AGENDA ITEM # 3

STRATEGIC PRIORITY:	Public Safety
AGENDA DATE:	February 14, 2018
COUNCIL DISTRICT(S):	N/A
DEPARTMENT:	City Attorney's Office
CMO:	Larry Casto, 670-3491
MAPSCO:	N/A

SUBJECT

An ordinance amending Chapter 13, "Courts, Fines and Imprisonments," of the Dallas City Code by amending Section 13-3 to **(1)** clarify division names of the municipal court of record; and **(2)** add new divisions of the municipal court of record - Financing: No cost consideration to the City

BACKGROUND

This ordinance is to identify the Northeast Community Court as Community Court No. 15 and the Downtown Community Court as Community Court No. 16.

PRIOR ACTION/REVIEW (COUNCIL, BOARDS, COMMISSIONS)

Information about this item will be provided to the Public Safety and Criminal Justice Committee on February 12, 2018.

FISCAL INFORMATION

No cost consideration to the City.

1/30/18

ORDINANCE NO. _____

An ordinance amending Chapter 13, "Courts, Fines and Imprisonments," of the Dallas City Code by amending Section 13-3; clarifying division names of the municipal court of record; providing for additional divisions of the municipal court of record; providing a saving clause; providing a severability clause; and providing an effective date.

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF DALLAS:

SECTION 1. That Subsection (a) of Section 13-3, "Municipal Court of Record; Created and Designated; Jurisdiction; Session," of Article II, "Municipal Court of Record," of Chapter 13, "Courts, Fines and Imprisonments," of the Dallas City Code, as amended, is amended to read as follows:

"(a) In accordance with Section 1, Chapter VIII of the Dallas city charter and Chapter 30 of the Texas Government Code, there is hereby created a municipal court of record, which is divided into 16[~~14~~] divisions to be designated as Municipal Court of Record No. 1, Municipal Court of Record No. 2, Municipal Court of Record No. 3, Municipal Court of Record No. 4, Municipal Court of Record No. 5, Municipal Court of Record No. 6, Municipal Court of Record No. 7, Municipal Court of Record No. 8, Municipal [~~Property~~] Court of Record No. 9, Municipal [~~Magistrate~~] Court of Record No. 10, Municipal [~~Community~~] Court of Record No. 11, Community Court No. 12, Community [~~Municipal~~] Court [~~of Record~~] No. 13, [~~and~~] Community Court No. 14, Community Court No. 15, and Community Court No. 16."

SECTION 2. That Chapter 13 of the Dallas City Code shall remain in full force and effect, save and except as amended by this ordinance.

SECTION 3. That any act done or right vested or accrued, or any proceeding, suit, or prosecution had or commenced in any action before the amendment or repeal of any ordinance, or part thereof, shall not be affected or impaired by amendment or repeal of any ordinance, or part thereof, and shall be treated as still remaining in full force and effect for all intents and purposes as if the amended or repealed ordinance, or part thereof, had remained in force.

SECTION 4. That the terms and provisions of this ordinance are severable and are governed by Section 1-4 of Chapter 1 of the Dallas City Code, as amended.

SECTION 5. That this ordinance shall take effect immediately from and after its passage and publication in accordance with the provisions of the Charter of the City of Dallas, and it is accordingly so ordained.

APPROVED AS TO FORM:

LARRY E. CASTO, City Attorney

By_____
Assistant City Attorney

Passed_____

AGENDA ITEM # 7

STRATEGIC PRIORITY:	Public Safety
AGENDA DATE:	February 14, 2018
COUNCIL DISTRICT(S):	All
DEPARTMENT:	Department of Communication and Information Services
CMO:	Jody Puckett, 670-3390
MAPSCO:	N/A

SUBJECT

Authorize an Interlocal Agreement with Dallas County to provide two-way radio service, equipment, antenna space, microwave service and radio system airtime for the period October 1, 2017 through December 31, 2020 - Revenue: $254,591

BACKGROUND

An Interlocal Agreement between the City and Dallas County was entered into in October 2005. The current three year term of that agreement ended September 30, 2017. Dallas County has found that it is advantageous to have their communication equipment maintained by and their radio airtime provided by the City of Dallas. On January 2, 2018, the Dallas County Commissioners' Court gave concurrent authorization for Dallas County to enter into a new three-year Interlocal Agreement with the City of Dallas for these services. The previous Interlocal Agreement with Dallas County had no adverse impact on the City's ability to provide wireless service to its own users and it will have no adverse impact in the future.

PRIOR ACTION/REVIEW (COUNCIL, BOARDS, COMMISSIONS)

On September 28, 2011, City Council authorized a three-year Interlocal Agreement with Dallas County to provide two-way radio service, equipment, antenna space, microwave service and radio system airtime for the period October 1, 2011 through September 30, 2014, by Resolution No. 11-2526.

On February 25, 2015, City Council authorized a three-year Interlocal Agreement with Dallas County to provide two-way radio service, equipment, antenna space, microwave service and radio system airtime for the period October 1, 2014 through September 30, 2017, by Resolution No. 15-0348.

Information about this item will be provided to the Public Safety and Criminal Justice Committee on February 12, 2018.

FISCAL INFORMATION

Revenue - $254,591

February 14, 2018

WHEREAS, on September 28, 2011, City Council authorized a three-year Interlocal Agreement with Dallas County to provide two-way radio service, equipment, antenna space, microwave service and radio system airtime for the period October 1, 2011 through September 30, 2014, by Resolution No. 11-2526; and

WHEREAS, on February 25, 2015, City Council authorized a three-year Interlocal Agreement with Dallas County to provide two-way radio service, equipment, antenna space, microwave service and radio system airtime for the period October 1, 2014 through September 30, 2017, by Resolution No. 15-0348.

Now, Therefore,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF DALLAS:

SECTION 1. That the City Manager is hereby authorized to sign an Interlocal Agreement with Dallas County, approved as to form by the City Attorney, to provide two-way radio service, equipment, antenna space, microwave service and radio system airtime for the period October 1, 2017 through December 31, 2020.

SECTION 2. That the Chief Financial Officer is hereby authorized to deposit funds from Dallas County in Fund 0197, Department DSV, Unit 1812, Revenue Code 7456.

SECTION 3. That this contract is designated as Contract No. DSV-2017-00003689.

SECTION 4. That this resolution shall take effect immediately from and after its passage in accordance with the provisions of the Charter of the City of Dallas, and it is accordingly so resolved.

AGENDA ITEM # 22

STRATEGIC PRIORITY:	Public Safety
AGENDA DATE:	February 14, 2018
COUNCIL DISTRICT(S):	All
DEPARTMENT:	Office of Emergency Management
CMO:	Jon Fortune, 670-1204
MAPSCO:	N/A

SUBJECT

Authorize adoption of the 2017-2022 City of Dallas Hazard Mitigation Action Plan, which identifies strategies to mitigate natural hazards in the City of Dallas - Financing: No cost consideration to the City

BACKGROUND

The 2017 City of Dallas Hazard Mitigation Action Plan (HazMAP) defines the hazards (such as flooding) and potential strategies to mitigate those hazards as federal grant funding becomes available. Without this strategy, the City of Dallas will not be eligible to apply for the grants. This Mitigation Action Plan is effective for Fiscal Years 2017 through 2022. The Federal Emergency Management Agency (FEMA) requires approval of Mitigation Action Plans every five years. The 2017 City of Dallas Hazard Mitigation Action Plan was approved by FEMA in late 2017 and will be effective once adopted by the City.

The City of Dallas Hazard Mitigation Action Plan satisfies the natural hazards mitigation planning requirements as specified in the Disaster Mitigation Act of 2000. The plan was developed following the process outlined by the Disaster Mitigation Act of 2000. The update follows guidelines provided by FEMA 386-8: Multijurisdictional Mitigation Planning (August 2006), FEMA's Local Multi-Hazard Mitigation Planning Guidance (July 2008), FEMA Hazard Mitigation Planning Handbook (March 2013) and other FEMA guidance.

The City completed the following tasks as required by law to ensure a functional, accurate, and thorough Hazard Mitigation Action Plan:

- Developed the Mitigation Planning Working Group that included internal City departments and community stakeholders
- Completed plan development and strategy meetings with the Mitigation Planning Working Group

BACKGROUND (continued)

- Invited public input on hazards affecting the City of Dallas through a public survey which was advertised in social and print media
- Conducted three public input meetings to obtain feedback on potential mitigation projects from community stakeholders
- Solicited a review of the plan from regional Subject Matter Experts in Mitigation planning to ensure thoroughness of the planning process

The 2017 City of Dallas Hazard Mitigation Action Plan was developed to identify projects that may be eligible for pre- and post- disaster mitigation grants when such funding does become available.

Hazard Mitigation Action Plans are a precursor to millions of dollars in Federal funding under the Hazard Mitigation Grant Program, the Flood Mitigation Grant Program, and post-disaster grants and reimbursements.

Hazard Mitigation Action Plans are used to assemble data about the hazards that impact the City of Dallas and quantify hazards into a vulnerability analysis. This analysis is then used to develop long-term sustainable projects. The City is under no obligation to complete any of the projects listed in the plan.
The State of Texas Division of Emergency Management (TDEM) and FEMA have approved the 2017 City of Dallas Hazard Mitigation Action Plan pending adoption by the City Council.

This action will replace adoption of the Dallas County Hazard Mitigation Plan, which the City of Dallas was previously a party to. The City sought to develop a standalone Hazard Mitigation Plan to provide greater detail and strategies within the plan.

PRIOR ACTION/REVIEW (COUNCIL, BOARDS, COMMISSIONS)

On January 13, 2016, City Council approved the adoption of the 2015 Dallas County Hazard Mitigation Plan, which identified strategies to mitigate natural hazards in the City of Dallas and Dallas County by Resolution No. 16-0084.

Information about this item will be provided to the Public Safety and Criminal Justice Committee on February 12, 2018.

FISCAL INFORMATION

No cost consideration to the City.

Dallas Hazard Mitigation Action Plan Executive Summary

Background and Authorities

The City of Dallas Hazard Mitigation Action Plan satisfies the natural hazards mitigation planning requirements as specified in the Disaster Mitigation Act of 2000**.** The plan was developed following the process outlined by the Disaster Mitigation Act of 2000. The update follows guidelines provided by *FEMA 386-8: Multijurisdictional Mitigation Planning (August 2006), FEMA's Local Multi-Hazard Mitigation Planning Guidance (July 2008), FEMA Hazard Mitigation Planning Handbook (March 2013) and other FEMA guidance*.

Purpose

The purpose of this Local Mitigation Action Plan is to document and analyze the City of Dallas' vulnerability to hazards, both natural and technical, and lessen their impacts based on the assumption that each of the hazards will occur at least once within the next ten years. This document represents a cumulative understanding of the hazards that have an effect on the City of Dallas, including hazards with or without tangible impact on its population or property. This document identifies those hazards that the City of Dallas is vulnerable to, states their probability and potential impact based on historical records, and identifies projects to lessen their vulnerability over the five-year life of this plan.

The desired outcome of the City of Dallas Local Mitigation Action Plan is a comprehensive understanding of the hazards that affect the City of Dallas. This document sets out to document the effects of the natural hazards that plague our community by virtue of our geographical location, and the technological hazards that come about as a result of our City's prestige.

The City identified current capabilities and mechanisms available for implementing hazard mitigation strategies. This captures a discussion of the roles of key departments, administrative and technical capacity, fiscal resources, and summaries of relevant planning mechanisms, codes, and ordinances.

Summary of Plan Sections

A complete copy of the City of Dallas Hazard Mitigation Action Plan is available to members of the City Council upon request.

Chapters 1 and 2 of the HazMAP outline the Plan's purpose and development, including how Planning Team members, stakeholders, and members of the general public were involved in the planning process.

Chapter 4 presents a hazard overview and information on individual natural hazards in the planning area. The hazards are analyzed and prioritized based on potential losses to life and property and other community concerns. For each hazard, the Plan Update presents a description of the hazard, a list of historical hazard events, and the results of the vulnerability and risk assessment process.

Chapter 5 presents hazard mitigation goals and objectives. Additionally, an analysis for the previous actions and proposed hazard mitigation actions by the City of Dallas is included. Chapter 6 identifies Plan maintenance mechanisms.

A community profile is included in appendix A. Documentation supporting the process for plan development is included in Appendix B. Appendix C contains sensitive information included in the plan and is not available for public release. Appendix D contains a consequence analysis of each of the hazards identified within the plan including the impact of the hazard on the public, responders, facilities, the environment, and the economy. Finally, appendix D details the mitigation plans link to the City's Community Rating system and the impact mitigation activities have on limiting the impact of flooding events on the public, property, and the environment

City of Dallas

OEM

Office of Emergency Management

Local Mitigation Action Plan

2017 – 2022

Chapter 1
Introduction

1.1 Statement of Purpose

The purpose of this Local Mitigation Action Plan is to document and analyze the City of Dallas' vulnerability to hazards, both natural and technical, and lessen their impacts based on the assumption that each of the hazards will occur at least once within the next ten years. This document represents a cumulative understanding of the hazards that have an effect on the City of Dallas, including hazards with or without tangible impact on its population or property. This document identifies those hazards that the City of Dallas is vulnerable to, states their probability and potential impact based on historical records, and identifies projects to lessen their vulnerability over the five-year life of this plan.

This page intentionally left blank.

1.2 Table of Contents

This page intentionally left blank.

1.3 Desired Outcomes

The desired outcome of the City of Dallas Local Mitigation Action Plan is a comprehensive understanding of the hazards that affect the City of Dallas. This document sets out to document the effects of the natural hazards that plague our community by virtue of our geographical location, and the technological hazards that come about as a result of our City's prestige. It is the hope of the Mitigation Working Group that the information within this plan will have a positive impact on the population and properties within the City of Dallas.

1.4 Contact Information

The City of Dallas Local Mitigation Action Plan is a living document which will be reviewed and updated periodically as described in Chapter 6 – Plan Maintenance.

Comments, suggestions, corrections and additions are enthusiastically encouraged from all interested parties.

Please send review comments to:

Nicholas F. LaGrassa
Emergency Management Specialist - Mitigation
City of Dallas Office of Emergency Management
1500 Marilla Street L2AN
Dallas, TX 75201
Nicholas.LaGrassa@DallasCityHall.com

This page intentionally left blank.

Chapter 2
Plan Development

The City of Dallas Local Mitigation Action Plan satisfies the natural hazards mitigation planning requirements as specified in the Disaster Mitigation Act of 2000**.** The plan was developed following the process outlined by the Disaster Mitigation Act of 2000. The update follows guidelines provided by *FEMA 386-8: Multijurisdictional Mitigation Planning (August 2006), FEMA's Local Multi-Hazard Mitigation Planning Guidance (July 2008), FEMA Local Mitigation Planning Handbook (March 2013) and other FEMA guidance*.

2.1 Internal Planning Process

The City of Dallas Local Mitigation Action Plan (LMAP) was developed primarily by the Office of Emergency Management, with input from other municipal departments through regular meetings of the Mitigation Working Group. Table 1 lists the names and titles of individuals on the Mitigation Working Group. Those members with "City Representative" in their plan role are employed by the City of Dallas. Members with "Public Representative" are from outside the municipal government.

Table 1 - City of Dallas Mitigation Working Group

Name	Title - Department	Plan Role
Nicholas F. LaGrassa	Emergency Management Specialist - Office of Emergency Management	LMAP Coordinator – City Representative
Kevin Oden	Assistant Emergency Management Coordinator - Office of Emergency Management	Hazard and Plan Development – City Representative
Rocky Vaz	Director - Office of Emergency Management	Hazard and Plan Development – City Representative
Steve Parker	Senior Program Manager - Trinity Watershed Management	Floodplain Administrator – City Representative
Dhruv Pandya	Assistant Director - Trinity Watershed Management	Flooding Specialist - City Representative
Kim Dewailly	Senior Engineer – Trinity Watershed Management	Dams and Levees – City Representative
Randall Payton	Assistant Director – Dallas Water Utilities	Dams and Levees – City Representative
Kevin Luper	Officer – Dallas Fire Rescue	Wildfire Specialist – City Representative
Lynn Brantley	Captain – Dallas Fire Rescue	Hazardous Materials Specialist – City Representative
Theresa O'Donnell	Chief Resiliency Officer	Hazard and Plan Development – City Representative

Name	Title - Department	Plan Role
Sheneice Hughes	Operations Specialist – Dallas Love Field	Aircraft Incident Specialist – City Representative
Don Knight	City Attorney's Office	Legal Review – City Representative
Justin Snasel	Public Information Officer	Public Outreach Development and Implementation – City Representative
Michael Gaciri	Dallas County Homeland Security and Emergency Management	County Liaison – Public Representative
Melanie Devine	Senior Specialist, Emergency Preparedness – North Central Texas Council of Governments	Regional Liaison - Public Representative
Mitch Osburn	Plans Administrator, Mitigation Section – Texas Division of Emergency Management	State Liaison – Public Representative
Jack Young	Project Manager - Halff Associates	Public Representative
Jessica Baker	Vice President - Halff Associates	Public Representative
Janette Monear	President – Texas Trees Foundation	Public Representative
Matt Grubisich	Operations Director – Texas Trees Foundation	Public Representative
Deborah Lockhart	CERT Member	Public Representative
Jen Edwards	CERT Member	Public Representative
Dennis Allan	CERT Member	Public Representative
Yazmin Mendoza	CERT Member	Public Representative
Ray Feagins	CERT Member	Public Representative
John Ozmun	CERT Member	Public Representative

Various subject matter experts were consulted on an as-needed basis. Their effort is acknowledged in the section(s) where their input was implemented. Their assistance with this plan is greatly appreciated by the Mitigation Working Group.

The purpose of the Mitigation Working Group was to facilitate a collaborative planning process for all participating departments and the general public. Mitigation Working Group meetings occurred bimonthly. Below is a documentation of those meetings that occurred and the summary of their purpose:

Table 2 – Meeting Summaries

Date	Purpose
November 5, 2015	Kickoff meeting. Introductions of all working group members. Discussion about the purpose of mitigation.
January 20, 2016	HIRA Meeting. Discuss the Hazard Identification and Risk Assessment chapter of the plan.
March 16, 2016	Mitigation Strategy Meeting. Discussed potential mitigation strategies and activities that could be listed in the plan.

The purpose of these meetings was to provide overall guidance to the planning process, review the existing hazard mitigation planning materials, update risk assessment, and discuss mitigation strategies. This plan was developed as a city-wide hazard mitigation plan focusing on collaboration to implement mitigation strategies while maintaining accountability within each participating city to identify and track specific mitigation actions.

The Working Group performed the following tasks:

- Approved the plan development process, and established goals, and objectives
- Established a time line for completion of the plan
- Ensured that the plan meets the requirements of the Disaster Mitigation Act of 2000
- Coordinated the Solicitation and encouraged the participation of the public in the plan development process
- Assisted in the gathering information for inclusion in the plan
- Organized and coordinated the public involvement process
- Gathered all pertinent information to be included in the plan
- Assisted in the completion of a draft plan for review

The Mitigation Working Group reviewed and identified hazards on a citywide basis, conducted risk assessment of these hazards, researched and analyzed data from various sources, and provided comments on the Dallas LMAP based on the above mentioned activity. Edits and comments were made to the various sections as needed.

Data sources and existing documentation used for developing this plan update included:

Source	Data
City Appraisal Data 2012 North Central Texas Council of Governments United States Census Bureau	Population, land use and demographics
Subject Matter Experts	Hazard occurrences
National Climatic Data Center (NCDC)	Hazard occurrences
Texas Forest Service/Texas Wildfire Risk Assessment Summary Report	Wildfire Threat and Urban Interface
National Inventory of Dams	Dam information

Source	Data
FEMA National Flood Insurance Program	National Flood Insurance Rate Maps
Texas Department of Public Safety – State of Texas Hazard Mitigation Plan	Hazard profiles and analysis
Dallas County Emergency Management Plan	Hazard profiles and analysis
Dam EAPs	Dam failure extent and impact
Trinity Watershed Needs Assessment	Hazard locations
Drought Contingency Plan Water Conservation Plan	Mitigation Strategies

These documents provided valuable guidance in the planning process. Some served to acquaint committee members with the many roles of emergency management. Planning guides helped to tie together the phases of mitigation planning for committee members from a broad range of backgrounds outside mitigation and emergency management.

State and federal response and homeland security documents were referenced to ensure Tarrant County's goals supported these plans and promoted compliance with requirements. The State of Texas Hazard Mitigation Plan (HMP) formed the basis for identifying and analyzing the natural hazards and technological hazards that could affect Tarrant County and participating jurisdictions.

Office of Emergency Management (OEM) served as the coordinator and lead department. OEM accomplished the following activities through the planning process:

- Assigned the Mitigation Specialist to coordinate and provide technical assistance and necessary data to the Planning Committee.
- Scheduled, coordinated, and facilitated community meetings with the assistance of the Mitigation Working Group
- Provided any necessary materials, handouts, etc. for public planning meetings
- Worked with the each city department to collect and analyze data and develop goals and implementation strategies.
- Prepared, based on community input and Mitigation Working Group direction, the first draft of the plan and provided technical writing assistance for review, editing and formatting.
- Coordinated with the stakeholders within the city during development.

Outside stakeholders were included in the Mitigation Working Group (MWG). These included both City Departments and members of the general public. Members of the general public are defined as individuals who exist outside the chain of command and do not have decision-making authority within The City of Dallas. Each member of the Mitigation Working Group participated in accomplishing similar activities associated with development of the plan as follows:

- Attended regular meetings of the MWG as coordinated by OEM
- Assisted in identifying hazards and estimating potential losses from future hazard events in City of Dallas

- Assisted in developing and prioritizing mitigation actions to address the identified risks within Dallas
- Identified the community resources available to support the planning effort

2.2 External Planning Process

Per FEMA requirements, input on this plan was sought from the general public and external stakeholders, including neighboring cities, the Dallas County Office of Homeland Security and Emergency Management, and the North Central Texas Council of Governments.

2.2.1 Public Outreach Campaign

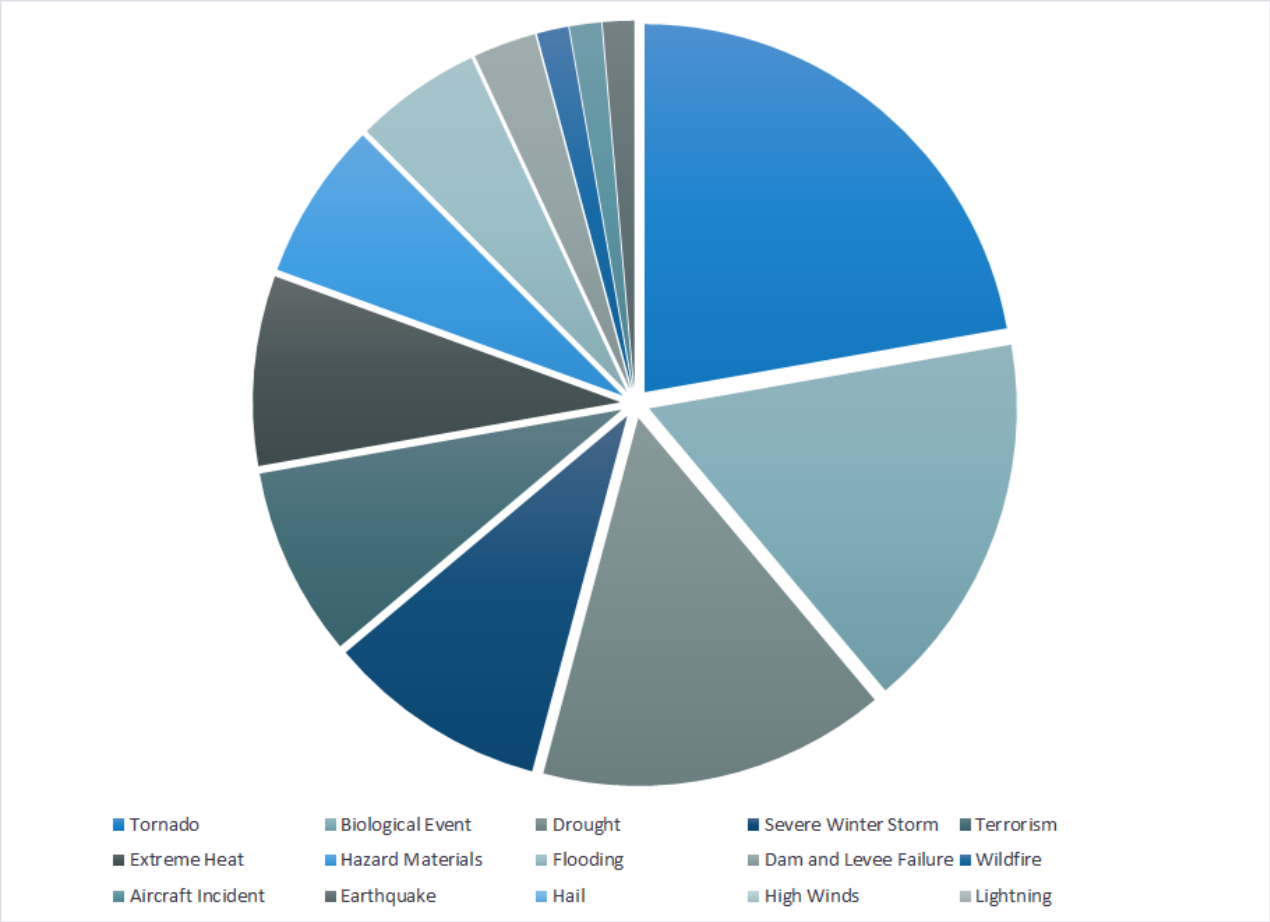
In conjunction with the internal plan development process, The Office of Emergency Management coordinated a campaign to seek public input on the LMAP. Public input was sought through social media and four public meetings. The social media component consisted of a public survey asking residents to pick three hazards that the city was most vulnerable to from a full list of the hazards profiled in this plan. Residents were also asked to explain their choices and to offer ideas for projects. The survey was hosted on the OEM website, with links distributed through a press release, an announcement on the City's website, Facebook, and Twitter. Flyers advertising the survey were also distributed at OEM events.

The results of that survey are listed below. The survey data was not significantly accurate enough to be incorporated into the HIRA or Mitigation Strategies. However, comments received have been incorporated into each hazard's section of the HIRA.

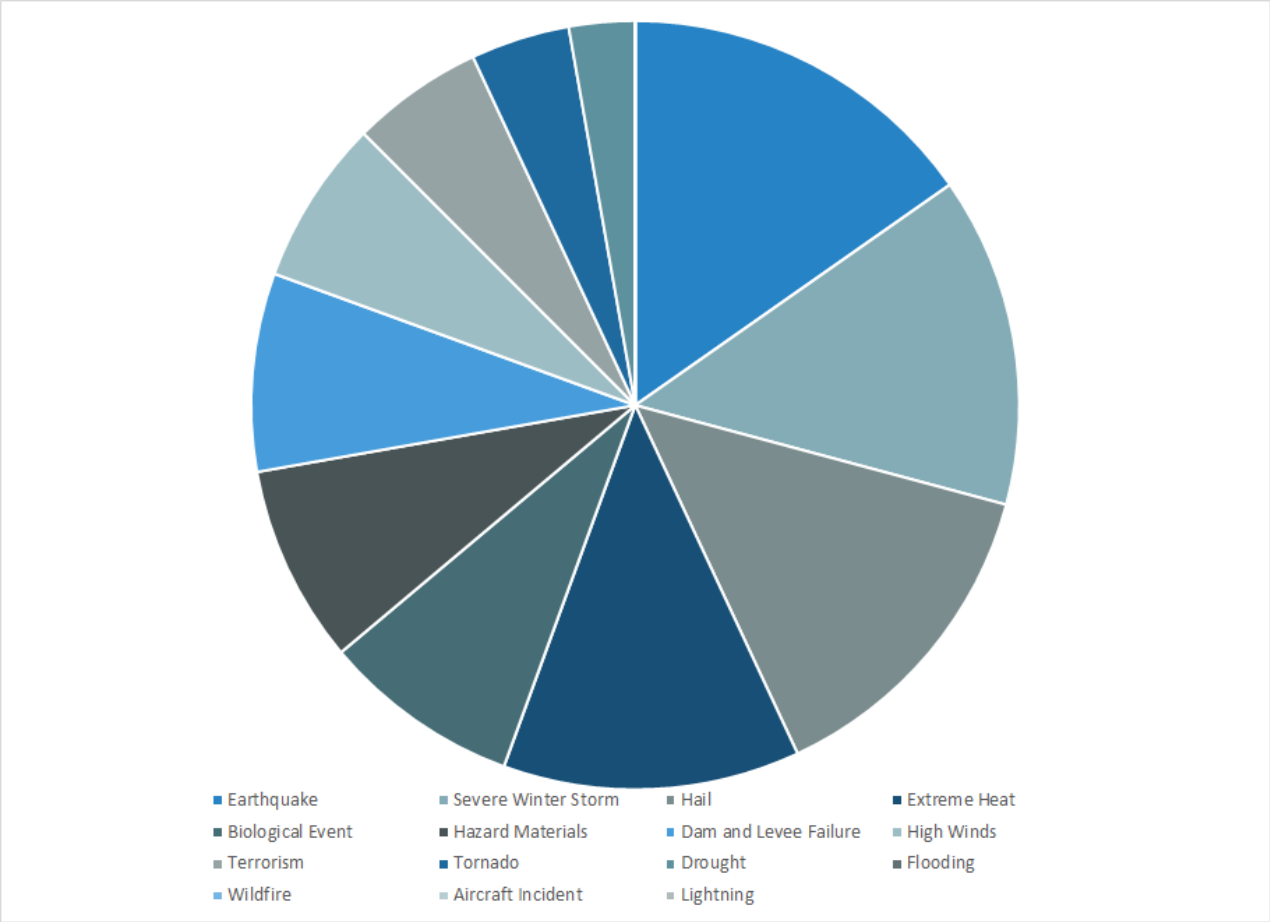
Table 3: Total Results of Public Survey

Hazard	Respondent Selection Order		
	First Choice	Second Choice	Third Choice
Aircraft Incident	1	1	3
Biological Event	12	6	6
Dam and Levee Failure	2	4	2
Drought	11	9	10
Earthquake	1	1	4
Extreme Heat	6	10	9
Flooding	4	9	6
Hail	0	1	0
Hazard Materials	5	7	6
High Winds	0	3	0
Lightning	0	0	0
Severe Winter Storm	7	7	11
Terrorism	6	7	10
Tornado	16	7	5
Wildfire	1	0	0

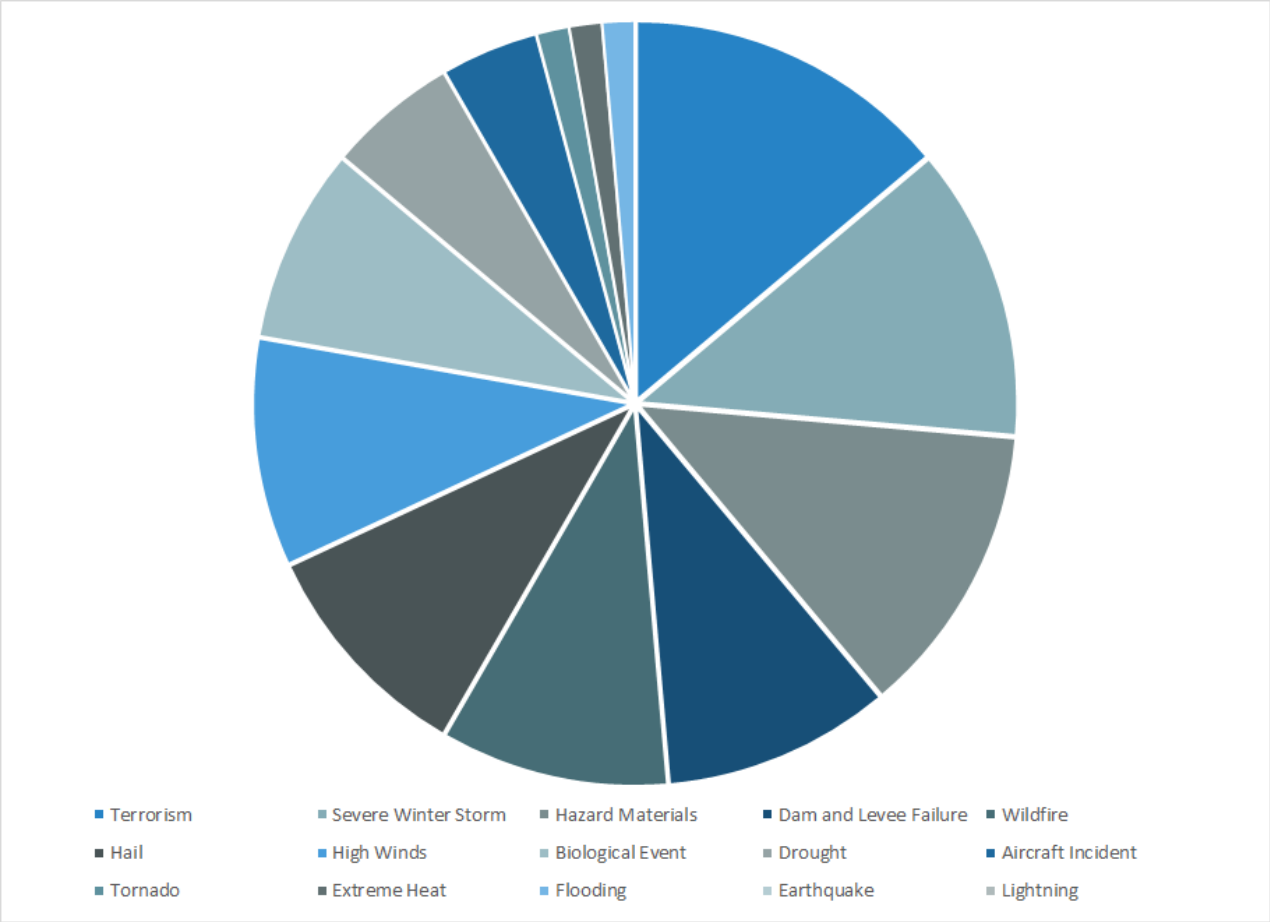
Graph 1: First-Choice Hazard Distribution



Graph 2: Second-Choice Hazard Distribution



Graph 3: Third-Choice Hazard Distribution



While quantitative data was not recoverable from the public survey, qualitative comments were compiled, summarized, and inserted into the respective section. Documentation of these efforts and results can be found in Appendix B.

