

When lightning strikes a human being, serious burns or death are the common outcomes. Of the people struck by lightning, 20% die from their injures. For those who survive, their injuries can lead to permanent disabilities. 70% of the survivors suffer serious, long-term effects, including memory loss, attention deficits, sleep disorders, depression, irritability, fatigue, weakness, numbness, dizziness, stiffness in joints, muscle spasms, and an inability to sit for long periods.

Lightning strikes can also cause high-voltage power surges that can seriously damage equipment and valuable data if electronic surge protection devices are not installed on computer systems. Property damage from power surges and resulting fires can destroy not only the electronics in private homes, but also unprotected telecommunications equipment, wireless systems, and radio base stations.

Frequency

National Geographic reports that lightning strikes the surface of the earth about 100 times every second. The U.S. National Lightning Detection Network estimates that one death occurs in every 86,000 flashes in the United States. Each year in this country, about 400 children and adults are struck by lightning during outdoor activities and an average of 73 people are killed.

The months most notorious for lightning incidents are June, with 21% of the strikes, July with 30%, and August with 22%. Sunday, Wednesday, and Saturday are the days that the most injurious lightning strikes occur, and between the hours of 12:00 noon and 6:00 PM.

3.3.2 Historical Events

According to the National Lightning Safety Institute, which has studied 35 years of reports on lightning fatalities, injuries, and damage in the United States, the most common locations of injurious lightning strikes are as shown in the following table.

Table 3–8: Locations of Injurious Lightning Strikes

Location	*Percentage*
Not reported	40
Open fields and recreation areas (not golf courses)	27
Under trees (not golf courses)	14
Water related (boating, fishing, swimming)	8
Golfing and on a golf course under trees	5
Heavy equipment and machinery related	3
Telephone related	2.4
Radio, transmitter and antenna related	0.6

From 1959 to 1995 in the United States, there were 3,239 deaths, 9,818 injuries, and 19,814 reports of property damage attributed to lightning strikes. Among the most severe were lightning strikes resulting in forest fires and damage to manufacturing plants and agricultural facilities.

According to NOAA, Oklahoma ranked 15th among states in the total number of casualties from lightning strikes during the 36-year period of their study, with 88 deaths and 243 injuries reported. It ranked 5th nationally in the number of damage reports, with 826.

Table 3–9: History of Lightning Events, Fatalities, and Damages from 1995 to 2000

Location	*Number of Events*	*Number of Deaths*	*Amount of Damage*
Tulsa County	113	0	$3,658,000
Tulsa	4	0	$210,000
State of Oklahoma	258	7	$13,150,000
United States		320	$216,100,000

From 1995 through 2000, Tulsa reported four lightning events that resulted in no fatalities or injuries, but caused $210,000 in property damage.

3.3.3 Vulnerable Population

Anyone out-of-doors during a thunderstorm is exposed and at risk of injury from lightning. More people are killed by lightning strikes while participating in some form of recreation than any other activity. The next largest group of fatalities involved people under trees, and those near or in bodies of water. Other common lightning incidents involved golfers, agricultural activity, telephone users, and people in proximity to radios and antennas.

The most lightning deaths occur in Florida, Michigan, Texas, New York, and Tennessee. The most lightning injuries occur in Florida, Michigan, Pennsylvania, North Carolina, and New York.

Oklahoma is vulnerable to frequent thunderstorms and convective weather patterns, and therefore injury or damage from lightning is a constant and widespread risk during the thunderstorm season.

3.3.4 Conclusion

Lightning is deadlier than tornadoes and hurricanes combined, occurring with more consistency every year during the thunderstorm season than any other natural hazard. People outside can have a false sense of security, thinking they are still safe because a storm front has not yet reached their location. In fact, lightning can strike ten miles out from the rain column, putting people that are still in clear weather at risk.

Lightning strikes occur most frequently during the summer months between 12:00 noon and 6:00 PM. However, the general rule of safety is that anyone outside during a thunderstorm should take cover.

Electronic equipment, from personal computers to enterprise-level communications systems, can also be seriously damaged by power surges from lightning. Surge protection should be included in any electronic system, and the absence of such should be considered a risk.

3.3.5 Sources

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3.4 Hailstorms

A hailstorm is an outgrowth of a severe thunderstorm in which balls or irregularly shaped lumps of ice fall with rain. Extreme temperature differences from the ground upward into the jet stream produce strong updraft winds that cause hail formation.

The size of hailstones is a direct function of the severity and size of the storm. High velocity updraft winds keep hail in suspension in thunderclouds. The greater the intensity of heating at the Earth's surface, the stronger the updraft will be. Higher temperatures relative to elevation result in increased suspension time, allowing hailstones to grow in size.

3.4.1 Hazard Profile

Hail can occur in any strong thunderstorm, which means hail is a threat everywhere. Hail is one of the most destructive hazards to agricultural crops and animals, and the major natural cause of automobile damage.

Hailstones can cause widespread damage to crops and automobiles, and also serious bodily injury

Effects

When hail hits, it can damage cars, shred roof coverings, and lead to water damaged ceilings, walls, floors, appliances, and personal possessions. Large hailstones can also cause serious bodily injury.

Normal Frequency

The middle area of the Great Plains is most frequently affected by hailstorms. Multiple impacts of concurrent severe thunderstorm effects (extreme winds, tornadoes, and hail) are very likely in this region. Outside of the coastal regions, most of the United States experiences hailstorms at least two or more days each year. A localized area along the border of Colorado and Wyoming experiences hailstorms eight or more days each year.

About 2% of United States crop production is damaged by hail each year, and in the Great Plains States it has sometimes reached 20%. Hail from thunderstorms causes nearly $1 billion in property and crop damage each year.

3.4.2 Historical Events

The Midwest hailstorm and tornado event in April 1994 lasted four days. According to Property Claims Services in Rahway, New Jersey, it produced 300,000 damage claims against insurers, more than Hurricane Andrew or the Northridge earthquake.

According to NOAA, the most expensive thunderstorm event in United States history occurred in April-May of 1995 in the Texas-Oklahoma region. Hailstones up to four inches in diameter caused 109 hailstone-related injuries and contributed to over $2 billion in damage in Fort Worth, Texas, alone.

Between 1959 and 1992, Oklahoma reported 1,152 hailstorm events. These storms resulted in six injuries, $32 million in property damage, and $250,000 crop damage. If these seem to be conservative figures for a span of 43 years, keep in mind that these amounts only reflect damages that were reported. There were likely many events that were *not* reported.

As shown in the table below, Oklahoma has experienced 2,364 hailstorm incidents with hail of at least 1" in diameter in the five-year period from January 1, 1995 to December 31, 2000. This is an average of 473 hailstorms each year, or about 1.3 per day. Damage to buildings and crops totaled $17 million.

Table 3–10: Fatalities and Reported Damages Caused by Hail From 1995 to 2000

Location	*Number of Events*	*Number of Deaths*	*Amount of Damage*
Tulsa County	113	0	$3,658,000
Tulsa	33	0	$3,505,000
Oklahoma	2364	0	$16,789,000
United States	Not figured	4	$4,498,300,000

3.4.3 Vulnerable Population

Hailstorms occur in every state on the mainland United States, but most frequently in the middle area of the Great Plains during the late spring and early summer when the jet stream migrates northward.

The peak periods for hailstorms, late spring and early summer, coincide with the Midwest's most critical agricultural seasons for wheat, corn, barley, oats and rye, tobacco and fruit trees. Long-stemmed vegetation is especially vulnerable to damage by hail impacts and winds. Severe hailstorms also cause considerable damage to buildings and automobiles, but rarely result in loss of life.

Oklahoma has significant exposure to hailstorms, and virtually all buildings and crops in the state are at risk.

3.4.4 Conclusion

Hailstorms can occur anywhere in the mainland United States where there are large thunderstorms. The states in the middle of the Great Plains are the most likely to have severe thunderstorms and therefore have the most hail events. The peak season for hail events is in the late spring and early summer.

In Oklahoma, there is significant exposure to hailstorms. There are an average of 473 hailstorms each year (or an average of 1.3 per day) with hailstones at least 1" in diameter. All buildings and crops are at risk.

3.4.5 Sources

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3.5 Winter Storms

A severe winter storm is one that drops four or more inches of snow during a 12-hour period, or six or more inches during a 24-hour period. An ice storm occurs when freezing rain falls from clouds and freezes immediately upon contact.

The National Weather Service (NWS) issues winter storm advisories when at least five inches of snow or any amount of ice is projected to occur over a 24-hour period. A winter storm warning means forecasters expect at least seven inches of snow or half an inch of ice.

3.5.1 Hazard Profile

A winter storm can range from moderate snow over a few hours to blizzard conditions with blinding, wind-driven snow lasting several days. Many winter depressions give rise to exceptionally heavy rain and widespread flooding. Conditions worsen if the precipitation falls in the form of snow, because it occupies seven to ten times more space than the same quantity of rain. The aftermath of a winter storm can impact a community or region for weeks, and even months.

Tulsa is vulnerable to ice storms produced by warm, moist Gulf air colliding with arctic air from the Canadian Shield

Effects

Winter storms bring the following hazards:

- Extreme cold, causing wind chill factors dangerous to humans and animals
- Snow accumulation, causing blocked transportation routes and possible residual flooding
- Reduced visibility and slick surfaces, causing hazardous driving and walking conditions
- Power lines and tree limbs coated with heavy ice, causing power and telephone service disruptions

Winter storms cause great inconvenience, injuries and deaths. Everyone is affected by the loss of mobility. Streets and highways are slick and hazardous, and even walking from house to car can be dangerous. Public transportation is often blocked, and commuters or travelers can easily become stranded and families separated. People are often

inconvenienced or at risk of physical harm from loss of power to their homes. Above-ground electrical and telephone lines and tree limbs are often coated with a heavy build-up of accumulating ice, and can break when stressed by sufficient weight. Falling trees also often down power lines. When electrical lines are damaged, other utilities such as natural gas, water and sewer systems can become inoperable.

Physical damage to homes and facilities can occur from high winds, snow and ice accumulation, and hail. Even small accumulations of snow can wreak havoc on transportation systems, if there is a lack of snow clearing equipment and drivers on the roads are inexperienced.

Winter storms are often deceptive killers, because most deaths are indirectly related to the storm. The cold temperatures that accompany winter storms cause their own secondary hazards. House fires occur more frequently in winter due to lack of proper safety precautions when using alternate heating sources (unattended fires, disposal of hot ashes, improperly placed space heaters, and so on). Fires during winter storms also present a greater danger because water supplies may freeze and impede firefighting efforts.

Normal Frequency

Using Oklahoma winter storm data from 1995 to 2000, the state averages 18 winter storm events each year. Low temperatures below freezing occur an average of 140 days per year in the western panhandle, and 60 days a year in the Red River plain in extreme southeastern Oklahoma. Days with high temperatures below freezing range from an average of 15 days per year in portions of north central and northwest Oklahoma to 3 days per year in the southeast.

3.5.2 Historical Events

Between 1988 and 1991, a total of 372 deaths in the United States, an average of 93 each year, were attributed to severe winter storms. The super storm of March 1993, considered among the worst non-tropical weather events in American history, killed at least 79 people, injured more than 600, and caused $2 billion in property damage across portions of 20 states and the District of Columbia.

In Oklahoma, 114 winter storm events with snow, ice, sleet, freezing rain and drizzle were reported during the 8-year period from January 1993 to July 2001. These resulted in two deaths, more than $86 million of property damage, and $7 million of crop damage.

Recently, Oklahoma was hit by two major severe winter storms that resulted in National Disaster Declarations. On Christmas Day, 2000, Oklahoma suffered the most costly winter storm in its history. As of December 2001, $122.26 million in disaster aid had been sent to Oklahomans to help them recover from this storm.

Another severe winter storm—this one an ice storm—struck Oklahoma on January 30, 2002. Ice laden limbs of trees fell on power lines, knocking out electricity to approximately 250,000 people. Four persons died. The Governor declared 44 counties a Disaster Area.

Table 3–11: History of Severe Winter Storms, Fatalities, and Damages from 1995 to 2000

Region	*Number of Events*	*Number of Injuries*	*Number of Deaths*	*Amount of Damage*
Tulsa County	14	0	0	$21,000
State of Oklahoma	90	0	2	$92,870,000
United States		2,574	343	$2,725,800,000

3.5.3 Vulnerable Population

The leading cause of death during winter storms is from automobile or other transportation accidents. Exhaustion and heart attacks caused by overexertion are also common causes of winter storm-related deaths. Indigent and elderly people account for the largest percentage of hypothermia victims.

Almost the entire United States is at some risk from winter storms, with the level or risk depending on the severity of the weather and vulnerability of local development. Every area that has streets, trees, or power lines is at risk from winter storms.

Oklahoma is particularly vulnerable to severe winter storms due to its proximity to the Gulf of Mexico. The Gulf can supply strong, warm, and wet air masses that move northward across Texas and Oklahoma to collide with the cold air of the southward-dipping jet stream. This mixture can, and often does, produce a deadly combination of heavy rain, ice storms, snowfall, hail, high winds, and frigid temperatures worsened by damp air. Ice storms occur when rain falls out of a warm, moist upper layer of the atmosphere into a dry layer with freezing or sub-freezing air near the ground. Rain freezes on contact with the cold ground and accumulates on exposed surfaces.

Most of those who died in Oklahoma were located outdoors.

3.5.4 Conclusion

Severe local storms are probably the most common widespread hazard. 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 loss of life, property damage, transportation problems, and utility service failure over a large area.

Secondary effects of winter storms include house fires from increased and improper use of alternate heating sources. Frozen water supplies can impede firefighting efforts.

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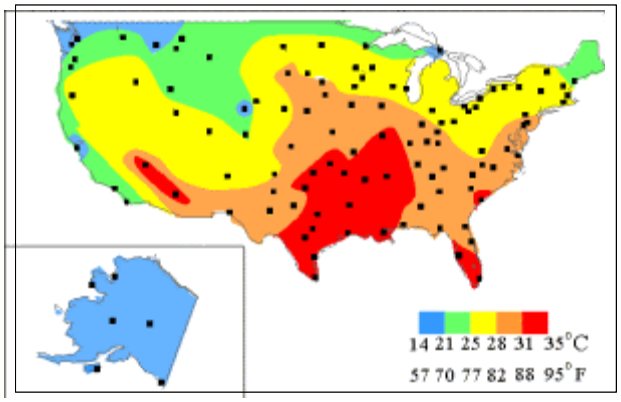
3.6 Extreme Heat

Extreme summer weather is characterized by a combination of very high temperatures and exceptionally humid conditions. A heat wave occurs when such conditions persist over time.

3.6.1 Hazard Profile

Approximately 200 people die each year in the United States because of extreme heat. Extreme summer temperatures are also hazardous to livestock and crops, and can cause water shortages, exacerbate fire hazards, and prompt excessive demands for energy. Even roads, bridges, and railroad tracks are susceptible to damage from extreme heat.



Over the last 10 years Tulsa's average temperature in July and August has been 94 degrees Fahrenheit

Effects

Human bodies dissipate heat by varying the rate and depth of blood circulation and by losing water through the skin and sweat glands. Perspiration is about 90% of the body's heat dissipating function. Sweating, by itself, does nothing to cool the body unless the water is removed by evaporation. Since high relative humidity retards evaporation, under conditions of high temperature (above 90 degrees) and high relative humidity, the body is hard pressed to maintain 98.6 degrees Fahrenheit inside.

When heat gain exceeds the level the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise and heat-related illness may develop.

Another extreme heat hazard is air pollution. During the summer months, consistent high temperatures and stagnant airflow patterns cause a build-up of hydrocarbons to form a dome-like ceiling over large cities. The abundance of factories, automobiles, lawn equipment, and other internal combustion machines emit high particulate matter that builds and worsens with the increase in temperature. The resulting stagnant, dirty, and toxic air does not move away until a weather front arrives to disperse it.

When the particulate matter reaches a pre-determined level, cities issue ozone alerts and implement measures to reduce the use of cars and the output of the offending chemicals. Ozone alerts usually include advisories for the elderly and those with breathing difficulties to stay indoors in air-conditioned environments.

Damage to property during extreme heat is largely related to expanding and contracting soil and is covered in the section, "Expansive Soils."

Normal Frequency

Over the past ten years, the average high temperature for July and August in the Tulsa area has been 94 degrees, which puts the area in the "Extreme Caution" category on the National Weather Service (NWS) Heat Index scale, without factoring in relative humidity.

Measurements

The Heat Index and Heat Disorders table (see below) relates index ranges with specific disorders, particularly for people in the higher risk groups. The heat index illustrates how the human body experiences the combined effects of high temperature and humidity. It more accurately reflects what the body experiences than simply measuring the air temperature. For example, when the air temperature is 98° Fahrenheit and the relative humidity is 50%, the human body experiences the discomfort and stress equivalent to 113° Fahrenheit.

Relative Humidity (%)

Heat Index
(Apparent Temperature)

Air Temperature (°F) / °F	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	102	106	110	114	119	124	129	136			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	106	109	113	117	122	127	132
88	88	89	91	93	95	98	100	103	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

With Prolonged Exposure and/or Physical Activity

Extreme Danger	Heat stroke or sunstroke highly likely
Danger	Sunstroke, muscle cramps, and/or heat exhaustion likely
Extreme Caution	Sunstroke, muscle cramps, and/or heat exhaustion possible
Caution	Fatigue possible

With 94 degrees F and 80 percent humidity, the body experiences the equivalent of 129 degrees F, and is in extreme danger of heat stroke or sunstroke

3.6.2 Historical Events

In the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the disastrous heat wave of 1980, more than 1,250 people died.

A 1988 drought and heat wave in the central and eastern United States caused approximately $40 billion in livestock and crop damage. Another in the southeastern United States in 1993 caused approximately $1 billion in livestock and crop damage and an undetermined number of deaths.

The Central Plains and Corn Belt States experienced a heat wave July 15 through 19, 1995, when temperatures climbed above 120 degrees Fahrenheit. A significant portion of the Eastern States was in the danger category during the same period, with temperatures ranging from 105 to 120 degrees Fahrenheit. This heat wave caused 670 deaths.

In Oklahoma, July is generally the hottest month of the year, closely followed by August. The NWS compiled a 106-year record of monthly and annual average temperatures in Oklahoma, and the years of 1921, 1931, and 1936 show the highest average temperatures across a 12-month period for the past 100 years.

The table below shows that 44 deaths resulted from 43 extreme heat episodes from 1995 to 2000 in Oklahoma compared with 1,971 deaths in the United States. The table also illustrates the percentage of fatalities that were people over 65 years of age.

Table 3–12: Deaths from Extreme Heat

Year	*Oklahoma*	*United States*	*Over 65*
1995	0	1,021	73%
1996	7	36	84%
1997	0	81	65%
1998	24	173	68%
1999	10	502	67%
2000	3	158	68%
Totals	44	1,971	

Humidity has worsened over the past 40 years in northeast Oklahoma due in part to the construction of new lakes. If humidity readings are factored in to the air temperature records, the Heat Index for this area in July and August could easily move into the "Dangerous" or even "Extremely Dangerous" levels in those two months. Therefore, this part of the state is quite vulnerable to the natural hazard of extreme heat during a large part of virtually every summer season.

Tulsa has experienced 90 ozone alert declarations in the past 10 years, and 50 in the last five years. The number of days when the air quality is so poor that alerts must be issued is increasing more rapidly in recent years. Surrounding communities may naturally be affected by the state of Tulsa's air quality.

Over the last 50 years Tulsa County has reported 16 events classified as *Record Warmth, Excessive Heat* or *Record Heat* by the National Climatic Data Center. These incidents are considered responsible for seven deaths, all but one of which occurred since 1995, and one extreme heat related incident occurred in 2001.

3.6.3 Vulnerable Population

Every person is subject to health problems during a heat wave. However, the poor, elderly, obese, and those with weakened hearts are more likely to suffer. The elderly and

obese have a higher rate of pulmonary disease and therefore are adversely affected by poor air quality. Furthermore, the poor and elderly may be less able to afford high utility bills and air conditioning units. Another segment of the population at risk are those whose jobs consist of strenuous labor outside exposed to high temperatures and humidity.

Studies indicate that, other things being equal, the severity of heat disorders tend to increase with age. Heat cramps in a 17-year-old may become heat exhaustion in a person who is 40 and heat stroke in a person over 60. Sweating is the body's natural mechanism for reducing high body temperature, and the body temperature at which sweating begins increases with age.

More deaths from extreme summer weather occur in urban centers than in rural areas. Poorer air quality in big cities exacerbates severe conditions. The masses of stone, brick, concrete, and asphalt that are typical of urban architecture absorb radiant heat energy during the day and radiate that heat during nights that would otherwise be cooler. Tall buildings may effectively decrease wind velocity, thereby decreasing the contribution of moving air to evaporative and convective cooling.

Out of Tulsa County's population of approximately 506,000 people, 58,404 (or 11.6%) are over 64, and 26,021 (or 7.8%) of the households are considered low income.

3.6.4 Conclusion

Oklahoma can expect to be hit by the hazard of extreme heat every summer. The severity of the hazard is dependent on a combination of temperature, humidity, and access to air conditioning. The most vulnerable groups are:

- The poor (See Figure 1–3: Low Income Areas, in Chapter 1)
- The elderly (See Figure 1–2: Population 65 Years and Older, in Chapter 1)
- Those with heart problems
- The obese
- Those who work outside

Everyone in Tulsa County is exposed, but the most vulnerable are the 11.6% of the population that is over 64 and the 7.8% of the population that is low income.

3.6.5 Sources

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3.7 Drought

Drought can be defined as "climatic dryness severe enough to reduce soil moisture and water below the minimum necessary for sustaining plant, animal, and human life systems." Drought is caused by a deficiency of precipitation, which can be aggravated by high temperatures, high winds, and low relative humidity. Duration and severity are usually measured by deviation from norms of annual precipitation and stream flows.

3.7.1 Hazard Profile

The "Dust Bowl" of the 1930s, the greatest natural disaster in Oklahoma history, drove over 800,000 people off the land

Drought is an insidious hazard of nature, often characterized as a "creeping phenomenon," since it is usually difficult to recognize the occurrence of drought before being in the middle of one. Drought analysis is more subjective than that for floods, because droughts do not occur spontaneously. They evolve 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. This multi-dimensional nature makes it difficult to define a drought and to perform comprehensive risk assessments. This leads to the lack of accurate, reliable, and timely estimates of drought severity and effects, and ultimately slows the development of drought contingency plans.

Effects

Adverse consequences of drought occur because of deficiencies in the following:

- Public and rural water supplies for human and livestock consumption
- Natural soil water or irrigation water for agriculture
- Water for hydroelectric power, forests, recreation, and navigation
- Water quality

The most direct impact of drought is economic rather than loss of life or immediate destruction of property. Drought affects water levels for use by industry, agriculture, and individual consumers.

Water shortages affect fire fighting capabilities through reduced water flows and pressures. Drought also affects power production, because low water levels force electric companies to curtail hydro generation and buy electricity from other, usually more expensive, sources to meet demand.

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. (See the section, "Wildfires.")

Drought is often associated with extreme heat. Wildlife, pets, livestock, crops, and humans are vulnerable to the high heat that accompanies drought. When temperatures reach 90 degrees and above, people and animals are more likely to suffer sunstroke, heat cramps, and heat exhaustion. (See the section, "Extreme Heat.")

Normal Frequency

Drought is a normal part of virtually all climates. However, an ample water supply is critical to the economic well being of the United States and of Oklahoma. During droughts, crops do not mature, wildlife and livestock are undernourished, land values decrease, and unemployment increases.

Given that six major drought events have occurred in Oklahoma over the past 50 years and that nine notable droughts occurred nationwide in the twentieth century, one may logically conclude that Oklahoma can expect a drought every decade and that we can expect droughts to occur more frequently than the country as a whole. However, long-term forecasts of droughts are difficult and inexact. There is no commonly accepted way of determining the probability that is analogous to the 100-year or 1-percent-annual flood chance.

The U.S. Army 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-years 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. Oklahoma, with one per ten years over the past 50 years, is obviously at a greater than normal risk from drought.

Measurements

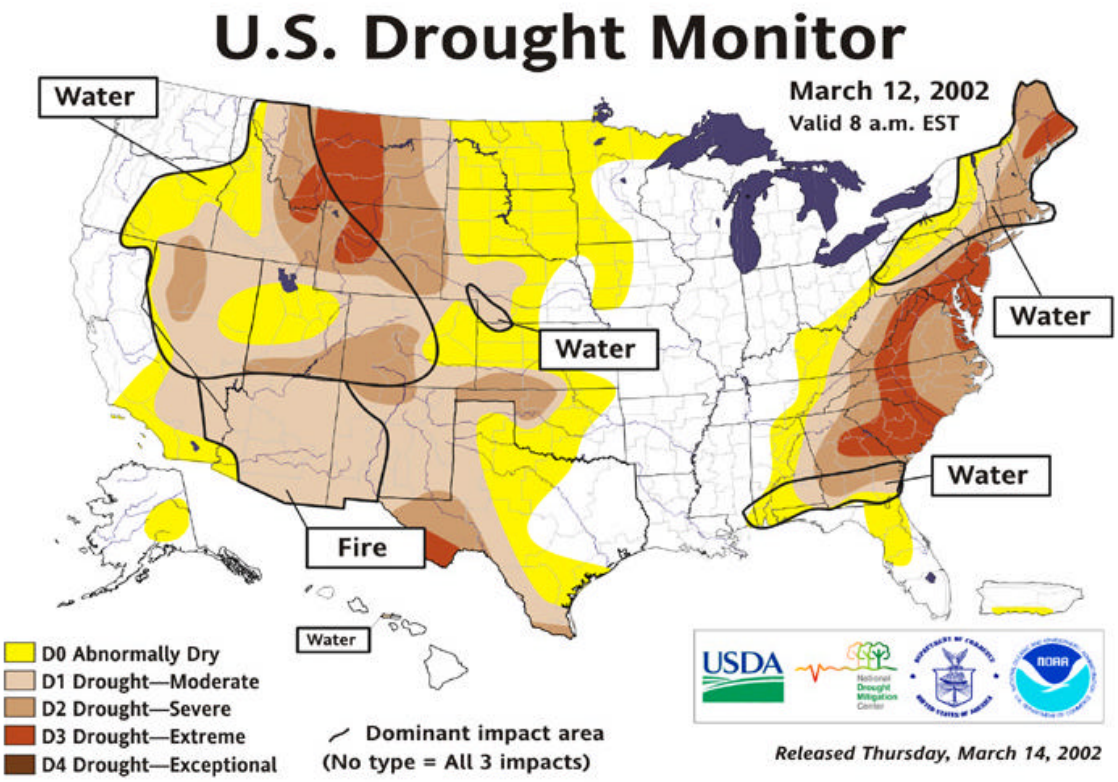
A variety of measures are used to predict the severity and impact of droughts, but each one measures different aspects or types of drought. Any single index cannot describe everything about the original data, and the indices are only approximations of real-world phenomena.

The Palmer Index, the most familiar and widely used, measures the departure from normal precipitation. This index uses a range from 4 (extremely wet) to –4 (extremely dry). It incorporates temperature, precipitation, evaporation, runoff, and soil moisture

when designating the degree of drought. Hydrologic indices of drought (such as groundwater levels, reservoir volumes, or water levels) may be used to determine surface water supplies.

3.7.2 Historical Events

The National Weather Service's current drought monitor map (see below) illustrates the pervasive nature and degrees of dryness and prolonged droughts in several areas of the country.



Nine notable droughts occurred during the twentieth century in the United States. Damage estimates are not available for most of these, however estimates indicate that the 1976-1977 drought in the Great Plains, Upper Midwest, and far Western States caused direct losses of $10-$15 billion. The 1987-1989 drought cost $39 billion, including agricultural losses, river transportation disruption, water supply problems, wildfires, and more general economic losses.

Approximately 20% of the contiguous United States is currently suffering from the effects of prolonged severe to extreme drought. Parts of the east coast have been particularly hard hit, and the drought in those areas is so severe that months of above-normal rainfall would be necessary to end it, according to the National Weather Service.

In Oklahoma, five major drought events were reported over the past 50 years resulting in damage to crops estimated at *$900 million*.

Major droughts in Oklahoma, as determined from stream flow records collected since the early 1920s, have predominantly occurred during four periods: 1929-1941, 1951-1957, 1961-1972, and 1975-1982.

One of the greatest natural disasters in U.S. history and the most severe and devastating to Oklahoma was the decade-long drought in the 1930s that has become known as the Dust Bowl. Reaching its peak from 1935 through 1938, high temperatures and low rainfall combined to destroy crops and livestock. High winds literally blew the land away, causing massive soil erosion. Hundreds of small rural communities were ruined and about 800,000 people were displaced. The total expenditure by the American Red Cross for drought relief in Oklahoma in 1930-1931 was the third largest ever in the nation.

Oklahoma has begun the new century with drought conditions. Since June of 2001, Oklahoma has received only 71 percent of its normal rainfall, according to the Oklahoma Climatological Survey.

Drought conditions in the western states have impacted wheat crops and some local water supplies

Currently, lack of rainfall and an infestation of insects are taking a toll on western Oklahoma's wheat crop. State officials say 26 percent of the wheat crop is in very poor shape and conditions are so dry in the Panhandle that soil erosion is beginning to occur. The state's "wheat belt" region, the area around and west of U.S. 81, has received less than 50 percent of its normal rainfall since October, said Derek Arndt, climatologist with the Oklahoma Climatological Survey.

In northeastern Oklahoma, an area referred to as “Green Country” for its forests, lakes, and streams, is not immune to the growing spread of drought. The big lakes in this area such as Keystone, Eufaula, Tenkiller, Broken Bow, and Fort Gibson have been at full conservation storage levels.

Birch, Skiatook and Grand lakes are at low levels. Skiatook Lake was between 5 and 6 feet below normal, about 17% down, according to a U.S. Army Corps of Engineers report. Birch was nearly 3 feet down, and Grand Lake was 8 feet down. However, none have dropped as dramatically as Copan Lake and Hulah Lake.

3.7.3 Vulnerable Population

In all droughts agriculture feels the impact, especially in non-irrigated areas such as dry land farms and rangelands. Other heavy water users, such as landscapers, are also negatively impacted. Water related activities of residential users might be restricted.

Droughts also cause power shortages in Oklahoma because much of the state's power comes from hydroelectric plants. Therefore, heavy electricity users are affected, usually by having to purchase more expensive replacement power.

Generally, in times of severe drought when water shortages reach near-disaster proportions, states rely on the federal government to provide relief to drought victims. Forty separate drought relief programs administered by 16 Federal agencies provided nearly $8 billion in relief as a result of the series of drought years during the mid-1970s. Federal assistance efforts totaled more than $5 billion in response to the 1987–1989 drought. However, since the disastrous droughts of the mid-1970s, most states have taken a more active role in prevention and mitigation, and drought contingency plans are now in place in at least 27 states.

3.7.4 Conclusion

There are signs that drought is becoming an increasing problem in the United States, including Oklahoma. However, it is difficult to predict drought probabilities for the near future because of the nature and complexity of the hazard.

Past drought response and recovery activities in Oklahoma, on both state and local levels, have not been successful. Planning for the state's critical and emergency water resources needs should not be done only during times of drought crises. There is a need to focus more on long-term water management and planning issues; to integrate the activities of numerous agencies with drought-related missions into a coherent national approach; and to achieve better coordination of mitigation, response, and planning efforts between state and federal officials.

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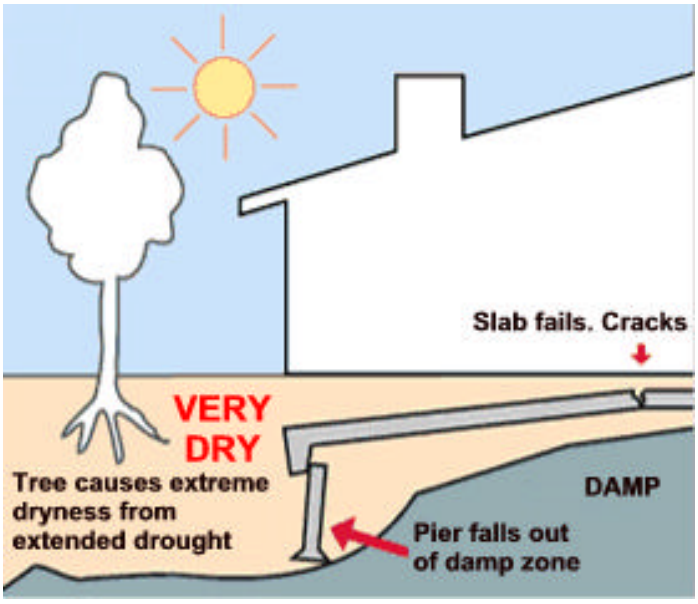
3.8 Expansive Soils

Soils and soft rock that swell and shrink with changes in moisture content are commonly known as expansive soils. These soils are also referred to as "swelling clays," because clay materials are most susceptible to swelling and shrinking. Dry clays are capable of absorbing water and will increase in volume in an amount proportional to the amount of water absorbed.

3.8.1 Hazard Profile

Changes in soil volume present a hazard primarily to structures built on top of expansive soils.

Most engineering problems caused by volume changes in swelling clays result from human activities that modify the local environment, and usually involve swelling clays beneath areas covered by buildings and slabs or layers of concrete and asphalt. Damage to the built environment results from differential vertical movement that occurs as clay moisture content adjusts to the changed environment.



Almost half of Tulsa's property is underlain by clay soils with a high shrink-swell potential

The total annual cost of 1) expansive soil-related damage and 2) preventative design of moderate to high-risk structures in the United States has been conservatively estimated at just under $2.5 billion. Recent estimates put the annual damage as high as $7 billion.

Because the hazard develops gradually and seldom presents a threat to life, expansive soils have received limited attention despite their costly effects. Many problems are not recognized as being related to expansive soils or may be considered only nuisances and therefore never repaired.

Effects

The most extensive damage from expansive soils occurs to highways and streets. The increase in soil volume also causes damage to foundations. The most obvious manifestations of damage to buildings are sticking doors, uneven floors, and cracked foundations, floors, walls, ceilings, and windows. If damage is severe, the cost of repair may exceed the value of the building.

Normal Frequency

Out of the 250,000 homes built each year on expansive soils, 10% sustain significant damage during their useful lives, some beyond repair, and 60% sustain minor damage. For all types of building construction, annual losses of $740 million are estimated.

Measurements

The risk associated with expansive soil is related to swelling potential in a qualitative manner: high, moderate to slight, and little to no swelling potential. Probability and frequency analyses have not been prepared because of the nature of occurrence of this hazard, which is consistent with other geologic hazards that occur rarely or slowly over time.

The Oklahoma Department of Transportation and the U.S. Department of Agriculture, Natural Resources Conservation Service have an ongoing program to evaluate the expansive tendencies of soils and shale formations in the state. Data on shrink-swell potential for each major soil type is kept for 77 counties.

3.8.2 Historical Events

In Oklahoma, numerous foundation failures caused by soil shrinkage occurred during the unusually hot and dry summer of 1998.

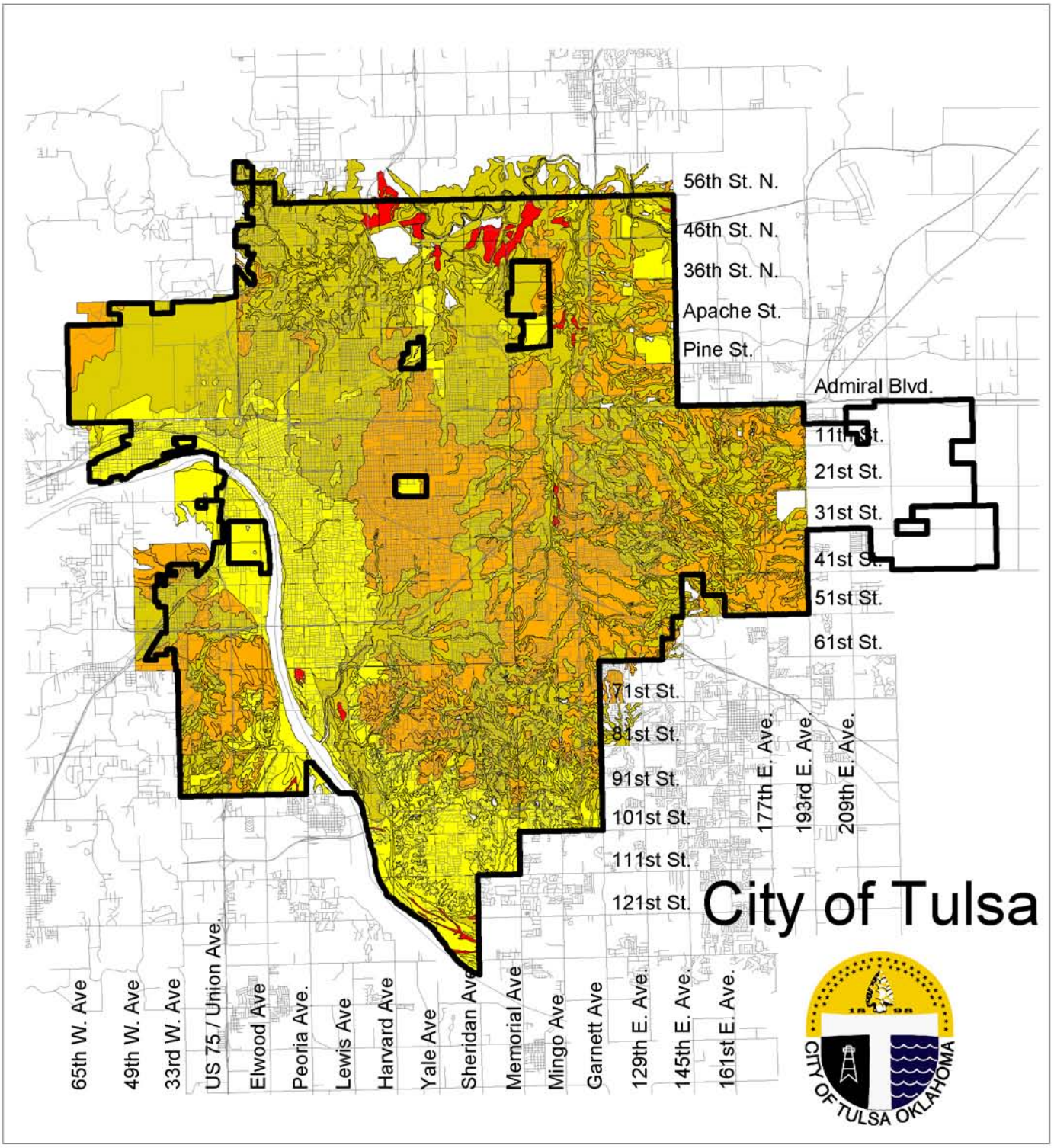
3.8.3 Vulnerable Population

The effects of expansive soils are most prevalent in regions of moderate to high precipitation, where prolonged periods of drought are followed by long periods of rainfall. The most problematic soil type for expansive soils is found in the semiarid West-central United States.

Houses and small buildings are impacted more by expansive soils than larger buildings. Large buildings are not as susceptible because their weight counters pressures from soil swelling. The greatest damage occurs when small buildings are constructed when clays are dry (such as during a drought) and then subsequent soaking rains swell the clay. Other cases of damage involve increases of moisture volume from broken or leaking water and sewer lines, over-watering of lawns and landscape, and modifications of the surface that produce ponding.

In Oklahoma, the principal geologic areas that have high shrink-swell potential are the Cretaceous shales that crop out in the southern part of the state.

Expansive soils for the City of Tulsa are shown in Figure 3–3 on the next page.



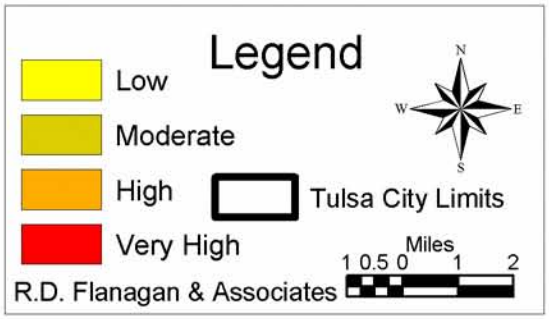


Figure 3-3

City of Tulsa
Expansive Soils

3.8.4 Conclusion

For large areas of the United States, little information is reported other than field observations of the physical characteristics of clay of a particular stratigraphic unit. Therefore, fixed criteria for determining the swelling potential have not been devised. However, the Oklahoma Department of Transportation and the U.S. Department of Agriculture, Natural Resources Conservation Service have an ongoing program to evaluate the expansive tendencies of soils and shale formations in the state.

Houses and one-story commercial buildings are more apt to be damaged by the expansion of swelling clays than are multi-story buildings, which usually are 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.

3.8.5 Sources

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3.9 Urban Fires

Home fire is the fifth leading unintentional cause of injury and death in the United States, behind motor vehicle crashes, falls, poisoning by solids or liquids, and drowning. It also ranks as the first cause of death for children under the age of 15 at home. Roughly 80% of all fire deaths occur where people sleep, such as in homes, dormitories, barracks, or hotels. The majority of fatal fires occur when people are less likely to be alert, such as nighttime sleeping hours. Nearly all home and other building fires are preventable, even arsons.

3.9.1 Hazard Profile

Frame houses in the poorer central and north sections of the city are particularly vulnerable to urban fire

Fires are an excellent example of how natural hazards interact in ways that spiral out of control. Lightning, high winds, earthquakes, volcanoes, and floods can trigger or exacerbate fires. Lightning can trigger structural fires. For example, in 1994, a $1.5 million historic mansion in Pennsylvania was lost to a lightning-triggered fire. Buildings with rooftop storage tanks for flammable liquids are particularly susceptible.

Effects

The leading cause of death in a fire is asphyxiation by a three-to-one ratio over burns. Fire consumes the oxygen and increases the concentration of deadly carbon monoxide and other toxic gases in the air. Inhaling carbon monoxide can cause loss of consciousness or death within minutes. The heat from a hostile fire exceeds anything to which a person is normally exposed. A fully developed room fire has temperatures over 1,100 degrees Fahrenheit. Fire generates a black, impenetrable smoke that blocks vision and stings the eyes, making it often impossible to navigate and evacuate the building on fire.

Normal Frequency

Approximately 900 adults die in fires annually in the United States.

3.9.2 Historical Events

The Great Chicago Fire of 1871 started around 9:00 on Sunday evening, October 8, somewhere in or near the O'Leary barn. Firemen might have been able to contain the blaze but for a series of technological and human failures in the alarm system. Fanned by

a strong wind, in a city largely built of wood structures, the blaze raged for nearly 30 hours. The "Burnt District" encompassed an area four miles long and an average of three-quarters of a mile wide—more than 2000 acres. About 18,000 buildings ($200 million in property, in 1871 dollars) were destroyed, about a third of the valuation of the entire city. One hundred thousand Chicagoans lost their homes and 1,152 were killed.

The 1906 San Francisco earthquake and fire ranks as one of the most significant natural disasters of all time. It was a textbook case in how natural hazards interact to make fire impossible to stop. The result was 3,000 dead, 225,000 injured, and $406 million in property damage (in 1906 dollars).

On October 20, 1991, a large, devastating fire occurred in the scenic hills above the cities of Oakland and Berkeley, California. Burning embers carried by high winds from a small but growing "duff fire" (from partly decayed organic matter) ignited overgrown vegetation and led to the further ignition of tree crowns and the combustible construction materials of adjacent homes, including many with wood shingle roofs. The result was a major combined wild land and urban fire that burned over 1,600 acres, killed 25 people and injured 150 others, destroyed nearly 2,449 single-family dwellings and 437 apartment and condominium units, and did an estimated $1.5 billion in damage.

In the United States during 1991, structural fires caused 4,465 civilian deaths and 21,850 injuries, and resulted in an estimated $8.3 billion in damage. In 1995, 3,640 people died in reported home fires—roughly 10 people per day. In addition, every year thousands of people are injured in home fires, many hospitalized for severe burns, and some disfigured for life.

Real progress has been made nationally and locally in reducing the number of urban fires and fire-related fatalities. Nationally, in 1877 there were 3,264,000 fires, and 7,395 fatalities. By 2000, both figures have been reduced by almost half to 1,708,000 fires, and 4,045 fire-related deaths.

In Tulsa, records of fire related deaths have been maintained since 1933. For the 23-year period from 1966 to 1989, 311 persons died from urban fires, an average of 13.5 per year. Since 1990, however, fire deaths have been dramatically reduced by two thirds to only five in 2001. The trend in injuries has also dropped from 54 in 1988, to only six in 2001.

In the ten-year period from 1990 to 2000, according to Tulsa Fire Department records, there have been a total of 9,379 fires, with $146.8 million in property losses. The number of fires per year has dropped from 1,041 in 1990, to 733 in 2000.

3.9.3 Vulnerable Population

In Tulsa, from 1990 to 2000, the vast majority of fires- 7,513 of a total of 9,379 (80%), occurred in residences. The average residential fire did $11,753 in damage.

In residences, the majority of fatal fires occur when people are less alert or sleeping. Victims are disproportionately children or elderly. Of the fires that kill children, two out of every five are started by children playing with fire.

States with the largest populations tend to have the greatest number of fire-related fatalities. The western United States is susceptible because of prolonged warm winds that can spread sparks and embers. Areas where seismic events are more likely to occur are also susceptible, particularly in areas where natural gas distribution systems can rupture (evident in 1989 during the San Francisco earthquake). Floods can also trigger fires. Volcanic events may involve multiple fires.

3.9.4 Conclusion

All areas of the United States are exposed to personal injury and property damage as a result of fires caused by natural hazards. Fires occur year-round, but the rate of residential fires in January is twice that of the summer months. Fatalities tend to be distributed according to population density. In 1987, 52% of the recorded fires occurred in 10 states. The public information and education and smoke alarm programs of the Tulsa Fire Department have proven successful, reducing the number of residential fires by almost a third, and cutting fire-related deaths by two-thirds from 1990 to 2000.

3.9.5 Sources

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3.10 Wildfires

As more people make their homes in woodland settings in or near forests, rural areas, or remote mountain sites, they face the real danger of wildfire. Wildfires often begin unnoticed and spread quickly, igniting brush, trees, and homes.

Wildfires can move on three different levels. A *surface fire* is the most common type and burns along the floor of a forest, moving slowly and killing or damaging trees. A *ground fire* is usually started by lightning and burns on or below the forest floor in the humus layer down to the mineral soil. A *crown fire* spreads rapidly by wind and moves by jumping along the tops of trees.

3.10.1 Hazard Profile

Wildfire is a serious and growing hazard over much of the United States, posing a great threat to life and property, particularly when it moves from forest or rangeland into developed areas. However, periodic forest, grassland, and tundra fires are a natural process in the environment, as natural and as vital as rain, snow, or wind. Naturally occurring or non-native species of trees, brush, and grasses fuel wildfires.

Wildfire is mainly a hazard for homes and properties on the rural/urban interface zone

Fire suppression is now recognized to have created a larger fire hazard, because live and dead vegetation accumulates in areas where fire has been excluded. In addition, the absence of fire has altered or disrupted the cycle of natural plant succession and wildlife habitat in many areas. Consequently, United States land management agencies are committed to finding ways of reintroducing fire into natural ecosystems (such as prescribed burning) while recognizing that fire fighting and some types of fire suppression are still important.

The four categories of wildfires experienced throughout the United States are:

- **Interface or intermix fires** are those fueled by both wild land vegetation and the built-environment.
- **Firestorms** are events of such extreme intensity that effective suppression is virtually impossible. They occur during extremely dry weather and generally burn until conditions change or available fuel is exhausted.

- **Prescribed fires** are those that are intentionally set or selected natural fires that are allowed to burn for beneficial purposes.
- **Wild land fires** are fueled by natural vegetation and typically occur in national forests and parks.

Causes

Topography, fuel, and weather are the three principal factors that impact wildfire hazards and behavior. Other hazard events have the potential to cause wildfires, such as earthquakes, lightning, and high winds. For example, in 1991, winds gusting to 62 mph downed power lines and caused 92 separate wildfires in Washington.

U.S. Forest Service (USFS) figures for 1990 indicate that 25.7% of reported wildfires were caused by arson, 24% were caused by debris burns, and 13.3% were caused by lightning.

Lightning can cause particularly difficult fires when dry thunderstorms move across an area that is suffering from seasonal drought. Multiple fires can be started simultaneously. In dry fuels, these fires can cause massive damage before containment.

Effects

Wildfires leave problems behind them, even when the last ember is extinguished. Post-fire effects can trigger additional consequences that cascade into other serious hazard events. The loss of ground-surface cover from a fire and the chemical transformation of burned soils make watersheds more susceptible to erosion from rainstorms. Subsequent unchecked debris flows can then carry mud, rock, chemicals, and other debris into water supplies, reducing water quality. (See “Historical Events,” below.)

It is impossible to fully assess the economic impact of wildfires due to incomplete reporting. However, the U.S. Forest Service compiles statistics for wildfires on federal lands and is the primary federal source of information.

Normal Frequency

According to the National Interagency Fire Center, between 1985 and 1994 there were about 73,000 fires each year on federal lands, burning a total of over 3 million acres and 900 homes, and costing more that $411.5 million to suppress.

3.10.2 Historical Events

The single worst wildfire event in United States history, in terms of deaths, occurred in Wisconsin in 1871, when 1,182 people were killed.

Between October 25 and November 3, 1993, 21 major wild land fires broke out in California, fanned by hot, dry winds. The fires collectively burned over 189,000 acres and destroyed 1,171 structures. Three people died and hundreds were injured. Combined property damage was estimated at approximately $1 billion.

In 1994, one of the worst years for wildfires since the early 1900s, 79,107 fires burned over four million acres and cost $934 million to put out. Tragically, 34 firefighters lost their lives. On July 6, 1994, 14 firefighters died in one terrible incident during the South Canyon Fire just west of Glenwood Springs, Colorado. Another wildfire burned 2,000 acres of forest and scrub on the steep slopes of Storm King Mountain, Colorado, leaving it exposed to erosion. The following September, torrential rains created burned debris flows that inundated a 3-mile stretch of Interstate 70. The flows engulfed 30 cars, sweeping two into the Colorado River. Some travelers were seriously injured, but fortunately there were no deaths.

In May 1996, an 11,900-acre fire burned most of the Buffalo Creek and Spring Creek watersheds. These small watersheds feed into the Strontia Springs Reservoir, which supplies more than 75 percent of the municipal water for the cities of Denver and Aurora. Two months after the fire, a severe thunderstorm caused flooding from the burned area, killing two people. In addition, the Denver Water Department immediately experienced a deterioration of water quality from burned debris and high levels of manganese. Two years after the fire, phosphate levels in the water remained high.

In Oklahoma during 1994, there were 16,781 grass, crop, and wild land fires that burned 61,634 acres. Four fire fighters died that year.

3.10.3 Vulnerable Population

Wildfires occur in virtually all of the United States. The western states, with their more arid climates and prevalent conifer and brush fuel types, are subject to more frequent wildfires. Wildfires are the most destructive in California, but they have become an increasingly frequent phenomenon nationwide. People are becoming more vulnerable to wildfires by choosing to live in wild land settings, and the value of exposed property is increasing at a faster rate than population.

In the Tulsa area, the vulnerable areas are the rural/urban interface zones. According to the Tulsa Fire Department, wildfires are not a serious problem for Tulsa. The Tulsa Fire Department assists adjacent communities and rural fire districts with wildfires that threaten their jurisdictions and could affect Tulsa's rural/urban development.

3.10.4 Conclusion

Wildfires are a serious and growing hazard because people continue to build their homes into woodland areas. The value of the property exposed to wildfires is increasing more rapidly, especially in the western states.

There were fire suppression measures taken in the past that caused an even greater fire hazard because ground cover that had been burning at natural intervals was able to build up. Western ecosystems have adapted to and have become dependent on wildfires, which play an essential role by thinning forests and creating stands of different plant species. Land management agencies are now changing their policies concerning the control of naturally occurring wildfires.

Like the rest of the United States, Oklahoma is vulnerable to some wildfires.

3.10.5 Sources

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3.11 Earthquakes

An earthquake is a sudden, rapid shaking of the ground caused by the fracture and movement of rock beneath the Earth's surface. Most severe earthquakes take place where the huge tectonic plates that form the Earth's surface collide and slide slowly over, under, and past each other. They can also occur along any of the multitude of fault and fracture lines within the plates themselves.

The faults most likely to affect Oklahoma are the New Madrid Fault, centered in the Missouri Bootheel region, and the Meers Fault, located in southwestern Oklahoma near Lawton.

3.11.1 Hazard Profile

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

Although located in the relatively quiet Central Plains Province, Tulsa's nearness to the New Madrid, Missouri, fault exposes the city to VI intensity tremors

The destructiveness of an earthquake depends upon a number of factors, including 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, such as roads, bridges, and pipelines.

Earthquake intensity can be significantly affected by the stability of underlying soils. For example, during the Northridge, California earthquake, three times as much damage was done to single-family homes and buried utilities in ground failure zones than in nearby areas where the footing was more solid. Also, the intensity of West Coast tremors is dissipated by the relative "warmth" of the region's geology. By contrast, the thick Pennsylvanian sandstone and limestone strata of the central United States are much more efficient conductors of tremors. Consequently, a 6.8-magnitude earthquake in the New Madrid Fault would have a much wider impact than a comparable event on the California coast.

Urbanization is probably the most important factor in translating earthquake magnitude into human impacts. In the continental United States, Alaska has the greatest number of large earthquakes—over a dozen above 7.3 magnitude between 1899 and 1999. However, these severe quakes resulted in relatively little loss of life or damage, since all but one occurred in uninhabited areas.

Effects

Earthquakes can cause poorly compacted, clay-free soils to temporarily lose strength and behave like viscous fluids rather than solids. This "liquefaction" can result in ground failure and damage to structures and buried utilities.

Normal Frequency

In the United States, California experiences the most frequent damaging earthquakes, and Alaska has the greatest number of large earthquakes.

Oklahoma has experienced an average of 50 earthquakes each year since records have been kept by the Oklahoma Geological Survey. Most of these earthquakes were so small that they could not be felt by people. Only about two or three per year have been large enough to be felt and most were so small they caused no damage.

The Meers Fault has had two major ruptures in the last 3000 years, the last one about 1600 years ago. If the fault has a 1500-year periodicity, it could be due for a major event in the next one or two hundred years.

Tulsa and its adjacent counties experienced 47 earthquakes between 1977 and 2000, or about two per year. None of these were felt events. The most likely major earthquake event that could impact the area would probably originate in the New Madrid Fault Zone, which has been relatively quiet for 150 years. Seismologists estimate the probability of a 6 to 7 magnitude earthquake in the New Madrid area in the next 50 years to be higher than 90 percent.

Measurements

Modern seismological technology has greatly enhanced the capability of scientists to sense earthquakes. Before the development of today's delicate sensors, only "felt" earthquakes were captured in the historical record.

Scientists use two standard measures to classify an earthquake's severity: *magnitude* and *intensity*. These measures are sometimes referred to as the Richter Scale (magnitude) and the Modified Mercalli (intensity).

Magnitude is an Arabic number representing the total amount of energy released by the earthquake source. It is based on the amplitude of the earthquake waves recorded on seismographs that have a common calibration. The magnitude of an earthquake is thus represented by a single, instrumentally determined value.

Intensity, expressed as a Roman numeral, is based on the earthquake's observed effects on people, buildings and natural features. It varies depending on the location of the observer with respect to the earthquake's epicenter. In general, the intensity decreases with distance from the fault, but other factors such as rupture direction and soil type also influence the amount of shaking and damage.

The Modified Mercalli and Richter Scales are compared in the following table.

Table 3–13: Comparison of Mercalli and Richter Scales

Mercalli	*Richter*	*Description*
I	0-4.3	Vibrations are recorded by instruments. People do not feel any Earth movement.
II		A few people might notice movement if they are at rest and/or on the upper floors of tall buildings.
III		Shaking felt indoors; hanging objects swing. People outdoors might not realize that an earthquake is occurring.
IV	4.3-4.8	Dishes rattle; standing cars rock; trees shake. Most people indoors feel movement. Hanging objects swing. Dishes, windows, and doors rattle. A few people outdoors may feel movement.
V		Doors swing; liquid spills from glasses; sleepers awake. Almost everyone feels movement. Dishes are broken. Pictures on the wall move. Small objects move or are turned over. Trees might shake.
VI	4.8-6.2	People walk unsteadily; windows break; pictures fall off walls. Everyone feels movement. Objects fall from shelves. Furniture moves. Plaster in walls might crack. Trees and bushes shake. Damage is slight in poorly built buildings. No structural damage.
VII		Difficult to stand; plaster, bricks, and tiles fall; large bells ring. Drivers feel their cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built buildings.
VIII	6.2-7.3	Chimneys fall; branches break; cracks in wet ground. Drivers have trouble steering. Houses that are not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Well-built buildings suffer slight damage. Poorly built structures suffer severe damage. Water levels in wells might change.
IX		General panic; damage to foundations; sand and mud bubble from ground. Well-built buildings suffer considerable damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks. Reservoirs suffer serious damage.
X		Most buildings destroyed; large landslides; water thrown out of rivers and lakes. Some bridges are destroyed. Dams are seriously damaged. The ground cracks in large areas. Railroad tracks are bent slightly.
XI	7.3-8.9	Roads break up; large cracks appear in ground; rocks fall. Most buildings collapse. Some bridges are destroyed. Underground pipelines are destroyed. Railroad tracks are badly bent.
XII		Total destruction; "waves" seen on ground surface; river courses altered; vision distorted. Almost everything is destroyed. Objects are thrown into the air. Large amounts of rock may move.

3.11.2 Historical Events

World history is punctuated with hundreds of earthquake catastrophes. In 1556 the Shansi, China, earthquake killed 800,000 people. An earthquake in Lisbon in 1775 took 70,000 lives. More recently, a moderate 6.7-magnitude earthquake struck Northridge, California, on January 17, 1994, killing 57 people, injuring 9,000, and causing over $25 billion in damage. A year later, in Kobe, Japan, a 6.9 magnitude tremor killed 5,100 people, injured 27,000, destroyed 100,000 buildings, and did $120 billion in damage.

In the United States, California and Alaska have earthquakes the most frequently, but the largest earthquake felt in the United States in historical times occurred in Missouri, along the New Madrid Fault. There, in 1811 and 1812, three earthquakes larger than a magnitude 8 totally destroyed the town of New Madrid, caused the land to roll in visible

waves, raised and sank land as much as 20 feet, and formed and emptied lakes. The tremors rang bells in church steeples as far away as Boston, Massachusetts. These earthquakes were probably the first ones felt by residents in Oklahoma in historical times. Intensity VII earthquakes hit the New Madrid area again in January 1852 and June 1862.

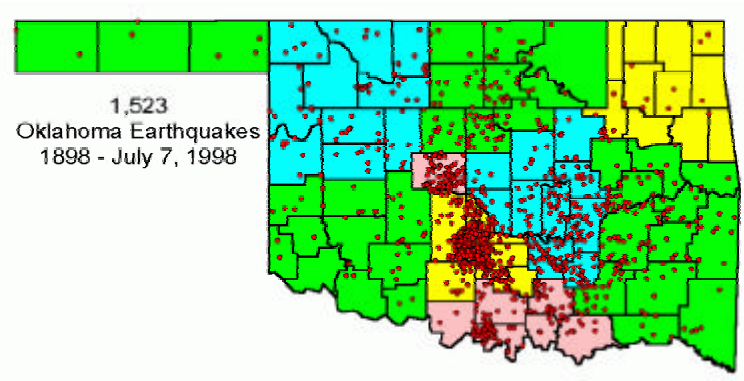
The earliest documented quake in what is now Oklahoma occurred on October 22, 1882, near Ft. Gibson, Indian Territory. The *Cherokee Advocate* reported that "the trembling and vibrating were so severe as to cause doors and window shutters to open and shut, hogs to squeal, poultry to run and hide, and cattle to low." Other felt quakes occurred near Cushing, in Payne County, in December 1900, and in Rogers County on November 8, 1915.

The largest earthquake on record in the state—a VII-intensity event that registered 5.5 on the Richter Scale—happened near El Reno on April 9, 1952. It was apparently caused by slippage along the Nemaha Fault. The tremor toppled chimneys and smokestacks, cracked bricks on buildings, broke windows and dishes, and was felt as far away as Austin, Texas, and Des Moines, Iowa. A 4.1-magnitude, VII-intensity earthquake struck Catoosa on October 30, 1956, causing minor damage in Tulsa and Beggs. Most recently, a 4.0 earthquake shook Ada on September 6, 1997.

The most recent felt earthquake in the Tulsa area was the Catoosa tremor of October 1956.

3.11.3 Vulnerable Population

Most earthquake injuries and fatalities occur within buildings from collapsing walls and roofs, flying glass, and falling objects. As a result, the extent of a community's risk depends not just upon its location relative to a known fault, and its underlying geology and soils, but also on the design of its structures. Buildings constructed to earlier seismic standards (or to no standard) can pose major threats to life and the continued functioning of key public services during an earthquake disaster. Un-reinforced masonry structures are the most vulnerable, while wood frame structures typically perform well. Of special concern are the design and construction of critical facilities such as hospitals and transportation facilities, oil and gas pipelines, electrical power and communication facilities, and water supply and sewage treatment facilities.



Oklahoma is in the relatively stable Central Plains Province. It does have a sustained level of seismicity due to the complex seismic zone that includes the Meers, Nemaha, Central Oklahoma, Choctaw, Chickasha, and Windingstair Faults.

As shown in the map at the left, the majority of Oklahoma earthquakes occur in south central Oklahoma where the Ouachita, Arbuckle and

Wichita mountains converge. They are concentrated in Garvin, Grady, McClain, and Canadian Counties. Note that earthquakes in the northeastern part of the state are relatively rare.

Tulsa's exposure to seismic risk is low. Any earthquake risk would most likely come from its proximity to the New Madrid and Meers Faults. Local earthquakes have been relatively infrequent and of small magnitude, causing little damage. According to Dr. James Lawson, chief geophysicist of the Oklahoma Geological Survey's Seismic Observatory at Leonard, the risk of an earthquake in the New Madrid Fault Zone should not be over emphasized. He believes a major seismic event there would have no greater impact on Tulsa than a locally generated earthquake. An 8-magnitude event in New Madrid would likely produce only VI-intensity tremors in northeastern Oklahoma, and would not be as severe as the Ft. Gibson quake of 1882.

3.11.4 Conclusion

Oklahoma is classified at moderate risk from earthquakes, due to its proximity to the South Central Oklahoma and New Madrid Seismic Zones. Almost all of the South Central Oklahoma earthquakes are too small to be felt and cause no visible damage. Unfelt earthquakes can, however, adversely affect the integrity of local buildings, infrastructure, and lifelines.