In addition to the social media campaign, four public meetings were held to discuss the plan and seek input from residents. These meetings were publicized with fliers posted at the location of the meeting. The chart below documents the date of each public meeting, the location, and general feedback received. Specific feedback was summarized and inserted into the respective section.

Table 4: Public Forum Dates and Locations

Date	Location	Meeting Intent	Feedback Received
December 16, 2015	Lochwood Public Library	Obtain input on natural hazards and vulnerabilities	No significant feedback received
February 17, 2016	Pleasant Grove Public Library	Obtain input on possible mitigation activities	No significant feedback received
April 13, 2016	Hampton-Illinois Public Library	Obtain input on mitigation ideas	No significant feedback received.

Date	Location	Meeting Intent	Feedback Received
June 28, 2016	Oak Lawn Public Library	Obtain input on finalized plan	

Public notices for each meeting can be found in Appendix B.

2.2.2 External Stakeholder Input

In addition to the public outreach campaign, City of Dallas sought input on the LMAP from its neighboring jurisdictions, county emergency management office, and regional Council of Government. Table 5 lists the individuals contacted, method of contact, and input received. All input received was implemented into the plan.

Table 5: External Stakeholder Input

Organization	Name-Title	Method of Contact	Comments/Input Received
City of Grand Prairie	Chase Wheeler Emergency Management Coordinator	Email	
City of Mesquite	Cindy Carlo Emergency Management Coordinator	Email	
City of Rowlett	Ed Balderas Emergency Management Specialist	Email	
City of Garland	Savannah L. Martin Senior Emergency Management Specialist	Email	
City of Carrollton	Elliott Reep Emergency Management Coordinator	Email	
Dallas County	Michael Gaciri Emergency Management Specialist	Email	
North Central Texas Council of Governments	Melanie Devine Senior Emergency Preparedness Specialist	Email	

This page intentionally left blank.

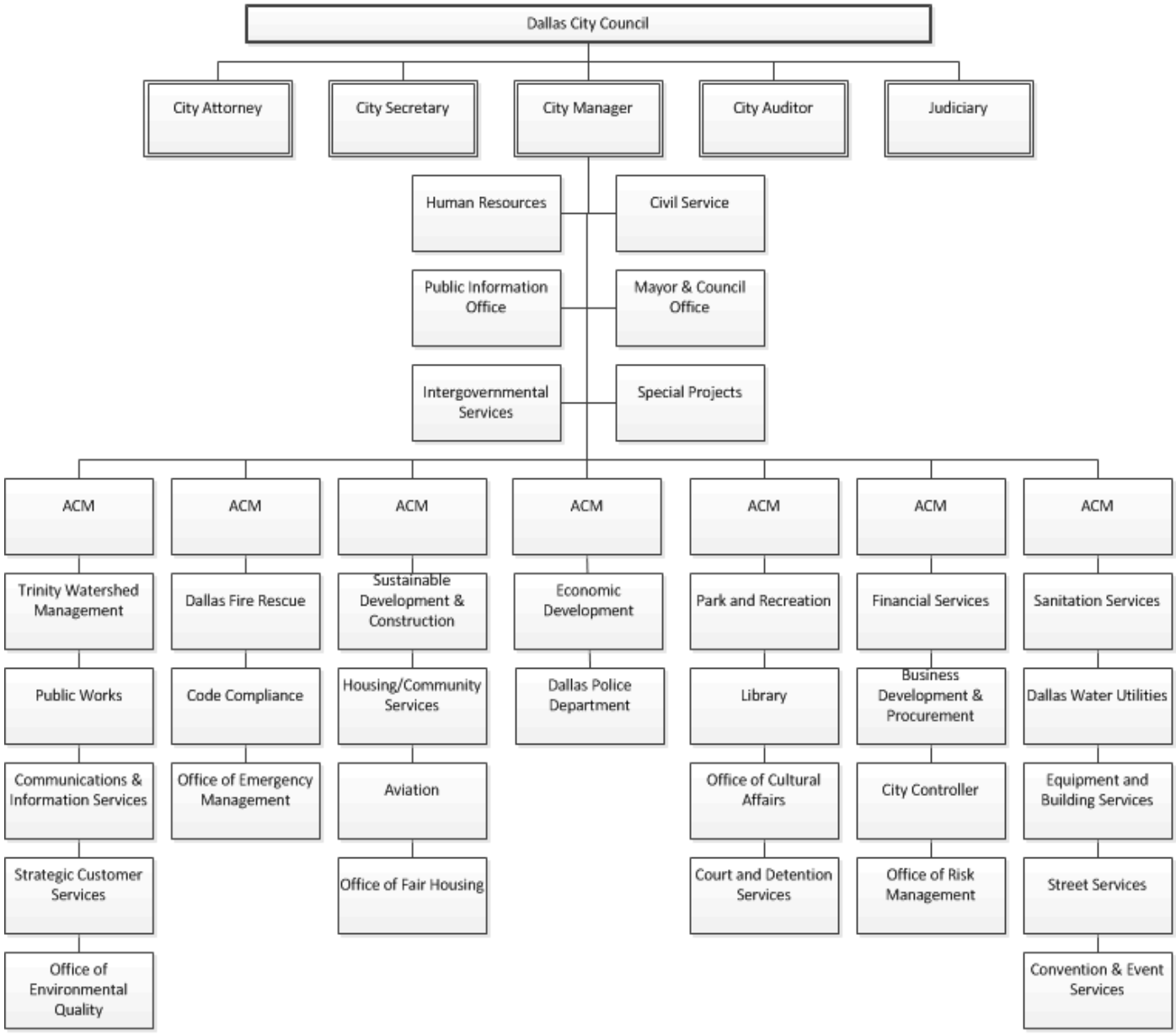
Chapter 3
Capabilities Assessment

The City identified current capabilities and mechanisms available for implementing hazard mitigation strategies. This section presents a discussion of the roles of key departments, administrative and technical capacity, fiscal resources, and summaries of relevant planning mechanisms, codes, and ordinances.

3.1 Key Departments

The following is a summary of existing departments in Dallas and their responsibilities related to hazard mitigation planning and implementation, as well as existing planning documents and regulations related to mitigation efforts within the community. Specific resources reviewed include those involving technical personnel such as planners/engineers with knowledge of land development and land management practices, engineers trained in construction practices related to building and infrastructure, planners and engineers with an understanding of natural, floodplain managers, personnel with GIS skills and scientists familiar with hazards in the community. The organizational chart below presents the structure of the City's government.

City of Dallas Organizational Chart



3.2 Administrative and Technical Capacity

The administrative and technical capabilities of Dallas, as shown in Table 3 provides an identification of the staff, personnel, and department resources available to implement the actions identified in the mitigation section of the Plan.

Table 6 – Administrative and Technical Capabilities

Staff/Personnel Resources	Y/N	Department
Planner(s) or engineer(s) with knowledge of land management practices	Y	Sustainable Development, Trinity Watershed Management, Public Works
Engineer(s) or professional(s) trained in constructions practices related to buildings and/or infrastructure	Y	Public Works, Code Compliance, Equipment and Building Services, Street Services.
Planners or Engineer(s) with an understanding of natural hazards	Y	Trinity Watershed Management, Dallas Water Utilities, Public Works
NFIP Participation	Y	Trinity Watershed Management, Office of Emergency Management
Floodplain Manager	Y	Trinity Watershed Management
Surveyors	Y	Public Works
Staff with education and experience to assess the community's vulnerability to hazards	Y	Trinity Watershed Management, Public Works, Office of Emergency Management.
Personnel skilled in GIS	Y	Dallas Water Utilities
Scientists familiar with hazards of the community	Y	National Weather Service, SMU
Emergency Manager	Y	Office of Emergency Management

3.3 Legal and Regulatory Capabilities

The legal and regulatory capabilities of Dallas are shown in Table 4, which presents the existing ordinances and codes that affect the physical or built environment of Dallas. Examples of legal/or regulatory capabilities can include: building codes, zoning ordinances, subdivision ordinances, special purpose ordinances, growth management ordinances, site plan review, General Plans, capital improvement plans, economic development plans, and emergency response plans.

Table 7 – Legal and Regulatory Capabilities.

Regulatory Tools (ordinances, codes, plans)	Local Authority (Y/N)	Does State Prohibit? (Y/N)
Building Code	Y	N

Regulatory Tools (ordinances, codes, plans)	Local Authority (Y/N)	Does State Prohibit? (Y/N)
Zoning Ordinance	Y	N
Subdivision ordinance or regulations	Y	N
Grown management ordinances	Y	N
Site plan review requirements	Y	N
General Plan	Y	N
Capital improvements Plan	Y	N
Economic Development Plans	Y	N
Emergency Response Plan	Y	N

3.5 Ability to Expand Capabilities

Table 8, below, describes the governing body of City of Dallas and its ability to expand capabilities to enhance mitigation efforts.

Table 8 – Governing Body and Administration

Chief Administrative Officer	Governing Body	Ability to Expand Capabilities
City Manager	City Council, comprised of the Mayor and 13 councilpersons elected from their respective districts across the city.	The City Council and City Manager address the budget, policies, regulations and codes, hire staff, approve plans, and determine the direction of the city overall. Ability to implement and approve mitigation actions, expand existing mitigation actions, and integrate mitigation into existing policies and programs is a function of this group.

Chapter 4
Hazard Identification and Risk Assessment

4.1 Overview

The City of Dallas's Mitigation Working Group prepared a general assessment of the hazards that have potential to impact the city. The following sections provide an overview of past hazard events in the city and brief descriptions of the potential for future losses. The term planning area is used frequently in this section. This term refers to the geographic limits of the City of Dallas. The Risk Assessment section addresses the effects of hazards on the City of Dallas, its assets and residents.

The following natural and technological hazards were identified for the City of Dallas.

Table 9: Hazards Included in Risk and Vulnerability Assessment

Hazard	Hazard Type	Justification for Inclusion
Aircraft Crash*	Technical	Potential adverse impact
Biological Event/Pandemic*	Technical	Frequency, previous incidents, citywide hazard
Dam/Levee Failure	Technical	Potential adverse impacts
Drought	Natural	Frequency, previous incidents, citywide hazard
Earthquake	Natural	Potential adverse impacts
Extreme Heat	Natural	Frequency, previous incidents, citywide hazard
Flooding	Natural	Frequency, previous incidents, citywide hazard
Hail	Natural	Citywide hazard
Hazardous Materials (Fixed and Transport)*	Technical	Previous incidents, citywide hazards
High Winds	Natural	Frequency, previous incidents, citywide hazard
Lightning	Natural	Frequency, citywide hazard
Severe Winter Storms	Natural	Frequency, previous incidents, citywide hazard
Terrorism*	Technical	Potential adverse impact
Tornado	Natural	Frequency, previous incidents, citywide hazard
Wildfire	Natural	Potential adverse impacts

**- Hazard not identified by the State of Texas Hazard Mitigation Action Plan*

Each of the hazards featured within this plan were agreed upon by the Mitigation Working Group.

The following hazards were not profiled due to geographic location, low occurrence, or low potential damage.

Table 10: Hazards Not Included in the Risk and Vulnerability Assessment

Hazard	Justification for Omission
Civil Disturbance	Low occurrence, low vulnerability
Coastal Erosion	Geographic proximity
Hurricane/Tropical Storms	Geographic proximity
Landslides	Low occurrence
Stream Bank Erosion	Low occurrence
Sinkholes	Low vulnerability

To ensure accurate analysis, the plan is analyzing hazard events from 07/01/2005 to 06/30/2015. Each hazard will be discussed individually in their respective section of this chapter.

4.2 HIRA Matrix

The City of Dallas defines its vulnerability to hazards based on the following variables

- Occurrence
  - The frequency by which a hazard event can be expected to occur within the city limits in a single year.
- Effect on Population
  - The impact that this hazard will have on the residents and visitors of the City of Dallas.
- Effect on Property
  - The impact that this hazard will have on improved property in the city of Dallas, including residential, commercial, industrial, and public facilities.
- Area of Extent
  - The size of the area that the average occurrence of the hazard will impact.

To present the most accurate picture of vulnerability, this data will be compiled from multiple sources, including the National Climatic Data Center, Dallas Fire Department call logs, Dallas Police Department call logs, discussions with subject matter experts, and reports from media and the general public as collected from public meetings and social media.

The HIRA Matrix was developed based on assigning a value to the vulnerability variables of each hazard.

Table 11: HIRA Matrix Criteria

Value	Occurrence	Effect on Population	Effect on Property	Area of Extent
1	**Rare**; Less than .5 anticipated events per year.	**Negligible**; No impact on population	**Negligible**; No damage to properties associated with this hazard	**Concentrated**; 10% or less of the city affected.
2	**Minor**; Between .51 and 1.5 anticipated events per year	**Minor**; 25 or fewer injuries, 1 or fewer fatalities per event	**Minor**; some damage to vulnerable properties	**Minor**; 25% or less of the city affected
3	**Moderate;** Between 1.51 and 2.5 anticipated events per year	**Moderate**; 50 or fewer injuries, 10 or fewer fatalities per event	**Moderate**; significant damage to vulnerable properties, minor damage to hardened facilities	**Moderate**; 50% or less of the city affected
4	**Chronic**; More than 2.50 anticipated events per year.	**Major**; greater than 50 injuries, greater than 10 fatalities per event	**Major**; catastrophic damage to vulnerable properties, moderate damage to hardened facilities	**Pervasive**; Greater than 50% of the city affected

Each value was then weighted based on their effect on the impact of as hazard event. The resulting formula is below:

(Occurrence*.4)*(Population*.3)(Property*.2)(Extent*.1)

Based on the information above, the finalized City of Dallas HIRA Matrix is shown in Table 12.

Table 12 - City of Dallas HIRA Matrix

Hazard	Occurrence	Effect on Population	Effect on Property	Area of Extent	Vulnerability Value
Aircraft Incident	1	4	4	1	2.5
Biological Event	2	4	1	2	2.4
Dam and Levee Failure	1	3	3	1	2
Drought	2	1	1	4	1.7
Earthquake	4	1	1	1	2.2
Extreme Heat	4	2	1	4	2.8
Flooding	3	2	2	3	2.5
Hail	2	1	3	1	1.8
Hazardous Materials	3	1	1	1	1.8
High Winds	3	1	2	1	2
Lightning	1	1	1	1	1.0
Severe Winter Storm	1	1	3	4	1.9
Terrorism	1	4	4	1	2.5
Tornado	2	2	3	1	2.1
Wildfire	1	2	2	1	1.5

Based on each resulting vulnerability value, the hazards were ranked High/Moderate/Low. Hazards with a Vulnerability Value of 2.5 or greater rank as high hazards. Hazards with a Vulnerability Value between 2.0 and 2.49 rank as moderate hazards. Hazard with a Vulnerability Value of 1.99 or less rank as low hazards. The rank of each hazard can be found in Table 13.

Table 13 – Hazard Rankings

High Hazards	Extreme Heat
	Aircraft Incident
	Terrorism
	Flooding
Moderate Hazards	Biological Event
	Earthquake
	Tornado
	High Winds
	Dam and Levee Failure
Low Hazards	Severe Winter Storm
	Hazardous Materials
	Hail
	Drought
	Wildfire
	Lightning

This ranking has been agreed upon by the Mitigation Working Group and will be factored into action item prioritization.

This page intentionally left blank.

4.3 Individual Hazard Analyses

Each hazard profiled in this plan has an individual section where its description, extent, occurrence, and impact will be discussed in greater detail. Each hazard section starts with a table summarizing the information present in the section. An example, with descriptions of each cell, is below.

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	Number of instances of hazard occurrence during the plan analysis period.	Prediction of future occurrences based on the historical data and other variables that may affect hazard occurrence.
Effect on Population	Total number of injuries and deaths as a direct result of hazard occurrences.	Prediction of future injuries and deaths based on the historical data and other variables that may affect hazard occurrence.
Effect on Property	Total amount of property damage as a direct result of hazard occurrences.	Prediction of future effects on properties based on the historical data and other variables that may affect hazard occurrence.
Area of Extent	Average area of effect previously noted in historical records.	Prediction of future area of extent based on the historical data and other variables that may affect hazard occurrence.
Public Perception of Vulnerability	Summary of public input received about this hazard.	

This page intentionally left blank.

4.3.1 Aircraft Incident

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	There have been 8 Alert III incidents at Dallas Love Field.	The City of Dallas can anticipate .8 aircraft incidents per year.
Effect on Population	There have been no effects to population from Aircraft Incident.	Future aircraft incidents may have major impacts on the population.
Effect on Property	There have been no effects to property from Aircraft Incident.	Future aircraft accidents may have major impacts on property.
Area of Extent	Previous airline incidents have had a limited area of effect, centered on Dallas Love Field.	Based on previous events, this hazard is projected to have a limited area of extent, affecting less than 10% of the City.
Public Perception of Vulnerability	Public comments received about Aircraft Incident include concerns about flight paths and development adjacent to Love Field. Mitigation ideas received involved developing and exercising emergency plans.	

Vulnerability Narrative: City of Dallas is home to two airports, Dallas Love Field and Dallas Executive Airport, and one Vertiport on top of the Kay Bailey Hutcheson Convention Center. Property and residents in a 2-mile radius of each property would be most at risk of impact by a takeoff/landing-related incident, or a land-based incident. Maps of each of these areas are included in this section. In both scenarios, property and population would be affected by debris (falling from the sky or acting as projectiles) and potentially the shockwave from an explosion. Dallas Love Field is a mixed used airport that includes commercial and general aviation operations. Dallas Executive Airport is a general aviation airport. The Vertiport is vertical takeoff and landing facility.
In addition, there are also 1 police station, 5 fire stations, 9 hospitals, 3 DART stations, and 17 schools within a 2-mile radius of Love Field. These properties would be most vulnerable in an Aircraft Incident.

Hazard Description: All aviation operations are unique and varied in a number of ways, by size, complexity, operations, facilities, geography, and types of aircraft served. If an aircraft were to crash anywhere in City of Dallas the extent of the damage could be very severe, depending on location and size of the aircraft. The City of Dallas is located in both Arrival and Departure Tracks for Dallas Love Field and Dallas/ Fort Worth International Airport. The City of Dallas owns and operates two airports, Dallas Love Field and Dallas Executive Airport, and one Vertiport located near downtown Dallas. The greater exposure for potential loss of life and/ or property will be at Dallas Love Field.

Dallas Love Field (DAL) is a city-owned public airport 6 miles northwest of downtown Dallas, Texas. It was Dallas' airline airport until 1974 when Dallas/Fort Worth International Airport (DFW) opened. Dallas Love Field is served by Southwest Airlines, Delta Air Lines, and Virgin America. Southwest Airlines corporate headquarters is at Dallas Love Field, and as such, Dallas is a focus city for them. Seven full service fixed base operators (FBOs) provide general aviation service: fuel, maintenance, hangar rentals, and charters.

Location of Airport/Aircraft Crash Hazard: Any part of the city that is located in the departure or arrival tracts are at greatest risk from an aircraft crash. The City of Dallas is located within the Standard Instrument Departure and Instrument Departure routes for both Dallas Love Field and Dallas/ Fort Worth International Airport.

Extent/Previous Occurrences: Incidents are sorted into two classifications, Alert II and Alert III:

- ✓ Alert II – Major aircraft emergency (e.g. engine out, hydraulic failure, airborne bomb threat, etc.)
- ✓ Alert III – Aircraft crash or fire involving aircraft not in flight.

The table below documents the previous occurrences of aircraft incidents.

Table 14: Occurrences of the Airport/Aircraft Crash Hazard

Date of Occurrence	Alert Type	Incident	Impacts/Result
3/10/2006	Alert III	Jet Star with nose gear collapsed	Rwy 13R opened at 2254
2/24/2007	Alert III	AA aircraft blown from Rwy 31R to Twy A2	Aircraft towed to AA ramp and Alert III cancelled
2/8/2008	Alert III	Bonanza landed with gear up	Aircraft clear of Rwy 31R at 2154
10/2/2010	Alert III	Conquest with both main gear tires blew	Rwy 31R opened at 0551
12/21/2010	Alert III	Velocity with a collapsed main gears	Rwy opened at 1341
12/24/2010	Alert III	Baron landed with gear up on Rwy 13L	FAA com notified and Rwy opened at 0552
3/8/2011	Alert III	Navaho with blown nose tire	Rwy 13L opened at 1710

Date of Occurrence	Alert Type	Incident	Impacts/Result
4/9/2013	Alert III	Fire in cockpit of Cessna 172	Fire extinguished and aircraft taxiied to Dalfort Fueling

Probability of Future Events: As stated in Table 14, there have been 8 aircraft incidents in the City of Dallas during the period of hazard analysis. This amounts to an average of .80 events per year. Probability of future occurrences is Rare. This is a value of 1 on the HIRA matrix for Aircraft Incident.

Future Population Impact: The criteria for analyzing injuries and deaths as a result of Aircraft Incident is that the injured party in question must have been on the ground at the time of the incident. Deaths and injuries that occur inside the aircraft are not subject to the mitigation efforts of The City of Dallas and are excluded. Based on that definition, future population impact from Aircraft Incident is Major. This is represented as a 4 on the HIRA Matrix for Aircraft Incident.

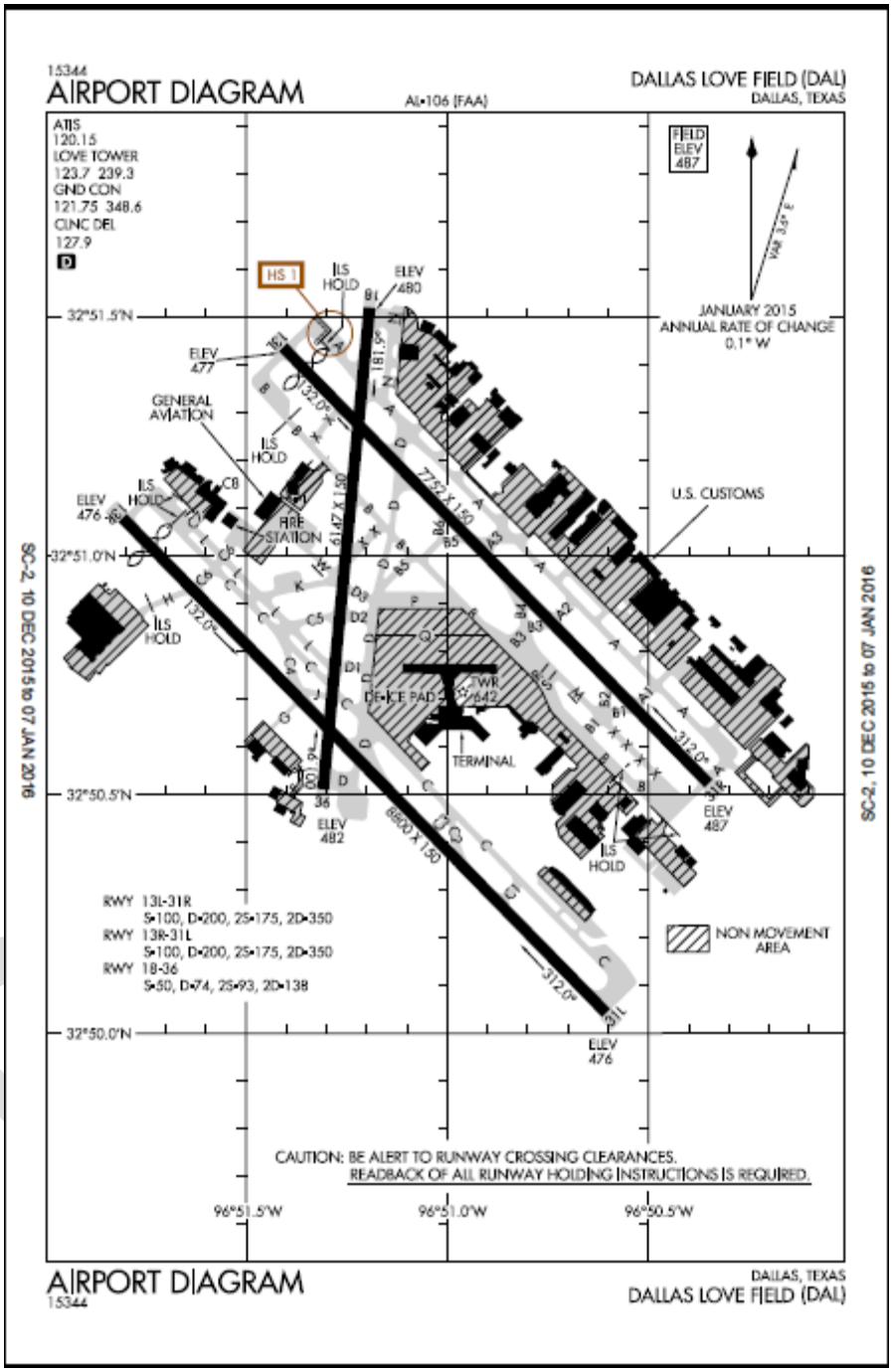
Probability of Future Property Impact: The criteria for analyzing property damage as a result of Aircraft Incident is that the damage in question must have been on the ground at the time of the incident. The resulting damage to the aircraft is excluded from any damage calculations. Based on that definition, there have been no impacts to property from Aircraft Incident. Based on this definition, future property impact from Aircraft Incident is Major. This is represented as a 4 on the HIRA Matrix for Aircraft Incident.

Probability of Future Area of Extent: Previous aircraft incidents have had a limited area of impact. Damage has been largely confined to Dallas Love Field and the immediate surrounding area. Based on this information, the Mitigation Working Group has elected to assign a value of "Concentrated" to area of extent. This is represented by a 1 on the HIRA Matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Aircraft Incident	1	4	4	1	2.5
	Rare	Major	Major	Concentrated	High

Map 1: Dallas Love Field Airport Diagram



Acknowledgements: This section was completed with assistance from various Department of Aviation personnel including, but not limited to: the Emergency Management Coordinator, the Airport Operations Manager, the Airport Security Manager, the Program Manager for Capital Development, among others.

Asset Documentation: The paragraphs below document the assets available to the City of Dallas to respond to this hazard.

Aircraft Rescue and Firefighting (ARFF): Aircraft rescue and firefighting (ARFF) , provided by Dallas Fire-Rescue, is a special category of firefighting that involves the response, hazard mitigation, evacuation and possible rescue of passengers and crew of an aircraft involved in an airport ground emergency. Due to the mass casualty potential of an aviation emergency, the speed with which emergency response equipment and personnel arrive at the scene of the emergency is of paramount importance. Their arrival and initial mission is to increase the survivability of the passengers and crew on board and to secure the aircraft against all hazards. ARFF personnel have advanced training in the application of firefighting foams, dry chemical and clean agents used to extinguish burning aviation fuel in and around an aircraft in order to maintain a path for evacuating passengers to exit the fire hazard area. Further, should fire either be encountered in the cabin or extend there from an external fire, the ARFF responders must work to control/extinguish these fires as well.

The Federal Aviation Administration (FAA) mandates ARFF operations at all U.S. airports that serve scheduled passenger air carriers. These are the only civilian fire protection services that are specifically regulated by any government entity. Airports required to have ARFF services are inspected annually by the FAA for compliance with FAR, Part 139 requirements.

Airport Index: An index is assigned to each FAA Part 139 certificate holder based on a combination of the air carrier aircraft length and the average number of daily departures. If the longest air carrier aircraft at the airport has five or more average daily departures, the matching index is used. If the longest aircraft has less than five average daily departures, the next lower index is used. That index determines the required number of ARFF vehicles and required amount of extinguishing agents.

Airport ARFF Index

Index	Aircraft Length	Vehicle	Extinguishing Agents
A	<90 ft.	1	Either 500 pounds of sodium-based dry chemical, halon 1211, or clean agent; or 450 pounds of potassium-based dry chemical and water with a commensurate quantity of AFFF to total 100 gallons for simultaneous dry chemical and AFFF application
B	90 ft. to <126 ft.	1	500 pounds of sodium-based dry chemical, halon 1211, or clean agent and 1,500 gallons of water and the commensurate quantity of AFFF for foam production
		2	One vehicle carrying the extinguishing agents as specified for Index A; and one vehicle carrying an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by both vehicles is at least 1,500 gallons.
C	126 ft. to <159 ft.	2	One vehicle carrying the extinguishing agents as specified for Index B; and one vehicle carrying water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by both vehicles is at least 3,000 gallons

Index	Aircraft Length	Vehicle	Extinguishing Agents
		3	One vehicle carrying the extinguishing agents as specified for Index A; and two vehicles carrying an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by all three vehicles is at least 3,000 gallons
D	159 ft. to <200 ft.	3	One vehicle carrying the extinguishing agents as specified for Index A; and two vehicles carrying an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by all three vehicles is at least 4,000 gallons
E	200 ft. and Longer	3	One vehicle carrying the extinguishing agents as specified for Index A; and two vehicles carrying an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by all three vehicles is at least 6,000 gallons

Source: FAA, Code of Federal Regulations, Federal Aviation Regulations (FAR) 139.315

Aircraft Lengths

Aircraft Type	Overall Length	Passengers	Carrier	ARFF Index
Boeing 717 - 200	124 ft.	110	Delta Air Lines	B
Boeing 737 – 300	105 ft. 7 in	149	Southwest	B
Boeing 737 – 500	101 ft. 9 in	122	Southwest	B
Boeing 737 - 700	110 ft., 4 in	143	Southwest	B
Boeing 737 – 800	129 ft., 6 in	175	Southwest	C
Airbus 319 - 100	111 ft.	119	Virgin America	B
Airbus 320 - 200	123 ft, 3 in	146 or 149	Virgin America	B

Source: Airbus, Boeing

DFR ARFF Equipment

Designation	Manufacturer	Capabilities/Capacity	Location
Red 01	2011 Rosenbauer Panther	3,000 gals. Of water, 400 gallons 3% foam, 500 lbs. dry chemical, Stinger.	Dallas Love Field
Red 02	1999 Oshkosh TI 3000	3,000 gals. Water, 420 gallons 3% foam, 500 lbs. Halotron, Snozzle	Dallas Love Field

Designation	Manufacturer	Capabilities/Capacity	Location
Red 03	2001 Oshkosh TI 3000	3,000 gals. Water, 420 gallons 3% foam, 500 lbs. dry chemical , Snozzle	Dallas Love Field
Red 42 RESERVE UNIT	1999 Oshkosh TI 3000	3000 gals. Water, 420 gal. 3% foam, 500 lbs. dry chemical, Snozzle	Dallas Love Field
Red 49	1998 Oshkosh TI 3000	3,000 gals. Water, 420 gals. 3% foam, 500 lbs. dry chemical	Dallas Executive Airport

Source: Dallas Fire-Rescue

This page intentionally left blank.

4.3.2 Biological Event

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	Dallas has only experienced one pandemic event during the analysis period.	Based on increased population and tourism growths to the DFW Metroplex, a biological incident can be anticipated to occur at least once within the next ten years.
Effect on Population	Due to HIPPA regulations, no data regarding injuries or deaths in the City of Dallas are available for analysis.	Based on Dallas County Health and Human Services modeling, projected population impact is major. A pandemic flu event can expect to impact 15-35% of the population.
Effect on Property	Due to the nature of biological agents, there is no record of this hazard having an effect on property.	Due to the nature of biological agents, property will never be affected by this hazard.
Area of Extent	Biological event has previously affected only a minor area of the city, less than 25% of the entire city.	Based on previous events, this hazard is projected to have a minor area of extent on the City of Dallas, affecting more than 10% but less than 25%.
Public Perception of Vulnerability	Public comments received included suggestions to increase coordination at all levels of government and with the private sector and increased use of social media in emergencies.	

Vulnerability Narrative: The City of Dallas is an international hotspot for tourism and regularly hosts individuals from all over the world for extended amounts of time. These individuals can bring pathogens from their native counties that residents would not have immunity to. The most vulnerable individuals to biological agents would be those who live and work in areas with frequent interpersonal contact, those with compromised immune systems, the young, the elderly, and individuals who travel frequently. Because of the transient nature of visiting populations, it is impossible to accurately map any areas of increased vulnerability.

There are also 8 police stations, 57 fire stations, 23 hospitals, 52 DART Transit Hubs, and 206 schools at risk of impact from Biological Event.

Hazard Description: Biological hazards, also known as biohazards, refer to biological substances that pose a threat to the health of living organisms, primarily that of humans. This can include medical waste or samples of a microorganism, virus or toxin (from a biological source) that can impact human health. It can also include substances harmful to animals. This term and its associated symbol or generally used as a warning, so that those potentially exposed substances will know to take precautions.

For the purpose of this hazard profile, biological events refer to those events that are accidental or naturally occurring. Intentional transmission of infectious agents is included in the profile of terrorism.

Extent: The Center for Disease Control and Prevention (CDC) determines the severity of pandemics and communicable disease outbreaks based on a measurement system is known as the Pandemic Severity Index. The index focuses less on how likely a disease will spread worldwide-that is, become a pandemic-and more upon how severe the epidemic actually is. The main criterion used to measure pandemic severity will be case-fatality ratio (CFR), the percentage of deaths out of the total reported cases of the disease. Given that Dallas experiences a high number of visitors and tourists (who arrive by car and air) Dallas could expect to experience the entire range of an outbreaks severity.

Table 15: Centers for Disease Control and Prevention Pandemic Severity Index

Category	Case Fatality Ration	Examples
1	Less than 0.1 %	Seasonal flu
2	0.1% to 0.5%	Asian flu and Hong Kong Flu
3	0.5% to 1%	No examples provided
4	1% to 2%	No examples provided
5	2% or higher	Spanish Flu

Source: Center for Disease Control and Prevention

Previous Occurrences: The most common example of pandemic disease outbreak is the Spanish Flu outbreak in 1918. It infected 500 million people across the world, including remote Pacific islands and the Arctic, and killed 50 to 100 million of them—three to five percent of the world's population—making it one of the deadliest natural disasters in human history.

Most influenza outbreaks disproportionately kill juvenile, elderly, or already weakened patients; in contrast the 1918 pandemic predominantly killed previously healthy young adults. Modern research, using virus taken from the bodies of frozen victims, has concluded that the virus kills through a cytokine storm (overreaction of the body's immune system). The strong immune reactions of young adults ravaged the body, whereas the weaker immune systems of children and middle-aged adults resulted in fewer deaths among those groups

The global mortality rate from the 1918/1919 pandemic is not known, but an estimated 10% to 20% of those who were infected died. With about a third of the world population infected, this case-fatality ratio means 3% to 6% of the entire global population died. Influenza may have killed as many as 25 million people in its first 25 weeks. Older estimates say it killed 40–50 million people, while current estimates say 50–100 million people worldwide were killed.

Probability of Future Events: The occurrence of a biological event is largely impossible to predict, due to the unpredictable nature of humans and the speed at which a pathogen can spread and mutate. The Mitigation Working Group has elected to assign a value of Rare to Occurrence. This is represented by a 1 on the HIRA Matrix.

Future Population Impact: The future population impact from Biological Event is major. This is represented as a 4 on the HIRA Matrix. The following charts are based on pandemic influenza modeling by Dallas County Health and Human Services, given the assumption of an 8-week pandemic period. The numbers have been modified to reflect City of Dallas' demographics.

Population: Risk Distribution by Age

Ages	0-19 years	20-64 years	65+ years	Totals	% Total
Non-High Risk	343,682	735,318	77,230	1,156,231	85%
High Risk	23,499	123,698	51,487	198,684	15%
Totals	367,182	859,016	128,717	1,354,915	100%

Source: Dallas County Health and Human Services

Population Impacts - Distribution by Age

Ages		Gross Attack Rate		
		15%	25%	35%
Deaths				
0-19	**Most Likely**	**6**	**10**	**14**
	Minimum	3	5	8
	Maximum	80	132	191
20-64	**Most Likely**	**269**	**448**	**627**
	Minimum	39	64	90
	Maximum	505	841	1,177
65+	**Most Likely**	**211**	**352**	**493**
	Minimum	205	341	477
	Maximum	262	437	611
Total	**Most Likely**	**486**	**809**	**1,134**
	Minimum	247	411	575
	Maximum	846	1,410	1,979

Ages		Gross Attack Rate		
		15%	25%	35%
Hospitalizations				
0-19	**Most Likely**	**103**	**172**	**240**
	Minimum	51	84	118
	Maximum	432	719	1,007
20-64	**Most Likely**	**1,588**	**2,647**	**3,705**
	Minimum	294	489	686
	Maximum	1,734	2,889	4,044
65+	**Most Likely**	**563**	**938**	**1,313**
	Minimum	402	670	938
	Maximum	711	1,185	1,660
Total	**Most Likely**	**2,254**	**3,756**	**5,258**
	Minimum	747	1,244	1,742
	Maximum	2,877	4,794	6,711
Outpatient Visits				
0-19	**Most Likely**	**32,575**	**54,291**	**76,008**
	Minimum	27,214	45,357	63,499
	Maximum	37,936	63,227	88,517
20-64	**Most Likely**	**66,280**	**110,467**	**154,654**
	Minimum	47,589	79,316	111,042
	Maximum	101,166	168,610	236,055
65+	**Most Likely**	**9,991**	**16,653**	**23,314**
	Minimum	9,429	15,714	22,000
	Maximum	15,510	25,850	36,191
Total	**Most Likely**	**108,846**	**181,411**	**253,976**
	Minimum	84,232	140,387	196,541
	Maximum	154,612	257,687	360,763

Source: Dallas County Health and Human Services

Future Property Impact: Due to the nature of this hazard, no property has been previously impacted by Biological Event. Based on this, the estimated property impact for a future Biological Event is “Negligible”. This is represented as a 1 on the HIRA Matrix.

Future Area of Extent: As noted in the population tables, predicted extent is between 15% and 35% of the population. Based on this, the working group has chosen to assign a value of “Minor” for Biological Event area of extent. This is represented by a 2 on the HIRA Matrix.

Conclusion

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Biological Event	1	4	1	2	2.4
	Rare	Major	Negligible	Minor	Moderate Hazard

Acknowledgements: This section was completed with assistance from Emily Gore, Public Health Manager for Dallas County Health and Human Services.

This page intentionally left blank.

4.3.3 Dam and Levee Failure

This section contains information classified as sensitive by the City of Dallas Office of Emergency Management. Specific information directly related to dam and levee failure vulnerabilities is located in **Appendix C – Sensitive Information**, which is not available to the general public. To receive this appendix, contact the Office of Emergency Management.

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	Dam and Levee Failure has never occurred in the City of Dallas.	REDACTED
Effect on Population	Dam and Levee Failure has caused 0 injuries or deaths in the City of Dallas.	REDACTED
Effect on Property	Dam and Levee Failure has caused $0 in property damage in the City of Dallas.	REDACTED
Area of Extent	Dam and Levee Failure has had no area of extent in the City of Dallas.	REDACTED
Public Perception of Vulnerability	Public feedback received argued against the proposed “Trinity Toll Road” that would be built inside the boundaries of the Trinity River Federal Levee System.	

This page intentionally left blank.

4.3.4 Drought

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	Based on the City's definition of drought, there have been 2 drought events within the analysis period.	Based on City predications and current climatological modeling, at least one drought event is anticipated within the next five years.
Effect on Population	Based on local records, there have been no deaths or injuries in the City of Dallas directly caused by drought.	Based on previous occurrences, future injuries or deaths resulting from Drought are not anticipated.
Effect on Property	There is no record of drought having an effect on property within the City of Dallas.	Based on previous occurrences, future injuries or deaths resulting from Drought are not anticipated.
Area of Extent	Previous occurrences of drought have impacted the entire City of Dallas.	Based on previous occurrences and current climatological conditions, drought is anticipated to have a major area of extent, impacting over 50% of the City of Dallas.
Public Perception of Vulnerability	Public comments included ideas on water conservation at city facilities and increasing sources of water for city use.	

Vulnerability Narrative: All areas of the City of Dallas are equally at risk for impact by drought. While there is no data to currently suggest an effect on any population, drought often coincides with Extreme Heat events, which impact elderly, low-income, and transient populations. The hazard does not have an effect on structures or properties.

There are also 8 police stations, 57 fire stations, 23 hospitals, 52 DART Transit Hubs, and 206 schools at risk of impact from Drought.

Hazard Description: Drought can be defined as a water shortage caused by the natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. It can be aggravated by other factors such as high temperatures, high winds, and low relative humidity.

Drought is a normal part of virtually all climatic regions, including areas with high and low average rainfall. Drought is the consequence of anticipated natural precipitation over an extended period of time, usually a season or more in length. Drought is one of the most complex of all natural hazards, as it is difficult to determine a precise beginning or end. In addition, drought can lead to or be exacerbated by our hazards, such as extreme winds or wildfires.

Droughts are classified as meteorological, hydrologic, agricultural and socioeconomic. Each of these classifications can be defined as follows:

- ✓ **Meteorological drought** is defined by a period of sustainability diminished precipitation duration and/or intensity. The commonly used definition of meteorological drought is an interval of time, generally on the order of months or years, during which the actual moisture supply at a given place consistently falls below the climatically appropriate moisture supply.
- ✓ **Agricultural drought** occurs when there is inadequate soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought usually occurs after or during meteorological drought, but before hydrological drought and can affect livestock and other dry land agricultural operations.
- ✓ **Hydrological drought** refers to the deficiencies in surface and subsurface water supplies. It is measured as stream flow, snow pack, and as lake, reservoir, and groundwater levels. There is usually a delay between lack of rain or snow and less measurable water in streams, lakes, and reservoirs. Therefore, hydrological measurement tends to lag behind other drought indicators.
- ✓ **Socio-economic drought** occurs when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product.

For the purposes of this plan, the City of Dallas defines a drought as a period of time in which the City of Dallas Drought Contingency Plan is activated. Traditionally this plan is activated when at least one reservoir's capacity is below 65%. However, the Drought Contingency Plan can be activated for any reason.

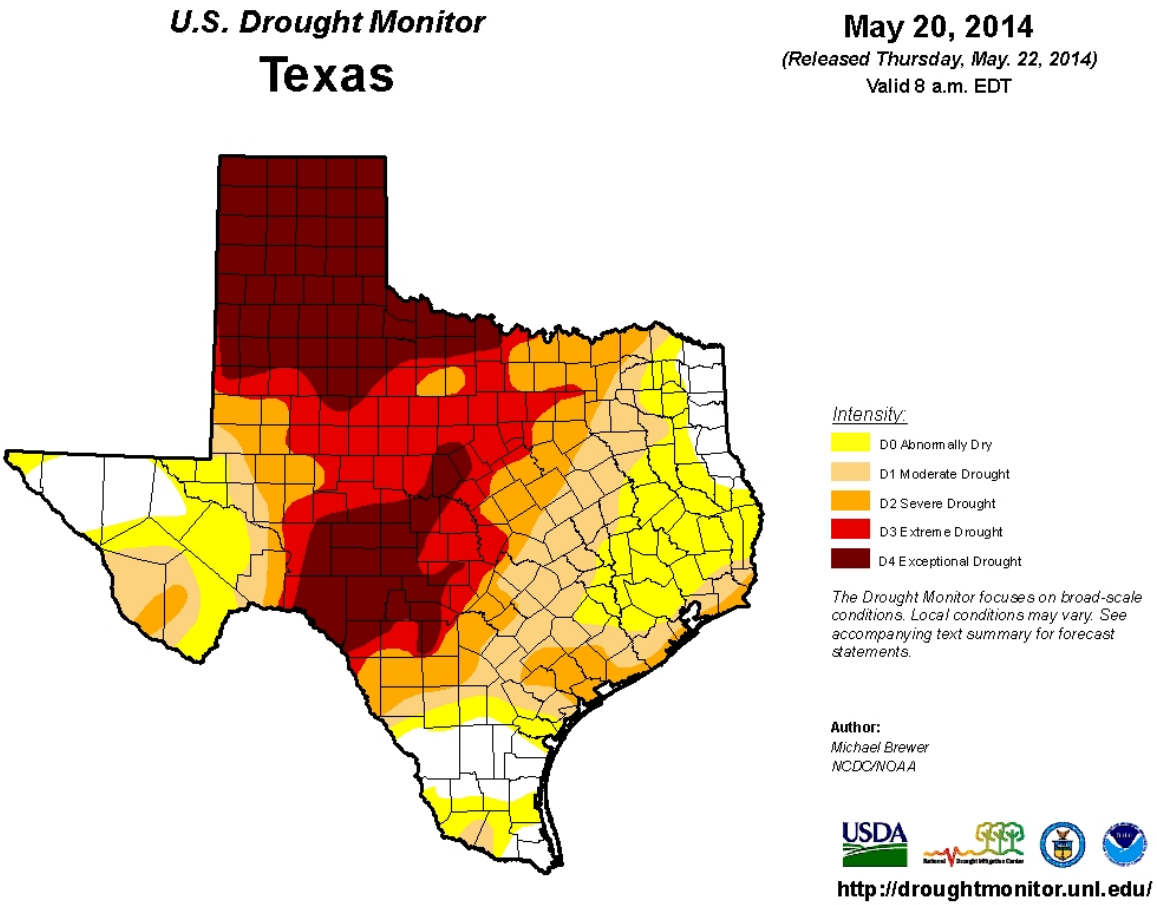
Location and Extent of Hazard: Droughts can affect areas as small as a few counties to entire regions of the country. Droughts are not defined by a specific geographic boundary or location. The entire planning area is subject to the drought hazard. The City could also be severely impacted by droughts on the mainland, as all of their potable water originates from mainland sources.

Drought extent is best tracked through the U.S. Drought Monitor (USDM). The USDM, established in 1999, is a weekly map of drought conditions that is produced jointly by the National Oceanic and Atmospheric Administration, the U.S. Department of Agriculture, and the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln. The U.S. Drought Monitor website is hosted and maintained by the NDMC.

Drought intensity categories are based on five key indicators, numerous supplementary indicators including drought impacts, and local reports from more than 350 expert observers around the country. The accompanying drought severity classification table shows the ranges

for each indicator for each dryness level. Because the ranges of the various indicators often don't coincide, the final drought category tends to be based on what the majority of the indicators show and on local observations. The analysts producing the map also weigh the indices according to how well they perform in various parts of the country and at different times of the year. Additional indicators are often needed in the West, where winter snowfall in the mountains has a strong bearing on water supplies. It is this combination of the best available data, local observations and experts' best judgment that makes the U.S. Drought Monitor more versatile than other drought indicators.

The Drought Monitor summary map identifies general drought areas, labelling droughts by intensity, with D1 being the least intense and D4 being the most intense. D0, drought watch areas, are either drying out and possibly heading for drought, or are recovering from drought but not yet back to normal, suffering long-term impacts such as low reservoir levels.



Source: National Weather Service

Below is the extent of drought on the City of Dallas.

Hazard Type	Extent (based on historical events)		Comments
	Minimum	Maximum	
Drought	D0	D4	The following narrative is from a drought event dated 11/01/2006: Drought conditions continued across North Texas. Although occasional rainfall helped some areas of North Texas improve by the end of October, many areas missed out on the beneficial rains. The U.S. Drought Monitor included more of the North Texas in the Extreme Drought (D3) category by the end of November than in the previous month, but did eliminate the Exceptional Drought (D4) area from North Texas. Areas which did receive rainfall experienced reduced fire danger. Hydrologic deficits remained extremely high, with almost every lake well below conservation levels. The worst included Lake Bridgeport at over seventeen feet below normal, and Lake Grapevine at twelve feet below normal. Stage 1 water restrictions remained in effect in most Metroplex counties. The Drought Impact Reporter reported that hay prices in Texas were approximately twice what they were before the drought began this month. Crops continued to suffer, with the cotton production this year about half of last year's crop. This event caused no deaths, injuries, or property damage.

Source: National Climatic Data Center (NCDC) Storm Event Database

The chart below from the National Oceanic and Atmospheric Administration depicts a typical seasonal drought outlook:

Previous Occurrences: Table 16 depicts historical occurrence of drought in the City of Dallas. According to Dallas Water Utilities, there have been two periods of drought within the city. The magnitude levels of these drought occurrences have not been provided.

Table 16: Drought Occurrences in the City of Dallas (7/1/2005 – 6/30/2015)

Dates	Total Time Period	Recorded Injuries	Recorded Deaths	Recorded Property Damage	Notes
10/10/2006 – 10/05/2007	360 Days	0	0	0	
12/12/2011 – 04/23/2012	135 Days	0	0	0	
Totals	495 Days	0	0	0	

Probability of Future Events: Drought conditions do occur in Dallas. According to the city data in Table 16, there have been 495 days of drought in the City of Dallas. Within the 10-year analysis period, there have been 3,652 days. This is an average of 47 days of drought per year, a rate of .13/year. Based on this amount, the Mitigation Working Group has elected to define future Drought occurrence as Minor. This is a value of 2 on the HIRA Matrix.

Future Property Impact: Damages to property may be contained to vegetation losses. The lack of water and restrictions to watering may cause grass or other vegetation to dry. Facilities may experience foundation shifts due to the dry soil underneath causing doors not to close and cracks in walls. The drying and cracking soil could damage water pumps and cause underground water pipes to burst. Decreasing water levels in lakes could increase the need for additional weed control. Drought can cause cracks in roads increasing the chances for pot holes.

There have been no reports of property damage. Based on this information the Mitigation Working Group has elected to define future Drought property impact as Negligible. This is a value of 1 on the HIRA Matrix.

Future Population Impact: As drought conditions are normally widespread across a significant geographic area, the entire City of Dallas would be affected by drought. The population would be vulnerable to the effects of drought, reduction of available water, wildfires, and structure fires. Impacts of drought to the public may include an increase in anxiety about economic losses cause by the drought and the reduction of recreational activities.

There have been no deaths or injuries directly caused by drought, based on the data in Table 16. Based on this information, the Mitigation Working Group has elected to define future Drought population impact as Negligible. This is a value of 1 on the HIRA Matrix.

Future Area of Extent: Drought affects the entire planning area equally. Based on the nature of this hazard, the Mitigation Working Group has elected to define future Drought area of extent as Pervasive. This is a value of 4 on the HIRA Matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Drought	2	1	1	4	2
	Minor	Negligible	Negligible	Pervasive	Low Hazard

4.3.5 Earthquake

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	There have been 67 earthquake events in the vicinity of The City of Dallas.	Based on previous occurrences and current modeling by Southern Methodist University, an earthquake is expected to occur at least once annually.
Effect on Population	Earthquakes have caused no deaths or injuries within the City of Dallas.	The City of Dallas can anticipate no deaths or injuries from a future earthquake event.
Effect on Property	No damage to property form earthquakes has been reported within the City of Dallas.	The City of Dallas can anticipate minimal to no property damage from a future earthquake event.
Area of Extent	Previous earthquakes have had limited areas of extent, impacting less than 10% of the City.	The City of Dallas can anticipate a limited area of extent for future earthquakes, impacting less than 10% of the City.
Public Perception of Vulnerability	Public comments received discussed mitigation of foundations and building construction materials.	

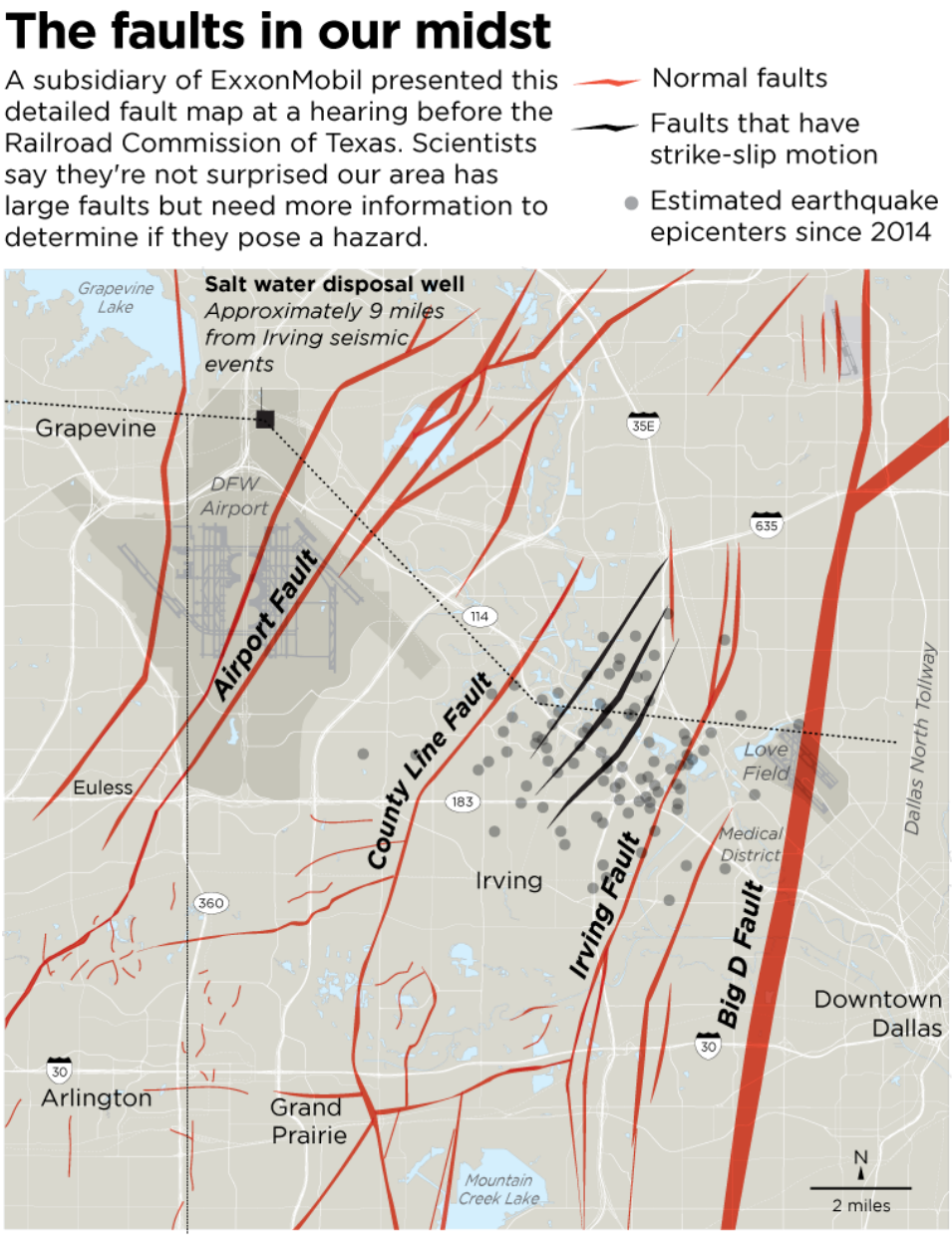
Vulnerability Narrative: Earthquakes affecting the City of Dallas have been limited to the northwestern quadrant of the city. Property and populations in that area of the city would be the most vulnerable to an earthquake event.

There are also 1 police station, 5 fire stations, 9 hospitals, 3 DART stations, and 17 schools in the northwest quadrant of Dallas. These critical facilities would be most at risk for Earthquake damage.

Hazard Description: An earthquake is the perceptible shaking of the surface of the Earth, which can be violent enough to destroy major buildings and kill thousands of people. The severity of the shaking can range from barely felt to violent enough to toss people around. Earthquakes have destroyed whole cities. They result from the sudden release of energy in the Earth's crust that creates seismic waves. The seismicity, seismism or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time.

Location of Hazard: Earthquake epicenters are concentrated in the northwestern corner of the City. To illustrate earthquake location, Map 2 below shows the location of fault lines in relation to the City of Dallas and the epicenter of several earthquakes.

Map 2: Fault Lines and Earthquake Epicenters near Dallas



Source: ExxonMobil, Texas Railroad Commission, Dallas Morning News

Extent of Hazard: Earthquakes are measured using observations from seismometers. The moment magnitude is the most common scale on which earthquakes larger than approximately 5 are reported for the entire globe. The more numerous earthquakes smaller than magnitude 5 reported by national seismological observatories are measured mostly on the local magnitude scale, also referred to as the Richter magnitude scale (Table 17). These two scales are numerically similar over their range of validity. Magnitude 3 or lower earthquakes are mostly almost imperceptible or weak and magnitude 7 and over potentially cause serious damage over larger areas, depending on their depth. The largest earthquakes in historic times have been of magnitude slightly over 9, although there is no limit to the possible magnitude. The most recent large earthquake of magnitude 9.0 or larger was a 9.0 magnitude earthquake in Japan in 2011 (as of March 2014), and it was the largest Japanese earthquake since records began. Intensity of shaking is measured on the modified Mercalli scale. The shallower an earthquake, the more damage to structures it causes, all else being equal.

Table 17 – Richter Magnitude Scale

Magnitude	Description	Mercalli intensity	Average earthquake effects	Average frequency of occurrence (estimated)
Less than 2.0	Micro	I	Microearthquakes, not felt, or felt rarely by sensitive people. Recorded by seismographs.	Continual/several million per year
2.0–2.9	Minor	I to II	Felt slightly by some people. No damage to buildings.	Over one million per year
3.0–3.9		II to IV	Often felt by people, but very rarely causes damage. Shaking of indoor objects can be noticeable.	10,000 to 15,000 per year
4.0–4.9	Light	IV to VI	Noticeable shaking of indoor objects and rattling noises. Felt by most people in the affected area. Slightly felt outside. Generally causes none to minimal damage. Moderate to significant damage very unlikely. Some objects may fall off shelves or be knocked over.	1,000 to 1,500 per year
5.0–5.9	Moderate	VI to VIII	Can cause damage of varying severity to poorly constructed buildings. At most, none to slight damage to all other buildings. Felt by everyone.	100 to 150 per year
6.0–6.9	Strong	VII to X	Damage to a moderate number of well-built structures in populated areas. Earthquake-resistant structures survive with slight to moderate damage. Poorly designed structures receive moderate to severe damage. Felt in wider areas; up to hundreds of miles/kilometers from the epicenter. Strong to violent shaking in epicentral area.	10 to 20 per year
7.0–7.9	Major	VIII or greater	Causes damage to most buildings, some to partially or completely	10 to 20 per year

Magnitude	Description	Mercalli intensity	Average earthquake effects	Average frequency of occurrence (estimated)
			collapse or receive severe damage. Well-designed structures are likely to receive damage. Felt across great distances with major damage mostly limited to 250 km from epicenter.	
8.0–8.9	Great		Major damage to buildings, structures likely to be destroyed. Will cause moderate to heavy damage to sturdy or earthquake-resistant buildings. Damaging in large areas. Felt in extremely large regions.	One per year
9.0 and greater			Near or at total destruction - severe damage or collapse to all buildings. Heavy damage and shaking extends to distant locations. Permanent changes in ground topography.	One per 10 to 50 years

Source: U.S. Geological Survey

Below is a chart detailing the extent of earthquakes in the City of Dallas.

Hazard Type	Extent (based on historical events)		Comments
	Minimum	Maximum	
Earthquake	1.6	3.6	A magnitude 2.4 earthquake struck Irving, Texas on April 17, 2014. Irving borders Dallas to the Northwest. No injuries, deaths, or property damage were recorded from this event. It can be assumed that future earthquakes will be similar in nature.

Previous Occurrences: 67 earthquakes have occurred either within the City of Dallas or in jurisdictions that directly border the City to the northwest. These earthquakes still have the potential to affect the City of Dallas, primarily through property damage. Table 18, below, describes each of those events. No damage, injuries, or deaths were recorded during any earthquake event.

Table 18 – Earthquake Events (7/1/2005 – 6/30/2015)

Date	Epicenter	Depth (km)	Magnitude
11/1/2008	Northern Texas*	5	2.7
8/1/2011	Northern Texas*	5	2.2
1/6/2012	Northern Texas*	5	2.1

Date	Epicenter	Depth (km)	Magnitude
9/30/2012	Northern Texas*	5	3.1
10/1/2012	Northern Texas*	5	2.3
4/17/2014	Irving, Texas	5	2.4
7/20/2014	University Park, Texas	3.23	2.2
9/11/2014	Irving, Texas	5	2.8
10/28/2014	Irving, Texas	5	2.4
11/10/2014	Irving, Texas	5	2.3
11/15/2014	Irving, Texas	5	2.6
11/23/2014	Irving, Texas	3.96	3.3
11/23/2014	Irving, Texas	8.01	2.5
11/24/2014	Irving, Texas	5	2.4
11/25/2014	Irving, Texas	5	2.2
11/25/2014	Irving, Texas	2.58	2.7
12/2/2014	Irving, Texas	5	2.7
12/10/2014	Irving, Texas	5	2.0
12/12/2014	Irving, Texas	3.02	2.7
12/15/2014	Irving, Texas	4.16	2.7
12/17/2014	Irving, Texas	5	2.6
12/19/2014	Irving, Texas	8.13	2.4
12/20/2014	Irving, Texas	3.18	2.4
12/30/2014	Irving, Texas	3.09	2.7
1/2/2015	Irving, Texas	2.25	2.4
1/6/2015	Irving, Texas	5	2.3
1/6/2015	Irving, Texas	5.93	3.5
1/7/2015	Irving, Texas	5	3.6
1/7/2015	Irving, Texas	8.24	2.9
1/7/2015	Irving, Texas	5	2.7
1/7/2015	Irving, Texas	5	1.7
1/7/2015	Irving, Texas	5	2.4
1/7/2015	Irving, Texas	5	1.6
1/7/2015	Irving, Texas	5	3.1
1/7/2015	Irving, Texas	4.27	2.3
1/7/2015	Irving, Texas	5	2.7

Date	Epicenter	Depth (km)	Magnitude
1/7/2015	Irving, Texas	7.24	2.7
1/8/2015	Irving, Texas	5	2.1
1/8/2015	Irving, Texas	5	2.3
1/9/2015	Irving, Texas	5.03	2.4
1/12/2015	Irving, Texas	5	2.4
1/14/2015	Irving, Texas	5	1.9
1/18/2015	Irving, Texas	5	2.2
1/20/2015	Irving, Texas	9.83	2.3
1/20/2015	Irving, Texas	8.77	2.6
1/20/2015	Irving, Texas	9.04	3.0
1/20/2015	Irving, Texas	10.4	2.4
1/20/2015	Irving, Texas	8.32	2.5
1/23/2015	Farmers Branch, Texas	8.74	2.2
2/27/2015	Irving, Texas	7.93	3.1
3/8/2015	Irving, Texas	5	2.2
3/12/2015	Farmers Branch, Texas	8.17	2.4
3/12/2015	Farmers Branch, Texas	5	2.0
3/14/2015	Irving, Texas	5	2.7
4/2/2015	Irving, Texas	5	2.7
4/2/2015	Irving, Texas	7.67	3.3
4/3/2015	Irving, Texas	5	2.5
4/3/2015	Irving, Texas	5.74	2.3
4/3/2015	Farmers Branch, Texas	5	2.2
5/3/2015	Irving, Texas	5	3.2
5/3/2015	Irving, Texas	5	2.5
5/4/2015	University Park, Texas	5	2.1
5/4/2015	University Park, Texas	5	2.7
5/9/2015	Irving, Texas	5	2.7
5/18/2015	Irving, Texas	5	3.3
6/13/2015	Farmers Branch, Texas	5	2.3

Source: USGS
** - Location not specified by data source.*

Probability of Future Events: According to USGS, there have been 67 earthquakes impacting the City of Dallas during the period of hazard analysis. This is an average of 6.7 events per

year. Based on this information, the Mitigation Working Group has elected to assign a value of "Chronic" to Occurrence. This is a value of 4 on the HIRA Matrix.

Future Property Impact: The most obvious effects would be damage to foundations and walls. Minor earthquakes can damage floor tiles and may shift foundations. The magnitude currently experienced in the City of Dallas has not caused significant damages to Property, Facilities, and Infrastructure. Based on the lack of damage from earthquakes, the Mitigation Working Group has elected to assign a value of Negligible, no damage to properties associated with this hazard. This is a value of 1 on the HIRA Matrix.

Future Population Impact: Earthquakes have only been recently recorded in Dallas County, to date there have been no injuries or fatalities or major damage recorded. The magnitudes experienced in the City of Dallas are considered minor only felt by humans and do not cause damage. Additionally there is currently not a significant amount of data for earthquakes in the City of Dallas and will need to be researched and studied. No data to support the change of building codes and engineering standards for high magnitude levels can affect buildings, transportation routes, and pipelines. Based on the lack of injuries and deaths from earthquake, the Mitigation Working Group has elected to assign a value of Negligible, no impact on population. This is a value of 1 on the HIRA matrix.

Future Area of Extent: Based on previous events, earthquake events in the City of Dallas would have a limited area of extent. While shaking can be felt throughout the city, any damage would be confined to an area not to exceed one-tenth of one mile of the epicenter. Based on the minimal area of extent from earthquake, the Mitigation Working Group has elected to assign a value of Concentrated, 10% or less of the city affected. This is a value of 1 on the HIRA matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Earthquake	4	1	1	1	2.2
	Chronic	Negligible	Negligible	Concentrated	Moderate Hazard

This page intentionally left blank.

4.3.6 Extreme Heat

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	Per the National Climatic Data Center, there have been 43 extreme heat events affecting the City of Dallas during the hazard analysis period.	Based on previous occurrences and current climatological conditions, extreme hear is expected to occur at least once in the next year.
Effect on Population	Per the National Climatic Data Center, there have been 130 injuries and 6 deaths directly caused by Extreme Heat events during the hazard analysis period.	Based on previous occurrences, the next Extreme Heat event can be expected to cause 16 injuries and less than 1 death.
Effect on Property	Per the National Climatic Data Center, there have been no property impacts from Extreme Heat during the hazard analysis period.	Based on previous occurrences, no property impacts are anticipated from Extreme Heat events.
Area of Extent	Previous Extreme Heat events have affected the entire planning equally.	Extreme Heat has a pervasive area of extent, affecting 100% of the planning area equally.
Public Perception of Vulnerability	Public comments received included distributing information about electricity conservations, partnering with ERCOT, and incentivizing working from home.	