In the last 24 years, only five earthquakes have been recorded in Tulsa County. The largest of these was the Catoosa earthquake of October 1956. Although relatively safe from locally generated earthquakes, the region's underlying geology exposes Tulsa to some risk from a severe earthquake in the New Madrid Seismic Zone. When Tulsa's infrastructure and critical facilities are reviewed for integrity against tornadoes and high winds, an analysis of their ability to ride through a VI-intensity earthquake without serious damage should be included.

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3.12 Hazardous Materials Events

Hazardous materials are chemical substances that, if released or misused, can pose a threat to the environment or human health. These chemicals are used in industry, agriculture, medicine, research, and consumer goods. Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. These substances are most often released as a result of transportation accidents or chemical accidents at plant sites.

The federal government has established detailed systems for keeping track of Tier 2 hazardous materials sites. The Emergency Planning and Community Right to Know Act of 1986 defines a Tier 2 site as any location that has, for any 24-hour period, either 1) specified threshold amounts of defined Extremely Hazardous Substances, or 2) any other substance requiring a Material Safety Data Sheet (MSDS) for amounts greater than 10,000 lbs.

Tulsa has a significant refining industry, and is a crossroads for highway traffic that could carry hazardous materials

3.12.1 Hazard Profile

Many products containing hazardous chemicals are routinely used and stored in homes. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines. In most cases, disasters involving hazardous materials are confined to a localized area, whether an accidental release occurs at a fixed facility or in association with a transportation incident.

As many as 500,000 products pose physical or health hazards and can be defined as hazardous chemicals. Each year, over 1000 new synthetic chemicals are introduced. In an average city of 100,000 residents, 23.5 tons of toilet bowl cleaner, 13.5 tons of liquid household cleaners, and 3.5 tons of motor oil are discharged into city drains each month.

The United States Environmental Protection Agency sorts hazardous materials into six categories:

1. Toxic Agents (irritants, asphyxiates, narcotics)
2. Other Toxic Agents (hepatoxic, nephratoxic)

3. Hazardous Wastes
4. Hazardous Substances
5. Toxic Pollutants
6. Extremely Hazardous Substances

Effects

Hazardous materials affect people through inhalation, ingestion, or direct contact with skin. They can cause death, serious injury, long-lasting health problems, and damage to buildings, homes and other property.

Normal Frequency

An average of approximately 6,700 hazardous materials events occur each year in the United States. Of these, 5,517 are highway events, 991 occur on railroads, and 266 are due to other causes. There is an average of 280 hazardous materials releases and spills at fixed sites that occur each year.

Most hazardous materials events occur during transport. Transportation of hazardous materials on highways involves tanker trucks or trailers and certain types of specialized bulk cargo vehicles. Because of the distances traveled, it is not surprising that trucks are responsible for the greatest number of hazardous materials events.

3.12.2 Historical Events

In 1984 a deadly cloud of methyl isocyanate killed thousands of people in Bhopal, India. Shortly thereafter, there was a serious chemical release at a sister plant in West Virginia. These incidents underscored demands by industrial workers and communities in several states for information on hazardous materials. Public interest and environmental organizations around the country accelerated demands for information on toxic chemicals being released "beyond the fence line"—outside the facility.

In Oklahoma in 2001 there were 28,000 Tier 2 sites.

In Tulsa in 2001 there were 503 Tier 2 sites. During the same reporting period there were 91 hazardous materials incidents in Tulsa County. Three hazardous materials events in the Tulsa area in the past five years have been significant enough to be noticed by local residents.

On February 10, 1997, a Sinclair Refinery stack at 902 W. 25th Street began emitting the thick, greenish-yellow, odorous cloud that drifted northeast across Tulsa. Sinclair officials said it could be an irritant but was non-toxic. As a precaution, city emergency officials urged people northeast of the Arkansas River and 41st Street to stay inside, close windows and doors, and turn off ventilation systems that draw air from the outside. Paramedics treated five people who complained of respiratory problems as a result of breathing the fumes.

On March 26, 1997, an explosion at Chief Supply Chemical Company, 5 miles northwest of Haskell on U.S. 64, sent up a column of smoke that could be seen for 50 miles. The fire continued to burn through the night of March 28. One employee was critically burned and later died. Chief Supply closed down.

On July 12, 2002, an over-pressured tank of toxic arsine gas exploded near the Port of Catoosa at Solkatronic Chemical Inc. Solkatronic and adjoining plants were evacuated. There were no deaths or injuries, although 100 people were taken to area hospitals as a precautionary measure.

3.12.3 Vulnerable Population

A hazardous materials accident can occur anywhere. Communities located near chemical manufacturing plants are particularly at risk. However, hazardous materials are transported on our roadways, railways and waterways daily, so any area is considered vulnerable to an accident.

Oklahoma is at some risk from accidental release of hazardous materials involving transportation incidences because it is literally the crossroads of America. The state has 111,000 miles of highways, 926 miles of which are interstate highways, including Interstates 35, 40, and 44. There are also approximately 4,000 miles of railway, thousands of miles of pipeline, and over 150 navigable river miles linking barge traffic to the Mississippi River.

Hazardous materials sites for the Tulsa are shown on the map in Figure 3–4 and a list of the sites are in Appendix K.

3.12.4 Conclusion

Varying quantities of hazardous materials are manufactured, used, or stored at an estimated 4.5 million facilities in the United States, from major industrial plants to local dry cleaning establishments or gardening supply stores.

The estimated annual damage from hazardous materials events is $22.4 million. Most victims of chemical accidents are injured at home. These incidents usually result from ignorance or carelessness in using flammable or combustible materials.

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For more information, contact information can be located on page xviii.

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3.13 Dam Failures

The Federal Emergency Management Agency (FEMA) defines a dam as "a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water." Dams typically are constructed of earth, rock, concrete, or mine tailings. A dam failure is the collapse, breach, or other failure resulting in downstream flooding.

The amount of water impounded in the reservoir behind a dam is measured in acre-feet. An acre-foot is the volume of water that covers an acre of land to a depth of one foot, or approximately 325,000 gallons. As a function of upstream topography, even a very small dam may impound or detain many acre-feet or millions of gallons of water.

3.13.1 Hazard Profile

The National Inventory of Dams (NID) listed about 80,000 dams in the United States in its 1997-1998 update. More than 3,300 high and significant hazard dams are located within 1 mile of a downstream population center, and more than 2,400 are located within 2 miles.

The overtopping or forced release of a dam due to heavy rain or abnormal river flows is a threat to downstream properties

Dam failures are primarily caused by hydrologic or structural deficiencies. A hydrologic deficiency is inadequate spillway capacity, caused by excessive runoff from heavy precipitation. Structural deficiencies include seepage, erosion, cracking, sliding, and overturning, mainly caused by the age of a dam and lack of maintenance. The operation of a reservoir can also influence the safety of the structure.

There can be varying levels of dam failure. Partial dam failures include 1) inadequate spillway capacity that causes excess flow to overtop the dam, and 2) internal erosion through the dam or foundation. Complete failure occurs if internal erosion or overtopping results in a total structural breach, releasing a high-velocity wall of debris-laden water that rushes downstream, damaging or destroying everything in its path.

Effects

In the event of a dam failure, the potential energy of the water stored behind even a small dam can cause loss of life and great property damage downstream. The following factors influence the impact of a dam failure:

- Level of failure (partial or complete)
- Rapidity of failure (sudden or gradual)
- Amount of water released

- Nature of the development and infrastructure located downstream

A break in a dam produces an extremely dangerous flood situation because of the high velocities and large volumes of water. The severity of impact on areas downstream and the height to which waters will rise are largely functions of valley topography and the volume of water released.

In some cases, there are hazardous actions that have to be taken to prevent dam failures, such as sudden releases of water when the dam is threatened with overtopping. In this case, a dam may have failed in its purpose to protect downstream people and property, without having literally or physically failed.

Measurements

Any artificial water barrier structure that has a height of 25 feet or more from the natural streambed and 50 acre feet or more of storage capacity qualifies as a dam and is under the jurisdiction of the Oklahoma Water Resources Board (OWRB).

There are 4,524 dams in Oklahoma (including private structures), with approximately half (2,300) operated by the Natural Resources Conservation Service (NRCS). Emergency Action Plans have been filed for 160 of the most important dams in the state.

The OWRB classifies dams as high-hazard, significant-hazard, and low-hazard, depending on the amount of water stored and downstream populations. The state has 183 high-hazard dams, which must be inspected every year. There are 88 dams having significant hazard potential, which are inspected every three years. The rest (4,250) are classified as low hazard, and are inspected every five years.

High-hazard dams are so designated due to the presence of occupied dwellings immediately downstream. If a high-hazard dam fails, there will probably be loss of life. This determination does not mean that a dam is in need of repair—it could be in excellent condition or in poor condition. “High-hazard” simply reflects a dam’s potential for doing damage downstream if it were to fail.

The areas impacted are delineated using dam breach analyses that consider both “sunny day” failures and failures under flood conditions.

3.13.2 Historical Events

The deadliest dam failure in United States history occurred in Johnstown, Pennsylvania, in 1889, with 2,209 people killed. Between 1960 and 1997, there have been at least 23 dam failures with one or more fatalities. Some failures also caused downstream dams to fail. There were 318 deaths as a result of these failures.

In February 1972, a privately owned tailings dam in Buffalo Creek, West Virginia, failed, devastating a 16-mile valley with 6,000 inhabitants. As a result of the failure, 125 people were killed and 3,000 left homeless. In 1976, Teton Dam in Idaho failed, causing $1 billion in property damage and leaving 11 dead. In May 1977, Laurel Run Dam in

Pennsylvania failed, killing 43 people. Six months later, Kelly Barnes Dam in Georgia failed, resulting in 39 deaths, most of them college students.

In response to the Buffalo Creek disaster, Congress enacted the National Dam Inspection Act in 1972, which authorized the U.S. Army Corps of Engineers to inventory and inspect all non-federal dams. After the Teton Dam failure, President Carter issued a memorandum on April 23, 1977, directing a review of federal dam safety activities by an ad hoc panel of recognized experts.

Despite the strengthening of dam safety programs since the 1970s, dams continue to fail, causing loss of life and millions of dollars in property damage. In July 1994, Tropical Storm Alberto caused over 230 dam failures in Georgia, resulting in 3 deaths.

There have been only two significant, documented dam failures in Oklahoma. On October 3, 1923, heavy rain caused Lake Overholser dam to fail, which displaced 15,000 residents. Cleveland, in Pawnee County, suffered losses in the half million-dollar range when the town was inundated by the Cleveland Dam break on September 4, 1940. Both events were caused by sudden and heavy rainfall.

In Tulsa County between September and October 1986, Keystone Reservoir filled to capacity, forcing the Corps of Engineers to release water at the rate of 310,000 cubic feet per second. Downstream flooding was inevitable. In Tulsa, a private west bank levee failed, causing $1.3 million in damages to 64 buildings. This was an example of how actions taken to avoid dam failure can themselves create hazards.

3.13.3 Vulnerable Population

The number of fatalities resulting from dam failures is highly influenced by the number of people occupying the predicted dam failure floodplain and the amount of warning they are provided. Most dams in the United States are privately owned, located on private property, and not directly in the visual path of most Americans. This factor contributes to the challenge of raising the issue of dam safety in the public consciousness and getting the information on dam safety to those who need it.

There are 33 dams in Tulsa County. The OWRB classifies four of these dams as high hazard. These four dams expose the City of Tulsa, with a population of 393,049, to the potential natural hazard of flooding. The remaining 29 structures are low hazard, meaning there is little or no downstream population or infrastructure. The Tulsa County dams with high hazard classifications are described below. Tulsa dam break inundation areas are shown in Figure 3–5.

Keystone Dam

Location:	On Arkansas River, 10 miles east of the City of Tulsa, on Highway 64
Source:	Arkansas River
Flows into:	Arkansas River drainage basin
Owner/operator:	U.S. Army Corps of Engineers
Year built:	1964
Length:	4,600 feet

Height:	121 feet
Construction material:	Masonry and earth-fill
Use of Dam:	Water storage, flood control, hydroelectric power, and recreation
Capacity:	250,700 acre feet of water
Land Area:	23,610 surface acres of water
Flood damage history:	None to date
Results of failure:	Inundation of cities of Sand Springs, Tulsa, Jenks, and Bixby

Yahola Dam

Location:	North of Tulsa on Lake Yahola
Source:	Tributary of Bird Creek
Flows into:	Bird Creek drainage basin
Owner/operator:	City of Tulsa
Year built:	1948
Length:	17,500 feet
Height:	35 feet
Construction material:	Earth-fill
Use of dam:	Water supply for Tulsa
Capacity:	6,445 acre feet of water
Land area:	431 surface acres of water
Flood damage history:	None to date
Results of failure:	Inundation of North Tulsa
Failures to date:	None

Warrenton Lake Dam

Location:	Near 61st and South Yale Avenue
Source:	Tributary to Joe Creek
Flows into:	Joe Creek Drainage Basin
Owner/Operator:	Warren Medical Center
Year built:	1936
Length:	400 feet
Height:	37 feet
Construction material:	Earth-fill
Use of Dam:	Recreation
Capacity:	Contains 41 acre feet of water
Flood damage history:	None to date
Results of failure:	Downstream property inundation
Failures to date:	None

A.B. Jewell Dam

Location:	East 21st Street and 193rd E. Avenue
Source:	Local drainage
Flows into:	East side of Tulsa
Owner/operator:	City of Tulsa
Year built:	1950
Length:	13,300 feet
Height:	15 feet
Construction material:	Earth-fill
Use of Dam:	Raw water storage
Capacity:	Contains 325 acre feet of water
Flood damage history:	None to date
Results of failure:	Inundation of parts of East Tulsa
Failures to date:	None

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3.13.5 Conclusion

People, property, and infrastructure downstream of dams could be subject to devastating damage in the event of failure. The areas impacted are delineated using dam breach analyses that consider both "sunny day" failures and failures under flood conditions. The downstream extent of impact areas and the height to which waters will rise are largely functions of valley topography and the volume of water released during failure.

If a dam has a classification of being high hazard, it means that failure of that dam would most likely result in loss of life. This classification does not mean the dam is necessarily at risk of failing.

The most important factor for public safety is the timeliness and effectiveness of warning given to vulnerable downstream populations. Dams are often not visible from the neighborhoods of most Americans and therefore dam safety is not in the public consciousness.

Tulsa is exposed to flooding from failure of four high-hazard upstream dams. These dams are Keystone (Arkansas River), Yahola (Bird Creek), Warrenton (Joe Creek), and A.B. Jewell. The dam posing the greatest threat to Tulsa is Keystone. There are about 11,000 residences and 1,700 commercial properties exposed to damage if Keystone Dam failed. However, the potential for failure is low because it is operated by the Corps of Engineers and is inspected at least once each year.

When there is a threat of a dam overtopping, the action of releasing large amounts of water can itself be a flood hazard, reminding us that dams offer finite protection. This was exemplified by the 1986 and 1989 Keystone Reservoir water releases that caused downstream flooding.

3.13.6 Sources

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3.14 Levee Failures

A levee is an embankment or barrier of compacted soil designed to keep floodwaters away from buildings or other development. Levees are considered a "structural" flood control project, and are generally constructed to protect floodplain development. Until the late 1960s, structural measures such as levees were the dominant approach to riverine floodplain management. Currently, however, under the National Flood Insurance Program (NFIP) regulations, levees are not recognized as acceptable measures for protecting new, substantially improved, or substantially damaged structures.

3.14.1 Hazard Profile

Arkansas River levees were threatened with failure and overtopping in 1986 and 1989

Levees and other structural measures are extremely costly and can disrupt or destroy the natural environment. Levees may also create a false sense of security, increasing the amount of property at risk of flooding as people and businesses locate behind levees and floodwalls. Platt (1982), for instance, described the experience of Jackson, Mississippi, where the Army Corps of Engineers had constructed levees in the 1960s to protect the town from flooding along the Pearl River. The levees were overtopped in the 1979 flood, with some 40% of the damage being inflicted on new construction behind the levee.

Levee failures or damages behind levees can result for several reasons:

- Overtopping due to flood heights exceeding levee design protection elevation
- Flooding from upstream sources internal to the levee
- Erosion caused by embankment leaking or piping
- Improper operation and maintenance, including failure to inspect and repair seepage problems

3.14.2 Historical Events

Floods have been recorded on the Arkansas River since before statehood. In May 1943, residents appealed to the County Commission to build levees to protect floodplain development along the Arkansas River west of Tulsa. The project was justified to protect vital war industries, such as the refineries in West Tulsa. The Corps-built levee was finished in 1945, and no major damage from the Arkansas River in West Tulsa or Sand

Springs has occurred since that time. Private levees have been built on the west side of the Arkansas River between 21st and 51st streets.

Although Tulsa area levees have not suffered major failure, properties protected by the levees have suffered flood damages from internal flooding in 1984, and levees were threatened with failure and overtopping in 1986 and 1989. The private levees on the west side of the Arkansas River protecting Garden City failed during the 1986 Arkansas River flooding.

A levee was completed around Jenks in 1949, protecting the city from floods from Polecat Creek as well as the Arkansas River.

3.14.3 Vulnerable Population

The levees of concern for Tulsa are confined to the Arkansas River, on the north side, west of the downtown area, and on the west side, protecting the refineries and adjacent neighborhoods. These levees will overtop if Keystone Dam reaches a release rate of 450,000 cfs.

The Arkansas River levees, as shown on the map in Figure 3–6, are: the western levee, located in Sand Springs and Tulsa County; the eastern levee, located north of the river, primarily within the jurisdiction of the City of Tulsa; and the West Tulsa levee, within the Tulsa city limits, but also containing large unincorporated areas. These unincorporated areas, located in Tulsa County, contain oil refineries, oil tank storage farms, and railroad switching yards. For purposes of this study, the east and West Tulsa levees were selected for levee failure damage analysis.

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3.14.5 Conclusion

Failure of the levees along the Arkansas River will have a devastating impact upon the City of Tulsa and Tulsa County. The damage to people, property, and businesses will have a significant adverse impact upon the community.

3.14.6 Sources

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Chapter 4:

Mitigation Strategies

Chapter 4: Mitigation Strategies

This chapter identifies the hazard mitigation goals set by the City of Tulsa and discusses the mitigation projects, or measures, to be taken to achieve those goals.

The Research, Review, and Prioritization Process

The THMCAC and TSTAC identified and prioritized 68 measures that will help protect the lives and property of the citizens of Tulsa.

National literature and sources were researched to identify best practices mitigation measures for each hazard. These measures were documented, and staff screened several hundred recommended mitigation actions and selected those that were most appropriate for the Tulsa area.

The THMCAC reviewed the measures recommended by staff and revised, added, deleted, and approved measures for each hazard. The THMCAC and TSTAC ranked and prioritized the measures and grouped them into categories.

Mitigation Categories

The measures that communities and individuals can use to protect themselves from, or mitigate the impacts of, natural and man-made hazards fall into six categories:

- Public Information and Education
- Preventive Measures
- Structural Projects
- Property Protection
- Emergency Services
- Natural Resources Protection

This chapter is organized by these mitigation categories, with the Tulsa mitigation mission statement and goals listed first in section 4.1.

Tulsa's natural hazard mitigation planning process involves citizens in every phase

4.1 Tulsa Hazard Mitigation Goals

4.1.1 General Goals for all Natural Hazards

- Minimize loss of life and property from natural hazard events.
- Protect public health and safety.
- Increase public awareness of risk from natural hazards.
- Reduce risk and effects of natural hazards.
- Identify hazards and assess risk for local area.
- Ascertain historical incidence and frequency of occurrence.
- Determine increased risk from specific hazards due to location and other factors.
- Improve disaster prevention.
- Improve forecasting of natural hazard events.
- Limit building in high-risk areas.
- Improve building construction to reduce the dangers of natural hazards.
- Improve government and public response to natural hazard disasters.

4.1.2 Specific Goals for Particular Natural Hazards

Floods

- Identify buildings at risk from 100- and 500-year floods.
- Buy properties that flood most frequently, clear the land, and put in green space or build detention ponds.
- Inform residents who refuse to vacate the floodplain of floodproofing alternatives.
- Limit additional building in flood zone areas.

Tornadoes

- Continue to improve tornado forecasting.
- Increase building code standards to build stronger houses.
- Build safe-rooms in new homes.

High Winds

- Institute measures that will improve resistance of new buildings to high winds.
- Require better roof construction and materials to withstand high winds.
- Identify homes and buildings vulnerable to loss from high winds, and suggest ways that their owners can prepare them for storms.

Lightning

- Promote public awareness of lightning dangers and what can be done to prevent/reduce personal injury and property damage.
- Encourage general public to put lightning rods on buildings to minimize destruction/damage.

Hailstorms

- Encourage the use of hail-resistant composite materials in automobile manufacture.
- Encourage insurance companies to offer premium incentives for purchase of affordable carports by people without garages.
- Require better roof construction and materials to withstand hailstorms.

Winter Storms

- Place exposed power and telephone lines underground to prevent damage from ice loading.
- Promote awareness of the advantages of all-wheel-drive cars with traction control.
- Encourage use of all-weather tires on automobiles.
- Convert electrically heated homes to gas.
- Identify elderly and indigent citizens who are at risk from winter storms.
- Encourage churches and community groups to assist persons at risk during power loss.
- Develop emergency plans to provide shelter when power fails from winter storms.

Extreme Heat

- Publicize signs and dangers of heat stroke, especially among elderly.
- Inform those at risk of preventive measures in advance of extreme heat wave.
- Invite churches and community groups to provide inexpensive air conditioning for indigent elders to protect them from extreme heat.
- Develop emergency plan for conserving electrical use during extreme heat.

Drought

- Promote awareness of importance and value of water.
- Promote water-free landscaping.
- Encourage water re-use or gray-water recycling for lawn irrigation.
- Involve public in finding new ways to conserve water.

Expansive Soils

- Inform the public about the hazard of expansive soils.
- Require Realtors to inform buyers of homes at risk from expansive soil.

- Encourage scientific/development community to find mitigation measures for expansive soils.

Urban Fires

- Identify neighborhoods especially vulnerable to fire.
- Educate the public about the most common causes of urban fires.
- Promote the use of fire-resistant materials in house construction.
- Notify absent landlords whose property is at high risk of fire and encourage them to remedy the problem.

Wildfires

- Encourage fireproof materials in building construction.
- Experiment with controlled burns of native vegetation to minimize the accumulation of forest fuels that lead to uncontrollable fires.
- Advise public and developers of the danger of building homes in remote areas where fire protection is not available.
- Alert homeowners when fire risk is great in rural and remote areas.

Earthquakes

- Investigate HAZUS to estimate earthquake damage in Tulsa area.
- Inform public of earthquakes in areas where they are frequent but unrecognized.
- Publicize and promote general awareness of earthquake emergency action plans.

Hazardous Materials Events

- Educate the public about the hazardous materials to which they are most frequently exposed.
- Help homeowners identify hazardous materials from which they are at risk.
- Locate “brown-fields” and hazardous material sites, and ensure preventive measures are in place to protect public.

Dam Failures

- Determine risk rating of dams affecting the Tulsa area.
- Identify homes and businesses vulnerable to flooding from dam failure.
- Ensure privately owned dams in the local area are complying with relevant inspection and maintenance codes.

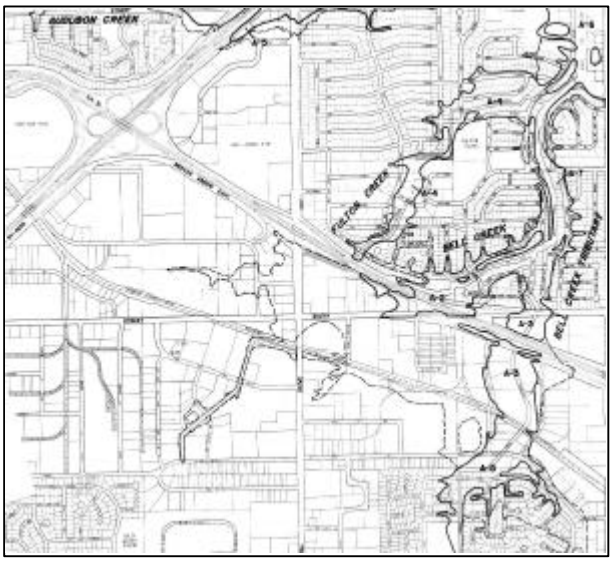
4.2 Public Information and Education

A successful public information and education program involves both the public and private sectors. Public information and education activities advise and educate citizens, property owners, renters, businesses, and local officials about hazards and ways to protect people and property from them. Public information activities are among the least expensive mitigation measures, and at the same time are often the most effective thing a community can do to save lives and property. All mitigation activities—preventive, structural, property protection, emergency services, and natural resource protection—begin with public information and education.

4.2.1 Map Information

Many benefits stem from making map information available to officials and the public. Residents and businesses that are aware of the potential hazards can take steps to avoid problems and reduce their exposure to those hazards that have a geographical distribution, such as flooding, dam failure or releases, expansive soils, and hazardous materials events. Real estate agents and homebuyers can find out if a property is flood-prone, and whether flood insurance may be required.

Maps provide a wealth of information about past and potential hazards. The City of Tulsa maintains maps in area libraries, provides popular map brochures, sends a general floodplain map to all citizens annually with their City utility bill, and each year mails flood hazard maps to all floodplain residents.



Hazard maps, like this one showing the location of the 100-year floodplain, are available from the City

Flood Maps

Several legal requirements are tied to FEMA's Flood Insurance Rate Maps (FIRMs), Flood Insurance Study, and Tulsa's Regulatory Floodplain Maps. These include building regulations and the mandatory purchase of flood insurance. Tulsa provides floodplain and FIRM information as a mitigation service. The City helps residents submit requests for map amendments and revisions when these are needed to show that a building is outside the mapped floodplain.

Although Tulsa's maps are extremely accurate, users and inquirers must remember that maps are not perfect. They display only the larger flood-prone areas that have been studied. In some areas, watershed developments make even recent maps outdated. Those inquiring about flood maps must be reminded that being outside the mapped floodplain is

no guarantee that a property will never flood. In fact, many properties that flood are not located in a designated floodplain.

Other Hazard Data

Other data that can be shown on maps include those hazards that are distributed geographically. These include:

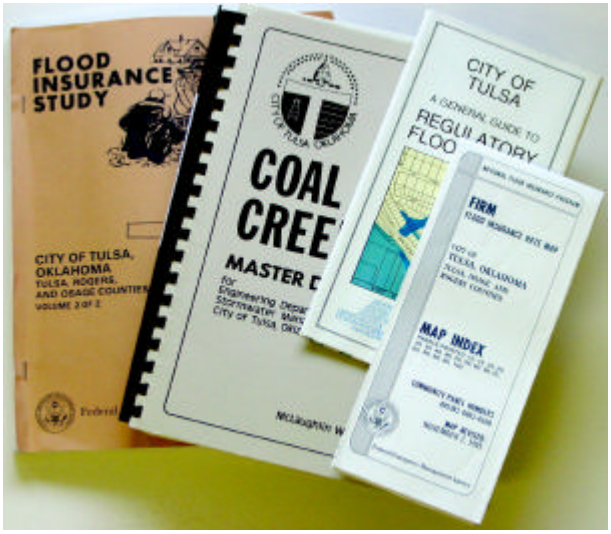
- Dam breach inundation areas
- Levee failure inundation areas
- Expansive soils
- Wildfire risk zones
- Earthquake risk zones
- Hazardous materials sites
- Wetlands

General location maps for many of these natural and man-made hazards have been developed by the City of Tulsa and INCOG through Project Impact, and are included in this Tulsa Hazard Mitigation Plan study.

Flood zone determinations are available, free of charge, to any citizen through the Department of Public Works. The various maps and outreach projects available to the public are discussed in Section 4.2.4.

4.2.2 Library

The Tulsa City-County Library is a valuable resource for residents seeking information on hazards, hazard protection, and natural resource preservation. Historically, libraries have been the first place people go when beginning to research a topic, since libraries have a wealth of free information on matters of public interest and concern. Libraries also have their own public information campaigns with displays, lectures, and other programs, which can augment the activities of the local government.



There are many references on hazard protection for property owners

The Tulsa City-County Library System maintains the flood related documents required under the NFIP/CRS. These are available at the Central Library, and some of the four regional branches.

4.2.3 Websites

Today, web sites are becoming more popular as research tools, since they provide quick access to a wide range of public and private sites and sources of information. There is almost no limit to the amount of up-to-date information that can be accessed by the user.

Web sites have become one of the most popular research tools

Information on Tulsa's floodplain management can be accessed at www.cityoftulsa.org. Go to the Public Works drop-down menu at the top of the page and select Flood Control and Drainage. Also visit www.tulsaprojectimpact.org.

4.2.4 Outreach Projects

Mapping and library activities are of little use unless people know they are available. An outreach project can provide this initial information.

Outreach projects are usually the first step in orienting property owners to property protection issues and helping them seek out more information to protect themselves and their properties.

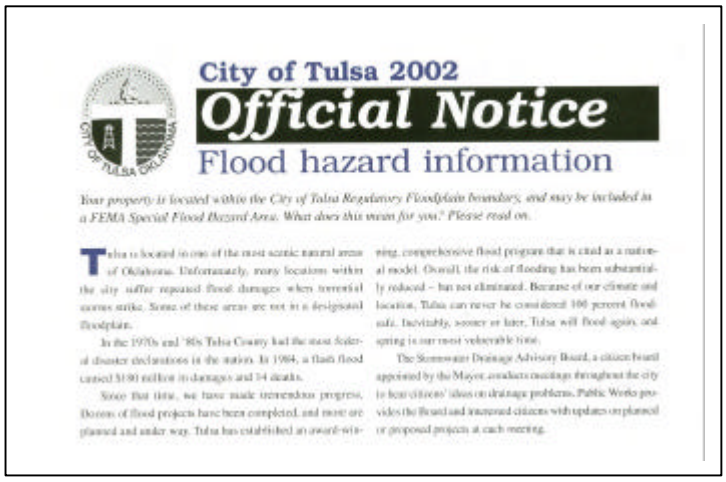
The most effective types of flood-oriented outreach projects are mailed or distributed to flood-prone property owners, or to everyone in the community. Other approaches include:

- Articles and special sections in newspapers
- Radio and TV news releases and talk shows
- Hazard protection video for cable TV programs or to loan to organizations
- Presentations at meetings of neighborhood, civic or business groups
- Displays in public buildings or shopping malls
- Open houses for floodproofed buildings

Research has shown that outreach projects work. However, awareness that a hazard exists is not enough. People also need expert advice on what they can do about them. Consequently, outreach projects should include information on safety, health, and property protection measures. Research also indicates that a properly run local information program is more effective at achieving these objectives than national advertising or publicity campaigns.

The City of Tulsa has several outreach programs designed to inform citizens about floods and other hazards.

- The *City of Tulsa Flood Safety and Insurance Fact Sheet* is produced by Community Affairs and Planning, Department of Public Works. It is included annually in utility bills mailed to all 150,000 City utility accounts.
- The *City of Tulsa Official Notice: Flood Hazard Information* is mailed annually prior to flood season to 8,575 owners and residents of buildings located in the FEMA Special Flood Hazard Area or the City of Tulsa's Regulatory Floodplains.


City of Tulsa 2002

Official Notice

Flood hazard information

Your property is located within the City of Tulsa Regulatory Floodplain boundary, and may be included in a FEMA Special Flood Hazard Area. What does this mean for you? Please read on.

Tulsa is located in one of the most scenic natural areas of Oklahoma. Unfortunately, many locations within the city suffer repeated flood damages when torrential storms strike. Some of these areas are not in a designated floodplain.

In the 1970s and '80s Tulsa County had the most federal disaster declarations in the nation. In 1984, a flash flood caused $100 million in damages and 14 deaths.

Since that time, we have made tremendous progress. Dozens of flood projects have been completed, and more are planned and under way. Tulsa has established an award-winning, comprehensive flood program that is cited as a national model. Overall, the risk of flooding has been substantially reduced – but not eliminated. Because of our climate and location, Tulsa can never be considered 100 percent flood-safe. Inevitably, sooner or later, Tulsa will flood again, and spring is our most vulnerable time.

The Stormwater Drainage Advisory Board, a citizen board appointed by the Mayor, conducts meetings throughout the city to hear citizens' ideas on drainage problems. Public Works provides the Board and interested citizens with updates on planned or proposed projects at each meeting.

An outreach project mailer sent to flood-prone property owners and residents each year

- *A General Guide to Regulatory Floodplains*, which includes a large color map of Tulsa's floodplains and other important hazard-related information, is distributed through City Hall information racks, at public meetings, the Tulsa Home and Garden Show, the Tulsa State Fair, and Tulsa Project Impact/Citizen Corps events.
- Copies of the *Regulatory Floodplain Map Atlas*, a 25-panel book showing the floodplains and individual parcels, are available from the Department of Public Works.

4.2.5 Technical Assistance

While general information helps, most property owners are not prepared to take major steps, like retrofitting their buildings, without expert guidance. Public Works staff can provide free advice and help steer the owner onto the right track.

Technical assistance can be provided in one-on-one sessions with property owners, or through seminars. Seminars or "open houses," for instance, can focus on retrofitting structures, selecting qualified contractors, and carrying out preparedness activities.

The Department of Public Works offers technical assistance on development, building, flooding, flood determination, erosion control, or protection measures. Public Works maintains a log of flood protection assistance it has provided.

4.2.6 Real Estate Disclosure

After a flood or other natural disaster, people often say they would have taken steps to protect themselves if they had known their property was exposed to a hazard.

Flooding and other hazards are sometimes not disclosed until it's too late. Hazard maps can help home buyers avoid surprises like this

Flood insurance is required for buildings located within the base floodplain if the mortgage or loan is federally insured. However, because this requirement has to be met only ten days before closing, applicants are often already committed to purchasing a property when they first learn of the flood hazard. To help counter this shortcoming, the City's map information service, described in Section 4.2.1, is widely publicized among real estate agencies and lenders.

4.2.7 Educational Programs

A community's most important natural resource is its children. They will inherit the resources, infrastructure and development built by earlier generations at great cost and effort. They will also face the same natural forces that bring floods, tornadoes, storms and other hazards.

Environmental education programs can teach children about natural hazards, the forces that cause them, and the importance of protecting people, property and nature, such as watersheds and floodplains. Educational programs can be undertaken by schools, park and recreation departments, conservation associations, and youth organizations, such as the Boy Scouts, Campfire Girls and summer camps. An activity can be complex enough as to require course curriculum development, or as simple as an explanatory sign near a river.

Educational programs designed for children often reach adults as well. Parents often learn innovative concepts or new ideas from their children. If a child comes home from school with an assignment in water quality monitoring, the parents will normally become interested in finding out about it as well.

There are many programs that provide information and curriculum materials on nature and natural hazards. These include Web sites ("FEMA for Kids," and the USGS "Water Science for Schools"), posters, coloring books, games, and references. These items, as

well as hands-on models that allow students to see the effects of different land use practices, are also available through the local natural resources conservation district.

4.2.8 Public Information Program Strategy

After reviewing existing and possible public information activities, the THMCAC prepared a Public Information Program Strategy using the Community Rating System format. The strategy consists of the following parts:

a. The local hazard (discussed in Chapters 2 and 3 of this plan)

b. Safety and property protection measures appropriate for the hazards (discussed in Chapters 2 and 3 and on the next page)

c. Flood-related public information activities currently being implemented within the community, including those by non-government agencies (discussed in Sections 4.2.1 to 4.2.7)

d. Goals for the community's public information program (covered in Chapter 4)

e. Outreach projects that will reach the goals (see Chapter 5, action items 2b, 6d, 8, and Table 5-1.)

Summer camps, and other educational programs for children, can teach a new generation about nature, natural hazards, and preservation

f. A process for monitoring and evaluating the projects (see Chapter 6)

4.2.9 Conclusions

1. There are many ways public information programs can be used to make people and businesses more aware of the hazards they face and how they can protect themselves.
2. Most public information activities can be used to advise people about all hazards, not just floods.
3. Some public information activities require coordination with other organizations, such as schools and real estate agents.
4. There are several area organizations that can provide support for public information and educational programs.

4.2.10 Recommendations

The following table lists recommended public information and education activities. They are listed in priority order, as recommended by the THMCAC. Refer to "Chapter 5: Action Plan," Table 5–1, for a complete listing of all recommended mitigation measures by hazard and priority.

Table 4–1: Recommended Mitigation Activities for Public Information and Education

Priority	*Hazard*	*Mitigation Measure*
2	Extreme Heat	Obtain funding for distribution of public information and education materials to vulnerable populations through participating community agencies.
8	General	Examine optimum methods of achieving public information and education objectives concerning tornadoes, high winds, lightning, winter storms, extreme heat, fire, Hazmat events, expansive soils, and wise use of water resources.
28	Lightning	Educate the community about proper lightning safety through public service announcements and other media outlets.
37	General	Contact agencies that distribute information to at-risk communities, such as the elderly, infirm, poor, and outside workers.
41	Tornadoes and high winds	Safe room rebates for low income and vulnerable populations.
43	Floods and tornadoes	Educate the public on what the multi-sound sirens mean in the Tulsa area.
48	Lightning	Provide educational demonstrations on whole-house surge protection technology.
54	Urban fires and wildfires	Develop a public education project addressing the advantages of individual fire suppression in residences.
57	Urban fires and wildfires	Continue education, and get funding to further inform people on evacuation plans for City offices, businesses and residential homes.
63	General	Translate current public information into other languages.
66	Lightning	Encourage utilities to provide lightning prevention information materials and programs to their customers.

Figure 4–1: Public Service Notice for Flooding

Flood Safety

- Do not walk through flowing water. Drowning is the number one cause of flood deaths. Currents can be deceptive; six inches of moving water can knock you off your feet. Use a pole or stick to ensure that the ground is still there before you go through an area where the water is not flowing.

- Do not drive through a flooded area. More people drown in their cars than anywhere else. Don't drive around road barriers; the road or bridge may be washed out.

- Stay away from power lines and electrical wires. The number two flood killer, after drowning, is electrocution. Electrical current can travel through water. Report downed power lines to the Mayor's Action Line, 596-2100.

- Look out for animals that have been flooded out of their homes and which may have sought shelter in yours. Use a pole or stick to poke and turn things over and scare away small animals.

- Look before you step. After a flood, the ground and floors are covered with debris, including broken bottles and nails. Floors and stairs that have been covered with mud can be very slippery.

- Be alert for gas leaks. Use a flashlight to inspect for damage. Don't smoke or use candles, lanterns, or open flames unless you know the gas has been turned off and the area has been ventilated.

- Carbon monoxide exhaust kills. Use a generator or other gasoline-powered machine outdoors. The same goes for camping stoves. Charcoal fumes are especially deadly. Cook with charcoal only outdoors.

- Clean everything that got wet. Flood waters pick up sewage and chemicals from roads, farms, factories, and storage buildings. Spoiled food, flooded cosmetics, and medicine can be health hazards. When in doubt, throw them out.

- Take good care of yourself. Recovering from a flood is a big job. It is tough on both the body and the spirit, and the effects of a disaster on you and your family may last a long time.

4.3 Preventive Measures

Preventive activities are designed to keep certain conditions from occurring or getting worse. The objective is to ensure that new development does not make an existing hazard worse, or increase damage or loss of life. Preventive measures are usually administered by building, zoning, planning, and code enforcement offices. They typically include planning, zoning, open space preservation, building codes, drainage criteria, master drainage plans, floodplain development regulations, and stormwater management. Preventive measures will be discussed in the following order:

4.3.1 Planning
4.3.2 Zoning
4.3.3 Open Space Preservation
4.3.4 Building Codes
4.3.5 Floodplain Development Regulations
4.3.6 Stormwater Management

Tulsa's mitigation planning process involves meetings with civic groups and local citizens, as well as decision-making councils and commissions

The first three measures (planning, zoning, and open space preservation) work to keep damage-prone development *out* of hazardous or sensitive areas.

The next two measures (building codes and floodplain development regulations) impose standards on what is allowed to be built *in* the floodplain. These protect buildings, roads, and other facilities from flood damage and prevent the new development from making any existing flood problem worse. Building codes are also critical to mitigating the impact of non-flood hazards on new buildings.

Stormwater management addresses the runoff of stormwater from new developments onto other properties and into floodplains.

4.3.1 Planning

"Planning" can cover a variety of community plans including, but not limited to, comprehensive plans, land use plans, transportation plans, and economic development plans. While plans generally have limited authority, they reflect what the community wants to see happen in the future. Plans also guide other local activities such as capital improvements and the development of ordinances.

4.3.2 Zoning

Tulsa's zoning ordinances regulate development by dividing the community into zones or districts, and establishing development criteria for each. Zoning ordinances are considered the primary tool for implementing a comprehensive plan's guidelines for how land should be developed.

4.3.3 Open Space Preservation

Keeping the floodplain open and free from development is the best approach to preventing flood damage. Floodplains, wetlands, and natural water ponding areas maintain the existing stormwater storage capacities of a watershed. These sites can also serve as recreational areas, greenway corridors, and habitat for local flora and fauna. Besides being preserved in its natural condition, open space can be maintained as a park, golf course, or put to agricultural use.

4.3.4 Building Codes

Hazard protection standards for all new or improved structures can be incorporated into the local building code. For example, these standards should include criteria to ensure that the foundation will withstand flood forces, and that all portions of the building subject to damage are above, or otherwise protected from, flooding.

Building codes are also a prime mitigation measure for other natural hazards, like earthquakes, tornadoes, windstorms, and severe heat and cold. When designed and constructed according to code, the average building can withstand the impacts of most of these forces. A building code would typically include such provisions as:

- Requiring sprinkler systems for fire protection in larger or public buildings
- Regulating overhanging masonry elements that could fall during an earthquake
- Ensuring that foundations can withstand earthquake movements, and that all structural elements are properly connected to the foundation
- Ensuring roof systems can handle high winds and expected snow loads

4.3.5 Floodplain Development Regulations

Most communities with a flood problem participate in the National Flood Insurance Program (NFIP). The NFIP sets minimum requirements for subdivision regulations and building codes. These are usually spelled out in a separate ordinance.

Experience has shown that the NFIP's minimum standard is insufficient for developing urban communities, such as Tulsa. The City's regulations exceed the NFIP's minimum national standards in several important ways.

Minimum National Flood Insurance Program Regulatory Requirements

The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA). As a condition of making flood insurance available for their residents, communities that participate in the NFIP agree to regulate new construction in areas subject to inundation by the 100-year (base) flood.

There are four major floodplain regulatory requirements. Additional floodplain regulatory requirements may be set by state and local law.

1. All development in the 100-year floodplain must have a permit from the community. The NFIP regulations define "development" as any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials.
2. Development should not be allowed in the floodway. The NFIP regulations define the floodway as the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. The floodway is usually the most hazardous area of a riverine floodplain and the most sensitive to development. At a minimum, no development in the floodway may cause an obstruction to flood flows. Generally an engineering study must be performed to determine whether an obstruction will be created.
3. New buildings may be built in the floodplain, but they must be protected from damage by the base flood. In riverine floodplains, the lowest floor of residential buildings must be elevated to or above the base flood elevation (BFE). Nonresidential buildings must be either elevated or floodproofed.
4. Under the NFIP, a "substantially improved" building is treated as a new building. The NFIP regulations define "substantial improvement" as any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement. This requirement also applies to buildings that are substantially damaged.

Communities are encouraged to adopt local ordinances that are more comprehensive or provide more protection than the state or federal criteria. This is especially important in areas with older Flood Insurance Rate Maps (FIRMs) that may not reflect the current hazard. Such ordinances could include prohibiting certain types of highly damage-prone uses from the floodway, or requiring that structures be elevated 1 or more feet above the BFE. The NFIP's Community Rating System provides insurance premium credits in order to recognize the additional flood protection benefit of higher regulatory standards.

Subdivision regulations govern how land will be subdivided into individual lots, and set the construction and location standards for the infrastructure a developer builds to serve those lots, including roads, sidewalks, utility lines, storm sewers, and drainageways. Subdivision regulations provide an additional vehicle for floodplain development rules. For example, some communities require that every subdivision in a floodplain provide a building site above the flood level for each lot, and/or require streets to be at or no more than one foot below the base flood elevation.

Floodplains are only one aspect of flood management. Water gathers and drains throughout entire watersheds, from uplands to lowlands. Each watershed is an interactive element of the whole. A change at one place can cause changes elsewhere, whether planned or inadvertent. Tulsa's current Master Drainage Planning program considers the entire watershed in its hydrologic and hydraulic analysis, mapping, and regulation.

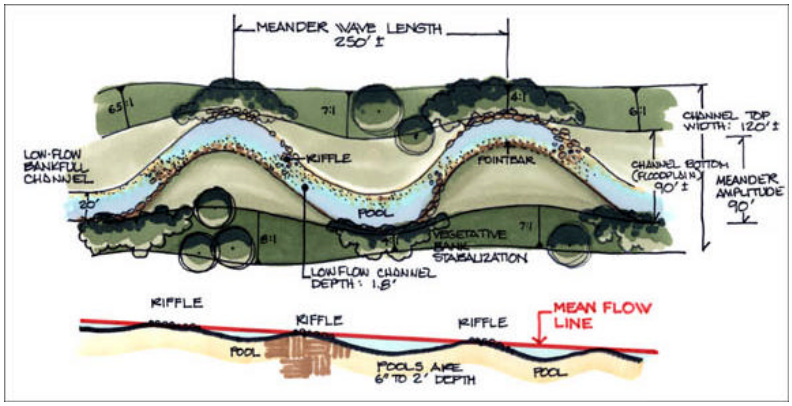
4.3.6 Stormwater Management

Development outside a floodplain can contribute significantly to flooding problems, since runoff is increased whenever natural ground cover is replaced by urban development.

As watersheds develop, runoff usually becomes deeper and faster and floods become more frequent. To prevent stormwater from flooding roads and buildings, developers construct storm sewers and improve ditches to carry the water away more efficiently. Water that once lingered in hollows, meandered around oxbows, and soaked into the ground, now speeds downhill, shoots through pipes, and sheets off rooftops and paving.

Insurance purposes require that NFIP floodplain maps be based on existing watershed development. However, unless plans and regulations are based on future watershed urbanization, development permitted today may flood tomorrow, when uphill urbanization increases runoff.

This combination of increased runoff and more efficient stormwater channels increases downstream storm peaks and changes the timing when storm peaks move downstream. Unconstrained watershed development will often overload a community's drainage system and aggravate downstream flooding.



In addition to detention facilities, Tulsa's stormwater management program envisions restoring some channelized streams with meanders and native vegetation to slow runoff and prevent flash flooding

A second stormwater problem is its impact on water quality. Runoff from developed areas picks up pollutants on the ground, such as road oil and lawn chemicals, and carries them into the receiving streams.

Tulsa enforces the NFIP minimum regulations and maps, in order to maintain eligibility for federal flood insurance. The City also enforces its own more restrictive regulations.

Retention / Detention

Tulsa's stormwater management regulations require developers to build retention or detention basins to minimize the increases in the runoff rate caused by impervious surfaces and new drainage systems. Generally, each development must not let stormwater leave at a higher rate than under pre-development conditions.

The Community Rating System (CRS) uses three factors to measure the impact of stormwater management regulations on downstream flooding:

1. What developments are required to account for their runoff? If only larger subdivisions have to detain the increased runoff, the regulations can miss the cumulative effect of many small projects, which can add up to greater flows to downstream properties.
2. How much water is managed? Historically, local stormwater management programs address smaller storms, such as the 2- or 10-year storms. The CRS reflects the growing realization nationally that runoff from larger storms must be managed. It provides full credit only for programs that address all storms up to the 100-year storm.
3. Who is responsible for ensuring that stormwater facilities work over the long term? Roads and sewers are located on dedicated public rights-of-way, and the community assumes the job of maintaining them in the future. Stormwater management detention basins, however, have traditionally stayed on private property and maintenance has been left up to the owner. Often homeowners associations have neither the knowledge nor capability to properly maintain these facilities. Half the CRS credit is based on whether the community assumes responsibility for ensuring that the facilities are maintained.

Stormwater detention ponds manage the increased runoff from new developments and temporarily store flood waters

Watershed Approaches

The standard regulatory approach that requires each development to manage stormwater to the same criteria has several shortcomings:

1. It does not account for differences in stream and watershed conditions (although the standards can be revised to reflect findings from watershed studies).

2. Municipalities within the same watershed may require different levels of stormwater control.
3. There is no review of the downstream impacts from runoff, or any determination of whether the usual standards will compound existing flooding problems.
4. It results in many small basins on private property that may or may not be properly maintained.

The way to correct these deficiencies is to conduct a master study of the watershed to determine the appropriate standards for different areas and, sometimes, to identify where a larger central basin would be more effective and efficient than many smaller ones. The CRS provides up to double the stormwater management regulations credit if communities adopt such master plans.

4.3.7 Conclusions

1. Planning and zoning help Tulsa develop the community proactively, so that the resulting infrastructure is laid out in a coherent and safe manner.
2. Building codes for foundations, sprinkler systems, masonry, and structural elements such as roofs are prime mitigation measures for floods, tornadoes, high winds, extreme heat and cold, and earthquakes.
3. Tulsa participates in the NFIP and uses subdivision regulations to control floodplain development.
4. Deficiencies in stormwater management can be corrected by conducting a master study of watersheds to determine appropriate standards for different areas.

4.3.8 Recommendations

The following table lists recommended preventive measures, prioritized by the THMCAC. Refer to "Chapter 5: Action Plan," Table 5–1, for a complete listing of all recommended mitigation measures by hazard and priority.

Table 4–2: Recommended Mitigation Activities for Preventive Measures

Priority	*Hazard*	*Mitigation Measure*
1	Dam failures and releases	Develop GIS (digitized) mapping program for results of Arkansas River's Keystone Dam release rates of 250, 350, and 450 thousand cubic feet per second.
3	Hazardous materials events	Continue the City's Household Pollutant Collection program, and build a year-round collection site.
5	Expansive soils	Investigate codes/incentives for the construction of new foundations to avoid expansive soil problems.
11	General	Update GIS to include public utility infrastructure.
13	Winter storms	Continue the City's aggressive snow and ice removal plan.

Priority	*Hazard*	*Mitigation Measure*
14	Earthquakes	Building reinforcements against wind and tornado damage will also protect against the minor earthquakes projected for the Tulsa area.
15	General	Review and update the Debris Management Plan.
16	Dam failures and releases	Develop pre- and post-flood plans for the Arkansas River floodplain, including the areas behind the levees.
17	Levee failures	Re-evaluate and update the master drainage plans for areas behind (protected by) the levees.
18	Tornadoes and high winds	Investigate building codes/incentives for adequacy for tornadoes and high winds.
29	Lightning	Study other communities that have lightning warning systems.
30	Winter storms	Provide for routine trimming of trees to reduce power outages during storms.
32	Hazardous materials events	Update the study for routing of hazardous materials through the Tulsa area.
35	Floods	Continue to update and revise basin-wide master drainage plans where changed conditions warrant.
38	Urban fires and wildfires	Apply for mitigation funding for backflow values for commercial, industrial, and multi-family buildings.
39	Urban fires and wildfires	Continue fire department's smoke detector program.
40	Tornadoes and high winds	Investigate community tornado shelter programs implemented in other cities or states.
45	General	Compile daytime population maps for the Tulsa community.
46	Dam failures and releases	Assemble facts about the Keystone Dam capacity, release rates and timing.
56	Urban fires and wildfires	Evaluate fire protection and prevention for animals, employees, and visitors to Tulsa Zoo.
60	Drought	Develop and implement plans to determine when a drought begins and ends.
64	Extreme heat	Review and update Tulsa's heat response plan.
65	Drought	Continue Tulsa's "Wise Use of Water" program.

4.4 Structural Projects

Structural projects are usually designed by engineers or architects, constructed by the public sector, and maintained and managed by governmental entities. Structural projects traditionally include stormwater detention reservoirs, levees and floodwalls, channel modifications, drainage and storm sewer improvements, and community tornado safe-rooms.

4.4.1 Reservoirs and Detention

Reservoirs control flooding by holding high flows behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate that the river can accommodate downstream. The lake created may provide recreational benefits or water supply (which could help mitigate a drought).

Reservoirs are suitable for protecting existing development downstream from the project site. Unlike levees and channel modifications, they do not have to be built close to or disrupt the area to be protected. Reservoirs are most efficient in deeper valleys where there is more room to store water, or on smaller rivers where there is less water to store. Building a reservoir in flat areas and on large rivers may not be cost-effective, because large areas of land have to be purchased.

Tulsa's multi-objective detention ponds also serve as community park, recreation and open space facilities

In urban areas, some reservoirs are simply man-made holes dug to store floodwaters. Some communities have reduced costs by using abandoned quarries as reservoirs. When built in the ground, there is no dam for these retention and detention basins and no dam failure hazard. Wet or dry basins can also serve multiple uses by doubling as parks or other open spaces.

4.4.2 Levees and Floodwalls

Probably the best known flood control measure is a barrier of earth (levee) or concrete (floodwall) erected between the watercourse and the property to be protected. Levees and floodwalls confine water to the stream channel by raising its banks. They must be well designed to account for large floods, underground seepage, pumping of internal drainage, erosion, and scour.

Levees placed along a river or stream edge degrade the aquatic habitat and water quality of the stream. They also are more likely to push floodwater onto other properties

upstream or downstream. To reduce environmental impacts and provide multiple use benefits, a setback levee (set back from the floodway) is usually the best project design. The area inside a setback levee can serve as open space for recreational purposes and provide access sites to the river or stream.

4.4.3 Channel Improvements

By improving channel conveyance, more water can be carried away at a faster rate. Improvements generally include making a channel wider, deeper, smoother or straighter. Some smaller channels in urban areas have been lined with concrete or put in underground pipes.

4.4.4 Crossings and Roadways

In some cases buildings may be elevated above floodwaters but access to them is lost when floodwaters overtop local roadways, driveways, and culverts or ditches. Depending on the recurrence interval between floods, the availability of alternative access, and the level of need for access, it may be economically justifiable to elevate some roadways and improve crossing points.

For example, if there is sufficient downstream channel capacity, a small culvert that constricts flows and causes localized backwater flooding may be replaced with a larger culvert to eliminate flooding at the waterway crossing point. The potential for worsening adjacent or downstream flooding needs to be considered before implementing any crossing or roadway drainage improvements.

4.4.5 Drainage and Storm Sewer Improvements

Man-made ditches and storm sewers help drain areas where the surface drainage system is inadequate, or where underground drainageways may be safer or more practical. Storm sewer improvements include installing new sewers, enlarging small pipes, and preventing back flows. Particularly appropriate for depressions and low spots that will not drain naturally, drainage and storm sewer improvements usually are designed to carry the runoff from smaller, more frequent storms.

Tulsa is constantly improving its stormwater drainage infrastructure, as here on Mooser Creek

Because drainage ditches and storm sewers convey water faster to other locations, improvements are only recommended for small local problems where the receiving stream or river has sufficient capacity to handle the additional volume and flow of water. To reduce the cumulative downstream flood impacts of numerous small drainage projects, additional detention or run-off reduction practices should be provided in conjunction with the drainage system improvements.

4.4.6 Drainage System Maintenance

The drainage system may include detention ponds, stream channels, swales, ditches and culverts. Drainage system maintenance is an ongoing program to clean out blockages caused by an accumulation of sediment or overgrowth of weedy, non-native vegetation or debris, and remediation of stream bank erosion sites.

"Debris" refers to a wide range of blockage materials that may include tree limbs and branches that accumulate naturally, or large items of trash or lawn waste accidentally or intentionally dumped into channels, drainage swales or detention basins. Maintenance of detention ponds may also require revegetation or repairs of the restrictor pipe, berm or overflow structure.

Drainageways are inspected regularly for blockage from debris

Maintenance activities normally do not alter the shape of the channel or pond, but they do affect how well the drainage system can do its job. Sometimes it is a very fine line that separates debris that should be removed from natural material that helps form habitat.

4.4.7 Conclusions

1. Reservoirs can hold high flows of water that can later be released slowly or retained for recreational purposes or drought mitigation.
2. Levees and floodwalls are not as effective overall because of possible underground seepage, erosion, degradation of aquatic habitat and water quality, and ineffectiveness in large floods.
3. Channel improvements allow more water to be carried away faster.
4. The effectiveness of elevating buildings depends on the availability of alternative access when flooding occurs.
5. Crossing and roadway drainage improvements must take into account additional detention or run-off reduction.
6. Drainage and storm sewer improvements carry runoff from smaller, more frequent storms.
5. Drainage system maintenance is an ongoing project of removing debris that decreases the effectiveness of detention ponds, channels, ditches, and culverts.

4.4.8 Recommendations

The following table lists recommended structural projects, as prioritized by the THMCAC. Refer to "Chapter 5: Action Plan," Table 5–1, for a complete listing of all recommended mitigation measures by hazard and priority.

Table 4–3: Recommended Mitigation Activities for Structural Projects

Priority	*Hazard*	*Mitigation Measure*
4	Drought	Build a third flow line to the Hudson Lake reservoir for additional water supply by 2020.
12	Drought	Tie the Oologah and Spavinaw systems together at the Bird Creek Station.
19	Tornadoes and high winds	Provide mobile home community shelters/safe rooms.
21	Urban fires and wildfires	Continue replacing inadequately sized water lines with lines of sufficient size to provide proper fire protection to annexed and existing areas.
22	Tornadoes and high winds	Provide employee shelters at critical facilities, such as 911 Center (priority 1), two fire stations (priority 2), and the remainder of fire stations.
23	Tornadoes and high winds	Provide group safe rooms at City Recreation Centers.
25	Levee failures	Continue work on checking, monitoring, and replacing existing levees.
31	Winter storms	Reduce the number of overhead power lines by moving existing and new lines below ground.
33	Tornadoes and high winds	Provide safe rooms in fire and police stations.
34	Tornadoes and high winds	Perform tornado and high wind evaluations of Tulsa schools to determine the best ways to retrofit or remodel buildings to make them more disaster resistant.
36	Dam failures and releases	Update US Army Corps of Engineers hydrology and hydraulics for the Arkansas River and Keystone Dam.
47	Levee failures	Study and develop a plan to address levee damage in Tulsa.
50	Tornadoes and high winds	Begin a revolving fund for families to build safe rooms.

4.5 Property Protection

Property protection measures are used to modify buildings or property subject to damage from various hazardous events. Property protection measures are normally implemented by the property owner. However, in many cases technical and financial assistance can be provided by a governmental agency. Property protection measures typically include acquisition and relocation, flood-proofing, building elevation, barriers, retrofitting, safe rooms, hail resistant roofing, insurance, and the like.

4.5.1 Acquisition and Relocation

Moving out of harm's way is the surest and safest way to protect a building from damage. Acquiring buildings and removing them is also a way to convert a problem area into a community asset and obtain environmental benefits.

Moving a home out of the floodplain is sometimes the only way to protect it from flooding

The major difference between the two approaches is that acquisition is undertaken by a government agency, so the cost is not borne by the property owner, and the land is converted to public use, such as a park. Relocation can be either government or owner-financed.

While almost any building can be moved, the cost goes up for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings. However, experienced building movers know how to handle any job.

Cost

An acquisition budget should be based on the median price of similar properties in the community, plus $10,000 to $20,000 for appraisals, abstracts, title opinions, relocation benefits, and demolition. Costs may be lower after a flood or other disaster. For example, the community may have to pay only the difference between the full price of a property and the amount of the flood insurance claim received by the owner.

One problem that sometimes results from an acquisition project is a "checkerboard" pattern in which nonadjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, prove reluctant to leave. Creating such an acquisition pattern in a community simply adds to the maintenance costs that taxpayers must support.

Relocation can be expensive, with costs ranging from $30,000 for a small wood frame building to over $60,000 for masonry and slab on grade buildings. Two story houses are more expensive to move because of the need to relocate wires and avoid overpasses. Additional costs may be necessary for acquiring a new lot on which to place the relocated

building and for restoring the old site. Larger buildings may have to be cut and the parts moved separately. Because of all these complications, there are cases where acquisition and demolition is less expensive than relocation.

Where Appropriate

Acquisition and relocation are appropriate in areas subject to:

- Flash flooding
- Deep waters
- Dam break flooding
- Landslides
- Potential hazardous materials spills
- Other high hazard that affects a specific area

Acquisition and relocation are not appropriate for some hazards such as tornadoes and winter storms because there are no areas safe from the hazard. Relocation is also preferred when structures are on large lots with buildable locations outside the hazardous area, or where the owner has a new lot in a safer area.

Acquisition (followed by demolition) is preferred over relocation for buildings that are difficult to move, such as larger, slab foundation, or masonry structures, and for dilapidated structures that are not worth preserving.

4.5.2 Building Elevation

Raising a building above the flood level is the best on-site property protection method for flooding. Water flows under the building, causing little or no damage to the structure or its contents. Alternatives are to elevate on continuous foundation walls (creating an enclosed space below the building) or elevation on compacted earthen fill.

4.5.3 Barriers

Barriers keep surface waters from reaching a building. A barrier can be built of dirt or soil ("berm"), or concrete or steel ("floodwall"). In cases of shallow flooding, regrading a yard can provide the same protection as a separate barrier.

4.5.4 Retrofitting

This term covers a variety of techniques for modifying a building to reduce its susceptibility to damage by one or more hazards.