Vulnerability Narrative: The City of Dallas has a hot and humid climate. Summers are hot, with temperatures approaching those of desert and semi-desert locations of similar latitude. Heat waves can be severe to vulnerable populations, including the elderly, transients, and those in homes without adequate cooling capabilities.

There are also 8 police stations, 57 fire stations, 23 hospitals, 52 DART Transit Hubs, and 206 schools at risk of impact from Extreme Heat.

Hazard Description: Extreme Heat events, also called “heat waves”, are prolonged periods of excessively hot weather, which may be accompanied by high humidity, especially in oceanic climate countries. The term is applied both to routine weather variations and to extraordinary spells of heat which may occur only once a century. Severe heat waves have caused catastrophic crop failures, thousands of deaths from hyperthermia, and widespread power outages due to increased use of air conditioning.

An Extreme Heat event is defined by the City of Dallas as a period of time of at least 48 hours where the officially-recorded daytime high temperature meets or exceeds 100°F.

Location and Extent of Hazard: Due to the nature of this hazard, all properties and populations of the City of Dallas are at equal risk for impacts from Extreme Heat.

The chart below details the effects of Extreme Heat based on the heat index.

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Source: NOAA

The city's all-time recorded high temperature is 113 °F (45 °C) during the Heat Wave of 1980, while the all-time recorded low is −8 °F (−22 °C) in 1980 and 1899 respectively. The average daily low in Dallas is 57.1 °F (13.9 °C) and the average daily high in Dallas is 76.7 °F (24.8 °C). The chart below documents the historic extent of Extreme Heat in the City of Dallas.

Hazard Type	Extent (based on historical events)		Comments
	Minimum	Maximum	
Extreme Heat	2 days	40 days	An extreme heat event occurred in the City of Dallas starting on June 15, 2008 and ending the next day. No injuries, deaths, or property damage were recorded during this event.

It can be anticipated that future Extreme Heat events will fall along that spectrum.

Previous Occurrences: Per the National Weather Service, there have been 43 extreme heat events affecting the City of Dallas during the hazard analysis period. Information on injuries and deaths was collected from the National Climatic Data Center. Table 19 details the event dates, length of time the event occurred, and any injuries or deaths associated with that event.

Table 19 – Previous Occurrences of Extreme Heat (7/1/2005 – 6/30-2015)

Event Date	Duration of Event	Injuries	Deaths	Event Notes
08/02/2005 – 08/03/2005	2 Days	0	0	
08/22/2005 – 08/27/2005	6 Days	0	0	
08/31/2005 – 09/01/2005	2 Days	0	0	
07/12/2005 – 07/21/2005	11 Days	0	0	
07/30/2006 – 08/06/2006	9 Days	0	0	
08/08/2006 – 08/26/2006	26 Days	0	0	
08/11/2007 – 08/15/2007	5 Days	0	1	
06/15/2008 – 06/16/2008	2 Days	0	0	
06/27/2008 – 06/28/2008	2 days	0	0	
07/18/2008 – 07/23/2008	6 days	0	2	
07/26/2015 – 08/05/2008	12 Days	0	1	
08/09/2008 – 08/10/2008	2 Days	0	0	
06/23/2009 – 06/25/2009	3 Days	0	0	
06/27/2009 – 06/28/2009	2 Days	0	0	
07/02/2009 – 07/04/2009	3 Days	0	0	

Event Date	Duration of Event	Injuries	Deaths	Event Notes
07/08/2009 – 07/16/2009	16 Days	0	0	
07/25/2009 – 07/26/2009	2 Days	0	0	
06/22/2010 – 06/23/2010	2 Days	0	0	
07/31/2010 – 08/17/2010	18 Days	0	0	
08/19/2010 – 08/23/2010	5 Days	0	0	
06/13/2011 – 06/19/2011	7 Days	0	0	
07/02/2011 – 08/10/2011	40 Days	130	1	
08/15/2011 – 03/03/2011	20 Days	0	0	
09/12/2011 – 09/13/2011	2 Days	0	0	
06/24/2012 – 06/28/2012	5 Days	0	0	
07/19/2012 – 07/22/2012	4 Days	0	1	
07/25/2012 – 07/26/2012	2 Days	0	0	
07/28/2012 – 08/07/2012	11 Days	0	0	
08/12/2012 – 08/14/2012	3 Days	0	0	
09/02/2012 – 09/07/2012	6 Days	0	0	
06/27/2013 – 06/28/2013	2 Days	0	0	
07/09/2013 – 07/13/2013	5 Days	0	0	
07/31/2013 – 08/09/2013	10 Days	0	0	
08/11/2013 – 08/12/2013	2 Days	0	0	
08/23/2013 – 08/24/2013	2 Days	0	0	
08/29/2013 – 09/01/2013	4 Days	0	0	
09/04/2013 – 09/06/2013	3 Days	0	0	
07/13/2014 – 07/14/2014	2 Days	0	0	
07/25/2014 – 07/27/2014	3 Days	0	0	
08/06/2014 – 08/10/2014	5 Days	0	0	
08/15/2014 – 08/16/2014	2 Days	0	0	

Event Date	Duration of Event	Injuries	Deaths	Event Notes
07/26/2015 – 07/27/2015	2 Days	0	0	
07/29/2015 – 07/30/2015	2 Days	0	0	
Totals	43 Events	130 Injuries	6 Deaths	

Source: National Weather Service, National Climatic Data Center

Probability of Future Events: Based on its climate, it can be projected that City of Dallas will continue to experience Extreme Heat events.

There have been 43 extreme heat events affecting the City of Dallas during the hazard analysis period. Over the 10-year analysis period, this averages to 4.3 events per year. Based on this average, the Mitigation Working Group has elected to assign a value of Chronic to Extreme Heat. This is a value of 4 in the HIRA Matrix.

Future Population Impact: Prolonged exposure to excessive heat potentially leads to severe health problems, including heat exhaustion and heat stroke. The stress of extreme heat can make chronic health conditions worse, including asthma and heart disease. Children and the elderly are more susceptible to extreme heat. Though injuries or deaths from extreme heat have been recorded at different locations throughout the city, there is no specific geographic scope to the extreme heat hazard. Extreme heat could occur at any area of the city.

There have been 130 injuries and 6 deaths directly related to Extreme Heat in the City of Dallas. Over the 10-year analysis period, this amounts to 13 injuries and .6 deaths per event. Based on this information, the Mitigation Working Group has elected to assign a value of Minor. This is a value of 2 on the HIRA Matrix.

Future Property Impact: Property, Facilities, and Infrastructure should experience few impacts from extreme heat events. Extended heat events may cause streets to incur damage, which may get progressively worse as the event persists. One potentially impacted sector would be energy, as increased energy demand for cooling may put a greater demand on the state's energy grid. Increased demand could cause parts of the grid to fail could cause ERCOT to implement "Brown Outs" in order to avoid a full outage of the electrical grid. Prolonged heat events coupled with drought conditions could be detrimental to water assets, as residents and critical infrastructure compete for dwindling water resources.

According to NCDC reports, Extreme Heat has caused no property or crop damage in Dallas. Based on this information, the Mitigation Working Group has elected to assign a value of Inconsequential. This is a value of 1 on the HIRA Matrix.

Future Area of Extent: In all previous Extreme Heat events, the event has affected the entire City of Dallas. Based on this information, the Mitigation Working Group has elected to assign a value of Pervasive. This is a value of 4 on the HIRA Matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Extreme Heat	4	2	1	4	2.8
	Chronic	Minor	Negligible	Pervasive	High Hazard

Acknowledgements: This section was completed with assistance from Mark Fox, Warning Coordination Meteorologist for the National Weather Service, Fort Worth Office

4.3.7 Flooding

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	According to the National Climatic Data Center, there have been 19 flood events during the hazard analysis period.	Based on previous occurrences, it can be anticipated that there will be 1.9 flood events within the city limits per year.
Effect on Population	There has been 1 death and no injuries recorded as a result of Flooding within the City of Dallas.	The City of Dallas can anticipate 0.048 deaths and no injuries in the next flood event.
Effect on Property	Flood events within the City have caused $37,290,000.00 in property damage during the period of analysis.	The City of Dallas can anticipate $1,775,714.29 in property damage during the next flood event.
Area of Extent	Previous flood events have affected up to 25% of the City.	Future flood events in the City of Dallas can be anticipated to affect between 10% and 25% of the City.
Public Perception of Vulnerability	Public comments received requested more green space, sandbag availability, and increasing debris removal from rivers to facilitate drainage.	

Vulnerability Narrative: There are 35,445 parcels of property within the 100-year and 500-year floodplains. The combined total value of these properties is $15,087,499,940. This represents 10% of property in the city.

In addition to these parcels, there are also 1 police stations, 6 fire stations, 0 hospitals, and 13 schools within the 500-year floodplain. These properties would be most vulnerable during a flooding event.

Hazard Description: A flood is an overflow of water that submerges land which is usually dry. Flooding may occur as an overflow of water from water bodies, such as a river or lake, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground. Flooding is the most common and widespread weather hazard.

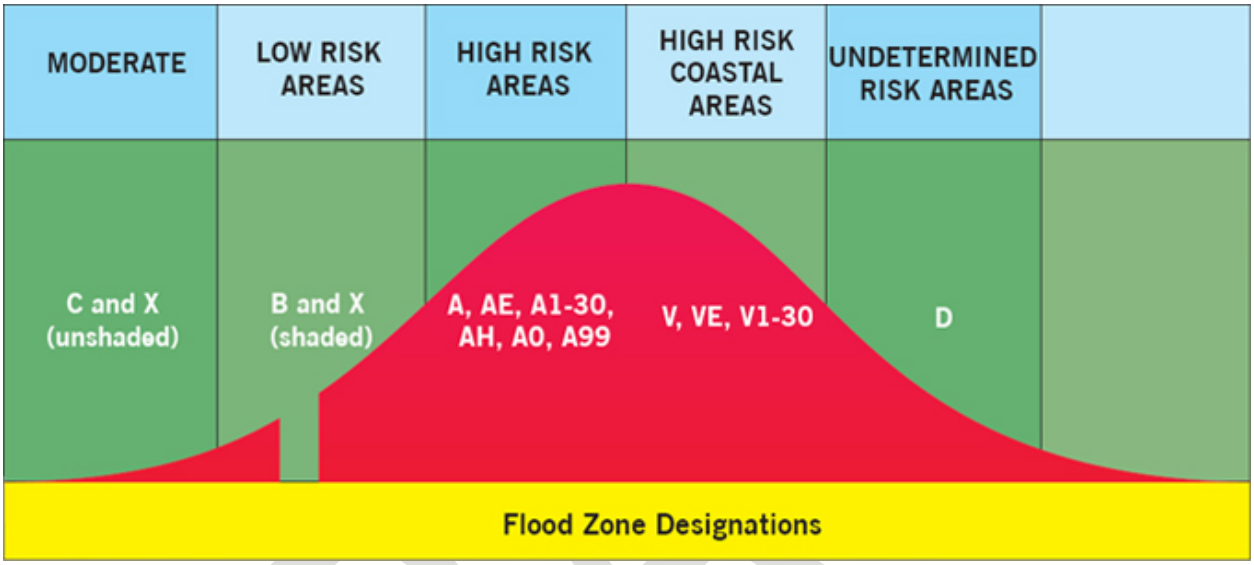
There are three common types of flooding in Dallas: riverine flooding, flash flooding, and urban flooding.

- Riverine Flooding occurs from excessive rainfall in upstream areas that forces rivers and streams to rise and overflow their banks, inundating the adjust floodplains. Riverine flooding is usually a gradual process, with several hours to several days of warning time for downstream communities. This type of event usually remains in flood for a longer period that flash flood or urban flooding and often causes more damage due to the length of time structures are inundated, the velocity and depth of water, and floating debris.
- Flash Flooding is associates with large convective thunderstorms and frequent the region that can drop between 1 and 5 inches of rain in the span of an hour. When the soil is already saturated, rainfall from such storms can converge in creeks and streams suddenly, with little warning. Flash floods can reach peak flows within a few minutes. Waters from flash floods move with great force and velocity and can tear out trees, carry away houses and outbuildings, and destroy roads and bridges. These walls of water often carry large amounts of debris, sewage and pollutants. Although potentially hazardous to life and destructive of property, flash flooding usually lasts only a matter of hours.
- Urban Flooding is the inundation of land or property in a built environment, particularly in more densely populated areas, caused by rainfall overwhelming the capacity of drainage systems, such as storm sewers. Although sometimes triggered by events such as flash flooding or snowmelt, urban flooding is a condition, characterized by its repetitive and systemic impacts on communities, which can happen regardless of whether or not affected communities are located within designated floodplains or near any body of water. Aside from potential overflow of rivers and lakes, snowmelt, stormwater or water released from damaged water mains may accumulate on property and in public rights-of-way, seep through building walls and floors, or backup into buildings through sewer pipes, toilets and sinks.

Extent of Hazard: The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to estimate the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1% chance of being equaled or exceeded in any given year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. Water surface elevations are determined along a stream using discharges from a given frequency to determine the floodplain extents for that storm event. The water surface elevations and resulting floodplain is one of the most important factors used in determining flood risk.

FEMA has established flood zones based on the frequency analysis that represent the floodplain extent for certain storm events. The zones are displayed on the county-wide Flood Insurance Rate Maps (FIRM). The Special Flood Hazard Area (SFHA) is the area that will be

inundated by the flood event having a 1-percent chance of being exceeded in a given year. It is also referred to as the base flood of 100-year flood and is the basis of the National Flood Insurance Program (NFIP) regulations and flood insurance requirements. In the City of Dallas the SFHAs are labeled as Zone A or Zone AE of the FIRMs. Moderate flood hazard areas labeled Zone X (Shaded) are also shown on the FIRM, and are the areas between the limits of the base flood and the 0.2-percent-annual chance (500-year) flood. The areas of minimal flood hazard, which are the areas outside of the 500-year floodplain, are labeled as Zone X (Unshaded). The following chart shows the flood zone designations in relation to the level of risk.



Source: Federal Emergency Management Agency

The potential for flooding can change and increase through various land use changes and changes to land surface. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining watersheds or natural drainage channels. These changes are commonly created by human activities (e.g., development). These changes can also be created by other events such as wildfires. Wildfires create hydrophobic soils, a hardening or “glazing” of the earth’s surface that prevents rainfall from being absorbed into the ground, thereby increasing runoff, erosion, and downstream sedimentation of channels.
Potential flood impacts include loss of life, injuries, and property damage. Floods can also affect infrastructure (water, gas, sewer, and power utilities), transportation, jobs, tourism, the environment, and ultimately local and regional economies.

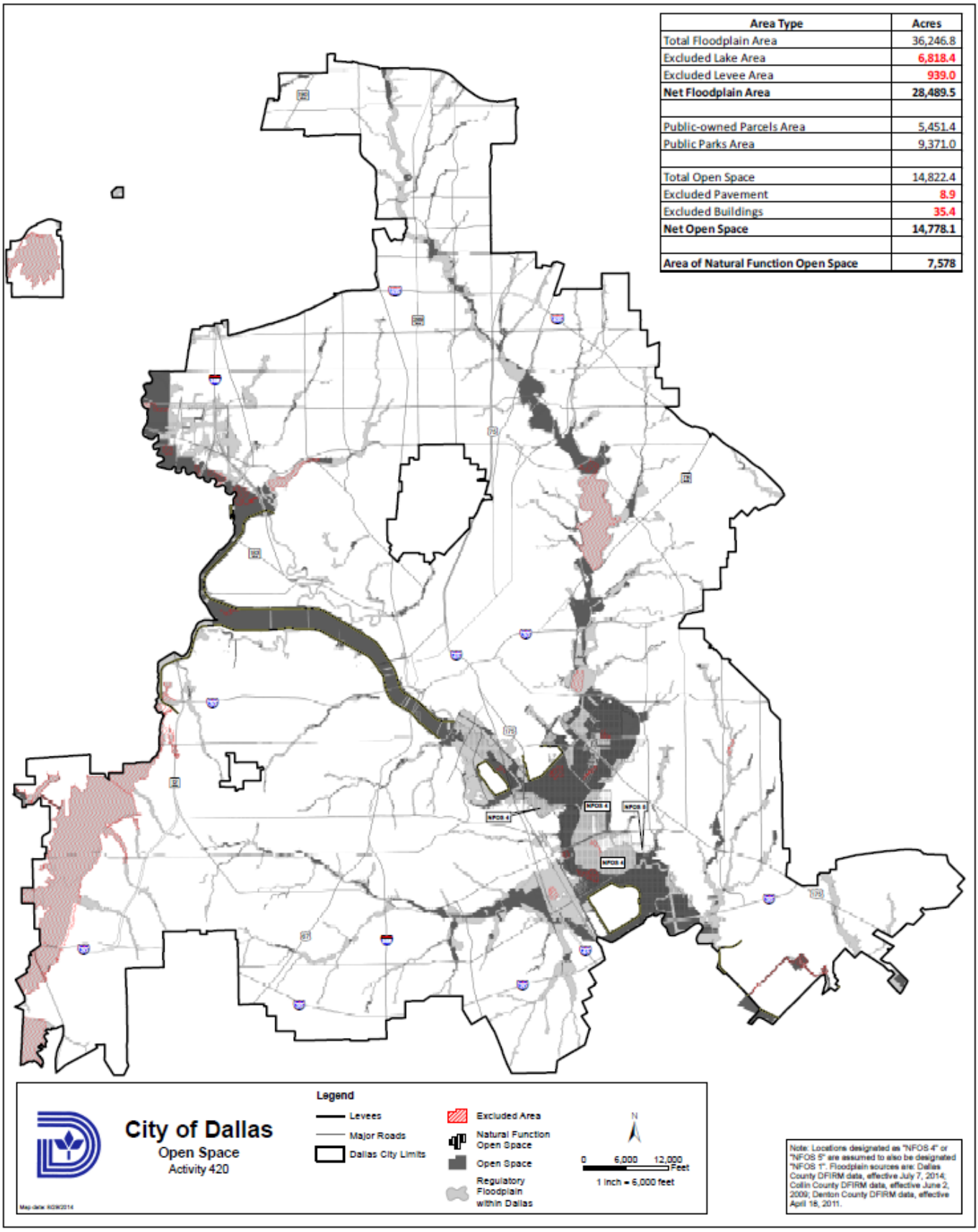
Flooding is one of the most common natural hazards in Dallas. Historically, Dallas has had regular occurrences of flash flooding. Most flood-producing storms are experienced in the spring and fall. The typical larger floods result from prolonged or successive storms that produce heavy rainfall, however, severe flooding can occur as a result of intense thunderstorms at any time. Historically, the 1908 flood on the Trinity River was one of the worst, but record floods occurred on White Rock Creek in 1964 and Bachman Creek in 1966. Damaging floods occurred on the Trinity in 1989, 1990, and 1991, and deadly flash flooding occurred in 1995. The most recent widespread flooding was March 19, 2006, predominately in the interior drainage areas behind the levees. Significant flooding also occurred on June 11, 2009.

The chart below documents the historical extent of flooding in the City of Dallas.

Hazard Type	Extent (based on historical events)		Comments
	Minimum	Maximum	
Flooding	0ft.	5ft.	Hall Street by Baylor Hospital in Dallas was flooded due to flash flooding. One fire truck and several vehicles parked on the street stalled in this area. Water also inundated the hospital parking garage where about 20 vehicles were damaged by the rising waters. Rainfall totals as high as 2-2.25 in 30 minutes were measured during the heavy rain event. It can be anticipated that future flood events will be similar in nature.

Location of Hazard:
Watershed Description - The City of Dallas is located entirely within the Trinity River Watershed which runs from the border of Texas and Oklahoma to the Gulf of Mexico. The West Fork and East Fork of the Trinity River merge as they enter Dallas to form the Trinity River which has an upstream drainage area of over 6,050 square miles. The River is contained within the Dallas Floodway System through the heart of Dallas. The system includes a combined 22.6 miles of levees on the East and West side of the River and provides flood protection for the Stemmons Corridor, Downtown Dallas, the Central Business District, and a large portion of West Dallas. The system protects over 200,000 people that live or work behind the levees and over $13.7 billion in property.

The Trinity River has two major tributaries through the City of Dallas. White Rock Creek, with a drainage area of 139 square miles, flows from through east Dallas and joins the Trinity River directly south of downtown. Fivemile Creek, with a drainage are of 55 square miles, flows through south Dallas and joins the Trinity River near the southern city limits. Additionally, White Rock Creek and Fivemile Creek contain a number of smaller tributaries. In total, the City of Dallas contains over 550 stream miles.


Area Type | Acres
Total Floodplain Area | 36,246.8
Excluded Lake Area | 6,818.4
Excluded Levee Area | 939.0
Net Floodplain Area | 28,489.5
Public-owned Parcels Area | 5,451.4
Public Parks Area | 9,371.0
Total Open Space | 14,822.4
Excluded Pavement | 8.9
Excluded Buildings | 35.4
Net Open Space | 14,778.1
Area of Natural Function Open Space | 7,578
City of Dallas
Open Space
Activity 420
Legend
Levees
Major Roads
Dallas City Limits
Excluded Area
Natural Function Open Space
Open Space
Regulatory Floodplain within Dallas
N
0 6,000 12,000 Feet
1 inch = 6,000 feet
Note: Locations designated as "NFOS 4" or "NFOS 5" are assumed to also be designated "NFOS 1". Floodplain sources are: Dallas County DFIRM data, effective July 7, 2014; Collin County DFIRM data, effective June 2, 2009; Denton County DFIRM data, effective April 18, 2011.

Runoff is captured to fill several lakes and reservoirs within the City. The lakes are designed to manage floodwaters with the overall goal of reducing downstream flooding. Mountain Creek Lake, White Rock Lake, Lake Joe Pool, and Bachman Lake are located partially or entirely within the City limits. Additionally, there are several large flood control lakes within the Trinity River System which control floodwaters entering the Dallas Floodway System.

The floodplain boundary extents for most of the streams in the City of Dallas have been mapped by FEMA during its Map Modernization Program. The resulting FIRMs provide an official depiction of flood hazard risks and risk premium zones for each community and for properties located within it. While the FEMA digital flood data is recognized as best available data for planning purposes, it does not always reflect the most accurate and up-to-date flood risk. Riverine flooding, stormwater flooding, and flood-related losses often do occur outside of delineated Special Flood Hazard Areas (SFHA). The City of Dallas has continued to fund studies to identify and quantify these flooding risks. The results of these studies provide the City of Dallas with more accurate flood risk data than what is shown on the DFIRM. The new information has been incorporated into a regulatory floodplain file which the City uses to regulate development.

In addition to the riverine flooding, the City of Dallas also experiences localized flooding caused by urbanization, which may increase the run-off potential of an area. The interior of the City is drained by a large network of stormsewer which includes over 1,800 miles of storm drainage pipes, 11,000 outfalls, 65,000 inlets, and 180 ponds. Many of the more severe localized flooding areas have been studied in detail and have been included in the City's regulatory floodplain. Table 20 contains a list of the drainage basins that lie partially or entirely within the City of Dallas. It also shows the area located in the floodplain for both the FEMA SFHA and City Regulatory 100-Year floodplain.

Table 20: City of Dallas Drainage Basins

Stream	Drainage Area (mi^2)	FEMA SFHA (Acres)	City Regulatory Floodplain (Acres)
Adams Branch	0.5	19	19
Alta Mesa Branch	1.1	105	107
Arapaho Branch	1.4	51	68
Ash Creek	6.7	253	314
Bachman Branch	13.0	756	789
Buffalo Creek	2.0	33	42
Caruth Creek	2.6	172	194
Cedar Creek	9.8	339	381
Cedar Springs Branch	3.0	58	55
Chalk Hill Branch	2.1	118	106
Coombs Creek	6.0	141	168
Cottonwood Creek (of White Rock Creek)	8.5	123	141
Crow Creek	2.7	32	33
Dixon Branch	7.2	295	350

Stream	Drainage Area (mi^2)	FEMA SFHA (Acres)	City Regulatory Floodplain (Acres)
Elam Branch	4.5	220	302
Fivemile Creek	26.5	4,284	4,721
Floyd Branch (of White Rock Creek)	4.5	77	104
Forney Branch	2.2	80	68
Hall Branch	2.1	29	89
Harden Branch	0.3	4	4
Hickory Creek	12.6	344	388
Highland Hills Branch	0.4	15	15
Honey Springs Branch	2.5	138	246
Jackson Branch	8.4	274	322
Jenkins Branch	1.8	62	68
Joes Creek	11.3	618	984
Keller Springs Branch	1.0	33	31
Kiowa Branch	2.2	41	94
Knights Branch	5.1	93	226
Ledbetter Branch	2.6	40	41
Lisbon Branch	1.3	35	39
Long Branch of Duck Creek	3.4	92	110
McCommas Branch	1.2	44	56
McKamy Branch	6.9	209	248
Mill Creek	6.1	0	182
Mountain Creek	120.7*	5,002	5,135
Mountain Creek Tributary 1	1.9	68	69
Newton Branch	11.2	502	519
Oakland Channel	1.6	79	164
Peaks Branch	6.7	79	545
Prairie Creek	17.4	958	1,192
Red Bird Branch	0.5	5	6
Reinhart Branch	1.5	40	163
Richardson Branch	0.9	31	34
Ricketts Branch	8.7	242	286
Royal Branch	1.3	15	19
Rush Creek	1.4	46	53
Stream 4B5	0.7	50	61
Stream 5A3	0.5	9	9
Stream 5B15	0.3	8	8
Stream 5B16	0.5	12	15
Stream 5B17	0.3	3	3

Stream	Drainage Area (mi^2)	FEMA SFHA (Acres)	City Regulatory Floodplain (Acres)
Stream 5B2	1.7	71	65
Stream 5B5	1.9	112	115
Stream 8C1	1.9	43	55
Trinity River	33.2*	4,588	5,156
Elm Fork Trinity River	42.8*	2,628	3,624
West Fork Trinity	29.9*	652	714
Trinity River East Levee	11.0	366	1916
Trinity River West Levee	17.4	2,620	3,362
Turtle Creek Branch	8.8	94	141
White Rock Creek	31.5	7,434	7,880
Stream 5B9	1.4	118	1
Williamson Branch	1.5	45	53
Woody Branch	10.4	176	199
TOTAL	**543**	**35,322**	**42,672**

**Area draining to portion of stream located within the city limits.*

Flood Hazard Identification and Mitigation

Floodplain Management Plans: Dallas' floodplain management has relied on both nonstructural and structural approaches to flood loss prevention. Nonstructural programs, such as the acquisition of floodplain property, subdivision regulation, and floodplain zoning, have protected many of the neighborhoods from flooding, while providing public parks and assuring safe urban development. Structural flood control measures, including the construction of storm sewers, channels, levees, dams, and retention basins, have reclaimed large areas and reduced the loss of life and property.

In the 1960's, the City of Dallas adopted a policy of studying watersheds on an individual basis and determining alternatives to reduce flooding within each watershed. These floodplain management plans have been the basis for the City's planning and funding of flood control projects. Each study looks at the following flood control methods:

- Nonstructural Flood Control Alternatives Analyzed: Open Space, floodplain ordinance, natural floodways, building codes, flood insurance
- Structural Flood Control Alternatives Analyzed: Land Reclamation, Man-Made Drainage Systems (storm sewers, open channels, dams, bypass systems, etc.), Maintenance, High-Water Response Systems.

The floodplain management plans will identify the watersheds problem areas and recommend nonstructural alternatives, structural alternatives, or a combination of both to alleviate the flooding issues. The recommended alternatives are then implemented by the City or assessed a score based on City criteria and added to the City's Needs Inventory for future bond program funding.

Hazard Identification Studies: In addition to the floodplain management plans, the City has regularly funded watershed studies. The goal of these studies is to identify the 10-year, 50-year, 100-year and 500-year discharge and water surface elevations for a watershed. The 100-year and 500-year floodplains are also mapped and added to the FEMA DFIRMs.

As part of FEMA RiskMAP program, the City has created depth grids for all watersheds studies since 2004. These depth grids show the depth of flooding for the 10-year, 50-year, 100-year and 500-year storm event. This tool allows the City to communicate more complete flood risk to residents by providing detailed depths of flooding, probability of flooding, and other flooding characteristics not available on the FEMA maps.

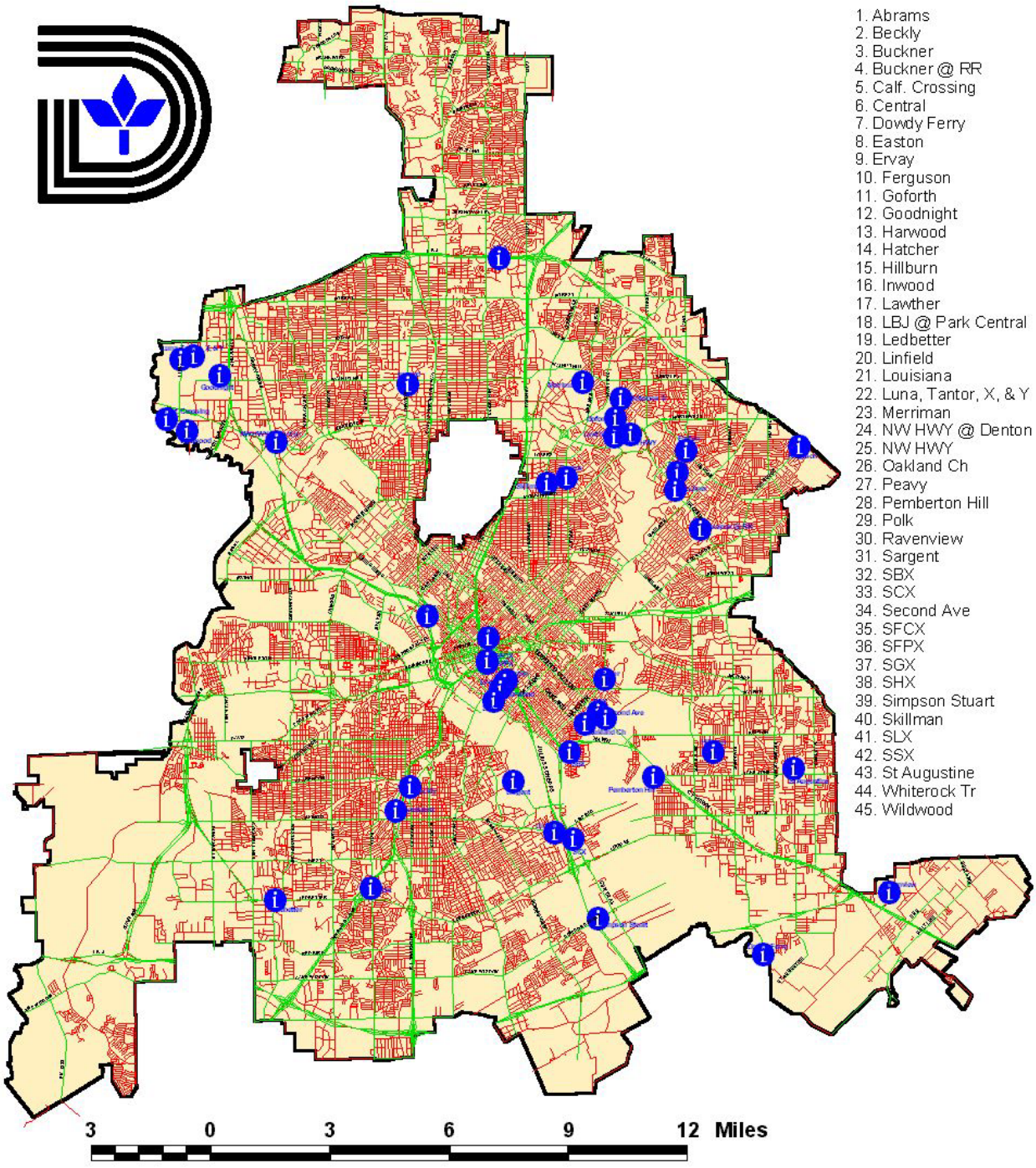
Flood Hazard Detection: While flooding in the general sense can occur anywhere, there are locations across the city that regularly flood. The City's Flooded Roadway Warning System has been installed at stream roadway crossings that are regularly inundated. The system constantly monitors the stream elevation from a central computer and activates a warning system when flood waters reach the edge of the roadway. Map X, below, gives a visual identification of the locations of the flooded roadway warning system and lists the locations.