Where Appropriate

Some of the more common approaches are:

Floods and Dam Failures

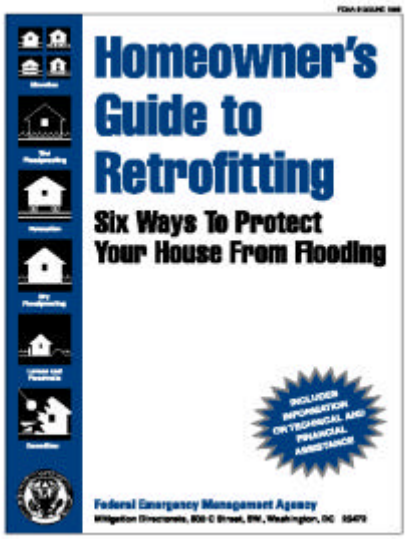
- Dry floodproofing (making walls watertight so floodwaters cannot get inside)
- Wet floodproofing (letting the water in and removing everything that could be damaged by a flood)
- Installing drain plugs, standpipes or backflow valves to stop sewer backup

Tornado

- Constructing an underground shelter or in-building "safe room"
- Securing roofs, walls and foundations with adequate fasteners or tie downs
- Strengthening garage doors and other large openings

High Winds

- Installing storm shutters and storm windows
- Burying utility lines
- Installing/incorporating backup power supplies



Tulsa uses FEMA guides to help homeowners retrofit their flood-prone properties

Hailstorms

- Installing hail resistant roofing materials

Lightning

- Installing lightning rods and lightning surge interrupters
- Burying utility lines
- Installing/incorporating backup power supplies

Winter Storms

- Adding insulation
- Relocating water lines from outside walls to interior spaces
- Sealing windows
- Burying utility lines
- Installing/incorporating backup power supplies

Extreme Heat and Drought

- Adding insulation
- Installing water saver appliances, such as shower heads and toilets

Urban and Wild Fires

- Replacing wood shingles with fire resistant roofing
- Adding spark arrestors on chimneys
- Landscaping to keep bushes and trees away from structures
- Installing sprinkler systems
- Installing smoke alarms

Earthquake

- Retrofitting structures to better withstand shaking
- Tying down appliances, water heaters, bookcases and fragile furniture so they won't fall over during an earthquake

Common Measures

From the above lists, it can be seen that certain approaches can help protect from more than one hazard. These include:

- Strengthening roofs and walls to protect from wind and earthquake forces
- Bolting or tying walls to the foundation to protect from wind and earthquake forces and the effects of buoyancy during a flood
- Adding insulation to protect for extreme heat and cold
- Anchoring water heaters and tanks to protect from ground shaking and flotation
- Burying utility lines to protect from wind, ice and snow
- Installing backup power systems for power losses during storms
- Installing roofing that is hail resistant and fireproof

4.5.5 Insurance

Insurance has the advantage that, as long as the policy is in force, the property is protected and no human intervention is needed for the measure to work. There are three types of insurance coverage:

1. The standard homeowner's dwelling and commercial insurance policies cover against the perils of wildfire and the effects of severe weather, such as frozen water pipes.
2. Many companies sell earthquake insurance as an additional peril rider on homeowner's policies. Individual policies can be written for large commercial properties. Rates and deductibles vary depending on the potential risk and the nature of the insured properties.
3. Flood insurance is provided under the National Flood Insurance Program (NFIP).

Flood Insurance

Although most homeowner's insurance policies do not cover a property for flood damage, an owner can insure a building against surface flooding through the National Flood Insurance Program (NFIP). Flood insurance coverage is provided for buildings and their contents damaged by a "general condition of surface flooding" in the area.

Building coverage is for the structure. Contents coverage is for the removable items inside an insurable building. A renter can take out a policy with contents coverage, even if there is no structural coverage.

Some people have purchased flood insurance because it was required by the bank when they got a mortgage or home improvement loan. Usually these policies just cover the building's structure and not the contents.

In most cases, a 30-day waiting period follows the purchase of a flood insurance policy before it goes into effect. The objective of this waiting period is to encourage people to keep a policy at all times. People ought not to wait for the river to rise before they buy their coverage.

NFIP Coordinator Dianna Herrera presenting a class on flood insurance requirements

4.5.6 The City's Role

Property protection measures are usually considered the responsibility of the property owner. However, the City should be involved in all strategies that can reduce losses from natural hazards, especially acquisition. There are various roles the City can play in encouraging and supporting implementation of these measures.

Providing basic information to property owners is the first step in supporting property protection measures. Owners need general information on what can be done to protect their lives and their assets. They need to see examples, preferably from nearby.

Financial Assistance

Communities can help owners by helping to pay for a retrofitting project, just like they pay for flood control projects. Financial assistance can range from full funding of a project to helping residents find money from other programs. Some communities assume responsibility for sewer backups and other flood problems that arise from an inadequate public sewer or drain system.

Less expensive community programs include low interest loans, forgivable low interest loans, and rebates. A forgivable loan is one that does not need to be repaid if the owner does not sell the house for a specified period, such as five years. These approaches don't fully fund the project but they cost the community treasury less and they increase the owner's commitment to the flood protection project.

Often, small amounts of money act as a catalyst to pique the owner's interest in getting a self-protection project moving. Several Chicago suburbs have active rebate programs that fund only 20% or 25% of the total cost of a retrofitting project. These programs have helped install hundreds of measures that protect buildings from low flood hazards.

Acquisition Agent

The City has been the focal point for many acquisition projects. In most cases, the City is the ultimate owner of the property, but in other cases the school district or other public agency can assume ownership and the attendant maintenance responsibilities.

Other Incentives

Sometimes only a little funding is needed to motivate a property owner to implement a retrofitting project, such as reducing a flood insurance premium if a building is elevated above the flood level. The reduction will not take much of a bite out of the cost of the project, but it reassures the owner that he or she is doing the right thing. Other forms of floodproofing may not be reflected in the flood insurance rates for residential properties, but they can help with the Community Rating System, which will, in turn, reduce the premiums of everyone's flood policies.

Other incentives to consider are programs to help owners calculate the benefits and costs of a project, and a "seal of approval" for retrofitted buildings. The latter would be given following an inspection that confirms that the building meets certain standards. There are many other personal but non-economic incentives to protect a property from flood damage, such as peace of mind and increased value at property resale.

4.5.7 Conclusions

1. Acquisition and relocation of property is the most effective measure for property protection when hazards are expected to occur repeatedly in the same locations. Acquisition followed by demolition is preferable.
2. Other methods of property protection for flooding include raising building elevations and constructing berms and floodwalls.
3. Building modifications or retrofits are appropriate for some hazards.
4. Property insurance has the advantage of protecting the property without human intervention.
5. The City can help reduce losses from natural hazards by providing financial assistance, having an acquisition program, and other incentives.

4.5.8 Recommendations

The following table lists recommended property protection measures, as prioritized by the THMCAC. Refer to "Chapter 5: Action Plan," Table 5–1, for a complete listing of all recommended mitigation measures by hazard and priority.

Table 4–4: Recommended Mitigation Activities for Property Protection

Priority	*Hazard*	*Mitigation Measure*
6	Floods	Implement structural and non-structural flood mitigation measures for flood-prone properties, as recommended in the basin-wide master drainage plans.
7	Floods	Acquire and remove Repetitive Loss Properties and repeatedly flooded properties where City plans identify acquisition to be the most cost effective and desirable mitigation measure.
27	Lightning	Provide surge protection for computer-reliant critical facilities, e.g., 911 Center, Emergency Operations Center, police stations, fire stations, and so on.
53	Hailstorms	Provide hail resistant roofing for City buildings.
55	Urban fires and wildfires	Fund a fire suppression pilot project for single-family residences in a publicly funded development in the Lacy Park area.
61	Tornadoes and high winds	Provide damage-resistant glass replacements for City Hall.
62	General	Provide security and surveillance equipment for police and fire stations.

4.6 Emergency Services

Emergency services measures protect people during and after a hazard event. Locally, these are coordinated by the Tulsa Area Emergency Management Agency (TAEMA), and include preparedness, threat recognition, warning, response, critical facilities protection, and post-disaster recovery and mitigation.

4.6.1 Threat Recognition

Threat recognition is the key. The first step in responding to a flood, tornado, storm or other natural hazard is to know that one is coming. Without a proper and timely threat recognition system, adequate warnings cannot be disseminated.

Floods

A flood threat recognition system provides early warning to emergency managers. A good system will predict the time and height of the flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels.

A flood warning sign on Mill Creek.

On larger rivers, including the Arkansas, the measuring and calculating is done by the National Weather Service, which is part of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Flood threat predictions are disseminated on the NOAA Weather Wire or NOAA Weather Radio. NOAA Weather Radio is considered by the federal government to be the official source for weather information.

The National Weather Service issues notices to the public, using two levels of notification:

Flood Watch: conditions are right for flooding

Flood Warning: a flood has started or is expected to occur

On smaller rivers, local rainfall and river gages are needed to establish a flood threat recognition system. The National Weather Service may issue a "flash flood watch." This means the amount of rain expected will cause ponding and other flooding on small streams and depressions. These events are sometimes so localized and rapid that a "flash flood warning" may not be issued, especially if no gages or other remote threat recognition equipment is available.

Meteorological Hazards

The National Weather Service is the prime agency for detecting meteorological threats, such as tornadoes, thunderstorms, and winter storms. As with floods, the federal agency can only look at the large scale, e.g., whether conditions are appropriate for formation of a tornado. For tornadoes and thunderstorms, the county or municipalities can provide more site-specific and timely recognition by sending out spotters to watch the skies when the Weather Service issues a watch or warning.

4.6.2 Warning

After the threat recognition system tells TAEMA that a flood or other hazard is coming, the next step is to notify the public and staff of other agencies and critical facilities. The earlier and the more specific the warning, the greater the number of people who can implement protection measures. The following are the more common warning media:

- Outdoor warning sirens
- Sirens on public safety vehicles
- NOAA Weather Radio
- Commercial or public radio or TV stations
- Cable TV emergency news inserts
- Telephone trees
- Door-to-door contact
- Mobile public address systems

Multiple or redundant systems are the most effective, since people do not hear one warning, they may still get the message from another part of the system. Each has advantages and disadvantages. Outdoor warning sirens can reach the most people quickly (except those around loud noise, such as at a factory or during a thunderstorm), but they do not explain what hazard is coming and cannot be sounded unless a timely means of threat recognition exists. Radio and TV provide a lot of information, but people have to know to turn them on. Telephone trees are also fast, but can be expensive and do not work when phones lines are down.

Just as important as issuing a warning is telling people what to do. A warning program should have a public information aspect. People need to know the difference between a tornado warning (when they should seek shelter in a basement) and a flood warning (when they should stay out of basements).

4.6.3 Response

The protection of life and property is the foremost important task of those responding to an emergency. Concurrent with threat recognition and issuing warnings, a community should respond with actions that can prevent or reduce damage and injuries. Typical actions and responding parties include the following:

- Activating the emergency operations room (emergency management)
- Closing streets or bridges (police or public works)
- Shutting off power to threatened areas (utility company)
- Holding children at school/releasing children from school (school district)
- Passing out sand and sandbags (public works)
- Ordering an evacuation (mayor)
- Opening evacuation shelters (Red Cross)
- Monitoring water levels (engineering)
- Security and other protection measures (police)

An emergency action plan ensures that all bases are covered and that the response activities are appropriate for the expected threat. These plans are developed in coordination with the agencies or offices that are given various responsibilities.

Emergency response plans should be updated annually to keep contact names and telephone numbers current and to make sure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and changing conditions. The end result is a coordinated effort implemented by people who have experience working together so that available resources will be used in the most efficient manner.

4.6.4 Critical Facilities Protection

"Critical facilities" are not strictly defined by any agency. Generally, they fall into two categories:

- Buildings or locations vital to the response and recovery effort, such as police and fire stations and telephone exchanges; and
- Buildings or locations that, if damaged, would create secondary disasters, such as hazardous materials facilities and nursing homes.

Protecting critical facilities during a disaster is the responsibility of the facility owner or operator. However, if they are not prepared for an emergency, the rest of the community could be impacted. If a critical facility is damaged, workers and resources may be unnecessarily drawn away from other response efforts. If such a facility is adequately prepared by the owner or operator, it will be better able to support the community's emergency response efforts.

Most critical facilities have full-time professional managers or staff who are responsible for the facility during a disaster, and who usually have their own emergency response plans. Many facilities would benefit from early warning, response planning, and coordination with community response efforts.

4.6.5 Post-Disaster Recovery and Mitigation

After a disaster, communities should undertake activities to protect public health and safety, facilitate recovery, and prepare people and property for the next disaster. Throughout the recovery phase, everyone wants to get "back to normal." The problem is, "normal" means the way they were before the disaster. Measures needed include the following:

Recovery Actions

- Patrolling evacuated areas to prevent looting
- Providing safe drinking water
- Monitoring for diseases
- Vaccinating residents for tetanus
- Clearing streets
- Cleaning up debris and garbage
- Regulating reconstruction to ensure that it meets all code requirements, including the NFIP's substantial damage regulations

The Department of Public Works continuously monitors the quality of the City's streams, waterways and detention ponds.

Mitigation Actions

- Conducting a public information effort to advise residents about mitigation measures they can incorporate into their reconstruction work
- Evaluating damaged public facilities to identify mitigation measures that can be included during repairs
- Acquiring substantially or repeatedly damaged properties from willing sellers
- Planning for long-term mitigation activities
- Applying for post-disaster mitigation funds

Requiring permits, conducting inspections, and enforcing the NFIP substantial improvement/substantial damage regulations can be very difficult for local, understaffed and overworked offices after a disaster. If these activities are not carried out properly, the municipality will not only miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations under the NFIP.

4.6.6 Conclusions

1. Using solid, dependable threat recognition systems is first and foremost in emergency services.
2. Following a threat recognition, multiple or redundant warning systems and instructions for action are most effective in protecting citizens.

3. Good emergency response plans that are updated yearly ensure that well-trained and experienced people can quickly take the appropriate measures to protect citizens and property.
4. To ensure effective emergency response, critical facilities protection must be part of the plan.
5. Post-disaster recovery activities include providing neighborhood security, safe drinking water, appropriate vaccinations, and cleanup and regulated reconstruction.

4.6.7 Recommendations

The following table lists recommended emergency service activities. They are listed in priority order as recommended by the THMCAC. Refer to "Chapter 5: Action Plan," Table 5–1, for a complete listing of all recommended mitigation measures by hazard and priority.

Table 4–5: Recommended Mitigation Activities for Emergency Services

Priority	*Hazard*	*Mitigation Measure*
9	General	Evaluate and upgrade warning systems.
10	General	Provide backup facilities for the 911 Center and the Emergency Operations Center.
20	Floods	Launch an automatic monitoring and warning system for spot flooding.
24	General	Install an emergency communication network for fire, police, 911, EMSA and other emergency operations.
26	Urban fires and wildfires	Implement a fire suppression system for City Hall.
42	Tornadoes and high winds	Prepare weather-warning systems for interstate travelers, such as message boards and proper education for travelers.
44	General	Provide community Emergency Response Team training for City employees and work with other local CERTs.
49	Tornadoes and high winds	Supply NOAA Weather Radio to all local government buildings, schools, hospitals, and critical facilities.
51	General	Provide survival equipment and supplies for City emergency response teams to cover employees and others who use City buildings.
52	Dam failures and releases	Develop warning and evacuation plans for Arkansas River areas at risk from dam failure or release flooding.
58	Lightning	Designate individuals at city recreation facilities that are educated in storm spotting and safety, who have the authority to take proper action.
59	Lightning	Add lightning warning into the current warning siren system.

4.7 Natural Resource Protection

Natural resource protection activities are generally aimed at preserving and restoring the natural and beneficial uses of natural areas. In doing so, these activities enable the beneficial functions of floodplains and drainageways to be better realized. These natural functions include:

- Storage of floodwaters
- Absorption of flood energy
- Reduction of flood scour
- Infiltration and aquifer/ groundwater recharge
- Removal/filtration of excess nutrients, pollutants, and sediments from floodwaters
- Habitat for flora and fauna
- Recreation and aesthetic opportunities, and
- Opportunities for off-street hiking and biking trails

Wetlands are a valued and protected resource in Tulsa.

This section reviews natural resource protection activities that preserve natural areas and mitigate damage from other hazards. Integrating these activities into the hazards mitigation program will not only reduce the City's susceptibility to flood damage, but will also improve the overall environment.

4.7.1 Wetland Protection

Wetlands are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as a natural filter, which helps to improve water quality, and provide habitat for many species of fish, wildlife, and plants.

Wetlands

- **Store large amounts of floodwaters**
- **Reduce flood velocities and erosion**
- **Filter water, making it cleaner for those downstream**
- **Provide habitat for species that cannot live or breed anywhere else**

Wetlands are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency under Section 404 of the Clean Water Act. Before a "404" permit is issued, the plans are reviewed by several agencies, including the Corps and the U.S. Fish and Wildlife Service. Each of these agencies must sign off on individual permits. There are also nationwide permits that allow small projects that meet certain criteria to proceed without individual permits.

4.7.2 Erosion and Sedimentation Control

Farmlands and construction sites typically contain large areas of bare exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Sediment tends to settle where the river slows down and loses power, such as when it enters a lake or a wetland.

Sedimentation will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters. When channels are constricted and flooding cannot deposit sediment in the bottomlands, even more is left in the channels. The result is either clogged streams or increased dredging costs.

Construction projects, which can expose large areas to erosion, are closely monitored.

Not only are the drainage channels less able to do their job, but the sediment in the water reduces light, oxygen, and water quality and often brings chemicals, heavy metals and other pollutants. Sediment has been identified as the nation's number one nonpoint source pollutant for aquatic life.

Practices to reduce erosion and sedimentation have two principal components:

1. Minimize erosion with vegetation; and
2. Capture sediment before it leaves the site.

Slowing surface water runoff on the way to a drainage channel increases infiltration into the soil and reduces the volume of topsoil eroded from the site. Runoff can be slowed down by measures such as terraces, contour strip farming, no-till farm practices, sediment fences, hay or straw bales, constructed wetlands, and impoundments (e.g., sediment basins and farm ponds).

Erosion and sedimentation control regulations mandate that these types of practices be incorporated into construction plans. They are usually oriented toward construction sites rather than farms. The most common approach is to require applicants for permits to submit an erosion and sediment control plan for the construction project. This allows the applicant to determine the best practices for the site.

One tried and true approach is to have the contractor design the detention basins with extra capacity. They are built first, so they detain runoff during construction and act as sediment catch basins. The extra capacity collects the sediment that comes with the runoff until the site is planted and erosion is reduced.

4.7.3 River Restoration

There is a growing movement that has several names, such as "stream conservation," "bioengineering" or "riparian corridor restoration." The objective of these approaches is to return streams, streambanks and adjacent land to a more natural condition, including the natural meanders. Another term is "ecological restoration" which restores native indigenous plants and animals to an area.

A key component of these efforts is to use appropriate native plantings along the banks that resist erosion. This may involve "retrofitting" the shoreline with willow cuttings, wetland plants, and/or rolls of landscape material covered with a natural fabric that decomposes after the banks are stabilized with plant roots.

Retrofitting streambanks with willow cuttings and geotextiles can be more cost effective than riprap or concrete-lined floodways.

Studies have shown that after establishing the right vegetation, long-term maintenance costs are lower than if the banks were concrete. The Natural Resources Conservation Service estimates that over a ten-year period, the combined costs of installation and maintenance of a natural landscape may be one-fifth of the cost for conventional landscape maintenance, e.g., mowing turf grass.

4.7.4 Best Management Practices

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. State and federal water quality laws have reduced the pollutants that come from these facilities.

Nonpoint source pollutants come from non-specific locations and are harder to regulate. Examples are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams.

Best management practices ("BMPs") are measures that reduce nonpoint source pollutants that enter the waterways. BMPs can be implemented during construction and as part of a project's design to permanently address nonpoint source pollutants.

There are three general categories of BMPs:

1. **Avoidance**—Setting construction projects back from the stream.
2. **Reduction**—Preventing runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage.

3. **Cleansing**—Stopping pollutants after they are en route to a stream, such as using grass drainageways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained.

In addition to improving water quality, BMPs can have flood related benefits. By managing runoff, they can attenuate flows and reduce the peaks after a storm. Combining water quality and water quantity measures can result in more efficient multi-purpose stormwater facilities.

Because of the need to clean up our rivers and lakes, there are several laws mandating the use of best management practices for new developments and various land uses. The farthest reaching one is the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) requirements.

4.7.5 Dumping Regulations

NPDES addresses liquid pollutants. Dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' ability to convey or clean stormwater.

Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations need to also apply to "non-objectionable" materials, such as grass clippings or tree branches that can kill ground cover or cause obstructions in channels.

City employee Laureen Gibson Gilroy on Mooser Creek with a clean up crew of children from South Haven Manor

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard not realizing that it is needed to drain street runoff. They may not understand how regrading their yard, filling a wetland, or discarding leaves or branches in a watercourse can cause a problem to themselves and others. Therefore, a dumping enforcement program should include public information materials that explain the reasons for the rules as well as the penalties.

Regular inspections to catch violations also should be scheduled. Finding dumped materials is easy; locating the source of the refuse is hard. Usually the owner of property adjacent to a stream is responsible for keeping the stream clean. This may not be fair for sites near bridges and other public access points.

4.7.6 Conclusions

1. Wetlands play an important role in flood control, preservation of water quality, and wildlife habitation, making a strong case for their protection.
2. Erosion can be reduced by use of vegetation. Sedimentation should be captured before it leaves its original location with oversized detention basins.
3. Vegetation used along riverbanks works more effectively in river maintenance than using banks made of concrete. The City of Tulsa uses geotextile fabric to establish vegetation along drainageways and stream banks. Bioengineering techniques, such as willow plantings, are used to stabilize the banks of larger natural waterways.
4. Nonpoint source pollutants are best managed by keeping construction projects away from streams, reducing sediment runoff, and using grass drainageways and detention basins for filtration.
5. Dumping regulations need to be communicated to the public and enforced.
6. The establishment and maintenance of wildlife habitat and natural ecosystems is an important aspect of the City of Tulsa's floodplain management and drainage system program. In the cooperation with the Oklahoma Department of Wildlife Conservation, aquatic plants and wildlife are established in stormwater detention ponds.

4.7.7 Recommendations

As of the date of this plan, there are no further recommendations made by the THMCAC that apply to natural resource protection activities. The City of Tulsa performs most of the activities mentioned in this section.

Chapter 5:

Action Plan

Chapter 5: Action Plan

The City of Tulsa has reviewed and analyzed the risk assessment studies for the natural hazards and hazardous material events that may impact the community. The THMCAC prioritized the mitigation measures identified in Chapter 4, and developed an Action Plan for the highest priority measures. This chapter identifies specific high priority actions to achieve the City's mitigation goals, the lead agency responsible for implementation of each action item, an anticipated time schedule, estimated cost opinion, and identification of possible funding sources.

Dam Failure

1. **Develop a computer mapping program for results of Arkansas River's Keystone Dam release rates of 250, 350, and 450 thousand cubic feet per second.**

1a. Reassess facts about the Keystone Dam capacity, release rates, and timing.

1b. Update U.S. Army Corps of Engineers Hydrology and Hydraulics for the Arkansas River and Keystone Dam.

1c. Develop GIS (digitized) mapping program for results of Arkansas River's Keystone Dam release rates of 250, 350, and 450 thousand cfs.

1d. Update warning and evacuation plans for Arkansas River areas at risk from dam failure or release flooding.

1e. Develop pre- and post-flood plans for the Arkansas River floodplain, including the areas behind the levees.

Lead: City of Tulsa Department of Public Works, U.S. Army Corps of Engineers (USACE), and Indian Nations Council of Governments (INCOG).

Time Schedule: 2003-2004

Estimated Cost: $325,000

Source of Funding: Local, USACE, HMGP

Work Product/Expected Outcome: 1) Updated hydrology and hydraulic model for the Arkansas River and the Keystone Dam; 2) Digitized mapping in GIS format of the Arkansas River floodplain with inundation areas for the 250 cfs, 350 cfs, 450 cfs release rates, and maximum probable flood mapped from the Keystone Dam to Wagoner County; 3) Updated warning and evacuation plan for the areas at risk, including the areas behind the levees; and 4) Pre- and post-flood development/redevelopment plans for the Arkansas River floodplain, including the areas behind the levees.

Extreme Heat

2. Obtain funding for distribution of public information and education materials to vulnerable populations through participating community agencies.

2a. Review and update Tulsa's heat response plan.

2b. Obtain funding for publication and distribution of public information and education materials to vulnerable populations through participating community agencies.

Lead: Project Impact/Mayor's Citizen Corps, Community Service Council, Tulsa Area Emergency Management Agency,

Time Schedule: 2002-2003

Estimated Cost: $38,000

Source of Funding: Local, HMGP

Work Product/Expected Outcome: 1) Update heat response plan, including identification of vulnerable populations, such as age, poverty, infirmed, non-English speaking, and so on; 2) Popular informational brochures specifically aimed at target vulnerable populations.

Hazardous Materials Events

3. Continue the City's Household Pollutant Collection program, and build a year-round site for collection.

3a. Update the study for routing of hazardous materials through the Tulsa area. (Hazardous materials routes through Tulsa study done in 1997 by the University of Oklahoma.)

3b. Continue the City's Household Pollutant Collection program and build a year-round site for collection.

Lead: Public Works, The Metropolitan Environmental Trust (The Met), INCOG

Time Schedule: 2002-2005

Estimated Cost: $2,000,000

Source of Funding: Local, HMGP, EPA

Work Product/Expected Outcome: 1) Updated Hazardous Materials Transportation Plan, and 2) Facility for the year-round collection and disposal of hazardous household pollutants.

Drought

4. Build a third flow line to the Hudson Lake reservoir for additional water supply by 2020.

Tulsa gets the raw water it uses to produce drinking water from two main sources: the Eucha/Spavinaw lakes chain and Lake Oologah. Each source is transported through a flow line to treatment plants in the city. The City also has rights to raw water from Lake Hudson, but that water travels through the same flow line as the Eucha/Spavinaw water. Adding a third flow line will allow Tulsa to use water from all three sources at the same time.

4a. Build a third flow line to Lake Hudson for additional water supply by 2020.

4b. Tie the Oologah and Spavinaw systems together at the Bird Creek Station.

4c. Continue Tulsa's "Wise use of Water" program.

4d. Develop and implement plans to designate when a drought begins and ends.

Lead: Department of Public Works, Utility Metropolitan Utility Authority

Time Schedule: 2002-2020

Estimated Cost: $2,000,000

Source of Funding: General Obligation Bond Issues, Rate Payer User Fees

Work Product/Expected Outcome: 1) A raw water line from Tulsa to Lake Hudson to secure municipal water resources for the next 50 years; 2) A line to tie the Oologah and Spavinaw systems together.

Expansive Soils

5. Investigate codes/incentives for the construction of new foundations to avoid expansive soil problems.

Lead: Department of Public Works, Development Services, U.S. Natural Resources Conservation Service, Tulsa Homebuilders Association.

Time Schedule: 2002-2003

Estimated Cost: $20,000

Source of Funding: Local, Natural Resources Conservation Service, HMGP

Work Product/Expected Outcome: 1) Plan and program to identify areas of existing development where expansive soils cause problems; 2) Identify areas for future development where expansive soils may cause problems; 3) Investigate the adequacy of current codes to alleviate foundation problems due to expansive soils; 4) Educational information for distribution to homeowners and home builders about expansive soils mitigation measures.

Floods

6. Implement structural and non-structural flood mitigation measures for flood-prone properties as recommended in the basin-wide master drainage plans.

Tulsa's Flood and Stormwater Management Plan looks at two ways to reduce and prevent flood damage to properties. One way is called "structural" and involves building detention ponds or other structures to keep the water away from the property. Another way is called "non-structural" and involves relocation or demolition so that the property is "moved away" from the water.

6a. Continue to update and revise basin-wide master drainage plans where changed conditions warrant.

6b. Implement structural and non-structural flood mitigation measures for flood-prone properties as recommended in the basin-wide master drainage plans.

6c. Launch an automatic monitoring and warning system for spot flooding.

6d. Educate the public on what the multi-sound sirens mean in the Tulsa area.

Lead: Department of Public Works, TAEMA (6e)

Time Schedule: Ongoing

Estimated Cost: $ 393,442,000

Source of Funding: Local General Obligation Bond Issues, Local Capital Improvements Sales Taxes, Stormwater Utility Fee, Fee-in-lieu-of Detention funds, U.S. Army Corps of Engineers projects, HMGP.

Work Product/Expected Outcome: A community where all property and infrastructure is protected to the 100-year Base Flood Elevation.

7. Acquire and remove Repetitive Loss Properties and repeated flooded properties where the City's Repetitive Loss and master drainage plans identify acquisition to be the most cost effective and desirable mitigation measure.

The National Flood Insurance Program keeps track of insurance claims made for flood damages. Properties where claims of $1,000 or more have occurred at least twice in the past 10 years are called "Repetitive Loss Properties." In addition, the City of Tulsa keeps track of properties that suffer repeated damages that are less than $1,000 each.

Lead: Department of Public Works

Time Schedule: Ongoing

Estimated Cost: $ 58,000,000

Source of Funding: Local sales tax and bond issues, HMGP, FMA

Work Product/Expected Outcome: Acquisition and removal of all buildings from the floodplain where acquisition is deemed to be the most cost-effective means of flood mitigation and protection.

General

8. Examine optimum methods of implementing public information and education objectives concerning tornadoes, high winds, lightning, winter storms, extreme heat, fire, Hazmat events, expansive soils, and wise use of water resources.

Currently, the City of Tulsa, other public agencies, private businesses, and non-profit groups conduct educational campaigns to inform the public about measures that can be taken to reduce the danger of property damage and injury from natural and technological hazards.

8a. Examine optimum methods of implementing public information and education objectives concerning tornadoes, high winds, lightning, winter storms, extreme heat, fire, hazardous materials incidents, expansive soils, and wise use of water resources.

8b. GIS update to include public utility infrastructure.

8c. Install an emergency communication network for Fire, Police, 911, EMSA and other emergency operations.

8d. Execute daytime population maps for the Tulsa community.

8e. Translate current public information to other languages.

8f. Review and update the Debris Management Plan.

Lead: Department of Public Works, Tulsa Area Emergency Management Agency, 911 Center, and Project Impact/Mayor's Citizen Corps

Time Schedule:

	Time Schedule	Cost	Lead
8a.	2002-2007	$ 78,000	Public Works, Project Impact /Mayor's Citizen Corps
8b.	2002-2006	$ 325,000	Public Works
8c.	2002-2006	$ 125,000	Telecom/ Info. Mgt. Dept.
8d.	2002-2005	$ 50,000	TCC Health, INCOG, Pub. Wks.
8e.	2002-2003	$ 35,250	Project Impact, Red Cross, Community Services Council
8f.	2002-2003	$ 45,000	Public Works

Sources of Funding: 8a. Local, HMGP; 8b. Local revenue issues, Homeland Security; 8c. Local, Homeland Security; 8d. Local, Homeland Security; 8e. Local, HMGP; 8f. Local, HMGP.

Work Products/Expected Outcome: 8a. A plan for the distribution of hazard preparedness and mitigation literature to vulnerable populations; 8b. GIS layer for public utility infrastructure; 8c. Emergency communications network for First Responders and disaster/emergency operations agencies; 8d. GIS inventory of daytime populations; 8e. Emergency and hazard information translated into languages of large foreign, non-English speaking populations; 8f. Updated debris management plan, especially

important for high debris producing events, such as tornadoes, high winds, and winter storms.

9. Evaluate and upgrade warning systems.

Tulsa's siren system was state of the art when it was installed in the mid-1980s, but newer, better designs are now available. The 79 sirens currently in place each have an expected lifespan of 20 years so they will likely need to be replaced during this decade.

Lead: Tulsa Area Emergency Management Agency

Time Schedule: 2002-2006

Estimated Cost: $1,500,000

Source of Funding: Local, FEMA

Work Product/Expected Outcome: Outdoor emergency warning system covering all areas of the city.

10. Provide backup facilities for the 911 Center and the Emergency Operations Center.

Currently, Tulsa's emergency operations are coordinated in one downtown building that houses the 911 Center and the Emergency Operations Center. If that building is damaged in a disaster, operations will have to be conducted from some other place. Contingency plans call for operations to be shifted to other government offices, but workers would not have equipment and supplies dedicated to emergency use at those facilities. Having backup facilities away from downtown designed exclusively for emergency use would save time during a disaster if current facilities were unavailable.

Lead: TAEMA and 911 Center

Time Schedule: 2002-2006

Estimated Cost: $6,000,000

Source of Funding: Local, Homeland Security

Work Product/Expected Outcome: Modern, secure Emergency Operation Center and 911 Center capable of operating during disasters or man-made emergencies.

Table 5–1: Multi-Hazard Mitigation Measures, By Priority and Hazard

Priority	*Hazard*	*Mitigation Measure*
1	Dam failures and releases	Develop GIS (digitized) mapping program for results of Arkansas River's Keystone Dam release rates of 250, 350, and 450 thousand cubic feet per second.
2	Extreme Heat	Obtain funding for distribution of public information and education materials to vulnerable populations through participating community agencies.
3	Hazardous materials events	Continue the City's Household Pollutant Collection program, and build a year-round collection site.
4	Drought	Build a third flow line to the Hudson Lake reservoir for additional water supply by 2020.
5	Expansive soils	Investigate codes/incentives for the construction of new foundations to avoid expansive soil problems.
6	Floods	Implement structural and non-structural flood mitigation measures for flood-prone properties, as recommended in the basin-wide master drainage plans.
7	Floods	Acquire and remove Repetitive Loss Properties and repeatedly flooded properties where City plans identify acquisition to be the most cost effective and desirable mitigation measure.
8	General	Examine optimum methods of implementing public information and education objectives concerning tornadoes, high winds, lightning, winter storms, extreme heat, fire, hazardous materials events, expansive soils, and wise use of water resources.
9	General	Evaluate and upgrade warning systems.
10	General	Provide new facilities for the 911 Center and the Emergency Operations Center.
11	General	Update GIS to include public utility infrastructure.
12	Drought	Tie the Oologah and Spavinaw systems together at the Bird Creek Station.
13	Winter storms	Continue the City's aggressive snow and ice removal plan.
14	Earthquakes	Building reinforcements against wind and tornado damage will also protect against the minor earthquakes projected for the Tulsa area.
15	General	Review and update the Debris Management Plan.
16	Dam failures and releases	Develop pre- and post-flood plans for the Arkansas River floodplain, including the areas behind the levees.
17	Levee failures	Re-evaluate and update the master drainage plans for areas behind (protected by) the levees.
18	Tornadoes and high winds	Investigate building codes/incentives for adequacy for tornadoes and high winds.
19	Tornadoes and high winds	Provide mobile home community shelters/safe rooms.

Priority	*Hazard*	*Mitigation Measure*
20	Floods	Launch an automatic monitoring and warning system for spot flooding.
21	Urban fires and wildfires	Continue replacing inadequately sized water lines with lines of sufficient size to provide proper fire protection to annexed and existing areas.
22	Tornadoes and high winds	Provide employee shelters at critical facilities, such as 911 Center (priority 1), two fire stations (priority 2), and the remainder of fire stations.
23	Tornadoes and high winds	Provide group safe rooms at City Recreation Centers.
24	General	Install an emergency communication network for fire, police, 911, EMSA and other emergency operations.
25	Levee failures	Continue work on checking, monitoring, and replacing existing levees.
26	Urban fires and wildfires	Implement a fire suppression system for City Hall.
27	Lightning	Provide surge protection for computer-reliant critical facilities, e.g., 911 Center, Emergency Operations Center, police stations, fire stations, and so on.
28	Lightning	Educate the community about proper lightning safety through public service announcements and other media outlets.
29	Lightning	Study other communities that have lightning warning systems.
30	Winter storms	Provide for routine trimming of trees to reduce power outages during storms.
31	Winter storms	Reduce the number of overhead power lines by moving existing and new lines below ground.
32	Hazardous materials events	Update the study for routing of hazardous materials through the Tulsa area.
33	Tornadoes and high winds	Provide safe rooms in fire and police stations.
34	Tornadoes and high winds	Perform tornado and high wind evaluations of Tulsa schools to determine the best ways to retrofit or remodel buildings to make them more disaster resistant.
35	Floods	Continue to update and revise basin-wide master drainage plans where changed conditions warrant.
36	Dam failures and releases	Update US Army Corps of Engineers hydrology and hydraulics for the Arkansas River and Keystone Dam.
37	General	Contact agencies that distribute information to at-risk communities, such as the elderly, infirm, poor, and outside workers.
38	Urban fires and wildfires	Apply for mitigation funding for backflow values for commercial, industrial, and multi-family buildings.

Priority	*Hazard*	*Mitigation Measure*
39	Urban fires and wildfires	Continue fire department's smoke detector program, Project Life.
40	Tornadoes and high winds	Investigate community tornado shelter programs implemented in other cities or states.
41	Tornadoes and high winds	Safe room rebates for low income and vulnerable populations.
42	Tornadoes and high winds	Prepare weather-warning systems for interstate travelers, such as message boards and proper education for travelers.
43	Floods and tornadoes	Educate the public on what the multi-sound sirens mean in the Tulsa area.
44	General	Provide community Emergency Response Team training for City employees and work with other local CERTs.
45	General	Compile daytime population maps for the Tulsa community.
46	Dam failures and releases	Assemble facts about the Keystone Dam capacity, release rates and timing.
47	Levee failures	Study and develop a plan to address levee damage in Tulsa.
48	Lightning	Provide educational demonstrations on whole-house surge protection technology.
49	Tornadoes and high winds	Supply NOAA Weather Radio to all local government buildings, schools, hospitals, and critical facilities.
50	Tornadoes and high winds	Begin a revolving fund for families to build safe rooms.
51	General	Provide survival equipment and supplies for City emergency response teams to cover employees and others who use City buildings.
52	Dam failures and releases	Develop warning and evacuation plans for Arkansas River areas at risk from dam failure or release flooding.
53	Hailstorms	Provide hail resistant roofing for City buildings.
54	Urban fires and wildfires	Develop a public education project addressing the advantages of individual fire suppression in residences.
55	Urban fires and wildfires	Fund a fire suppression pilot project for single-family residences in a publicly funded development in the Lacy Park area.
56	Urban fires and wildfires	Evaluate fire protection and prevention for animals, employees, and visitors to Tulsa Zoo.
57	Urban fires and wildfires	Continue education, and get funding to further inform people on evacuation plans for City offices, businesses and residential homes.
58	Lightning	Designate individuals at city recreation facilities that are educated in storm spotting and safety, who have the authority to take proper action.
59	Lightning	Add lightning warning into the current warning siren system.

Priority	*Hazard*	*Mitigation Measure*
60	Drought	Develop and implement plans to determine when a drought begins and ends.
61	Tornadoes and high winds	Provide damage-resistant glass replacements for City Hall.
62	General	Provide security and surveillance equipment for police and fire stations.
63	General	Translate current public information into other languages.
64	Extreme heat	Review and update Tulsa's heat response plan.
65	Drought	Continue Tulsa's "Wise Use of Water" program.
66	Lightning	Encourage utilities to provide lightning prevention information materials and programs to their customers.

Chapter 6:

Plan Maintenance and Adoption

Chapter 6: Plan Maintenance and Adoption

This chapter includes a discussion of the plan maintenance process and documentation of the adoption of the plan by the Tulsa Hazard Mitigation Citizen Advisory Committee, the Tulsa Metropolitan Area Planning Commission, and the Tulsa City Council.

6.1 Monitoring, Evaluating, and Updating the Plan

The City of Tulsa will ensure that a regular review and update of the Multi-Hazard Mitigation Plan occurs. The THMCAC will continue to meet on a quarterly basis, or as conditions warrant, to oversee and review updates and revisions to the plan. The Department of Public Works will continue to head the Staff Technical Advisory Committee, which will monitor and oversee the day-to-day implementation of the plan.

The City of Tulsa is in the process of updating the city-wide Flood and Stormwater Management Plan 1999-2014, and the Elm Creek Master Drainage Plan, preparing an Open Channel Inventory program for all streams and drainage channels within the city, has applied for Hazard Mitigation Grant Projects (FEMA-1355-DR-OK and FEMA-1401-DR-OK), and an HMGP Phase 2 Hazard Mitigation Plan grant to plan for man-made and technological hazards, including terrorism. These plans are anticipated to take about 2 years to complete. Many Action Items recommended in this plan have already been incorporated into the City's Capital Improvements Planning process. These programs, like the CRS Repetitive Loss Plan, will continue to be monitored and updated on an annual basis, if not more often.

6.2 Public Involvement

The City of Tulsa is committed to involving the public directly in updating and maintaining the Multi-Hazard Mitigation Plan.

Electronic copies of the Plan will be distributed to the public libraries, and the plan will be placed on the City of Tulsa's Website.

Activities to Consider

1. Public meetings will be held prior to the severe weather season in Oklahoma, probably in the spring. These meetings will be advertised to the general citizenry, and specifically mentioned in the annual floodplain notice mailed to all occupants of the city's floodplains. These meetings will be held to update citizens on the progress that has been made during the year in implementing the plan, stormwater plans and capital improvements, and related public infrastructure capital projects. The meetings will

also be used to distribute literature and inform and educate citizens as to actions they can take to mitigate natural hazards, save lives, and prevent property damage. Input from the citizens will be solicited as to how the mitigation process can be more effective.

2. City Life bill stuffers
3. Tulsa Hazard Mitigation Citizens Advisory Committee will continue to meet on a monthly basis or as needed.
4. Public Service Announcements

6.3 Incorporating the Multi-Hazard Mitigation Plan

The Tulsa Multi-Hazard Mitigation Plan has been adopted by the Tulsa Metropolitan Area Planning Commission as an amendment to the Tulsa Metropolitan Area Comprehensive Plan. The Tulsa City Council has adopted the plan to guide City mitigation activities. Appropriate Action Items will be incorporated into the Capital Improvements Plan and planning process. The recommendations will also be used to guide City actions for the Community Rating System's (CRS) Repetitive Loss Plan.

Included on the following pages of this chapter are Resolutions of Adoption of the City of Tulsa Multi-Hazard Mitigation Plan:

1. Tulsa Hazard Mitigation Citizen Advisory Committee (THMCAC)
2. Tulsa Metropolitan Area Planning Commission
3. Tulsa City Council

216.4 5

REQUEST FOR ACTION

AGENDA: X Mayor X Council **Date: 01-03-02**

OTHER: ____DTU ____MTTA ____RMUA ____TAEMA ____TARE ____TDA ____TMAPC ____TMUA ____TPA ____TPFA ____ Utility Bd ____Airport Auth ____Airport Impv Trust ____Other

FOR INFORMATION CONTACT:

Name: Mike Buchert
Address: Room 512, City Hall
Telephone: 596-7274
Subject: HAZARD MITIGATION PLANNING COMMITTEE

Note: All City Council Agenda Items, including appropriate back-up submitted to the Council secretary, Office of the City Council, not later than 3:00 pm Thursdays preceding Tuesday, 7:00 pm meetings, and not later than 5:00 pm Mondays preceding Thursday, 4:30 pm meetings:

RESOLUTION NO. 6840

SUMMARY:

In the future to receive Federal Hazard Mitigation money (money used to buy flood-prone property), the Federal Government is requiring that a multi-hazard plan be developed. As part of this planning process, a Hazard Mitigation Planning Committee (HMPC) needs to be formed. The recommendation is to form the HMPC with five members of the Stormwater Drainage Advisory Board and five members of the Executive Board of the Tulsa Project Impact Foundation, a non-profit corporation.

BUDGET: **FINANCE DIRECTOR APPROVAL:**

No budget impact.

Approved By City Council On JAN 3 1 2002

REQUEST FOR ACTION: All department items requiring Council approval must be submitted through Mayor's Office.

Please approve and sign the proposed resolution and return all copies to Mike L. Buchert, Room 512, City Hall.

PLH

DEPARTMENT HEAD APPROVAL: MB Charles Landt **DATE:** 1/3/02

ATTORNEY APPROVAL: (M. SWINEY) 1-16-02

BOARD APPROVAL: 1-17-02

MAYORAL APPROVAL: M. Susan Savage JAN 24 2002

OTHER:

APPROVED BY CITY OF TULSA FEB - 4 2002

02-58

FOR CITY COUNCIL OFFICE USE: **DATE RECEIVED:** 1-24-02 **APPROVED:** JAN 3 1 2002

FIRST AGENDA DATE: 1-31-02 **SECOND AGENDA DATE:** N/A

HEARING: PW 1-29-02 **ORDINANCE/RESOLUTION:**

(Published in the Tulsa Daily Commerce and Legal News,
February 8, 2002,
Retherford Publications, Inc.)

RESOLUTION 6840

A RESOLUTION REQUESTING THE CREATION OF A HAZARD MITIGATION PLANNING COMMITTEE, AND PROVIDING FOR THE COMPOSITION OF SAID COMMITTEE; STATING THE DUTIES OF SAID COMMITTEE; REQUESTING THAT CITY DEPARTMENTS AND EMPLOYEES ASSIST SAID COMMITTEE; AND DECLARING AN EMERGENCY.

WHEREAS, the City of Tulsa and its residents are subject to danger and damage from flood, tornadoes, fire, high winds, lightning, storms and other natural hazards; and

WHEREAS, the Federal Emergency Management Agency (FEMA) administers a Community Rating System (CRS) which confers credits and other benefits on communities that adopt hazard mitigation plans; and

WHEREAS, the City of Tulsa created the Stormwater Drainage Advisory Board (Title 11-A, Tulsa Revised Ordinances, Section 104) to provide public input and awareness, and policy guidance to the City in the area of flood-control; and

WHEREAS, the City of Tulsa passed a resolution in 1998 (amended September 5, 2000) to participate in the Federal "Project Impact" initiative to build a disaster-resistant community in cooperation with other governmental and non-governmental agencies, citizens, corporations and organizations (Resolution No. 19348); and

WHEREAS, Article III of the Amended Charter of the City of Tulsa, Section 1.4, sub-sections G and O, charges the Mayor with control and supervision of boards and agencies and the administration of civil defense and emergency services;

NOW THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF TULSA:

Section 1. The Mayor is hereby requested to create a Hazard Mitigation Planning Committee (HMPC), to be composed of ten (10) members, namely: five (5) members *ex officio* of the Stormwater Drainage Advisory Board, and five (5) members *ex officio* of the Executive Board of the Tulsa Project Impact Foundation, a non-profit corporation.

5d

Section 2. The HMPC shall have the following duties:

A. Collect and organize data on natural hazards and their impact on life, safety and property.

B. Involve citizens, property owners, businesses, government agencies and other interested parties in the hazard mitigation and planning process.

C. Coordinate public and private hazard mitigation and planning efforts.

D. Initiate new hazard mitigation efforts, where appropriate.

E. Inform the public of HMPC activities, deliberations and recommendations.

F. Prepare and submit a recommended hazard mitigation plan and other measures to the Mayor and Council of the City of Tulsa by September 15, 2002.

Section 3. The Mayor is requested to assign City departments and employees to assist and support the HMPC.

Section 4. An emergency exists for the preservation of life, health and welfare, wherefore this Resolution shall take effect immediately upon its adoption and approval.

ADOPTED by the Council: JAN 3 1 2002.
Date

ADOPTED as an emergency measure: JAN 3 1 2002.
Date

Chairman of the Council

OFFICE OF THE MAYOR

Received by the Mayor: _____, at _____.
Date Time

M. Susan Savage, Mayor

By_____
Secretary

2.16.4

APPROVED by the Mayor of the City of Tulsa, Oklahoma: FEB - 4 2002,
Date

at 0900.
Time

M. Susan Savage
Mayor

(Seal)
ATTEST:

City Clerk

APPROVED:

City Attorney MDS

Public Works Department

Stormwater Drainage Advisory Board 1/17/02

Tulsa Project Impact Foundation

2165

REQUEST FOR ACTION

GENDA FOR: [X] MAYOR [X] COUNCIL AUTHORITY [ ] DATE: October 31, 2002

Tulsa City Clerk's Office: 596-7513 or 596-7514

FOR INFORMATION CONTACT:

DEPARTMENT: PUBLIC WORKS
CONTACT NAME: PAUL D. ZACHARY
ADDRESS: 2317 SOUTH JACKSON AVENUE
TELEPHONE: 596-9240 (KENNETH E. HILL)
TYPE: MULTI-HAZARD MITIGATION PLAN
AMOUNT: $0.00

UMMARY:

The Multi-Hazard Mitigation Plan for the City of Tulsa is presented in fulfillment of requirements of the Hazard Mitigation rant Program (HMGP) for the Federal Emergency Management Agency (FEMA), according to the Stafford Disaster Relief d Emergency Assistance Act (Public Law 93-288), Title 42 United States Code (U.S.C.). 5121 et seq., as amended and Title 4 Code of Federal Regulations (CFR), Subchapter D - Disaster Assistance, Subpart M - Hazard Mitigation Planning, Sections 6.400, et seq.

The purpose of this Plan is to assess ongoing mitigation activities in the community, identify and assess the hazards that ose a threat to citizens and property, evaluate additional mitigation measures that should be undertaken, and outline a rategy for implementation of mitigation projects.

The objective of this Plan is to provide guidance for community activities for the next five years and to ensure that the City Tulsa and other partners implement activities that are most effective and appropriate for mitigating natural hazards and azardous materials incidents.

By unofficial vote, the Hazard Mitigation Citizen Advisory Committee approved recommending adoption of the Plan by the ayor and City Council. A meeting isscheduled for November 6, 2002 for the formal vote.

UDGET: FINANCE DIRECTOR APPROVAL:

UNDING SOURCE(S): N/A at this time. Funding will be requested in subsequent budget years.

EQUEST FOR ACTION: *All department items requiring Council approval must be submitted through Mayor's Office.*

ec. mend Mayor and City Council approval of the Multi-Hazard Mitigation Plan and corresponding Resolution adopting said lan and direct departments to implement recommendations. Please return one executed copy to the Public Works epartment, 2317 South Jackson Avenue, Room S-312, Tulsa, Oklahoma 74107.

KEH
KEH:BSS:aik

ttachments (10/31/02)

DEPARTMENT HEAD APPROVAL: Charles Hardt DATE: 10/31/02

CITY ATTORNEY APPROVAL: Patrick H. Boulds DATE: 11-14-2002

BOARD APPROVAL: DATE: DEC 9 - 2002

MAYORAL APPROVAL: Stephen L. Sewell PRO-TEM DATE: NOV 14 2002

OTHER: DATE:

Approved By City Council On DEC 05 2002

FOR CITY COUNCIL OFFICE USE ONLY: 02-596-3 DATE RECEIVED: 11-14

COMMITTEE: PW COMMITTEE DATE(S): 11-17 FIRST AGENDA DATE: 11-21

HEARING DATE: N/A SECOND AGENDA DATE: N/A APPROVED DEC 05 2002

For City Clerk's Office Use Only (Agenda Date: MMDDYYYY; Sec #, Dept ##, Item ##, Sub-Item ##, Status: S=Synopsis):

wpdata\proiplan\Facilities\SafeSecureReportRFA

RESOLUTION NO. 7157

A RESOLUTION OF THE CITY OF TULSA, OKLAHOMA, ADOPTING AN ALL-HAZARD MITIGATION PLAN FOR THE CITY OF TULSA, OKLAHOMA; AND DECLARING AN EMERGENCY.

WHEREAS, the Multi-Hazard Mitigation Plan (the "Plan") for the City of Tulsa is presented in fulfillment of requirements of the Hazard Mitigation Grant Program (HMGP) for the Federal Emergency Management Agency (FEMA), according to the *Stafford Disaster Relief and Emergency Assistance Act* (Public Law 93-288), Title 42 United States Code (U.S.C.), §§5121 *et seq.*, as amended and Title 44 Code of Federal Regulations (CFR) , Subchapter D —Disaster Assistance, Subpart M —Hazard Mitigation Planning, Sections 206.400, *et seq.*; and

WHEREAS, The purpose of this Plan is to assess ongoing mitigation activities in the community, identify and assess the hazards that pose a threat to citizens and property, evaluate additional mitigation measures that should be undertaken, and outline a strategy for implementation of mitigation projects; and

WHEREAS, the objective of this Plan is to provide guidance for community activities for the next five years and to ensure that the City of Tulsa and other partners implement activities that are most effective and appropriate for mitigating natural hazards and hazardous materials incidents.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY OF TULSA, OKLAHOMA:

Section 1. That the Multi-Hazard Mitigation Plan (the "Plan") for the City of Tulsa, presented in fulfillment of requirements of the Hazard Mitigation Grant Program (HMGP) for the Federal Emergency Management Agency (FEMA), according to the *Stafford Disaster Relief and Emergency Assistance Act* (Public Law 93-288), Title 42 United States Code (U.S.C.), §§5121 *et seq.*, as amended and Title 44 Code of Federal Regulations (CFR), Subchapter D —Disaster Assistance, Subpart M —Hazard Mitigation Planning, Sections 206.400, *et seq.*, is hereby approved and adopted by the City of Tulsa, Oklahoma.

Section 2. That the Plan approved and adopted by this Resolution is more particularly described as a compilation labeled "City of Tulsa, Oklahoma Multi-Hazard Mitigation Plan", dated November 25, 2002, Chapters One (1) through Six (6), including Appendices 'A' through 'L', and the Table of Contents of which is attached to this Resolution as Exhibit 'A'.

Section 3. *Emergency Clause.* That an emergency is hereby declared to exist for the preservation of the public peace, health and safety, by reason whereof this Resolution shall take effect immediately from and after its passage and approval.

2.105

ADOPTED, and emergency clause ruled upon separately and **APPROVED** 5 day of ~~November~~ December 2002.

Chairman of the Council

APPROVED by the Mayor of the City of Tulsa, Oklahoma, this DEC 09 2002 day of ~~November~~ 2002 at 0900 o'clock _____.m.

Mayor PRO-TEM

ATTEST:

City Clerk

APPROVED:

City Attorney

1.16.1

REQUEST FOR ACTION

AGENDA FOR: [X] MAYOR [X] COUNCIL AUTHORITY [ ] DATE: October 31, 2002

Tulsa City Clerk's Office: 596-7513 or 596-7514

FOR INFORMATION CONTACT:

DEPARTMENT: PUBLIC WORKS
ADDRESS: 2317 SOUTH JACKSON AVENUE
TYPE: MULTI-HAZARD MITIGATION PLAN

CONTACT NAME: PAUL D. ZACHARY
TELEPHONE: 596-9240 (KENNETH E. HILL)
AMOUNT: $0.00

SUMMARY:

The Multi-Hazard Mitigation Plan for the City of Tulsa is presented in fulfillment of requirements of the Hazard Mitigation Grant Program (HMGP) for the Federal Emergency Management Agency (FEMA), according to the Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), Title 42 United States Code (U.S.C.). 5121 et seq., as amended and Title 44 Code of Federal Regulations (CFR), Subchapter D - Disaster Assistance, Subpart M - Hazard Mitigation Planning, Sections 206.400, et seq.

The purpose of this Plan is to assess ongoing mitigation activities in the community, identify and assess the hazards that pose a threat to citizens and property, evaluate additional mitigation measures that should be undertaken, and outline a strategy for implementation of mitigation projects.

The objective of this Plan is to provide guidance for community activities for the next five years and to ensure that the City of Tulsa and other partners implement activities that are most effective and appropriate for mitigating natural hazards and hazardous materials incidents.

By unofficial vote, the Hazard Mitigation Citizen Advisory Committee approved recommending adoption of the Plan by the Mayor and City Council. A meeting isscheduled for November 6, 2002 for the formal vote.

BUDGET: FINANCE DIRECTOR APPROVAL:

FUNDING SOURCE(S): N/A at this time. Funding will be requested in subsequent budget years.

REQUEST FOR ACTION: *All department items requiring Council approval must be submitted through Mayor's Office.*

Recommend Mayor and City Council approval of the Multi-Hazard Mitigation Plan and corresponding Resolution adopting said plan and direct departments to implement recommendations. Please return one executed copy to the Public Works Department, 2317 South Jackson Avenue, Room S-312, Tulsa, Oklahoma 74107.

KEH
KEH:BSS:aik

Attachments (10/31/02)

DEPARTMENT HEAD APPROVAL: Charles Hardt DATE: 10/31/02

CITY ATTORNEY APPROVAL: Patrick A. Boulds DATE: 11-14-2002

BOARD APPROVAL: DATE:

MAYORAL APPROVAL: Stephen L. Swell PRO-TEM DATE: NOV 14 2002

OTHER: DATE:

FOR CITY COUNCIL OFFICE USE ONLY: DATE RECEIVED:

COMMITTEE: COMMITTEE DATE(S): FIRST AGENDA DATE:

HEARING DATE: SECOND AGENDA DATE: APPROVED:

For City Clerk's Office Use Only (Agenda Date: MMDDYYYY; Sec #, Dept ##, Item ##, Sub-Item ##, Status: S=Synopsis):

wpdata\projplan\Facilities\SafeSecureReportRFA

Resolution 3b

REQUEST FOR ACTION: ~~ORDINANCE~~

AGENDA FOR: [X] MAYOR [X] COUNCIL AUTHORITY: [ ] DATE: November 26, 2002

Tulsa City Clerk's Office: 596-7513 or 596-7514

FOR INFORMATION CONTACT:

DEPARTMENT: TMAPC CONTACT NAME: Dane Matthews

ADDRESS: 201 West 5th, Suite 600, Tulsa, OK 74103 TELEPHONE: (918) 584-7526

ORDINANCE TYPE: OTHER BA or CT #:

SUBJECT:

AMENDMENT OF ORD#: TRO TITLE: TRO SUBTITLE: PLANNING DISTRICT:

ZONING #: SSID #: PUD #: PROP/NON-PROP: COUNCIL DISTRICT:

SUMMARY:

Resolution No. 2327:846

Applicant: TMAPC

RESOLUTION NO. 7160

Summary: A resolution amending the Comprehensive Plan for the Tulsa Metropolitan Area by adopting the Multi-Hazard Mitigation Plan for the City of Tulsa.

Approved By City Council On DEC 12 2002

RECEIVED ON DEC 06 2002 BY CITY COUNCIL

BUDGET: FINANCE DIRECTOR APPROVAL:

FUNDING SOURCE: N/A

REQUEST FOR ACTION: *All department items requiring Council approval must be submitted through the Mayor's Office.*

TMAPC voted 9-0-0 to recommend the City Council approve Resolution No. 2327:846 amending the Comprehensive Plan for the Tulsa Metropolitan Area, by adopting the Multi-Hazard Mitigation Plan for the City of Tulsa.

DEPARTMENT HEAD APPROVAL:
CITY ATTORNEY APPROVAL:
BOARD APPROVAL:
MAYORAL APPROVAL:
OTHER:

APPROVED BY MAYOR CITY OF TULSA DEC 16 2002

DATE:

FOR CITY COUNCIL OFFICE USE ONLY: 97-206-26 DATE RECEIVED: 12-6-02

COMMITTEE: WED COMMITTEE DATE(S): 12-10-02 FIRST AGENDA DATE:

HEARING DATE: NA SECOND AGENDA DATE: APPROVED DEC 12 2002

For City Clerk's Office Use Only (Agenda Date: MMDDYYYY; Sec #; Dept ##, Item ##, Sub-Item ##, Status: S=Synopsis):

12-16-2002	2	18	1		

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RESOLUTION NO.: 2327:846

A RESOLUTION AMENDING THE COMPREHENSIVE PLAN FOR THE TULSA METROPOLITAN AREA, BY ADOPTING THE MULTI-HAZARD PLAN FOR THE CITY OF TULSA

WHEREAS, Pursuant to Title 19, OSA, Section 863.7, the Tulsa Metropolitan Area Planning Commission (TMAPC) did, by Resolution on the 29th day of June 1960, adopt a Comprehensive Plan for the Tulsa Metropolitan Area, which Plan was subsequently approved by the Mayor and Board of Commissioners of the City of Tulsa, Oklahoma, and by the Board of County Commissioners of Tulsa County, Oklahoma, and was filed of record in the Office of the County Clerk, Tulsa, Oklahoma, all according to law; and

WHEREAS, the TMAPC is required to prepare, adopt and amend, as needed, in whole or in part, an official Master Plan to guide the physical development of the Tulsa Metropolitan Area; and

WHEREAS, a public hearing was held on the 13th day of November, 2002 and after due study and deliberation, this Commission deems it advisable and in keeping with the purpose of this Commission, as set forth in Title 19, OSA, Section 863.7, to adopt the Multi-Hazard Mitigation Plan for the City of Tulsa as a part of the Comprehensive Plan of the Tulsa Metropolitan Area;

NOW, THEREFORE, BE IT RESOLVED by the TMAPC, that the adoption of the Multi-Hazard Mitigation Plan, as set out above, be and is hereby adopted as part of the Comprehensive Plan for the Tulsa Metropolitan Area.

DATED this 13 day of NOVEMBER, 2002.

TULSA METROPOLITAN AREA PLANNING COMMISSION

Chair

ATTEST:

Mary E. Lill

Secretary

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RESOLUTION NO.: 2327:846

APPROVED by the City Council of the City of Tulsa, Oklahoma this 12 day of December, 2002.

Mayor

Council Chair

ATTEST:

DEPUTY City Clerk

APPROVED AS TO FORM:

City Attorney

Appendix A:

Glossary of Hazard Mitigation Terms

Glossary of Terms

***Anchoring*:** Special connections made to ensure that a building will not float off, blow off or be pushed off its foundation during a flood or storm.

***Base Flood*:** Flood that has a 1 percent probability of being equaled or exceeded in any given year. Also known as the 100-year flood.

***Base Flood Elevation (BFE)*:** Elevation of the base flood in relation to a specified datum, such as the National Geodetic Vertical Datum of 1929. The Base Flood Elevation is used as the standard for the National Flood Insurance Program.

***Basement*:** Any floor level below grade.

***Bedrock*:** The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

***Building*:** A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.

***Community Rating System (CRS)*:** A National Flood Insurance Program (NFIP) that provides incentives for NFIP communities to complete activities that reduce flood hazard risk. When the community completes specified activities, the insurance premiums of policyholders in these communities are reduced.

***Computer-Aided Design And Drafting (CADD)*:** A computerized system enabling quick and accurate electronic 2-D and 3-D drawings, topographic mapping, site plans, and profile/cross-section drawings.

***Consequences*:** The damages, injuries, and loss of life, property, environment, and business that can be quantified by some unit of measure, often in economic or financial terms.

***Contour*:** A line of equal ground elevation on a topographic (contour) map.

***Critical Facility*:** Facilities that are critical to the health and welfare of the population and that are especially important during and following hazard events. Critical facilities include shelters, police and fire stations, schools, childcare centers, senior citizen centers, hospitals, disability centers, vehicle and equipment storage facilities, emergency operations centers, and city hall. The term also includes buildings or locations that, if damaged, would create secondary disasters, such as hazardous materials facilities, vulnerable facilities, day care centers, nursing homes, and housing likely to contain occupants who are not very mobile. Other critical city infrastructure such as telephone exchanges and water treatment plants are referred to as lifelines. See Lifelines.

***Dam Breach Inundation Area*:** The area flooded by a dam failure or programmed release.

***Debris*:** The scattered remains of assets broken or destroyed in a hazard event. Debris caused by a wind or water hazard event can cause additional damage to other assets.

***Development*:** Any man-made change to real estate.

***Digitize*:** To convert electronically points, lines, and area boundaries shown on maps into x, y coordinates (e.g., latitude and longitude, universal transverse mercator (UTM), or table coordinates) for use in computer applications.

***Duration*:** How long a hazard event lasts.

***Earthquake*:** A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of earth's tectonic plates.

***Emergency*:** Any hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, drought, fire, explosion, or other catastrophe in any part of the United States which requires federal emergency assistance to supplement State and local efforts to save lives and protect property, public health and safety, or to avert or lessen the threat of a disaster. Defined in Title V of Public Law 93-288, Section 102(1).

***Emergency Operations Center (EOC)*:** A facility that houses communications equipment that is used to coordinate the response to a disaster or emergency.

***Emergency Operations Plan (EOP)*:** Sets forth actions to be taken by State or local governments for response to emergencies or major disasters.

***Emergency Response Plan*:** A document that contains information on the actions that may be taken by a governmental jurisdiction to protect people and property before, during, and after a disaster.

***Extent*:** The size of an area affected by a hazard or hazard event.

***Fault*:** A fracture in the continuity of a rock formation caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are differentially displaced parallel to the plane of fracture.

***Federal Emergency Management Agency (FEMA)*:** The independent agency created in 1978 to provide a single point of accountability for all Federal activities related to disaster mitigation and emergency preparedness, response and recovery.

***FIPS*:** Stands for Federal Information Processing Standards. Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the National Institute of Standards and Technology (NIST)

for Federal computer systems. These standards and guidelines are issued by NIST as Federal Information Processing Standards (FIPS) for use government-wide. NIST develops FIPS when there are compelling Federal government requirements such as for security and interoperability and there are no acceptable industry standards or solutions.

***Fire Potential Index (FPI)*:** Developed by United States Geological Survey (USGS) and United States Forest Service (USFS) to assess and map fire hazard potential over broad areas. Based on such geographic information, national policy makers and on-the-ground fire managers established priorities for prevention activities in the defined area to reduce the risk of managed and wildfire ignition and spread. Prediction of fire hazard shortens the time between fire ignition and initial attack by enabling fire managers to pre-allocate and stage suppression forces to high fire risk areas.

***Flash Flood*:** A flood event occurring with little or no warning where water levels rise at an extremely fast rate.

***Flood*:** A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.

***Flood Depth*:** Height of the flood water surface above the ground surface.

***Flood Elevation*:** Elevation of the water surface above an established datum, e.g. National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or Mean Sea Level.

***Flood Hazard Area*:** The area shown to be inundated by a flood of a given magnitude on a map.

***Flood Insurance Rate Map (FIRM)*:** Map of a community, prepared by the Federal Emergency Management Agency, which shows both the special flood hazard areas and the risk premium zones applicable to the community.

***Flood Insurance Study (FIS)*:** A study that provides an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations in a community or communities.

***Flood Mitigation Assistance Program (FMA)*:** A planning and project implementation grant program funded by the National Flood Insurance Program. Provides pre-disaster grants to State and local governments for both planning and implementation of mitigation strategies. Grant funds are made available from NFIP insurance premiums, and therefore are only available to communities participating in the NFIP.

***Flood of Record*:** The highest known flood level for the area, as recorded in historical documents.

***Floodplain*:** Any land area, including watercourse, susceptible to partial or complete inundation by water from any source.

***Floodproofing*:** Protective measures added to or incorporated in a building to prevent or minimize flood damage. "Dry floodproofing" measures are designed to keep water from entering a building. "Wet floodproofing" measures minimize damage to a structure and its contents from water that is allowed into a building.

***Floodway*:** The stream channel and that portion of the adjacent floodplain which must remain open to permit conveyance of the base flood. Floodwaters are generally the swiftest and deepest in the floodway. The floodway should remain clear of buildings and impediments to the flow of water.

***Freeboard*:** A margin of safety added to a protection measure to account for waves, debris, miscalculations, lack of scientific data, floodplain fill, or upstream development.

***Frequency*:** A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1 percent chance – its probability – of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered.

***Fujita Scale of Tornado Intensity*:** Rates tornadoes with numeric values from F0 to F5 based on tornado wind speed and damage sustained. An F0 indicates minimal damage such as broken tree limbs or signs, while an F5 indicates severe damage sustained.

***Functional Downtime*:** The average time (in days) during which a function (business or service) is unable to provide its services due to a hazard event.

***Geographic Area Impacted*:** The physical area in which the effects of the hazard are experienced.

***Geographic Information System (GIS)*:** A computer software application that relates physical features on the earth to a database to be used for mapping and analysis.

***Ground Motion*:** The vibration or shaking of the ground during an earthquake. When a fault ruptures, seismic waves radiate, causing the ground to vibrate. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter, but soft soils can further amplify ground motions.

***Hazard*:** A source of potential danger or adverse condition. An event or physical condition that has the potential to cause fatalities, injuries, property and infrastructure damage, agriculture loss, damage to the environment, interruption of business, or other types of harm or loss. Hazards, as defined in this study, will include naturally occurring events such as floods, dam failures, levee failures, tornadoes, high winds, hailstorms, lightning, winter storms, extreme heat, drought,

expansive soils, urban fires, wildfires that strike populated areas, and earthquakes. A natural event is a hazard when it has the potential to harm people or property. For purposes of this study, hazardous materials events are also included.

***Hazard Event*:** A specific occurrence of a particular type of hazard.

***Hazard Identification*:** The process of defining and describing a hazard, including its physical characteristics, magnitude and severity, probability and frequency, causative factors, and locations or areas affected.

***Hazard Mitigation*:** Sustained actions taken to reduce or eliminate long-term risk to human life and property from natural and technological hazards and their effects. Note that this emphasis on long-term risk distinguishes mitigation from actions geared primarily to emergency preparedness and short-term recovery.

***Hazard Mitigation Grant Program (HMGP)*:** Authorized under Section 404 of the Stafford Act; a FEMA disaster assistance grant program that funds mitigation projects in conformance with post-disaster mitigation plans required under Section 409 of the Stafford Act. The program is available only after a Presidential disaster declaration.

***Hazard Mitigation Plan*:** The plan resulting from a systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards present in society that includes the actions needed to minimize future vulnerability to hazards. Section 409 of the Stafford Act requires the identification and evaluation of mitigation opportunities, and that all repairs be made to applicable codes and standards, as condition for receiving Federal disaster assistance. Enacted to encourage identification and mitigation of hazards at all levels of government.

***Hazard Profile*:** A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.

***HAZUS (Hazards U.S.)*:** A GIS-based nationally standardized earthquake loss estimation tool developed by FEMA.

***Hydrology*:** The science of dealing with the waters of the earth. A flood discharge is developed by a hydrologic study.

***Infrastructure*:** The public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or Internet access, vital services such as public water supplies and sewer treatment facilities, and includes an area's transportation system such as airports, heliports; highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots, and waterways, canals, locks, and regional dams.

***Insurance Service Office, Inc. (ISO)*:** An insurance organization that administers several programs that rate a community's hazard mitigation activities.

***Intensity*:** A measure of the effects of a hazard event at a particular place.

***Landslide*:** Downward movement of a slope and materials under the force of gravity.

***Lifelines*:** Transportation and utility systems that are essential to the function of a region and to the well being of its inhabitants. Transportation systems include highways, air, rail, and waterways, ports, and harbors. Utility systems include electric power, gas and liquid fuels, telecommunications, water, and wastewater.

***Liquefaction*:** The phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.

***Lowest Floor*:** Under the NFIP, the lowest floor of the lowest enclosed area (including basement) of a structure.

***Magnitude*:** A measure of the strength of a hazard event. The magnitude (also referred to as severity) of a given hazard event is usually determined using technical measures specific to the hazard.

***Mitigation*:** Sustained action taken to reduce or eliminate the long-term risk to human life and property from natural and technological hazards and their effects. Note that this emphasis on long-term risk distinguishes mitigation from actions geared primarily to emergency preparedness and short-term recovery (Burby, 1998).

***National Flood Insurance Program (NFIP)*:** A federal program created by Congress in 1968 that provides the availability of flood insurance to communities in exchange for the adoption and enforcement of a minimum floodplain management ordinance specified in 44 CFR §60.3. The ordinance regulates new and substantially damaged or improved development in identified flood hazard areas.

***National Geodetic Vertical Datum of 1929 (NGVD)*:** Datum established in 1929 and used in the NFIP as a basis for measuring flood, ground, and structural elevations, previously referred to as Sea Level Datum or Mean Sea Level. The Base Flood Elevations shown on most of the Flood Insurance Rate Maps issued by the Federal Emergency Management Agency are referenced to NGVD.

***National Weather Service (NWS)*:** Prepares and issues flood, severe weather, and coastal storm warnings and can provide technical assistance to Federal and state entities in preparing weather and flood warning plans.

***Oklahoma Department of Civil Emergency Management (ODCEM)*:** The State department responsible for hazard mitigation, community preparedness, emergency response, and disaster recovery.

***Oklahoma Water Resources Board (OWRB)*:** The State agency responsible for administration of the National Flood Insurance Program, and the dam safety program.

***Planimetric*:** Describes maps that indicate only man-made features like buildings.

***Planning*:** The act or process of making or carrying out plans; the establishment of goals, policies and procedures for a social or economic unit.

***Planning for Post-Disaster Reconstruction*:** The process of planning (preferably prior to an actual disaster) those steps the community will take to implement long-term reconstruction with one of the primary goals being to reduce or minimize its vulnerability to future disasters. These measures can include a wide variety of land-use planning tools, such as acquisition, design review, zoning, and subdivision review procedures. It can also involve coordination with other types of plans and agencies but is distinct from planning for emergency operations, such as restoration of utility services and basic infrastructure.

***Preparedness*:** Activities to ensure that people are ready for a disaster and respond to it effectively. Preparedness requires figuring out what will be done if essential services break down, developing a plan for contingencies, and practicing the plan.

***Probability*:** A statistical measure of the likelihood that a hazard event will occur.

***Project Impact*:** A program that encourages business, government agencies and the public to work together to build disaster-resistant communities.

***Reconstruction*:** The long-term process of rebuilding the community's destroyed or damaged buildings, public facilities, or other structures.

***Recovery*:** The process of restoring normal public or utility services following a disaster, perhaps starting during but extending beyond the emergency period to that point when the vast majority of such services, including electricity, water, communications, and public transportation have resumed normal operations. Recovery activities necessary to rebuild after a disaster include rebuilding homes, businesses and public facilities, clearing debris, repairing roads and bridges, and restoring water, sewer and other essential services. Short-term recovery does not include the reconstruction of the built environment, although reconstruction may commence during this period.

***Recurrence Interval*:** The time between hazard events of similar size in a given location. It is based on the probability that the given event will be equaled or exceeded in any given year.

***Repetitive Loss Property*:** A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1000 each have been paid within any 10-year period since 1978. While Repetitive Loss Properties constitute only 2% of insured properties, they account for 40% of flood damage claims against the NFIP.

***Replacement Value*:** The cost of rebuilding a structure. This is usually expressed in terms of cost per square foot, and reflects the present-day cost of labor and materials to construct a building of a particular size, type and quality.

***Retrofitting*:** Modifications to a building or other structure to reduce its susceptibility to damage by a hazard.

***Richter Scale*:** A numerical scale of earthquake magnitude devised by seismologist C.F. Richter in 1935.

***Risk*:** The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

***Risk Assessment*:** A process or method for evaluating risk associated with a specific hazard and defined in terms of probability and frequency of occurrence, magnitude and severity, exposure and consequences. Also defined as: "The process of measuring the potential loss of life, personal property, housing, public facilities, equipment, and infrastructure; lost jobs, business earnings, and lost revenues, as well as indirect losses caused by interruption of business and production; and the public cost of planning, preparedness, mitigation, response, and recovery. (Burby, 1998).

***Riverine*:** Of or produced by a river.

***Scale*:** A proportion used in determining a dimensional relationship; the ratio of the distance between two points on a map and the actual distance between the two points on the earth's surface.

***Scarp*:** A steep slope.

***Scour*:** Removal of soil or fill material by the flow of flood waters. The term is frequently used to describe storm-induced, localized conical erosion around pilings and other foundation supports where the obstruction of flow increases turbulence.

***Seismicity*:** Describes the likelihood of an area being subject to earthquakes.

***Special Flood Hazard Area (SFHA)*:** An area within a floodplain having a 1 percent or greater chance of flood occurrence in any given year (100-year floodplain); represented on Flood Insurance Rate Maps by darkly shaded areas with zone designations that include the letter A or V.

***Stafford Act*:** The Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-107 was signed into law November 23, 1988 and amended the Disaster Relief Act of 1974, PL 93-288. The Stafford Act is the statutory authority for most Federal disaster response activities, especially as they pertain to FEMA and its programs.

***State Hazard Mitigation Team*:** Composed of key State agency representatives, the team evaluates hazards, identifies strategies, coordinates resources, and implements measures that will reduce the vulnerability of people and property to damage from hazards. The Oklahoma State Hazard Mitigation Team is convened by the Oklahoma Department of Civil Emergency Management (ODCEM), and includes the State departments of Agriculture, Climatological Survey, Commerce, Environmental Quality, Health, Human Services, Insurance, Transportation, Wildlife Conservation, Conservation Commission, Corporation Commission, Historical Society, Insurance Commission, Water Resources Board, Association of County Commissioners (AACCO), Oklahoma Municipal League (OML), Department of Housing and Urban Development (HUD), and the U.S. Army Corps of Engineers (USACE).

***State Hazard Mitigation Officer (SHMO)*:** The representative of state government who is the primary point of contact with FEMA, other state and Federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities.

***Stormwater Management*:** Efforts to reduce the impact of stormwater or snowmelt runoff on flooding and water quality.

***Stormwater Detention*:** The storing of stormwater runoff for release at a restricted rate after the storm subsides, or the flood crest passes.

***Substantial Damage*:** Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage.

***Surface Faulting*:** The differential movement of two sides of a fracture – in other words, the location where the ground breaks apart. The length, width, and displacement of the ground characterize surface faults.

***Tectonic Plate*:** Torsionally rigid, thin segments of the earth's lithosphere that may be assumed to move horizontally and adjoin other plates. It is the friction between plate boundaries that cause seismic activity.

***Topographic*:** Characterizes maps that show natural features and indicate the physical shape of the land using contour lines. These maps may also include man-made features.

***Tornado*:** A violently rotating column of air extending from a thunderstorm to the ground.

***Vulnerability*:** Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power – if an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct ones.

***Vulnerability Assessment*:** The extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard events on the existing and future built environment.

***Wildfire*:** An uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures.

***Zone*:** A geographical area shown on a Flood Insurance Rate Map (FIRM) that reflects the severity or type of flooding in the area.

Appendix B:

Stormwater Capital Improvements Projects

Appendix B

PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
High Priority								
Dirty Butter Creek	DB2	22.0	High	$ 150	ACQUISITION OF TWO HOUSES BETWEEN APACHE AND MOHAWK	MAINSTEM FROM CONFLUENCE WITH RB1 (DB5) TO CONFLUENCE WITH LB2 (DB12) AT CRAWFORD PARK		
Swan Creek & Travis Park	SW3	22.0	High	$ 65	REPLACE ALL STORM SEWER INLETS AND INLET PIPES ALONG MAIN STORM SEWER TRUNK LINE	SWAN CREEK FROM PEORIA TO DOWNSTREAM OF UTICA WOODWARD PARK REACH		
Center Creek	CT1B	19.0	High	$ 116	ONE ACQUISITION	CENTER CREEK MAINSTEM UPSTREAM FROM 177TH E. AVENUE		
Upper Middle Mingo Creek	MUM6C&D	19.0	High	$ 135	NEW LARGE INLET WITH 130 LINEAR FEET OF 8 X 5 RCB AND PURCHASE ONE HOUSE; RETAINING WALL ON EASTLAND ACRES PARKING LOT	UPSTREAM OF LAST FMA (MUM6C) ON TRIBUTARY FROM THE MALL		
Nickel Creek	NI16	18.0	High	$ 85	FLOODPROOF TWO HOUSES	LOWER HALF OF REACH NB-1		
Swan Creek & Travis Park	SW2	17.0	High	$ 138	REPLACE ALL STORM SEWER INLETS AND INLET PIPES ALONG MAIN STORM SEWER TRUNK LINE	SWAN CREEK MAINSTEM FROM RAIL ROAD TO PEORIA - SUNSET TERRACE REACH		
Nickel Creek	NI8	16.0	High	$ 48	ONE HOUSE TO BE FLOODPROOFED	REACH NC-1		
Lower Middle Mingo Creek	MLM5G	14.0	High	$ 146	129TH EAST AVENUE BRIDGE REPLACEMENT	FROM UPSTREAM OF TMS-6 TO UPSTREAM OF TMS-7		
Lower Middle Mingo Creek	MLM5E	13.0	High	$ 146	21ST STREET BRIDGE REPLACEMENT	MAINSTEM AT 21ST STREET BRIDGE		
Nickel Creek	NI15	12.0	High	$ 134	ACQUIRE ONE HOUSE	NA-1 ON THE MAINSTEM OF NICKEL CREEK		
Swan Creek & Travis Park	SW4	12.0	High	$ 198	REPLACE INLETS, REPLACE "HYDRAULIC CONSTRICTION" AT UTICA AND ACQUISITION OF ONE HOUSE 1717 EAST 17TH	BUNGALOW RANCH - SWAN CREEK FROM DOWNSTREAM OF UTICA UPSTREAM		
Coal Creek	CL7A	11.0	High	$ 75	NEWTON STREET CROSSING $0.05M	LB1 FROM CONFLUENCE TO UPSTREAM OF NEWTON STREET CROSSING		
Nickel Creek	NI11	11.0	High	$ 102	PROPOSED CROSSING REPLACEMENT AT WEST 78TH STREET	REACH NF-2		
Lower Middle Mingo Creek	MLM2H	10.0	High	$ 319	54"/ 60" RCP TO DEAL WITH STEET FLOODING	FULTON AND 15TH TO 14TH THEN WEST TO ERIE		
Parkview Creek	PV3	9.0	High	$ 155	LB-1 existing natural channel: Expressway Storage			
Coal Creek	CL3A	8.0	High	$ 224	COAL/RB1/RB2 CONFLUENCE ACQUISITION	RB1 TO CONFLUENCE WITH RB2		
Parkview Creek	PV8	8.0	High	$ 51	RB-2 Edison St. culvert			
Center Creek	CT8B	7.5	High	$ 230	4TH PLACE BRIDGE AND DOWNSTREAM CHANNEL	ROSE DEW CREEK FROM SOUTH SIDE OF ROSE DEW ADDITION 3RD TO NORTH OF 4TH PLACE BRIDGE	#348 ROSE DEW CHANNEL & CROSSING IMPROVEMENTS	MEDIUM/MEDIUM
Lower Mingo Creek	ML15B	7.5	High	$ 352	STRUCTURE #68 - REPLACE 2 - 6 X 6 X 70 RCB WITH 2 - 10 X 8 X 100 RCB ON MINGO ROAD - $144,500	LB4 FROM DOWNSTREAM OF MINGO ROAD UP		
Lower Middle Mingo Creek	MLM5C	7.5	High	$ 157	REPLACE FOOTBRIDGE WITH 2 - 12 X 10 RCB	TUPELO MAINSTEM FROM UPSTREAM OF 16TH STREET TO UPSTREAM OF THIS BRIDGE		
Coal Creek	CL4B	7.0	High	$ 105	2 RAILROAD CROSSINGS - (ASSUMES BAMA PIE STORAGE CONSTRUCTED BY PRIVATE DEVELOPERS)	NORTH RAILROAD CROSSING UP-STREAM TO PINE ON RB2	ANDERSON WATERLINE	
Crow Creek	CR9	7.0	High	$ 410	INSTALL 7 X 4 REINFORCED CONCRETE BOX OR EQUIVALENT AT BROKEN ARROW UNDERPASS	MAINSTEM UPSTREAM OF CONFLUENCE WITH LEFT BANK 3 TO CONFLUENCE WITH LEFT BANK 4 AND LEFT BANK 4		
Lower Mingo Creek	ML13	7.0	High	$ 133	REPLACE MINGO ROAD CROSSING SOUTH OF APACHE	AREA 5W		
Upper Middle Mingo Creek	MUM6A	7.0	High	$ 602	MAYO PLAZA STORM SEWER	BROOKHOLLOW MAINSTEM TO UPSTREAM OF STORM SEWER EAST OF 129TH EAST AVENUE		

Appendix B

PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Crow Creek	CR4	6.7	High	$ 249	GRASS-LINED CHANNEL AND FLOOD BERMS	MAINSTEM FROM ABOVE ROCKBRIDGE STORM SEWER TO 21ST STREET		
Upper Middle Mingo Creek	MUM2H	6.5	High	$ 191	2 OPEN CHANNELS AND 2 CULVERTS	EVERYTHING ABOVE DETENTION POND		
Swan Creek & Travis Park	SW6	6.5	High	$ 1,016	REPLACEMENT OF 48" REINFORCED CONCRETE PIPE WITH 96" REINFORCED CONCRETE PIPE AND REPLACE INLETS IMPROVE FLAP GATES AT OUTFALL	MIDDLE TRAVIS PARK RECOMMENDATIONS	RIVERSIDE, NOT FUNDED	HIGH/HIGH
Coal Creek	CL9B	6.4	High	$ 703	PROPOSED STORM SEWER FROM RAILROAD TO JUST UPSTREAM OF HARVARD	JUST UPSTREAM OF HARVARD TO RAILROAD		
Haikey Creek	HK9	6.0	High	$ 141	C12 INSTALL 2 - 10 X 8 REINFORCED CONCRETE BOXES	TRIBUTARY 2-2L1		
Parkview Creek	PV10	6.0	High	$ 112	HIGH SCHOOL CHANNEL			
Lower Middle Mingo Creek	MLM5F	5.7	High	$ 292	120TH E. PL. AND 121ST E. PL. BRIDGES SOUTH OF 21ST ST.	UPSTREAM OF 21ST ON MAINSTEM TO UPSTREAM OF TMS-6		
Little Joe Creek	LJ4	5.5	High	$ 196	ADD 2 8 X 6 REINFORCED CONCRETE BOXES TO EXISTING 2 8 X 6	UPSTREAM OF JOPLIN TO UPSTREAM OF 54TH STREET		
Haikey Creek	HK6B	5.2	High	$ 523	12 AF DETENTION POND	UPSTREAM FROM 71ST ON LITTLE HAIKEY		
Lower Middle Mingo Creek	MLM5A	5.2	High	$ 535	PAVED CHANNEL			
Lower Middle Mingo Creek	MLM5D	5.2	High	$ 696	21ST STREET DETENTION	TUPELO MAINSTEM FROM FOOTBRIDGE TO DOWNSTREAM OF 21ST STREET		
Crow Creek	CR15B	5.0	High	$ 329	NEW STORM SEWER UNDER EIGHT ACRES DEVELOPMENT AND RESTORE CHANNEL DOWNSTREAM	LEFT BANK 1 FROM UPSTREAM OF LEWIS UPSTREAM		
Fred Creek	FR7	5.0	High	$ 226	GRASS-LINED CHANNEL - REPLACE PITTSBURG AND KNOXVILLE CROSSINGS	MAINSTEM FROM ABOVE HARVARD THROUGH PITTSBURG + PEBBLE CREEK TO NORTH OF 71ST		
Haikey Creek	HK21	5.0	High	$ 158	PROJECT SS1 54" REINFORCED CONCRETE PIPE FROM 78TH STREET SOUTH TO LITTLE HAIKEY CREEK DOWNSTREAM OF THE 72ND EAST AVENUE CROSSING	TRIBUTARY 2 - 9R1		
Harlow Creek	HR5	5.0	High	$ 215	TR-2 private driveway: TR-2 Storage			
Harlow Creek	HR6	5.0	High	$ 4	Harlow Tributary floodproofing (1)			
Lower Mingo Creek	ML15A	5.0	High	$ 1,238	ACQUIRE 1225 N. MINGO ROAD -- $125,000	LB4 UP TO MINGO ROAD		
Lower Middle Mingo Creek	MLM7B	5.0	High	$ 41	CONSTRUCT TWO INLETS (EC 2A AND EC3) ALONG 129TH E. AVE.	EC TRIBUTARY FROM DOWN STREAM OF EC DETENTION POND TO UPSTREAM OF BOTH INLETS		
Mooser Creek	MO5	5.0	High	$ 274	PROPOSED CROSSING, FLOOD-PROOF TWO HOUSES	REACH MA-5 ON THE MAINSTEM		
Swan Creek & Travis Park	SW1	5.0	High	$ 168	INLET REPLACEMENTS, FLOOD BERM ALONG THE ARKANSAS, SPECIAL STORM SEWER INLET JUST WEST OF THE BICYCLE PATH	SWAN CREEK MAINSTEM FROM MOUTH TO THE RAILROAD - BLAIR ESTATES REACH -	RIVERSIDE IMPROVEMENTS - FY 2000	BANK STABILIZATION SANITARY SEWER - FY 1998
Dirty Butter Creek	DB3	4.9	High	$ 1,795	ACQUISITION OF 40 HOUSES	FROM CRAWFORD PARK TO OSAGE EXPRESSWAY DOWNSTREAM OF OSAGE DETENTION ON MAINSTEM.	LINCOLN-DUNBAR RE-DEVELOPMENT AREA	IN PROCESS OLD CITY WIDE PRIORITY 19
Upper Middle Mingo Creek	MUM2C	4.8	High	$ 804	FOLLOWS FMA ALIGNMENT - ALL STORM SEWERS	ALONG NORTH SIDE OF BLOCK 16, BOMAN ACRES FROM JOPLIN TO IRVINGTON, ALONG 28TH STREET WEST TO HUDSON PLACE NORTH ON HUDSON PLACE TO 27TH STREET + SMALL STORM SEWER BETWEEN LOTS 6 AND 7 BLOCK 10, BOMAN ACRES		

Appendix B

PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Coal Creek	CL4A	4.8	High	$ 673	LOWER CONDUIT TO OUTFALL $0.45M	RB2 FROM CONFLUENCE TO RR	ANDERSON WATERLINE	2001/2002
Lower Basin	LB2	4.8	High	$ 14,952	Verndale storage: 41st W. Ave Conduit & backup pump: 33rd W. Ave Storage: Madison School Storage: Hayden Lewis Stor: 33rd W. ave. & 5th Street Storm Sewer Imprv.			
Crow Creek	CR7	4.8	High	$ 351	PROPOSED 54" RCP	RIGHT BANK 1		
Coal Creek	CL1F	4.7	High	$ 1,534	NEW BRIDGE AT DAWSON ROAD, RAISE ROAD AND CHANNEL WORK UPSTREM AND DOWNSTREAM $1.03M (CHANNEL $0.49M)	HALF WAY BETWEEN DAWSON ROAD AND YALE TO UPSTREAM OF RAILROAD		
Crow Creek	CR17	4.7	High	$ 239	NEW PARALLEL STORM SEWER 31ST TO 33RD PLACE	LEFT BANK 0 ABOVE 31ST		
Lower Middle Mingo Creek	MLM8C	4.6	High	$ 639	8 X 4 RCB ALONG 18TH STREET FROM 125TH EAST PLACE TO 145TH EAST AVENUE	FROM UPSTREAM OF MLM8B TO 129TH EAST AVENUE		
Coal Creek	CL6	4.5	High	$ 1,000	LOUISVILLE HEIGHTS ACQUISITION $0.91M	LB0		
Coal Creek	CL9A	4.5	High	$ 374	LOUISVILLE AND MARION CROSSINGS $0.25M	TL1 BELOW CONFLUENCE OF TL1/TL2 UPSTREAM ALONG TL1 TO RR		
Coal Creek	CL9C	4.5	High	$ 897	GRASS-LINED CHANNEL FROM JUST UPSTREAM OF HARVARD TO EVANSTON	GRASS-LINED CHANNEL FROM JUST UPSTREAM OF HARVARD TO EVANSTON		
Parkview Creek	PV12	4.5	High	$ 157	Mainstem at 25th W. Ave. culvert: 24th W Ave Stor			
Parkview Creek	PV9	4.5	High	$ 426	RB-3 Edison St. culvert: RB-3 33rd W Ave Channel			
Harlow Creek	HR1	4.2	High	$ 627	Raise Harlow Creek levee, 4th W. Ave.			
Upper Mingo Creek	MU1A	4.2	High	$ 685	RAILROAD BRIDGE, US169 BRIDGE	MAINSTEM FROM BROKEN ARROW EXPRESSWAY THROUGH SOUTH BOUND US 169 BRIDGE		
Coal Creek	CL9D	4.1	High	$ 1,496	CELIA CLINTON DETENTION	TRIBUTARY FLOW APPROXIMATELY ABOVE GARY		
Coal Creek	CL1G	4.1	High	$ 1,858	RAISE PINE STREET DECK RAISE ROAD AND CHANNEL WORK 400' DOWNSTEAM (RAISING ROAD AND CHANNEL WORK $0.85M) TOTAL $1.24M	UPSTREAM OF RAILROAD (UPSTREAM OF DAWSON) TO CONFLUENCE WITH TL1	WATERLINE FUNDED 2001/2002	98HIGH/97LOW
Mooser Creek	MO6	4.1	High	$ 1,575	37TH WEST AVENUE CROSSING AND 57TH STREET CROSSING, 4' HIGH RETAINING WALL SOUTH BANK BETWEEN THE TWO, STREET IMPROVEMENTS AT 57TH STREET, 4 FLOOD-PROOFED BUILDINGS	REACH MA-6 ON MAINSTEM		
Center Creek	CT8C	4.0	High	$ 1,096	CONCRETE CHANNEL	ROSE DEW CREEK ABOVE 4TH PLACE BRIDGE	#348 ROSE DEW CHANNEL A& CROSSING IMPROVEMENTS	MEDIUM/MEDIUM $940
Flat Rock Creek	FL3C	4.0	High	$ 105	36th St. N. culvert	RB-1 (TRIB. A)		
Haikey Creek	HK23	4.0	High	$ 539	INSTALL A 48" REINFORCED CONCRETE PIPE STORM SEWER ALONG 77TH EAST AVENUE PROJECT STORM SEWER 3	TRIBUTARY 2-10L2		
Lower Mingo Creek	ML9	4.0	High	$ 1	RELOCATE OR ELEVATION ONE MOBILE HOME.			
Lower Middle Mingo Creek	MLM5H	4.0	High	$ 1,445	SMITTLE DETENTION	UPSTREAM OF 129TH EAST AVENUE ON MAINSTEM		
Lower Middle Mingo Creek	MLM8B	4.0	High	$ 733	8 X 4 RCB FROM JOHNSON A PARK TO 125TH EAST AVENUE AND 17TH - INCLUDES 2 ACQUISITIONS	UPPER END OF NEW 2 - 8 X 4 TO 125TH EAST AVENUE AND 17TH	JOHN ATELIER PARK IMPROVEMENTS	HIGH/HIGH -- $230,000
Oak Creek	OC4B	4.0	High	$ 909	MARSHALL STORAGE $703,000	DOWNSTREAM OF MARSHALL UPSTREAM TO TOP OF WATERSHED		
Parkview Creek	PV7	4.0	High	$ 573	Mainstem at Edison St. culvert			

Appendix B

PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Swan Creek & Travis Park	SW5	4.0	High	$ 1,906	DIVERSION STORM SEWER (96") WITH ONE ACQUISITION FOR RIGHT OF WAY REPLACE INLETS, IMPROVE FLAP GATES AT OUT FALL	TRAVIS PARK - NORTHERN RECOMMENDATION	RIVERSIDE - NOT FUNDED	HIGH/HIGH
TOTAL HIGH PRIORITY PROJECTS				**$ 48,972**				
Medium Priority								
Coal Creek	CL7B	3.9	Medium	$ 9,647	WAVERLY STORM SEWER DIVERSION, NEWTON/EXPRESSWAY STORAGE			
Coal Creek	CL10	3.9	Medium	$ 2,495	NEWTON CROSSING $0.125; MARSHALL/BURLINGTON STORAGE $1.1M AND BNRR CROSSING $? (USE $0.1m)	TL2		
Upper Middle Mingo Creek	MUM2A	3.9	Medium	$ 3,234	STORM SEWER/CULVERT FROM 67TH EAST PLACE TO SAME AS FMA DESCRIPTION	FROM 67TH EAST PLACE TO JOPLIN AVENUE ALONG 31ST TO SHERIDAN, NORTH TO 27TH, WEST TO NORWOOD THEN ALONG 27TH PLACE.	SHERIDAN AVENUE IMPROVEMENTS 21ST - 31ST $4.59M	
Lower Middle Mingo Creek	MLM8A	3.9	Medium	$ 1,609	2 - 8 X 5 RCB AT CONFLUENCE WITH TUPELO CREEK MAINSTEM - INCLUDES 2 ACQUISITIONS	FROM CONFLUENCE WITH TUPELO TO UPSTREAM END OF STORM SEWER		
Perryman Ditch	PE2	3.9	Medium	$ 2,088	Floodproofing 7 buildings and 25-year storm sewer	0		
Little Joe Creek	NLJ1	3.9	Medium	$ 1,485	LAFORTUNE GOLF COURSE DETENTION	CONFLUENCE WITH LITTLE JOE TO 51ST		
Lower Middle Mingo Creek	MLM8D	3.8	Medium	$ 532	HARVEY YOUNG DETENTION	ABOVE 129TH EAST AVENUE		
Perryman Ditch	PE8,9,10	3.8	Medium	$ 7,966	PEORIA AVENUE STORM SEWER AND LATERAL SEWER (25 YEAR PROTECTION)			
Center Creek	CT8A	3.8	Medium	$ 474	REGIONAL DETENTION FACILITY	ROSE DEW CREEK TO SOUTH SIDE OF ROSE DEW 3RD ADDITION		
Little Joe Creek	LJ6	3.8	Medium	$ 430	ADD ONE 8 X 4.5' REINFORCED CONCRETE BOX TO EXISTING 2 - 8 X 4.5	SHERIDAN TO UPSTREAM OF 67TH EAST AVENUE		
Vensel	VE7A	3.8	Medium	$ 350	SOUTH LOUISVILLE CROSSING	TRIBUTARY J TO ABOVE SOUTH LOUISVILLE		
Coal Creek	CL5A	3.7	Medium	$ 1,197	ROSE HILL STORAGE $0.8M	RB3 FROM MOUTH TO CROSSTOWN EXPRESSWAY		
Flat Rock Creek	FL7C	3.7	Medium	$ 1,286	56th St. N. grass lined channel: 56th St N bridge / culvert: 56th St. N bridge/ culvert tributary: Cincinnati Ave Bridge / culvert: Elgin Ave bridge / culvert	LB4		
Oak Creek	OC1	3.7	Medium	$ 1,409	ROSEDALE AVENUE STORM SEWER $1,103,000	ARKANSAS RIVER TO 1ST STREET		
Coal Creek	CL2A	3.7	Medium	$ 4,038	ADMIRAL PLACE TO INDEPENDENCE STORM SEWER IMPROVEMENTS	FROM CONFLUENCE WITH LB1\TL1 ON MAINSTEM TO TURNER PARK (CONFLUENCE WITH LB2)		
Coal Creek	CL8A	3.7	Medium	$ 6,282	STORM SEWERS TO 12TH STREET $4.2M	LB2 UPSTREAM TO 12TH STREET	HARVARD AVENUE UPGRADE 4TH - 11TH	MEDIUM/MEDIUM
Dirty Butter Creek	DB5C	3.7	Medium	$ 10,469	SPRINGDALE STORAGE, COMMERCIAL ACQUISITION, STORM SEWER PINE TO YOUNG.	US 75 TO UPSTREAM OF YOUNG ON RB1 (DB5)		
TOTAL MEDIUM PRIORITY PROJECTS				**$ 54,992**				

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PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Low Priority								
Lower Basin	LB1	3.7	Low	$ 21,205	Storage floodproofing at 65th W. Ave.: Sunset Acres West Stor: 61st W Ave conduit & backup pump: Sunset Acres East Stor: Mayfair Stor: Lawn Ridge Stor: Ex Turnaround Stor: Mayfair Channel: Turnaround Channel: North Lawn Ridge Channel: South Lawn Ridge Channel: Vern Heights Stor: Overflow Acq & Inlets			
Coal Creek	CL3B	3.7	Low	$ 2,288	(KINGSTON SUMP ACQUISITION DONE!) STORM SEWER - RAILROAD TO OUTFALL ($1.53M) INCLUDING INLET STRUCTURE AT SUMP (ALTERNATIVE 37)	CONFLUENCE WITH RB2 TO RAIL ROAD END		
Dirty Butter Creek	DB5A	3.7	Low	$ 1,018	MOHAWK BRIDGE AT RB1 (DB5)	RB1 FROM CONFLUENCE TO UPSTREAM OF MOHAWK BLVD.		
Haikey Creek	HK5C	3.7	Low	$ 258	C10 - 3 8 X 8 REINFORCED CONCRETE BOXES AT 72ND STREET SOUTH	UPSTREAM OF 74TH EAST AVENUE TO DOWNSTREAM OF 71ST ON LITTLE HAIKEY		
Little Joe Creek	LJ2	3.7	Low	$ 251	3-12 X 6 REINFORCED CONCRETE BOX (REPLACE EX)	CONFLUENCE WITH NORTHFORK TO UPSTREAM OF HUDSON		
Little Joe Creek	LJ3	3.7	Low	$ 285	REPLACE EXISTING WITH 35' SINGLE SPAN BRIDGE	UPSTREAM OF HUDSON TO UPSTREAM OF JOPLIN		
Lower Middle Mingo Creek	MLM2A	3.7	Low	$ 4,020	2 - 8 X 8 RCB; 2 - 8 X 5 RCB AND 2 - 8 X 4 RCB	UPSTREAM FROM MCCLURE PARK TO 67TH E. AVENUE AND 6TH STREET		
Parkview Creek	PV1	3.7	Low	$ 3,632	Newblock storm sewers: Charles Page Culvert: 33rd W Ave Storage: 25th W Ave Storage: Newblock berm North: Newblock berm South			
Parkview Creek	PV5	3.7	Low	$ 3,173	Easton St. storage			
Dirty Butter Creek	DB5B	3.6	Low	$ 1,944	GRASS-LINED CHANNEL, STORM SEWER AND APACHE CROSSING	RB1 UPSTREAM OF MOHAWK TO RAILROAD/US 75		
Crow Creek	CR13	3.6	Low	$ 569	21st St. underpass storm sewer	LEFT BANK 2R (HICKORY MANOR)		
Flat Rock Creek	FL6	3.6	Low	$ 658	Peoria Ave. storm sewer & grass-lined channel : 46th St. N Storm Sewer	LB3		
Flat Rock Creek	FL7A	3.6	Low	$ 733	46th St. No. Bridge Replacement	LB4		
Upper Mingo Creek	MU6	3.6	Low	$ 569	Commerce Park channelization & replace 2 street structures			
Coal Creek	CL1C	3.6	Low	$ 1,532	APACHE STREET CROSSING - DAWSON ACQUISITION IS COMPLETE	MAINSTEM GILCREASE EXPRESSWAY TO ERIE AVENUE		
Rolling Hills	RH1	3.6	Low	$ 1,302	GRASS-LINED CHANNEL 1150' LONG	ROLLING HILLS CREEK TO CARL SANBURG ELEMENTARY		
Upper Mingo Creek	MU5	3.6	Low	$ 3,034	Crossing replacement along tributary, channel construction from 55th Pl. south to Garnett Rd. & property acquisition (1 acq.)			
Bird Creek	BD1	3.5	Low	$ 162	0			
TOTAL LOW PRIORITY PROJECTS				**$ 46,634**				
Deferred Projects								
Coal Creek	CL2B	3.5	Defer	$ 7,628	PROPOSED NEW HAVEN STORM SEWER UPSTREAM OF TURNER PARK $5.1M	MAINSTEM FROM TURNER PARK TO 15TH STREET.		
Coal Creek	CL3C	3.5	Defer	$ 4,427	STORM SEWER - RAILROAD TO NEWTON PLACE $2.96M	RAILROAD TO NEWTON PLACE ON RB1		
Flat Rock Creek	FL8A	3.5	Defer	$ 479	PROPERTY ACQUISITION; 39TH ST. NO. GRASS-LINED CHANNEL	RB3		

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PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Haikey Creek	HK5B	3.5	Defer	$ 504	C8 - ADD 12 X 9 REINFORCED CONCRETE BOXES AT 74TH EAST AVENUE -- CH1 - GRASSLINED CHANNEL 74TH EAST AVENUE TO 76TH EASE AVENUE -- C9 - REPLACE WITH 3 8 X 8 REINFORCED CONCRETE BOXES AT 76TH EAST AVENUE	LH8 AND LH9 TO UPSTREAM OF 74TH EAST AVENUE		
Harlow Creek	HR2	3.5	Defer	$ 334	Harlow acquisition (1 acq.) & floodproofing (3 struct.): Harlow Edison St. Culvert: Harlow Private driveway			
Lower Basin	LB4	3.5	Defer	$ 5,715	Sandy Park storage: Cunningham Storage: Vern Rayburn Storage: Vern Rayburn Channel: Allowance for local collector pipes & inlets			
Lower Middle Mingo Creek	MLM2C	3.5	Defer	$ 2,212	OPEN CHANNEL AND 4 BRIDGES (2 RR, JOPLIN AND 15TH)	UPSTREAM FROM 11TH TO UPSTREAM FROM 15TH		
Vensel	VE4	3.5	Defer	$ 237	91ST STREET CROSSING	TRIBUTARY F TO ABOVE 91ST STREET		
Coal Creek	CL4C	3.4	Defer	$ 3,290	BRIDGE AT PINE, GRASS-LINED CHANNEL PINE TO INDEENDENCE $2.2M	PINE TO INDEPENDENCE ON RB2	ANDERSON WATERLINE FROM ARCHER TO PINE	CONSTRUCTED IN 2000/2001
Lower Middle Mingo Creek	MLM3A	3.4	Defer	$ 2,607	CHANNEL IMPROVEMENTS, 71ST E. AVENUE, 68TH E. PLACE CULVERT	FROM JOHN PAUL JONES SCHOOL TO 21ST STREET		
Mooser Creek	MO4	3.4	Defer	$ 1,364	1,200 LINEAR FEET GRASS-LINED CHANNEL;FLOOD-PROOF ONE HOUSE, 2 CROSSINGS (1 PRIVATE DRIVE AND 1 LOWER CROSSING)	REACH MA-4 ON THE MAINSTEM		
Fry Ditch No. 2	FD1B	3.4	Defer	$ 4,883	BRIDLE TRAILS ACQUISITION	DOWNSTREAM OF BRIDLE TRAILS TO DOWNSTREAM OF 101ST		
Parkview Creek	PV6	3.4	Defer	$ 617	LB-2 Channel; Mainstem at 33rd W. Ave. culvert: Edison St Channel: Lower Edison Channel			
Upper Middle Mingo Creek	MUM2G	3.4	Defer	$ 1,752	DETENTION POND	EXPRESSWAY SOUTH TO 36TH STREET		
Harlow Creek	HR3	3.3	Defer	$ 3,878	Upper Harlow storage: Upper Harlow Culverts			
Little Joe Creek	LJ5	3.3	Defer	$ 935	PROJECT UNIT JL-9 IN REPORT STORMWATER DETENTION FACILITY AND ONE ACQUISITION	UPSTREAM OF 54TH STREET TO SHERIDAN		
Coal Creek	CL3D	3.3	Defer	$ 6,985	STORM SEWER NEWTON PLACE TO INDEPENDENCE AND JOPLIN $4.67M	RB ABOVE NEWTON PLACE		
Garden City	GC1	3.3	Defer	$ 4,156	Pond 1 and Outlet to Arkansas River: Outlet for Pond 2 to Arkansas River: Swales and Appurtenances: Storm Sewers	GARDEN CITY		
Flat Rock Creek	FL7D	3.3	Defer	$ 1,361	Houston detention facility: Cincinnati Ave bridge / culvert trib.	LB4		
Coal Creek	CL5B	3.3	Defer	$ 2,243	URBANA STORAGE $1.5M	RB3 AT POND LOCATION		
Harlow Creek	HR4	3.3	Defer	$ 359	RB-2 storage			
Dirty Butter Creek	DB5D	3.2	Defer	$ 4,068	WHEELING LATIMER STORAGE FACILITY ON RB1 (DB5), RR SPUR CROSSING, GRASS-LINED CHANNEL FROM SPUR TO BNRR, BNRR CROSSING	UPSTREAM FROM YOUNG TO UPPER END OF RB1 (DB5)		
Dirty Butter Creek	DB6	3.2	Defer	$ 4,038	STORM SEWER FROM LATIMER TO OPEN CHANNEL, GRASS-LINED CHANNEL TO DETENTION FACILITY, 2 CROSSINGS	TL-2 ABOVE SPRINGDALE STORAGE		
Coal Creek	CL4D	3.2	Defer	$ 897	STORM SEWER ALONG INDEPENDENCE $0.6M	DRAINAGE BASIN TO MAINSTEM AT INDEPENDENCE FOR THIS PROJECT ONLY	ANDERSON WATERLINE	2000/2001 CONSTRUCTION
Oak Creek	OC3A	3.2	Defer	$ 1,046	0		OWEN PARK DEVELOPMENT	

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PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Crow Creek	CR1	3.1	Defer	$ 1,270	NEW GRASS-LINED CHANNEL DOWNSTREAM OF RIVERSIDE DRIVE: CHANNEL REHABILITATION FROM RIVERSIDE TO CINCINNATI AND ACQUISITION OF ONE APARTMENT BUILDING; NEW CONCRETE LINED CHANNEL FROM CINCINNATI TO A POINT 300' DOWNSTREAM OF PEORIA AVENUE; REHAB 300' OF OLD SANDSTONE CHANNEL DOWNSTREAM OF PEORIA.	FROM ARKANSAS RIVER TO PEORIA	RIVERSIDE PARKWAY WIDENING	PHASE 1 - FY2000 - $560,000 ALSO PEDESTRIAN BRIDGE & STORMWATER IMPROVEMENTS - NOT FUNDED NEST BOND ISSUE - HIGH/HIGH; NOTE: SUBMITTED FOR ICT FUNDS
Crow Creek	CR10	3.1	Defer	$ 1,762	CITYVIEW STORAGE (RIGHT OF WAY PARTIALLY ACQUIRED)	MAINSTEM ABOVE CONFLUENCE WITH LEFT BANK 4		
Flat Rock Creek	FL7B	3.1	Defer	$ 1,720	48th Pl. N. & Hartford concrete channel exp.: Property Acquisition (2 acq): 48th Pl N Bridge / culvert: Hartford Ave bridge / culvert	LB4		
Lower Middle Mingo Creek	MLM2I	3.1	Defer	$ 1,799	8 X 5 RCB UPSTREAM AND PARALLEL TO EX. 54" RCP, REPLACE 48" WITH 8 X 7 , THEN 8 X 6 THEN 7 X 5 THEN 6 X 5	FROM OPEN CHANNEL NORTH OF 15TH WEST OF RAILROAD UPSTREAM THROUGH RAILROAD PROPERTY, THROUGH GLEASON VILLAGE, ACROSS 21ST TO 21ST PLACE AND FULTON		
Coal Creek	CL1E	3.1	Defer	$ 2,736	NEW YALE BRIDGE, RAISE ROAD AND CHANNEL WORK $1.83M (CHANNEL $0.98M)	HALF WAY BETWEEN DARLINGTON AND YALE TO HALF WAY BETWEEN YALE AND DAWSON ROAD.	YALE WIDENING PINT TO APACHE	LOW/LOW
Upper Mingo Creek	MU2	3.1	Defer	$ 3,680	3 Street crossing replacements on 145th E. Ave. & 51st St. S.; & B.A. Expwy. crossing box addition, & regional detention			
Lower Basin	LB3	3.1	Defer	$ 4,585	Industrial West Storage: Industrial East Storage: Newblock Park Storage: East Newblock Park Channel: West Newblock Park Channel: Quarry Storage: Rehabilitation of ex pump sta at Parkway Outfall			
Perryman Ditch	PE4,6	3.1	Defer	$ 22,724	Floodproofing 5 buildings and redesign and rehab. of existing storm sewer			
Coal Creek	CL2C	3.0	Defer	$ 2,691	FAIRGROUNDS STORAGE $1.8M	MAINSTEM UPSTREAM FROM 15TH STREET		
Coal Creek	CL7C	3.0	Defer	$ 5,384	UPPER AND LOWER DELAWARE STORM SEWER			
Dirty Butter Creek	DB7A	3.0	Defer	$ 8,375	XYLER STORAGE	TR1 TO UPSTREAM OF XYLER STORAGE		
Haikey Creek	HK26	3.0	Defer	$ 77	PROJECT C24 - GARNETT OPENING 9' X 4.5' REINFORCED CONCRETE BOX	TRIBUTARY 3		
Harlow Creek	HR7	3.0	Defer	$ 516	TL-1 57th W. Ave. culvert and channel: Harlow Trib Storage			
Little Joe Creek	NLJ2	3.0	Defer	$ 1,704	YMCA DETENTION FACILITY	51ST TO UPSTREAM SIDE OF YMCA DETENTION AT FULTON		
Little Joe Creek	NLJ4	3.0	Defer	$ 2,448	HUDSON - IRVINGTON STORM SEWER	EVERYTHING ABOVE HUDSON PLACE		
Oak Creek	OC3B	3.0	Defer	$ 336	EDISON STREET STORAGE $265,000	DOWNSTREAM OF EDISON TO UPSTREAM OF PROPOSED EDISON STORAGE		
Parkview Creek	PV2	3.0	Defer	$ 2,763	Lower LB-1 channel: Middle LB-1 Channels: LB-1 Conduit			
Rolling Hills	RH2	3.0	Defer	$ 1,543	REGIONAL DETENTION	ROLLING HILLS CREEK UPSTREAM FROM CARL SANDBURG ELEMENTARY		
Lower Middle Mingo Creek	MLM2B	2.9	Defer	$ 2,651	0	NEAR 67TH E. AVENUE AND 6TH TO UPSTREAM TO 11TH		
Flat Rock Creek	FL8B	2.9	Defer	$ 1,840	Lower Northland detention facility (5.9% public pay) & 36th St. N. storm sewer	RB3		

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PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Flat Rock Creek	FL5	2.9	Defer	$ 1,481	McClain detention facility: 46th St N Crossing: Grass-lined channel at Peoria & 51st	LB2		
Parkview Creek	PV4	2.9	Defer	$ 1,104	LB-1 Upper channel: LB-1 Storm Sewer			
Dirty Butter Creek	DB12	2.8	Defer	$ 5,084	GRASS-LINED CHANNEL, 2 CROSSINGS, STORM SEWER	LB2		*POSSIBLY WITH CRAWFORD PARK IMPROVEMENTS (PARK DEPT.)
Coal Creek	CL5C	2.8	Defer	$ 2,393	STORM SEWERS ABOVE EXPRESSWAY DRAINING INTO URBANA STORAGE $1.6M	RB3 DRAINAGE AREA ABOVE CL5C		
South Fork Joe	JSF2	2.8	Defer	$ 2,680	REMAINDER OF RECOMMENDED PLAN	JSF FROM UPPER END OF IMPROVEMENTS UPSTREAM OF HARVARD TO 61ST STREET		
Little Joe Creek	LJ8	2.8	Defer	$ 2,728	0	UPSTREAM OF 57TH THROUGH WOODLAND VIEW DETENTION POND		
Little Joe Creek	LJ9	2.8	Defer	$ 2,459	WOODLAND VIEW STORM SEWER	UPSTREAM OF WOODLAND VIEW		
Little Joe Creek	LJ7	2.7	Defer	$ 1,286	72ND EAST AVENUE STORM SEWER	UPSTREAM OF 67TH PLACE TO 57TH		
Dirty Butter Creek	DB10	2.7	Defer	$ 1,092	CHANNEL & RAIL ROAD CROSSING	LB1	GILCREASE EXPRESSWAY R/W	*R/W PURCHASE WHEN GILCREASE R/W IS PURCHASED
Fred Creek	FR13	2.7	Defer	$ 309	ADD 5 X 5 REINFORCED CONCRETE BOX AND REPLACE ANOTHER WITH A 12 X 6 REINFORCED CONCRETE BOX AT 69TH STREET SOUTH	WEST TRIBUTARY ABOVE 71ST		
Lower Middle Mingo Creek	MLM3H	2.6	Defer	$ 1,852	Channel Improvements			
Crow Creek	CR16	2.6	Defer	$ 547	NEW PARALLEL STORM SEWER	LEFT BANK 0 FROM MAINSTEM TO 31ST		
Flat Rock Creek	FL1	2.6	Defer	$ 6,326	Property acquisition near Birmingham Pl. & 4th Pl. (9 acq.) : Lewis Ave bridge & roadway elevation	MAINSTEM		
Coal Creek	CL1D	2.6	Defer	$ 1,097	NEW BRIDGE (DARLINGTON) AND CHANNEL ENLARGEMENT THROUGH DAWSON PARK 0.71 M (0.36m IS CHANNEL WORK)	MAINSTEM ERIE AVENUE TO 1/2 WAY BETWEEN DARLINGTON AND YALE		
Vensel	VE9B	2.5	Defer	$ 218	HARVARD AVENUE CROSSING	TRIBUTARY D ABOVE 91ST		
Parkview Creek	PV11	2.4	Defer	$ 545	Fairview concrete channel			
Vensel	VE7B	2.4	Defer	$ 527	EAST 108TH STREET SOUTH CROSSING	TRIBUTARY J ABOVE SOUTH LOUISVILLE		
Cooley Creek	CO8	2.3	Defer	$ 305	141st E. Ave. culvert replacement: 138th E Ave culvert replacement: 11th St S culvert replacement			
Lower Mingo Creek	ML14B	2.3	Defer	$ 306	MODIFY STRUCTURE #64 TO RAISE PINE TO ELEVATION 630 -- $105,967	LB3 FROM UPSTREAM OF MINGO TO WEST SIDE OF PINE	WIDEN PINE FROM MEMORIAL/MINGO $5,635,000	MED/MED
Elm Creek	EL7	2.3	Defer	$ 4,157	CPS branch storm sewer (7th St.): CPS Det. Fac.			
Cherry/Red Fork	CH7A	2.3	Defer	$ 1,371	0			
Crow Creek	CR12	2.3	Defer	$ 2,031	GLENDALE STORAGE	LEFT BANK 3 FROM RAILROAD UPSTREAM		
Dirty Butter Creek	DB7B	2.2	Defer	$ 3,290	STORM SEWER UPSTREAM OF XYLER STORAGE	TR1 ABOVE XYLER STORAGE		
Upper Mingo Creek	MU1B	2.2	Defer	$ 4,853	CHANNEL REHABILITATION AND DETENTION POND	52ND AND 105TH EAST AVENUE, SE UPSTREAM THROUGH TS1D TO MINGO		
Flat Rock Creek	FL3F	2.2	Defer	$ 1,062	Apache Rd. detention pond on main stem	RB-1 (TRIB. A)		
Elm Creek	EL3	2.1	Defer	$ 1,403	BROKEN ARROW DETENTION FACILITY: MIDDLE BRANCH STORM SEWER (18th ST)			

Appendix B

PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Crow Creek	CR3	2.1	Defer	$ 3,813	REHAB SANDSTONE CHANNEL AND REPLACE 29TH STREET STRUCTURE WITH 3-CELL REINFORCED CONCRETE BOX, ELEVATE ROADWAY; REHAB SANDSTONE CHANNEL; NEW SANDSTONE/GRASS-LINED CHANNEL; REHAB SANDSTONE CHANNEL AND UPGRADE UTICA/TERWILLIGER BRIGHT/CULVERT; NEW GRASS-LINED CHANNEL AND ROCKBRIDGE STORM SEWER	MAINSTEM FROM CONFLUENCE WITH LEFT BANK O TO APPROX. 200' UPSTREAM OF THE CONFLUENCE WITH LB1 (CR14/15)		
Lower Middle Mingo Creek	MLM4	2.1	Defer	$ 2,598	3 BRIDGES AND 2 CHANNEL IMPROVEMENTS	ALL OF TRIBUTARY LB72-R		
Upper Mingo Creek	MU1C	2.1	Defer	$ 2,970	CHANNEL AND DETENTION POND AND ACQUISITION	61ST STREET TO MINGO ROAD		
Coal Creek	CL8B	2.0	Defer	$ 4,188	STORM SEWER IMPROVEMENTS ABOVE 12TH STREET - $2.8M	LB1 UPSTREAM OF 12TH STREET		
Fry Ditch No. 2	FD4A	2.0	Defer	$ 234	91ST STREET CROSSING	DOWNSTREAM OF 91ST TO DOWNSTREAM OF HOLLAND DETENTION	91ST WIDENING $14.26 MILLION	MEDIUM/MEDIUM
Haikey Creek	HK20A	2.0	Defer	$ 523	PROJECT P11 IN MDP - CONSTRUCT BERM AND 36" OUTLET PIPE ALONG SHERIDAN TO POND 53 AK	TRIBUTARY 2-9 TO BELOW MINSHALL PARK POND		
Haikey Creek	HK27	2.0	Defer	$ 333	PROJECT C25 - 2 15' X 14' REINFORCED CONCRETE BOX	TRIBUTARY 4 TO UPSTREAM OF HWY 169 DETENTION POND		
Haikey Creek	HK28	2.0	Defer	$ 230	C7 IN REPORT - ADD 2 - 10 X 8 REINFORCED CONCRETE BOXES TO EXISTING STRUCTURE AT 81ST STREET	LITTLE HAIKEY AT 81ST	81ST STREET WIDENING YALE TO MEMORIAL $13,470,000	MEDIUM/MEDIUM FUTURE BOND ISSUE OR SALES TAX
Lower Mingo Creek	ML10	2.0	Defer	$ 195	STRUCTURE #51 - REPLACE 14 X 4 X 90 RB WITH 3 - 10 X 8 X 100' RCB -- $107,037	LB1		
Lower Mingo Creek	ML5	2.0	Defer	$ 77	BRIDGE - REPLACE EX 2 - 8 X 3 X 43 WITH ; 2 - 12 X 8 X 43 $36,591			
Lower Mingo Creek	ML6A	2.0	Defer	$ 81	STRUCTURE #9 - REPLACE A 2 - 10 X 4 X 28 WITH A 3 - 12 X 8 -28 RCB -- $35,355	UPSTREAM OF GARNETT ON RB2 (LITTLE CREEK)		
Lower Mingo Creek	ML8A	2.0	Defer	$ 303	STRUCTURE #41 - AT PINE - REPLACE 16 X 5 X 27' RCB WITH 3 - 12 X 8 X 100 -- $126,304	CONFLUENCE THROUGH PINE ON RB4 (EAGLE CREEK)	MINGO CREEK INTERCEPTOR SEWER $17 MILLION	MEDIUM/MEDIUM DEFERRED
Lower Middle Mingo Creek	MLM2D	2.0	Defer	$ 1,459	OPEN CHANNEL	UPSTREAM OF 15TH TO UPPER END OF OPEN CHANNEL AND 36" RCP FROM 17TH AND CANTON		
Upper Middle Mingo Creek	MUM2B	2.0	Defer	$ 1,810	FOLLOWS FMA ALIGNMENT	31ST AND SHERIDAN, WEST TO JOPLIN, NORTH TO 30TH PLACE, WEST TO IRVINGTON, NORTH TO 28TH STREET		
South Tulsa	ST4B	2.0	Defer	$ 102	CULVERT REPLACEMENT AT 114TH PLACE SOUTH PRIVATE DRIVEWAY SOUTH OF 114TH PLACE	ON TRIBUTARY D		
Vensel	VE11A	2.0	Defer	$ 506	STORM SEWER	TRIBUTARY B TO DOWNSTREAM FROM 91ST		
Big Heart Creek	BH2	1.9	Defer	$ 1,612	0			
Cherry/Red Fork	CH7B	1.9	Defer	$ 1,776	0			
Flat Rock Creek	FL2A	1.9	Defer	$ 1,571	Hartford Ave. bridge	MAINSTEM		
Upper Middle Mingo Creek	MUM2D	1.9	Defer	$ 1,202	STORM SEWERS	67TH AVENUE FROM MAINSTEM NORTH TO 26TH PLACE		
Coal Creek	CL1B	1.8	Defer	$ 801	LOWER COAL ACQUISITION	36TH STREET NORTH TO GILCREASE EXPRESSWAY ON MAINSTEAM		
Flat Rock Creek	FL3B	1.8	Defer	$ 972	Mohawk Blvd. Culvert : Mohawk Blvd culvert trib.: Delaware Ave culvert	RB-1 (TRIB. A)		
Fred Creek	FR5	1.8	Defer	$ 1,038	GRASS-LINED CHANNEL AND EVANSTON CROSSING, EROSION CONTROL MEASURES	FROM PROPOSED GRASSLINED CHANNEL (ORU) TO HARVARD		

Appendix B

PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Elm Creek	EL4	1.8	Defer	$ 8,789	CPN branch storm sewer (Rockford to 4th St.): Central Park detention facility			
Fred Creek	FR6	1.7	Defer	$ 242	REPLACE HARVARD AVENUE STREET	HARVARD ONLY (MAINSTEM)		
Fred Creek	FR9	1.7	Defer	$ 302	ADD 60" REINFORCED CONCRETE PIPE NORTH AND EAST OF 71ST AND LEWIS ON OLD JOE 4 TRIBUTARY	OLD JOE 1 TRIBUTARY + OLD JOE 4 TRIBUTARY		
Haikey Creek	HK1	1.7	Defer	$ 921	150' BRIDGE AT 101ST STREET (REPLACEMENT)	LITTLE HAIKEY 101ST - TO MINGO		
Lower Mingo Creek	ML14C	1.7	Defer	$ 249	REPLACE STRUCTURE #66 -- REPLACE EXISTING 2 - 6 X 3 X 70 WITH 2 - 10 X 4 X 100 RCB - $71,608 -- AT ADMIRAL PLACE	DOUGLAS CREEK (LB3) FROM UPSTREAM OF PINE TO TOP	LOWER MINGO SEWER REHABILITATION	LOW
Crow Creek	CR2	1.6	Defer	$ 1,969	REHAB 500' OF SANDSTONE CHANNEL; ~1,100 LINEAR FEET SANDSTONE CHANNEL (NEW); ~500' CONCRETE CHANNEL AND 31; 270' CONCRETE LINED CHANNEL; REHAB SANDSTONE CHANNEL	PEORIA - UPSTREAM ON MAINSTEM TO CONFLUENCE WITH LB0		
Flat Rock Creek	FL2B	1.6	Defer	$ 4,381	Cincinnati Ave. detention pond: Property Acquisition (4)	MAINSTEM		
Cooley Creek	CO7	1.5	Defer	$ 230	4th Pl. culvert repl.: I-44 culvert rplc & const dike: 129th E Ave culvert rplc: E. Admiral Pl culvert rplc.			
Elm Creek	EL5	1.5	Defer	$ 917	N.E. branch storm sewer (Admiral Park)			
Fred Creek	FR10	1.5	Defer	$ 986	TWO STORM SEWER SEGMENTS IN OJ3 74TH STREET TO 72ND STREET	OLD JOE 2 TRIBUTARY AND OLD JOE 3 TRIBUTARY		
Haikey Creek	HK10	1.5	Defer	$ 361	C13 -- 2- 10 X 6 REINFORCED CONCRETE BOXES	TRIBUTARY 2 - 3L1		
Haikey Creek	HK5A	1.5	Defer	$ 197	C27 - MINGO ROAD STRUCTURE 2 - 10 X 7 REINFORCED CONCRETE BOXES	UPPER END OF TRIBUTARY 4 (FROM ABOVE HWY 169 DETENTION TO TOP)		
Lower Mingo Creek	ML12	1.5	Defer	$ 229	STRUCTURE #56 - REPLACE 2 - 10 X 5 X 86 RCB WITH 3 - 12 X 8 X 100' RCB -- $126,304	LB2		
Upper Middle Mingo Creek	MUM6H	1.5	Defer	$ 179	REPLACE CULVERT SH-2 ON 145TH EAST AVENUE	SUNWOOD HILLS TRIBUTARY ABOVE 31ST STREET		
Upper Middle Mingo Creek	MUM6I	1.5	Defer	$ 179	REPLACE CULVERT SH-7 ON 145TH EAST AVENUE	TRIBUTARY OF SUNWOOD HILLS TRIBUTARY ABOVE CONFLUENCE WITH SUNWOOD HILLS TRIBUTARY		
Oak Creek	OC4A	1.5	Defer	$ 441	UNION AVENUE STORM SEWERS AND CHANNEL $326,000	UPSTREAM OF EDISON STORAGE TO DOWNSTREAM OF PROPOSED MARSHALL STORAGE		
Flat Rock Creek	FL3D	1.4	Defer	$ 538	Apache Rd. detention pond on RB1	RB-1 (TRIB. A)		
Fred Creek	FR8	1.4	Defer	$ 682	STORM SEWER FROM PAUL JOHNSON PARK TO TOLEDO AVENUE	ABOVE PITTSBURG ON MAINSTEM TO VANDALIA		
Flat Rock Creek	FL3G	1.4	Defer	$ 1,750	AMOS HALL DETENTION POND	RB-1 (TRIB. A)		
Lower Mingo Creek	ML6B	1.3	Defer	$ 249	STRUCTURE #11 - REPLACE A 2 - 12 X 2 X 25 RCB WITH 3 - 12 X 8 X 100 -- $126,304	UPSTREAM OF GARNETT THROUGH 36TH STREET NORTH BRIDGE ON RB2 (LITTLE CREEK)		
Lower Mingo Creek	ML6C	1.3	Defer	$ 281	STRUCTURE #13 - 2 - 12 X 3 X 23' RCB WITH 2 - 10 X 7 X 100' RCB -- $142,894	UPSTREAM OF 36TH STREET NORTH THROUGH 129TH EAST AVENUE		
Lower Mingo Creek	ML8C	1.3	Defer	$ 272	STRUCTURE #43 - REPLACE 6 X 4 X 40 CGMP WITH 3 - 10 X 5 X 100 RCB -- $107,037	RB TRIBUTARY NORTH OF MAINSTEM RB4 TR3		
Fred Creek	FR3	1.2	Defer	$ 727	LEWIS BRIDGE	MAINSTEM THROUGH LEWIS ONLY		
Flat Rock Creek	FL3A	1.2	Defer	$ 957	US Hwy. 75 culvert on mainstem	RB-1 (TRIB. A)		
Flat Rock Creek	FL3E	1.2	Defer	$ 1,032	Santa Fe detention pond at expressway	RB-1 (TRIB. A)		
Elm Creek	EL6	1.1	Defer	$ 2,326	NW branch storm sewer (Ow.): Nw2 Det. Fac.			