Table 21: Low-Water Crossing Locations

Location	Mitigated	Location	Mitigated
Abrams	Yes	Northwest Highway @ Denton	Yes
Beckley	Yes	Northwest Highway	Yes
Buckner	Yes	Oakland	Yes
Buckner @ RR	Yes	Peavy	Yes
California Crossing	Yes	Pemberton Hill	Yes
Central	Yes	Polk	Yes
Dowdy Ferry	Yes	Ravenview	Yes
Easton	Yes	Sargent	Yes
Ervay	Yes	SBX	Yes
Ferguson	Yes	SCX	Yes
Goforth	Yes	Second Avenue	Yes
Goodnight	Yes	SFCX	Yes
Harwood	Yes	SFPX	Yes
Hatcher	Yes	SGX	Yes
Hillburn	Yes	Simpson Stuart	Yes
Inwood	Yes	Skillman	Yes
Lawther	Yes	SLX	Yes
LBJ @ Park Center	Yes	SSX	Yes
Ledbetter	Yes	St Augustine	Yes
Lousiana	Yes	Whiterock Trail	Yes
Luna, Tantor, X &Y	Yes	Wildwood	Yes
Merriman	Yes		

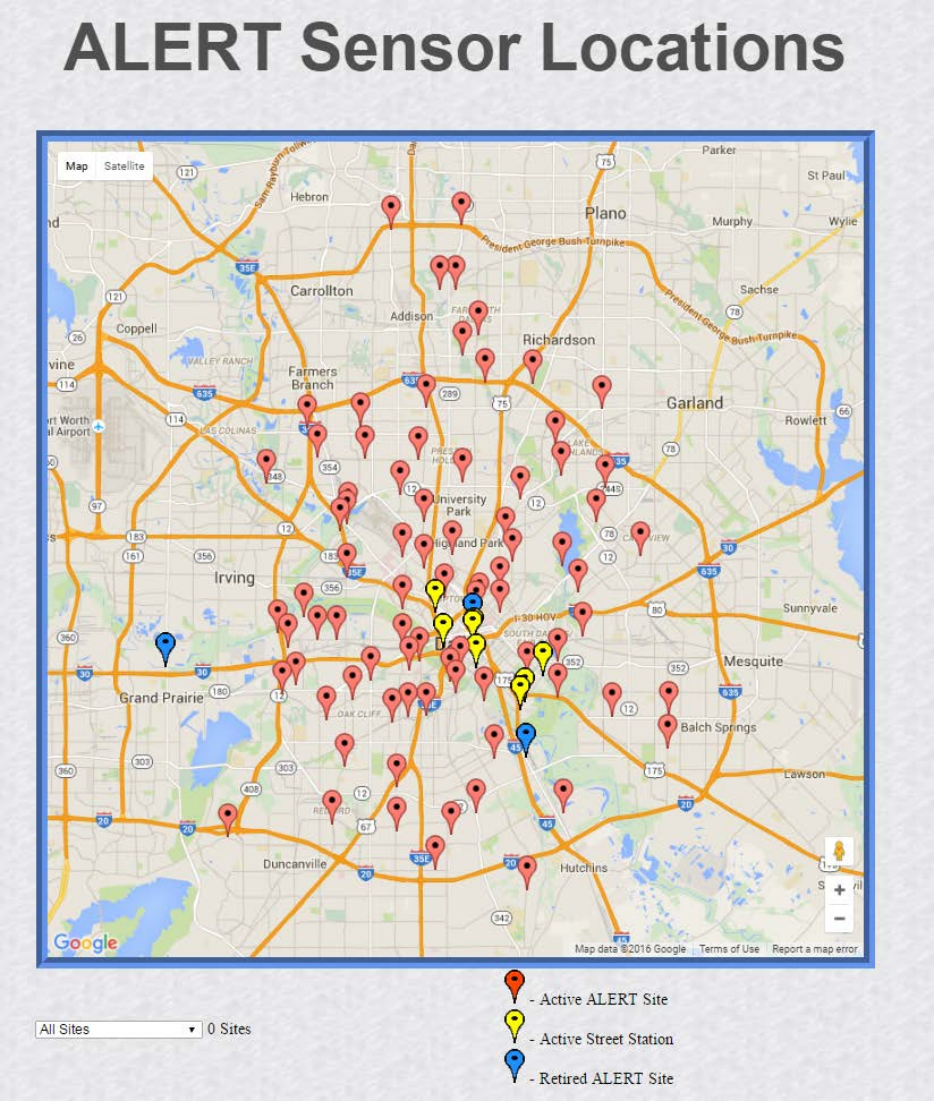
Map 2, below, gives a visual identification of the low-water crossings that have been mitigated.

Map 2: Mitigated Low-Water Crossings



The City of Dallas has installed 88 Automated Local Evaluation in Real Time (ALERT) sensors throughout the City which monitor rainfall, stream flow, and stream level at various locations throughout the City. The information gathered through this system allows the City to monitor and predict flooding levels during storm events in areas that have the potential to flood. Map 3, below, shows the location of the ALERT sensors.

Map 3: ALERT Sensor Locations



Warning Time: Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger.

Critical Facilities and Infrastructure: The services and functions provided by critical facilities are essential to a community, especially during and after a disaster. For a critical facility to function, it must be supplied with essential utilities. The loss of city operated utilities may prevent some critical facilities from operating. For example the loss of water and waste disposal can prevent a facility from operating long after the flood waters have receded. The City of Dallas has no critical facilities located within FEMA's SFHA. However, there are 20 critical facilities located within the 500-year floodplain. A summary of the critical facilities is listed in the table below.

Table 22: Critical Facilities and Infrastructure in the Floodplain

Critical Facilities and Infrastructure in the Floodplain			
Facility Type	Building Count		
	100-Year Floodplain	500-Year Floodplain	Total
Schools	0	13	13
Fire Stations	0	6	6
Police Stations	0	1	1
Hospitals	0	0	0

Floodplain Ecosystem: Floodplains can support ecosystems that are rich in plant and animal species. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. This makes floodplains valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees. The City of Dallas contains 7,500 acres of open space located within the SFHA that has been designated as permanent open space to reduce flooding and preserve the ecosystem.

Previous Occurrences: According to the National Climatic Data Center, there have been 19 flood events during the hazard analysis period. Table 23 depicts these events, along with the injuries, deaths, property damage, and crop damage each event caused. The magnitude of each individual event was not provided.

Table 23 – Previous Flood Occurrences (7/1/2005 – 6/30/2015)

Date	Location	Event Type	Deaths	Injuries	Property Damage
7/1/2005	DALLAS (ZONE)	Flood	0	0	$0
8/8/2005	DALLAS	Flash Flood	0	0	$0
3/19/2006	DALLAS (ZONE)	Flood	0	0	$0
5/24/2007	EAST DALLAS	Flash Flood	0	0	$0
5/30/2007	DALLAS LOVE FLD	Flash Flood	0	0	$3,000.00
7/2/2007	DALLAS	Flood	0	0	$0
7/3/2007	DALLAS	Flash Flood	0	0	$10,000.00
10/15/2007	DALLAS	Flash Flood	0	0	$20,000.00
3/18/2008	DALLAS	Flash Flood	1	0	$150,000.00
6/11/2009	(DAL)LOVE FLD DALLAS	Flash Flood	0	0	$750,000.00
6/11/2009	(DAL)LOVE FLD DALLAS	Flash Flood	0	0	$30,000.00
6/11/2009	DALLAS	Flash Flood	0	0	$15,000.00
6/11/2009	HENSLEY FLD ARPT	Flash Flood	0	0	$7,000.00
4/8/2012	(RBD)REDBIRD ARPT DA	Flash Flood	0	0	$20,000.00
8/18/2012	DALLAS	Flash Flood	0	0	$50,000.00
8/18/2012	DALLAS	Flash Flood	0	0	$200,000.00
5/24/2015	(DFW)DALLAS-FT WORTH	Flood	0	0	$36,000,000.00
5/29/2015	(DAL)LOVE FLD DALLAS	Flash Flood	0	0	$0
5/29/2015	HENSLEY FLD ARPT	Flash Flood	0	0	$0
Totals	19 Events		1	0	$37,290,000.00

Source: NCDC

Previous Event Narratives: Table 24 lists several event narratives that discuss past flooding incidents. The narratives were taken from the National Climatic Data Center database.

Table 24 – Past Flooding Event Narratives

Event Date	Narrative
2008-03-18	Numerous streets were closed due to high water after four to six inches of rain fell across the county, including Loop 12 near White Rock Lake. Voluntary evacuations were in place for residents of DeSoto near Ten Mile Creek which overflowed its banks for the second time in less than four years. A total of sixteen roads were closed in the area. Another rescue was needed after a van stalled in high water near Lawnview Avenue and Military Parkway. There was widespread flooding in Lancaster with numerous homes flooded. Lancaster's fire department performed five high water rescues. Two teenagers were playing near a creek near Interstate 635 and Bruton Road when one of them was swept into the water and then into a drainage pipe. His body was recovered the next day.

Event Date	Narrative
2009-06-11	The water was reported to be 3 feet deep near Fair Park in Dallas. The flooding was the result of training echoes over Dallas County.
2012-08-18	Multiple roads were being closed in Downtown Dallas due to flash flooding. Rainfall totals as high as 2 in 30 minutes were measured during the heavy rain event.
2015-05-24	Flooding across Dallas County persisted from Sunday the 24th, until the early morning hours of Thursday, May 28th. In Dallas, Loop 12, underneath the Interstate 30 overpass was closed for several days thanks to flood waters. Other areas in the county sustained an extended period of flooding, from Duck Creek in Garland, to the Trinity River in Dallas, which submerged parts of several city streets for nearly a week.

Source: NCDC

Probability of Future Events: There have been 19 flood events affecting the City of Dallas. Over the 10 year analysis period, this is an average of 1.9 events per year. Based on this analysis, the Mitigation Working Group has elected to assign a value of Moderate. This is a value of 3 on the HIRA Matrix.

Climate Change Impacts: Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods.

Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management, and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness, and emergency response.

High frequency flood events (e.g., 10-year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into

the design, operation, and regulation of flood protection facilities such as dams, floodways, bypass channels, and levees, as well as the design of local sewers and storm drains.

Future Trends in Development: There has been a rapid growth in North Texas in the last five years. The increase in population has caused an increase in the development of residential, commercial, and infrastructure within the Trinity River Watershed. The increased development has the potential to increase runoff entering the City and therefore increase water surface elevations along the Trinity and its tributaries. The City will continue to work with regional agencies to adopt development ordinances which will limit the impact of development along the Trinity River.

The City of Dallas floodplain development regulations prohibit any development in the regulatory floodplain. As development increases around the City's floodplains, properties currently located within the City's floodplains will be required to remove the property from the floodplain before any development occurs. The goal of the regulation is a reduction in the number and value of properties located within the SFHA.

Future Property Impact: In terms of property damage, floods are just behind tornados as the top natural disaster. In the United States, flood damages totaled $8.41 billion is 2011. Floods can affect any area to some degree; wherever rain falls, flooding can occur.
The services and functions provided by critical facilities are essential to a community, especially during and after a disaster. For a critical facility to function, it must be supplied with essential utilities. The loss of city operated utilities may prevent some critical facilities from operating. For example the loss of water and waste disposal can prevent a facility from operating long after the flood waters have receded.

Structure/Property Flood Vulnerability within Dallas

Category of Property in Jurisdiction	FEMA 100 Parcels	FEMA 100 or 500	FEMA 100 Parcels with buildings	FEMA 100 and 500 Parcels with buildings
Residential				
Count	11,595	24,368	9,318	19,575
Value	$4,628,411,970	$5,450,406,560	$3,634,097,450	$4,382,020,090
Commercial				
Count	1,324	4,509	805	2,986
Value	$3,095,219,000	$5,564,761,390	$2,839,545,440	$5,128,349,800
Industrial				
Count	2,044	4,663	933	2,838
Value	$1,667,444,090	$2,687,006,710	$1,600,192,780	$2,595,576,550
Government / Public*				
Count	1,431	1,905	270	434
Value	$1,343,044,570	$1,385,325,280	$284,918,760	$306,938,270
Totals				
Count	16,394	35,445	11,326	25,833
Total Value	$10,734,119,570	$15,087,499,940	$8,358,754,430	$12,412,885,610

Source: Dallas County Appraisal District
**Based on being owned by the City of Dallas in DCAD*

According to data from the NCDC flood events have caused $37,290,000.00 in damage during the hazard analysis period. This is an average damage amount of $1,775,714.29 per event. Based on this analysis, the Mitigation Working Group has elected to assign a value of Major to Property Impact. This is a value of 4 on the HIRA Matrix.

Future Population Impact: Floodwaters can damage homes, businesses, and roadways. The severity of the flood will determine the recovery time, recovery can take a few weeks to several months. The adverse impacts depends on the vulnerability of population and the frequency, intensity, and duration of the flooding. Immediate impacts from flooding include loss of life, damage to property, damage to infrastructure facilities and deterioration of health conditions due to waterborne diseases.

Flash floods that occur with little or no warning cause more deaths than slow rising riverine flooding. Psychological effects on flood victims and their families can traumatize them for long periods of time. The loss of their home, family members, livelihood or business can cause continuing stress. The stress associated with these losses can overwhelm individuals and produce lasting psychological impacts.

According to data from the NCDC, flood events have caused 0 injuries and 1 death during the hazard analysis period. This is an average of 0 injuries and 0.048 deaths per event. Based on this analysis, the Mitigation Working Group has elected to assign a value of Negligible to Population Impact. This is a value of 1 on the HIRA Matrix.

Impact on the Environment: The environmental impacts of flooding can be quite wide-ranging, from the dispersion of low-level household wastes into the storm water system to contamination of community water supplies and wildlife habitats with extremely toxic substances. The actions undertaken prior to the event will have repercussions on the level of damages accruing from the flood. Effective remedial actions can significantly reduce losses, and with planning, prevent some of these secondary environmental impacts. Specifically, the removal of fuel tanks and attention to hazardous wastes would eliminate some of the potential problems. During a flood variables such as depth of water, velocity of flows, and duration of inundation, in combination with land-use attributes, all contribute to the relative severity of flood impact (Tobin and Montz, 1994).

Floods of greater depth are likely to result in greater environmental damage than floods of lesser severity, in part because more area has been flooded. Long duration floods will exacerbate environmental problems because clean-up will be delayed and contaminants may remain in the environment for much longer time. During the post-flood phase many other environmental impacts can become apparent. The volume of the debris to be collected, the extent to which public utilities such as water supply systems and sewage operations have been damaged, and the quantity of agricultural and industrial pollutants entering the river system might present pressing problems.

Impact on the Economy: Flooding can have a devastating impact on the local and regional economy and the livelihood of its people. Loss of human life, property damage, non-functioning infrastructure, and the possibility of waterborne disease are just some the ways flooding can impact a community.

The NOAA National Climatic Database shows that from July 1994 to July 2015, Dallas County has experienced $45 million worth of property damage from flooding events, an average of $700,000 per event. City sponsored studies estimate that a 100 year flood would cause roughly 1.2 Billion dollars in damage and that a 500 year event could cause over $3.0 billion dollars in losses. Mitigation efforts, including acquisition of property with Repetitive Flood Loss claims, could reduce the impact of flood events on the economy. Participation in the National Flood Insurance Community Rating System (CRS) reduces insurance burdens on residents and

businesses within the City. As of 2014, The City of Dallas does participate in the CRS with a current rating of 5. The city is working on achieving a class rating of 4 in the next two years.

Impacts on the economy will greatly depend on the severity of the flood, area flooded, depth of water, and the length of time before water fall back past flood stage. If flood waters take utilities off line, businesses can lose productivity. Inaccessible roads also have an effect on business revenues and costs, increasing the number of lost trips (dampening consumer activity) and lengthening others (increase shipping time and costs).

Future Area of Extent: Previous flood events has been limited to approximately 25% of the City. The Mitigation Working Group has elected to assign a value of Moderate to Area of Extent. This is a value of 3 on the HIRA Matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Flooding	3	2	2	3	2.5
	Moderate	Minor	Minor	Moderate	High Hazard

4.3.7.1 National Flood Insurance Program and Community Rating System

The City of Dallas has a robust Floodplain Management program that includes NFIP and CRS Participation. Below is a general outline of the program:

Table 25: NFIP/CRS General Summary

NFIP Topic	Source of Information	Comments
Insurance Summary		
How many NFIP policies are in the community? What is the total premium and coverage?	Flood Control	3,420 policies, $2,886,779 premiums.
How many claims have been paid in the community? What is the total amount of paid claims? How many of the claims were substantial damage?	Flood Control	1,015 claims, value of $12,465,936 since 03/27/1977 through 09/01/2012.
How many structures are exposed to flood risk within the community?	Flood Control	26,895 buildings touching the floodplain (includes all flood zones) 8,259 buildings touching the floodplain (Only 100yr flood zones)
Describe any areas of flood risk with limited NFIP policy coverage.	Flood Control	NFIP existing policies (as of 12/2012) – (3,400)
Staff Resources		
Is the community FPS or NFIP Coordinator Certified?	Flood Control	Yes
Is floodplain management an auxiliary function?	Flood Control	Yes
Provide and explanation of NFIP administration services, (e.g. permit review, GIS, education or outreach, inspections, engineering capability)	Flood Control	GIS mapping, flood plain management.
What are the barriers to running an effective NFIP program in the community, if any?	N/A	City of Dallas is compliant with all NFIP regulations
Compliance History		
Is the community in good standing with the NFIP?	Flood Control	Yes
Are there any outstanding compliance issues (i.e., current violations)?	Flood Control	No

NFIP Topic	Source of Information	Comments
When was the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC)	Flood Control	December 1st, 2009
Is a CAV or CAC scheduled or needed?	Flood Control	No
Regulation		
When did the community enter the NFIP?	Flood Control	03/16/1983
Are the FIRMS digital or paper	Flood Control	Both
Do floodplain development regulations exceed FEMA or State minimum requirements? If so, in what ways?	Flood Control	Exceed. The City of Dallas Floodplain Ordinance includes several higher standards including 3 feet of freeboard, fully developed conditions, no rise in the entire 100-year floodplain, and no loss in valley storage.
Provide an explanation of the permitting process.	Flood Control	
Community Rating System (CRS)		
Does the community participate in CRS?	Flood Control	Yes
What is the community's CRS class Ranking?	Flood Control	Class 5
What categories and activities provide CRS points and how can the class be improved?	Flood Control	A total of 2,772 credit points are verified which results in a recommendation that the community improve from a CRS Class 7 to a CRS class 5. The following in a summary of the total CRS credit points. Activity 310 Elevation Certificates, Activity 320 Map Information Service, Activity 330 Outreach projects, Activity 240 Hazard Disclosure, Activity 350 Flood Protection Information, Activity 360 Flood Protection Assistance, Activity 410 additional flood data, Activity 420 Open Space Preservation, Activity 430 Higher Regulatory Standards, Activity 440 Flood Data Maintenance, Activity 450 Stormwater Management, Activity, 510 Floodplain Management Planning, Activity 520 Acquisition and Relocation, Activity 540 Drainage System Maintenance, Activity 610 Flood Warning Program, Activity 630 Dam Safety.
Does the plan include CRS planning requirements?	Flood Control	Yes

Repetitive Loss

As per Requirement 201.6(c)(2)(ii) “The risk assessments in all plans approved after October 1, 2008 must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods.” Repetitive Loss Property information provides local jurisdictions with the properties that had submitted insurance claims due to flooding damage to buildings and its contents.

Table 26 below provides a summary of the Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties in the jurisdictions participating in this plan.

Table 26: Repetitive Loss (RL) and Severe Repetitive Loss (SRL) Properties

City of Dallas	Years	Properties	Number of losses	Payments
Single Family	2005-2015	19,575	230	$5,756,700.00
Other Residential	2005-2015	1,905	0	$0
Non Residential	2005-2015	2,838	434	$14,382.020.00
Total		24,318	664	$20,138,720.00

4.3.8 Hail

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	There have been 17 hail events in the City of Dallas during the analysis period.	Based on historical data, The City of Dallas can anticipate 1.7 hail events per year.
Effect on Population	Hail events in the City of Dallas during the analysis period have caused no deaths or injuries.	Based on historical data, The City of Dallas can anticipate no injuries or deaths during the next hail event.
Effect on Property	Hail events in the City of Dallas during the analysis period have caused $526,000.00 in property damage.	Based on historical data, the City of Dallas can anticipate $30,941.18 in property damage during the next hail event.
Area of Extent	Hail events in the City of Dallas have affected all areas within the city limits.	Based on previous occurrences and current climatological conditions, hail is anticipated to have a major area of extent, impacting over 50% of the City of Dallas.
Public Perception of Vulnerability	Public comments received requested an increase in alerts and warnings about hail.	

Vulnerability Narrative: The entire city is equally at risk for hail. In addition, there are also 8 police stations, 57 fire stations, 23 hospitals, 52 DART Transit Hubs, and 206 schools at risk of impact from Hail.

Hazard Description: Hail is a form of solid precipitation. It is distinct from sleet, though the two are often confused for one another. It consists of balls or irregular lumps of ice, each of which is called a hailstone. Hail is possible within most thunderstorms as it is produced by cumulonimbi, and within 2 nautical miles (3.7 km) of the parent storm. Hail formation requires environments of strong, upward motion of air with the parent thunderstorm (similar to tornadoes) and lowered heights of the freezing level.

Unlike ice pellets, hailstones are layered and can be irregular and clumped together. Hail is composed of transparent ice or alternating layers of transparent and translucent ice at least 1 millimetre (0.039 in) thick, which are deposited upon the hailstone as it travels through the cloud, suspended aloft by air with strong upward motion until its weight overcomes the updraft and falls to the ground. Although the diameter of hail is varied, in the United States, the average observation of damaging hail is between 2.5 cm (1 in) and golf ball-sized (1.75 in). The largest diameter hailstone known, measuring 7.87 in (20.0 cm) in diameter - larger than a bowling ball - and weighing 1.9375 lb (878.8 g), fell on Vivian, South Dakota during an exceptional hailstorm.

Location and Extent of Hazard: Due to the rapidly changing climate in Texas, large scale hailstorms are especially prevalent. Hailstorm incidents have been reported throughout the North Texas region, including City of Dallas, therefore establishing that all parts of the region are equally vulnerable to hailstorms.

The size of hailstones is directly related to the severity and size of the storm. Strong updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. The higher the temperature the higher the elevation which results in increased suspension time and bigger hailstone sizes.

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

The NOAA/TORRO Hailstorm Intensity Scale as seen in Table 27 is representative of the damage from hail storms Dallas County has experienced in the past and will likely experience in the future.

Table 27: Combined NOAA/TORRO Hailstorm Intensity Scales

Size Code	Intensity Category	Typical Hail Diameter	Approximate Size	Typical Damage Impacts
H0	Hard Hail	Up to 0.33	Pea	No Damage
H1	Potentially Damaging	0.33-.60	Marble or Mothball	Slight damage to crops, plants
H2		0.61-.80	Dime or Grape	Significant damage to crops, plants
H3	Severe	0.81-1.20	Nickel to Quarter	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4		1.21-1.60	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage

Size Code	Intensity Category	Typical Hail Diameter	Approximate Size	Typical Damage Impacts
H5	Destructive	1.61-2.00	Silver dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6		2.01-2.40	Lime or Egg	Aircraft bodywork dented, brick walls pitted
H7	Very Destructive	2.41-3.00	Tennis ball	Severe roof damage, risk of serious injuries
H8		3.0-3.5	Baseball to Orange	Severe damage to aircraft bodywork
H9	Super Hailstorm	3.5-4.0	Grapefuit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10		4+	Softball and Up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

The Hailstorm Intensity Scale allows planners to gauge past damage and mitigate for future expected damage. Below is the range of extent experienced by the City of Dallas. It can be anticipated that future event will fall within this extent.

Hazard Type	Extent (based on historical events)		Comments
	Minimum	Maximum	
Hail	H2	H5	On March 9, 2013, a hail storm produced up to 1.75 inches (a size code of H5 with an intensity category of destructive) in “East Dallas” causing property damage cost of $500,000. The NOAA/TORRO Hailstorm Intensity Scale ranks this as a H5, Destructive.

Previous Occurrences: Based on data from NCDC, there have been 17 hail events within the City of Dallas during the period of hazard analysis. Table 28 below lists each event, sorted by date, along with magnitude, deaths, injuries, and property damage.

Table 28: Hail Events in the City of Dallas (7/1/2005 – 6/30/2015)

Date	County	Location	Mag.	Deaths	Injuries	Property Damage
7/11/2005	DALLAS CO.	DALLAS	0.75	0	0	$0
7/15/2005	DALLAS CO.	DALLAS	0.75	0	0	$0
7/1/2006	DALLAS CO.	DALLAS	1	0	0	$0
4/13/2007	DALLAS CO.	DALLAS	1.75	0	0	$10,000.00

Date	County	Location	Mag.	Deaths	Injuries	Property Damage
5/24/2007	DALLAS CO.	DALLAS	0.88	0	0	$0
2/5/2008	DALLAS CO.	DALLAS	1.75	0	0	$5,000.00
7/8/2009	DALLAS CO.	DALLAS	1	0	0	$0
5/22/2011	DALLAS CO.	DALLAS	1	0	0	$0
5/23/2011	DALLAS CO.	DALLAS	0.75	0	0	$0
5/24/2011	DALLAS CO.	DALLAS	1.5	0	0	$8,000.00
5/24/2011	DALLAS CO.	EAST DALLAS	1	0	0	$0
6/6/2012	DALLAS CO.	EAST DALLAS	0.88	0	0	$0
6/13/2012	DALLAS CO.	EAST DALLAS	1.75	0	0	$400,000.00
6/13/2012	DALLAS CO.	EAST DALLAS	1.75	0	0	$100,000.00
3/9/2013	DALLAS CO.	(DAL) LOVE FLD DALLAS	1.25	0	0	$3,000.00
4/27/2014	DALLAS CO.	DALLAS	0.75	0	0	$0
5/8/2014	DALLAS CO.	(DAL) LOVE FLD DALLAS	0.88	0	0	$0
Totals		**17 Events**	**Average Magnitude: 1.14**	**0**	**0**	**$526,000.00**

Source: NCDC

Probability of Future Events: There have been 17 recorded hail events within the City of Dallas during the 10-year analysis period. This is an average of 1.7 events per year. Based on this, the Mitigation Working Group has elected to assign a value of Moderate to Occurrence. This ranks as a 3 on the HIRA Matrix.

Future Population Impact: According to the NCDC data, there have been no deaths or injuries as a result. Based on this information, the Mitigation Working Group has elected to assign a value of Negligible to Property Impact. This ranks as a 1 on the HIRA Matrix.

Future Property Impact: Hail can cause serious damage, notably to automobiles, aircraft, skylights, glass-roofed structures, livestock, and most commonly, farmers' crops. Hail damage to roofs often goes unnoticed until further structural damage is seen, such as leaks or cracks. It is hardest to recognize hail damage on shingled roofs and flat roofs, but all roofs have their own hail damage detection problems. Metal roofs are fairly resistant to hail damage, but may accumulate cosmetic damage in the form of dents and damaged coatings.

The City of Dallas has experienced $526,000 in property damage from the 17 recorded hail events. This is an average of $30,941.18 in damage per event. Based on this analysis, the Mitigation Working Group has elected to assign a value of Minor to Property Impact. This ranks as a 2 on the HIRA Matrix.

Future Area of Extent: Previous hail events have impacted between 25% and 50% of the planning area. The Mitigation Working Group has elected to assign a value of Moderate to Area of Extent. This is a value of 3 on the HIRA Matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Hail	2	1	3	1	1.8
	Minor	Negligible	Moderate	Concentrated	Low Hazard

This page intentionally left blank.

4.3.9 Hazardous Materials

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	There have been 204 hazardous material events during the hazard analysis period.	Based on previous occurrences, The City of Dallas can anticipate multiple hazard material events per year.
Effect on Population	There have been no injuries or deaths associated with hazardous materials incidents.	Based on previous occurrences, The City of Dallas can anticipate no hazard material injuries or deaths per year.
Effect on Property	There have been no reports of property damage associated with hazardous materials incidents.	Based on previous occurrences, The City of Dallas can anticipate no hazard material damages to property per year.
Area of Extent	Previous hazardous materials incidents have been limited to less than 10% of the city.	Based on previous occurrences, The City of Dallas can anticipate that future hazardous materials events will impact less than 10% of the city.
Public Perception of Vulnerability	Public comments received called for increasing awareness of hazardous locations, first responder training, and increasing inspections of hazardous materials sites.	

Vulnerability Narrative: The City of Dallas has Tier II facilities throughout the city. The residents and structures surrounding these facilities would be the most vulnerable to impact.

In addition, there are also 8 police stations, 57 fire stations, 23 hospitals, 52 DART Transit Hubs, and 206 schools within a 1-mile radius of a Tier I or Tier II facility. These facilities would be at greatest risk of impact from a Hazardous Materials event.

Hazard Description: A hazardous material is a biological, chemical or physical agent with the potential to cause harm to the environment or people on its own or when combined with other factors or materials. For the purposes of this mitigation plan, this hazard will include fixed site facilities, pipelines, and transportation incidents.

Hazardous materials incidents are technological (meaning non-natural hazards created or influenced by humans) events that involve large-scale accidental or intentional releases of chemical, biological, or radiological (nuclear) materials.

Pipeline incidents are typically incidents in which the pipeline is breached or fails. An estimated 2.2 million miles of pipelines carry hazardous materials throughout the United States – more than 77,000 miles of which is in Texas. Pipelines transport natural gas, crude or refined oils, fuels, and petrochemical products. Some pipelines also transport liquefied gases, such as carbon dioxide.

Hazardous materials come in the form of explosives, flammable and combustible substances, toxic releases and waste materials. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants. Hazardous materials in various forms can cause death, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines.

Hazardous materials are monitored and recorded by the US Environmental Protection Agency (ESP) through the Toxics Release Inventory (TRI), which is a publically accessible database that contains information on toxic chemical releases and other hazardous materials activities.

Data is reported annually by certain industry groups and various federal agencies. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and later expanded by the Pollution Prevention Act of 1990.

Each year, facilities that meet specified thresholds must report their releases and other waste management activities for listed toxic chemicals to the EPA and to their State or tribal entity. A facility must report incidents that meet the following criteria:

- The facility falls within one of the following industrial categories:
    - Manufacturing
    - Metal Mining
    - Coal Mining
    - Electric generating facilities that combust coal and/or soil,
    - Chemical wholesale distributors,
    - Petroleum terminals and bulk storage facilities,
    - RCRA Subtitle C treatment, storage and disposal (TSF) facilities, and
    - Solvent recovery services;
- Has 10 or more full time employees (or equivalent); and
- Manufactures or processes more than 25,000 pounds or uses more than 10,000 pounds of any listed chemical during the calendar year. Persistent, bio accumulative and toxic (PBT) chemicals are subject to different thresholds of 10 pounds, 100 pounds, or 0.1 grams, depending on the chemical

Tier 2 data is a publicly available database from the Texas Department of State Health Services Tier 2 Chemical Reporting Program. Under the community right-to-know regulations imposed at

the state and federal levels, all facilities that store significant quantities of hazardous chemicals must share this information with state and local emergency responders and planners.

Facilities in Texas share this information by filing annual hazardous chemical inventories with the state, Local Emergency Planning Committees (LEPCs), and local fire departments. The Texas Tier 2 reports contain facility identification information and detailed chemical data about the hazardous materials stored at the facility. A facility must report chemicals to the Tier 2 database if it meets the following criteria:

- Any company using chemicals that could present a physical or health hazard, or
- If an industry has an Occupational Safety and Health Administration (OSHA) deemed chemical that exceeds the appropriate threshold at any point in time. These chemicals may be on a list of 356 Extremely Hazardous Substances (EHS), or may be one of the 650,000 reportable hazardous substances that do not appear on the EHS list. Hazardous Materials pose a secondary event risk to communities when they are involved in transportation accidents. Transport by ground, rail and sea is a common occurrence in the US.

Location and Extent of Hazard: The City of Dallas is home to over 1,400 industries and transporters of hazardous materials. The city has several Interstate highway routes that are designated as hazardous materials routes and several thousand pounds are transported thru the city on a daily basis. The city is also part of the radiological shipments for the Waste Isolation Pilot Plant (WIPP). WIPP shipments are conducted by The U.S. Department of Energy (DOE) developed the Transportation As part of the shipping protocols agreed to by the DOE, states and tribes, state officials are notified by DOE's Transportation Tracking and Communication System (TRANSCOM) two hours prior to a WIPP shipment entering the state.

In June 2007 a series of explosions occurred at the Southwest Industrial Gases, Inc. plant located near Downtown Dallas. The plant is a welding cutting supply plant and a gas and equipment distributor. The fire was caused due to a mechanical failure of pig-tailed acetylene cylinders. Two employees on the ground were engulfed in the explosion and were transported to Parkland Hospital. The explosion resulted in the closure of several major thoroughfares near downtown. The explosion from the plant caused debris to become airborne as the debris landed it caused smaller fires in the area of the explosion.

Previous Occurrences: Occurrences of the hazardous materials incident hazard are often dependent on external factors. An incident can be caused intentionally or accidentally, and may or may not involve human action. Major disaster events can be a major cause, as inundation by flood water or damage from high winds may result in a hazardous materials release. This is usually caused or exacerbated by damage to infrastructure, such as water supply/distribution and waste water treatment facilities.

Table 29: Total and Type of Hazardous Material Calls (7/1/2005 – 6/30/2015)

Year	03 – Hazardous Materials	12H – Gas Leak w/ HazMat	36 – Carbon Monoxide	71 – NBC Threat	Total
7/1/2005-	0	0	19	3	22
2006	0	0	17	3	20
2007	28	0	0	0	28

Year	03 – Hazardous Materials	12H – Gas Leak w/ HazMat	36 – Carbon Monoxide	71 – NBC Threat	Total
2008	70	5	0	2	77
2009	81	2	0	0	83
2010	113	2	6	0	121
2011	225	1	3	1	230
2012	225	50	5	44	324
2013	193	27	36	13	269
-6/30/2015	230	94	17	9	350
Totals	**1165**	**181**	**84**	**72**	**1502**

Source: Dallas Fire Rescue

Probability of Future Events: It's almost impossible to predict the statistical probability of future occurrences of the hazardous materials incident hazard, as there are simply too many variables, including human behavior. However, the number of possible points of origin for such an incident must be taken into account. Therefore, the Mitigation Working Group has elected to assign a value of Moderate to Occurrence. This is a value of 3 on the HIRA Matrix.