Appendix B

PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Coal Creek	CL4E	1.0	Defer	$ 3,844	STORM SEWER FROM INDEPENDENCE TO UPPER END SOUTH OF EXPRESSWAY $2.57M - DIVERSION OF RB1 TO RB2	RB2 ABOVE INDEPENDENCE	ANDERSON WATERLINE	2000/2001 CONSTRUCTION
Cooley Creek	CO13	1.0	Defer	$ 156	E. Admiral Pl. culvert replacement			
Dirty Butter Creek	DB11	1.0	Defer	$ 1,001	STORM SEWER	DB11		
Fred Creek	FR11	1.0	Defer	$ 418	6 X 6 REINFORCED CONCRETE BOX AT HARVARD AND 60" REINFORCED CONCRETE PIPE AT 82ND STREET	SOUTHWOOD TRIBUTARY		
Fred Creek	FR16	1.0	Defer	$ 433	74TH STREET CROSSING AND SOUTHRIDGE DETENTION	URBANA TRIBUTARY		
Lower Mingo Creek	ML7C	1.0	Defer	$ 506	STRUCTURE #26 - REPLACE 3 17 X 6 X 28 RCB WITH 3 - 12 X 10 X 100 RCB -- $254,748			
Lower Middle Mingo Creek	MLM2G	1.0	Defer	$ 1,435	8 X 4 RCB	ALONG 15TH STREET FROM CREEK AT 15TH TO THE WEST		
Lower Middle Mingo Creek	MLM3C	1.0	Defer	$ 91	6 X 6 RCB ND 4 X 5 RCB	TIES INTO JONES CREEK UPSTREAM OF 68TH E. PLACE		
Lower Middle Mingo Creek	MLM6A	1.0	Defer	$ 409	BRIDGE AT GARNETT	CONFLUENCE TO UPSTREAM OF GARNETT	WIDEN GARNETT ROAD/I244 - 11TH -- $5,580,000	MED/MED
Vensel	VE11B	1.0	Defer	$ 166	81ST STREET CROSSING	TRIBUTARY B AT HARVARD ONLY	81ST STREET HARVARD TO YALE	
Vensel	VE8	1.0	Defer	$ 224	SOUTH YALE AVENUE CROSSING	TRIBUTARY H		
Fred Creek	FR4	0.9	Defer	$ 2,930	CONCRETE LINED CHANNEL	UPSTREAM OF LEWIS TO UPPER END OF CHANNEL		
Upper Middle Mingo Creek	MUM2F	0.9	Defer	$ 1,152	BOX CULVERTS	31ST STREET SOUTH TO EXPRESSWAY		
Crow Creek	CR15A	0.8	Defer	$ 814	REPLACE BRIDGE	LEFT BANK 1 AT LEWIS ONLY	UPGRADE LEWIS AVE BA-I44	LOW/LOW
Lower Mingo Creek	ML14A	0.8	Defer	$ 571	STRUCTURE #60 - REPLACE 3 - 10 X 12 X 70 WITH 3 - 12 X 12 X 100' RCB -- $256,889	DOUGLAS CREEK LB3 FROM MOUTH TO UPSTREAM OF MINGO	LOWER MINGO DOUGLAS SEWER REHABILITATION	LOW
Coal Creek	CL1A	0.8	Defer	$ 449	36TH STREET NORTH CROSSING IMPROVEMENTS	MAINSTEM TO 36TH STREET NORTH	PORT ROAD EXTENSION	HIGH/HIGH, CONSTRUCTION ENGR. 94 BOND, R/W 96 SALES TAX
Lower Mingo Creek	ML7B	0.8	Defer	$ 508	STRUCTURE #25 - REPLACE 2 - 17 X 6 X 28' RCB WITH 3 - 12 X 12 X 100' RCB -- $256,889	RB3 - FROM UPSTREAM OF GARNETT TO UPSTREAM OF APACHE		
South Tulsa	ST4A	0.7	Defer	$ 4,482	NEW BOX CULVERT (OTHER 1/2 OF EXISTING) FROM ARKANSAS RIVER TO 117TH STREET	PICKS UP TRIBUTARY B		
Lower Mingo Creek	ML7A	0.7	Defer	$ 250	STRUCTURE #18 - REPLACE 7 X 5.5 X 47 CGMP WITH 3 - 12 X 12 X 47 -- $120,738	RB3 - QUARRY CREEK MOUTH TO UPSTREAM SIDE OF GARNETT ROAD		
Upper Middle Mingo Creek	MUM2E	0.7	Defer	$ 248	STORM SEWER FROM 26TH PLACE TO 28TH STREET THROUGH YARDS ALONG APPROXIMATE ALIGNMENT OF 66TH EAST AVENUE	TRIBUTARY DRAINING TO 72" RCP ALONG 66TH EAST PLACE		
Elm Creek	EL8	0.6	Defer	$ 1,819	OC branch storm sewer (11th St.)			
Lower Middle Mingo Creek	MLM3B	0.6	Defer	$ 517	2 - 7 X 6 RCB, 2 - 6 X 6, 1 - 7 X 6, 1 - 5 X 5, 54" RCP AND 48" RCP	UPSTREAM OF 21ST TO TOP ON JONES MAINSTEM	SHERIDAN AT 21ST TO 31ST	$4.590 MILLION DEFER LOW/LOW
Upper Middle Mingo Creek	MUM3	0.6	Defer	$ 8,128	0			
Crow Creek	CR14	0.5	Defer	$ 360	LEWIS DOWNSTREAM - CHANNEL RESTORATION	LEFT BANK 1 TO DOWNSTREAM OF LEWIS		
Lower Mingo Creek	ML6D	0.5	Defer	$ 222	STRUCTURE #15 - REPLACE 5-66" DIAMETER CGMP WITH 3-12 X 8 X 2- RCB -- $25,261; STRUCTURE #16 - REPLACE 3 84" DIAMETER CGMP WITH 3-96" X 100' DIAMETER RCP $96,840	UPSTREAM OF 129TH EAST AVENUE TO TOP OF RB2		
Upper Middle Mingo Creek	MUM6E	0.5	Defer	$ 930	NORTH DETENTION POND ON EASTLAND ACRES TRIBUTARY (CULVERT IS OK)	EASTLAND ACRES TRIBUTARY		
Upper Middle Mingo Creek	MUM6G	0.5	Defer	$ 179	BRIDGE SH-1 REPLACE EXISTING 8 X 5.5 WITH 2 - 10 X 8	SUNWOOD HILLS TRIBUTARY FROM CONFLUENCE WITH BROOKHOLLOW CREEK TO UPSTREAM OF 31ST		

Appendix B

PRIORITIZED STORMWATER CAPITAL PROJECTS

Watershed Name	FMA	Ranking Value	Priority	Revised Cost ($1,000)	Description of Stormwater Project	Location of Project	CIP Project Link	Priority of CIP Project
Upper Mingo Creek	MU1D	0.4	Defer	$ 1,419	Memorial Dr. Crossing			
Fry Ditch No. 2	FD3A	0.4	Defer	$ 647	SHERIDAN ROAD	DOWNSTREAM OF SHERIDAN TO UPSTREAM OF SHERIDAN	SHERIDAN WIDENING 91ST - 101ST	LOW/LOW $4.8 MILLION DEFERRED
Cooley Creek	CO11	0.4	Defer	$ 1,907	Detention pond east of 145th E. Ave.: 21st St S Culvert Addition: 15th St culvert replacement: 145th E Ave Culvert Replacement			
South Tulsa	ST1A	0.4	Defer	$ 2,049	GRASS-LINED CHANNEL FROM INTERSECTION OF 121ST AND SHERIDAN TO NEW FRY 2 CHANNEL			
Adams Creek	AD1	0.3	Defer	$ 2,549	REGIONAL DETENTION	ADAMS CREEK		
Fry Ditch No. 2	FD5	0.3	Defer	$ 281	COMPLETED	LB1 FROM CONFLUENCE WITH MAINSTEM TO UPSTREAM OF LB1TL1		
Haikey Creek	HK22	0.3	Defer	$ 250	0	2-10L1		
Lower Mingo Creek	ML8B	0.3	Defer	$ 277	STRUCTURE #46 - REPLACE 6 X 4 X 40 RCB WITH 3 - 10 X 5 X 100 -- $107,037	UPSTREAM OF PINE TO ROGERS COUNTY (145TH EAST AVENUE)		
Lower Middle Mingo Creek	MLM6B	0.3	Defer	$ 794	DETENTION POND FROM OLD MDW REPORT	UPSTREAM OF GARNETT ROAD TO TOP		
Vensel	VE10	0.3	Defer	$ 872	2 YALE CROSSINGS AND 91ST STREET CROSSING	TRIBUTARY E	YALE 81ST TO 91ST FY 1999 UN-FUNDED HIGH/HIGH	91ST AND YALE INTERSECTION FY 1999 UN-FUNDED HIGH/HIGH
Vensel	VE11C	0.3	Defer	$ 258	OSWEGO CROSSING EAST 80TH STREET SOUTH CROSSING	ALL OF TRIBUTARY B AND TRIBUTARY B WEST ABOVE 91ST STREET		
Hager Creek	HG3A	0.3	Defer	$ 1,103	GRASS-LINED CHANNEL AND FLOOD WARNING SYSTEM	HG3 TO DETENTION POND	WATERLINE	1998 CONSTRUCTION
Fry Ditch No. 2	FD2A	0.3	Defer	$ 455	101ST AND CHANNEL	DOWNSTREAM OF 101ST TO DOWNSTREAM OF SHERIDAN		
South Tulsa	ST5B	0.2	Defer	$ 3,202	GRASS-LINED CHANNEL, DROP STRUCTURE AND CROSSING AT SANDUSKY?	DRAINS TRIBUTARY G AND E		
Cooley Creek	CO5	0.2	Defer	$ 611	11th St. S. culvert replacement: E. Admi ral Pl culvert replacement: I-44 culvert replacement & const dike			
South Tulsa	ST3A	0.2	Defer	$ 1,064	CONNECTION TO FRY CREEKS CHANNEL AT ~ 126TH STREET - GRASS-LINED CHANNEL			
Dirty Butter Creek	DB1	0.1	Defer	$ 1,481	ACQUISITION OF 4 HOUSES, GRASS-LINED CHANNEL TRANSITIONS TO NEW BRIDGE, NEW BRIDGE AT 36TH ST. NORTH	DIRTY BUTTER MAINSTEM FROM CONFLUENCE WITH FRC TO CONFLUENCE WITH TRIB. RB1 - NOTE: BUILDINGS HAVE BEEN REMVED EXCEPT ONE MOBILE HOME.		OLD CITYWIDE PRIORITY #101
Fry Ditch No. 2	FD3B	0.1	Defer	$ 1,375	MILL CREEK POND CHANNEL	UPSTREAM OF SHERIDAN TO DOWNSTREAM OF 91ST	91ST - 101ST SHERIDAN WIDENING	LOW/LOW $4.8 MILLION DEFERRED
Haikey Creek	HK25	0.1	Defer	$ 1,373	P8 - MODIFY SHERIDAN ROAD DETENTION POND	TRIBUTARY 2 - 10R1		
South Tulsa	ST2A	0.1	Defer	$ 1,729	GRASS-LINED CHANNEL ARKANSAS RIVER TO 131ST TO 121ST			
TOTAL DEFERRED PROJECTS				**$300,844**				

Appendix C:

Hazard Mitigation Capital Improvements Projects

Appendix C: City of Tulsa
Capital Projects for Inclusion in Hazard Mitigation Grant Funding

No.	*Department*	*Project Title*	*Cost Estimate (in Thousands)*	*Priority*	*FY Funding*
	General Hazard Mitigation Measures				
20	Telecommun/Info Services	800 MHz Radio System Upgrade	$1,750	H	FY03
30	Telecommun/Info Services	Network Security Enhancements	$350	H	FY03
31	Telecommun/Info Services	New Public Safety Response Facility	$2,500	H	FY03
32	Telecommun/Info Services	PSSI/HP Computer Dispatch Upgrade	$345	H	FY03
277	Water Projects	UIS Backup Computer System	$1,400	H	FY05
303	Sanitary Sewer Projects	Sanitary Sewer Flow Monitoring	$1,400	H	FY03
34	Telecommun/Info Services	Redundant Radio System Zone Controller	$225	H	FY04
35	Telecommun/Info Services	Twenty Channel Emergency Commun System	$670	H	FY05
33	TelecommunIS Projects	Public Works 800 MHz Flowline Radio Upgrade	$615	H	FY05
19	Telecommun/Info Services	800 MHz Catoosa Receiver Site	$570	M	None
	Flood Mitigation				
58	Mohawk Park & Redbud ValleyImp	Redbud Valley Nature Center	$100	H	FY04
65	Youth & Adults Sports Facility	Firecracker Stormwater Detention Site Facilities Dev	$140	H	FY04
316	Flood Control	15th Street & BA Expressway Detention Basin	$3,830	H	FY04
321	Flood Control	Bridle Trails Detention- Channel Erosion	$2,000	H	FY04
324	Flood Control	Celia Clinton Detention & Storm Sewer- Coal Creek	$2,200	H	FY04
325	Flood Control	Central High School Channel	$280	H	FY04
327	Flood Control	Channel Erosion & Stabilization	$4,375	H	FY04
330	Flood Control	City Master Plan & Master Drain Plan Updates	$500	H	FY04
331	Flood Control	Concrete channel Rehab, Various Locations	$7,025	H	FY04
333	Flood Control	Crow Creek Channel Rehabilitation & Culvert Replace	$7,850	H	FY04
334	Flood Control	Crow Creek Pedestrian Bridge & Stormwater Improvements	$900	H	FY04
335	Flood Control	Crow Creek Travis Park Storm Sewer, Inlets and Valves	$4,800	H	FY04
340	Flood Control	Elm Street East 6th Street Drainage Improvements	$9,000	H	FY04
341	Flood Control	Flatrock 3400 North Lansing Place Channel	$1,200	H	FY04
342	Flood Control	Flood Plain Acquisition- City Wide	$11,000	H	FY04
343	Flood Control	Fred Creek – Evanston Ave. Bridge and Channel at 76th Pl.	$1,400	H	FY04
344	Flood Control	Fred Creek Channel, Culverts, Rehab., Maintenance, Phase II	$1,500	H	FY04
351	Flood Control	Harvey Young Detention (Upper Brookhollow, Tupelo)	$610	H	FY04
363	Flood Control	Mingo – Moeller Heights Creek LB7-2R Channel Rehab	$1,520	H	FY04
382	Flood Control	Stormwater Facility Repair and Construction	$2,000	H	FY04
388	Flood Control	Urban Lake Maintenance	$2,000	H	FY04

No.	Department	Project Title	Cost Estimate (in Thousands)	Priority	FY Funding
389	Flood Control	Urgent Small Drainage Projects	$4,320	H	FY04
390	Flood Control	Vensel Creek Erosion Control	$5,000	H	FY04
42	General Parks Sites Renovation	Drainage Problem Corrections	$1,090	H	FY05
329	Flood Control	Cherokee Village Relief Drainage System	$5,125	H	FY05
336	Flood Control	Downtown Storm Drainage System Reconstruction	$12,800	H	FY05
353	Flood Control	Jones Storm Sewer Channel & Bridge Replacement	$1,000	H	FY05
357	Flood Control	Langenheim Park Detention Phase I Channel	$3,000	H	FY05
361	Flood Control	Mill Creek Pond Channel –Fry Ditch #2	$1,310	H	FY05
369	Flood Control	Red Fork Creek Detention Basin- W 48th & SW Boulevard	$1,170	H	FY05
374	Flood Control	Sheridan and 54th Stormwater Detention Facility	$815	H	FY05
47	General Parks Sites Renovation	Park Dept Pond Dredging & Cleaning	$150	H	FY06
71	Land Acquisition for Parks	Land Acquisition for Parks	$4,690	H	FY06
312	Flood Control	11th & Sheridan Storm Sewer Rehab	$7,240	H	FY06
313	Flood Control	15th and Fulton Storm Sewer & Drain Imp	$1,150	H	FY06
314	Flood Control	21st Street Detention Basin	$1,730	H	FY06
328	Flood Control	C Page Blvd Lower Basin Storm Sewer & Det Imp	$21,500	H	FY06
373	Flood Control	Shadow Mountain Detention Basin Enlargement	$600	H	FY06
376	Flood Control	South Tulsa Drainage Improvements	$3,390	H	FY06
319	Flood Control	Bridge & Culvert Replacements	$6,965	H	None
384	Flood Control	Triad Sewer and Channel (21st and BA Underpass)	$310	H	None
391	Flood Control	Woodland View Stormwater Detention Facility	$2,480	M	FY04
315	Flood Control	26th & Louisville Detention, Upper Joe Creek	$1,450	M	None
317	Flood Control	37th & Memorial Storm Sewer	$800	M	None
320	Flood Control	Bridge Improvements – Little Joe Mainstem	$895	M	None
322	Flood Control	Burlington Detention & Crossing Improv- Coal Crk	$1,575	M	None
326	Flood Control	Central Park South Detention & Storm Sewer (Elm)	$3,900	M	None
332	Flood Control	Crosstown Detention & Stormsewer Improv- Elm Creek	$2,815	M	None
337	Flood Control	Eastland Mall Relief Drainage System (Adjacent Areas)	$430	M	None
338	Flood Control	Edison Street Culvert Enlargement	$140	M	None
346	Flood Control	Fry Ditch #2 Bank Stabilization & Erosion Control	$6,000	M	None
347	Flood Control	Garden City Drainage Improvements Phase 2	$2,000	M	None
348	Flood Control	Gun Boat Detention Elm Creek	$1,190	M	None
349	Flood Control	Harlow HR3 Levees , Culverts and Detention	$4,035	M	None
350	Flood Control	Harlow Storage TR 2 Harlow Creek	$540	M	None
352	Flood Control	Joe Creek Channel Rehabilitation , Phase II	$2,000	M	None
354	Flood Control	Jones Tributary Channel & Crossing Improvement	$1,665	M	None
355	Flood Control	LaFortune Park Storm Water Detention Facility	$1,025	M	None
356	Flood Control	Langenheim Detention and Storm Sewer- Upper Joe Creek	$5,465	M	None
358	Flood Control	Maxwell Park Storm Sewer, Channel- Coal Creek	$18,360	M	None
359	Flood Control	Mayfair Stormwater Pump Station- Parkview	$500	M	None

No.	Department	Project Title	Cost Estimate (in Thousands)	Priority	FY Funding
360	Flood Control	Mayo Plaza Drainage Relief System	$1,640	M	None
362	Flood Control	Mill Creek Storm Sewer and Bridges (West of McClure Park)	$7,535	M	None
365	Flood Control	Mooser Creek Channel and I-44 Culvert	$3,400	M	None
366	Flood Control	Nickle Creek Property Acquisition	$160	M	None
367	Flood Control	Parkview Creek Expressway Storage	$425	M	None
370	Flood Control	Rockbridge Storm Sewer – Crow Creek	$290	M	None
371	Flood Control	Rolling Hills Channel - Spunky Creek	$1,870	M	None
372	Flood Control	Roosevelt and Edison Street Detention – Oak Creek	$1,210	M	None
375	Flood Control	South Haven Floodwall & Culvert Improve – Mooser Crk	$1,320	M	None
377	Flood Control	Steel Companies Channel Improvement- Mooser Crk	$660	M	None
378	Flood Control	Storm Sewer Improvements – 58th & South Haven Place	$1,230	M	None
379	Flood Control	Storm Sewer Improvements – 72nd East Avenue and 55th	$1,170	M	None
380	Flood Control	Storm Sewer Improvements – 73rd E. Avenue and 58th	$2,240	M	None
381	Flood Control	Storm Sewer Improvements – S. Irvington Avenue	$750	M	None
383	Flood Control	Thornton YMCA Stormwater Detention Facility	$1,260	M	None
385	Flood Control	TU Phase 1/2 Detention, S. Sewer/Crossing/ Imp Coal Crk	$12,425	M	None
386	Flood Control	TU Phasse 3 Detention, Stormsewer, & Crossing – Coal Crk	$12,425	M	None
387	Flood Control	Upper Brook Hollow Detention Sites	$2,900	M	None
392	Flood Control	Yorktown Apts. Diversion Channel and Stormsewer	$690	M	None
318	Flood Control	56th Street Culvert Replacement & Channel	$500	L	None
323	Flood Control	Cascia Hall Diversion Channel & Storm Sewer	$470	L	None
339	Flood Control	Eight Acres Bank Restoration	$270	L	None
345	Flood Control	Fred Creek Richmond Trib Drainage Channel Improvements	$225	L	None
364	Flood Control	Mockingbird Lake Dredging	$335	L	None
368	Flood Control	Perryman Ditch I-44 Storm Sewer	$10,350	L	None

No.	Department	Project Title	Cost Estimate (in Thousands)	Priority	FY Funding
	Drought Mitigation				
250	Water Projects	Water Quality Plan, All Basins	$4,550	H	FY03
254	Water Projects	AB Jewell Plant Maintenance & Improvements	$5,885	H	FY03
259	Water Projects	16” Main – Pine Harvard to Hudson	$895	H	FY03
276	Water Projects	Unserved Areas	$9,350	H	FY03
278	Water Projects	Water System Site Improvements	$150	H	FY03
261	Water Projects	48” Line – Mowhawk WTP on Sheridan C & L	$3,525	H	FY04
243	Water Projects	Grand River Flow Line Phase 1(Salina Pumpback)	$82,000	H	FY05
257	Water Projects	12” WaterLoop – 76th to 96th Street North	$465	H	FY05
275	WaterProjects	Turkey Mountain Secondary Service Area	$2,100	H	FY05
258	Water Projects	16” Main Edison Elwood to 65th W. Ave	$1,800	H	FY06
279	Water Projects	Water Vault Safety Upgrades	$100	H	FY06
249	Water Projects	Tiawah Tunnel Insert	$4,000	H	FY07
252	Water Projects	AB Jewell Plant 30 MGD Expansion	$43,125	H	FY07
260	Water Projects	24” Water Loop Fair Oaks Annexation	$7,900	H	FY07
273	Water Projects	Second Tank – Southside (Secondary System)	$1,400	H	FY07
255	Water Projects	AB Jewell Plant Sludge Landfill	$2,220	M	None
262	WaterProjects	48” Main 51st & Memorial to Sheridan Tank System $6,060	$6,060	M	None
244	Water Projects	Grand River Flow Line Phase II (US 69 to AB Jewell)	$87,330	L	None
251	Water Projects	AB Jewell Plant 15 MGD Expansion	$21,565	L	None
256	Water Projects	AB Jewell & Mohawk Plants Chloramine Conv	$300	L	None
263	Water Projects	60” Line – 21st Street from AB Jewell (Clean&Line)$1,090	$1,090	L	None
	Dam Failures Mitigation				
247	Water Projects	Spanivaw and Eucha Dam Repairs	$800	H	FY03
	Hazardous Materials Events Mitigation				
15	Fire Projects	Hazardous Materials Protection Complex	$3,500	H	None

Appendix D:

City of Tulsa Critical Facilities

This page removed due to sensitive nature of information.

For more information, contact information can be located on page xviii.

Appendix E:

City of Tulsa Government Buildings

Appendix E: City of Tulsa Government Buildings

Type of Facility *City of Tulsa Administration*

Name	Address	City	Phone	ZipCode	POC	POCTitle	POCPhone
City Of Tulsa (City Hall)	200 Civic Center Plaza	Tulsa	(918) 596-2100	74103			
Tulsa Convention Center	100 Civic Center	Tulsa	(918) 596-7177	74103			
Tulsa Performing Arts Center	110 E 2nd St	Tulsa	(918) 596-7122	74103			

Type of Facility *Tulsa International Airport*

Name	Address	City	Phone	ZipCode	POC	POCTitle	POCPhone
Tulsa International Airport	7777 E Apache	Tulsa	(918) 838-5000	74115			

Type of Facility *Public Works*

Name	Address	City	Phone	ZipCode	POC	POCTitle	POCPhone
Chemical Storage Building	2317 S Jackson Ave	Tulsa					
Equipment Maintenance	5625 S Garnett Rd				Tom Graham		(918) 596-9842
Equipment Management	1720 Newblock Park Dr	Tulsa	(918) 596-9825		Jim Don Cheek		(918) 596-9825
Field Customer Services	2445 S Jackson Ave	Tulsa	(918) 596-9777				
Fuel Facility	2317 S Jackson Ave	Tulsa					
Portable Building	2317 S Jackson Ave	Tulsa					
Satellite Fuel Station	1747 S 101st E Ave	Tulsa					
Storage Shed	2317 S Jackson Ave	Tulsa					
Street Dept Garage/Offices	5675 S Garnett Rd	Tulsa			Darren Stefanek		(918) 527-0233
Structural Maintenance	1712 Charles Page Blvd	Tulsa	(918) 596-2496		Ric Brown		(918) 519-7700
Surplus Facility	2317 S Jackson Ave	Tulsa					
Tire Shop	2317 S Jackson Ave	Tulsa					
W&M South Yard Storage Building	2317 S Jackson Ave	Tulsa					
W&M South Yard Office/stock Building	2317 S Jackson Ave	Tulsa					
Warehouse/Materials Stockroom	2317 S Jackson Ave	Tulsa					
Water District Office/Warehouse	5605 S Garnett Rd	Tulsa	(918) 252-0669		Eric Lee		(918) 527-0197

Type of Facility *Water Supply & Distribution*

Name	Address	City	Phone	ZipCode	POC	POCTitle	POCPhone
Bird Creek #2 Pump Station	17111 E 46th St N	Tulsa			Jim Tweet		(918) 591-4570

Bird Creek 5mg Storage Tank	17111 E 46th St N						
Bishop Tract Detention Basin	3600 S 103rd E Ave						
Grand River Pump Station # 1	Waterline Rd - 7 To 8 Mi. W of St		(918) 369-5961		Dean Nichols		(918) 261-9171
Lake Eucha Offices		Jay	(918) 596-9924		Jerry Youngblood		(918) 253-8601
Lake Spavinaw Bldgs & Grounds		Jay			Otis Mcdonald		(918) 261-9174
Oologah Pump Station	Hwy 88 At Oologah Dam						
Permit Office	West of Hwy 10-59 - 5 Mi. S of Ja						
Permit Office/water Plant/Lab/Shop	401 E Lake Ave						
Reservoir Manager Residence	402 E Lake Ave						
Residence - Dam Operator	~ 8 Mi. Due West of Boat Basin						
Sampling Station Ind. Pre-treatment	E 54th Stat Mingo Creek	Tulsa	(918) 591-4379		Scott Vanloo		(918) 261-9142
Sampling Station Ind. Pre-treatment	58th St & Mingo Creek	Tulsa			Scott Vanloo		(918) 261-9142
Sewage Pump Station	16th Pl. & West Bank River -- Ri	Tulsa					
Shop Area	East of Hwy 10-59 - 5 Mi. S of Ja						
Storm Water Pump Station	5665 N 105th E Ave						
Storm Water Storage	5665 N 105th E Ave						
Tower Site	Tiawa, OK						
Tower Site	Top of FNB	Tulsa					
Tower Site	Bristow, OK						
Tower Site	Top of FNB - Fire, Police, Comm	Tulsa					
Tower Site	Spavinaw, Ok						
Tower Site	11707 East 31st St						
Tower Site	7310 East 71st St	Tulsa					
Tower Site	21st & Louisville Water Tank And	Tulsa					
Tower Site	Eucha Lake						
Tower Site	7429 S Lewis Ave	Tulsa					
Tower Site	14333 East 11th St						
Tower Site	2404 West 51st St N						
Tower Site - Communications	6650 E 61st	Tulsa					
Tower Site - Spavinaw	6 Miles W Spavinaw						
Tower Site/Building - Pryor	2080 S New Haven						

Type of Facility *Waste Water Collection & Treatment*

Name	***Address***	***City***	***Phone***	***ZipCode***	***POC***	***POCTitle***	***POCPhone***
501 Activated Sludge Facilities	5665 N 105th E Ave						

502 Activated Sludge Fac (11 MGD)	5665 N 105th E Ave						
601/602 Activated Sludge Fac (21 MGD	5665 N 105th E Ave						
Administrative Bldg. & Operations	5665 N 105th E Ave						
Airport Lift Station	5665 N 105th E Ave	Tulsa			Jim Tweet		(918) 591-4557
Cherokee Lift Station	5702 E 66th St N	Tulsa			Bill Fall-Leaf		(918) 261-2901
Chlorination Facilities	5665 N 105th E Ave						
DAF Building	5665 N 105th E Ave						
Dechlorination Facilities	5665 N 105th E Ave						
Excess Flow Diversion Facilities	5665 N 105th E Ave						
Haikey Creek Lift Station	11602 E 151st St						
Headworks Building	5665 N 105th E Ave						
Maintenance Building	5665 N 105th E Ave						
Multifunctional Laboratory	5665 N 105th E Ave						
Northside Wastewater Treatment Plant	5655 N 105th E Ave	Tulsa			Jim Tweet		(918) 591-4570
Return Flow Pump Station	5665 N 105th E Ave						
Secondary Digesters	5665 N 105th E Ave						
Septic/Vactor Disposal Facility	5665 N 105th E Ave						
Sewage Lift Station (Central)	5111 N 220th E Ave						
Sewage Lift Station (North)	6420 N 213th E Ave						
Sewage Lift Station (South)	4821 N 211th E Ave						
Sewage Pump Station - Abandoned	22nd & Olympia	Tulsa					
Sewer Base Lift Station	4235 N 93rd E Ave	Tulsa					
Sewer Lift Station	4203 1/2 N Evanston	Tulsa			Bill Fall-Leaf		(918) 261-2901
Sewer Lift Station	21st & Riverside	Tulsa	(918) 591-4226		Bill Fall-Leaf		(918) 261-2901
Sewer Lift Station	67th & Gary	Tulsa					
Sewer Lift Station	76th St N & Trenton	Turley	(918) 669-6101		Bill Fall-Leaf		(918) 261-2901
Sewer Lift Station	2220 E 66th St N	Turley	(918) 669-6101		Bill Fall-Leaf		(918) 261-2901
Sewer Pump Station	34 S 119th E Ave						
Southside Lift Station (Raw Sewage Pu	5300 S Elwood Ave	Tulsa					

Type of Facility *Parks Department*

Name	***Address***	***City***	***Phone***	***ZipCode***	***POC***	***POCTitle***	***POCPhone***
Adams Park	1627 N Atlanta Pl	Tulsa					
Admiral Park	29 N Victor Ave	Tulsa					
Alfred E Aaronson Park	4807 S 87th E Ave	Tulsa					

Alsuma Soccer Complex	9801 E 51st St	Tulsa				
Archer Park (Pool Bldg)	2831 E Archer St	Tulsa	(918) 838-9479			
Bales Park (Restroom)	5801 S Union Ave	Tulsa	(918) 446-6880			
Benedict Park	1630 E 12th St	Tulsa				
Benton Park	1167 N 66th E Ave	Tulsa				
Berry Park (Pool)	5002 N Wheeling Ave	Tulsa	(918) 591-4259			
Bishop Park	3342 S 101st E Ave	Tulsa				
Boeing Park	9311 E 2nd St	Tulsa				
Boots Adams Park	6441 S 76th E Ave	Tulsa				
Braden Park - Shelter w/ Restrooms	5036 E 7th St	Tulsa				
Bullette Park	1001 E King St	Tulsa				
Carbondale Park	2802 W 48th St	Tulsa				
Carl Smith Sports Complex	17120 E 21st St	Tulsa	(918) 234-3254		Max Wiens	
Cathedral Square	22 W 10th St	Tulsa				
Centennial Park & Central Senior Cente	1028 E 6th St	Tulsa	(918) 596-1455			
Challenger 7 Park (Pool)	3909 W 41st St	Tulsa	(918) 591-4493			
Clinton Park	3121 E Queen Pl	Tulsa				
Council Oak Park	1750 S Cheyenne Ave	Tulsa				
Cousins Park	121st & S Yale Ave	Tulsa				
Cowan Park	10901 E 19th St	Tulsa				
Creek Stickball Park	18th & Cheyenne Ave	Tulsa				
Creek Turnpike Trail	9599 S Lakewood Ave	Tulsa				
Forche Field Baseball Stadium	1712 Charles Page Blvd	Tulsa	(918) 596-2542		Dale Cox	(918) 646-0157
Gilcrease Museum	1400 Gilcrease Museum Rd	Tulsa	(918) 596-2700	74127		
Haikey Creek Park	11300 S Garnett Rd	Tulsa	(918) 369-5998		Kevin Derrick	(918) 521-7724
Hall Park & Community Center	3340 N Delaware Ave	Tulsa	(918) 591-4152			
Heller Park & Theatre	5328 S Wheeling Ave	Tulsa	(918) 746-5065			
Hicks Park & Community Center	3443 S Mingo Rd	Tulsa	(918) 591-4379		Rhonda Freiner	(918) 669-6355
Hunter Park (Shelter)	5804 E 91st St	Tulsa				
L. C. Clark Park & Theatre	11440 E Admiral Pl	Tulsa	(918) 669-4655			
Manion Park & Dramatic Arts	3003 E 56th St	Tulsa	(918) 747-9494		Nancy Morgan	
Mohawk Park Shelters	5701 E 36th St N	Tulsa	(918) 596-7275		Karl Miller	(918) 646-0157
Mohawk Golf Course	5223 E 41st St	Tulsa	(918) 425-6871	74115	Ken Idleman	(918) 591-4160
Newblock Park - Bathhouse & Junior P	1712 W Charles Page Blvd	Tulsa				
Newblock Park - Concession #1	1712 W Charles Page Blvd	Tulsa				

Newblock Park - Concession #2	1712 W Charles Page Blvd	Tulsa					
Newblock Park - Garage	1712 W Charles Page Blvd	Tulsa					
Newblock Park - Metal Storage Shed	1712 W Charles Page Blvd	Tulsa					
Newblock Park - Restroom #1	1712 W Charles Page Blvd	Tulsa					
Oxley Nature Center	6700 Mohawk Blvd	Tulsa	(918) 669-6644		Bob Jennings		(918) 646-0157
Page Belcher Golf Course	6666 S Union Ave	Tulsa	(918) 446-1529		George Glen		(918) 446-7332
Page Belcher Golf Course - Cart Storag	6666 S Union	Tulsa					
Page Belcher Golf Course - Maint. Buil	6666 S Union	Tulsa					
Page Belcher Golf Course - Rest Facilit	6666 S Union	Tulsa					
Tulsa Zoo	5701 E 36th St N	Tulsa	(918) 669-6600	74115	Larry Nunley		(918) 646-0157
Whiteside Park & Community Center	4009 S Pittsburg Ave	Tulsa	(918) 746-5040		Suzie Marcum		
Woodward Greenhouse	2324 S Rockford Ave	Tulsa	(918) 596-7275		Mark Linholm		(918) 746-5157

Type of Facility *Fire Department*

Name	***Address***	***City***	***Phone***	***ZipCode***	***POC***	***POCTitle***	***POCPhone***
Communication Area For Fire Dept	1712 S Phoenix Ave	Tulsa					
Fire Dept Dog Kennel	1760 Newblock Park Dr	Tulsa					
Fire Station #9	1420 Charles Page Blvd	Tulsa					
Garage & Fuel Facility	1720 Newblock Park Dr	Tulsa					
Tulsa Fire Department #10	508 E Pine St	Tulsa	(918) 596-1710	74106			
Tulsa Fire Department #11	5009 E 15th St	Tulsa	(918) 669-6151	74112			
Tulsa Fire Department #12	3123 W 40th St	Tulsa	(918) 591-4412	74107			
Tulsa Fire Department #13	345 S 41st W Ave	Tulsa	(918) 596-1713	74127			
Tulsa Fire Department #14	3602 S Lewis Ave	Tulsa	(918) 746-5114	74105			
Tulsa Fire Department #15	4168 E Admiral Pl	Tulsa	(918) 669-6168	74115			
Tulsa Fire Department #16	1401 N Lewis Ave	Tulsa	(918) 596-1716	74110			
Tulsa Fire Department #17	1351 N Sheridan Rd	Tulsa	(918) 669-6163	74115			
Tulsa Fire Department #18	4802 S Peoria Ave	Tulsa	(918) 746-5118	74105			
Tulsa Fire Department #19	509 E 56th St N	Tulsa	(918) 591-4019	74126			
Tulsa Fire Department #2	524 W Edison	Tulsa	(918) 596-1702	74103			
Tulsa Fire Department #21	4606 E 31st St	Tulsa	(918) 746-5121	74135			
Tulsa Fire Department #22	616 S 73rd E Ave	Tulsa	(918) 669-6158	74112			
Tulsa Fire Department #23	4348 E 51st St	Tulsa	(918) 596-1723	74135			
Tulsa Fire Department #24	3520 N Peoria Ave	Tulsa	(918) 591-4224	74106			
Tulsa Fire Department #25	7419 E 42nd Pl	Tulsa	(918) 669-6325	74145			

Tulsa Fire Department #26	2404 W 51st St	Tulsa	(918) 591-4426	74107			
Tulsa Fire Department #27	11707 E 31st St	Tulsa	(918) 669-6327	74146			
Tulsa Fire Department #28	7310 E 71st Street	Tulsa	(918) 252-7012	74133			
Tulsa Fire Department #29	7429 S Lewis Ave	Tulsa	(918) 596-1729	74136			
Tulsa Fire Department #3	62 N Utica Ave	Tulsa	(918) 596-1703	74110			
Tulsa Fire Department #30	14333 E 11th St	Tulsa	(918) 669-6450	74108			
Tulsa Fire Department #31	3002 N Mingo	Tulsa	(918) 669-6173	74116			
Tulsa Fire Department #32	6010 E 91st St	Tulsa	(918) 596-1732	74137			
Tulsa Fire Department #4	524 W 12th St	Tulsa	(918) 596-1704	74119			
Tulsa Fire Department #5	102 E 18th St	Tulsa	(918) 596-1705	74119			
Tulsa Fire Department #51 (Airport)	Taxiway Echo & Bravo	Tulsa	(918) 838-5043	74116			
Tulsa Fire Department #6	7212 S Union Ave	Tulsa	(918) 591-4406	74132			
Tulsa Fire Department #7	601 S Lewis Ave	Tulsa	(918) 596-1707	74104			
Tulsa Fire Department Hazardous Mtls	1420 W Charles Page Blvd	Tulsa	(918) 596-1254	74127	Mike Mallory		(918) 596-1228
Tulsa Fire Department Hdqtrs	411 S Frankfort	Tulsa	(918) 596-9444	74120	Allen Lacoy		(918) 596-1790
Tulsa Fire Department Supply	1790 Newblock Park Dr	Tulsa	(918) 596-1230	74127			
Tulsa Fire Department Training	1760 Newblock Park Dr	Tulsa	(918) 596-9411	74127			
Tulsa Fire Dept (Alarm Office/tower)	1010 E 8th St	Tulsa	(918) 596-9977				

Type of Facility *Police Department*

Name	***Address***	***City***	***Phone***	***ZipCode***	***POC***	***POCTitle***	***POCPhone***
Fuel Island - UDN	3411 N Columbia	Tulsa					
Fuel Island - UDSW	7515 S Riverside	Tulsa					
Police Special Investigations	Confidential	Tulsa					
Tulsa Police Department (Courts Bldg)	600 Civic Center	Tulsa	(918) 596-2100	74103			
Tulsa Police Department Training Facili	6066 E 66th St N	Tulsa	(918) 591-4500	74117			
Tulsa Police Dept (North Div)	3411 N Columbia	Tulsa	(918) 591-4100	74110	Walter Evans		
Tulsa Police Dept (East Div)	10122 E 11th St	Tulsa	(918) 669-6000	74128			
Tulsa Police Dept (Southwest Div)	7515 Riverside Dr	Tulsa	(918) 596-1100	74136			
Tulsa Police Dept Seized Vehicle Facilit	1326 E Mohawk Blvd	Tulsa					
Tulsa Police Offices Lower Level Cente							

Type of Facility *EMSA*

Name	***Address***	***City***	***Phone***	***ZipCode***	***POC***	***POCTitle***	***POCPhone***
EMSA	1417 N Lansing Ave	Tulsa	(918) 596-3003				

Appendix F:

Hazard Mitigation Committee Meeting Agendas

SPECIAL MEETING

NOTICE AND AGENDA

CITIZEN HAZARD MITIGATION COMMITTEE

Wednesday, October 31, 2001

City Hall, Room 1101, 9:00 a.m.

Report, discuss, and take appropriate action, if any, on the following:

1. Call to Order
2. Introductions
3. Video - Tulsa Floods
4. Briefing on Hazard Mitigation Planning Program - Ron Flanagan
5. CRS (Community Rating System) Reverification - French Wetmore
6. (Hazard Mitigation) Project Impact - Gaylon Pinc
7. Schedule of Meeting Dates
8. Election of Officers
9. Public Comments
10. Date of the Next Meeting
11. Adjourn

Hazard Mitigation Staff Meeting
Wednesday, October 31, 2001
City Hall, Room 201, 10:30 a.m.
Draft Agenda – as of 12/11/01

Report, discuss, and take appropriate action, if any, on the following:

1. Call to Order

2. Introductions

3. Overview of Hazard Mitigation Planning Process and timetable

4. 2002 Meeting Schedule

5. Draft Resolution – establishing this planning process

6. Hazard Mitigation Plan Outline

7. Framework, Section 3: Natural Hazard Mitigation Topics

8. Adjourn

Hazard Mitigation Staff Meeting
Tuesday, November 13, 2001
City Hall, Room 532, 3:00 p.m.

1. Call to Order
2. Review of Initial TSTAC Meeting of Oct 31, 2001
3. Overview of Hazard Mitigation Planning Process and timetable
4. Status on HMGP grant
5. Status on resolution
6. Hazard Mitigation Plan Outline
7. Addition of Hazard-Mitigation to SDAB standard item line in agenda
8. Needs for Tulsa historical data
9. Review of committee members' comments, questions, and goals/objectives
10. Adjourn

Hazard Mitigation Staff Meeting
Tuesday, December 11, 2001
City Hall, Room 532, 3:00 p.m.

1. Call to Order

2. Review of November 13, 2001 TSTAC Meeting

3. Status on HMGP grant

4. Hazard-Mitigation Workshop – tentatively set for April 23, 2002

5. Discussion on changing the time of the HM Citizen Meeting from 10:30a to 3:00p

6. Hazard Mitigation Plan Outline

7 Review of committee members' recommendations on specific goals and natural disasters

8 Adjourn

Hazard Mitigation Citizens Meeting

Wednesday, December 19, 2001

City Hall, Room 201, 10:30 a.m.

Draft Agenda – as of 12/11/01

Report, discuss, and take appropriate action, if any, on the following:

1. Call to Order
2. Introductions
3. Overview of Hazard Mitigation Planning Process and timetable
4. 2002 Meeting Schedule
5. Draft Resolution – establishing this planning process
6. Hazard Mitigation Plan Outline
7. Framework, Section 3: Natural Hazard Mitigation Topics
8. Adjourn

Hazard Mitigation Staff Meeting
Tuesday, January 8, 2002
City Hall, Room 532, 3:00 p.m.
Draft Agenda – as of 1/7/02

1. Call to Order
2. Review of Citizens' Agenda packet for January 16, 2002
3. Overview of Hazard Mitigation Planning Process and timetable
4. Status on HMGP grant
5. Status on resolution
6. Hazard Mitigation Plan Outline
7. Addition of Hazard-Mitigation to SDAB standard item line in agenda
8. Needs for Tulsa historical data
9. RFA on naming Mingo Trail
10. Bibliography/Chronology
11. Review of committee members' comments, questions, and goals/objectives
12. Adjourn

Hazard Mitigation Citizens Meeting

Wednesday, January 16, 2002

City Hall, Room 1101, 10:30 a.m.

Draft Agenda – as of 1/16/02

1. Call to Order
2. Review of Minutes
3. Natural Hazard Mitigation Goals and Objectives
4. Draft Resolution – establishing this planning process
5. Overview of Hazard Mitigation Planning Process, outline and timetable
6. Public Comments
7. Date of next meeting
8. Adjourn

Hazard Mitigation Staff Meeting
Tuesday, February 12, 2002
City Hall, Room 532, 3:00 p.m.
Draft Agenda – as of 2/11/02

1. Call to Order
2. Review of Citizens' Agenda packet for Feb 20, 2002
3. Status on HMGP grant
4. Hazard-Mitigation Workshop – tentatively set for April 23, 2002
5. Discussion on changing the time of the HM Citizen Meeting from 10:30a to 3:00p
5. Hazard Mitigation Plan Outline
6. Review of committee members' recommendations on specific goals and natural disasters
7. Adjourn

Hazard Mitigation Citizens Meeting
Wednesday, February 20, 2002
City Hall, Room 1101, 10:30 a.m.
Draft Agenda – as of 1/29/02

1. Call to Order

2. Review of Minutes

3. Overview of Hazard Mitigation Planning Process, outline and timetable - Group's recommendations on the specific goals and natural disasters.

4. Hazard-Mitigation Workshop – tentatively set for April 23, 2002

5. Identification of mitigation measures

6. Date of next meeting

7. Adjourn

Hazard Mitigation Staff Meeting
Tuesday, March 12, 2002
City Hall, Room 532, 3:00 p.m.

1. Call to Order

2. Review of Citizens' Agenda Meeting of January 16, 2002

3. Status on HMGP grant

4. Hazard-Mitigation Workshop – tentatively set for April 23, 2002

5. Hazard Mitigation Plan Outline

6. Review of committee members' recommendations on specific goals and natural disasters

7. Adjourn

NOTICE AND AGENDA

Hazard Mitigation Citizens' Committee

Wednesday, March 20, 2002

City Hall, Room 1101, 10:30 a.m.

1. Call to Order

2. Approve Minutes of the Meeting of February 20, 2002

3. Overview of Hazard Mitigation Planning Process, Outline and Timetable - Group's Recommendations on Specific Goals and Natural Disasters

4. Hazard Mitigation Workshop - Tentatively Set for April 23, 2002

5. Identification of Mitigation Measures

6. Date of Next Meeting - The next meeting will be held Wednesday, April 17, 2002, 10:30 a.m., City Hall, Room 1101

7. Adjourn

Hazard Mitigation Staff Meeting
Tuesday, April 9, 2002
City Hall, Room 532, 3:00 p.m.

1. Call to Order

2. Review of Citizens' Agenda Meeting of March 20, 2002

3. Status on HMGP grant

4. Hazard-Mitigation Workshop – tentatively set for April 23, 2002

5. Hazard Mitigation Plan Outline

6. Review of committee members' recommendations on specific goals and natural disasters

7. Adjourn

Minutes

Hazard Mitigation Citizens Committee

April 17, 2002, 10:30 a.m.

City Hall, Room 1101

The meeting was cancelled due to the Hazard Mitigation Workshop, which will be held on April 23, 2002. The next meeting will be Wednesday, May 15, 2002.

Secretary

Hazards Workshop Agenda
Tuesday, April 23, 2002

Start Time	Subject	Time	Agency	Speaker
8:30 AM	Coffee and Danish	0:30		
9:00 AM	Welcome	0:10	City of Tulsa	**Mayor Lafortune (NP) / Charles Hardt**
9:10 AM	Hazard Mitigation Overview	0:15	ODCEM	**Albert Ashwood / Fred Liebe (NP)**
9:25 AM	GIS: Overview of Hazards	0:15	INCOG	**Gaylon Pinc**
9:40 AM	GIS: Future of Hazard Mitigation Planning	0:15	TCCHD	**Amy Thomas**
9:55 AM	Drought	0:20	ODCEM	**Albert Ashwood**
10:15 AM	BREAK	0:15		
10:30 AM	Severe Thunderstorms, High Winds, Hail, Lightning	0:45	NWS / Metro Call	**George Mathews / Tim Diehl**
11:15 AM	Severe Thunderstorms, High Winds, Hail, Lightning	0:45	Private Prespective - State Farm Ins	**Mike Gurley**
12:00 PM	**LUNCH**	0:30		
12:30 PM	Keynote Speaker	0:30	FEMA Region VI	**Lonnie Ward / John Westmoreland**
1:00 PM	BREAK	0:15		
1:15 PM	Tornadoes	0:20	TAEMA	**Mike McCool**
1:35 PM	Extreme Cold, Ice, Winter Storms	0:20	Red Cross	**Steve Whitehead**
1:55 PM	Extreme Heat	0:15	Red Cross	**Bob Roberts**
2:10 PM	Fire, Wildfires	0:20	TFD	**Bill Kaiser**
2:30 PM	BREAK	0:15		
2:45 PM	Floods	0:20	USACE / OWRB	**Joe Remondini / Jeff McMurphy**
3:05 PM	Dam Failures	0:15	OWRB	**Cecil Bearden**
3:20 PM	Expansive Soils	0:15	NRCS	**Gary Bishop**
3:35 PM	Hazardous Materials	0:15	TFD	**Tom Bergman (NP) / Randy Brasfield**
3:50 PM	Earthquakes	0:10	OK Geo Suvey	**Dr. James Lawson**
4:00 PM	Adjourn			

Hazard Mitigation Staff Meeting
Tuesday, May 7, 2002
City Hall, Room 532, 3:00 p.m.

1. Call to Order

2. Review of Regional Multi-Hazard Mitigation Workshop, April 23, 2002

3. Status on HMGP grant

4.

5.

6. Review of committee members' recommendations on specific goals and natural disasters

7. Adjourn

Tulsa Hazard Mitigation
Citizens Advisory Committee
Agenda
Wednesday, May 15, 2002 10:30 AM
Room 1101 City Hall

1. Call to order
2. Approval of Minutes
3. Review Status of HM 1401 Application
4. HM Workshop Report
5. Review Updated Hazard write-ups; Tornadoes, Drought, Extreme Heat, Winter Storms
6. Review Mitigation Measures
    a. General Approach
    b. Categories of Measures
    c. Schedule of Review
7. Old Business
8. New Business
9. Date of Next Meeting
10. Adjourn

Hazard Mitigation Staff Meeting
Tuesday, June 11, 2002
City Hall, Room 532, 3:00 p.m.

1. Call to Order

2. Review of Citizens' Agenda Meeting of May 15, 2002

3. Status on HMGP grant

4.

5.

6. Review of committee members' recommendations on specific goals and natural disasters

7. Adjourn

Hazard Mitigation Measures Workshop

Homebuilders Association of Greater Tulsa
11545 E. 43rd Street

Workshop Agenda

Thursday, June 13, 2002
9:00 am – 12:00 pm

Time	Subject/Topic	Facilitator Presenter
0900	Welcome	Sandy Cox, Chair
	Workshop Goals and Objectives	Ron Flanagan
	Overview, Hazard Mitigation Planning Process	
	Hazards Investigated	
	Profile, History, Vulnerability	
	Mitigation Measures to be Identified	
	Preventive	
	Property Protection	
	Natural Resource Protection	
	Emergency Activities	
	Structural Projects	
	Public Information and Education	
	General Measures	Mike Buchert
	Floods	
	Dam Failures/Releases	
	Levee Failures	
1018	Morning Coffee/Networking Break	
1028	Tornadoes	
	High Winds	
	Lightning	Hail
	Winter Storms/Ice/Extreme Cold	
	Extreme Heat	
	Drought	
	Expansive Soils	
	Earthquakes	
	Urban Fires	Brent Stout
	Wildfires	
	Hazardous Materials Events	
	Conclusion/Wrap-up	
1200	Adjourn	

Tulsa Hazard Mitigation
Citizens Advisory Committee
Agenda
Wednesday June 19, 2002 10:30 AM
Room 1101 City Hall

11. Call to order

12. Approval of Minutes-Meeting of March 29, 2002

13. Review Status of Hazard Mitigation 1401 Application

14. Hazard Mitigation Workshop Report

5. Review Updated Hazard Write-Ups

6. Review Mitigation Measures

7. Old Business

8. New Business

9. Date of Next Meeting-10: 30 a.m., July 17, 2002

10. Adjourn

Hazard Mitigation Staff Meeting
Wednesday, July 10, 2002
City Hall, Room 532, 3:00 p.m.

1. Call to Order

2. Review of Citizens' Agenda Meeting of June 19, 2002

3. Status on HMGP grant

4.

5. Hazard Mitigation Plan Outline

6. Review of committee members' recommendations on specific goals and natural disasters

7. Adjourn

Tulsa Hazard Mitigation Citizens Advisory Committee
10:30am, Wednesday, July 17, 2002
Room 1101, City Hall

Agenda

1. Call to order
2. Approval of Minutes
3. Schedule
4. Workshop Mitigation Measures
5. Recommend Capital Improvement Projects

6.Old Business

7. New Business

8. Date of Next Meeting – 10:30 a.m., August 21, 2002

9. Adjourn

NOTICE AND AGENDA

STORMWATER DRAINAGE ADVISORY BOARD MEETING

Thursday, July 18, 2002, 3:00 p.m.

City Hall, Room 1101

Report, discuss, and take appropriate action on the following:

1. Call to Order

2. Approval of Minutes - Meeting of January 17, 2002 (March meeting cancelled – May meeting no quorum)

3. Budget and 5-Year Financial Plan - Mike Buchert

4. Fees in Lieu of Detention - Comparison of Fees with Surrounding Areas - Deborah Stowers

5. Community Rating System Outreach Program Strategy – Laureen Gilroy

6. Citizens' Hazard Mitigation Committee Report – Mike Buchert and Ron Flanagan

7. Director's Report

8. Public Comments

9. New Business (Any matter not known about or which could not have been reasonably foreseen prior to the time of posting the agenda)

10. General Discussion

11. Items for Future Agendas:

    a. General review of City Stormwater Ordinances and function of staff
    b. General Construction Permits - Region 6
    c. Computerize Fees in Lieu of Detention that have been paid

12. Date of Next Meeting – The next regularly scheduled meeting will be held September 19, 2002, 3:00 p.m., City Hall, Room 1103. A Special Meeting will be scheduled to discuss the Hazard Mitigation Plan.

13. Adjourn

Hazard Mitigation Staff Meeting
Thursday, August 1, 2002
City Hall, Room 532, 3:00 p.m.

1. Call to Order

2. Review of Citizens' Agenda Meeting of July 17, 2002

3. Status on HMGP grant

4.

5. Hazard Mitigation Plan Outline

6. Review of committee members' recommendations on specific goals and natural disasters

7. Adjourn

SPECIAL MEETING

AGENDA

TULSA HAZARD MITIGATION CITIZENS' ADVISORY COMMITTEE

7:00 p.m., Tuesday, August 20, 2002

North Commons, Union High School, 6636 S. Mingo Road

1. Call to order
2. Welcome, Introductions – Sandy Cox, Committee Chair
3. Presentation about Hazard Mitigation Report and Plan – Ken Hill, Ron Flanagan
4. Receive public comment on report and action plan's mitigation measures
5. Adjourn

SPECIAL MEETING

AGENDA

STORMWATER DRAINAGE ADVISORY BOARD

7:00 p.m., Tuesday, August 20, 2002

North Commons, Union High School, 6636 S. Mingo Road

6. Call to order
7. Welcome, Introductions – Sandy Cox
8. Presentation about Hazard Mitigation Report and Plan – Ken Hill, Ron Flanagan
9. Receive public comment on report and action plan's mitigation measures
10. Adjourn

NOTICE AND AGENDA

Hazard Mitigation Citizens' Committee

Wednesday, September 18, 2002, 10:30 a.m.

City Hall, Room 1101

Report, discuss, and take appropriate action on the following:

1. Call to Order
2. Approval of Minutes - Meeting of July 17, 2002
3. Review Status of Hazard Mitigation 1401 Application
4. Report on Hazard Mitigation Committee Special Meeting of August 20, 2002 held at Union High School, 6636 S. Mingo Road
5. Review Updated Hazard Write-Ups; Tornadoes, Drought, Extreme Heat, and Winter Storms
6. Review Mitigation Measures:
    a. General Approach
    b. Categories of Measures
    c. Schedule of Review
7. Old Business
8. New Business
9. Date of Next Meeting – October 16, 2002, City Hall, Room 1101, 10:30 a.m.
10. Adjourn

NOTICE AND AGENDA

Hazard Mitigation Citizens' Advisory Committee

Wednesday, October 16, 2002

City Hall, Room 1101, 10:30 a.m.

1. Call to Order

2. Approval of Minutes of the September 18, 2002 meeting.

3. Review of Hazard Mitigation Plan and submittal schedule.

4. Presentation of *Safe and Secure Plan* presented to City Council on February 28, 2002.

5. Consider approval of 2002 Meeting Schedule.

6. Report on various City sponsored hazard mitigation programs.

7. Date of next meeting - The next regular meeting will be held Wednesday, November 20, 2002, 10:30 a.m., City Hall, Room 1101.

8. Adjourn.

Notice and Agenda

SPECIAL MEETING

Hazard Mitigation Citizens' Advisory Committee

Wednesday, November 6, 2002

City Hall, ~~Room 532~~, 12:30p.m.
CAFETERIA

1. Call to Order

2. **All-Hazards Mitigation Plan.** Committee will consider a recommendation for approval and adoption of the All-Hazards Mitigation Plan prepared by R. D. Flanagan & Associations. Recommend approval and adoption by Mayor and City Council.

3. Adjourn.

CONSOLIDATION OF COMMITTEE AGENDAS

Tuesday, November 5, 2002
Room 201 - 200 Civic Center

FILED
CITY OF TULSA
STATE OF OKLAHOMA
2002 NOV -1 P 2:5
MICHAEL P. KIER
CITY CLERK

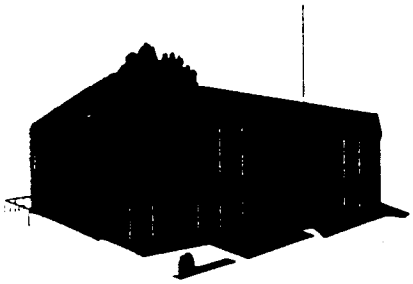
asentation, review and/or discussion of:

8:00 AM **Public Works - (Co-Chairs: Justis, Roop, Christiansen, Sullivan)**

1. Cheryl Conenour - Reappointment to the Tulsa Authority for the Recovery of Energy (TARE); term expires 7/31/2005; (42/46 meetings). 99-605-3
2. Tom Palmer - Reappointment to the Building, Housing and Fire Prevention Board, term expires 6/30/2005; (23/4 meetings). 02-600
3. Kenny (Leroy) Martin - Reappointment to the Plumbing Appeals Board; term expires 6/30/2005; (6/8 meetings). 99-506-3
4. Charles Fitch - Reappointment to the Plumbing Appeals Board; term expires 6/30/2005; (7/8 meetings). 99-646-3
5. Stephen Schuller - Appointment to the Tulsa Authority for the Recovery of Energy (TARE); term expires 7/31/04; (replaces Gilliam). 02-593
6. Application to close a utility easement located at or near S. Toledo Ave. & Creek Turnpike. (Ashton Creek Village) requested by Ashton Creek Village, L.L.C. 02-595
7. Proposed Change Order No. 1 to Non-Arterial Street Rehabilitation, (Project #994816), to provide pay items not included in the original contract. (0.4%). 01-10-13
8. Resolution authorizing condemnation of property located at or near 2837 N Trenton (Lot 003, Block 6, Standard Heights Amended) (Alfonso & Earline Gaines) for Gilcrease Expressway from Lewis Avenue to L.L. Tisdale Parkway (Project #966119). **(Emergency Clause)** (CD-3) [00-227-20
9. Proposed Multi-Hazard Mitigation Plan for the City of Tulsa. 02-596
10. Proposed Resolution adopting an all-hazard Mitigation plan for the City of Tulsa and directing departments to implement recommendations. (Emergency Clause). 02-596-2
11. Review of progress of drainage improvements in Cedar Ridge Park and Saddle Ridge. (Christiansen) 02-205-2
12. Upcoming Public Works Committee agenda items. 96-86
12. Discussion of request by Warrington Homeowners Association and Saint Francis Hospital for refiguring traffic light patterns at 61st & Hudson. (Sullivan) 02-479-2

10:00 AM **Urban & Economic Development - (Co-Chairs: Williams, Christiansen, Neal, Baker)**

1. Michael McConnell - Appointment to the Sales Tax Overview Committee, term expires 12/31/04; (replaces Tisdale). (CD-1) 02-591
2. Charles Meckfessel - Appointment to the Tulsa Port of Catoosa Facilities Authority; term expires 10/31/03; (replaces Bost). 02-594
3. Council Work Item: Marketing - discussion on developing City of Tulsa economic development strategy. (Baker) 02-287-29



TULSA METROPOLITAN AREA PLANNING COMMISSION

For Meeting No. 2327

November 13, 2002
1:30 PM
Francis Campbell City Council Room
Plaza Level, Tulsa Civic Center

CONSIDER, DISCUSS AND/OR TAKE ACTION ON

Call to Order:

1. Minutes of October 23, 2002, Meeting No. 2325

REPORTS

Chairman's Report:

Worksession Report:

Director's Report:

SUBDIVISIONS

FINAL PLAT:

2. **Metro Park East** – IL (3394) (PD-18) (CD-6)
   Northeast corner of East 61st Street and South 129th East Avenue, 4 Lots, 1 Block, 28 acres

3. **College Center at Meadowbrook** – PUD 625, CO-Z-6735-SP-1 (PD-18) (CD-8)
   (1884) East of the Southeast Corner of 81st Street and South Mingo Road, 4 Lots, 1 Block, 9 acres

PRELIMINARY PLAT:

4. **Northwest Passage** – PUD 624 (2202) (PD-11) (CD-1)
   North of Apache, between Gilcrease Drive and Osage Drive (Continued from 11/6/02)

PUBLIC HEARING TO CONSIDER ADOPTION OF THE MULTI-HAZARD MITIGATION PLAN AS AN AMENDMENT TO THE COMPREHENSIVE PLAN FOR THE TULSA METROPOLITAN AREA

5. Consider adoption of the Multi-Hazard Mitigation Plan (Resolution No. 2327:846)

CONTINUED ZONING PUBLIC HEARING

6. **Z-6873 – John W. Moody** **RS-3 to OL**
   South of southeast corner of East 51st Street and South Oswego (PD-18) (CD-7)

OTHER BUSINESS

7. **PUD-579-A – F. Scott Ferguson** (PD-18) (CD-8)
   Northwest corner of East 81st Street and Highway 169 South (Detail Site Plan for a new medical office building.)

8. **PUD-649 – John (Jack) Arnold** (PD-6) (CD-9)
   33rd Street South and South Birmingham Avenue (Detail Site

NOTICE AND AGENDA
TULSA CITY COUNCIL REGULAR MEETING
Thursday, November 21, 2002 at 6:00 p.m.
CITY COUNCIL ROOM
PLAZA LEVEL OF CITY HALL, 200 CIVIC CENTER

FILED
CITY OF TULSA
STATE OF OKLAHOMA

2002 NOV 19 P 3:5

MICHAEL P. KIER
CITY CLERK

PLEDGE OF ALLEGIANCE & PRAYER

PROCLAMATIONS AND SPECIAL ANNOUNCEMENTS

CALL TO ORDER & ROLL CALL

Unless otherwise noted, the Council may discuss, review and/or possibly take action on the following:

1. RECEIPT AND FILING OF MINUTES

a. Minutes of Special Meeting held November 7, 2002 at 3:30 PM. 02-641

b. Minutes of Special Meeting held November 7, 2002 at 5:00 PM. 02-641-2

c. Minutes of Regular Meeting held November 7, 2002. 02-641-3

2. APPOINTMENTS & REAPPOINTMENTS

a. Robert Lorton, III - Appointment to the River Parks Authority; term expires 4/8/04; (replaces Sims). [UED 11-19] 02-613

b. James Pielsticker - Appointment to the River Parks Authority, term expires 4/8/05, (replaces Helmerich). [UED 11-19] 02-612

c. Steve Sewell - Appointment to the Municipal Employee Retirement System (MERP); term expires 12/31/03; (replaces Lemons). [UED 11-19] 02-611

d. Dr. Roberto Ruiz - Reappointment to the Tulsa Authority for the Recovery of Energy (TARE); term expires 7/31/05; (3/5 meetings). [PW 11-19] 02-142-3

e. Suzanne Taylor - Reappointment to the Building, Housing and Fire Prevention Appeals Board; term expires 6/30/2005; (3/4 meetings). [PW 11-19] 98-50-3

3. AUTHORITIES, BOARDS & COMMISSION ITEMS

a. Hearing regarding rezoning application PUD-671, Z-6579-SP-3, requested by Roy Johnsen (Robert D. Nelson), to rezone property located at or near north of the NW/c of E. 101 St. & S. Memorial. (TMAPC voted 8-0-1 to recommend approval.) Including Petition Protesting Rezoning Application. (CD-8) (PD-26) 99-91-7

b. Hearing regarding rezoning application PUD-670, requested by Roy Johnsen (31st & Rockford Development, LLC), to rezone property located at or near the SW/c of E. 31 St. & S. Rockford from RS-3 to RS-3/PUD. (TMAPC voted 7-0-0 to recommend approval.) 02-568

4. ORDINANCES - First Reading

a. Ordinance creating Sanitary Sewer Improvement District #3047 located at or near S. Rosedale Ave. & Southwest Blvd. (O'Donnell Sewer Extension). **(Emergency Clause)** (CD-2) 02-632

b. Ordinance creating Sanitary Sewer Improvement District #3032 located at or near E. 51 St. & S. 187 E. Ave. (Stone Creek Farms). **(Emergency Clause)** (CD-6) 02-633

c. Ordinance creating Sanitary Sewer Improvement District #3043 located at or near E. 77 St. S. & S. Harvard. **(Emergency Clause)** (CD-8) 02-634

5. ORDINANCES - Second Reading

a. Rezoning ordinance PUD-571-A, requested by Roy D. Johnsen (81st & Memorial, LLC), to rezone property located at or near east of the NE/c of E. 81 St. & S. Memorial Dr. from CS/RM-1/PUD to CS/RM-1/PUD. **(Emergency Clause)** (Council approved application on 11-7.) (CD-7)(PD-18) 97-1040-4

b. Rezoning ordinance PUD-643-A, requested by John W. Moody (French Creek Development Co.), to rezone property located at or near east of the NE/c of E. 74th Pl. & S. Memorial Dr. from OL to OL/PUD-643. **(Emergency Clause)** (Council approved application on 11-7.) (CD-7)(PD-18) 01-109-8

c. Rezoning ordinance for Z-6871, requested by Jerry Ledford, Jr. (Lin & Sons Enterprises, Inc.), to rezone property located at or near the NW/c of W. 81 St. & S. Elwood Ave. from AG to RS-3. **(Emergency Clause)** (Council approved application on 11-14.) (CD-2)(PD-8) 02-587-2

d. Budget amendment ordinance making supplemental appropriations of $47,903.00 within the Local Law Enforcement Block Grant Fund, Round Five (#5655) from unencumbered and unallocated fund balance of $41,533.00 and from received grant interest revenues of $6,370.00. [UED 11-19] 02-419-2

e. Budget amendment ordinance increasing appropriations by $16,800.00 within the Historical Preservation Grant Fund (#5315) from receipt of a grant from the Oklahoma Historical Society, State Historic Preservation Office. [UED 11-19] 02-616

6. MAYOR'S ITEMS

a. Resolution approving and adopting an All-hazard Mitigation Plan for the City of Tulsa. **(Emergency Clause)** [PW 11-12] 02-596-3

b. Resolution authorizing condemnation of property located at or near 2837 N Trenton (Lot 003, Block 6, Standard Heights Amended) (Alfonso & Earline Gaines) for Gilcrease Expressway from Lewis Avenue to L.L. Tisdale Parkway (Project #966119). **(Emergency Clause)** (CD-3) [PW 11-5] 00-227-20

c. Quit Claim Deed, from Tulsa County to the City of Tulsa, for 25 parcels of land that will be used as right-of-way for the Gilcrease North Expressway (Project # 96119) . [PW 11-19] 02-628

d. Donation of an storm sewer easement from East Tulsa Christian Church, on property located at or near 9729 E 11th St. (unplatted), as part of the requirements for PFPI 2795. (CD-6) [PW 11-19] 02-626

e. Donation of a storm sewer easement from Southern Hills Baptist Church on property located at or near 5590 S. Lewis Ave. (unplatted), as part of the requirements for a building permit. (CD-9) [PW 11-19] 02-627

f. Donation of an overland drainage from the Vera Mae Dill Trust, on property located at or near 9921 E. 66 St. (Union Gardens), as part of the requirements for PFPI 2789. (CD-7) [PW 11-19] 02-625

g. Donation of a Spectacled Bear from the Queens Wildlife Center, Flushing, NY to the Tulsa Zoological Park. 02-629

h. Donation from McDonald's Corporation of $3,200.00 to purchase ten "Hot Dog Alarms" for the Tulsa Police Department K-9 Unit. 02-638

i. Special Event Application: Lighting of Greenwood, Dec. 7. 00-715-2

j. Special Event Application: ABATE of Tulsa Toy Run, Dec. 8. 02-630

k. Mayor's Report. 97-631

7. COUNCIL ITEMS

a. Issue notice to receive proposals for projects requesting 1985 Sales Tax Economic Development Fund monies and waive Council Rule XIX to restrict the time allotted to receive such proposals. 02-637-2

b. Committee Reports. 97-223

c. Chair's Report. 98-849

8. NEW BUSINESS

9. HEARING OF PUBLIC COMMENTS

a. John Mosher: The Tulsa Metropolitan Sports Authority and Valley Park Soccer. 02-622

b. Lenora J. Davis: MTTA Proposed Fixed Route Cuts, February 2003,Federal Transit Law USC 5333(b); employee protections a/k/a the Urban Mass Transportation Act Sec.13c, FTA Grant Funds, high administration cost, and excessive employee turnover, costly termination's reversed by arbitrations with full benefits. 02-639

c. Kurt G. Arras: Whiteside Park (41st and Pittsburg Ave.) Excessive loitering in the park after dark; curfew change from 11:00 p.m. to dark; proper lighting in the park; police patrol of the park. 02-640

10. ADJOURNMENT

CONSOLIDATION OF COMMITTEE AGENDAS

Tuesday, December 3, 2002
Room 201 - 200 Civic Center

FILED
CITY OF TULSA
STATE OF OKLAHOMA

2002 NOV 27 P 1:14

MICHAEL P. KIER
CITY CLERK

Presentation, review and/or discussion of:

8:00 AM Public Works - (Co-Chairs: Justis, Roop, Christiansen, Sullivan)

1. Barbara Gardner - Reappointment to the City of Tulsa/Rogers County Port Authority: term expires 12/1/2006: (21/32 meetings). 99-123-3
2. Change Order No. 1 to Contract 21769 (Becco Contractor) for Non-Arterial Street Rehabilitation, (Project #994816), adding $2,775.20 (0.4%). 01-10-14
3. License agreement with Park Plaza South Homeowners Association to install and maintain neighborhood-identifying signs located at or near E. 67 St. & S. Sheridan Rd. and S. 73 E. Ave. & E. 71 St. (CD-7) 02-528-2
4. Ordinance creating Sanitary Sewer Improvement District #3047 located at or near S. Rosedale Ave. & Southwest Blvd. (O'Donnell Sewer Extension). **(Emergency Clause)** (CD-2) 02-632
5. Ordinance creating Sanitary Sewer Improvement District #3032 located at or near E. 51 St. & S. 187 E. Ave. (Stone Creek Farms). **(Emergency Clause)** (CD-6) 02-633
6. Ordinance creating Sanitary Sewer Improvement District #3043 located at or near E. 77 St. S. & S. Harvard. **(Emergency Clause)** (CD-8) 02-634
7. Three-year Cycle Reverification for the Community Rating System (CRS) developed by the Federal Emergency Management Agency (FEMA) & the National Flood Insurance Program (NFIP). 98-653-7
8. Resolution approving and adopting an All-hazard Mitigation Plan for the City of Tulsa. **(Emergency Clause)** [PW 11-12] 02-586-3
9. **Status of Project:** Coal Creek Collection Sewer Improvements. (CD-3) 97-870-2
10. **Status of Project:** Darlington Bridge over Coal Creek. 00-443
11. **Status of Project:** Elm Creek Master Drainage Plan. (CD-4) 97-869
12. **Status of Project:** Mingo Road from 51st St. to 61st St. 98-337
13. **Status of Project:** Widening of Peoria Ave. from Mohawk Blvd. to Pine St. 99-287
14. **Status of Project:** Port Road Extension. (CD-3) 96-55
15. **Status of Project:** Salt Storage Buildings. 01-46
16. **Status of Project:** Civic Center Plaza structural repairs. 02-44
17. **Status of Project:** S. Union Avenue over Mooser Creek . 99-416
18. **Status of Project:** Tisdale Expressway & Apache St. interchange. 02-46
19. **Status of Project:** Highway 169: 21st St. to I-44. 01-625
20. **Status of Project:** Highway 169: 11th St. and Admiral Bridges. 01-626
21. **Status of Project:** Gilcrease Expressway from Highway 75 to Peoria. 99-61-11

FILED
CITY OF TULSA
STATE OF OKLAHOMA
2002 DEC -3 P 3:4
MICHAEL R. KIER
CITY CLERK

NOTICE AND AGENDA
TULSA CITY COUNCIL REGULAR MEETING
Thursday, December 5, 2002 at 6:00 p.m.
CITY COUNCIL ROOM
PLAZA LEVEL OF CITY HALL, 200 CIVIC CENTER

PLEDGE OF ALLEGIANCE & PRAYER

PROCLAMATIONS AND SPECIAL ANNOUNCEMENTS

CALL TO ORDER & ROLL CALL

Unless otherwise noted, the Council may discuss, review and/or possibly take action on the following:

1. RECEIPT AND FILING OF MINUTES

a. Minutes of Special Meeting held November 14, 2002. 02-650

b. Minutes of Regular Meeting held November 14, 2002. 02-651

c. Minutes of Special Meeting held November 21, 2002. 02-652

d. Minutes of Regular Meeting held November 21, 2002. 02-653

2. APPOINTMENTS & REAPPOINTMENTS

a. Steve Sewell - Appointment to the Municipal Employee Retirement System (MERP); term expires 12/31/03; (replaces Lemons). [UED 11-19] 02-611

b. J. M. Hewgley, Jr. - Reappointment to the City of Tulsa/Rogers County Port Authority; term expires 10/4/2006; (28/43 meetings). [UED 12-3] 98-862-5

3. AUTHORITIES, BOARDS & COMMISSION ITEMS

a. Sales Tax Overview Committee - Monthly report to Council (November 2002) and response to inquiries concerning the report. 02-658

b. Resolution relating to the incurring of indebtedness of no more that $12,000,000.00 by the Trustees of the Tulsa Metropolitan Utility Authority and approving documents as may be necessary or required. **(Emergency Clause)** [UED 12-3] 02-647

c. Continuation of hearing regarding rezoning application PUD-671, Z-6579-SP-3, requested by Roy Johnsen (Robert D. Nelson), to rezone property located at or near north of the NW/c of E. 101 St. & S. Memorial. (TMAPC voted 8-0-1 to recommend approval.) Including Petition Protesting Rezoning Application. (CD-8) (PD-26) 99-91-9

d. Hearing regarding rezoning application Z-6874, requested by Walter E. Broach, to rezone property located at or near 6802 S. Garnett from AG to OM. (TMAPC voted 9-0-0 to recommend **denial of OM and approval of OL.**) (CD-7)(PD-18) 02-645

e. Hearing regarding rezoning application Z-6872, requested by Robert Nichols, (Violet Rothrock), to rezone property located at or near south of the SE/c of E. 76 St. & S. Sheridan Rd. from AG to OL/RS-3. (TMAPC voted 9-0-0 to recommend **denial of OL zoning and approval of RS-3 zoning**.) (CD-8)(PD-18) 02-648-2

f. Request from applicant, Robert J. Nichols, attorney, for hearing regarding TMAPC denial of application PUD-674 requesting to rezone property located at or near south of the SE/c of E. 76 St. & S. Sheridan Rd., from AG to OL/RS-3/PUD. (TMAPC voted 9-0-0 to deny.) (CD-8)(PD-18) 02-648

4. ORDINANCES - First Reading

a. Ordinance closing an easement located at or near E. 91 St. & S. Sheridan Rd. (Boatmen's Bank I) requested by Bank of America. **(Emergency Clause)** [PW 10-15] 02-542-2

b. Ordinance closing a utility easement located at or near S. Toledo Ave. & Creek Turnpike. (Ashton Creek Village) requested by Ashton Creek Village, L.L.C. **(Emergency Clause)** [PW 11-5] 02-595-2

c. Budget amendment ordinance making supplemental appropriations of $6,001.96 from donations received within the Non-grant Miscellaneous Special Revenue Fund (#5809). 02-400-4

5. ORDINANCES - Second Reading

a. Ordinance creating Sanitary Sewer Improvement District #3047 located at or near S. Rosedale Ave. & Southwest Blvd. (O'Donnell Sewer Extension). **(Emergency Clause)** (CD-2) [PW 12-3] 02-632

b. Ordinance creating Sanitary Sewer Improvement District #3032 located at or near E. 51 St. & S. 187 E. Ave. (Stone Creek Farms). **(Emergency Clause)** (CD-6) [PW 12-3] 02-633

c. Ordinance creating Sanitary Sewer Improvement District #3043 located at or near E. 77 St. S. & S. Harvard. **(Emergency Clause)** (CD-8) [PW 12-3] 02-634

6. MAYOR'S ITEMS

a. Resolution of the Mayor and Council of the City of Tulsa, Oklahoma opposing the proposed E9-1-1 tariff of Southwestern Bell Telephone Company filed with the Oklahoma Corporation Commission to create per-call charges for each E9-1-1 call placed from a cellular phone. **(Emergency Clause)** [Budget 12-3] 02-656

b. Resolution approving and adopting an All-hazard Mitigation Plan for the City of Tulsa. **(Emergency Clause)** [PW 11-12 & 12-3] 02-596-3

c. Three-year Cycle Reverification for the Community Rating System (CRS) developed by the Federal Emergency Management Agency (FEMA) & the National Flood Insurance Program (NFIP). [PW 12-3] 98-653-7

d. License agreement with Park Plaza South Homeowners Association to install and maintain neighborhood-identifying signs located at or near E. 67 St. & S. Sheridan Rd. and S. 73 E. Ave. & E. 71 St. (CD-7) [PW 12-3] 02-528-2

e. Change Order No. 1 to Contract 21769 (Becco Contractor) for Non-Arterial Street Rehabilitation, (Project #994816), adding $2,775.20 (0.4%). [PW 12-3] 01-10-14

f. Monthly Financial Report - Executive Summary for Period ending August 31, 2002. [Budget 12-3] 02-170-10

g. Mayor's Report. 97-631

7. COUNCIL ITEMS

a. 2003 Schedule for Regular Meetings of the Tulsa City Council. 02-642

b. 2003 Schedule for Regular Committee Meetings of the Tulsa City Council. 02-642-2

c. Amendment to the Council Rules and Order of Business adding a new section entitled "Annual Budget Development & Review Process". [Budget 12-3] 97-530-12

d. Committee Reports. 97-223

e. Chair's Report. 98-849

8. NEW BUSINESS

9. HEARING OF PUBLIC COMMENTS

a. James Alexander, Jr.: Deception of north Tulsa when it comes to taxpayers dollars, particularly entitlement funds. 00-194-8

10. ADJOURNMENT

See items 2.16.4 and 2.16.5 on page 4

Synopsis: All item approved my Mayor Protem except: add item 1.16.1.

Items for Approval by Mayor

MONDAY, DECEMBER 9, 2002

Items have been received in City Clerk's Office and are ready for approval and/or execution by the Mayor

1 ITEMS TO COUNCIL:

1.1 Airports Authority
(None)

1.2 Council
(None)

1.3 Equipment Management
(None)

1.4 Finance
(None)

1.5 Fire
(None)

1.6 Gilcrease Museum
(None)

1.7 Human Resources

1.7.1 Confirmation of Michael P. Kier to the Municipal Employees Retirement Board.

1.8 Human Rights
(None)

1.9 Internal Auditing
(None)

1.10 Legal
(None)

1.11 Mayor's Office
(None)

1.12 Municipal Court
(None)

1.13 Park & Recreation
(None)

1.14 Performing Arts Center
(None)

1.15 Police
(None)

1.16 Public Works

1.16.1 Ordinance amending and correcting Ordinance # 20467.

1.17 Telecommunications/Information Services
(None)

1.18 TMAPC
(None)

1.19 Tulsa Convention Center
(None)

1.20 Urban Development
(None)

2 ITEMS FROM COUNCIL:

2.1 Airports Authority
(None)

2.2 Council

2.2.1 Resolution of the Mayor and City Council opposing the proposed E-911 Tariff of Southwestern Bell Telephone Company filed with the Oklahoma Corporation Commission to create per-call charges for each E-911 call placed from a cellular phone.

2.3 Equipment Management
(None)

2.4 Finance

2.4.1 Resolution relating to the incurring of indebtedness by the Trustees of the Tulsa Metropolitan Utility Authority, not to exceed $12,000.000.00.

2.5 Fire
(None)

2.6 Gilcrease Museum
(None)

2.7 Human Resources
(None)

2.8 Human Rights
(None)

2.9 Internal Auditing
(None)

2.10 Legal
(None)

2.11 Mayor's Office
(None)

2.12 Municipal Court
(None)

2.13 Park & Recreation
(None)

2.14 Performing Arts Center
(None)

2.15 Police
(None)

2.16 Public Works

2.16.1 Ordinance creating SSID 3047: O'Donnel Sewer Extension, S. Rosedale Ave. &

Southwest Blvd.

2.16.2 Ordinance creating SSID 3032: Stone Creek Farms, E. 51st St. & S. 187th E. Ave.

2.16.3 Ordinance creating SSID 3043 at E. 77th St. S. and S. Harvard.

2.16.4 FEMA-NFIP Community Rating System: 3-Year Reverification.

2.16.5 Resolution adopting an all-hazard mitigation plan for the City of Tulsa.

2.16.6 License agreement with Park Plaza South Area Homeowners Association to install and maintain neighborhood-identifying signs at 67th St. at South Sheridan Road, and S. 73rd E. Ave. at 71st Street.

2.16.7 Change Order No. 1 to Contract No. 21769 with Becco Contractor, Inc. for Project No. 994816: Non-Arterial Street Rehabilitation, $2,775.20.

2.17 Telecommunications/Information Services
(None)

2.18 TMAPC
(None)

2.19 Tulsa Convention Center
(None)

2.20 Urban Development
(None)

3 CONTRACTS:

3.1 Airports Authority

3.1.1 Weather forecasting service agreement with Surface Systems, Inc., $3,450.00.

3.2 Council
(None)

3.3 Equipment Management
(None)

3.4 Finance
(None)

3.5 Fire
(None)

3.6 Gilcrease Museum

Consolidated Committee Agendas

Room 201 City Hall 10:00 AM

12/10/2002

NOTE: Agendas are provided here for informational purposes only and are not official postings. Please contact the City Council Office at 596-1990 if an official, posted agenda is needed.

Presentation, review and/or discussion of:

8:00 Public Works - (Co-Chairs: Justis, Roop, Christiansen, Sullivan)

1. Proposed ordinance amending Title 26, TRO (Parks), Section 103, entitle "Prohibited Acts," to prohibit glass items on any park property, except in certain areas, as specifically provided. (Emergency Clause) 99-142-5

2. Right of Way Occupancy Permit (020018) application for MBO Video, Inc., Mannford, OK. 02-574

3. Donation of a compensatory storage easement located at or near 2690 S. Terwillger Blvd. from Don & Marilyn McCorkell as a part of the requirements for PFPI 684. (CD-9) 02-669

4. Donation of a utility easement located at or near 1230 Hazel Blvd. (Sunset Terrace) from Richard & Janetta Williamson as a part of the requirements for Lot Split 19411. (CD-9) 02-670

5. Donation of a detention easement located at or near 1102 S. 131 E. Ave. from Oklahoma Conference Corp of Seventh Day Adventists as a part of the requirements for a building permit. (CD-6) 02-671

6. Application to close a compensatory storage easement located at or near S. 129 E. Ave. & State Farm Blvd. (Amberjack, Lot 1, Block 2), requested by Sack & Associates, Inc. 02-667

7. Ordinance amending and correcting Ordinance No. 20467 approved by the Council on Nov. 7, 2002, which contained an error in the legal description of the sewer easement located at or near W. Newton St. & N. Osage Dr. (Osage Hills Apartments). (Emergency Clause) [Tracking: 5-3-02-41 & 5-2-02-42] (CD-1) 01-466-24

8. Resolution authorizing condemnation of property located at or near 4932 E. 91 St. (Yale Cleaners Inc.) for South Yale & 91 Street Intersection (Project #946173). (Emergency Clause) (CD-8) 02-668

9. Proposed suggestions to Mayor LaFortune from the Permitting and Inspections Subcommittee. (Christiansen) 02-432-25

10. Presentation from by Traffic Engineering on the City of Tulsa's traffic calming policy and education program. (Christiansen) 99-452-15

11. Traffic flow levels through neighborhoods near the intersection of 91st Street and Mingo Road. (Christiansen) 02-624-2

12. Health and safety concerns relating to the burning of trees and other materials at construction sites within the City of Tulsa. (Christiansen) 02-665

13. Upcoming Public Works Committee agenda items. 96-86

10:00 Urban & Economic Development - (Co-Chairs: Williams, Christiansen, Neal, Baker)

ITEM #5

1. Elizabeth de Verges - Reappointment to the Tulsa Preservation Commission; term expires 7-12-05; (7/12 meetings). 99-868-3

2. Resolution relating to the incurring of indebtedness by the Trustees of the Tulsa Parking Authority to be evidenced by the not to exceed $16,000,000 Parking Revenue Bonds, Series 2003; waiving competitive bidding on the sale of the bonds and authorizing the sale of the bonds at a discount; approving a bond purchase agreement, and projects agreement. (Emergency Clause) 02-662

3. Budget amendment ordinance making supplemental appropriations of $6,001.96 from donations received within the Non-grant Miscellaneous Special Revenue Fund (#5809). 02-400-4

4. Proposed Tulsa Transit fixed ~~rate~~ route service reduction. (Neal) 98-957-8

5. Resolution No. 2327:846 amending the Comprehensive Plan for the Tulsa Metropolitan Area, by adopting the Multi-hazard Plan for the City of Tulsa. (TMAPC voted 9-0-0 to recommend approval.) [NOTE: If no Council action by 01/20/03 amendment will be officially approved.] 97-206-26

6. Proposed City of Tulsa vehicle usage policy. (Christiansen) 02-673

11:30 Budget - (Co-Chairs: Roop, Baker, Patrick, Neal)

1. No meeting this week. 97-657

1:30 Legislative/Public Safety - (Co-Chairs: Justis, Baker, Christiansen)

1. No meeting this week. 97-657

3:00 Finance - (Co-Chairs: Patrick, Williams)

1. No meeting this week. 97-657

Brent Atkins

on agenda Thursday.

Appendix G:

Repetitive Loss Plan

Appendix G: Repetitive Loss Inventory by Status by Depth

Rank	Address	Owner's Name	Creek	LU	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
	Status:	**2001 HMGP Acquisition (1355) in Process**								
1	6139 E. 54th St.	Phillip & Paula Thompson	LJ-5	R	FP / RL	715.20	718.20	3.00	RL - 2001 1355 HMGP List. / NSM - Joe Creek MDP recommend acquisition.	66510
2	10209 S. 76th E. Ave.	Scott, John P & Sue G		R	NSA	658.97	661.26	2.29	RL - Previous Owners - Michael F Mullins Trust Trust Co of Okla 2001 1355 HMGP / NSM - Bridle Trails Estates.	16302
3	3829 E. 72nd St.	Thomas M & Iva F Flanaga	FR5	R	RL	698.30	700.40	2.10	RL - 2001 1355 HMGP (Acquired, closed) / NSM - High Priority Acquisition	38390
4	10221 S. 76th E. Ave.	William S & Melissa K Kelly	FD1	R	NSA / RL	658.30	659.72	1.42	RL - 2001 1355 HMGP Candidate / NSM - Bridle Trails Estates.	36060
5	10233 S. 76th E. Ave.	Allen, Mark Steven & Pame	FD1	R	NSA / RL	657.57	658.79	1.22	RL - 2001 1355 HMGP Candidate / NSM - Bridle Trails Estates	52796
6	9550 E. Latimer St.	Bobby C & Virginia M Hans	ML15	R	RL	612.60	613.45	0.85	RL - 2001 1355 HMGP Candidate / NSM - High Priority, RL, 2001 HMGP, B/C:2.25,	52500
7	10385 S. 76th E. Ave.	Randall & Carol White	FD1	R	NSA / RL	655.47	655.37	-0.10	RL - 2001 1355 HMGP Candidate; Last Flooded May 2000. $31,000 cumulative damages. / NSM - Bridle Trails Estates	16346
8	3027 E. 82nd St.	Harry & Margaret Bayouth	FR11	R		671.80	671.60	-0.20	RL - Repetitive Loss Property. Cumulative damages approaching 40% of value. Latest damages in May 2000.	108868
9	5512 S. Hudson Pl.	Donald G & Ellen M Todd	LJ-3	R	RL	704.60	703.10	-1.50	RL - 2001 1355 HMGP Candidate (FEMA b/c .03) Flooding from stormsewer, subbasin	16347
10	2747 E. 49th N. St.	Merton & Sally Leigh	FL1	R	NSA / RL	607.80	606.20	-1.60	RL - 2001 1355 CandidateHMGP	16318
	Status:	**To Be Acquired by City (Non-HMGP)**								
11	4740 S. Yorktown Ave.	Eddie M. Abbott		R		0.00	0.00	0.00	RL - Perryman Detention Pond R.O.W., to be acquired by City	108628
	Status:	**Further Investigation Required**								
12	5345 S. Toledo E. Ave.	Mark A & Teryl A Sperle		R	RL	670.82	672.00	1.18	RL - Little Joe Creek Channel Improvement	32466
13	8119 E. 12th St.		MLM4	A			0.00	0.00	RL - Between Jones & Mill / NSM - Mill Creek - Correction Needed	32463
14	8123 E. 12th St.	Jerry L & Pauline Smith					0.00	0.00	RL - Between Jones & Mill. / NSM - Mill Creek - Correction Needed	32464
15	4706 #13 E. 54th St.	c/o Prestige Mgmt 5400 So					0.00	0.00	RL - Correction to 4706 E. 54th St. - Protected by Little Joe Creek Channel Improvements	32476
16	2531 E. 56th St.	Johnny Kye & Cynthia M Ch			RL	646.40	0.00	0.00		32502
17	4138 E. 53rd Pl.	Jeanne Edwards			RL	0.00	0.00	0.00	RL - Little Joe Creek Channel Improvement	16300
18	4706 #19 E. 54th St.	c/o Prestige Mgmt 5400 So			RL		0.00	0.00	RL - Correction to 4706 E. 54th St. Protected by Little Joe Creek Channel Improvements / NSM - Owner would not allow access to property, Apts	32481

Rank	Address	Owner's Name	Creek	LU	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
19	4706 #14 E. 54th St.	c/o Prestige Mgmt 5400 So			RL		0.00	0.00	RL - Correction to 4706 E. 54th St. - Protected by Little Joe Creek Channel Improvements	32479
20	4706 #17 E. 54th St.	c/o Prestige Mgmt 5400 So			RL		0.00	0.00	RL - Correction to 4706 E. 54th St. - Protected by Little Joe Creek Channel Improvements	32478
21	4706 #9 E. 54th St.	c/o Prestige Mgmt 5400 So			RL		0.00	0.00	RL - Correction to 4706 E. 54th St. - Protected by Little Joe Creek Channel Improvements	32475
22	4706 #20 E. 54th St.	c/o Prestige Mgmt 5400 So			RL		0.00	0.00	RL - Correction to 4706 E. 54th St. Protected by Little Joe Creek Channel Improvements / NSM - Owner would not allow access to property, Apts	32482
23	5807 E. 56th St.	Lawrence J Mundus, Truste		R	RL	710.70	0.00	0.00	RL - Little Joe	32488
24	4024 E. 53rd St.	J Dwight & S Claudine Tayl			RL	667.50	0.00	0.00	RL - Little Joe LOMR. / NSM - Little Joe Channel - Correction Needed	16332
25	2811 S. Cincinnati Ave.	Teresa M Hron		R	RL	638.00	0.00	0.00	RL - Local Drainage	16327
26	5206 S. Harvard Ave., 311	Grace E. McIntosh			RL	662.30	0.00	0.00	RL - Investigate, Little Joe Channel Improvements	32467
27	5206 S. Harvard Ave., 315	Bates, Jerry T & Betti J Tru			RL	662.30	0.00	0.00	RL - Correct Address 5206 S Harvard #315. This property is listed as 5260 S. Harvard in the Repetitive Loss Report.	41198
28	1345 S. 99th E. Ave.	Charles & Loyce Saylor		R	RL	0.00	0.00	0.00	RL - Investigate for Correction, Mingo Creek project	66518
29	701 S. Mingo Rd.	Wesley Methodist Church		R	RL	623.70	622.90	-0.80		16338
30	5278 S. Joplin Pl.	John C & Stella E Huskinso	LJ-4	R	RL	709.30	708.20	-1.10	RL - Little Joe, subbasin drainage	66523
31	4706 E. 54th St.	c/o Prestige Mgmt 5400 So		R	RL	681.39	678.57	-2.82	RL - 5400 Apts. See RL#32477. Protected by Little Joe Creek Channel Improvements.	32480
32	5502 S. Joplin Ave.	Roland D & Eleanor C Wilki		R	RL	707.70	704.40	-3.30	RL - Little Joe	32473
	Status:	**Remain on RL List - Local Drainage**								
33	4923-25 S. Oswego Ave.	Alexander Novovich		D2	RL	689.20	0.00	0.00	RL - Duplex - Local Drainage	16335
34	4916-18 S. Pittsburg Ave.	Alexander Novovich		D2	RL	691.10	0.00	0.00	RL - Duplex - Local Drainage	16334
35	4919-21 S. Oswego Ave.	Alexander Novovich		D2	RL	690.50	0.00	0.00	RL - Duplex - Local Drainage / NSM - Duplex	16333
36	5309 E. 35th St.	Josephine Irene Hinson			RL		0.00	0.00	RL - Address listed in FEMA report is 5309 E. 36th St. Correct Address is 5309 E. 35th St. / NSM - Flood depth survey in progress, 8/27/02	32468
37	6121 S. 72nd E. Ave.	William Sparks		R	RL	776.50	0.00	0.00		40466
	Status:	**Remain on RL List - Deferred**								
38	3708 S. Sandusky Ave.	Johnnie Lee Jr. Eckles	JU3	R	RL	687.50	695.70	8.20	RL - Split Level / NSM - Floor below ground, 1/2 story.	50956
39	4322 E. 74th Pl.	Randall S & Joan E Miller	FR6	R	RL	742.40	743.50	1.10	RL - Upper Fred	32491
40	4330 E. 74th S. Pl.	Holly O'Shea Nunn	FR6	R	RL	743.20	744.00	0.80	RL - Upper Fred	32497
41	4911 E. 26th Terr.	Jeanine C Loftin		R	RL	752.60	753.00	0.40	RL - EB, Upper Joe Creek, 1355 offer refused	52215
42	4329 E. 74th Pl.	Susan C & Mark Hamilton	FR6	R	RL	745.80	746.20	0.40	RL - Upper Fred	16323
43	4476 Oak Rd.	Cook, Harold H Jr & Rosali		R		0.00	0.00	0.00	RL - Built Over Creek	108627
44	2860 S. Florence Ave.	Roger & Ruth Horn		R		0.00	0.00	0.00	RL - Split Level	105235

Rank	Address	Owner's Name	Creek	LU	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
45	6913 S. Knoxville Pl.	Larry Lee & Vicky Lee Lusk			RL		0.00	0.00	RL - City local drainage project may solve problem / NSM - Flood depth survey in progress, 8/27/02	16328
46	3030 E. 51st N. St.	Joseph P & Gilda Cacoperd	FL4	R	NSA / RL		0.00	0.00	RL - Cacoperdo Property / NSM - Offer Rejected	54683
47	3030 Rear E. 51st N. St.	Joseph P & Gilda Cacoperd			RL		0.00	0.00	RL - Cacoperdo Property / NSM - Offer Rejected	54682
48	3004 E. 51st N. St.	Joseph P & Gilda Cacoperd	FL4	R	NSA / RL		0.00	0.00	RL - Cacoperdo Property / NSM - Offer Rejected	54681
49	3006-08 E. 51st N. St.	Joseph P & Gilda Cacoperd	FL4	R	RL		0.00	0.00	RL - Cacoperdo Property / NSM - Offer Rejected	54680
50	3120 E. 51st N. St.	Joseph P & Gilda Cacoperd			NSA / RL		0.00	0.00	RL - Cacoperdo Property / NSM - Offer Rejected	54679
51	7102 S. Columbia E. Ave.	Edna Ruth Baldwin		R	RL	698.70	0.00	0.00	RL - Partial Acquisition for 71st St. R.O.W., refused 1355 HMGP offer / NSM - Offer Rejected	37216
52	7225 S. Gary Ave.	Donald & Olivia Mauritson T	FR12	R	RL	689.40	0.00	0.00	RL - Upper Fred Creek, Guier Woods Condo, local drainage	32508
53	6705 E. 66th St.	Betty M & Lynn D Sammon		R	RL	790.20	0.00	0.00		32472
54	2615 E. 59th St.	Cynthia D Harkins			RL	643.10	0.00	0.00	RL - Joe Creek MS	32490
55	6523 E. 66th St.	Janet M, Ladon K, Chance		R	RL	790.80	0.00	0.00		32470
56	3444 E. 75th S. St.	Hall, Jo Ann & William O Tr		R	RL	729.20	0.00	0.00		44148
57	522 S. 90th E. Ave.	Claudia L & Percy Rose		R	RL	622.20	0.00	0.00	RL - Local Drainage, 2002 1401 HMGP offer refused	32487
58	622 S. 132nd E. Ave.	Matthew & Renee Steel		R		0.00	0.00	0.00	RL - Illegal Enclosure	108486
59	7225 E. 58th St.	Mary E Houck	LJ	R	RL	751.70	751.50	-0.20	RL - Repetitive Loss Property. 2001 HMGP List	32493
60	5206 S. Harvard Ave.	Jewel M Wallace Trust	JSF	C	RL	662.60	661.50	-1.10	RL - Apartments #301, 303, 305, 307, Little Joe Channel Improvements / NSM - Apt. building. AKA # 301, etc.	70013
61	7139-41 S. Indianapolis E.	Mohawk Properties, LLC.		D2	RL	687.00	685.60	-1.40	RL - Fred Creek (Pebble Creek) - Duplex	16344
62	1 W. 81st St.	Juanita Satterfield	HG3	R		631.50	629.19	-2.31	RL - White House, Hager Creek	108630
63	21 N. 38th W. Ave.	Nicholas W & Twyla M Owe		R	RL	641.40	637.70	-3.70	RL - Cumulative damages exceed 50% of value. Should be acquired and cleared. West Tulsa, Behind Levee	16307
64	2724 E. 57th St.	Virgil F & Pauline F (Truste			RL	645.70	615.20	-30.50	RL - Joe Creek MS	16299
	Status:	**Remain on RL List - Commercial/Industrial**								
65	440 S. Trenton Ave.	c/o J.S. Demaree Craig, Le	EL4	C	RL	700.60	705.10	4.50	RL - Elm Creek / NSM - Defer - Industrial	73927
66	1505 E. 5th St.	Southwest United Industries			RL	701.00	705.00	4.00	RL - Property was renumbered. Address is listed as: 435 S St. Louis Ave. / NSM - Office - Flood depth survey in progress, 04/30/01	38505
67	1505 E. 5th St., R	Southwest United Industries			RL	701.00	705.00	4.00	RL - aka correctly known as 1505 E. 5th St. Property was renumbered. Listed as 435 R St. Louis. / NSM - Flood depth survey in progress, 04/30/01	54073
68	2706 N. Madison Ave.	Henry E. & Luella Ann Lah		I	NSA / RL	639.50	643.20	3.70	RL - Industrial Property / NSM - Industrial building.	32441
69	3165-71 E. 49th St.	BCS Assoc Ltd	JU1	MO	RL	661.90	665.30	3.40	RL - Listed as 3185 E. 49th St in Upper Joe Basin Drainage Study - Hermitage Apts. File Folder has Elevation certificates for 3167, 3169, and 3171 also. All part of same property / NSM - Apartments	35301

Rank	Address	Owner's Name	Creek	LU	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
70	8542 E. 41st St.	Alan F Cuddy			RL	667.20	670.00	2.80	RL - File location is with 8532-8550 E. 41st St. / NSM - Commercial	46654
71	8532-50 E. 41st St.	Alan F Cuddy		C	RL	667.20	670.00	2.80	RL - This claim was placed by Owner/Mgr. Corresponds with RL# 46654 - Commercial	16301
72	2715 N. Madison Ave.	Henry E. & Luella Ann Lah		I	RL	638.60	641.00	2.40	RL - Industrrail Property / NSM - Industrial Building.	32485
73	5840 S. Mingo Rd.	c/o Mirza Shahivand Green,	MU3	R	RL	681.90	683.80	1.90	RL - Day care center. Now 2 story. 1355 offer refused.	32443
74	6030 E. Pine St.	Troy N & Jo Ann Ellison	CL3	C	RL	668.00	669.30	1.30	RL - Commercial - See also RL#77468 / NSM - Commercial - See also RL#77468	77467
75	728 S. Wheeling Ave.	Chitton, June K Trustee Jun	EL7	C	RL	713.40	714.50	1.10	RL - Commercial	43284
76	10116 E. 54th St.	Heartland Realty Trust		I	RL	671.20	671.60	0.40	RL - Address in CADB has change to 5401 S 101 E Ave. / NSM - Industrial. See RL notes.	16331
77	8516 E. 41st St.					669.90	670.00	0.10	RL - See Listing for RL# 32469. Commercail - Same property, two different insurance policies	73050
78	8516 E. 41st St.	Ester B Semones Family Tr	MUM4	C	RL	669.90	670.00	0.10	RL - See Listing for RL#73050-Commercial-Same property-two different insurance policies / NSM - Flood depth survey in progress, 3/25/99	32469
79	844 E. 46th N. St.	Northside Christian Center		CH		0.00	0.00	0.00	RL - Northside Christian Center / NSM - Church	108255
80	6030 E. Pine St., Rear	Troy N & Jo Ann Ellison			RL	668.00	0.00	0.00	RL - Part of RL#77467 / NSM - Commercial - Part of RL#77467 - Flood depth survey in progress, 3/25/99	77468
81	1250 S. Memorial Dr., B	Oklahoma Bay Homestead			RL		0.00	0.00	RL - 1250-B is located in a complex listed in County DB as 1240 S. Memorial. Owner/Mgr is at 1246 S. Memorial Dr. / NSM - Flood depth survey in progress, 04/30/01	16321
82	815 S. Utica Ave.	Tulsa Rec Ctr for Phys. Lmt			RL	710.70	0.00	0.00	RL - Handicapped Center	16336
83	6915 E. 38th St.	Davis, Reuben, Robert & R		C	RL	720.30	0.00	0.00	NSM - Commercial	32492
84	7682 E. 46th Pl.	Carroll J Jr & T Yvonne Jac		C	RL	703.40	0.00	0.00	NSM - Flood depth survey in progress, 04/30/01 - Commercial	50403
85	6219 E. 11th St.	Roger W, Walter D. Sr., &	MLM2	C/M	RL	693.50	0.00	0.00	RL - Permanent Structure value is $131,500. Add $11,770 for a Mobile Home (MH) for a total value of $318,370. / NSM - Flood depth survey in progress, 04/30/01 - Industrial	78005
86	5002 S. Fulton Ave.	Young Men's Christian Ass		Rec	RL	710.30	0.00	0.00	RL - YMCA Center / NSM - Commercial	72001
87	1531 S. Cincinnati Ave.	Ron Holderman & Tommy	EL3	C	RL	656.50	656.00	-0.50	RL - Elm Creek / NSM - Commercial	66526
	Status:	**Correction Sheets Needed - Elevated**								
88	4733 #1 S. Harvard Ave.	LP Chesterfield C/O Randy			RL	663.70	665.90	2.20	RL - Being Elevated, 9/98, Listed as 4753 S. Harvard in Upper Joe Basin Drainage Study. / NSM - Chesterfield North Building; FFFE by White Surveying; Elevated above BFE; Correction Needed.	16355
89	4733 #3 S. Harvard Ave.	LP Chesterfield					0.00	0.00	RL - Being Elevated, 9/98, Listed as 4753 S. Harvard in Upper Joe Basin Drainnage Study. / NSM - New Construction - Chesterfield	16354
90	3112-3330 S. Memorial Dr	Kelly W McNew			RL		0.00	0.00	RL - New Buildings. Elevated by owner. / NSM - Correction, new construction	66507

Rank	Address	Owner's Name	Creek	LU	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
91	4737-45 #4 S. Harvard Av	LP Chesterfield			RL		0.00	0.00	RL - Being Elevated, 9/98, Listed as 4753 S. Harvard in Upper Joe Basin Drainage Study. / NSM - New Construction - Chesterfield	16353
	Status:	**Correction Sheets Needed - Vacant Lots**								
92	3939 E. 60th St.	Danny P & Roberta Zalta	JSF	R	RL	693.70	696.50	2.80	RL - Vacant Lot - No Bldg - Correction Needed	32511
93	10101 E. 46th N. St.			R			0.00	0.00	RL - Land is vacant. Repetitive Loss Correction Sheet needed. / NSM - Vacant - RL Correction Needed	54915
94	5810 S. Mingo Rd.	Bert & Georgia Sanders	MU3	V	RL		0.00	0.00	RL - Building Removed by Owner / NSM - Removed by Owner	32460
	Status:	**Correction Sheets Needed - Address Correction**								
95	7 NITS Location .						0.00	0.00	RL - Correction to 4706 E. 54th St.	32477
	Status:	**Correction Sheets Needed - Acquired by City of Tulsa**								
96	8213 S. Elwood Ave.	City of Tulsa		V	RL	624.33	628.67	4.34	RL - Hager Creek, Acquired by City (Creel)	73054
97	1225 S. 141st E. Ave.	City of Tulsa	CO8	V		713.70	716.80	3.10	RL - Property Acquired per letter from Rita Henze dated 1-8-02. Closed 9-11-01. Demolition completed 12-04-01.	108246
98	6898 E. 56th St.	Trustee of C E Gessner Tru	LJ	V	FP / RL	741.60	743.71	2.11	RL - Acquired by city. Closed 5/00. Demolition 9/00. / NSM - Acquired- Rep. Loss.	32471
99	6894 E. 56th St.	Warren G & Teresa F Falki	LJ	V	RL	741.80	743.63	1.83	RL - Property Acquired per letter from Rita Henze dated 1-8-02. Closed 6/19/00. Demolition completed 9/00. / NSM - Acquired- Rep. Loss	42160
100	10524 S. 77th E. Ave.		FD1	V	NSA	651.70	653.20	1.50	RL - Bridle Trails. Closed 8/10/00. Demolition 9/12/2001.	90119
101	6890 E. 56th St.	Beverley R Stanley	LJ	V	RL	742.70	743.06	0.36	RL - Acquired by City. Closed 6/00. Demolition 9/00. / NSM - Acquired- Rep Loss.	16313
102	3008 N. Joplin Ave.	City of Tulsa		V	RL		0.00	0.00	RL - Property Acquired per letter from Rita Henze dated 1-8-02. Closed 7-29-98. Demolition 11-6-98. / NSM - Acquired - Property aka (3018 N. Joplin Ave. & 3000 N. Sheridan)	36059
103	6929 S. Knoxville Pl.	City of Tulsa	FR14	V	RL	705.40	704.00	-1.40	RL - Acquired by City. Project R.O.W.	32449
	Status:	**Correction Sheets Needed (Outside City Limits)**								
104	5622 W. 25th St.	Jolinda Ann Armstrong		R	RL	653.80	655.50	1.70	RL - Outside of City. Correction needed. Tulsa County	77725
105	3604 W. 85th St.					0.00	0.00	0.00	RL - Outside city limits. . Correction needed. Tulsa County	108327
106	3031 W. 101st St.					0.00	0.00	0.00	RL - Outside city limits. Correction needed. Tulsa County	108518
107	10031 S. 31st W. Ave.					0.00	0.00	0.00	RL - Outside city limits. Correction needed. Tulsa County	108629
108	5604 W. 24th St.			R		0.00	0.00	0.00	RL - Outside City Limits. Tulsa County / NSM - Out of City - Correction Needed	108322

Rank	Address	Owner's Name	Creek	LU	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
109	9145 S. 33rd W. Ave.					0.00	0.00	0.00	RL - Outside city limits. Correction needed. Tulsa County.	108558
110	8750 E. 169th S. Pl.					0.00	0.00	0.00	RL - Outside city limits. Located in Bixby, OK. Correction needed.	105148
	Status:	**Correction Sheets Approved**								
111	10201 E. 47th St.	Hufnagel, Paul L & Blanch		C	RL	661.20	662.00	0.80	RL - This property is no longer considered a RL property. Updated as - Flood protection - on 06/11/1993. / NSM - Removed from A Zone - Correction Needed	32489
112	4421 S. Zenith St.				RL	0.00	0.00	0.00	RL - This property is no longer considered a RL property Up dated as - Flood protection provded - on 07/18/1994 / NSM - Improvements in place/Not listed in CW Plan, 9/98	32465
113	4407 S. Zenith Ave.				RL	0.00	0.00	0.00	RL - No Building on Property-1994. Correction Sheet submitted. Acquired by City. / NSM - Acquired & Removed/Not listed in CW Plan, 9/98	16349
114	4415 S. Zenith Ave.			V	RL	0.00	0.00	0.00	RL - No Building on Property-1994. Correction Sheet submitted. Acquired by City / NSM - Acquired & Removed / Not listed in CW Plan, 9/98	16330
115	4422 S. Zenith Ave.				RL	0.00	0.00	0.00	RL - No Building on Property-1994. Correction Sheet submitted. Acquired by City / NSM - Acquired & Removed/Not listed in CW Plan, 9/98	32510
116	2134 N. Canton Ave.			V	RL	0.00	0.00	0.00	RL - No Building on Property-1994. Correction Sheet submitted. / NSM - Acquired and Removed	45365
117	8855 E. 91st St.				RL	0.00	0.00	0.00	RL - No Building on Property-1994. Correction Sheet submitted. Acquired by City / NSM - Demolished/ Not in CW Plan	16298
118	2820 S. 88th E. Ave.				RL	0.00	0.00	0.00	RL - This property is no longer considered a RL property. Updated as - Flood protection provided - on 07/18/1994 / NSM - Problem solved/Channel improved/Not listed in CW Plan, 9/98	32496
119	8198 E. 46th St.	SMJ Properties Inc		C	RL	683.00	0.00	0.00	RL - Is an existing actual address. Correction sheet is in error. / NSM - Flood depth survey in progress, 04/30/01 - Commercial	44366
120	9539 E. 9th St.				RL	0.00	0.00	0.00	RL - No Building on Property-1994. Correction Sheet submitted. / NSM - Acquired & Removed	32518
121	8111 E. 11th St.			V	RL	0.00	0.00	0.00	RL - No Building on Property-1994. Correction Sheet submitted. / NSM - Acquired & Removed - Motel	54834
122	9715 E. 13th Pl.				RL	0.00	0.00	0.00	RL - This proprty is no longer considered a RL property. Updated as -- Flood protection provided - on 07/15/1994 / NSM - Removed from A Zone/Not listed in CW Plan, 9/98	16337
123	2625 E. 22nd Pl.			V	RL	0.00	0.00	0.00	RL - No Building on Property-1995. Correction Sheet submitted. / NSM - Removed - Vacant	32448

Appendix H:

Floodplain Acquisition Candidates

NonStructural Inventory by Status by Depth

Hazard Mitigation and Repetitive Loss List

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
				Status:			**Recommend**					
1	1	6745 W. 3rd St.	Kathy Sue Roe Reed	BH2	R	A	NSA	648.00	659.30	11.30		
2	11	3948 S. Troost Ave.	John J Bernadine		R		FP	652.51	657.49	4.98	High Priority Candidate	
3	20	5502 S. 33rd W. Ave.	David & Eileen Imwalle	MO6	R		FP	692.56	696.40	3.84	High priority candidate	
4	17	2437 S. Marion Ave.	William B. Bell	JU14	R		FP	773.88	777.70	3.82	Priority acquisition candidate.	
5	23	4415 E. 38th St.	Visicek,Daniel J	JU3	R		FP	691.75	695.27	3.52	High Priority Candidate	
6	25	4508 E. 39th St.	Virginia A. Sample	JU10	R		FP	695.86	699.34	3.48	High Priority Candidate	
7	32	4923 N. Hartford E. Ave.	Margaret A Walker	FL7	R		NSA	640.80	643.80	3.00	High Prioirty Candidate. Fld depth cert by White Survey.	
8	151	6139 E. 54th St.	Phillip & Paula Thompson	LJ-5	R	B	FP / RL	715.20	718.20	3.00	Joe Creek MDP recommend acquisition.	66510
9	38	2415 E. 18th St.	Stephanie Webb	CR8	R		MDP	716.30	718.98	2.68	Lewiston Detention Site	
10	40	2550-52 S. Jamestown Av	Stokely	JU14	D2		FP	762.48	765.13	2.65		
11	47	2409 E. 18th St.	Keith and Laura Goggans	CR8	R		MDP	716.50	718.98	2.48	Lewiston Detention Pond Site	
12	33	10209 S. 76th E. Ave.	Scott, John P & Sue G		R	D	NSA	658.97	661.26	2.29	Bridle Trails Estates.	16302
13	57	2417-19 E. 17th Pl.	Robin Faulk Giannini	CR9	D2		FP	720.50	722.70	2.20	Lewiston Detention Pond Site	
14	60	2412 E. 17th Pl.	Kenneth Buttress & Laurie	CR9	R		MDP	718.40	720.58	2.18	Lewiston Detention Pond Site	
15	406	3829 E. 72nd St.	Thomas M & Iva F Flanaga	FR5	R	C	RL	698.30	700.40	2.10	High Priority Acquisition	38390
16	73	9526 E. Latimer St., B		ML15	R		FP	611.50	613.45	1.95	Acquisition / High Priority/ Associated with NSM # 459	
17	289	5840 S. Mingo Rd.	c/o Mirza Shahivand Green,	MU3	R	A	RL	681.90	683.80	1.90		32443
18	80	2418 E. 17th Pl.	Dick Harris, Jr.	CR9	R		MDP	718.70	720.58	1.88	Lewiston Detention Pond Site	
19	52	2543 S. Cincinnati Ave.	Gracie E. Best	SW2	R		FP	660.70	662.40	1.70	High Priority Candidate.	
20	72	10221 S. 76th E. Ave.	William S & Melissa K Kelly	FD1	R	A	NSA / RL	658.30	659.72	1.42	Bridle Trails Estates.	36060
21	78	10233 S. 76th E. Ave.	Allen, Mark Steven & Pame	FD1	R	A	NSA / RL	657.57	658.79	1.22	Bridle Trails Estates	52796
22	133	5353 S. 33rd W. Ave.	Dan & Louise Maher	MO5	R		FP	688.52	689.70	1.18	Priority acquisition candidate.	
23	158	10232 S. 77th E. Ave.	Pike, William & Toni-Ann	FD1	R		NSA	656.80	657.80	1.00	Bridle Trails Estates	
24	70	9550 E. Latimer St.	Bobby C & Virginia M Hans	ML15	R	A	RL	612.60	613.45	0.85	High Priority, RL, 2001 HMGP, B/C:2.25,	52500
25	459	9526 E. Latimer St.	William J Bryant	ML15	R			613.00	613.45	0.45	Associated with NSM # 73	
26	423	522 S. 90th E. Ave.	Claudia L & Percy Rose		R	X	RL	622.20	0.00	0.00		32487
27	455	4920 S. Joplin Ave.	Heath Hardcastle		R	X		719.40	0.00	0.00		
28	457	1030 E. 32nd Pl.	Greene, Wayne & Lynn Ric		R			0.00	0.00	0.00		
29	146	10385 S. 76th E. Ave.	Randall & Carol White	FD1	R	D	NSA / RL	655.47	655.37	-0.10	Bridle Trails Estates	16346
30	414	7225 E. 58th St.	Mary E Houck	LJ	R	C	RL	751.70	751.50	-0.20		32493

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
31	453	3027 E. 82nd St.	Harry & Margaret Bayouth	FR11	R	C		671.80	671.60	-0.20		108868
32	284	5512 S. Hudson Pl.	Donald G & Ellen M Todd	LJ-3	R	C	RL	704.60	703.10	-1.50		16347
33	439	2747 E. 49th N. St.	Merton & Sally Leigh	FL1	R	A	NSA / RL	607.80	606.20	-1.60		16318
34	319	21 N. 38th W. Ave.	Nicholas W & Twyla M Owe		R	C	RL	641.40	637.70	-3.70		16307
				Status:			**Pending**					
35	7	5267 S. Union Ave.	Willis & Evelyn Johnson	MO3	R		FP	643.71	649.50	5.79	Pending- Union Bridge project	
36	14	8215 S. Elwood Ave.	Daniel Toms	HG2	R		NSA	624.07	628.67	4.60	Closed Pending resolution of probate/Funded.	
37	42	222 N. 91st E. Ave.	L.M. Knapp	ML15	R		FP	615.67	618.26	2.59	Listed as 216 N. 91st E. Ave. in L Mingo MDP. Defer. Study.	
38	24	5265 S. Union Ave.	Willis & Evelyn Johnson	MO3	R	A	FP	646.98	649.50	2.52	Pending- Union Bridge project	
39	36	5301 S. Union Ave., B	Smith	MO3	C		FP	647.46	649.50	2.04	High Priority Candidate, Part of Acquisition authorized for Union Bridge project	
40	65	5251 S. Union Ave.	O.D. & Janice H. Hooker	MO3	R		FP	648.25	649.60	1.35	Pending- Union Bridge project	
41	88	5301 S. Union Ave., C	Smith	MO3	C		FP	648.64	649.50	0.86	Pending- Union Bridge project	
42	427	5301 S. Union Ave., A	Smith	MO3	R		FP	650.47	649.50	-0.97	High Priority Candidate, Part of Acquisition authorized for Union Bridge project	
				Status:			**Deferred**					
43	16	3708 S. Sandusky Ave.	Johnnie Lee Jr. Eckles	JU3	R	A	RL	687.50	695.70	8.20	Floor below ground, 1/2 story.	50956
44	10	2873 E. 39th St.	Silvan Levinson	JU13	R		NSA	700.70	706.30	5.60	Defer for funding.	
45	12	3015 E. 26th St.	Jimmie D. Giddens	JU14	R		FP	752.38	757.30	4.92	Defer for funding.	
46	260	440 S. Trenton Ave.	c/o J.S. Demaree Craig, Le	EL4	C	C	RL	700.60	705.10	4.50	Defer - Industrial	73927
47	15	10335 S. 76th E. Ave.	James Brinton			A	NSA	656.97	661.43	4.46	Defer: Bridle Trails Estates	
48	18	3123 E. 37th St.	Toi Jean Sanders	JU13	R		FP	697.09	700.90	3.81	Defer for funding.	
49	19	1717 E. 17th St.	Bruce Holmbde	SW4	C		NSA	723.60	727.40	3.80	Defer: Commercial building.	
50	22	5527 E. Ute Pl.	Hayden D. Crisp	CL4	R		NSA	628.30	632.00	3.70	Offer Rejected	
51	45	2706 N. Madison Ave.	Henry E. & Luella Ann Lah		I	C	NSA / RL	639.50	643.20	3.70	Industrial building.	32441
52	27	4770 S. Harvard Ave.	Richardson Trustee	JU1	C		FP	662.83	666.20	3.37	Defer: Commercial; previously known as 4774 S. Harvard Ave. now known as 4770 S. Harvard Ave.	
53	28	1225 N. Mingo Rd.	Harris Boat	ML15	C		NSA	610.00	613.30	3.30	Defer: Commercial building, North Mingo.	
54	29	2943 E. 26th Pl.	Ronald G. Abbott	JU14	R		FP	747.89	751.00	3.11	Split Level	
55	34	3104 E. 48th Pl.	John W. Vance, Jr.	JU1	R		FP	662.56	665.50	2.94	Neighborhood, Defer for Funding	
56	35	5202 S. Houston Ave., 4	Not listed	MO-3	C		FP	631.08	634.00	2.92	Defer: Commercial Building	
57	99	5202 S. Houston Ave.	Not listed	MO1	C		FP	631.08	634.00	2.92	Comm bldg listed in SW MDP but not listed in Cnty Assess DB	
58	320	8542 E. 41st St.	Alan F Cuddy			C	RL	667.20	670.00	2.80	Commercial	46654
59	41	4015 E. Woodrow Pl.	Georgia May	CL1	R		NSA	677.10	679.70	2.60	Oswego Woodrow Group. Defer	
60	43	3144 E. 44th St.	Karen Nelson Trust	JU12	R		FP	676.72	679.30	2.58	Defer for Funding	