Future Property and Population Impact: Property, Facilities, and Infrastructure should experience few impacts from hazardous material events. A hazardous materials event would have little impact to structures that are outside of the immediate accident/incident area. Exception for this will depend on what type of chemical is involved and how close structures are to the location. For example, the 2013 West Fertilizer event was located outside the city limits of West but the blast zone for the ammonium nitrate was enough to level the structures in the immediate area. The temporary closing of city facilities may be required if they are located in or near an evacuation area. Prolonged evacuations may require the city to open shelters for residents who were ordered to evacuate.

April 2013, an ammonium nitrate explosion occurred at the West Fertilizer Company storage and distribution facility in West, Texas while emergency services personnel were responding to a fire at the facility. At least 15 people were killed, more than 160 were injured and more than 150 buildings were damaged or destroyed. Investigations confirmed that ammonium nitrate was the trigger for the explosion.

On the 23rd, March 2005, a hydrocarbon vapor cloud explosion occurred at the isomerization process unit at BP's Texas City refinery in Texas City, Texas, killing 15 workers and injuring more than 170 others. The Texas City Refinery was the second largest oil refinery in the state, and the third-largest in the United States with an input capacity of 437,000 barrels per day as of January 1, 2000. Both incidents occurred in Texas. Although incidences of this size are rare, smaller scale incidents, those requiring a response and evacuation or other protective measures, are relatively common. Depending on the severity of the incident, the potential impact to life and property is great in Dallas. Incidents can cause multiple fatalities.

Depending on the severity of the incident, the potential impact to life and property is great in Dallas. Incidents can cause multiple fatalities, completely shut down facilities (and the surrounding area) for days or weeks, and cause extensive property and infrastructure damage.

Weather conditions can directly impact how a hazardous materials incident develops or can be the initiator of the incident, as in the case of facilities impacted by a tornado. Noncompliance with fire and building codes can substantially increase damage from an incident, as the containment features may not be up to standards.

Based on this information, the Mitigation Working Group has elected to assign a value of "Negligible" to Population and Property. This is a value of 1 on the HIRA.

Future Area of Extent: The extent of future hazardous material incidents would be directly limited to the area around the incident. Based on this information, the Mitigation Working Group has elected to assign a value of "Concentrated" to Area of Extent. This is a value of 1 on the HIRA.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Hazardous Materials	3	1	1	1	1.8
	Moderate	Minor	Minor	Concentrated	Low Hazard

This page intentionally left blank.

4.3.10 High Winds

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	There have been 25 high wind events in the City of Dallas during the analysis period.	Based on historical data, The City of Dallas can anticipate 2.5 high wind events per year.
Effect on Population	High wind events in the City of Dallas during the analysis period have caused no deaths or injuries.	Based on historical data, The City of Dallas can anticipate no injuries or deaths during the next high wind event.
Effect on Property	Hail events in the City of Dallas during the analysis period have caused $136,500 in property damage.	Based on historical data, the City of Dallas can anticipate $5,460.00 in property damage during the next high wind event.
Area of Extent	High wind events in the City of Dallas have affected all areas within the city limits.	Based on previous occurrences and current climatological conditions, high wind is anticipated to have a major area of extent, impacting over 50% of the City of Dallas.
Public Perception of Vulnerability	Public comments received called for better radar technology and "preparedness for evacuation of buildings during high winds."	

Vulnerability Narrative: High winds can occur suddenly and without warning. Damages sustained from "micro and macro-bursts, straight line, and other types of winds" can cause significant damages to structures, infrastructure, and vehicles throughout the City of Dallas. The entire City is equally exposed to the damage risks associated with high winds. Typically, incidents are fairly localized and damages associated with individual events are relatively limited.

There are also 8 police stations, 57 fire stations, 23 hospitals, 52 DART Transit Hubs, and 206 schools at risk of impact from High Winds.

Hazard Description: Wind is defined as the motion of air relative to the earth's surface. The horizontal component of the three-dimensional flow and the near-surface wind phenomenon are the most significant aspects of the hazard.

Straight-line winds are often responsible for most of the wind damage associated with a thunderstorm. These winds are often confused with Tornadoes because of similar damage and wind speeds. However, the strong and gusty winds associated with straight-line winds blow roughly in a straight line unlike the rotating winds of a tornado. Downbursts or microbursts are examples of damaging straight-line winds. A downburst is a small area of rapidly descending rain and rain-cooled air beneath a thunderstorm that produces a violent, localized downdraft covering 2.5 miles or less.

Wind speeds in some of the stronger downbursts can reach 100 to 150 miles per hour, which is similar to that of a strong tornado. The winds produced from a downburst often occur in one direction, and the worst damage is usually on the forward side of the downburst.

Location of Hazard: High Winds are a meteorological event and affect the entire planning area equally.

Extent of Hazard: The Beaufort Wind Scale is representative of the damage from high winds Dallas County may endure. For example, in 2007 a high wind storm of a Beaufort Wind Scale Force 11 (60 knots) was reported as causing damage resulting no structures being damaged or destroyed. The Beaufort Wind Scale allows planners in the community to assess historical data and mitigate for future high wind storms.

Force	Wind speed (knots)	WMO Designation	Appearance of Wind Effects	
			On Water	On Land
0	Less Than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft. taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft., whitecaps common, more spray	Larger tree branches moving, whistling in wires

Force	Wind speed (knots)	WMO Designation	Appearance of Wind Effects	
			On Water	On Land
7	28-33	Near Gale	Sea heaps up, waves 13-20 ft., white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (13-20 ft.) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Whole trees in motion, resistance felt walking against wind
9	41-47	Strong Gale	High waves (20 ft.), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (20-30 ft.) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, “considerable structural damage"
11	56-63	Violent Storm	Exceptionally high (30-45 ft.) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft., sea completely white with driving spray, visibility greatly reduced	

Source: NOAA – National Climatic Data Center

Below is a chart documenting the extent range of events experienced by the City of Dallas. It can be anticipated that future events will fall within that range.

Hazard Type	Extent (based on historical events)		Comments
	Minimum	Maximum	
High Winds	Force 8	Force 11	A thunderstorm on July 14, 2014 produced 52 MPH (Force 10) winds at Redbird Airport. The windstorm caused $40,000 in damage, no deaths, and no injuries.

Previous Occurrences: According to data available from the National Climatic Data Center, there have been 25 high wind events affecting the City of Dallas. Those events are depicted in Table 30.

Table 30 – High Wind Events (7/1/2005-6/30/2015)

Date	County	Location	Type	Mag.	Deaths	Injuries	Property Damage
7/11/2005	DALLAS CO.	DALLAS	Thunderstorm Wind	52	0	0	$0
7/15/2005	DALLAS CO.	DALLAS	Thunderstorm Wind	54	0	0	$0
9/28/2005	DALLAS CO.	DALLAS	Thunderstorm Wind	50	0	0	$5,000.00
8/27/2006	DALLAS CO.	DALLAS	Thunderstorm Wind	50	0	0	$3,000.00
4/24/2007	DALLAS CO.	DALLAS	Thunderstorm Wind	60	0	0	$0
4/24/2007	DALLAS CO.	DALLAS-FT WORTH INTL	Thunderstorm Wind	55	0	0	$0
5/2/2007	DALLAS CO.	DALLAS	Thunderstorm Wind	53	0	0	$0
6/3/2007	DALLAS CO.	DALLAS-FT WORTH INTL	Thunderstorm Wind	55	0	0	$0
10/15/2007	DALLAS CO.	DALLAS	Thunderstorm Wind	50	0	0	$8,000.00
4/10/2008	DALLAS CO.	DALLAS	Thunderstorm Wind	50	0	0	$1,000.00
4/10/2008	DALLAS CO.	DALLAS LOVE FLD	Thunderstorm Wind	50	0	0	$0
6/17/2008	DALLAS CO.	DALLAS-FT WORTH INTL	Thunderstorm Wind	56	0	0	$0
6/10/2009	DALLAS CO.	(DFW) DALLAS-FT WORTH	Thunderstorm Wind	56	0	0	$4,000.00
6/10/2009	DALLAS CO.	DALLAS REDBIRD ARPT	Thunderstorm Wind	62	0	0	$4,000.00
4/23/2011	DALLAS CO.	(DFW) DALLAS-FT WORTH	Thunderstorm Wind	50	0	0	$3,000.00
5/24/2011	DALLAS CO.	(DAL) LOVE FLD DALLAS	Thunderstorm Wind	65	0	0	$5,000.00
5/29/2012	DALLAS CO.	(DAL) LOVE FLD DALLAS	Thunderstorm Wind	50	0	0	$4,000.00
7/20/2012	DALLAS CO.	(DFW) DALLAS-FT WORTH	Thunderstorm Wind	56	0	0	$0
12/19/2012	DALLAS CO.	(DAL) LOVE FLD DALLAS	Thunderstorm Wind	57	0	0	$5,000.00
5/8/2014	DALLAS CO.	(DAL) LOVE FLD DALLAS	Thunderstorm Wind	52	0	0	$50,000.00
5/25/2014	DALLAS CO.	(DFW) DALLAS-FT WORTH	Thunderstorm Wind	50	0	0	$4,000.00
7/14/2014	DALLAS CO.	(RBD) REDBIRD ARPT DA	Thunderstorm Wind	52	0	0	$40,000.00

Date	County	Location	Type	Mag.	Deaths	Injuries	Property Damage
8/16/2014	DALLAS CO.	(DAL) LOVE FLD DALLAS	Thunderstorm Wind	56	0	0	$500
10/2/2014	DALLAS CO.	(DAL) LOVE FLD DALLAS	Thunderstorm Wind	56	0	0	$0
10/2/2014	DALLAS CO.	(RBD) REDBIRD ARPT DA	Thunderstorm Wind	57	0	0	$0
Totals			25 Events		0	0	$136,500.00

Source: National Climatic Data Center

Future Occurrences: According to data available from the National Climatic Data Center, there have been 25 high wind events occurring in the City of Dallas during the 10-year analysis period. The City of Dallas can expect 2.5 high wind events per year. Based on this information, the Mitigation Working Group has elected to assign a value of "Chronic" to Occurrence. This is represented as a 4 in the HIRA Matrix.

Future Population Impact: According to data available from the National Climatic Data Center, there have been no deaths or injuries associated with high winds in the City of Dallas. Based on this information, the Mitigation Working Group has elected to assign a value of "Negligible" to Effect on Population. This is represented by a 1 on the HIRA Matrix.

Future Property Impact: All property throughout the planning area has an equal chance of being affect by high wind. According to the NCDC data, there have been $136,500 in damage from 25 wind events during the period of hazard analysis. This is an average of $5,460 per event. Based on this information, the Mitigation Working Group has elected to assign a value of "Minor" to Effect on Property. This is represented as a 2 on the HIRA Matrix.

Future Area of Extent: As a meteorological hazard, high wind events occur equally throughout the entire planning area. Based on this, the Mitigation Working Group has elected to assign a value of Minor to Area of Extent. This is represented by a 2 on the HIRA Matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
High Winds	4	1	2	2	2
	Chronic	Negligible	Minor	Minor	Moderate Hazard

This page intentionally left blank.

4.3.11 Lightning

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	The City of Dallas has had 4 lightning strike events within the city limits.	The City of Dallas can anticipate .4 lightning strikes per year.
Effect on Population	No deaths or injuries have been reported from lightning strikes within the City of Dallas.	The City of Dallas can anticipate no deaths or injuries in future lightning strike events.
Effect on Property	Lightning strikes within the City of Dallas have caused $110,000.00 in property damage.	The City of Dallas can anticipate $27,500.00
Area of Extent	Previous lightning strikes within the city of Dallas have had a limited area of extent, affecting less than 10% of the City.	Future lightning strikes can be anticipated to have a limited area of extent, affecting less than 10% of the City.
Public Perception of Vulnerability	No public comments received.	

Vulnerability Narrative: Whiling lightning traditionally affects taller skyscraper-type buildings, lightning within the City of Dallas has, historically, stuck structures of all shapes and sizes. All structures and populations within the City are equally vulnerable to the effects of lightning strikes.

In addition, there are also 8 police stations, 57 fire stations, 23 hospitals, 52 DART Transit Hubs, and 206 schools at risk of impact from Lightning.

Hazard Description: Lightning is a sudden electrostatic discharge during an electrical storm between electrically charged regions of a cloud (called intra-cloud lightning or IC), between that cloud and another cloud (CC lightning), or between a cloud and the ground (CG lightning). The charged regions in the atmosphere temporarily equalize themselves through this discharge referred to as a strike if it hits an object on the ground. Although lightning is always accompanied by the sound of thunder, distant lightning may be seen but be too far away for the thunder to be heard. A lightning strike forms a visible plasma.

Location and Extent of Hazard: All locations within the planning area are vulnerable to lightning. Lightning can occur throughout the planning area.

Previous Occurrences: There have been 4 lightning strike events within the City of Dallas, based on data from the NCDC. They are documented below in Table 31. Magnitude was not provided in the dataset.

Table 31 – Lightning Occurrences in the City of Dallas (7/1/2005 – 6/30/2015)

Date	County Name	Location	Magnitude	Deaths	Injuries	Property Damage
8/27/2006	DALLAS CO.	DALLAS		0	0	$5,000.00
6/11/2009	DALLAS CO.	EAGLE FORD		0	0	$50,000.00
5/24/2011	DALLAS CO.	EAST DALLAS		0	0	$45,000.00
6/9/2015	DALLAS CO.	MEADERS		0	0	$10,000.00
Totals		4 Events		0	0	$110,000.00

Source: NCDC

Probability of Future Events: Based on data from the National Climatic Data Center, there have been 4 lightning strikes within the City of Dallas between 7/1/2005 and June 30, 2015. This is an average of .4 events per year. Based on this information, the Mitigation Working Group has elected to assign a value of Rare. This is a value of 1 on the HIRA Matrix.

Future Property Impact: Lightning strikes have caused $110,000.00 in property damage during the period of analysis. Based on the 4 lightning strikes recorded by NCDC, this is an average of $27,500 per lightning strike. Based on this analysis, the Mitigation Working Group has elected to assign a value of Minor. This is a value of 2 on the HIRA Matrix.

Future Population Impact: Lightning strikes have caused no deaths or injuries within the City of Dallas. Based on this analysis, the Mitigation Working Group has elected to assign a value of Negligible. This is a value of 1 on the HIRA Matrix.

Future Area of Extent: Lightning strikes have an extremely limited area of extent. Future area of extent can be anticipated to affect a single property within the city. The Mitigation Working Group has elected to assign a value of Concentrated. This is a value of 1 on the HIRA Matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Lightning	1	1	1	1	1
	Rare	Negligible	Negligible	Concentrated	Low Hazard

This page intentionally left blank.

4.3.12 Severe Winter Storm

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	The City of Dallas has experienced 19 severe winter storm events.	The City of Dallas can anticipate 1.9 severe winter storm events per year.
Effect on Population	There has been 1 recorded death and no recorded injuries from severe winter storm events.	The City of Dallas can anticipate less than 1 death and no injuries in the next severe winter storm event.
Effect on Property	Severe winter storms have caused $4,000,000 in property damage in the City of Dallas.	Based on a total of 19 events, this is an average of $210,526.32 per event.
Area of Extent	Severe winter storms have previously impacted 100% of Dallas.	Based on historical occurrence, severe winter storms are predicated to impact 100% of Dallas.
Public Perception of Vulnerability	Public comments received included “critical transport continuity”, “shelters”, and “winter weather service vehicles.”	

Vulnerability Narrative: Severe winter storms have an increased impact on vulnerable populations and properties, including the elderly and impoverished individuals. These storms would also have an increased impact on streets and highways, especially overpasses.

In addition, there are also 8 police stations, 57 fire stations, 23 hospitals, 52 DART Transit Hubs, and 206 schools at risk of impact from Severe Winter Storm.

Hazard Description: A winter storm is an event in which the varieties of precipitation are formed that only occur at low temperatures, such as snow or sleet, or a rainstorm where ground temperatures are low enough to allow ice to form (i.e. freezing rain). Heavy showers of freezing rain are one of the most dangerous types of winter storm. They typically occur when a layer of warm air hovers over a region, but the ambient temperature a few meters above the ground is near or below 0 °C (32 °F), and the ground temperature is sub-freezing.

Winter weather occurs every year in Dallas but not every storm in severe. Each year, the City experiences some level of ice accumulation and dangerous environmental conditions. The main impact from winter weather to the City is icy roads and loss of power. In 2011, while hosting the Super Bowl, the region experienced a historical winter weather event. Historical snow accumulations blanketed the area and most jurisdictions did not have sufficient snow removal equipment.

The National Climatic Data Center has several data sets for severe winter storms, including ice storms, winter weather, and winter storm. The City of Dallas has elected to include a compilation of those sets in order to capture the most data for analysis.

Location and Extent of Hazard: Severe winter storms are metrological hazards and affect the entire planning area equally.

The index used by the National Weather Service to measure the wind chill temperature was developed in 2001.

Wind Chill Chart

Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	29	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

The Wind Chill Chart displays the frostbite times in regards to temperature and wind. This chart allows the communities to prepare for severe winter storms or an ice event. These events are infrequent but can cause damage. The primary areas of concern are on bridges and roadways.

The Sperry-Piltz Ice Accumulation Index, or "SPIA Index" – Copyright, February, 2009

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

(Categories of damage are based upon combinations of precipitation totals, temperatures and wind speeds/directions.)

Source: http://www.spia-index.com/SPIAIndexDescription.png

The SPIA index chart allow for a community to prepare for a winter or an ice storm event. These events are infrequent but can cause damage. The primary areas of concern are on bridges, roadways and utility infrastructure including electric and natural gas supply lines.

According to the National Climatic Data Center, the planning area experienced 19 winter storm/ice events between 2005 and 2015 that resulted in one death and property damage worth $4 million dollars. The magnitude of these events ranged from 3-5 inches of snow fall, 1-3 inches of sleet, and up to an inch of ice accumulation. It can be expected that any future events will be similar in magnitude.

Previous Occurrences: Table 32 below lists the 19 severe winter storm events occurring within the planning area during the hazard analysis period, as obtained from the National Climatic Data Center. Magnitude was not provided by the data source.

Table 32: City of Dallas Severe Winter Storm Events (7/1/2005 – 6/30/2015)

Date	Location	Type	Deaths	Injuries	Property Damage
12/7/2005	DALLAS (ZONE)	Winter Storm	0	0	$0
2/18/2006	DALLAS (ZONE)	Winter Weather	0	0	$0
11/30/2006	DALLAS (ZONE)	Winter Storm	0	0	$20,000.00
1/13/2007	DALLAS (ZONE)	Ice Storm	0	0	$50,000.00
1/17/2007	DALLAS (ZONE)	Winter Weather	0	0	$20,000.00
2/1/2007	DALLAS (ZONE)	Winter Weather	0	0	$0
12/15/2008	DALLAS (ZONE)	Winter Weather	0	0	$0
12/23/2008	DALLAS (ZONE)	Winter Weather	0	0	$0
1/5/2009	DALLAS (ZONE)	Winter Weather	0	0	$35,000.00
1/27/2009	DALLAS (ZONE)	Ice Storm	1	0	$300,000.00
12/24/2009	DALLAS (ZONE)	Winter Weather	0	0	$250,000.00
1/7/2010	DALLAS (ZONE)	Winter Weather	0	0	$700,000.00
3/20/2010	DALLAS (ZONE)	Winter Weather	0	0	$100,000.00
2/1/2011	DALLAS (ZONE)	Ice Storm	0	0	$500,000.00
12/5/2013	DALLAS (ZONE)	Winter Storm	0	0	$2,000,000.00
2/10/2014	DALLAS (ZONE)	Winter Weather	0	0	$0
2/22/2015	DALLAS (ZONE)	Winter Storm	0	0	$25,000.00
3/4/2015	DALLAS (ZONE)	Winter Weather	0	0	$0
3/5/2015	DALLAS (ZONE)	Winter Weather	0	0	$0
Totals		19 Events	1	0	$4,000,000

Probability of Future Events: According to the National Climatic Data Center, 19 winter storm events occurred during the 10-year hazard analysis period. This is an average of 1.9 events per year. Based on this information, the Mitigation Working Group has elected to assign a value of Moderate to Occurrence. This is a value of 3 on the HIRA Matrix.

Future Population Impact: Direct impacts on the public during a winter weather event are power outages, injury or death from traffic accidents, and fires caused by space heaters. Power outages in are normally caused by ice accumulation on power lines, fallen trees from ice, and heavy demand on the electrical grid. In 2014 The Electric Reliability Council of Texas stated impact to the electrical grid was driven by demand and not from damage to the grid system. Deaths and injuries during a winter weather event are predominantly caused by traffic accidents. The Texas Department of Public Safety states that 75% of fatalities during winter weather are traffic accident related.

According to the National Climatic Data Center, there has been 1 death and no injuries from severe winter storms. Based on a total of 19 events, this is an average of 0.05 deaths and no injuries per event. Based on this information, the Mitigation Working Group has elected to assign a value of Negligible to Population Impact. This is a 1 on the HIRA Matrix.

Future Property Impact: The major impact during winter weather are to roads. In ice and snow events, the roads in Dallas could be hazardous to navigate until the area is treated. Streets Department may need to work around the clock to treat city streets clear and available for use. Ice and snow can damage power lines by weighing them down or causing trees to fall from the weight of the ice onto active lines. Subfreezing temperatures can cause pipes to freeze and burst causing damage to the inside of the building or home. In rare occurrences the City experiences heavy snow which can put stress on a structures roof and support structure.

According to the National Climatic Data Center, severe winter storms have caused $4,000,000 in property damage. Based on a total of 19 events, this is an average of $210,526.32 per event. Based on this analysis, the Mitigation Working Group has elected to assign a value of Moderate to Property Impact. This is a value of 3 on the HIRA Matrix.

Area of Extent: Severe winter storms affect the entire city. The Mitigation Working Group has elected to assign a value of Pervasive to Population Impact. This is a 4 on the HIRA Matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Severe Winter Storm	1	1	3	4	1.9
	Rare	Negligible	Moderate	Pervasive	Low Hazard

This page intentionally left blank.

4.3.13 Terrorism

This section contains information classified as sensitive by the City of Dallas Office of Emergency Management. Specific information directly related to Terrorism vulnerabilities is located in **Appendix C – Sensitive Information**, which is not available to the general public. To receive this appendix, contact the Office of Emergency Management.

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	There have been two previous occurrences of Terrorism in the City of Dallas.	REDACTED
Effect on Population	There have been no injuries or deaths directly caused by Terrorism in the City of Dallas.	REDACTED
Effect on Property	Previous occurrences of terrorism have had minimal impacts to property.	REDACTED
Area of Extent	Previous occurrences of Terrorism in the City of Dallas have been limited, impacting less than 10% of the City.	REDACTED
Public Perception of Vulnerability	Public comments received included hardening infrastructure, and increasing warning system contingencies.	

Vulnerability Narrative: The City of Dallas ranks as the ninth-largest city in the United States and the third-largest in Texas. Within the City of Dallas, there are numerous facilities deemed Critical Infrastructure and Key Resource (CIKR) facilities. Each of these facilities is a target of terrorism and each increases the vulnerability of the City. Considering the potential effects on population and property, the planning team ranks this as a moderate hazard.

This page intentionally left blank.

4.3.14 Tornado

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	There have been 4 tornados in the City of Dallas between 7/1/2005 and 6/30/2015	Based on previous occurrences, The City of Dallas can anticipate .4 tornado events per year.
Effect on Population	There have been 11 injuries and no deaths directly caused by the 4 tornado events affecting the City of Dallas.	Based on previous occurrences, the City of Dallas can anticipate 2.75 injuries and 0 deaths per event.
Effect on Property	The total amount of property damage from 4 tornado occurrences in the City of Dallas is $880,000.	Based on previous occurrences, the City of Dallas can anticipate approximately $220,000 in damage per tornado event.
Area of Extent	Previous tornado events in the City of Dallas have had a small area of extent, less than 1 square mile.	Based on previous occurrences, the City of Dallas can anticipate a similar area of extent in future tornado events, less than 1 square mile.
Public Perception of Vulnerability	Public comments received included “bury electric lines”, “cell phone notifications”, and “wind protection standards.”	

Vulnerability Narrative: All buildings and populations are equally at risk for a tornado event. In addition, there are also 8 police stations, 57 fire stations, 23 hospitals, 52 DART Transit Hubs, and 206 schools at risk of impact from Tornado.

Hazard Description: A tornado is a violently rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. Tornadoes come in many shapes and sizes, but they are typically in the form of a visible condensation funnel, whose narrow end touches the earth and is often encircled by a cloud of debris and dust. Most tornadoes have wind speeds less than 110 miles per hour (180 km/h), are about 250 feet (80 m) across, and travel a few miles (several kilometers) before dissipating. The most extreme tornadoes can attain wind speeds of more than 300 miles per hour (480 km/h), stretch more than two miles (3 km) across, and stay on the ground for dozens of miles (more than 100 km).

Location and Extent of Hazard: Because tornado events are metrological in nature, all of the planning area is equally at risk of a tornado event. This includes all buildings and all populations.

Extent for tornados is measured by the Enhanced Fujita Scale, a derivative of the Fujita Scale. The six categories for the EF scale are listed below (Table 33), in order of increasing intensity. Although the wind speeds and photographic damage examples are updated, the damage descriptions given are those from the Fujita scale, which are more or less still accurate. However, for the actual EF scale in practice, damage indicators (the type of structure which has been damaged) are predominately used in determining the tornado intensity.

Table 33: Enhanced Fujita Scale

Scale	Estimated Wind Speed (MPH)	Relative Frequency	Potential Damage
EF0	65–85	53.5%	Minor or no damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	86–110	31.6%	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111–135	10.7%	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136–165	3.4%	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations are badly damaged.
EF4	166–200	0.7%	Extreme damage. Well-constructed and whole frame houses completely leveled; cars and other large objects thrown and small missiles generated.
EF5	>200	<0.1%	Total destruction of buildings. Strong framed, well built houses leveled off foundations and

Scale	Estimated Wind Speed (MPH)	Relative Frequency	Potential Damage
			swept away; steel-reinforced concrete structures are critically damaged; tall buildings collapse or have severe structural deformations; some cars, trucks and train cars can be thrown approximately 1 mile (1.6 kilometers).

Source: NOAA

Below is a chart documenting the historic extent of Tornado events with the City of Dallas. It can be anticipated that future events will occur within this scope**.**

Hazard Type	Extent (based on historical events)		Comments
	Minimum	Maximum	
Tornado	EF0	EF2	On April 13, 2007, an EF0 tornado caused damages to trees, fences, and apartment roof damage totaling $50,000. No deaths or injuries were reported as a result of the event.

Previous Occurrences: There have been 4 tornado events affecting the City of Dallas. These include tornados that started elsewhere but crossed into the City limits. Each event is listed below in Table 35, sorted by date, and includes magnitude (EF rating), deaths, injuries, and property damage.

Table 35: Tornado Occurrences in City of Dallas (7/1/2005-6/30/2015)

Date	County Name	Origin	Magnitude	Deaths	Injuries	Property Damage
4/13/2007	DALLAS CO.	DALLAS	EF0	0	0	$50,000.00
9/8/2010	DALLAS CO.	EAGLE FORD	EF2	0	1	$750,000.00
4/3/2012	DALLAS CO.	DE SOTO CARROLL ARPT	EF2	0	10	$0
Totals		3 Events		0	11	$880,000

Probability of Future Events: There have been 3 tornado events affecting the City of Dallas during the period of analysis. This is an average of .3 events per year. Based on this

information, the Mitigation Working Group has elected to assign a value of Rare to occurrence. This is a value of 1 on the HIRA Matrix.

Future Property Impact: Severe winds associated with a tornado may severely damage or destroy structures and property. Structures can be completely destroyed or completely obliterated by winds and debris. Manufactured homes and vehicles can be carried several miles by a tornado. Manufactured homes can be severely damage by weak tornadoes and could potentially drive up residential losses and increase displacement.

The total amount of property damage from 4 tornado occurrences in the City of Dallas is $880,000. The average amount of damage per event is $220,000. Based on this information, the Mitigation Working Group has elected to assign a value of Moderate to Property Impact. This is a value of 3 on the HIRA Matrix.

Future Population Impact: Tornadoes rank fourth among the most deadly weather pattern following heat, hurricanes and floods. In the United States death tolls from tornadoes vary from one year to the next. Since 2000 deaths associated with tornadoes have ranged from 21 in 2009 to 553 in 2011, with an average of 94 deaths a year during that time period. The high death toll in 2011 was due to the 2011 tornado outbreak in which 748 tornadoes occurred in the month of April, followed by a devastating tornado strike on Joplin Missouri in May. Tornadoes that occur at night tend to be the deadliest because the public who are asleep may not hear the tornado warning in time.

There have been 11 injuries and no deaths directly caused by the 4 tornado events affecting the City of Dallas. This is an average of 2.75 injuries and 0 deaths per event. Based on this information, the Mitigation Working Group has elected to assign a value of Minor to Population Impact. This is a value of 2 on the HIRA Matrix.

Future Area of Extent: Despite their incredibly destructive power, tornados generally have an extremely limited area of extent. The Fort Worth tornado that struck downtown Fort Worth in 2000 was rated an EF3, caused $500 million in damage, killed 2 people, and injured 80 more only caused damage in a .56 square mile area (4 miles long, .14 miles wide).

Future tornados are anticipated to have similar damage patterns as the Fort Worth tornado. The Mitigation Working Group has elected to assign a value of Concentrated to Area of Extent. This is a value of 1 on the HIRA Matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Tornado	2	2	3	1	2.1
	Minor	Minor	Moderate	Concentrated	Moderate Hazard

4.3.15 Wildfire

Vulnerability Variable	Historical Impacts	Future Vulnerability
Occurrence	There have been 93 wildfire incidents within the City of Dallas between 7/1/2005 and 6/30/2015	Based on previous occurrences, the City of Dallas can anticipate 9.3 incidents of wildfire per year.
Effect on Population	Wildfire has caused no deaths or injuries within the City of Dallas.	Based on previous occurrences, The City of Dallas can anticipate no injuries or deaths in future wildfire incidents.
Effect on Property	Wildfire has caused no property damage within the City of Dallas	Based on previous occurrences, there City of Dallas can anticipate no property damage in future events.
Area of Extent	Previous wildfire have impacted less than 10% of the City of Dallas.	Based on the information available, wildfire is anticipated to have a Concentrated area of extent, impacting less than 10% of the City of Dallas.
Public Perception of Vulnerability	Public comments received included “Forest Fire service training.”	

Vulnerability Narrative: Based on information from the Texas Forest Service’s Wildfire Risk Assessment Portal, a GIS-based program for targeting wildfire vulnerability, it is estimated that 15% of the population (198,045 people) live in the Wildland-Urban Interface. Dallas is home to the world’s largest urban forest, which leads to its increased Wildland-Urban Interface and Wildfire Threat Index.

In addition, there are also 2 police stations, 8 fire stations, 2 hospitals, 3 DART Transit Hubs, and 30 schools within the Wildland-Urban Interface.

Hazard Description: A wildfire or wildland fire is an uncontrolled fire in an area of combustible vegetation that occurs in the countryside area. Other names such as brush fire, bush fire, forest fire, desert fire, grass fire, hill fire, peat fire, vegetation fire, and veldfire may be used to describe the same phenomenon depending on the type of vegetation being burned, and the regional variant of English being used. A wildfire differs from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to change direction unexpectedly, and its ability to jump gaps such as roads, rivers and fire breaks. Wildfires are characterized in terms of the cause of ignition, their physical properties such as speed of propagation, the combustible material present, and the effect of weather on the fire.

For the purposes of this plan, the City of Dallas defines a wildfire as meeting two of these three criteria:

- The size of the fire must be equal to or greater than one (1) acre
- The fire must require two (2) or more pumping apparatuses to extinguish
- The fire takes more than thirty (30) minutes to extinguish

Specific fires are discussed in Table 37.

Extent of Hazard: Extent of wildfire is measured through the Texas A&M Forest Service's Characteristic Fire Intensity Scale (FIS).

> **Characteristic Fire Intensity Scale (FIS) specifically identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist based on a weighted average of four percentile weather categories**. Similar to the Richter scale for earthquakes, FIS provides a standard scale to measure potential wildfire intensity. FIS consist of 5 classes where the order of magnitude between classes is ten-fold. The minimum class, Class 1, represents very low wildfire intensities and the maximum class, Class 5, represents very high wildfire intensities.

The table below (Table 36) documents the range of this scale and the acreage within the city limits.