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
61	44	4028 W. 57th St.	Maurice E. Reagle	MO6	R		FP	714.98	717.50	2.52	Vacant, substandard. Outside City Limits. Defer to County.	
62	46	2423 E. 32nd St.	Harold Staples III				FP	742.46	744.96	2.50	Defer for Funding.	
63	61	5141 S. 24th W. Ave.		MO4	C		FP	659.35	661.79	2.44	Defer: Commercial/Industrial Bldg.	
64	48	2715 N. Madison Ave.	Henry E. & Luella Ann Lah		I	C	RL	638.60	641.00	2.40	Industrial Building.	32485
65	49	1803 E. 17th St.	Wayne D. McKenzie	Swan	C		FP	726.30	728.70	2.40	Defer for Funding and further study.	
66	50	4814 S. Florence Ave.	Mortenson	JU1	R		FP	663.42	665.75	2.33	Defer for funding.	
67	51	1010 N. Mingo Rd.	Environmental RS	ML15	C		FP	611.15	613.45	2.30	Defer: Commercial building.	
68	53	1026 N. Mingo Rd.	Lane Supply Co.	ML15	C		FP	611.07	613.37	2.30	Defer: Commercial building.	
69	54	1319 N. Mingo Rd.	Machine Engineering Co.	ML15	C		FP	611.05	613.30	2.25	N. Mingo Residual FP. Commercial. Defer.	
70	56	10550 S. 77th E. Ave.		FD1	R		NSA	651.00	653.20	2.20	Defer: Bridle Trails Estates	
71	58	3026 N. Joplin Ave.		CL1	MH		NSA	611.50	613.70	2.20	Deferred	
72	62	3185 E. 49th St.					FP	662.24	664.38	2.14	Defer: Apt. Bldg valued at $600,000, 3 bldgs.	
73	63	2950 E. 48th Pl.	Rick Lynn Wilson	JU1	R		FP	663.38	665.50	2.12	Defer for funding. Neighborhood.	
74	66	5202 S. Houston Ave., 3	Not listed	MO	C		FP	630.96	633.00	2.04	Defer: Commercial building.	
75	67	2441 E. 40th St.	Gregory Alex Farrar				FP	728.92	730.92	2.00	Defer for restudy.	
76	68	3530 S. Zunis Ct.					FP	708.61	710.61	2.00	Perryman: defer.	
77	69	3939 S. Troost Ave.	Elizabeth K. Lane Trust				FP	656.87	658.87	2.00	Defer for restudy with 3948 S. Troost.	
78	71	1335 N. Mingo Rd.	Mitchell Fence Co.	ML15	C		FP	611.34	613.30	1.96	Defer. Mingo Residual FP / Commercial	
79	74	10198 S. 77th E. Ave.		FD1	R		NSA	657.18	659.10	1.92	Defer: Bridle Trails Estates	
80	76	3004 E. 49th St.	Robin E Webb	JU1	R		FP	663.49	665.40	1.91	Defer for funding. Joe Creek. Restudy.	
81	75	1313 N. Mingo Rd.		ML15	R		FP	611.39	613.30	1.91	N. Mingo Residual FP - Residential	
82	77	1628 S. Victor Ave.	Nell S. Bradshaw	Swan	R		FP	726.80	728.70	1.90		
83	79	2878 E. 34th St.	Berry W. Hamilton	JU13	R		FP	717.42	719.30	1.88	Defer. Joe Creek. Restudy.	
84	82	3154 E. 42nd St.	James C. Leake Jr.	JU12	R		FP	679.24	681.10	1.86	Defer: Joe Creek restudy.	
85	83	1327 N. Mingo Rd.	The Jackson Co.				FP	611.47	613.30	1.83	Defer / Commercial.	
86	85	1501 E. 19th St.	David C. Smith	SW3	R		FP	707.20	709.00	1.80	Defer / Swan Creek	
87	87	4806 S. Florence Ave.		JU1	R		FP	664.04	665.80	1.76	Defer	
88	89	5300 S. Lawton Ave.		MO	I		FP	634.50	636.20	1.70	Defer: Industrial	
89	90	7515 E. 106th St.			R	A	NSA	652.55	654.25	1.70	Defer: Bridle Trails Estates	
90	91	3326 E. 28th St.	Bob Omstead	JU14	R		FP	749.54	751.20	1.66	Vacant, only garage remains.	
91	92	3636 S. Florence Pl.		JU13	R		FP	699.25	700.90	1.65	Defer for funding.	
92	93	3025 E. Skelly Dr.		WBUJ	C	A	MDP	662.88	664.50	1.62	Commercial, FP Recommended by MDP	
93	94	1120 N. Mingo Rd.	Wm A Barnett	ML15	C	A	FP	611.71	613.33	1.62	N. Mingo Residual FP - Commercial	
94	97	3751 S. Fulton Ave.		JU9	R		FP	727.33	728.90	1.57	Defer / Joe creek	
95	98	3112 E. 26th Pl.		JU14	R		FP	746.76	748.30	1.54	Defer for Joe Creek Restudy	
96	108	2429 E. 40th St.	Mary Katheryn Hazer				FP	715.15	716.65	1.50	Defer for funding	

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
97	109	2420 E. 32nd St.	Linda Hamilton Welch				FP	743.41	744.91	1.50	Defer for funding	
98	111	1425 E. 20th St.		SW3	R		FP	703.50	705.00	1.50	Defer for funding.	
99	118	816 N. Mingo Rd.	Mott Roofing and Sheet	ML15	C		FP	612.07	613.45	1.38	N Mingo defer: Commercial	
100	138	1102 N. Mingo Rd.	Wm A Barnett	ML15	C		FP	611.96	613.34	1.38	North Mingo Residual Floodplain / Commercial	
101	123	10312 S. 77th E. Ave.		FD1	R		NSA	656.10	657.40	1.30	Defer: Bridle Trails Estates	
102	121	1321 N. Mingo Rd.	Barges				FP	612.00	613.30	1.30	North Mingo Residual FP / Defer Commercial	
103	122	1642 E. 17th Pl.					FP	717.20	718.50	1.30	Bridle Tails Estates	
104	271	6030 E. Pine St.	Troy N & Jo Ann Ellison	CL3	C	C	RL	668.00	669.30	1.30	Commercial - See also RL#77468	77467
105	125	10112 S. 77th E. Ave.		FD1	R		NSA	662.35	663.60	1.25	Defer: Bridle Trails Estates	
106	128	4003 E. Woodrow Pl.	K & S Carter	CL1	R		NSA	677.70	678.90	1.20	Oswego Woodrow Group / Deferred	
107	129	2213 N. Oswego Ave.	Floyd Smith	CL6	R		NSA	677.70	678.90	1.20	Oswego Woodrow Group / Deferred	
108	130	2207 N. Oswego Ave.	David Heath	CL6	R		NSA	677.70	678.90	1.20	Oswego Woodrow Group / Deferred	
109	150	4775 S. Harvard Ave.	Allen Properties Co.	JU1	C		FP	666.79	667.80	1.01	Defer / Commercial	
110	162	10142 S. 77th E. Ave.		FD1	R		NSA	660.16	661.11	0.95	Defer: Bridle Trails Estates	
111	166	4012 E. Woodrow Pl.	Ellis Williams	CL1	R		NSA	677.20	678.10	0.90	Oswego Woodrow Group/Deferred	
112	167	4011 E. Woodrow Pl.	Layman Smith	CL1	R		NSA	676.20	677.10	0.90	Oswego Woodrow Group/Deferred	
113	169	4007 E. Woodrow Pl.	Jeffrey Fitts	CL1	R		NSA	677.20	678.10	0.90	Oswego Woodrow Group/Deferred	
114	190	2149 N. Oswego Ave.	Charles E Spears	CL6	R		NSA	678.20	678.90	0.70	Oswego Woodrow Group / Deferred.	
115	55	3135 E. 44th St.	Robt P & Sandra Reid	JU12	R		FP	679.67	680.10	0.43	Defer for funding. Neighborhood.	
116	338	10116 E. 54th St.	Heartland Realty Trust		I	A	RL	671.20	671.60	0.40	Industrial. See RL notes.	16331
117	224	4014 E. Woodrow Pl.	Paul Lamanskly	CL1	R		NSA		0.00	0.00	Oswego Woodrow Group/Deferred	
118	237	2143 N. Oswego Ave.		CL6	R		NSA	0.00	0.00	0.00	Oswego Woodrow Group / Deferred.	
119	267	6030 E. Pine St., Rear	Troy N & Jo Ann Ellison			C	RL	668.00	0.00	0.00	Commercial - Part of RL#77467 - Flood depth survey in progress, 3/25/99	77468
120	318	6915 E. 38th St.	Davis, Reuben, Robert & R		C	C	RL	720.30	0.00	0.00	Commercial	32492
121	323	7682 E. 46th Pl.	Carroll J Jr & T Yvonne Jac		C	C	RL	703.40	0.00	0.00	Flood depth survey in progress, 04/30/01 - Commercial	50403
122	340	8198 E. 46th St.	SMJ Properties Inc		C	C	RL	683.00	0.00	0.00	Flood depth survey in progress, 04/30/01 - Commercial	44366
123	369	10305 S. 76th E. Ave.		FD1	R	A	NSA	659.60	659.60	0.00	Defer: Bridle Trails Estates	
124	395	5002 S. Fulton Ave.	Young Men's Christian Ass		Rec	X	RL	710.30	0.00	0.00	Commercial	72001
125	454	4740 S. Yorktown Ave.	Eddie M. Abbott		R	B		0.00	0.00	0.00		108628
126	458	622 S. 132nd E. Ave.	Matthew & Renee Steel		R	A		0.00	0.00	0.00		108486
127	256	10115 S. 76th E. Ave.	Patricia Marquardt	FD1	R		NSA	662.64	662.60	-0.04	Defer: Bridle Trails Estates	
128	257	10220 S. 77th E. Ave.		FD1	R		NSA	659.77	659.68	-0.09	Defer: Bridle Trails Estates	
129	378	1531 S. Cincinnati Ave.	Ron Holderman & Tommy	EL3	C	C	RL	656.50	656.00	-0.50	Commercial	66526

Status: **Declined**

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
130	4	14101 E. 52nd N. St., J	Wynema Mendoza	BC	A		NSA	576.40	583.60	7.20	Offer Rejected	
131	5	14101 E. 52nd N. St., K	Wynema Mendoza	BC	A		NSA	576.60	583.60	7.00	Offer Rejected	
132	6	14101 E. 52nd N. St., B	Wynema Mendoza	BC	A		NSA	576.80	583.60	6.80	Offer Rejected	
133	8	14101 E. 52nd N. St., I	Wynema Mendoza	BC	A		NSA	577.50	583.60	6.10	Offer Rejected	
134	9	14101 E. 52nd N. St., H	Wynema Mendoza	BC	A		NSA	577.70	583.60	5.90	Offer Rejected	
135	13	1639 S. Lewis Pl.	Hilda Hudson Trust	CR8	R		NSA	718.00	722.70	4.70	Appraisal 9/28/98. Made Offer.	
136	37	14101 E. 52nd N. St., G	Wynema Mendoza	BC	A		NSA	580.80	583.60	2.80	Offer Rejected	
137	64	3012 N. Joplin Ave.	R & B McGehee	CL1	R		NSA	610.20	612.30	2.10	Offer declined on 9/29/98	
138	84	3011 N. Irvington Ave.	Marvin McGehee	CL1	R		NSA	610.50	612.30	1.80	Offer rejected	
139	86	5417 E. Apache St.	A & R Balocca	CL1	R		NSA	620.70	622.50	1.80	Offer rejected	
140	131	3002 N. Joplin Ave.	M & L McGehee	CL1	R		NSA	611.20	612.40	1.20	Offer rejected AKA 3001 N. Joplin	
141	157	1714 N. Kingston Pl.	Kenneth Ingraham	CL3	R		NSA	660.50	661.50	1.00	Offer rejected	
142	189	3005 N. Irvington Ave.		CL1	R		NSA	611.70	612.40	0.70	Offer Rejected	
143	311	3030 E. 51st N. St.	Joseph P & Gilda Cacoperd	FL4	R	A	NSA / RL		0.00	0.00	Offer Rejected	54683
144	327	3030 Rear E. 51st N. St.	Joseph P & Gilda Cacoperd			A	RL		0.00	0.00	Offer Rejected	54682
145	328	3004 E. 51st N. St.	Joseph P & Gilda Cacoperd	FL4	R	A	NSA / RL		0.00	0.00	Offer Rejected	54681
146	329	3006-08 E. 51st N. St.	Joseph P & Gilda Cacoperd	FL4	R	A	RL		0.00	0.00	Offer Rejected	54680
147	330	3120 E. 51st N. St.	Joseph P & Gilda Cacoperd			A	NSA / RL		0.00	0.00	Offer Rejected	54679
148	361	3112 E. 51st N. St.	Joseph Cacoperdo	FL4	R		NSA		0.00	0.00	Offer Rejected	
149	363	3110 E. 51st N. St.	Joseph Cacoperdo	FL4	R		NSA		0.00	0.00	Offer Rejected	
150	364	3010 E. 51st N. St.	Joseph Cacoperdo	FL4	R		NSA		0.00	0.00	Offer Rejected	
				Status:			**Correction**					
151	402	3939 E. 60th St.	Danny P & Roberta Zalta	JSF	R	C	RL	693.70	696.50	2.80		32511
152	443	4733 #1 S. Harvard Ave.	LP Chesterfield C/O Randy			C	RL	663.70	665.90	2.20	Chesterfield North Building; FFFE by White Surveying; Elevated above BFE; Correction Needed.	16355
153	81	8501 S. Elwood Ave.	Davis	HG2	V		NSA	626.75	628.62	1.87	Offer Rejected - Vacant Lot?	
154	315	5622 W. 25th St.	Jolinda Ann Armstrong		R	C	RL	653.80	655.50	1.70		77725
155	266	436 S. St. Louis Ave.					RL	0.00	704.90	0.00		73051
156	283	736 S. Wheeling Ave.					RL	0.00	0.00	0.00		73052
157	285	5520 S. Toledo Pl.	Gerald & Arlene Ramey		R		RL	680.60	0.00	0.00		71944
158	286	3112-3330 S. Memorial Dr	Kelly W McNew			C	RL		0.00	0.00	Correction, new construction	66507
159	288	5810 S. Mingo Rd.	Bert & Georgia Sanders	MU3	V	C	RL		0.00	0.00	Removed by Owner	32460
160	352	9715 E. 13th Pl.				A	RL	0.00	0.00	0.00	Removed from A Zone/Not listed in CW Plan, 9/98	16337
				Status:			**Acquired**					
161	2	6539 W. 3rd St.	CK & Jude Kapple	BH2	V	A	NSA	648.30	659.30	11.00	Acquired	

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
162	3	6747 W. 3rd St.	Ben & Ida Graham	BH2	R	A	NSA	650.00	659.30	9.30	Pending - Title Opinion and closing	
163	398	8213 S. Elwood Ave.	City of Tulsa		V	A	RL	624.33	628.67	4.34		73054
164	21	5525 E. Ute Pl.	S. Massey & C. Patrick	CL4	R		NSA	628.30	632.00	3.70	Closed	
165	30	3022 S. Joplin Ave.	M Agee & D Tatum	CL1	V		NSA	608.70	611.80	3.10		
166	452	1225 S. 141st E. Ave.	City of Tulsa	CO8	V			713.70	716.80	3.10		108246
167	59	3024 N. Joplin Ave.		CL1	MH		NSA	611.50	613.70	2.20	Acquired 8-20-99	
168	26	6898 E. 56th St.	Trustee of C E Gessner Tru	LJ	V	C	FP / RL	741.60	743.71	2.11	Acquired- Rep. Loss.	32471
169	31	6894 E. 56th St.	Warren G & Teresa F Falki	LJ	V	C	RL	741.80	743.63	1.83	Acquired- Rep. Loss	42160
170	101	8901 S. 33rd W. Ave.	B & A Syndergard	NI5	V		NSA	635.08	636.61	1.53	Acquired: 11/24/98 / Primary structure. (Duplicate 102 - removed)	
171	105	10524 S. 77th E. Ave.		FD1	V	A	NSA	651.70	653.20	1.50		90119
172	39	6890 E. 56th St.	Beverley R Stanley	LJ	V	C	RL	742.70	743.06	0.36	Acquired- Rep Loss.	16313
173	272	3008 N. Joplin Ave.	City of Tulsa		V	A	RL		0.00	0.00	Acquired - Property aka (3018 N. Joplin Ave. & 3000 N. Sheridan)	36059
174	275	4407 S. Zenith Ave.				C	RL	0.00	0.00	0.00	Acquired & Removed/Not listed in CW Plan, 9/98	16349
175	277	4415 S. Zenith Ave.			V	C	RL	0.00	0.00	0.00	Acquired & Removed / Not listed in CW Plan, 9/98	16330
176	291	4422 S. Zenith Ave.				C	RL	0.00	0.00	0.00	Acquired & Removed/Not listed in CW Plan, 9/98	32510
177	304	2134 N. Canton Ave.			V	A	RL	0.00	0.00	0.00	Acquired and Removed	45365
178	324	8855 E. 91st St.				D	RL	0.00	0.00	0.00	Demolished/ Not in CW Plan	16298
179	349	9539 E. 9th St.				A	RL	0.00	0.00	0.00	Acquired & Removed	32518
180	350	8111 E. 11th St.			V	A	RL	0.00	0.00	0.00	Acquired & Removed - Motel	54834
181	353	2625 E. 22nd Pl.			V	C	RL	0.00	0.00	0.00	Removed - Vacant	32448
182	294	6929 S. Knoxville Pl.	City of Tulsa	FR14	V	C	RL	705.40	704.00	-1.40		32449
				Status:								
183	390	3759 N. Hartford Ave.		FL8	R		NSA	636.20	700.30	64.10		
184	450	3211 E. 32nd N. St.	Louis & Gertrude Baker	FL3			NSA	662.80	679.20	16.40		
185	446	3236 E. 36th N. St.	Myrtle Waldon	FL3	D	C	NSA	650.70	655.00	4.30	White Survey	
186	411	1505 E. 5th St.	Southwest United Industries			C	RL	701.00	705.00	4.00	Office - Flood depth survey in progress, 04/30/01	38505
187	412	1505 E. 5th St., R	Southwest United Industries			C	RL	701.00	705.00	4.00	Flood depth survey in progress, 04/30/01	54073
188	430	4923 S. College Ave.	Kevin D. Newport	JU1	R		FP	661.90	665.40	3.50		
189	325	3165-71 E. 49th St.	BCS Assoc Ltd	JU1	MO	A	RL	661.90	665.30	3.40	Apartments	35301
190	434	3030 E. 49th St.	Eugene & Marla Brierly	JU1	R		FP	662.28	665.40	3.12		
191	346	6556 W. 1st St.	Roy Earl Capp	BH2	R		NSA	654.90	658.00	3.10		
192	435	3038 E. 49th St.	Barbara Jo McBride	JU1	R		FP	662.40	665.40	3.00		
193	437	3014 E. 49th St.	Michael S. Cook	JU1	R		FP	662.53	665.40	2.87		
194	322	8532-50 E. 41st St.	Alan F Cuddy		C	C	RL	667.20	670.00	2.80		16301
195	161	6403 E. 54th St.	James McElroy		R		FP	715.44	718.03	2.59		

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
196	429	3023 E. 49th St.	Jack Seay	JU1	R		FP	663.00	665.40	2.40		
197	343	6901 W. 1st St.	Clara F. Mercy	BH2	R		NSA	656.00	658.00	2.00	Two listings (343 - Storage Building, 344 - Primary Building) Now consolidated into one listing.	
198	100	4750 S. Harvard Ave.			A	A	FP	666.19	668.00	1.81	Apartments	
199	214	4760 S. Irvington Ave.		LJ	R		FP	714.23	716.04	1.81		
200	216	3120 E. 28th St.		JU14	R		FP	731.54	733.20	1.66		
201	95	2104 N. Darlington Pl.	B & P Cosner	CL1	R		NSA	644.00	645.60	1.60	Dawson Park Acquisition Area	
202	96	1515 E. 19th St.		SW3	R		FP	707.50	709.10	1.60	Floodproofing recommended by MDP	
203	345	6557 W. 1st St.	Francis R. Alltizer	BH2	R		NSA	656.40	658.00	1.60		
204	103	3116 E. 47th St.	Roy & Levon Snyder	JU1	R		FP	664.49	666.00	1.51	Identified by Joe Creek MDP for floodproofing.	
205	104	2544 S. Cincinnati Ave.		SW2	R		FP	660.90	662.40	1.50		
206	106	2405 E. 18th St.		CR8	R		MDP	717.70	719.20	1.50		
207	107	2142 S. Florence Pl.		CR6	R		FP	766.30	767.80	1.50	MDP recommends floodproofing	
208	110	3926 S. Utica Ave.					FP	660.16	661.66	1.50	MDP recommends floodproofing	
209	112	4004 S. Utica Ave.					FP	759.83	761.33	1.50		
210	113	4626 S. Florence Pl.		JU12	R		FP	665.34	666.80	1.46		
211	114	7520 E. 106th St.		FD1	R		NSA	652.16	653.60	1.44		
212	115	2232 N. Lansing Ave.	T & J Parks		R		NSA	660.00	661.40	1.40	Lacey Park, Urban Development	
213	116	2138 S. Delaware Ct.					FP	752.80	754.20	1.40		
214	117	3021 W. 91st St.		NI5	R		FP	634.25	635.64	1.39	Nickle Creek	
215	119	3136 E. 44th St.	James A & Jane Roden	JU12	R		FP	677.95	679.30	1.35		
216	120	4514 E. 39th St.	Edna I White	JU10	R		FP	697.46	698.80	1.34		
217	180	4821 S. Florence Pl.		JU1	R		FP	664.27	665.60	1.33		
218	313	204 E. 15th St.	Oklahoma Electrical Supply		R		RL	657.10	658.40	1.30	AKA 214 E. 15th St. (Original Address for RL) - Correction Needed - Commercial	71998
219	124	1315 N. Mingo Rd.	Taylor Boat Storage	ML15	R		FP	612.01	613.30	1.29	North Mingo residual floodplain, commercial.	
220	126	4724 S. Florence Ave.		JU1	R		FP	664.56	665.80	1.24		
221	127	4636 S. Jamestown Ave.		JU1	R		FP	667.56	668.78	1.22		
222	132	4642 S. Jamestown Ave.		JU1	R		FP	667.44	668.64	1.20		
223	447	3234 E. 34th N. St.	Annie Barnes	FL3	R		NSA	653.80	655.00	1.20	Flood depth survey in progress, 3/25/99	
224	297	5345 S. Toledo E. Ave.	Mark A & Teryl A Sperle		R	C	RL	670.82	672.00	1.18		32466
225	134	1339 N. Mingo Rd.		ML15	R		FP	612.16	613.30	1.14	North Mingo Residual FP	
226	135	3151 E. 38th Pl.	William Craig Gille	JU13	R		FP	692.16	693.30	1.14		
227	136	3105 E. Skelly Dr.	Pecan Properties Inc	JU1	C		MDP	664.17	665.30	1.13		
228	137	3145 E. 42nd St.	David E & Jo Sawyer	JU12	R		FP	681.39	682.50	1.11		
229	139	1632 S. Victor Ave.	Bruce & Nancy Holmde	SW4	C		FP	726.60	727.70	1.10		
230	141	1510 E. 19th St.		SW3	R		FP	706.60	707.70	1.10		

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
231	140	2132 S. Florence Pl.		CR6	R		FP	766.70	767.80	1.10		
232	142	3155 E. 42nd St.	Peggy J Krisa	JU12	R		FP	681.40	682.50	1.10		
233	280	728 S. Wheeling Ave.	Chitton, June K Trustee Jun	EL7	C	C	RL	713.40	714.50	1.10		43284
234	410	4322 E. 74th Pl.	Randall S & Joan E Miller	FR6	R	C	RL	742.40	743.50	1.10		32491
235	145	3322 E. 28th St.		JU14	C		FP	750.12	751.20	1.08		
236	147	3830 S. Florence Pl.		JU13	R		FP	691.04	692.10	1.06		
237	148	1126 N. Mingo Rd.	Underground Const.	ML15	C		FP	612.32	613.36	1.04	Mingo Residual FP - Commercial	
238	149	3109 E. 48th St.	Karl E Baer	JU1	R		FP	664.87	665.90	1.03		
239	152	3035 E. 49th St.	W Saxon Moore	JU1	R			664.39	665.40	1.01		
240	153	2272 E. 34th St.	William Satterfield				FP	719.86	720.86	1.00		
241	154	2136 S. Florence Pl.		CR6	R		FP	766.80	767.80	1.00		
242	155	3520 S. Zunis Ct.					FP	711.09	712.09	1.00		
243	156	3933 S. Troost Ave.	Robert J Childers				FP	658.01	659.01	1.00		
244	159	2132 S. Delaware Ct.		CR6	R		FP	753.20	754.20	1.00		
245	160	2203 N. Lansing Ave.	Mae A. Reynolds		R		NSA	660.50	661.50	1.00	Lacey Park, Urban Development	
246	416	3443 E. 57th St.	Joe J. & Dorothy L. Koliha	JSF	R		RL	677.50	678.50	1.00	Flood depth survey in progress, 3/25/99	
247	163	2824 S. Harvard Ave.			C		FP	745.15	746.10	0.95		
248	164	3303 S. Florence Ave.		JU13	R		FP	714.16	715.10	0.94		
249	165	3840 S. Florence Pl.		JU13	R		FP	690.06	691.00	0.94		
250	168	2550 S. Cincinnati Ave.		SW2	R		FP	661.50	662.40	0.90		
251	170	2246 N. Lansing Ave.	Annie Lee Hatcher		R		NSA	660.50	661.40	0.90		
252	171	2238 N. Lansing Ave.	G. Dotson, D Bunn, et.al.	DB8	R		NSA	660.50	661.40	0.90		
253	365	510 S. 69th W. Ave.		BH2			NSA	658.40	659.30	0.90		
254	367	406 S. 69th W. Ave.		BB2		A	NSA	658.40	659.30	0.90	Flood Depth Survey in Progress, 3/25/99	
255	172	5704 S. 39th W. Ave.	Clifford L Bierly	MO6	R		FP	715.96	716.80	0.84	Mooser Creek	
256	173	4634 S. Florence Pl.		JU12	R		FP	665.67	666.50	0.83		
257	143	3337 E. 47th Pl.		JU1	R		FP	667.59	668.42	0.83		
258	144	3335 E. 47th Pl.	Jack P Revell	JU1	R		FP	667.59	668.42	0.83		
259	174	3810 S. Florence Pl.		JU13	R		FP	693.78	694.60	0.82		
260	175	4708 S. Florence Ave.	Jane E. Burns	JU1	R		FP	665.19	666.00	0.81		
261	176	3104 S. Florence Ct.		JU13	R		FP	722.50	723.30	0.80		
262	177	3818 S. Florence Pl.	Daniel P Schuman	JU13	R		FP	692.50	693.30	0.80		
263	178	2818 E. 21st Pl.		CR6	R		FP	755.20	756.00	0.80		
264	359	10201 E. 47th St.	Hufnagel, Paul L & Blanch		C	B	RL	661.20	662.00	0.80	Removed from A Zone - Correction Needed	32489
265	403	4330 E. 74th S. Pl.	Holly O'Shea Nunn	FR6	R	C	RL	743.20	744.00	0.80		32497
266	179	3115 E. 48th St.	Charles Lilly	JU1	R		FP	665.11	665.90	0.79		

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
267	183	545 N. 91st E. Ave.		ML15	R		FP	616.10	616.88	0.78		
268	181	4820 S. Florence Ave.	Kenneth & Hysuk Smith	JU1	R			664.82	665.60	0.78	Identified in Joe Creek MDP as structure w flood depth above 1st FF	
269	182	4821 S. Florence Ave.		JU1	R		MDP	664.82	665.60	0.78	Identified in Joe Creek MDP w fld depth above FFF	
270	184	8751 S. 33rd W. Ave.		NI5	R		FP	636.84	637.61	0.77	Nickle Creek	
271	185	4711 S. Florence Ave.	Jane S. Cowdery	JU1	R		FP	665.24	666.00	0.76		
272	186	4820 S. Florence Pl.	Charles Cook	JU1	R			664.87	665.60	0.73		
273	187	5722 S. 39th W. Ave.	Maurice E Reagle	MO6	R		FP	717.77	718.50	0.73	Mooser Creek	
274	188	3132 S. Florence Ct.		JU13	R		FP	719.49	720.20	0.71		
275	191	3127 S. Florence Ct.		JU13	R		FP	721.20	721.90	0.70		
276	192	2144 N. Madison Ave.	Patricia Harris		V		NSA	661.30	662.00	0.70	Lacey Park, Urban Development	
277	193	3144 E. 42nd St.	Philip L Essley	JU12	R		FP	680.44	681.10	0.66		
278	194	3128 S. Florence Ct.		JU13	R		FP	720.67	721.30	0.63		
279	195	8745 S. 33rd W. Ave.		NI5	R		FP	637.88	638.50	0.62	Nickle Creek	
280	196	3111 S. Florence Ct.		JU13	R		FP	722.08	722.70	0.62		
281	197	3131 S. Florence Ct.		JU13	R		FP	719.59	720.20	0.61		
282	198	4618 S. Florence Pl.		JU12	R		FP	666.49	667.10	0.61		
283	203	1624 S. Victor Ave.		SW4	R		FP	728.10	728.70	0.60		
284	205	1710 E. 17th St.		SW4	C		FP	725.80	726.40	0.60		
285	199	2146 S. Florence Pl.		CR6	R		FP	767.20	767.80	0.60		
286	200	2149 S. Florence Ave.		CR6	R		FP	764.90	765.50	0.60		
287	201	1421 E. 20th St.		SW3	R		FP	704.40	705.00	0.60		
288	204	2141 S. Florence Ave.		CR6	R		FP	764.90	765.50	0.60		
289	445	3008 E. 36th N. St.	Lolita Cooper	FL3	C	X	NSA	650.50	651.10	0.60		
290	206	3119 S. Florence Ct.		JU13	R		FP	721.62	722.20	0.58		
291	208	3103 S. Florence Ct.		JU13	R		FP	722.79	723.30	0.51		
292	209	2538 S. Norfolk Ave.	Michael Neale Ward	SW2	R		FP	661.90	662.40	0.50		
293	342	6908 W. 1st St.	Joe & Kara Fleming	BH2	R		NSA	657.50	658.00	0.50		
294	448	3132 E. 34th N. St.	Theodore Dikes	FL3	R		NSA	654.50	655.00	0.50	Flood depth survey in progress, 3/25/99	
295	210	4526 S. Gary Ave.		JU12	R		FP	670.02	670.50	0.48		
296	213	3138 E. 37th St.	Mark S Bearden	JU13	R		FP	696.24	696.70	0.46		
297	215	3011 E. 49th St.	Mark & Deborah Lawrence	JU1	R			664.98	665.40	0.42		
298	207	3333 E. 47th Pl.		JU1	R		FP	668.16	668.57	0.41		
299	220	2556 S. Cincinnati Ave.		SW2	R		FP	662.00	662.40	0.40		
300	221	2667 S. Boston Pl.		SW1	R		FP	649.30	649.70	0.40		
301	222	2663 S. Boston Pl.		SW1	R		FP	649.30	649.70	0.40		
302	225	2145 S. Florence Ave.		CR6	R		FP	765.10	765.50	0.40		

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
303	316	4911 E. 26th Terr.	Jeanine C Loftin		R	C	RL	752.60	753.00	0.40		52215
304	424	4329 E. 74th Pl.	Susan C & Mark Hamilton	FR6	R	D	RL	745.80	746.20	0.40		16323
305	223	2900 S. Harvard Ave.		JU14	C		FP	743.70	744.10	0.40		
306	368	402 S. 69th W. Ave.		BB2	R	A	NSA	658.90	659.30	0.40	Flood Depth Survey in Progress, 3/25/99	
307	211	3331 E. 47th Pl.	Rita N & Paula Rowe	JU1	R		FP	668.20	668.57	0.37		
308	227	3120 S. Florence Ct.		JU13	R		FP	721.53	721.90	0.37		
309	229	5708 S. 39th W. Ave.		MO6	R		FP	717.75	718.10	0.35	Mooser Creek	
310	230	2822 S. Harvard Ave.			C		FP	745.75	746.10	0.35		
311	233	3922 S. Florence Pl.		JU13	R		FP	688.75	689.10	0.35		
312	235	2819 S. Harvard Ave.		JU14	C		FP	747.57	747.90	0.33		
313	236	4446 S. Gary Ave.		JU12	R		FP	676.39	676.70	0.31		
314	238	1403 E. 21st St.		SW3	R		FP	697.20	697.50	0.30		
315	438	2301 E. 42nd N. Pl.	Elizabeth Williams	FL1	R		NSA	613.20	613.50	0.30		
316	226	2649 S. Florence Ave.		JU14	R		FP	740.37	740.64	0.27		
317	239	3130 E. 44th St.	James C Netherton	JU12	R		FP	678.04	678.30	0.26		
318	240	3125 E. 27th St.		JU14	R		FP	741.75	742.00	0.25		
319	241	4716 S. Florence Ave.		JU1	R		FP	665.65	665.90	0.25		
320	258	6722 E. 53rd Pl.	Mary Clare Kerns		R		FP	729.29	729.53	0.24		
321	242	3850 S. Florence Pl.		JU13	R		FP	690.17	690.40	0.23		
322	243	510 N. 91st E. Ave.		ML15	R		FP	618.05	618.26	0.21		
323	244	2657 S. Boston Pl.		SW1	R		FP	649.50	649.70	0.20		
324	246	2147 S. Florence Pl.		CR6	R		FP	769.80	770.00	0.20		
325	357	433 E. 40th N. Pl.		FL2	R		NSA	630.20	630.40	0.20	Flood depth survey in progress, 3/25/99	
326	245	1625 S. Columbia Ave.		CR12	R		FP	751.40	751.60	0.20		
327	250	1516 E. 19th St.		SW3	R		FP	707.60	707.70	0.10		
328	252	2534 S. Norfolk Ave.		SW2	R		FP	662.30	662.40	0.10		
329	249	2205 S. Florence Ave.		CR6	R		FP	765.40	765.50	0.10		
330	321	8516 E. 41st St.	Ester B Semones Family Tr	MUM4	C	C	RL	669.90	670.00	0.10	Flood depth survey in progress, 3/25/99	32469
331	231	3323 E. 47th Pl.	Jack P Revell	JU1	R		FP	668.33	668.42	0.09		
332	232	3325 E. 47th Pl.		JU1	R		FP	668.33	668.42	0.09		
333	234	4652 S. Jamestown Ave.		JU1	R		FP	668.35	668.42	0.07		
334	254	3133 E. 38th St.	Jay I & Sandra Rozen	JU13	R		FP	695.94	696.00	0.06		
335	212	1422 N. 77th E. Ave.		LM	R		FP	0.00	0.00	0.00		
336	217	1419 N. 77th E. Ave.		LM	R		FP	0.00	0.00	0.00		
337	218	2221 N. Lansing Ave.	Samuel & Erma Pearson		R		NSA		0.00	0.00	Lacey Park, Urban Development	
338	219	2225 N. Lansing Ave.,	Erma Pearson		R		NSA		0.00	0.00	Lacey Park, Urban Development	

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339	228	5209 S. Vandalia Ave.		LJ	R		FP	0.00	0.00	0.00		
340	248	1429 E. 20th St.		SW	R		FP	0.00	0.00	0.00		
341	251	2204 N. Madison Ave.			R		NSA		0.00	0.00		
342	259	4421 S. Zenith St.				C	RL	0.00	0.00	0.00	Improvements in place/Not listed in CW Plan, 9/98	32465
343	261	4923-25 S. Oswego Ave.	Alexander Novovich		D2	C	RL	689.20	0.00	0.00		16335
344	262	4238 N. Lewis Ave.		FL1	R		NSA	0.00	612.90	0.00		
345	263	7200 N. Lewis Ave.	Fugate John			C	RL	0.00	0.00	0.00	Outside City Limits/Not in CW Plan, 9/98	32434
346	265	652 E. Virgin St.			V		NSA		669.50	0.00		
347	268	648 E. Virgin St.			V		NSA		669.50	0.00		
348	270	4210 N. Lewis Ave.		FL1	V		NSA		612.90	0.00		
349	273	4916-18 S. Pittsburg Ave.	Alexander Novovich		D2	C	RL	691.10	0.00	0.00		16334
350	274	2219 N. Lansing Ave.,			V		NSA		661.20	0.00		
351	279	6913 S. Knoxville Pl.	Larry Lee & Vicky Lee Lusk			C	RL		0.00	0.00	Flood depth survey in progress, 8/27/02	16328
352	281	638 E. Seminole Pl.,			V		NSA		663.40	0.00		
353	282	514 S. Quantico .	Ron & Rose Trimble			A	RL	0.00	0.00	0.00	Outside City Limits/Not in CW Plan	50043
354	287	1250 S. Memorial Dr., B	Oklahoma Bay Homestead			C	RL		0.00	0.00	Flood depth survey in progress, 04/30/01	16321
355	292	231 E. Ute St.			R		NSA		699.50	0.00	Flood depth survey in progress, 3/25/99	
356	293	815 S. Utica Ave.	Tulsa Rec Ctr for Phys. Lmt			C	RL	710.70	0.00	0.00		16336
357	295	1627 N. Main St.	Cristopher Gafney Et Al.		R		NSA	683.40	0.00	0.00		
358	296	4919-21 S. Oswego Ave.	Alexander Novovich		D2	C	RL	690.50	0.00	0.00	Duplex	16333
359	298	593 E. Ute St.			V		NSA		0.00	0.00	Flood depth survey in progress, 3/25/99	
360	299	1631 N. Main St.	Lucy Glover & Retha Bords		R		NSA	683.00	0.00	0.00		
361	300	2128 N. Norfolk Ave.		DB8	R		NSA	0.00	0.00	0.00		
362	301	2120 N. Norfolk Ave.		DB8	V		NSA	0.00	0.00	0.00		
363	302	1635 N. Main St.	Trumark Co. LLC		R		NSA	682.40	0.00	0.00		
364	303	598 E. Tecumseh St.		DB9			NSA	0.00	0.00	0.00		
365	305	2112 N. Norfolk Ave.	Charlie Moore	DB8	R		NSA	671.30	0.00	0.00		
366	306	1639 N. Main St.	Marie Jordan		R		NSA	682.90	0.00	0.00		
367	307	1643 N. Main St.	Floyd & Rosie Ruff		R		NSA	682.30	0.00	0.00		
368	308	1647 N. Main St.	Elmira Washington		R		NSA	682.20	0.00	0.00		
369	312	2531 E. 56th St.	Johnny Kye & Cynthia M Ch			B	RL	646.40	0.00	0.00		32502
370	314	2430 E. 17th Pl.	Snider, Victoria and Randy	CR9	R		MDP	722.00	722.00	0.00		
371	317	5309 E. 35th St.	Josephine Irene Hinson			C	RL		0.00	0.00	Flood depth survey in progress, 8/27/02	32468
372	326	2820 S. 88th E. Ave.				C	RL	0.00	0.00	0.00	Problem solved/Channel improved/Not listed in CW Plan, 9/98	32496
373	331	1540 N. Cheyenne Ave.	Marion Ross		R		NSA	690.30	0.00	0.00	Flood depth survey in progress, 3/25/99	
374	332	4138 E. 53rd Pl.	Jeanne Edwards			A	RL	0.00	0.00	0.00		16300

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375	333	4737-45 #4 S. Harvard Av	LP Chesterfield			C	RL		0.00	0.00	New Construction - Chesterfield	16353
376	334	4706 #19 E. 54th St.	c/o Prestige Mgmt 5400 So			A	RL		0.00	0.00	Owner would not allow access to property, Apts	32481
377	336	4706 #14 E. 54th St.	c/o Prestige Mgmt 5400 So			A	RL		0.00	0.00		32479
378	337	4706 #17 E. 54th St.	c/o Prestige Mgmt 5400 So			A	RL		0.00	0.00		32478
379	339	4706 #9 E. 54th St.	c/o Prestige Mgmt 5400 So			A	RL		0.00	0.00		32475
380	348	6706 W. 3rd St.		BH2			NSA	0.00	0.00	0.00		
381	354	6219 E. 11th St.	Roger W, Walter D. Sr., &	MLM2	C/M	C	RL	693.50	0.00	0.00	Flood depth survey in progress, 04/30/01 - Industrial	78005
382	355	3236 E. 36th N. St., 2	Myrtle Waldon	FL3	D	C	NSA	652.20	0.00	0.00	Secondary Structure, Flood Depth Survey in Progress	
383	356	4706 #20 E. 54th St.	c/o Prestige Mgmt 5400 So			A	RL		0.00	0.00	Owner would not allow access to property, Apts	32482
384	358	2369 E. 42nd N. Pl.		FL1			NSA	0.00	612.90	0.00		
385	362	111 N. 2nd St.						0.00	0.00	0.00		
386	366	366 S. 69th W. Ave.		BH2			NSA	0.00	0.00	0.00		
387	370	5620 W. 25th Pl.				C	RL	0.00	0.00	0.00	Out of City - Correction Needed	32498
388	371	5631 N. Elgin Ave.	Sonny Egede	FL7	R	A	NSA	675.90	0.00	0.00	Flood depth survey in progress, 3/25/99	
389	372	1806 N. Boston Ave.	Elmer & Gladys Jenkins		R		NSA	675.70	0.00	0.00	Flood depth survey in progress, 3/25/99	
390	373	5807 E. 56th St.	Lawrence J Mundus, Truste		R	C	RL	710.70	0.00	0.00		32488
391	374	1550 N. Cheyenne Ave.	Carl & Athlene Barnett		R		NSA	690.90	0.00	0.00	Flood depth survey in progress, 3/25/99	
392	375	4024 E. 53rd St.	J Dwight & S Claudine Tayl			A	RL	667.50	0.00	0.00	Little Joe Channel - Correction Needed	16332
393	376	1528 N. Cheyenne Ave.	Nadine Outland		R		NSA	692.60	0.00	0.00	Flood depth survey in progress, 3/25/99	
394	377	20-22 N. Cheyenne Ave.	Lee James Evans		R		RL	687.40	0.00	0.00		72020
395	379	2811 S. Cincinnati Ave.	Teresa M Hron		R	B	RL	638.00	0.00	0.00		16327
396	380	1923 N. Cincinnati Ave.	A. D. & Louise Jackson	DB3	R		NSA	675.70	0.00	0.00	Removed from Floodplain	
397	381	7102 S. Columbia E. Ave.	Edna Ruth Baldwin		R	C	RL	698.70	0.00	0.00	Offer Rejected	37216
398	382	1531 N. Denver Ave.	Almeta Buggs		R		NSA	692.10	0.00	0.00	Flood depth survey in progress, 3/25/99	
399	383	1527 N. Denver Ave.	Lorell Kirk		R		NSA	691.70	0.00	0.00	Flood depth survey in progress, 3/25/99	
400	384	1523 N. Denver Ave.	Almeda & Edward Goodwin		R		NSA	684.90	0.00	0.00	Flood depth survey in progress, 3/25/99	
401	385	1818 N. Boston Ave.		DB3			NSA	0.00	0.00	0.00		
402	386	7225 S. Gary Ave.	Donald & Olivia Mauritson T	FR12	R	A	RL	689.40	0.00	0.00		32508
403	387	5206 S. Harvard Ave., 311	Grace E. McIntosh			A	RL	662.30	0.00	0.00		32467
404	388	5206 S. Harvard Ave., 315	Bates, Jerry T & Betti J Tru			A	RL	662.30	0.00	0.00		41198
405	391	1623 N. Greenwood Pl.			R		NSA		0.00	0.00		
406	392	1519 N. Denver Ave.	Rod Spurlin		R		NSA	692.10	0.00	0.00	Flood depth survey in progress, 3/25/99	
407	393	1637 N. Greenwood Pl.			R		NSA		0.00	0.00		
408	394	4501 W. Edison St.		HR3	CH		NSA		664.20	0.00	Flood depth survey in progress, 3/25/99	
409	396	4103 N. Frankfort Pl.		FL2	R		NSA		0.00	0.00		
410	399	5626 N. Elgin Ave.	James & Joycilla Wortham	FL7	R	A	NSA	674.10	0.00	0.00	Flood depth survey in progress, 3/25/99	

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411	401	1625 N. Greenwood Pl.			R		NSA		0.00	0.00		
412	404	1532-34 N. Cheyenne Ave	Lloyd & Olivia Jackson		R		NSA	690.70	0.00	0.00	Flood depth survey in progress, 3/25/99	
413	405	1522 S. 74th E. Ave.					RL	0.00	0.00	0.00		66519
414	407	6121 S. 72nd E. Ave.	William Sparks		R	C	RL	776.50	0.00	0.00		40466
415	408	1827 N. Boston Ave.			R		NSA		0.00	0.00	Flood depth survey in progress, 3/25/99	
416	409	6705 E. 66th St.	Betty M & Lynn D Sammon		R	C	RL	790.20	0.00	0.00		32472
417	413	2615 E. 59th St.	Cynthia D Harkins			C	RL	643.10	0.00	0.00		32490
418	417	6523 E. 66th St.	Janet M, Ladon K, Chance		R	C	RL	790.80	0.00	0.00		32470
419	418	3444 E. 75th S. St.	Hall, Jo Ann & William O Tr		R	C	RL	729.20	0.00	0.00		44148
420	419	1839 N. Boston Ave.	St Luke's Methodist Church		R		NSA	676.60	0.00	0.00	Flood depth survey in progress, 3/25/99	
421	420	1848 N. Boston Pl.			R		NSA	679.60	0.00	0.00	Flood depth survey in progress, 3/25/99	
422	422	1345 S. 99th E. Ave.	Charles & Loyce Saylor		R	C	RL	0.00	0.00	0.00		66518
423	425	1831 N. Boston Ave.	Paul Carbin		R		NSA	681.70	0.00	0.00	Flood depth survey in progress, 3/25/99	
424	431	2233 N. Lansing Ave.			R		NSA		661.20	0.00		
425	432	2237 N. Lansing Ave.			R		NSA		661.20	0.00		
426	433	2239 N. Lansing Ave.	Willie Paylor		R		NSA		661.20	0.00		
427	456	2818 E. 38th St.			R			0.00	0.00	0.00		
428	426	3105 E. 47th St.	Susan Stegman	JU12	R		FP	666.66	666.60	-0.06		
429	253	3327 E. 47th Pl.	Dana E Hallum Trust	JU1	R		FP	668.61	668.53	-0.08		
430	341	503 E. 40th N. Pl.		FL2	R		NSA	630.40	630.30	-0.10	Flood depth survey in progress, 3/25/99	
431	255	3329 E. 47th Pl.	Public Service Company	JU1	R		FP	668.64	668.53	-0.11		
432	247	4642 S. Knoxville Ave.		JU1	R		FP	668.55	668.42	-0.13		
433	428	2421 E. 18th St.		CR8	R		MDP	719.70	719.20	-0.50		
434	444	3113 E. 36th N. St.	Joey Boyd	FL3	R		NSA	645.80	645.30	-0.50	White survey	
435	451	2748 E. 29th N. St.	Earlene Walker	FL3	R		NSA	679.90	679.40	-0.50	White Survey	
436	202	2161 S. Owasso Pl.					FP	687.20	686.60	-0.60		
437	290	701 S. Mingo Rd.	Wesley Methodist Church		R	A	RL	623.70	622.90	-0.80		16338
438	436	3124 E. 47th St.	Patrick Walters	JU1	R		FP	666.90	666.00	-0.90		
439	276	708 S. Sheridan Rd.	Marilyn Sue Kloehr	MLM2	C		RL	690.80	689.70	-1.10	Flood depth survey in progress, 04/30/01	73053
440	309	5278 S. Joplin Pl.	John C & Stella E Huskinso	LJ-4	R	C	RL	709.30	708.20	-1.10		66523
441	389	5206 S. Harvard Ave.	Jewel M Wallace Trust	JSF	C	X	RL	662.60	661.50	-1.10	Apt. building. AKA # 301, etc.	70013
442	269	7139-41 S. Indianapolis E.	Mohawk Properties, LLC.		D2	D	RL	687.00	685.60	-1.40		16344
443	351	17609 E. 13th St.		CT4	R		NSA	660.00	658.50	-1.50	Flood depth survey in progress, 3/25/99	
444	397	4118 N. Frankfort Ave.		FL2	R		NSA	632.30	630.70	-1.60		
445	441	2216 E. 42nd N. Pl.	Linda Bear	FL1	R		NSA	615.20	613.50	-1.70		
446	440	2436 E. 17th Pl.,		CR	R		MDP	724.00	722.00	-2.00		

Rank	NSM	Address	Owner's Name	Creek	LU	FP	Orig List	FFFE	Reg Fld	Fld Dep	Comments	RL Num
447	278	436 E. Virgin St.	Sylvester & Phyllis Wrather		R		NSA	666.20	663.70	-2.50		
448	442	4344 N. Lewis Ave.	Gene & Lynda Young	FL1	R		NSA	615.40	612.90	-2.50	White Survey	
449	347	6748 W. 3rd St.	Frank Murry	BH2	R		NSA	660.70	658.00	-2.70		
450	335	4706 E. 54th St.	c/o Prestige Mgmt 5400 So		R	A	RL	681.39	678.57	-2.82		32480
451	264	5502 S. Joplin Ave.	Roland D & Eleanor C Wilki		R	C	RL	707.70	704.40	-3.30		32473
452	400	7237 W. Cameron St.	Marion & Mary Sturdy	BH2	MH		NSA	670.70	666.80	-3.90		
453	449	3237 E. 34th N. St., 2	Myrtle Waldon	FL3		X	NSA	656.50	651.10	-5.40		
454	421	6726 W. Admiral Blvd.	Kellen & Fleta Buckles	BH2	R		NSA	680.30	658.00	-22.30		
455	415	2724 E. 57th St.	Virgil F & Pauline F (Truste			C	RL	645.70	615.20	-30.50		16299

Appendix J:

City of Tulsa Overtopped Bridges

APPENDIX J

OVERTOPPED BRIDGES

The City of Tulsa's Master Drainage Plans and the Flood and Stormwater Management Plan 1999-2014, September 10, 1998, identified all public street and roadway bridges which will be overtopped during the 100-year flood event.

Appendix J: Overtopped Bridges, provides a comprehensive listing of all overtopped bridges and culverts in the City of Tulsa. The list includes:

- Location of bridge/culvert
- Name of the Creek
- Flood Management Area (FMA), the stream segment planning designation in which the bridge/culvert is located
- Description of the existing bridge/culvert
- Depth of flooding over the low point in the roadway profile that includes the bridge deck.

Appendix J: Overtopped Bridges

Location	Creek Name	FMA	Description	Depth
Apache St., 900' East of Mingo Rd.	Lower Mingo	ML13	Low water crossing	13.3
77th St. S. and 69th E. Place	Haikey	HK20a	2 - 7' x 5' RCB	12.3
72nd E. Ave., E. 76th St. S.	Haikey	HK5	2 - 7' x 5' RCB	12.1
W. Cameron St. & North Quanah Ave.	Oak	OC3	102" Underground storm sewer	12
Edison St., East of 49th W. Ave.	Harlow	HR2	2 - 10' x 10' RCB	8.7
36th S. S., East of Florence Ave.	Upper Joe	JU13		8.1
88th St. S., 100' West of Lewis Ave.	Fred	FR1	Low water crossing 48" CMP	8
5300 S. Lawton Ave.	Mooser	MO1	Bridge, 61.4' x 7.8'	7.8
81st St. S., 1/4 mile East of Elwood Avenue	Hager	HG1	Low water crossing	7.5
East service rd. to M.V. Expwy.	Lower Mingo	ML7a	5.5' x 7' CGMP	7.4
112th E. Ave. and 11th St. S.	Lower Middle Mingo	MLM5a	Double tee bridge	7.4
72nd St. S. and 7100 block East	Haikey	HK24	2 - 6' x 6' RCB	7.3
Lewis Ave., 39th St. N. to 44th St. N.	Flat Rock	FL1	19' depth	7.1
Mingo Rd., 900' South of Apache St.	Lower Mingo	ML13	2' x 6' RCB	7.1
B.A. Expressway, 14th St. to Cincinnati Avenue	Elm	EL3	Storm sewers, various sizes	7
94th St. S. and Maplewood Ave.	Fry Ditch No.2	FD4	36" & 28" CGMP	7
T.I. Speedway access road	Lower Mingo	ML7a	5' x 30' RCB	6.6
Apache St. at North Kenosha Ave.	Dirty Butter	DB2	Trapezoidal Channel, 28; BW, 8	6.5
49th St. S., West of Gary Ave.	Upper Joe	JU1b		6.2
36th St. N., 1/2 mile East of Yale Ave.	Coal	CL1	4 - 10' x 10' RCB Bridge	6
4th Pl., 1/4 mile East of Harvard Ave.	Coal	CL2	8' Semi-elliptical storm sewer	6
15th St., under B. A. Expressway	Crow	CR9	Storm sewer	6
Mohawk Blvd., North Owasso Ave.	Dirty Butter	DB2	Trapezoidal Channel 40' BW, 5	6
13th Street South Cincinnati to Detroit	Elm	EL3	Storm sewer	6
Lansing Ave. at 30th Street North	Dirty Butter	DB10	Low water crossing	5.9
11th St. S. and 83rd E. Ave.	Lower Middle Mingo	MLM2a	3 - 10' x 7' x 28' RCB	5.9
Independence St., 1/2 mile E. of Harvard Ave.	Coal	CL2	10' x 6' RCBC storm sewer	5.8
102nd E. Ave. and 7th St. S.	Lower Middle Mingo	MLM5a	2 - 8' x 7' x 37.7' RCB	5.8
Delaware Ave., 38th Place North	Flat Rock	FL3	2 - 54" RCP	5.7
Elwood Ave., 1.2 mi. South of 81st St. S.	Hager	HG2	Bridge 3 - 10' x 5.5'	5.7
Holiday Park, 1/4 mile West of Garnett Rd.	Cooley	CO1	13" x 15" CMP	5.5
Toledo Ave. & 82nd St. S.	Vensel	VE6	84" Semi-ellip.	5.5
Carl Smith Sports Complex	Center	CT2b	Low water crossing with CGMP	5.4
Peoria Ave., East of 31st Street North	Dirty Butter	DB2	Bridge, trapezoidal Channel, 23'	5.4
Mingo Rd., 2,000' South of Apache Street	Lower Mingo	ML13	3 - 12' x 10' RCB	5.4

Location	Creek Name	FMA	Description	Depth
Pittsburg Ave. at 27th St., St., & B. A. Expressway	Upper Joe	JU3		5.3
1st St. S. & Rosedale Avenue	Oak	OC2	Partial 96" & 60"	5.3
Cincinnati Ave. at 31st Street North	Dirty Butter	DB10	10' x 4' RCB	5.1
37th St. S., East of Jackson Avenue	Garden City	GC	Bridge underpass	5
115th E. Ave.and 16th St. S.	Lower Middle Mingo	MLM5b	2 - 10' x 6' x 66' RCB	5
14th St. S., East of Garnett Road	Lower Middle Mingo	MLM5b	2 - 40' x 20' RCP	4.9
M.V. Expwy. & 18th St. S.	Lower Middle Mingo	MLM9	2 - 8' x 6' x 180' RCB	4.9
Yale Ave., North of 31st St. South	Upper Joe	JU4		4.8
Gary Pl. and E. 12th Street	Coal	CL8	54" Storm sewer	4.7
173rd E. Ave.,north of 12th St. S.	Center	CT1b	Double RCP, 42" diameter	4.7
E. Admiral Pl., 1/4 mile East of Harvard Ave.	Coal	CL2	2 - 10' x 7' x 40' RCB storm sew	4.6
New Haven Ave.	South Fork Joe	JSFc	2 - 3.5' x 10' RCB	4.6
E. Newton St. & N. Marion (Louisville?) Ave.	Coal	CL7	2 - 5' RCP	4.5
E. 114th Pl. S	South Tulsa	ST-8	81" x 59" ACP	4.5
Pine St., 200' East of Memorial Drive	Lower Mingo	ML14	3' x 7' RCB	4.4
M.V. Expressway, South of Apache Street	Lower Mingo	ML8a	2 - 5' x 15' & 5' x 19.4'	4.4
Hartford Avenue at 49th Street	Flat Rock	FL7	3 - 10' x 8 ' RCBC	4.3
53rd St., 800' East of 33rd W. Ave,	Mooser	MO5	Bridge, 10' x 8.5'	4.3
37th W. Ave., 1/2 mile South of Skelly Drive	Mooser	MO6	Box culvert 2 - 8' x 5'	4.2
101st St. S. and 76th East Avenue	Fry Ditch No.2	FD1	3 - 9' CGMP	4.1
13th St. S. and 87th E. Ave.	Lower Middle Mingo	MLM4	16.5' x 7' x 21' Opening	4.1
13th St. S., 120th E. Ave.	Lower Middle Mingo	MLM7	2 - 30" x 24" CGMP	4.1
30th St. S. & 111th E. Ave.	Upper Middle Mingo	MUM6b	3 - 7' x 10' RCB	4.1
71st St. S., 2,400' East of 33rd W. Ave.	Nickel	NI9	54" RCP	4.1
21st St., under B. A. Expressway	Crow	CR13	24" x 48" Storm sewer	4
Harvard Ave. at B. A. Expressway	Upper Joe	JU14b		4
108th E. Ave. & 54th St. S.	Upper Mingo	MU5	3 - 8' x 6' RCB	4
29th St. & South 87th E. Ave.	Upper Middle Mingo	MUM2a	3 - 7' x 10' RCB	4
31st St. & South 73rd East Ave.	Upper Middle Mingo	MUM2c	2 - 120" Semi-ellip.	4
3,700 W. Easton Pl.	Parkview	PV8	Rect. Channel, 20' BW, 8.5' de	4
E. 113th Pl. S.	South Tulsa	ST-7	49" x 33" ACP	4
T.I. Speedway side drainage	Lower Mingo	ML7a	1.5' x 2' CGMP	3.9
145th E. Ave. & 46th St. S.	Upper Mingo	MU2	3' x 4' RCB	3.9
Crosstown Expressway, 1/4 mile N. of Harvard Ave.	Coal	CL2	8' Semi-circular storm sewer	3.8
129th E. Ave., 400' S. of I-244	Cooley	CO3	Bridge triple RCB 13'-17'-13' 6'	3.8
111th St. S. at 70th E. Ave.	Fry Ditch No.2	FD1	2 - 10' x 10' RCB	3.8
Hartford Ave. at 40th Pl. N.	Flat Rock	FL8	96" Semi-elliptical	3.8

Location	Creek Name	FMA	Description	Depth
Garnett Rd. overflow structure	Lower Mingo	ML8a	2' x 3' RCB	3.8
33rd St. S., East of Florence Ave.	Upper Joe	JU13		3.7
129th E. Ave., 900' South of 21st St. S.	Lower Middle Mingo	MLM5c	2 - 5' x 3' x 50' RCB	3.7
I44 and 17th St. S.	Lower Middle Mingo	MLM9	10' x 7' x 304' RCB	3.7
Union Ave., 1/3 mile North of 91st St. S.	Nickel	NI16	10' x 4' RCB	3.7
Dawson Rd., 1/8 mile West of Yale Ave.	Coal	CL1	12' x 14' RCB	3.6
Garnett Rd., 1/4 mile N. of Admiral Pl.	Cooley	CO1	12' x 5.67' RCB	3.6
Gardens of Cortez Apts. across road, below Cooley Dam (Stone Creek?)	Cooley	CO1	Triple 24' x 11.2' CM arch bridg	3.6
138th E. Ave. & 11th Street South	Cooley	CO8	24" RCP & 56" x 48" Semi-ellipt	3.6
93rd E. Ave.	Lower Mingo	ML14	3 - 9' x 10'	3.6
16th St. S. and Memorial Drive	Lower Middle Mingo	MLM4	2 - 10' x 6' x 125' RCB	3.6
Peoria Ave. at 56th St. South to 58th St. S.	Perryman Ditch	PE8a	Storm sewers	3.6
New Haven Ave., North of 11th St.	Coal	CL2	102" Storm sewer	3.5
Harvard Ave. & E. Oklahoma St.	Coal	CL9	8' x 3' RCBC Storm sewer	3.5
6th St. S., Peoria to Utica Avenue	Elm	EL7	78" x 168" Storm sewer	3.5
14th St. S. East of Joplin Ave.	Lower Middle Mingo	MLM2c	8' x 6' RCB	3.5
13th Pl. and 121st E. Avenue	Lower Middle Mingo	MLM7	4' x 14.3' RCP & 2' x 16' CGMP	3.5
1/2 mile East of Yale Ave., 1/8 mile North of 36th St. N.	Coal	CL1	30' x 13' - Mohawk Park Bridge	3.4
Packing plant bridge, 200' E. of Yale Ave. & 1/2 mile North of Pine St.	Coal	CL1	Trapezoidal channel, 23' BW, 1	3.4
E. Archer St., 3/8 mile East of Harvard Ave.	Coal	CL2	19' x 9.5' Semi-circular storm se	3.4
76th E. Ave. and 105th St. S.	Fry Ditch No.2	FD1	2 - 9' x 7' RCB	3.4
Cincinnati Ave., at 56th Street North	Flat Rock	FL7	10' x 6' RCBC	3.4
16th St. S. and 71st E. Ave.	Lower Middle Mingo	MLM3b	2 - 8' x 5' x 42' RCB	3.4
35th W. Ave., 2,500' South of Skelly Drive	Mooser	MO6	RCP, 2-60"	3.4
Waco St. S., 600' West of Union Ave.	Nickel	NI13	30" CMP	3.4
122nd E. Ave., 1/4 mile N. of E. Admiral Pl.	Cooley	CO2	Wood plank bridge, 48' x 7/8' w/	3.3
4th St. South, Rockford Avenue to Troost Avenue	Elm	EL4	90" Storm sewer	3.3
98th St. S. and 77th East Avenue	Fry Ditch No.2	FD5	10' x 3' RCB	3.3
South Hudson Ave	Little Joe	JL7	2-12.8' x 6.3' x 31' RCB	3.3
13th St. S. East of Joplin Ave.	Lower Middle Mingo	MLM2c	10' x 11.5' x 48.5' RCB	3.3
12th St. S. and Garnett Road	Lower Middle Mingo	MLM5b	2 - 8' x 6' x 47' RCB	3.3
27th St. and South 87th E. Ave.	Upper Middle Mingo	MUM2a	3' x 10'	3.3
34th St. & S. 89th Ave.	Upper Middle Mingo	MUM3	2 - 5' x 8' RCB	3.3
17th St. S. and 79th East Ave.	Lower Middle Mingo	MLM4	6' x 48' and 4' x 34' CGMP	3.2
17th St. S. and 101st E. Ave.	Lower Middle Mingo	MLM9	9' x 9' x 26.2' RCB	3.2
29th St. S. & Mingo Road	Upper Middle Mingo	MUM6a	3 - 10' x 13' RCB	3.2