Table 36: Wildfire Extent

Class		Description	Acres	Percent
0	Non-Burnable		195,658	79.4%
1	Very Low	Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment.	9,220	3.7%
1.5			12,907	5.2%
2	Low	Small flames, usually less than two feet long; small amount of very short range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools.	7,349	3.0%
2.5			2,202	0.9%
3	Moderate	Flames up to 8 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property.	16,020	6.5%
3.5			9	0.0%
4	High	Large Flames, up to 30 feet in length; short-range spotting common; medium range spotting possible.	868	0.4%

Class		Description	Acres	Percent
4.5		Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property.	2,138	0.9%
5	Very High	Very large flames up to 150 feet in length; profuse short-range spotting, frequent long-range spotting; strong fire-induced winds. Indirect attack marginally effective at the head of the fire. Great potential for harm or damage to life and property.	0	0.0%
	Total		**246,371**	**100.0%**

Source: Texas A&M Forest Service

Location of Hazard: Wildfire is a geographically-defined hazard. The primary threat of wildfire is in the southern areas of the city. The greatest wildfire threat is in the southwest, south of Interstate 20. Below are maps describing the Wildland Urban Interface (WUI), Wildfire Threat, and Property Values within the WUI.

This page intentionally left blank.

Map 3: Wildland-Urban Interface

This page intentionally left blank.

Map 4: Wildfire Threat

This page intentionally left blank.

INSERT WUI PROPERTY MAP HERE

This page intentionally left blank.

Previous Occurrences: Wildfire events are common throughout Texas. The Bastrop County Complex fire in 2011 is the most famous Texas wildfire. The fire burned 34,356 acres of land, destroyed almost 1,700 homes caused 2 fatalities, and inflicted an estimated $325 million of insured property damage. Two wildfires have occurred within Dallas County, one in Combine and one in the unincorporated county. The Combine fire burned 5 homes, completely destroying 1, along with "a few vehicles and some sheds" (NOAA, 2011).

Table 37 discusses wildfire occurrences within the City of Dallas.

Table 37: Wildfire Occurrences in City of Dallas (07/01/2005 – 06/30/2015)

Date	Location	Acreage Burned	Ignition Source/Cause	Deaths	Injuries	Value of Property Damaged ($)
9/15/2007	Marvin D Love Acrd Nb / L B J Fwy Wb	1	Unknown	0	0	0
11/11/2007	401 E WHEATLAND RD	20	Lg Mulch Co.	0	0	0
11/28/2007	1634 Nina Dr	1	Unknown	0	0	0
12/5/2007	E Camp Wisdom Rd / S R L Thornton Fwy Nb	1	Unknown	0	0	0
1/11/2008	L B J Acrd Eb / N Stemmons Nb L B J Eb Ramp Eb	1	Unknown	0	0	0
1/20/2008	800 Wideman Dr	1	Unknown	0	0	0
1/30/2008	733 Cliffview Dr	5	Unknown	0	0	0
2/4/2008	4500 W JEFFERSON BLVD	5	Unknown	0	0	0
2/27/2008	3320 Los Angeles Blvd	3	Unknown	0	0	0
6/24/2008	4398-4508 Spur 408 Nb	2	Unknown	0	0	0
6/28/2008	5248-5265 Handicap Cir	1	Unknown	0	0	0
7/27/2008	S R L Thornton Acrd Sb / W Ledbetter Dr	1	Unknown	0	0	0
7/29/2008	S LEDBETTER DR / W KIEST BLVD	1	Unknown	0	0	0

8/3/2008	4200 SINGLETON BLVD	1	Unknown	0	0	0
8/14/2008	Southerland Ave / Sargent Rd	20	Unknown	0	0	0
11/4/2008	2600 COOMBS CREEK DR	5	Unknown	0	0	0
11/9/2008	N Stemmons Fwy Sb / L B J Fwy Wb	2	Unknown	0	0	0
11/20/2008	524-535 BARNES BRIDGE RD	5	Unknown	0	0	0
12/25/2008	10500 Leroy Ct	1	Unknown	0	0	0
12/28/2008	C F Hawn Fwy Eb / S St Augustine Dr	2	Unknown	0	0	0
1/19/2009	Barnes Bridge Rd / Bobtown Rd	1	Assist Garland	0	0	0
1/20/2009	Forney Rd / Sam Houston Rd	1	Unknown	0	0	0
2/19/2009	S Walton Walker Blvd Sb / W Illinois Ave	1	Unknown	0	0	0
6/10/2009	2222 N St Augustine Dr	5	Arson	0	0	0
8/10/2009	L B J Fwy Eb / Plano Rd	1	Unknown	0	0	0
3/3/2010	3406 Los Angeles Blvd	3	Poss. Arson	0	0	0
3/29/2010	1257 S BELT LINE RD	5	Unknown	0	0	0
8/6/2010	3730 Mountain Creek Pkwy	30	Unknown	0	0	0
8/10/2010	C F Hawn Fwy Eb / Silverado Dr	1	Unknown	0	0	0
8/18/2010	E Laureland Rd / S R L Thornton Fwy Sb	2	Unknown	0	0	0
8/21/2010	6500 S LOOP 12	15	Unknown	0	0	0
8/29/2010	Seagoville Rd / Ranch Rd	5	Unknown	0	0	0

9/4/2010	L B J Fwy Wb / Plano Rd	1	Unknown	0	0	0
9/17/2010	28501 - 28699 L B J Fwy Wb	1	Unknown	0	0	0
12/14/2010	0 Kidd Springs Dr	2	Unknown	0	0	0
2/17/2011	Highland Hills Dr / Bonnie View Rd	5	Unknown	0	0	0
2/19/2011	Wandt Dr / W Camp Wisdom Rd	5	Unknown	0	0	0
2/24/2011	3103 Wheelock St	1	Unknown	0	0	0
3/31/2011	401 E Wheatland Rd	10	Lg Mulch Co.	0	0	0
5/8/2011	5599 Barnes Bridge Rd	2	Warming Fire	0	0	0
6/4/2011	5599 Barnes Bridge Rd	1	Cigarette	0	0	0
6/18/2011	L B J Ramp E / Spur 408	1	Unknown	0	0	0
7/22/2011	14550 Kleberg Rd	1	Unknown	0	0	0
8/11/2011	S MERRIFIELD RD / CAPELLA PARK AVE	3	Unknown	0	0	0
8/12/2011	3834 KIEST KNOLL DR	2	Unknown	0	0	0
8/20/2011	Mountain Creek Pkwy / W Kiest Blvd	1	Equipment Heat	0	0	0
8/20/2011	9215 WHITE ROCK TRL	5	Unknown	0	0	0
8/23/2011	9755 CLIFFORD DR	1	Unknown	0	0	0
8/29/2011	Kleberg Rd / C F Hawn Fwy Eb	5	Unknown	0	0	0
8/29/2011	Elam Rd / N Prairie Creek Rd	5	Unknown	0	0	0
9/4/2011	321 Calumet Ave	20	Unknown	0	0	0
9/6/2011	L B J Fwy Wb / Spur 408	15	Unknown	0	0	0
9/12/2011	3535 MARVIN D	1	Unknown	0	0	0

	LOVE SERV SB					
9/16/2011	CHALK HILL RD / W DAVIS ST	5	Unknown	0	0	0
9/24/2011	CHAPEL OAKS / CYPRESS WATERS BLVD	5	Unknown	0	0	0
9/24/2011	14901 North Lake Blvd	20	Assist Coppell	0	0	0
9/26/2011	14901 North Lake Blvd	20	Assist Coppell	0	0	0
10/7/2011	L B J Ramp Wb / S R L Thornton Fwy Nb	5	Unknown	0	0	0
1/1/2012	400 S PRAIRIE CREEK RD	5	Unknown	0	0	0
2/29/2012	3100 - 3199 Mcneil St	5	Unknown	0	0	0
7/2/2012	7600 W CAMP WISDOM RD	3	Poss. Fireworks	0	0	0
7/4/2012	L B J Fwy Eb / Mountain Creek Pkwy	1	Embers/Winds	0	0	0
7/15/2012	3501 Samuell Blvd	1	Unknown	0	0	0
7/23/2012	Eagle Ford Dr / Mountain Creek Pkwy	12	Unknown	0	0	0
7/24/2012	S Walton Walker Blvd Nb / W Illinois Ave	3	Unknown	0	0	0
8/12/2012	12037 Kleberg Rd	3	Unknown	0	0	0
11/10/2012	5477 Barnes Bridge Rd	1	Unknown	0	0	0
11/10/2012	5620 Parkdale Dr	1	Unknown	0	0	0
1/18/2013	2900 PRICHARD LN	1	Unknown	0	0	0
2/3/2013	18880 Marsh Ln	1	Arson	0	0	0
3/3/2013	40601 - 40659 L B J Fwy Wb	1	Unknown	0	0	0
3/5/2013	8001 L B J SERV WB	1	Power Lines	0	0	0

5/15/2013	5900 W DAVIS ST	1	Burn Pile	0	0	0
6/10/2013	Fm 1382 Hwy / Mansfield Rd	2	Unknown	0	0	0
7/9/2013	7529 Marietta Ln	1	Unknown	0	0	0
7/29/2013	8921 C F Hawn Fwy Eb	10	Unknown	0	0	0
8/21/2013	Scott St / Sunday St	2	Unknown	0	0	0
8/28/2013	I 20 WB / S BELT LINE RD	3	Unknown	0	0	0
9/9/2013	3116 S St Augustine Rd	1	Unknown	0	0	0
1/19/2014	Cleveland Rd / Bonnie View Rd	10	Unknown	0	0	0
1/23/2014	12217 QUINCY LN	1	Power Lines	0	0	0
1/29/2014	7333 E Northwest Hwy	1	Unknown	0	0	0
2/17/2014	13805 - 13899 L B J Fwy Wb	2	Unknown	0	0	0
3/19/2014	4601 W Kiest Blvd	2	Unknown	0	0	0
6/17/2014	11340 - 11398 C F Hawn Serv Eb	10	Unknown	0	0	0
7/23/2014	900 Pemberton Hill Rd	5	Unknown	0	0	0
7/27/2014	1301 N WALTON WALKER BLVD SB	4	Unknown	0	0	0
8/28/2014	Woody Rd / Greenhaw Ln	1	Unknown	0	0	0
8/28/2014	BRIERWOOD LN / S ST AUGUSTINE DR	15	Unknown	0	0	0
9/29/2014	2171 - 2191 DOWDY FERRY RD	3	Unknown	0	0	0
10/29/2014	5500 SCYENE RD	2	Unknown	0	0	0
11/19/2014	14101 - 14349	1	Unknown	0	0	0

	INTERSTATE 20					
4/5/2015	5300 HIDDEN CT	8	Unknown	0	0	0

Probability of Future Events: There have been 93 previous occurrences of wildfire within the City of Dallas. According to the Texas A&M Forest Service's Texas Wildfire Risk Assessment for City of Dallas (Maps 3 and 4), the greatest areas of wildfire threat and risk are in the southern portions of the City. These risk areas bleed into western and central portions of the city. These areas are primarily classified as a 1 (Low) on the proprietary Wildfire Threat scale, but there is a southwestern area ranked as a 4 on the scale. Due to the limited scope of these fires (most approximately 1 acre in size), the Mitigation Working Group has elected to assign a value of Rare to Occurrence. This is a value of 1 on the HIRA Matrix.

Future Property Impact: Property impact based on previous occurrences is ranked as Minor. This is a value of 2 on the HIRA Matrix.

Based on 2014 Dallas County Appraisal District parcel data, the values of properties within the Wildland-Urban Interface total $8,511,809,111. Each of these properties is equally at risk of being damaged by wildfire and their risk is greater than that of these outside the WUI. The location and distribution of these properties are depicted in Map 5. While we cannot predict future losses, the Mitigation Working Group will be targeting these areas in their wildfire mitigation action items.

Future Population Impact: There have been no previous deaths or injuries from wildfire. However, based on the population distributions described in Maps 3 and 5, Effect on Population is assigned a value of Minor.

Future Area of Extent: Most of the previous fires have been limited to 1 acre of damage. Area of Extent is assigned a value of Concentrated. This is a value of 1 on the HIRA Matrix.

Conclusion:

Hazard	Occurrence	Population	Property	Area of Extent	Vulnerability Value
Wildfire	1	2	2	1	1.5
	Rare	Minor	Minor	Concentrated	Low Hazard

Chapter 5: Mitigation Strategy

This chapter of the City of Dallas Local Mitigation Action Plan (LMAP) discusses the strategies and actions the City plans to take over the life of this document. The first section of this plan discusses the goals and objectives of the plan, broad statements outlining the direction that the City intends to conduct its mitigation program. The second section presents the action items the City has developed to lower its vulnerability over the life of the plan. These two sections intertwine to represent the City's mitigation program.

This page intentionally left blank.

5.1 Mitigation Goals and Objectives

Goal 1: *Protect life and property from the impacts of natural, technological, and man-made disasters.*

Objective 1.1: Reduce the risk posed to lives and property by frequently occurring hazard events and practices.

Objective 1.2: Focus on hazards that cause repetitive damage and/or pose severe risk.

Objective 1.3: Develop and implement strategies that make critical facilities and community assets, as well as private homes and businesses, more resistant to impact of hazard events.

Objective 1.4: Encourage preventative measures for existing and new development areas vulnerable to hazards, and develop strategies that support municipal efforts towards responsible development in hazard prone - areas.

Goal 2: *Enhance awareness and education of the risks associated with natural, technological, and human caused hazards.*

Objective 2.1: Determine what issues the public needs to understand about hazard mitigation.

Objective 2.2: Develop and execute education outreach programs to increase public awareness of both risks associated with hazards, and strategies that can be adopted to lessen the impact of hazard events.

Objective 2.3: Provide information on resources available for implementing mitigation strategies

Goal 3: *Build a hazard mitigation infrastructure and promote pre-disaster mitigation as the most effective means to reduce future disaster losses.*

Objective 3.1: Utilize the LMAP effectively by clearly communicating the process for plan implementation, maintenance, and updates. This includes helping the public understand what their role is in both disaster response and pre-disaster mitigation.

Objective 3.2: Identify agencies, personnel and resources available or needed to implement pre disaster mitigation activities and initiatives.

Objective 3.3: Enforce, track, and/or recommend Federal, State, and local legislation related to hazard mitigation.

Goal 4*: Promote growth in sustainable manner.*

Objective 4.1: Incorporate hazard mitigation into long-range planning, budgeting and development activities.

Objective 4.2: Promote beneficial uses of hazardous areas while expanding space and recreational opportunities.

Objective 4.3: Prevent creation of future hazards to life and property.

This page intentionally left blank.

5.2 Potential Mitigation Actions

In accordance with Community Rating System 510 – Floodplain Management Planning, the City of Dallas is including all potential mitigation actions for lowering vulnerability to the hazards described in this plan. This is a systematic review that includes pros and cons of each action, sorted by each of the six floodplain management activities defined by the CRS program. While the CRS program is designed primarily for floodplain management, actions for all hazards discussed in this plan are listed in this section.

Each table lists the action, the cost, the pros/cos, and whether or not the action was slated for inclusion in the plan. Slated actions, including those not listed here, can be found in Section 5.3 - Slated Action Items.

5.2.1 Preventative Activities

Preventative activities keep problems from getting worse. Actions that would increase vulnerability, like developing in a floodplain or improper construction practices, are limited through planning, land acquisition, or regulation. They are usually managed by building, zoning, planning, and/or code enforcement offices.

Preventative Activities Actions

Action	Hazards Addressed	Pros	Cons	Slated
Require New City Multi-Use Facilities to be Built to FEMA 361 Standards	Earthquake, High Winds, Tornados	Regulations are inexpensive	Actual construction of structures would be expensive	Yes
Adopt and Enforce the 2016 International Building Code	Dam and Levee Failure, Drought, Earthquake, Extreme Heat, Flooding, Hail, High Winds, Lightning, Severe Winter Storm, Terrorism, Tornado, Wildfire	Cost-Effective	None	Yes

5.2.2 Property Protection

Property protection activities are usually undertaken by property owners on a building-by-building or parcel basis.

Property Protection Actions

Action	Hazards Addressed	Pros	Cons	Slated
Develop and Adopt "Wildfire Defense" Ordinances for Properties in Wildland-Urban Interface Areas	Wildfire	Lowers wildfire risk for properties within the WUI.	Politically untenable	Yes
Buyout Properties in Hazardous Areas	Flooding, Dam Failure	Eliminates flood risk for residents/ properties in 100-year floodplain	Expensive, requires voluntary participation	Yes

5.2.3 Natural Resource Protections

Natural resource protection activities preserve or restore natural areas or the natural functions of those areas. They are implemented by a variety of agencies, primarily parks, recreation, or conservation agencies or organizations.

Natural Resource Protections Actions

Action	Hazards Addressed	Pros	Cons	Slated
Purchase and Plant Trees on Publicly-Owned Lands to Limit Impacts of Severe Events	Drought, Dam Failure, Extreme Heat, Flooding, Hail, High Winds, Severe Winter Storms	Cost-effective	Politically untenable	Yes
Revise and Update Watershed Master Plans	Flooding	Cost-effective	None	Yes

5.2.4 Emergency Services

Emergency service measures are taken during an emergency to minimize its impact. These measures are usually the responsibility of city or county emergency management staff and the owners/operators of CI/KR.

Emergency Services Actions

Action	Hazards Addressed	Pros	Cons	Slated
Purchase and Distribute Hand Sanitizer Dispensers for Use in Schools	Biological Event	Cost-Effective	Requires voluntary participation by DISD	Yes
Purchase and Install Outdoor Warning Sirens	Aircraft Incident, Dam and Levee Failure, Flooding, Hail, Hazard Materials, High Winds, Terrorism, Tornado, Wildfire	Cost-effective	None	Yes

5.2.5 Structural Projects

Structural projects keep flood waters away from an area with a levee, reservoir, or other flood control measure. They are usually designed by engineers and managed or maintained by public works staff.

Structural Projects Actions

Action	Hazards Addressed	Pros	Cons	Slated
Decommission Lake Simmonds Dam	Dam Failure	100% eliminates dam failure risk.	Expensive	Yes
Correct and Prevent Degradation of Emerald Lake Dam	Dam Failure	Prevents dam failure in the future.	Expensive	Yes
Harden the Luna Vista Pump Station	Earthquake, Hail, High Winds, Lightning, Severe Winter Storm, Terrorism, Tornado	Cost-effective, ensures continuity of operation	None	Yes
Improve the Trinity River Levee System with improvements aimed at increasing their durability, longevity, and flood protection	Flooding	Mitigates potential loss	Expensive	Yes
Design and Construction of Erosion Control Projects	Flooding	Mitigates potential losses	Expensive	Yes

5.2.6 Public Information

Public information activities advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards, and the natural and beneficial functions of local floodplains. They are usually implemented by a public information office.

Public Information Actions

Action	Hazards Addressed	Pros	Cons	Slated
Purchase and Distribute NOAA All-Hazard Radios for Vulnerable Populations	Aircraft Incident, Biological Event, Dam and Levee Failure, Drought, Earthquake, Extreme Heat, Flooding, Hail, Hazard Materials, High Winds, Lightning, Severe Winter Storm, Terrorism, Tornado, Wildfire	Cost-effective	None	Yes
Develop and Implement a Comprehensive Private Mitigation Education Program	Aircraft Incident, Biological Event, Dam and Levee Failure, Drought, Earthquake, Extreme Heat, Flooding, Hail, Hazard Materials, High Winds, Lightning, Severe Winter Storm, Terrorism, Tornado, Wildfire	Cost-effective	None	Yes

This page intentionally left blank.

5.3 Slated Action Items

The flowing action items have been agreed upon by the Mitigation Working Group for inclusion in the Dallas Local Mitigation Action Plan.

City of Dallas Action Item	Purchase and Distribute NOAA All-Hazard Radios for Vulnerable Populations
Hazards Addressed	Aircraft Incident, Biological Event, Dam and Levee Failure, Drought, Earthquake, Extreme Heat, Flooding, Hail, Hazard Materials, High Winds, Lightning, Severe Winter Storm, Terrorism, Tornado, Wildfire
Goal/Objective	2.2
Priority	High
Cost	$1,000,000
Funding Source(s)	HMGP, UASI
Matching Source(s)	Resident cost-match, general fund
Responsible Department	OEM
Cost-Effectiveness Statement	Early warning saves lives and property. By offering radios to vulnerable populations, the percentage of people receiving and responding to these messages approaches 100%.
Effect on Existing Construction	None
Effect on New Construction	None
Implementation Schedule	12 Months
Discussion	The City of Dallas will purchase a set number of NOAA weather radios, 18,000 radios per million dollar allocation, and distribute them to vulnerable populations.

City of Dallas Action Item	Decommission Lake Simmonds Dam
Hazards Addressed	Dam Failure
Goal/Objective	1.1
Priority	Low
Cost	$7,000,000
Funding Source(s)	HMGP, UASI, City Funds
Matching Source(s)	General funds
Responsible Department	Parks and Recreation
Cost-Effectiveness Statement	The current maintenance costs associated with Lake Simmonds and its accompanying dam far exceed the value of the lake and dam. By decommissioning the dam, we protect lives and property while also saving the City money in upkeep costs.
Effect on Existing Construction	Existing property in the inundation area would no longer be at risk for damage from dam failure.
Effect on New Construction	New properties could be developed in the area that once was the inundation zone.
Implementation Schedule	>2 years
Discussion	Dallas Parks and Recreation owns and maintains the dam at Lake Simmonds. The costs associated with maintaining the lake and dam exceed the current value of the lake and dam. Parks and Rec wishes to decommission the dam and lake by draining the water and preventing it from collecting later on.

City of Dallas Action Item	Purchase and Plant Trees on Publicly-Owned Lands to Limit Impacts of Severe Events
Hazards Addressed	Drought, Dam Failure, Extreme Heat, Flooding, Hail, High Winds, Severe Winter Storms
Goal/Objective	4.2
Priority	High
Cost	$1,000,000
Funding Source(s)	HMGP, City Funds
Matching Source(s)	General funds, private donations
Responsible Department	OEM, PKR, OEQ
Cost-Effectiveness Statement	Using the city of Davis, California as a model, existing data on the benefits and costs of municipal trees were applied to the results of a sample inventory of the city's public and private street trees. Results indicate that Davis maintained nearly 24,000 public street trees that provided $1.2 million in net annual environmental and property value benefits, with a benefit–cost ratio of 3.8:1
Effect on Existing Construction	Existing structures would benefit from lower utility costs and increased protection from urban flooding.
Effect on New Construction	New facilities could be constructed in tree-dense areas, allowing them to benefit from lowered utility costs and increased protection from urban flooding.
Implementation Schedule	12-18 Months
Discussion	Countless studies have shown the positive effect of trees on numerous aspects of life, including protection from urban flooding by limiting storm water flow, lowering use of heating and air conditioning, removing pollutants from the air and water, protect roadways, and reduce wind speeds.

City of Dallas Action Item	Purchase and Install Automatic Gates at Low Water Crossings
Hazards Addressed	Flooding
Goal/Objective	1.1
Priority	High
Cost	$25,000/site
Funding Source(s)	HMGP, FMA
Matching Source(s)	Local funds, donations, in-kind
Responsible Department	TWM
Cost-Effectiveness Statement	Flood gates prevent individuals from traveling through high water, saving lives.
Effect on Existing Construction	None
Effect on New Construction	New warning signs and gates would be added to low-water crossing locations.
Implementation Schedule	12 Months
Discussion	Automatic flood gates would be purchased and installed at low water crossings across the City. These would prevent vehicle travel across roads, protecting lives and property.

City of Dallas Action Item	Correct and Prevent Degradation of Emerald Lake Dam
Hazards Addressed	Dam Failure
Goal/Objective	1.1
Priority	Medium
Cost	$1.5 Million
Funding Source(s)	HMGP, other state/federal grants
Matching Source(s)	Local funds, in-kind
Responsible Department	TWM
Cost-Effectiveness Statement	Maintenance costs related to preserving them dam at its current condition exceed costs associated with retrofitting the dam.
Effect on Existing Construction	Improvements would be made to the existing dam structure to decrease the likelihood of failure.
Effect on New Construction	None
Implementation Schedule	2 years
Discussion	Emerald Lake Dam was constructed through poor engineering practices and now is no longer compliant with TCEQ regulations. While not currently at risk of failure, improvements should be made soon to curtail damage. These improvements include improving primary and auxiliary spillways, raising the dam, armoring the primary spillway, and improving the downstream slope of the dam.

City of Dallas Action Item	Buyout Properties in Hazardous Areas
Hazards Addressed	Flooding, Dam Failure
Goal/Objective	1.3
Priority	High
Cost	Market Rate/Property
Funding Source(s)	HMGP, other state/federal grants
Matching Source(s)	Local funds, in-kind
Responsible Department	TWM
Cost-Effectiveness Statement	The investment of federal funds into purchasing properties in the floodplain is paltry compared to the amount of RL/SRL claims each year.
Effect on Existing Construction	Existing structures inside floodplains and dam inundation zones
Effect on New Construction	None
Implementation Schedule	12 Months
Discussion	This project would enable homeowners to voluntarily sell their vulnerable properties to the city. Eligible homes would be those in floodplains or dam inundation zones.

City of Dallas Action Item	Purchase and Install New Cameras in High Risk Areas
Hazards Addressed	Terrorism
Goal/Objective	3.1
Priority	Medium
Cost	TBD
Funding Source(s)	UASI, General Funds
Matching Source(s)	Local funds
Responsible Department	DPD, OEM
Cost-Effectiveness Statement	Better cameras would act as greater deterrents to crime, including terrorism.
Effect on Existing Construction	None
Effect on New Construction	None
Implementation Schedule	12 Months
Discussion	The existing camera system that Dallas Police Department uses is obsolete and does not currently meet the demands of a UASI jurisdiction with 1.5 million residents. This project would purchase and install new cameras that would increase the observability of critical infrastructure and key resources across the city.

City of Dallas Action Item	Purchase and Distribute Hand Sanitizer Dispensers for Use in Schools
Hazards Addressed	Biological Event
Goal/Objective	1.4
Priority	Medium
Cost	$20/dispenser
Funding Source(s)	UASI, HHS grants, general funds
Matching Source(s)	Local funds, donations, matching partnership with schools
Responsible Department	OEM
Cost-Effectiveness Statement	Successful distribution of hand sanitizers can prevent disease outbreaks before they occur, protecting lives.
Effect on Existing Construction	None
Effect on New Construction	None
Implementation Schedule	12 Months
Discussion	Hand sanitizer dispensers would be distributed to schools within the City of Dallas, including public and private schools, to stop the spread of harmful pathogens before they lead to an outbreak.

City of Dallas Action Item	Harden the Luna Vista Pump Station
Hazards Addressed	Earthquake, Hail, High Winds, Lightning, Severe Winter Storm, Terrorism, Tornado,
Goal/Objective	1.3
Priority	Medium
Cost	$75,000
Funding Source(s)	City Budget, HMGP
Matching Source(s)	Local funds, donations, in-kind
Responsible Department	TWM
Cost-Effectiveness Statement	Reinforcing the enclosure surrounding the Luna Vista Pump Station will decrease the amount of damage that occurs to the structure during events.
Effect on Existing Construction	Existing pump structure would be better protected against damage during events.
Effect on New Construction	None
Implementation Schedule	12-18 Months
Discussion	Project based on Guam Memorial Hospital Wind Mitigation (HSDL, 2005). Structure would be surrounded by a cage of reinforced chain link steel and concrete. The foundation of the structure would be augmented to protect against earthquake impacts. This will prevent damage from debris and unauthorized access. A lightning rod will be added to the structure to mitigate any increased risk of lightning damage.

City of Dallas Action Item	Develop and Implement a Comprehensive Private Mitigation Education Program
Hazards Addressed	Aircraft Incident, Biological Event, Dam and Levee Failure, Drought, Earthquake, Extreme Heat, Flooding, Hail, Hazard Materials, High Winds, Lightning, Severe Winter Storm, Terrorism, Tornado, Wildfire
Goal/Objective	2.3
Priority	High
Cost	$20,000
Funding Source(s)	UASI, SHSP, HMGP, City Funds
Matching Source(s)	Local funds, donations, in-kind
Responsible Department	OEM
Cost-Effectiveness Statement	Public education programs
Effect on Existing Construction	None
Effect on New Construction	None
Implementation Schedule	18 Months
Discussion	This project would create a program for educating private residents on tools for mitigating their property against hazards. This program would be delivered to residents through public education meetings and presentations.

City of Dallas Action Item	Purchase and Install Outdoor Warning Sirens
Hazards Addressed	Aircraft Incident, Dam and Levee Failure, Flooding, Hail, Hazard Materials, High Winds, Terrorism, Tornado, Wildfire
Goal/Objective	1.3
Priority	Medium
Cost	35,000 per siren
Funding Source(s)	HMGP, General Fund
Matching Source(s)	Local funds, donations, in-kind, public-private partnerships
Responsible Department	OEM
Cost-Effectiveness Statement	Early warning saves lives and property. By increasing the amount of vulnerable populations that will be able to receive the warning notification, the percentage of people receiving and responding to these messages approaches 100%.
Effect on Existing Construction	None
Effect on New Construction	None
Implementation Schedule	12 Months
Discussion	The City of Dallas will purchase and install outdoor warning sirens in neighborhoods that are currently underserved by the existing warning system. This will increase the amount of residents who are able to hear the OWS and react accordingly.

City of Dallas Action Item	Develop and Adopt “Wildfire Defense” Ordinances for Properties in Wildland-Urban Interface Areas
Hazards Addressed	Wildfire
Goal/Objective	1.3
Priority	High
Cost	$20,000
Funding Source(s)	General Fund
Matching Source(s)	N/A
Responsible Department	DFR Wildland Team, PUD
Cost-Effectiveness Statement	Regulations to limit or eliminate the impact of wildfire on private property would protect lives and property for minimal cost.
Effect on Existing Construction	Existing properties could be modified to meet the new regulations and ordinances.
Effect on New Construction	New properties constructed within designated areas would be required to meet new regulations and ordinances.
Implementation Schedule	Within 12 Months
Discussion	Ordinances would be adopted and enforced based on the location of a property.

City of Dallas Action Item	Require New City Multi-Use Facilities to be Built to FEMA 361 Standards.
Hazards Addressed	Earthquake, High Winds, Tornados
Goal/Objective	4.3
Priority	Medium
Cost	$20,000
Funding Source(s)	General Funds
Matching Source(s)	None
Responsible Department	EBS, OEM
Cost-Effectiveness Statement	Building new facilities to FEMA 361 standards ill not only protect them against damage during severe events, it will also enable them to act as public shelters during severe weather, saving lives.
Effect on Existing Construction	None.
Effect on New Construction	New city “multi-use” facilities would be constructed to the FEMA 361 standard.
Implementation Schedule	12 months
Discussion	

City of Dallas Action Item	Adopt and Enforce the 2016 International Building Code
Hazards Addressed	Dam and Levee Failure, Drought, Earthquake, Extreme Heat, Flooding, Hail, High Winds, Lightning, Severe Winter Storm, Terrorism, Tornado, Wildfire
Goal/Objective	4.3
Priority	High
Cost	$20,000
Funding Source(s)	General Funds
Matching Source(s)	None
Responsible Department	SDC, Code Compliance, CMO
Cost-Effectiveness Statement	Adopting the 2016 International Building Code will save lives and money by ensuring that privately-owned buildings are protected against natural hazards.
Effect on Existing Construction	Existing buildings that meet the “Improved Property” ordinance threshold will be required to meet the new building code.
Effect on New Construction	New construction will be required to be in compliance with the new ordinance.
Implementation Schedule	12 months
Discussion	

City of Dallas Action Item	Provide WMD / CBRNE training for all members of the Hazmat Response Team at the CDP in Anniston, Alabama
Hazards Addressed	Hazardous Materials, Biological Event, Terrorism
Goal/Objective	1.1
Priority	High
Cost	$250,000
Funding Source(s)	UASI
Matching Source(s)	General Fund
Responsible Department	DFR
Cost-Effectiveness Statement	Quick detection and mitigation will save many lives in the event of a Biological Event or a WMD Terrorism event. Training is the only way to prepare the team to respond and quickly mitigate an event of this nature.
Effect on Existing Construction	None
Effect on New Construction	None
Implementation Schedule	1-3 years
Discussion	Center for Domestic Preparedness is the only live agent training facility in the world. The training is provided at no cost. The only cost incurred by the city is the overtime and backfill for the members to be absent from duty to attend.

City of Dallas Action Item	Provide Confined Space training for all members of the Hazmat Response Team
Hazards Addressed	Hazardous Materials, Terrorism, Tornado
Goal/Objective	1.1
Priority	Moderate
Cost	$150,000
Funding Source(s)	UASI
Matching Source(s)	General Fund
Responsible Department	DFR
Cost-Effectiveness Statement	Quick response and actions will ultimately help save lives and property.
Effect on Existing Construction	None
Effect on New Construction	None
Implementation Schedule	1-3 years
Discussion	C onfined space emergencies are normally handled by USAR, but it is actually a Hazmat discipline. USAR cannot go into a confined space until the air quality has been monitored, and then has to be monitored for the duration that members are in the confined space. Hazmat provides the air monitoring.

City of Dallas Action Item	Provide Ropes training for all members of the Hazmat Response Team
Hazards Addressed	Hazardous Materials, Terrorism, Tornado
Goal/Objective	1.1
Priority	High
Cost	$140,000
Funding Source(s)	UASI
Matching Source(s)	General Fund
Responsible Department	DFR
Cost-Effectiveness Statement	Quick response and actions will ultimately help save lives and property.
Effect on Existing Construction	None
Effect on New Construction	None
Implementation Schedule	1-3 years
Discussion	This course is a pre-requisite for the Confined Space training.