Location	Creek Name	FMA	Description	Depth
Wheeling Ave., 48th Pl. S. to 50th St.	Perryman Ditch	PE6g		3.2
141st E. Ave. & 12th St. S.	Cooley	CO8	Double 36" RCP	3.1
Sheridan Rd. and 97th E. Avenue	Fry Ditch No.2	FD3	5 - 66" CGMP	3.1
East 54th Street	Little Joe	JL10	2-8' x 6' x 36' RCB	3.1
31st St. South, East of Florence Ave.	Upper Joe	JU14a		3.1
M. V. Expwy. Service road Northwest at 46th St. North	Lower Mingo	ML5a	2 - 4' x 9.3' RCB	3.1
13th St. S. and Memorial Drive	Lower Middle Mingo	MLM3b	3 - 12; x 6' x 93' RCB	3.1
N. Union Ave. & North Latimer Place	Oak	OC4	48" Underground storm sewer	3.1
Access road East of Lake Yahola & Yale Ave.	Coal	CL11	36" RCP	3
E. Archer St., 1/4 mile W. of Harvard Ave.	Coal	CL7	108" Semi-elliptical storm sewer	3
Utica Ave. & Terwilliger Blvd.	Crow	CR3	Box culverts	3
Yorktown Ave., South of 21st St. S.	Crow	CR4	Storm sewer	3
21st St. S., West of Lewis Ave.	Crow	CR8	Storm sewer	3
177th E. Ave. at 13th St. S	Center	CT1b	Steel I-beam bridge, 6.5' high, 3	3
41st St. S., East of Florence Ave.	Upper Joe	JU12b		3
11th St. S., 350' East of Memorial Drive	Lower Middle Mingo	MLM2a	3 - 10' x 8' x 112' RCB	3
57th St. S., 1,000' West of 33rd W. Ave.	Mooser	MO25	Corrugated arch pipe 206' x 3.6'	3
27th St. and South 90th E. Ave.	Upper Middle Mingo	MUM2a	10' H x 12' W x 14' W x 12' W	3
29th St. S. & 129th E. Ave.	Upper Middle Mingo	MUM6d	5' x 17' RCB	3
Apache St. bridge, 1/2 mile East of Yale Ave.	Coal	CL1	54' x 13' Bridge	2.9
E. 36th St. N., 1/8 mile West of Yale Ave.	Coal	CL11	10' x 6' Bridge	2.9
Iroquois Ave. at 29th Street North	Dirty Butter	DB10	4 - 48" CMP	2.9
91st St. S. and South Joplin Ave.	Fry Ditch No.2	FD4	12.5' x 10' RCB	2.9
Mohawk Blvd., at Delaware Avenue	Flat Rock	FL3	2 - 8' x 4' RCBC	2.9
28th St. South., East of Florence Ave.	Upper Joe	JU14a		2.9
S. Memorial Drive and I-44	Upper Middle Mingo	MUM2d	5' x 6' RCB	2.9
Quincy Ave. at 56th St. South	Perryman Ditch	PE8a	Storm sewers	2.9
Quincy Ave. at 53rd Place South	Perryman Ditch	PE8b		2.9
56th St. S. at Utica Ave.	Perryman Ditch	PE8b	Storm sewers	2.9
Pine St. at N. Elwood Ave.	Dirty Butter	DB3	54" Storm sewer	2.8
91st St. S. and 69th East Avenue	Fry Ditch No. 2	FD7	8' x 6.5' RCB	2.8
Memorial Drive & East 31st St.	Upper Middle Mingo	MUM2a	3 - 8' x 10' RCB	2.8
34th St. & S. Mingo Road	Upper Middle Mingo	MUM3	2 - 5' x 8' RCB	2.8
56th St. S., East of Utica Ave.	Perryman Ditch	PE8b		2.8
N. Quebec Ave. & E. Latimer Pl.	Coal	CL5	20' x 5' Wooden bridge	2.7
N. Knoxville Ave. & 1/8 mile S. of Pine St.	Coal	CL9	5' RCP	2.7
Mohawk Blvd. at N. St. Louis Avenue	Dirty Butter	DB5	2 - 10' x 7' RCB	2.7
Erie Ave. at 38th St. South	Upper Joe	JU9b		2.7

Location	Creek Name	FMA	Description	Depth
Minor gravel road, East of Mingo Road	Lower Mingo	ML10	2' x 2' Metal pipe	2.7
13th St. S. and 83rd East Ave.	Lower Middle Mingo	MLM3a	18' x 10' x 23' opening	2.7
33rd W. Ave., 2,000' South of Skelly Drive.	Mooser	MO6	Bridge, 10.5' x 9.4'	2.7
W. Easton Pl. & N. Quanah Ave.	Oak	OC3	2 - 5' RCP	2.7
2,100 block of West Easton Street	Parkview	PV10	2 - 5' RCP	2.7
81st St. S. & Pittsburg Ave.	Vensel	VE11	6' x 8' RCB	2.7
Detroit Avenue at 31st St. North	Dirty Butter	DB10	4' CMP	2.6
56th St. N., 300 block East	Flat Rock	FL7	10' x 4.5' RCBC	2.6
81st St., West of Memorial Drive	Haikey	HK5	2 - 10' x 8' RCB	2.6
Pittsburg Ave. at 39th Street South	Upper Joe	JU8		2.6
Bridge downstream of Byers Lake, West of M.V. Expwy.	Lower Mingo	ML6a	3 - 8.5' x 7.1' RCB	2.6
15th St. S.	Lower Middle Mingo	MLM2e	8' x 6' RCB	2.6
30th St. S. & Garnett Road	Upper Middle Mingo	MUM6c	3 - 7' x 10' RCB	2.6
N. New Haven Ave., 1/4 mile S. of Pine St.	Coal	CL7	25' x 9' RCB	2.5
21st Street South at Boulder Avenue	Elm	EL1	215" Storm sewer	2.5
69th Pl. S. East of Harvard Ave.	Fred	FR14	2 - 54" RCP culvert	2.5
O.R.U. Bridge #2, E. 7900 & S. Delaware	Fred	FR2	Single span 40' bridge	2.5
49th W. Ave. South of Edison St.	Harlow	HR5	9' x 7' RCB	2.5
Souht Joplin Ave.	Little Joe	JL11	2-14' x 6.4' x 31' ARCH	2.5
Union Ave., 1,400' South of Skelly Drive	Mooser	MO3	Bridge, 38.6' x 9.3'	2.5
91st St. S., 1/2 mile East of 33rd W. Ave.	Nickel	NI16	18" RCP	2.5
61st St. S., 550' West of Rockford Ave.	Perryman Ditch	PE10	Storm sewer	2.5
West of S. Sheridan Road	South Tulsa	ST-17	2-30" RCP	2.5
N. Darlington Pl. & E. Woodrow St.	Coal	CL1	Trapezoidal channel, 20' BW, 1	2.4
N. Louisville Ave. & E. Newton St.	Coal	CL9	(2) 4.5' RCP	2.4
I-244, 750' E. of 120th E. Ave.	Cooley	CO3	Bridge triple RCB 13'-17'-13' 6'	2.4
Pittsburg Ave., South 36th Pl. S.	Upper Joe	JU8		2.4
Admiral Pl., 2,000' West of Sheridan Road	Lower Mingo	ML14	2 - 2.5' RCP	2.4
91st E. Ave.	Lower Mingo	ML15	3' x 3' CGMP	2.4
25th St. S. & Garnett Road	Lower Middle Mingo	MLM9	6' x 2.8' x 30' RCB	2.4
29th St. S. & 136th E. Ave.	Upper Middle Mingo	MUM6b		2.4
34th St. S. & 121st E. Ave.	Upper Middle Mingo	MUM6d	2 - 5.5' x 9' RCB	2.4
Yukon St. S., 1,200' West of Union Ave.	Nickel	NI13	30" CMP	2.4
Utica Ave., 550' North of 61st St. S.	Perryman Ditch	PE10	Storm sewer	2.4
61st St. S. at Peoria Ave.	Perryman Ditch	PE10	Storm sewer	2.4
33rd St. S. & Lewis Place	Perryman Ditch	PE2	Storm sewer	2.4
E. Latimer St., 1/4 mile E. of Harvard Ave.	Coal	CL7	13' x 8.5' Semi-elliptical storm s	2.3
E. Admiral Pl. 750' West of 129th E. Ave.	Cooley	CO7	Double 10' x 8' RCB	2.3

Location	Creek Name	FMA	Description	Depth
Lewis Ave., North of 20th St.	Crow	CR8	Storm sewer	2.3
Madison Ave. at 29th Place North	Dirty Butter	DB10	2 - 5' RCP	2.3
E. Apache Street at N. Utica Avenue	Dirty Butter	DB5	2 - 9' x 10' RCB	2.3
Pine St. at N. Utica Avenue	Dirty Butter	DB6	72" Storm sewer	2.3
7th St. S., Rockford Ave. to Utica Ave.	Elm	EL7	Storm sewer various sizes	2.3
28th Pl. S., East of Pittsburg Ave.	Upper Joe	JU3		2.3
Yorktown Ave., 48th Pl. S. to 50th St. S.	Perryman Ditch	PE6g		2.3
56th St. South at Rockford Ave.	Perryman Ditch	PE89b	Storm sewers	2.3
North of E. 121st Street S	South Tulsa	ST-15	3-24" RCP	2.3
145th E. Ave. & 15th St. South	Cooley	C11	Bridge 28' x 4'	2.2
15th St. S., 150' East of 145th E. Ave.	Cooley	C11	60" RCP	2.2
E. 4th Pl., 700' East of 129th E. Ave.	Cooley	CO7	Double 36" RCP	2.2
Osage Dr. at N. Queen Street	Dirty Butter	DB3	Trapezoidal Channel, 10' BW, 7'	2.2
N. Lewis Avenue at E. Young St.	Dirty Butter	DB7	78" Storm sewer	2.2
51st St. N. Cincinnati Ave. to Frankfort Pl.	Flat Rock	FL7	N/A	2.2
45th St. S., East of Florence Ave.	Upper Joe	JU12a		2.2
41st St. S. at Pittsburg Ave.	Upper Joe	JU2		2.2
Oswego Ave. at 42nd Place	Upper Joe	JU2		2.2
31st St. S., West of Yale Ave.	Upper Joe	JU4		2.2
38th St. S., East of Pittsburg Ave.	Upper Joe	JU8		2.2
East service rd. to M.V. Expwy.	Lower Mingo	ML6a	2 - 4' x 10' RCB	2.2
59th St. S., 200' West of 33rd W. Ave.	Mooser	MO24	RCP 3 - 30"	2.2
44th St. & S. 76th E. Ave.	Upper Middle Mingo	MUM4d	2 - 60" RCP	2.2
28th Pl. S. & 139th E. Ave.	Upper Middle Mingo	MUM6e	3 - 9' x 7' RCB	2.2
Quincy Ave. & 37th St. & 37th Place	Perryman Ditch	PE1	Storm sewer	2.2
61st St. S. at Riverside Drive	Perryman Ditch	PE10	Storm sewer	2.2
41st St. South & 1 1/2 blocks East of Rockford Ave.	Perryman Ditch	PE2	Storm sewer	2.2
56th St. S., 150' West of Cincinnati Ave.	Perryman Ditch	PE8a	Storm sewer	2.2
91st St. S. & Jamestown Ave.	Vensel	VE4	2 - 3' x 16' & 5' x 12' RCB	2.2
Harvard Ave. & 93rd St. S.	Vensel	VE4	2 - 60" CMP	2.2
Pine St., 1/4 mile West of Yale Ave.	Coal	CL1	37' x 12 ' RCB	2.1
Admiral Pl., 1/8 mile West of Yale Ave.	Coal	CL5	8' x 6' RCBC storm sewer	2.1
17th Street at Baltimore Avenue	Elm	EL3	102" Storm sewer	2.1
Haskell St., West of Peoria Ave.	Elm	EL6	54" Storm sewer	2.1
71st St. S. East of Jamestown Ave.	Fred	FR14	12' x 6' culvert	2.1
47th Pl., East of Jamestown Ave.	Upper Joe	JU1a		2.1
37th Pl. S., East of Sandusky Ave.	Upper Joe	JU4		2.1
Yale Ave., South of 38th Place South	Upper Joe	JU9b		2.1
39th St. & S. 93rd E. Ave.	Upper Middle Mingo	MUM4d	3 - 7' x 10'	2.1

Location	Creek Name	FMA	Description	Depth
30th St. S. & 137th E. Ave.	Upper Middle Mingo	MUM6d		2.1
41st St. S. & 119th E. Ave.	Upper Middle Mingo	MUM7c		2.1
Utica Ave., 300' North of 41st St. South	Perryman Ditch	PE2	Storm sewer	2.1
51st St., West of 177th E. Ave.	Adams	AD1	Double RCB, 4' x 6'	2
Crosstown Expressway at Delaware Ave.	Coal	CL7	Pedestrian bridge, trapezoidal c	2
129th E. Ave., 450' NW of I-44	Cooley	CO7	Bridge, triple RCB 13'-17'13', 6'	2
Columbia Pl., South of 16th St.	Crow	CR12	Storm sewer	2
Delaware Ave. at 16th St.	Crow	CR12	Storm sewer	2
29th St., East of Rockford Ave.	Crow	CR3	Bridge/culvert	2
Boulder Avenue 21st Street to 18th Street	Elm	EL1	Storm sewers, various sizes	2
Boulder Avenue 21st Street to 18th Street	Elm	EL1	Storm sewers, various sizes	2
16th Street at Boston Avenue	Elm	EL3	96" & 102" Storm sewer	2
Sleepy Hollow Drive & E. 72nd St. S.	Fred	FR5	9' Arch cluvert	2
Toledo Ave., North of 39th Street S.	Upper Joe	JU9a		2
3rd St. S., West of 49th W. Ave.	Lower Basin	LB1	Storm sewer	2
41st W. Ave., South of Cameron Street	Lower Basin	LB2	Storm sewer	2
4th St. S. at 40th W. Ave. to 33rd W. Ave.	Lower Basin	LB2		2
34th W. Ave., 35th W. Ave., 36th W. Ave., 36th W. Pl. North of 4th St. S.	Lower Basin	LB2	Storm sewer	2
40th W. Ave. 39th W. Ave., 38th W. Ave., & 37th W. Ave., South of 4th St. S.	Lower Basin	LB2		2
33rd W. Ave., 1st St. to 5th St. S.	Lower Basin	LB2	Storm sewer	2
25th W. Ave., North of Charles Page Blvd.	Lower Basin	LB3	Storm sewer	2
10th St. S., at 57th W. Ave. to 49th W. Ave.	Lower Basin	LB4		2
Mingo Rd., 2,000' North of Apache St.	Lower Mingo	ML12	2 - 5' x 10' RCB	2
36th St. N., 1/4 mi West of 129th E. Ave.	Lower Mingo	ML6a	2 - 2' x 12' RCB	2
Pine St., 1,200' East of 129th E. Ave.	Lower Mingo	ML8b	5' x 16' RCB	2
12th St. S., 124th E. Ave.	Lower Middle Mingo	MLM7	8' x 5' x 38.5' RCB	2
U.S. 75 & I-44 on S. W. Frontage Rd.	Mooser	MO2	Box Culvert 12' x 14' x 10.2'	2
46th Pl. & S. 89th E. Ave.	Upper Middle Mingo	MUM4d	2 - 5' x 9.5'	2
46th St. & S. 91st E. Ave.	Upper Middle Mingo	MUM4d	2 - 5' x 10'	2
43rd St. S. & 129th E. Ave.	Upper Middle Mingo	MUM7d	7' x 10'	2
39th St. S., 1/4 mile West of Lewis Ave.	Perryman Ditch	PE2	Storm sewer	2
41st St. South & Rockford Ave.	Perryman Ditch	PE2	Storm sewer	2
100 block North of 41st W. Ave.	Parkview	PV5	2 - 96" Semi-elliptical concrete	2
193rd E. Ave., 1,500' South of Admiral Blvd.	Rolling Hills	RH	Concrete bridge 5' x 16'	2
E. 119th Street S.	South Tulsa	ST-8	2-18" CMP	2
Harvard Ave., 1,800' S. of E. Pine St.	Coal	CL10	120" Semi-elliptical	1.9
11th St., South-west of 177th E. Ave.	Center	CT1c	Double RCP, 4' x 13'	1.9
161st E. Ave., North of 21st St. S.	Center	CT2b	3' x 6' RCB	1.9

Location	Creek Name	FMA	Description	Depth
4th Pl. S., East of 161st E. Ave.	Center	CT8	2 - 3' x 6' RCB	1.9
Kenosha Ave. 1800' North of Apache St.	Dirty Butter	DB10	2 - 48" RCP	1.9
46th St. North, 2,100' East of Cincinnati Ave.	Flat Rock	FL7	8.5 depth	1.9
E. 67th St. S. West of Elwood Avenue	Hager	HG5	18" RCP	1.9
33rd St. S., East of Urbana Ave.	Upper Joe	JU4		1.9
A - 11th St. S., 1,650' West of Mingo Road	Lower Middle Mingo	MLM2a	RCB	1.9
61st St. S., 2,300' West of 33rd W. Ave.	Mooser	MO25	8' x 3' RCB	1.9
57th St., 2,300' West of 33rd W. Ave.	Mooser	MO6	10' x 4' RCB	1.9
42nd Pl. & S. 79th E. Ave.	Upper Middle Mingo	MUM4b	3' x 10'	1.9
33rd St. S. & Garnett Road	Upper Middle Mingo	MUM6g	3 - 60" CMP	1.9
E. 118th Street S.	South Tulsa	ST-8	24" RCP	1.9
Pine St., 1,100' West of Sheridan Rd.	Coal	CL3	96" Semi-elliptical	1.8
Lewis Avenue., North of 26th Pl.	Crow	CR15	Bridge	1.8
31st St. S., 1/4 mile West of Utica Ave.	Crow	CR3	Bridge/culvert	1.8
Trenton Ave., 1,500' North of 46th St. N.	Flat Rock	FL5	78" RCP	1.8
Mingo Rd., South of 91st Street South	Haikey	HK2	77' Bridge; 3 spans	1.8
Sheridan Rd., South of 71st St. S.	Haikey	HK20b	7' x 5' Bridge	1.8
Marion Ave.	South Fork Joe	JSFb	2 - 11' x 10' RCB	1.8
37th St. S., West of New Haven Ave.	Upper Joe	JU7		1.8
Mingo Rd., South of Latimer Street	Lower Mingo	ML15	2 - 5' x 6' RCB	1.8
Garnett Rd., near Lewis & Clark J.H.S.	Lower Middle Mingo	MLM6	12' x 3.8' x 39.5' RCB	1.8
E. 39th St. & S. 82nd E. Ave.	Upper Middle Mingo	MUM3	2 - 5' x 9' RCB	1.8
41st St. & S. 93rd E. Ave.	Upper Middle Mingo	MUM4d	2 - 4' x 8' RCB	1.8
33rd St. S. & 145th E. Ave.	Upper Middle Mingo	MUM6f	4' x 4' RCB	1.8
26th W. Ave., 250' North of 81st St. S.	Nickel	NI11	42" RCP	1.8
Cemetery Rd.	Vensel	VE4	2 - 5' x 10' RCB	1.8
Burlington Northern Railroad	Coal	CL1	Trapezoidal channel, 40' BW, 1	1.7
E. Latimer St. & N. Harvard Ave.	Coal	CL10	60" Semi-elliptical	1.7
Rose Hill Cemetery	Coal	CL5	Trapezoidal channel, 7' BW, 9'	1.7
15th St. & S. Gary Ave.	Coal	CL8	42" RCP	1.7
E. 11th St. S., 1/2 mile West of 145th E. Ave.	Cooley	CO8	Double 12.5' x 4' bridge	1.7
11th St., Southwest of 161st St. S.	Center	CT1c	3' x 6' RCB	1.7
Virgin St., 2,100' West of North Lewis Avenue	Dirty Butter	DB5	2 - 102" Semi-ellip. Storm sewe	1.7
91st St. S., West of Mingo Road	Haikey	HK3	42' x 15' Bridge	1.7
E. 38th St. & S. 86th E. Ave.	Upper Middle Mingo	MUM3	2 - 5' x 10' RCB	1.7
37th St. & S. 93rd E. Ave.	Upper Middle Mingo	MUM4a	7' x 30'	1.7
41st St. South & Madison Ave.	Perryman Ditch	PE2	Storm sewer	1.7
45th Pl. S. & Trenton Ave.	Perryman Ditch	PE4c	Storm sewer	1.7

Location	Creek Name	FMA	Description	Depth
5th St., 2,300' W. of Harvard Ave.	Coal	CL7	60" RCP	1.6
Harvard Ave., 2,000' N. of Admiral Pl.	Coal	CL7	120" Semi-elliptical RCP	1.6
161st E. Ave., North of 11th St. S.	Center	CT1c	5' x 6' RCB	1.6
21st St. S., East of 161st E. Ave.	Center	CT2b	4' x 8' RCB	1.6
Pine St., 2,200' West of N. Lewis Avenue	Dirty Butter	DB5	2 - 8' x 4' RCB Storm sewer	1.6
Mohawk Blvd., 2,000' West of Harvard Avenue	Flat Rock	FL3	6' x 4.3' RCBC	1.6
76th St. S.	Haikey	HK5	2 - 8' x 5' RCB	1.6
T.I. Speedway East/ West access road	Lower Mingo	ML7a	3' x 3' CGMP	1.6
61st St. S., 1,600' East of U. S. 75	Mooser	MO9	10' x 4' RCB 3' x 7.5' RCB	1.6
61st St. S. & 94th E. Ave.	Upper Mingo	MU3	6.1' x 23. 8'	1.6
61st St. S. & 87th E. Ave.	Upper Mingo	MU6	4.5' x 8' RCB	1.6
24th Pl. & S. 104th E. Ave.	Upper Middle Mingo	MUM5	60" RCP	1.6
West of S. Sheridan Road	South Tulsa	ST-17	36" CMP	1.6
81st St. S., West of Yale Ave.	Vensel	VE6a	6' x 8' RCB	1.6
31st St. at Utica Ave.	Crow	CR17	Storm sewer	1.5
177th E. Ave., North of 21st St. S.	Center	CT2a	6' x 8' RCB	1.5
Peoria Ave., M.L.K. Expressway to Archer St.	Elm	EL6	48" Storm sewer	1.5
Quincy Ave. North of Admiral Blvd.	Elm	EL6	48" Storm sewer	1.5
8th St. Wheeling Ave. to Xanthus Ave.	Elm	EL7	Storm sewer various sizes	1.5
75th St. S. at Lewis Ave.	Fred	FR9	8' x 4' culvert	1.5
101st St. S., East of Mingo Rd.	Haikey	HK1	50' x 8.3' Bridge	1.5
S. Memorial Drive, North of 91st St. S.	Haikey	HK16	2 - 8' x 6' Bridges	1.5
Garnett Rd., North of 81st St.	Haikey	HK27	15' x 6' Bridge	1.5
59th St. S.	South Fork Joe	JSFc	2 - 10' x 10' RCB	1.5
38th St. S., East of Richmond Ave.	Upper Joe	JU3		1.5
120th E. Ave., South of 21st St. S.	Lower Middle Mingo	MLM5c	2 - 8' x 5' x 37' RCB	1.5
42nd St. S. & 145th E. Ave.	Upper Middle Mingo	MUM7e	3' x 11'	1.5
177th E. Ave., 2,000' South of 21st St. S.	Reservoir	RV5	2.5' x 6' RCB	1.5
91st St. St., 600' West of Harvard Ave.	Vensel	VE9	4.5' x 8' RCB	1.5
E. Pine St., 1,600 W. of Harvard Ave.	Coal	CL9	30" RCP	1.4
NA - M.V.R.R., 1,500' South of E. Apache Street	Dirty Butter	DB8	78" Storm sewer	1.4
48th Pl. N., 2,600' West of Peoria Avenue	Flat Rock	FL7	3 - 10' x 8' RCBC	1.4
28th St. N. at 49th West Avenue	Harlow	HR3c	8' x 6' RCB	1.4
46th St. S. at Sandusky Ave.	Upper Joe	JU11		1.4
36th St. S., East of Urbana Ave.	Upper Joe	JU4		1.4
Darlington Ave. at 38th St. S.	Upper Joe	JU9b		1.4
37th St. S. & 129th E. Ave.	Upper Middle Mingo	MUM6h	20" RCP	1.4
78th St. S., 2,000' North of 81st St. S.	Nickel	NI11	2 - 26" CMP	1.4

Location	Creek Name	FMA	Description	Depth
91st S., 900' East of 33rd W. Ave.	Nickel	NI8	6' x 75' RCB	1.4
193rd E. Ave., 500' South of 31st St. S.	Pond	PDa	30" RCP	1.4
177th E. Ave., 800' North of 31st St. S.	Reservoir	RV2	3.5' x 9.5' RCB	1.4
41st St. S., 2,500' West of 193rd E. Ave.	Spunky	SP4	4' x 8' RCB	1.4
West of S. Sheridan Road	South Tulsa	ST-17	2-28" PCP	1.4
Louisville Ave., 2,200' North of 11th St. S.	Vensel	VE7	60" CMP	1.4
108th St. S., 800' East of Louisville Ave.	Vensel	VE7	70" CMP	1.4
15th St. S., 1,700' East of Harvard Ave.	Coal	CL2		1.3
Access road at Ellis Park	Coal	CL6	2 - 48" RCP	1.3
Harvard Ave. & 11th St. S.	Coal	CL8	72" Semi-elliptical	1.3
Cincinnati Ave., 2,300' South of 56th St. N.	Flat Rock	FL7	2 - 48" RCP	1.3
Evanston Ave., South of 76th St. S.	Fred	FR3	3 - 14' x 7' Culverts	1.3
Harvard Ave., South of 74th St. S.	Fred	FR4	2 - 10' x 8'	1.3
Pittsburgh Ave., South of 71st St. S.	Fred	FR6	2 - 36" CMP	1.3
33rd W. Ave., 600' North of W. Newton Street	Harlow	HR3d	48" RCP	1.3
Keystone Expwy, 900' East of S. 65th W. Ave.	Harlow	HR6		1.3
25th St. South, East of Marion Ave.	Upper Joe	JU14a		1.3
Yale Ave. at 36th St. S.	Upper Joe	JU5		1.3
15th St. S. and 83rd E. Ave.	Lower Middle Mingo	MLM4	14' x 7' x 20' Steel and Timber b	1.3
21st St. S., 150' West of 120th East Ave.	Lower Middle Mingo	MLM5c	2 - 8' x 5' x 36' RCB	1.3
Olympia St., 650' East of U.S. 75	Mooser	MO2	2 - 12' x 10' & 14' x 10' RCB	1.3
46th St. S. & Garnett Rd.	Upper Middle Mingo	MUM8b	3' x 11'	1.3
26th W. Ave. South of 71st St. South	Nickel	NI2	3 - 60" RCP	1.3
33rd W. Ave., 1/2 mile South of 71st St. S.	Nickel	NI2	Bridge, 18' x 30'	1.3
56th St. S., 150' East of Cincinnati Ave.	Perryman Ditch	PE8a	Storm sewer	1.3
33rd W. Ave., 1,250' North of W. Edison St.	Parkview	PV9	6' x 3' RCB	1.3
41st St. S., 1,700' West of 193rd E. Ave.	Spunky	SP4	3.5' x 8' RCB	1.3
Pine St., 2,500' East of Yale Ave.	Coal	CL4	5' RCP	1.2
Rose Hill Cemetery	Coal	CL5	Trapezoidal channel, 10' BW 9'	1.2
Admiral Pl. and S. College Ave.	Coal	CL7	102" Semi-elliptical, RCP	1.2
Atlanta St., North of 17th Pl.	Crow	CR11	Storm sewer	1.2
2nd St. S., East of 161st E. Ave.	Center	CT8	42" RCP	1.2
11th St. S., 2,000' West of 193rd E. Ave.	Center	CT9	5' x 8 ' RCB	1.2
Rockford Avenue at Admiral Place	Elm	EL5	48" Storm sewer	1.2
Hartford Ave. 2,500' North of 36th St.	Flat Rock	FL2	Trapezoid channel, 80' BW, 14.	1.2
Harvard Ave. near Christian Church	South Fork Joe	JSFb	2 - 7' x 9' RCB	1.2
61st St. S., West of Urbana Ave.	South Fork Joe	JSFc	2 - 60" CMP	1.2

Location	Creek Name	FMA	Description	Depth
31st St. S., East of Pittsburg Ave.	Upper Joe	JU3		1.2
Granite Ave. at 38th St. South	Upper Joe	JU9b		1.2
Mingo Rd., 2,000' North of 36th St. N.	Lower Mingo	ML10	4' x 14' RCB	1.2
129th E. Ave., 1/8 mi. South of 36th St. N.	Lower Mingo	ML6b	2 - 3' x 12' RCB	1.2
I44, North of 11th St. S.	Lower Middle Mingo	MLM6	8' x 5' x 257' RCB	1.2
61st St. S., 1,900' West of Union Ave.	Mooser	MO12	10' x 8' RCB	1.2
145th E. Ave. & 46th St. S.	Upper Mingo	MU2	2 - 8' x 3' RCP	1.2
63rd E. Ave. & Mingo Road	Upper Mingo	MU4	2 - 15" RCP	1.2
South of 61st St. S., West of 93rd E. Ave.	Upper Mingo	MU4	66" RCP	1.2
33rd St. S. & 145th E. Ave.	Upper Middle Mingo	MUM6d	4' x 2'	1.2
35th St. S. & 129th E. Ave.	Upper Middle Mingo	MUM6g	2 - 50" x 33" CMP	1.2
40th St. South & Garnett Road	Upper Middle Mingo	MUM7b	5' x 18' RCB	1.2
81st St. S., 2,000' East of 33rd W. Ave.	Nickel	NI11	10' x 4' RCB	1.2
36th Pl., 1 block East of Rockford Ave.	Perryman Ditch	PE1	Storm sewer	1.2
Boston & Boston Pl. 550' S. of 49th St. S.	Perryman Ditch	PE5	Storm sewer	1.2
Cincinnati Ave, 550' S. of 49th St. S.	Perryman Ditch	PE5	Storm sewer	1.2
15th St. diversion S., 200' West of Peoria Ave.	Perryman Ditch	PE6a	Storm sewer	1.2
49th Pl. S., 200' West of Peoria Ave.	Perryman Ditch	PE6a		1.2
Wheeling Ave., 51st St. diversion to 46th Pl. S.	Perryman Ditch	PE6e		1.2
Quincy Pl., 56th St. South to 58th St. South	Perryman Ditch	PE8b	Storm sewers	1.2
56th St. S. East of St. Louis Ave.	Perryman Ditch	PE8b	Storm sewers	1.2
53rd St. S., 500' East of Quincy Ave.	Perryman Ditch	PE8c		1.2
33rd W. Ave. North of Easton St.	Parkview	PV9	10' x 7' RCB	1.2
Edison St., 300' West of 33rd W. Ave.	Parkview	PV9	6' x 2' RCB	1.2
41st St. S., 600' West of 193rd E. Ave.	Spunky	SP1b	2 - 3.5' x 9' RCB	1.2
Rose Hill Cemetery	Coal	CL5	Rectangular channel, 10.5' BW	1.1
11th St., 2,500' W. of Harvard Ave.	Coal	CL7	36" RCP	1.1
112th E. Ave., 1,150' N. of E. Admiral Pl. at Wood Creek Apts.	Cooley	CO1		1.1
30th Pl. and Trenton Ave.	Crow	CR16	Storm sewer	1.1
Utica Ave., South of 30th Place	Crow	CR16	Storm sewer	1.1
21st St., West of 177th E. Ave.	Center	CT2b	Double RCB 6' x 8'	1.1
177th E. Ave. North of 21st St. S.	Center	CT3	3' x 6' RCB	1.1
Cincinnati Ave., 2,000' North of Pine Street	Dirty Butter	DB3	10.9' x 14' Arch	1.1
Pine St., 2,500' West of North Peoria Avenue	Dirty Butter	DB9	7.6' x 11' Arch Storm sewer	1.1
81st St. S., 1/2 mile West of Elwood Ave.	Hager	HG8	4' x 3' CMP Arch	1.1
91st St. S., East of Mingo Road	Haikey	HK10	8' x 3.4' RCB	1.1
91st St. S., East of Mingo Road	Haikey	HK9	8' x 2.8' RCB	1.1

Location	Creek Name	FMA	Description	Depth
South Sheridan Road	Little Joe	JL9	2-14' x 5' x 590' RCB	1.1
45th St. S., East of Toledo Ave.	Upper Joe	JU11		1.1
47th St. S., East of Florence Ave.	Upper Joe	JU12a		1.1
Florence Ave., North of 44th Pl. S.	Upper Joe	JU12c		1.1
36th St. S., East of Richmond Ave.	Upper Joe	JU3		1.1
38th St. S., East of New Haven Ave.	Upper Joe	JU7		1.1
36th St. S. at Oswego Ave.	Upper Joe	JU8		1.1
129th E. Ave.	Lower Middle Mingo	MLM7	3' x 2' RCB	1.1
26th W. Ave., 400' South of I-44	Mooser	MO5	57' x 16'	1.1
Garnett Rd. & 50th St. S.	Upper Mingo	MU1	2 - 24" RCP	1.1
51st St. S. & 136th E. Ave.	Upper Mingo	MU2	2 - 60" CMP	1.1
South of 51st St. S., East of Hwy. 169	Upper Mingo	MU3	4 - 10' x 8' RCB	1.1
54th St. S. & 96th E. Ave.	Upper Mingo	MU6	5' x 7' & 8' x 7.9' RCB	1.1
34th St. S. & 93rd East Ave.	Upper Middle Mingo	MUM3	9' x 10'	1.1
31st St. S. & M. V. Expressway	Upper Middle Mingo	MUM6a	4 - 10' x 15'	1.1
26th St. S. & 145th E. Ave.	Upper Middle Mingo	MUM6e	5 - 56" CMP	1.1
91st S. S., 500' East of 33rd W. Ave.	Nickel	NI5	Bridge, 96' x 40'	1.1
37th St. S., 300' East of Riverside Drive	Perryman Ditch	PE1	Storm sewer	1.1
37th S. S., 400' East of Riverside Drive	Perryman Ditch	PE1	Storm sewer	1.1
51st St. diversion South & Madison Ave.	Perryman Ditch	PE6a	Storm sewer	1.1
51st St. diversion S., 200' East of Cincinnati Ave.	Perryman Ditch	PE6a	N/A	1.1
21st St. S., 400' West of 193rd E. Ave.	Reservoir	RV1	2 - 6' x 11.5' RCB	1.1
193rd E. Ave., 2,100' North 31st St. S.	Reservoir	RV6	24" RCP	1.1
S Yale Avenue	South Tulsa	ST-8	84" Steel Pipe	1.1
Burlington & SL & SF Railroad	Coal	CL3	5.5' x 6.5' Semi-elliptical CGMP	1
SL & SF Railroad bridge	Coal	CL4	8' x 6' RCB	1
Crosstown Expressway 650' W. of Yale Ave.	Coal	CL5	7' x 6' RCBC	1
32nd Pl. at Yorktown Ave.	Crow	CR17	Storm sewer	1
Victor Ave. at 32nd St.	Crow	CR17	Storm sewer	1
Lewis Ave., South of 21st St. S.	Crow	CR5	Storm sewer	1
17th Pl., East of Lewis Ave.	Crow	CR8	Storm sewer	1
16th St., East of Lewis Ave.	Crow	CR9	Storm sewer	1
11th St. S., West of 177th E. Ave.	Center	CT 6	3 - 24" diameter RCP	1
36th St. N., 1,900' East of N. Peoria Ave.	Dirty Butter	DB1	Trapezoidal channel 42' BW, 12	1
11th St., South Quincy Ave. to Frankfort Ave.	Elm	EL8	54" Storm sewer	1
Apache St., 2,500' East of N. Lewis Avenue	Flat Rock	FL3	48" x 42" RCP	1
Peoria Ave., 700' South of 46th St. North	Flat Rock	FL6	48" CGMP	1
Pittsburg Ave., North of 46th PL. S.	Upper Joe	JU11		1

Location	Creek Name	FMA	Description	Depth
Florence Ave., South of 38th Pl. S.	Upper Joe	JU12d		1
49th W. Ave. at 3rd St. South	Lower Basin	LB1		1
3rd St. S., East of 57th W. Ave.	Lower Basin	LB1		1
49th W. Ave. at Admiral Pl.	Lower Basin	LB1		1
1st St. S., West of 57th W. Ave. & 57th W. Ave to 49th W. Ave.	Lower Basin	LB1		1
49th W. Ave. at 1st St. South	Lower Basin	LB1		1
Admiral Pl., 49th W. Ave. to 50th W. Ave.	Lower Basin	LB1		1
7th St. S. at 65th W. Ave.	Lower Basin	LB1		1
41st W. Ave. at 5th St. South	Lower Basin	LB2		1
5th St. S. at 45th W. Ave. to 43rd W. Ave.	Lower Basin	LB2	Storm sewer	1
45th W. Ave., 44th W. Ave., 43rd W. Ave. & 42nd W. Ave., 3rd St. S. to 4th St. South	Lower Basin	LB2		1
48th W. Ave., 46th W. Ave., 45th W. Ave., 44th W. Ave.. 43rd W. Ave. 42nd W. Ave., 4th St. S. to Charles	Lower Basin	LB2		1
43rd W. Ave., South of Cameron St.	Lower Basin	LB2		1
3rd St. S. at 45th W. Ave. to 42nd W. Ave.	Lower Basin	LB2	Storm sewer	1
Charles Page Blvd., East 25th W. Ave.	Lower Basin	LB3		1
Chas. Page Blvd., 33rd W. Ave. to 25th W. Ave.	Lower Basin	LB3	Storm sewer	1
65th W. Ave. South of 8th St. S.	Lower Basin	LB4		1
57th, 54th and 51st W. Ave., South of 10th St. S.	Lower Basin	LB4		1
Apache St., 1/3 mi. East of 129th E. Ave.	Lower Mingo	ML7b	3 - 6' x 17' RCB	1
129th E. Ave., 2,000' South of Pine St.	Lower Mingo	ML8c	2 - 4' x 6' CGMP	1
40th St. & S. 90th E. Ave.	Upper Middle Mingo	MUM4b	2 - 6' x 10' RCB	1
B.A. Expressway & South 92nd E. Ave.	Upper Middle Mingo	MUM4d	2 - 7' x 8.5'	1
33rd W. Ave., North of 71st St. South	Nickel	NI1	6' x 2.5' RCB	1
73rd St. S., South of 71st St. S.	Nickel	NI2	3 - 60" RCP	1
Peoria Ave., 500' North of 61st St. S.	Perryman Ditch	PE10	Storm sewer	1
Lewis Ave., 1,000' North of 36th St. South	Perryman Ditch	PE2	Storm sewer	1
36th St. S., 500' West of Lewis Ave.	Perryman Ditch	PE2	Storm sewer	1
56th St. diversion S. & Riverside Drive	Perryman Ditch	PE6a	Storm sewer	1
Utica Ave., 51st St. diversion to 47th Pl. S.	Perryman Ditch	PE6b		1
Troost Ave., 51st St. diversion to 46th Pl. South	Perryman Ditch	PE6b		1
Trenton Ave., 49th St. S. to 46th Pl. South	Perryman Ditch	PE6b		1
49th St. S., Rockford Ave. to Utica Ave.	Perryman Ditch	PE6b		1
49th Pl. S., Rockford Ave. to Utica Ave.	Perryman Ditch	PE6b		1
50th St. S., Rockford Ave. to Utica Ave.	Perryman Ditch	PE6b		1
50th Pl. S., Rockford Ave. to Utica Ave.	Perryman Ditch	PE6b		1

Location	Creek Name	FMA	Description	Depth
48th St., Victor Ave. to Wheeling Ave.	Perryman Ditch	PE6e		1
Victor Ave., 48th St. S. to 45th Pl. S.	Perryman Ditch	PE6e		1
46th Pl. S., Victor Ave. to Wheeling Ave.	Perryman Ditch	PE6e		1
193rd E. Ave., 150' North of 31st St. S.	Reservoir	RV7	24" RCP	1
E. 121st Street S.	South Tulsa	ST-12	2-24"	1
E. 116th Street S.	South Tulsa	ST-17	24" RCP	1
River Road	South Tulsa	ST-19	18" RCP	1
River Road	South Tulsa	ST-21	12" RCP	1
Owasso Ave., South of 25th St. S.	Swan-Travis Park	SW2		1
Woodward Blvd., South 25th St. S.	Swan-Travis Park	SW2		1
Peoria Ave., South of 21st St. S.	Swan-Travis Park	SW3		1
21st St. S., East of Peoria Ave.	Swan-Travis Park	SW3		1
Lewis Ave. at 16th St. South	Swan-Travis Park	SW4		1
77th St. S., 3,000' West of Yale Ave.	Vensel	VE11	42" RCP	1
84th St. S., 2,200' East of Harvard Ave.	Vensel	VE5	3 - 6' x 10' RCB	1
E. 61st Street	Little Joe	JL1	66" SEP	0.5
South Sheridan Road	South Tulsa	ST-17	2-4' x 1.5' RCB	0.4
E. 121st Street	South Tulsa	ST-17	6' x 1.5' RCB	0.4

Appendix K:

City of Tulsa Hazardous Materials Sites

APPENDIX K

TIER 2 HAZARDOUS MATERIALS FACILITIES

The Tier 2 Hazardous Material list is a comprehensive listing of all hazardous material sites within the City of Tulsa, as reported to the Oklahoma Department of Environmental Quality.

All facilities which have any hazardous substance (defined as any product requiring an MSDS filing) must submit an annual Tier 2 form. The Federal Emergency Planning and Community Right-To-Know Act (SARA Title III). Section 312 requires an annual submission of a Tier Two form detailing the site's hazardous chemical inventories.

Appendix K presents the name and address of all Tier 2 Hazardous Material sites. The chemicals located at each site have not been included in this list due to size of file.

This page removed due to sensitive nature of information.

For more information, contact information can be located on page xviii.

Appendix L:

Public Comments Survey

Interoffice Memo

Date: August 29, 2002

To: Hazard Mitigation Citizens Advisory Committee

CC: Kim MacLeod, Public Works Community Affairs and Planning

Ken Hill, Public Works Engineering Services

From: Laureen Gibson Gilroy, Public Works Community Affairs and Planning

RE: Public Comments on Multi-Hazard Mitigation Plan

Community Affairs and Planning coordinated efforts to solicit public comments on the Multi-Hazard Mitigation Plan. Deadline for comments was August 28. We did not receive any public comments.

The following activities were conducted as part of our solicitation of comments:

1. Draft copies of the plan were presented at a public meeting on August 20, 2002. Letters announcing the meeting and opportunity for comment were mailed to approximately 600 neighborhood association members and people who attended the Citywide Drainage Plan Update meetings held during Spring 2001. The August 20 session included presentation of the results of the Spring 2001 meetings with the public. Comment forms were available for completion at the August 20 meeting or for take home and mailing later to City Hall. No completed forms were collected that night. Approximately 33 people attended the meeting, including committee members.
2. Newspaper announcement of the meeting included information on how to comment.
3. The City's home web page included a news release about public comment and link to the plan and comment form. The "Public Works" button also led to a link to the plan.
4. Comment forms were available in the Community Affairs office. One person, a City of Tulsa employee, picked up a copy, but did not return a completed form to our office.

The Community Affairs office will maintain a file on the August 20 meeting that includes:

Agenda
A printout of the PowerPoint presentation slides.
Photocopy of newspaper article.
Comment form and other handouts from the meeting
Mailing lists

Tulsa's Multi-Hazard Mitigation Plan

Natural Hazards

A group of citizens has proposed a multi-hazard mitigation plan for the City of Tulsa. The plan aims to reduce or prevent damages caused by natural, manmade and technological disasters. The federal government is requiring communities to have a multi-hazard mitigation plan in place in order to receive certain grant monies. The first phase of planning, which focused on natural hazards and hazardous materials events, is almost complete. The draft action plan is presented here for public review through August 28, 2002.

3 Ways to Submit Public Comments

A. Use this form to record your comments. Mail or drop off the completed form (Monday-Friday, 8 a.m.-5 p.m.) before August 28, 2002:

Community Affairs and Planning
City of Tulsa Public Works Department
515 City Hall
Tulsa, OK 74103

B. Use this form as a guide and respond via e-mail to Lgilroy@ci.tulsa.ok.us before August 28, 2002.

C. Access the City of Tulsa Internet site at www.cityoftulsa.org . Click on "Public Works". Deadline is August 28, 2002.

Draft Report

1. On a scale of 1 to 3, how do you rate the report? (Circle or click one)
   1 – Good, most **or** all sections were easy to understand
   2 – Fair, some sections were hard to understand
   3 – Poor, most **or** all sections were hard to understand

2. How much of the report did you read before you began recording your comments (Check all that apply)
   - I read the executive summary and table of contents.
   - I read all the chapters on the Internet or at City Hall.
   - I read the action plan, but not the other chapters.

3. Enter your other comments about the draft report in the space below (If you are not using an electronic version to record and send your comments, you may attach extra sheets to this form or use the back of this sheet):

Next, we would like your comments on the list of measures we plan to take to mitigate disasters. (Mitigation means steps taken to reduce or prevent damages caused by natural and technological hazards such as tornadoes, floods and terrorism.)

The following measures, if funded, were designed to mitigate natural hazards and hazardous materials events. The list begins with measures aimed at hazards in general, then it shows measures by the type of natural hazard they are designed to mitigate.

Proposed Mitigation Measures

1. General

Currently, the City of Tulsa, other public agencies, private businesses, and non-profit groups conduct educational campaigns to inform the public about measures that can be taken to reduce the danger of property damage and injury from natural and technological hazards. How effective are these campaigns at reaching residents and visitors to Tulsa? What can we do to improve our outreach? To answer these questions, we plan to:

1a. Examine optimum methods of implementing public information and education objectives concerning tornadoes, high winds, lightning, winter storms, extreme heat, fire, hazardous materials events, expansive soils, and wise use of water resources.

4. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
   1 – This should be a top priority
   2 – This is important, but not a top priority
   3 - OK to do if money is available
   4 – This is not important; don't spend money on it
   5 – No opinion

5. Which source(s) do you use for information about disaster mitigation and safety? (Check all that apply)
   - o CityLife utility bill stuffer
   - o City of Tulsa web site (www.cityoftulsa.org)
   - o Other Internet sites
   - o Tulsa Project Impact/Mayor's Citizen Corps publications
   - o Public Library
   - o Newspaper
   - o TV and radio
   - o Magazines
   - o Other (Please specify)

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Tulsa's siren system was state-of-the-art when it was installed in the mid-1980s, but newer, better designs are now available. The 82 sirens currently in place each have an expected life span of 20 years so they will likely need to be replaced during this decade. We plan to:

1b. Evaluate and upgrade warning systems.

6. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
   1 – This should be a top priority
   2 – This is important, but not a top priority
   3 - OK to do if money is available
   4 – This is not important; don't spend money on it
   5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Currently, Tulsa's emergency operations are coordinated in one downtown building that houses the 911 Center and the Emergency Operations Center. Since these facilities were built, newer designs and construction techniques have been developed that make buildings more disaster-resistant. The 911 Center and the Emergency Operations Center are essential to enabling the city to restore normal operations after a disaster. We plan to:

1c. Provide new facilities for the 911 Center and the Emergency Operations Center.

7. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
   1 – This should be a top priority
   2 – This is important, but not a top priority
   3 - OK to do if money is available
   4 – This is not important; don't spend money on it
   5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

The Federal Emergency Management Agency offers a program called Community Emergency Response Team, or CERT. The program educates citizens about the hazards they face and trains them in lifesaving skills. We plan to:

1d. Provide Community Emergency Response Team training for City employees and work with other local CERTs.

8. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
   1 – This should be a top priority
   2 – This is important, but not a top priority
   3 - OK to do if money is available
   4 – This is not important; don't spend money on it
   5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

1e. Provide survival equipment and supplies for City emergency response teams to cover employees and others who use City buildings.

9. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
   1 – This should be a top priority
   2 – This is important, but not a top priority
   3 - OK to do if money is available
   4 – This is not important; don't spend money on it
   5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Tulsa maintains information such as the location and sizes of water lines, storm sewers and sanitary sewers to aid engineers and field crew during daily operations. This information used to be available only on paper atlases. Currently, Tulsa is putting the information on computers, using a software program called a Geographic Information System, or GIS. Emergency responders would benefit by being able to quickly access data about all public utilities including water, gas, electrical and telephone lines. Therefore, we are planning a:

1f. GIS update to include public utility infrastructure.

10. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Two-way radio and other communication networks used by Tulsa's first responders are not totally compatible with each other. This sometimes causes delays as responders look for ways to communicate between departments. A common system is needed to improve emergency response times. We plan to:

1g. Install an emergency communication network for Fire, Police, 911, EMSA and other emergency operations.

11. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

The Tulsa City-County Health Department has maps that show where people live in the Tulsa area. These maps are used to predict how many people might be affected by a power outage, tornado, flood or other disaster. Unfortunately, many people are out of the house during the day and no maps exist to show where they work or go to school. If a disaster occurs during the day, rescue teams would have a difficult time predicting how many people might be trapped or require evacuation. Therefore, we plan to:

1h. Execute daytime population maps for the Tulsa community.

12. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

During the 1990s, Tulsa's Spanish-speaking population grew tremendously. Therefore, we plan to:

1i. **Translate current public information to Spanish.**

13. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Storms can blow or carry tree limbs and other debris into public places such as streets and parks. The debris can keep fire engines, ambulances and other emergency vehicles from reaching affected areas and, in some cases, can contribute to outbreaks of disease after a disaster. Tulsa can benefit from lessons learned in other communities during recent disasters. We plan to:

1j. **Review and update the Debris Management Plan.**

14. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Proposed Mitigation Measures

2. Floods

The City of Tulsa has identified more than 50 creek and drainage basins. These basins have been studied in about 30 basin-wide master drainage plans and updates. A master drainage plan is a comprehensive basin-wide study of a watershed that takes into account community values, goals and objectives, existing conditions and future plans. We plan to:

2a. Continue to update and revise basin-wide master drainage plans where changed conditions warrant.

15. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Tulsa's Flood and Stormwater Management Plan looks at two ways to reduce and prevent flood damage to properties. One way is called structural and it involves building detention ponds or other structures to keep the water away from the property. Another way is called non-structural and it involves relocation or demolition so that the property is "moved away" from the water. We plan to:

2b. Implement structural and non-structural flood mitigation measures for flood-prone properties as recommended in the basin-wide master drainage plans.

16. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

The National Flood Insurance Program keeps track of insurance claims made for flood damages. Properties where claims of $1,000 or more have occurred at least twice in the past 10 years are called "Repetitive Loss Properties." In addition, the City of Tulsa keeps track of properties that suffer repeated damages that are less than $1,000 each. We plan to:

2c. Acquire and remove Repetitive Loss Properties and repeated flooded properties where the City's Repetitive Loss and master drainage plans identify acquisition to be the most cost effective and desirable mitigation measure.

17. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Tulsa has a flood alert center that monitors rainfall and stream levels in the Tulsa area. However, much of the flooding Tulsa now suffers is overland drainage problems resulting in flash floods that carry water into streets. Automatic systems are available that detect flooding in low lying areas and trigger a warning arm to block traffic from entering the trouble spot, similar to devices used to stop traffic at many railroad crossings. We plan to:

2d. Launch an automatic monitoring and warning system for spot flooding.

18. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

The siren system has three sounds available: 1) Three-minute steady tone indicates tornado or chemical release; 2) Three-minute wavering tone warns of military attacks; and 3) Three-minute high-low tone indicates flooding. Many residents and visitors have reported they do not know what each sound indicates. Therefore, we plan to:

2e. Educate the public on what the multi-sound sirens mean in the Tulsa area.

19. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

3. Tornadoes and High Winds

The City of Tulsa follows the International Building Code that requires that new construction be able to withstand winds of up to 80 miles per hour. Researchers continue to develop better construction techniques that result in buildings that can withstand stronger winds. Is the international standard adequate for Tulsa's tornado risk? Can insurance companies, government or other groups provide incentives to builders so they will want to make structures that can withstand higher wind speeds? To answer these questions we plan to:

3a. Investigate building codes/incentives for adequacy for tornadoes and high winds.

20. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

The Tulsa Convention Center, other City facilities, and most schools and businesses have tornado emergency plans that include identifying the safest place to be in the structure during a tornado warning. Are these safe places adequate or should large public gathering places include shelters? Do other communities require these types of shelters? To answer these questions we plan to:

3b. Investigate community tornado shelter programs implemented in other cities or states.

21. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Intensive reviews and assessments conducted by experts in the fall of 2001 determined a number of areas where the city is vulnerable to natural or manmade disasters, as well as areas where improvements can be made to improve safety and security. One result of these studies was development of the "Safe and Secure" program. Among the program's goals are (a) to foster a safe and secure environment (including the workplace) at all City of Tulsa public facilities, whether they are buildings or open spaces and (b) to enable the city to recover from disasters, emergencies, and other critical incidents and restore normal operations. Therefore, we plan to perform the following mitigation measures:

3c. Provide mobile home community shelters/safe rooms. (Tornado shelters, also called "safe rooms", are able to withstand high winds that severely damage other parts of a building.)

22. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

3d. Supply NOAA Weather Radios to all local government buildings, schools, hospitals, and critical facilities at a cost of about $70.00 each.

23. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

3e. Provide Safe Rooms in Fire and Police stations.

24. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

3f. Provide employee shelters at critical facilities, such as 911 Center and fire stations.

25. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

3g. Provide group safe rooms at City Recreation Centers.

26. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

3i. Provide damage resistant glass replacement for City Hall.

27. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

In-house shelters provide space where people can survive a tornado with little or no injury. These shelters, also called "safe rooms", cost $2,000 or more to put in a home. Therefore, we plan to:

3j. Provide safe room rebates for low income and vulnerable populations.

28. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Revolving funds are sometimes used to provide no-interest or low-interest loans to people who do not qualify for a regular loan. With loans from a revolving fund, people can purchase materials and labor to build Safe Rooms then repay the money into the revolving fund so other people can get loans. Safe Rooms cost $2,000 or more to put in a home. Therefore, we plan to:

3k. Begin a revolving fund for families to build safe rooms.

29. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Other mitigation measures from the "Safe and Secure" program are listed under "Lightning", "Hailstorms", and "Urban Fires, Wildfires".

3l. Perform tornado and high wind structural evaluations of Tulsa schools to determine the best way to retrofit or remodel the buildings to make them more disaster-resistant.

30. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

3m. Prepare weather warning systems for interstate travelers, such as electronic message boards on highways and work with other agencies to provide educational materials at rest stops and information centers.

31. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

4. Lightning

In recent years, surge protectors for individual appliances or computers have become common in homes and businesses. New technology is being developed that provides surge protection to the entire building, not just individual electrical outlets. We plan to:

4a. Provide educational demonstrations on whole-house surge protection technology.

32. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

In recent years, surge protectors for individual appliances or computers have become common in homes and businesses. New technology is being developed that provides surge protection to the entire building, not just individual electrical outlets. We plan to:

4b. Provide surge protection for computer-reliant Critical Facilities, e.g., 911Center, Emergency Operations Center, police sub-stations, fire stations, etc.

33. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

4c. Designate individuals at city recreation facilities that are educated in storm spotting and safety, who have the authority to take proper action.

34. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

4d. Educate the community about proper lightning safety through public service announcements and other media outlets.

35. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Currently, Tulsa's siren system has the capability to warn people who are outdoors of tornadoes, military attacks and floods. In some parts of the country, communities also provide warnings about lightning. We plan to:

4e. Add lightning warning to the current siren system.

36. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

4f. Study other communities that have lightning warning systems intact.

37. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

4g. Encourage utilities to provide lightning prevention information materials and programs to their customers.

38. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Proposed Mitigation Measures

5. Hailstorms

In recent years, thicker, more hail resistant roofing materials have been developed that greatly reduce damage caused by hail. We plan to:

5a. Provide hail resistant roofing for City buildings.

39. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

6. Winter Storms

The City of Tulsa Public Works Department activates street crews when weather conditions indicate the possibility of snow or ice in the Tulsa area. Since weather forecasts are not always 100 percent accurate, crews sometimes work overtime preparing for storms that never happen. However, in the past, the City's aggressive snow and ice removal plan has reduced the impact of winter storms on motorists. Therefore, we plan to:

6a. Continue the City's aggressive snow and ice removal plan.

40. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Public utilities and homeowners can maintain trees on their properties so branches do not hang over power lines. We plan to:

6b. Encourage routine trimming of trees to reduce power outages during storms.

41. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

6c. Reduce the number of overhead powerlines by moving existing lines below the surface and installing new lines underground.

42. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Proposed Mitigation Measures

7. Extreme Heat

Local agencies work together on several programs that are designed to reduce and prevent heat-related illnesses and deaths in the city. These programs make up Tulsa's heat response plan. We intend to:

7a. Review and update Tulsa's heat response plan.

43. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

7b. Obtain funding for distribution of public information and education materials to vulnerable populations through participating community agencies.

44. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Proposed Mitigation Measures

8. Drought

Tulsa gets the raw water it uses to produce drinking water from two main sources: the Eucha/Spavinaw lakes chain and Lake Oologah. Each source is transported through a flow line to treatment plants in the city. The City also has rights to raw water from Lake Hudson, but that water travels through the same flow line as the Eucha/Spavinaw water. Adding a third flow line will allow Tulsa to use water from all three sources at the same time. We plan to:

8a. Build a third flow line to the Lake Hudson reservoir for additional water supply by 2020.

45. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Raw water from the Eucha/Spavinaw lakes chain is treated at the Mohawk Water Treatment Plant. Raw water from Lake Oologah is treated at the A.B. Jewell Water Treatment Plant. If either plant is shut down for an extended period, it would become more difficult to provide adequate supplies of drinking water to all parts of the City. If the systems were linked north of the City, then each plant would be able to pull raw water from either source. Therefore, we plan to:

8b. Tie the Oologah and Spavinaw systems together at the Bird Creek Station.

46. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

The Public Works Department conducts educational activities that encourage customers to not waste drinking water. For example, the Wet in the City program teaches youngsters to shut off the faucet while they brush their teeth. We plan to:

8c. Continue Tulsa's "Wise Use of Water" program.

47. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

The City of Tulsa's water restrictions program specifies certain levels of use as the triggers for voluntary and mandatory restrictions. Excessively high use can occur any year during summer months, not just during a drought. Other communities have developed activities to reduce or prevent damages to property during droughts. These activities are triggered when officials determine that a drought has begun. We plan to:

8d. Develop and implement plans to designate when a drought begins and ends.

48. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

9. Expansive Soils

9a. Investigate codes/incentives for the construction of new foundations to avoid expansive soil problems.

49. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Proposed Mitigation Measures

10. Urban Fires, Wildfires

Sprinkler systems that provide for fire suppression in buildings use treated drinking water. Sometimes the water in the pipes will flow backwards and be used for drinking water unless a valve is installed that prevents the backflow. Since the water stands in the pipes for long periods of time, the water may become stagnant and cause public health problems if ingested. Backflow valves can cost $2,000 or more. Therefore, we plan to:

10a. Apply for mitigation funding for backflow valves for commercial, industrial and multi-family buildings.

50. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Statistics show that most deaths due to fire occur in homes. Sprinkler systems in houses can control a fire in the early stages and, thus, save lives. All multi-family buildings in Tulsa are now required to have fire suppression systems. We plan to:

10c. Develop public education project addressing the advantages of individual fire suppression in single family residences.

51. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

10d. Continue replacing inadequately sized water lines with lines of sufficient size to provide proper fire protection to annexed and existing areas.

52. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

The Tulsa Fire Department's Project Life program has helped reduce injuries due to fires. Under the program, firefighters install smoke detectors for needy individuals. They also produce media events and awareness campaigns to encourage the general public to install and maintain smoke detectors.

10e. Continue fire department's Project Life program.

53. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

10f. Fund a fire suppression pilot project for single family residences in a publicly funded development in the Lacy Park area.

54. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

10g. Evaluate wildfire protection and prevention for animals, employees, and visitors to Tulsa Zoo.

55. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

10h. Continue education and get funding to inform people on proper evacuation plans for fires for City facilities, businesses and residential homes.

56. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

11. Earthquakes

11a. Adopt the International Building Code in 2002. The code contains stricter requirements that make new construction more resistant to damage from earthquakes.

12. Hazardous Materials Events

A study of routing of hazardous materials was conducted in 1997. Since then road construction projects have been completed and some companies that use hazardous materials have moved their operations. Therefore, we plan to:

12a. Update the study for routing of hazardous materials through the Tulsa area.

57. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

The City of Tulsa Public Works Department conducts a Household Pollutant Collection event twice a year, in spring and autumn. Some, but not all, household pollutants are accepted throughout the year at depots operated by the Metropolitan Environmental Trust. We plan to:

12b. Continue the City's Household Pollutant Collection program, and build a year-round site for collection.

58. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

13. Keystone Dam Releases

13a. Re-assess the effects of Keystone Dam release rates and timing on downriver properties.

59. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

13b. Update US Army Corps of Engineers Hydrology and Hydraulics for the Arkansas River and Keystone Dam.

60. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

13c. Develop a computer mapping program for results of Arkansas River's Keystone Dam release rates of 250, 350, and 450 thousand cubic feet per second.

61. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

13d. Update warning and evacuation plans for Arkansas River areas at risk from dam failure or release flooding.

62. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

13e. Update pre- and post-flood plans for the Arkansas River floodplain, including the areas behind the levees.

63. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

14. Levee Failures

A master drainage plan is a comprehensive basin-wide study of a watershed that takes into account community values, goals and objectives, existing conditions and future plans. The plan includes assessments of the integrity of structures such as levees. We plan to:

14a. Re-evaluate and update the master drainage plans for areas behind (protected by) the levees.

64. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

Severe storms have destroyed levees in other communities. As a result, the levees could no longer hold back rising rivers and property was flooded. What would happen if a levee was damaged in Tulsa? How many businesses and homes would be affected? We intend to:

14c. Study and develop a plan to address levee damage in Tulsa.

65. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)

14d. Continue checking, monitoring and replacing existing levees when necessary.

66. On a scale of 1 to 5, how do you rate this measure? (Circle or click one)
    1 – This should be a top priority
    2 – This is important, but not a top priority
    3 - OK to do if money is available
    4 – This is not important; don't spend money on it
    5 – No opinion

- o Check here if you added comments about this mitigation measure on the back of this sheet. (Be sure to indicate the number and letter of the measure you are commenting on, for example "4c".)