City of Dallas Action Item	Improve the Trinity River Levee System with improvements aimed at increasing their durability, longevity, and flood protection
Hazards Addressed	Flooding
Goal/Objective	1.2
Priority	High
Cost	$485,106,000
Funding Source(s)	City Funds
Matching Source(s)	USACE
Responsible Department	TWM
Cost-Effectiveness Statement	The Dallas Floodway System protects over $12 billion in property.
Effect on Existing Construction	Improvements to the Trinity River Levee System would reduce the risk of inundation to existing structures due to levee failure. Improvements to the interior drainage system would provide an additional layer of protection to properties and reduce the inundated areas.
Effect on New Construction	New properties could be developed in the area previously inundated by the interior drainage system.
Implementation Schedule	TBD
Discussion	The Trinity River Corridor Project is a multi-phase development of the Trinity River basin, which runs through a significant portion of Dallas. This project will augment and strengthen the levee system along the Trinity River basin thus mitigating the potential for Levee Failure. Improvements would be made to the interior drainage system to increase the capacity of the pump stations and storm sewer systems

City of Dallas Action Item	Revise and Update Watershed Master Plans
Hazards Addressed	Flooding
Goal/Objective	4.1
Priority	Medium
Cost	$15,000,000
Funding Source(s)	FEMA HMGP, City Funds
Matching Source(s)	General Funds
Responsible Department	TWM
Cost-Effectiveness Statement	Implementation of mitigation projects based on current engineering allow the project to be designed for existing watershed conditions and not be under or over designed.
Effect on Existing Construction	Revised engineering and floodplain mapping will determine the extent of flooding through existing structures. The mitigation alternatives will identify structural and non-structural measures to remove properties from the floodplain.
Effect on New Construction	The identified mitigation alternatives can potentially reduce the flooding due to riverine and storm sewer flooding and allow for additional areas to be developed.
Implementation Schedule	TBD
Discussion	In that time that the City of Dallas has been developing watershed plans, there has been substantial development in many of the study areas. There has also been a significant advancement in topography and engineering methods. The watershed master plans will be updated with new engineering to verify the extent of mapping due to riverine and storm sewer flooding. The study will revise the recommended mitigation measures to alleviate the flooding problems through the watershed.

City of Dallas Action Item	Design and Construction of Erosion Control Projects for Streams within Dallas
Hazards Addressed	Flooding
Goal/Objective	4.1
Priority	Medium
Cost	$11,594,000
Funding Source(s)	FEMA HMGP, City Funds
Matching Source(s)	General Funds
Responsible Department	TWM
Cost-Effectiveness Statement	Implementation of erosion control projects limit the threat of erosion during a storm event to the surrounding structures.
Effect on Existing Construction	Implementation of erosion control projects reduce the risk of structural failure of existing structures.
Effect on New Construction	New properties could be developed in the areas previously eroded by the stream.
Implementation Schedule	TBD
Discussion	Erosion protection of all structures identified on the City of Dallas Needs Inventory.

This page intentionally left blank.

Chapter 6: Maintenance

6.1 Plan Update

The Disaster Mitigation Act of 2000 requires that the City of Dallas Local Mitigation Action Plan be updated once every five years. The City of Dallas Office of Emergency Management Hazard Mitigation Specialist will be responsible for ensuring that this update is completed. The Mitigation Working Group will be involved to ensure all departments provide input into the planning process. The public will also be invited to participate in the process.

6.2 Plan Maintenance

Once formally adopted by council resolution the plan will be submitted to the Texas Department of Emergency Management (TDEM) and the Federal Emergency Management Agency (FEMA). The plan will be revised and maintained as required under the guidance of the Hazard Mitigation Working Group members. Each revision will be formally adopted by the City of Dallas.

Public participation will be sought throughout the plan implementation, evaluation, and maintenance. This will be included in periodic presentations of the plans progress to the City of Dallas Public Safety Commission, annual questionnaires and surveys, public meetings, and postings on social media and the Office of Emergency Management's website.

Incorporating into Existing Planning Documents
It will be the responsibility of the Office of Emergency Management to determine additional implementation procedures when appropriate. This will include integrating the requirements of the City of Dallas Local Mitigation Plan into other City of Dallas planning documents or processes such as the following:

- ✓ Emergency Management Accreditation Program (EMAP) Standards
- ✓ Strategic plan
- ✓ Continuity of Operations Plans
- ✓ National Flood Insurance Community Rating System
- ✓ Ordinances, resolutions, and regulations

Specific points of integration are identified below in Table 38.

Technical assistance with hazard mitigation-related projects and programs will be conducted by the Office of Emergency Management. This includes, but is not limited to, public education presentations on the hazards identified in this plan, and various recommended mitigation strategies.

Opportunities to integrate the requirements of this plan into other planning mechanisms will continue to be identified through future meetings of the Mitigation Working Group and through the five year review process as required by FEMA.

Table 38 – LMAP Incorporation Processes

Local Planning Documents	Responsible Personnel	Integration Schedule	Integration Plan
City Budget	City Manager	Annually	Integration of mitigation projects identified in LMAP, grants, and other fiscal allowances for mitigation actions and related costs
Emergency Operations Plan updates	Senior Emergency Management Specialist - Planning	Reviewed Annually, updated as needed	EOP Mitigation annex updates based on LMAP HIRA; update preparedness, response and recovery actions related to identified hazards
Floodplain ordinances	Floodplain Manager	As needed	Enhance mitigation of flood hazards using LMAP flood data for floodplain management and community development.
Community Rating System Program	CRS Coordinator	Annually	
Capital improvement plans	Economic Development	Annually	Strengthen critical infrastructure and key resources based on LMAP hazard analysis, incorporate vulnerability data and action items.
Public Education Programs	Community Outreach Coordinator	Bi-annually	Update public education presentations to include new information about hazards and private mitigation projects.

Appendix A – Community Profile

Dallas is a major city in the State of Texas. While the city proper ranks ninth in the United States and third in Texas for population, it is also a part of the “D/FW Metroplex”, an urban conglomerate that ranks fourth in the US for population and sixth for economic output. Dallas is the largest component of the Metroplex in both population and economic output. In 2014, Dallas ranked 50th in *Foreign Policy*’s ranking of global cities.

History

In 1839, Warren Angus Ferris surveyed the area around present-day Dallas. John Neely Bryan established a permanent settlement near the Trinity River named Dallas in 1841. The Republic of Texas was annexed by the United States in 1845 and Dallas County was established the following year. Dallas was formally incorporated as a city on February 2, 1856.

With construction of railroads, Dallas became a business and trading center, and was booming by the end of the 19th century. It became an industrial city, attracting workers from Texas, the South and the Midwest. The Praetorian Building of 15 stories, built in 1909, was the first skyscraper west of the Mississippi and the tallest building in Texas for some time. It marked the prominence of Dallas as a city. A racetrack for Thoroughbreds was built and their owners established the Dallas Jockey Club. Trotters raced at a track in Fort Worth, where a similar Drivers Club was based. The rapid expansion of population increased competition for jobs and housing.

In 1958 a version of the integrated circuit was invented in Dallas by Jack Kilby of Texas Instruments; this event punctuated the Dallas area's development as a center for high-technology manufacturing (though the technology Mr. Kilby developed was soon usurped by a competing technology simultaneously developed in the "Silicon Valley" in California by engineers who would go on to form Intel Corporation). During the 1950s and 1960s, Dallas became the nation's third-largest technology center, with the growth of such companies as Ling-Temco-Vought (LTV Corporation) and Texas Instruments.

On November 22, 1963, President John F. Kennedy was assassinated on Elm Street while his motorcade passed through Dealey Plaza in downtown Dallas. The upper two floors of the building from which Lee Harvey Oswald shot Kennedy, the Texas School Book Depository, have been converted into a historical museum covering the former president's life and accomplishments.

In the late 1970s and early to mid-1980s, Dallas underwent the building boom which produced a distinctive contemporary profile for the downtown area and a prominent skyline, influenced by nationally acclaimed architects. By the 1980s, when the oil industry mostly relocated to Houston, Dallas was beginning to benefit from a burgeoning technology boom (driven by the growing computer and telecom industries), while continuing to be a center of banking and business. In 1983, voters in Dallas and area cities approved the creation of Dallas Area Rapid

Transit to replace the Dallas Transit System. Dallas annexed Audelia in 1981, and Renner in 1983. In 1984, the Dallas Museum of Art moved from Fair Park as one of the first buildings in downtown's Arts District. Also in 1984, the Republican National Convention was held in Dallas. In 1985, at the peak of the real estate boom, the 72-story Bank of America Plaza (then InterFirst Plaza) opened as the tallest building in Dallas. From the mid-to-late 1980s, many banks, especially in Dallas, collapsed during the Savings and Loan crisis, nearly destroying the city's economy and scrapping plans for hundreds of structures.

In the late 1990s, the booming telecom industry exploded in Dallas, especially in areas like Las Colinas and the Telecom Corridor. During this time, Dallas became known as Texas's Silicon Valley, or the "Silicon Prairie". Another recession prompted by the dot-com bubble-burst and the 2001 terrorist attacks hurt several of the city's vital industries. By 2004, signs of an economic turnaround began to appear. In 2005, three towers began construction amid tens of residential conversions and smaller residential projects. By the year 2010, the North Central Texas Council of Governments expects 10,000 residents to live within the loop. Just north, Uptown is one of the hottest real estate markets in the country. At the beginning of 2006, nine highrise residential buildings or hotels were under construction in that area. Leading the way is the $500M phase two of Victory Park, a $3B+ project. At full build-out, it should contain more than 4,000 residences and 4M ft² of office and retail space.

The Arts District in downtown is also expected to become a major point of growth. As the Dallas Center for the Performing Arts Foundation implements construction on several new projects in its master plan for the area. When the new Winspear Opera House (Foster and Partners) and Wyly Theatre (Office for Metropolitan Architecture - Rem Koolhaas) join the existing Nasher Sculpture Center (Renzo Piano) and Meyerson Symphony Center (I.M. Pei and Partners), Dallas will be the only city in the world that has four buildings within one contiguous block that are all designed by Pritzker Architecture Prize winners.

Demographics

As of the 2010 Census Dallas had a population of 1,197,816. The median age was 31.8.

According to the 2010 Census, 50.7% of the population was White (28.8% non-Hispanic white), 25.0% was Black or African American, 0.7% American Indian and Alaska Native, 2.9% Asian, 2.6% from two or more races. 42.4% of the total population was of Hispanic or Latino origin (they may be of any race).

There were 458,057 households at the 2010 census, out of which 29.1% had children under the age of 18 living with them, 36.1% were headed by married couples living together, 16.0% had a female householder with no husband present, and 42.0% were classified as non-family households. 33.7% of all households had one or more people under 18 years of age, and 17.6% had one or more people who was 65 years of age or older. The average household size was 2.57 and the average family size was 3.42.

Dallas is a major destination for Mexican immigrants. The southwestern portion of the city, particularly Oak Cliff is chiefly inhabited by Hispanic residents. The southeastern portion of the city Pleasant Grove is chiefly inhabited by black and Hispanic residents, while the southern portion of the city is predominantly black. The West and East sides of the city are predominately Hispanic; Garland also has a large Spanish speaking population. North Dallas is many enclaves of predominantly white, black and especially Hispanic residents.

Recognized for having the sixth largest lesbian, gay, bisexual, and transgender (LGBT) population in the nation, the Dallas metropolitan is widely noted for being home to a thriving and diverse LGBT community. Throughout the year there are many well-established LGBT events held in the area, most notably the annual Alan Ross Texas Freedom (Pride) Parade and Festival held every September since 1983 which draws tens of thousands from around the world. For decades, the Oak Lawn and Bishop Arts districts have been known as the epicenters of the LGBT community in Dallas.

Appendix B – Planning Process Documentation

Mitigation Working Group Kickoff Meeting
November 5, 2015

Participant Sign-in Sheet
(PLEASE PRINT CLEARLY)

NAME	AGENCY/DEPARTMENT	PHONE/FAX	E-MAIL
Dennis Allen	CERT	214-370-9089	ddallen20@att.net
Sherece Hughes	City of Dallas Dallas Love Field	214-670-0548	sherece.hughes@dallascityhall.com
Janette Monreal	Texas Trees	214 273 6655	janette@texastrees.org
Jen Edwards	CERT	214 557 0497	jen.edwards@gmail.com
Matt Gabbert	Texas Trees	214-500-9557	matt@texastrees.org
Michael Garcia	Dallas County HSEM	214 653 6962	michael.garcia@dallascounty.org

Mitigation Working Group Kickoff Meeting
November 5, 2015

Participant Sign-in Sheet
(*PLEASE PRINT CLEARLY*)

NAME	AGENCY/DEPARTMENT	PHONE/FAX	E-MAIL
David Vespucci	CERT	972 804 3656	dvespucci@hotmail.com
David Cegielski	CERT	214.801.2708	david@dynamicgrowthstrategies.com
Jessica Baker	HALFF	214 217 6692	jbaker@halff.com
Jack Young	~~HALFF~~	214 217 6676	jyoung@halff.com
Don Knight	ATT	214 670 3224	don.knight@att.net
Kim Dowailly	TWM - Floodplain	214-948-4619	kimberly.dowailly@dallascityhall.com
Steve Parker	~~Tom Floodplain~~	214-948-4666	~~steven.parker@dallascityhall.com~~
Kevin Oden	OEM		
Emily Black	PIO	7135690266	emily.black@dallascityhall.com

Mitigation Working Group Kickoff Meeting
November 5, 2015

Participant Sign-in Sheet
(PLEASE PRINT CLEARLY)

NAME	AGENCY/DEPARTMENT	PHONE/FAX	E-MAIL
DEBORAH LOCKHART	CERT	214-361-7615	OWLBEAR@IKSNET.COM
LYNN BRANTLEY	DFR/HAZMAT	469-323-5810	lynn.brantley@dallascityhall.com
Yazmun Mendoza	CERT	214-529-7619	Mendozayaz@hotmail.com
John Ozmun	CERT	214 5574925	Johnozmun@yahoo.com
Ray Feagins	CERT	469 955 3826	rfeagins@aviall.com
Kevin Luper	DFR/WILDLAND	817-939-3359	Kevin.Luper@dallascityhall.com
Andrea Wilson	NCTCOG	8176959091	AWilson@nctcog.org
Billy Rios	TWM	214 671 2130	billy.rios1@dallascityhall.com
Rick McRay	TWM/FC	214-670-7124	rick.mcray@dallascityhall.com

Mitigation Working Group Meeting #2
January 20, 2016

Participant Sign-in Sheet
(PLEASE PRINT CLEARLY)

NAME	AGENCY/DEPARTMENT	PHONE/FAX	E-MAIL
Kevin Luper	DFR	817-939-3359	Kevin.Luper@DallasCityhall.com
Ryan Thornton	DFR	252-646-4417	thorntonr79@yahoo.com
Deborah Lockhart	CERT	214-341-4445	OH!BEAR@IX.NETCOM.COM
Jessica Baker	Halff	214-217-6692	jbaker@halff.com
Jack Young	Halff	214 217 6676	Jyoung@halff.com
Lynn Brantley	DFR	469.323-5810	lynn.brantley@dallascityhall.com
Dhruv Bamaiya	TWM	214-671-0333	
Ray Feagins	CERT	469 955 3826	rfeagins@aviall.com
Dennis Allen	CERT	908-672-7749	ddallen20@att.net

Mitigation Working Group Meeting #2
January 20, 2016

Participant Sign-in Sheet
(PLEASE PRINT CLEARLY)

NAME	AGENCY/DEPARTMENT	PHONE/FAX	E-MAIL
MICHAEL GACIRI	DALLAS COUNTY HSEM	214-653-6962	michael.gaciri@dallascounty.org
Sarah Carroll	City of Dallas OFS	214-670-3078	sarah.carroll@dallascityhall.com
Tam Vu	COD / Floodplain	214-948-4683	tam_vu@dallascityhall.com
Kim Dewailly	COD / Floodplain	214-948-4619	kimberly.dewailly@dallascityhall.com

Mitigation Working Group Meeting #3
March 16, 2016

Participant Sign-in Sheet
(PLEASE PRINT CLEARLY)

NAME	AGENCY/DEPARTMENT	PHONE/FAX	E-MAIL
Lynn Brantley	DFR - HAZMAT	214/670-8555	lynn.brantley@dallascityhall.com
James Overbey	HALFF / TRINITY WATERSHED MANAGEMENT	214-217-6621	joverbey@halff.com
MICHAEL GACIRI	DALLAS COUNTY - HSEM	214 653 6962	michaeligaciri@dallascounty.org
Jack Young	HALFF	214 217 6676	jyoung@halff.com
FIKRE ABRAHA	TWM - FP	214-948-4133	fikre.abraha@dallascityhall.com
Don Knight	City Attorney	214-670-3224	don.knight@dallascityhall.com
RANDY PAYTON	DWU	670-1201	Randall.payton@dal-

Mozilla Firefox Start Pa... | Slate Magazine - Politi... | Amazon blocks sale of... | DAC | Welcome to the City o...

dallascityhall.com/Pages/default.aspx

Search

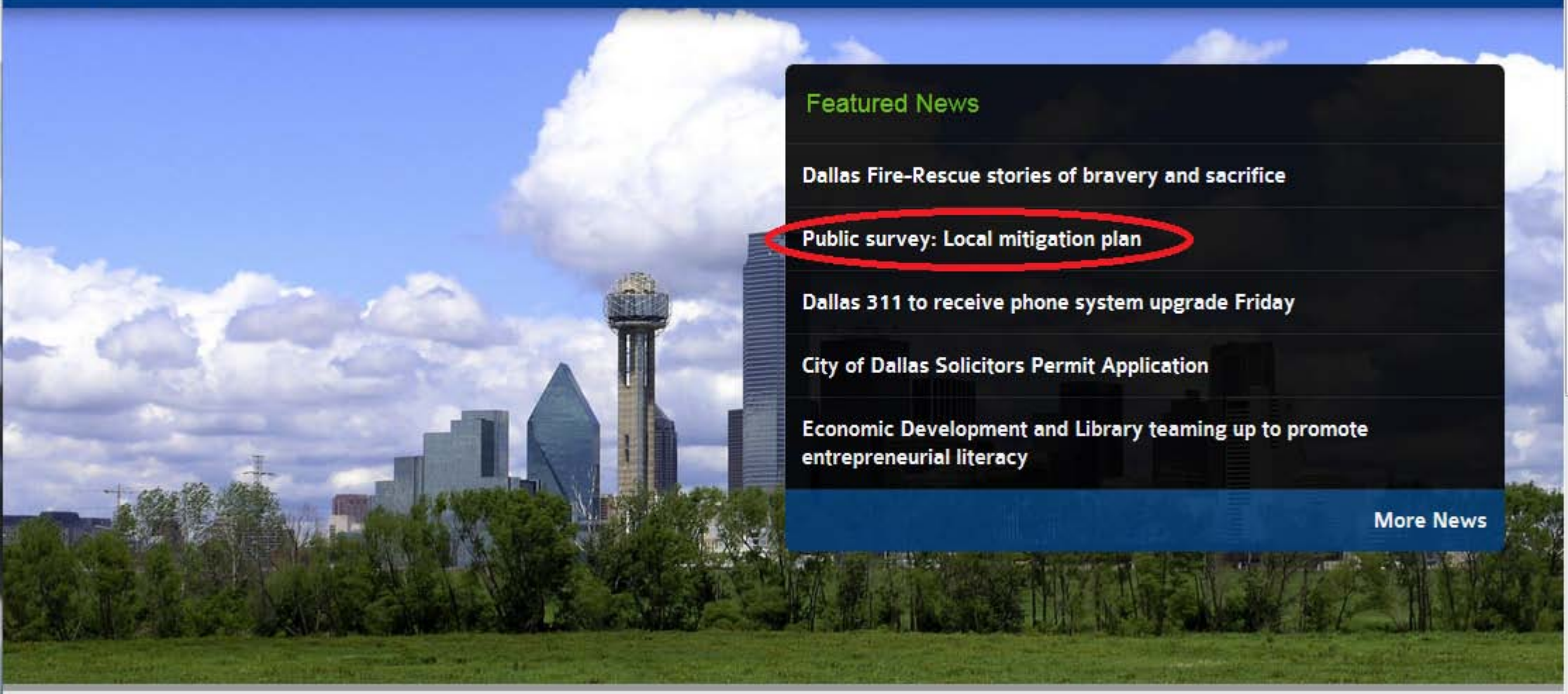
Most Visited | Getting Started | Suggested Sites | Web Slice Gallery

Sign In

Mayor | City Council | City Manager | Departments | Document Center | Select Language | Feedback | Connect | Pay

City of Dallas

Resident | Business | Government | 311 | News



Featured News

Dallas Fire-Rescue stories of bravery and sacrifice

Public survey: Local mitigation plan

Dallas 311 to receive phone system upgrade Friday

City of Dallas Solicitors Permit Application

Economic Development and Library teaming up to promote entrepreneurial literacy

More News

Find

Request

Pay

Financial Transparency

OFFICIAL POSTINGS

- Open Meetings
- Council Agenda
- Council Briefings
- Committee Briefings
- City Calendar

QUICK LINKS

- West Nile Virus Updates
- Court Online Payments
- Employment
- Warrants & Bonds
- Water Utilities

8:07 AM
10/2/2015

Local Mitigation Action Plan Public Survey

The City of Dallas Office of Emergency Management needs your help to identify the hazards that most affect residents and visitors in Dallas. Please take a moment to answer a few questions about what hazards you feel affect the city the most and what you think the City should do to protect lives and property.

http://app.keysurvey.com/votingmodule/s180/f/978244/e50c/

Your assistance is greatly appreciated

Local Mitigation Action Plan Public Survey

The City of Dallas Office of Emergency Management needs your help to identify the hazards that most affect residents and visitors in Dallas. Please take a moment to answer a few questions about what hazards you feel affect the city the most and what you think the City should do to protect lives and property.

http://app.keysurvey.com/votingmodule/s180/f/978244/e50c/

Your assistance is greatly appreciated

LaGrassa, Nicholas

From: Snasel, Justin
Sent: Friday, October 02, 2015 12:01 PM
To: LaGrassa, Nicholas
Subject: FW: Courtesy Copy: Dallas OEM Public Survey: Local Mitigation Action Plan

Nick,

Here is a copy of the release as requested.

-Justin

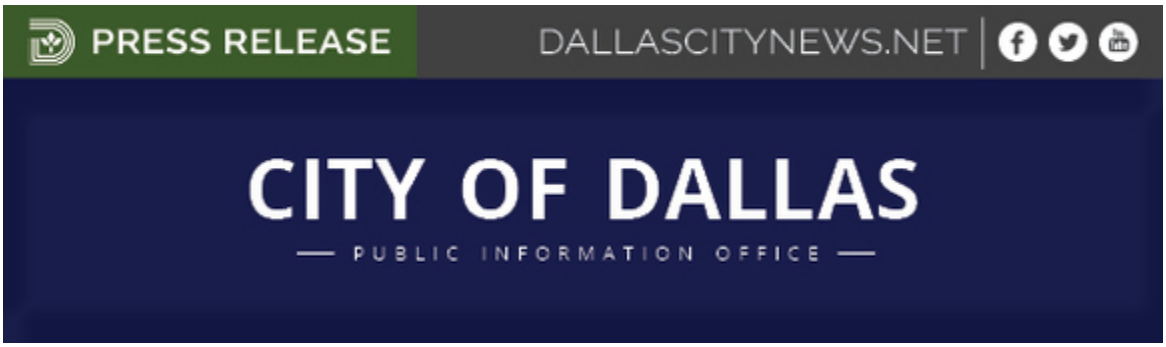
From: City of Dallas [mailto:dallas@service.govdelivery.com]
Sent: Wednesday, September 30, 2015 10:12 AM
To: Hill, Richard <richard.hill@dallascityhall.com>; Lavender, Joel <joel.lavender@dallascityhall.com>; Clapper, Jeffrey <jeffrey.clapper@dallascityhall.com>; Ornelas, Estela <estela.ornelas@dallascityhall.com>; Fullwood, Margaret <margaret.fullwood@dallascityhall.com>; Sanchez, Amanda <amanda.sanchez@dallascityhall.com>; Webgroup <webgroup@dallascityhall.com>; Torres, Jose Luis <jose.torres@dallascityhall.com>; Evans, Jason <jason.evans@dallascityhall.com>; Syed, Sana <sana.syed@dallascityhall.com>; Schmidt, Judy <judy.schmidt@dallascityhall.com>; Cantril Dulac, Helen <helen.dulac@dallascityhall.com>; Black, Emily <emily.black@dallascityhall.com>; Gardner, Landon <landon.gardner@dallascityhall.com>; Hawkins, Andrea <andrea.hawkins@dallascityhall.com>; Snasel, Justin <justin.snasel@dallascityhall.com>; Allen, Brenda <brenda.allen@dallascityhall.com>; Gonzalez-Kurz, C.C. <c.gonzalezkurz@dallascityhall.com>; Williams, Shawn <shawnp.williams@dpd.ci.dallas.tx.us>
Subject: Courtesy Copy: Dallas OEM Public Survey: Local Mitigation Action Plan

This is a courtesy copy of an email bulletin sent by Justin Snasel.

This bulletin was sent to the following groups of people:

Subscribers of PIO - English Media List, PIO - News Releases, or PIO - Spanish Media List, (7757 recipients)

Dallas City News Releases I View Online



FOR IMMEDIATE RELEASE
September 30, 2015

FOR MORE INFORMATION CONTACT
Nicholas LaGrassa
214-670-4275
nicholas.lagrassa@dallascityhall.com

Public Survey: Local Mitigation Action Plan

The City of Dallas Office of Emergency Management (OEM) is conducting a public survey to collect information for residents on their perception of hazard vulnerability, both natural and man-made.

The data collections in this survey will be used for funding projects to lower the vulnerability of hazards identified in the plan. The survey will conclude on November 30, 2015.

We want to know: What hazards you feel affect the city the most? What you think the City should do to protect lives and property?

TAKE THE PUBLIC SURVEY
http://app.keysurvey.com/votingmodule/s180/f/978244/e50c

“Public perception of vulnerability is a huge part of this plan,” Director of Emergency Management Rocky Vaz said. “It is important to us in the Office of Emergency Management that public concerns are heard and acted upon.”

The Basic Plan outlines City's approach to emergency operations, providing general guidance for emergency management activities. This is an overview of the City's methods of mitigation, preparedness, response, and recovery.

The plan describes the City's emergency response organization and responsibilities for emergency tasks. This plan provides a framework for more specific responsibilities through accompanying Annexes. This plan applies to all City of Dallas officials, departments, and agencies.

“This survey will assist OEM in analyzing vulnerability of hazards on the City of Dallas,”Vaz added. "Your assistance will directly lead to prioritization of mitigation actions.”

Office of Emergency Mana... | DallasOEM (@DallasOEM) |...

Twitter, Inc. (US) | https://twitter.com/DallasOEM?ref_src=twsrc^tfw

Search

Most Visited | Getting Started | Suggested Sites | Web Slice Gallery

New to Twitter? Sign up

Search Twitter | Have an account? Log in

DallasOEM
@DallasOEM

TWEETS	FOLLOWING	FOLLOWERS	FAVORITES	LISTS
4,637	371	5,651	80	1

Follow

2 2

DallasOEM @DallasOEM · Sep 1

To better plan for emergencies, we need YOUR input on hazards & how to limit impacts to the City. Click for survey: ow.ly/RDs30

RETWEETS 4 FAVORITES 3

9:45 AM - 1 Sep 2015 · Details

DallasOEM @DallasOEM · Sep 1

RT "When roads are flooded, Turn Around. Don't Drown. It may save your life!"
#NatlPrep Wk 1 - #floodsafety.

4:03 PM
9/3/2015

Office of Emergency Mana...

dallascityhall.com/departments/officeemergencymanagement/Pages/default.aspx

Search

Most Visited | Getting Started | Suggested Sites | Web Slice Gallery

Allow dallascityhall.com to run "Microsoft Office"? Continue Blocking | Allow...

Sign In

Mayor | City Council | City Manager | Departments | Document Center | Select Language | Feedback | Connect | Pay

City of Dallas

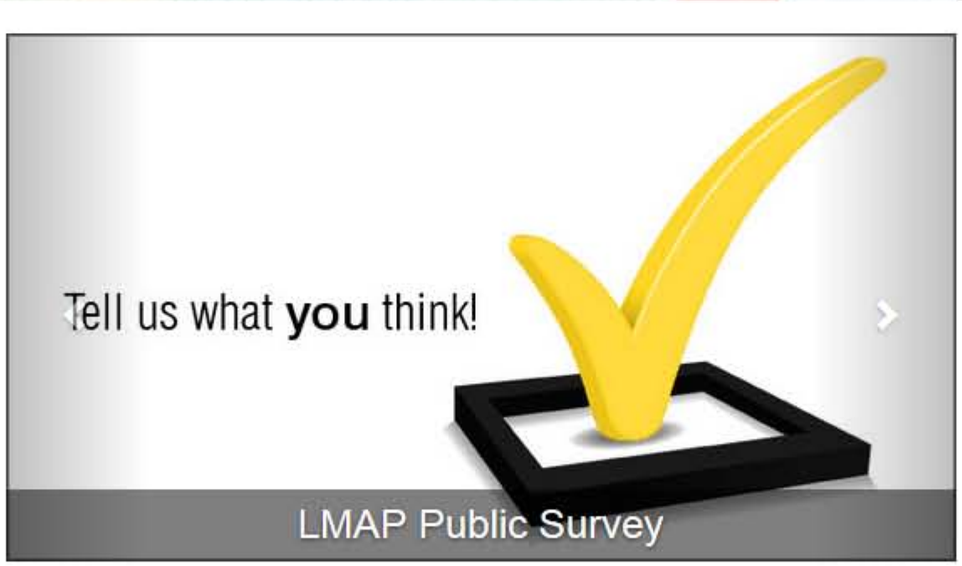
Resident | Business | Government | 311 | News

City of Dallas OEM Office of Emergency Management

City of Dallas Office of Emergency Management

- Home
- About
- News & Events
- Get Informed
- Get Prepared
- Get Involved
- Warnings
- Plans & Programs
- Gallery

Office of Emergency Management
1500 Marilla St.,
L2AN
Dallas, Texas 75201
Phone: (214) 670-4275
Fax: (214) 670-4677



Alerts

Follow us on Twitter for up-to-date information.

Spotlight

Tweets Follow

311 Dallas @311Dallas 5h
Mosquito Spraying Thurs. & Fri. between 9PM & 5AM, 5900 block of Monitcello, 11400 block of Park Central, 7100 block of Joyce Way
Retweeted by DallasOEM
Expand

DallasOEM @DallasOEM 5h
Reps & depts from around North Texas attend training on managing rail emergencies exercise hosted by @NCTCOGEP pic.twitter.com/wtIkJ2CLE2

3:50 PM
9/3/2015

something sat something.... Trite but true!
June 28, 2015 · 2 Reviews ·

Rose Brown — 5★ Did the dogs do we have a good thing for everybody
February 1, 2014 · 45 Reviews ·
1

Tell people what you think

PEOPLE ALSO LIKE

Dallas Police Department
Government Organization

The Dallas Morning News
Newspaper

US National Weather Service For...
Government Organization

See more City Halls in Dallas, Texas

LIKED BY THIS PAGE

US National Weather Service For...

Storm Prediction Center

National Terrorism Advisory System (...

FEMA AMERICA'S PrepareAthon! Ready.

Like Comment Share

Brenda Arevalo de Vizcarra likes this.

City of Dallas- Office of Emergency Management
September 1 at 9:45am ·

To better plan for emergencies, we need YOUR input on hazards & how to limit impacts to the City. Click for survey: http://ow.ly/RDs30

Office of Emergency Management Plans and Programs
Dallas OEM works continually to improve our plans to mitigate, prepare, respond, and recover from emergencies. This survey lets residents weigh in...
DALLASCITYHALL.COM

Like Comment Share

1 share

[redacted] Several of those listed potential incidents could happen in Dallas. I just moved from the city but tornadoes, aircraft incidents, HazMat / Terrorism. The 737 and Airbus planes taking and landing at Love Field fly over very populated areas of housing and businesses (and fly very low to these areas when on approach or taking off).

You ask a good question. Educate the residents on the hazards. Get them to understand the hazards. Explain in detail and in simple terms. Provide mitigation procedures to them on what they can do if such incidents happen. Provide a list of emergency items/food stock that they should have on hand that is reasonable.

Seems like Dallas has terrible bad luck with power issues when severe storms roll in, ice, or high winds. My apt complex lost power several times over the past 2 years due to storms. Its frustrating when it is hot or cold. I have lived in other cities in Arkansas, Oklahoma and California and never had that much bad luck with power grid issues.
Yesterday at 2:11am

City of Dallas- Office of Emergency Management
September 1 at 5:55am ·

Public Forum Notice

City of Dallas

OEM

Office of Emergency Management

The City of Dallas Office of Emergency Management is hosting a **public meeting** addressing residents' views and opinions about vulnerability to local disasters.

Lochwood Branch Library
December 16, 2015
6:30pm to 7:30pm

For more information contact:
Office of Emergency Management at (214) 670-4275

July 11, 2015 ·

Like · Comment · 2

PEOPLE ALSO LIKE

The Library Bar
Bar

George W. Bush Presidential ...
Public Places & Attractions

University Park Public Library
Library

See more Libraries in Dallas, Texas

LIKED BY THIS PAGE

Visit Dallas

Little Free Libraries / Libros Libres

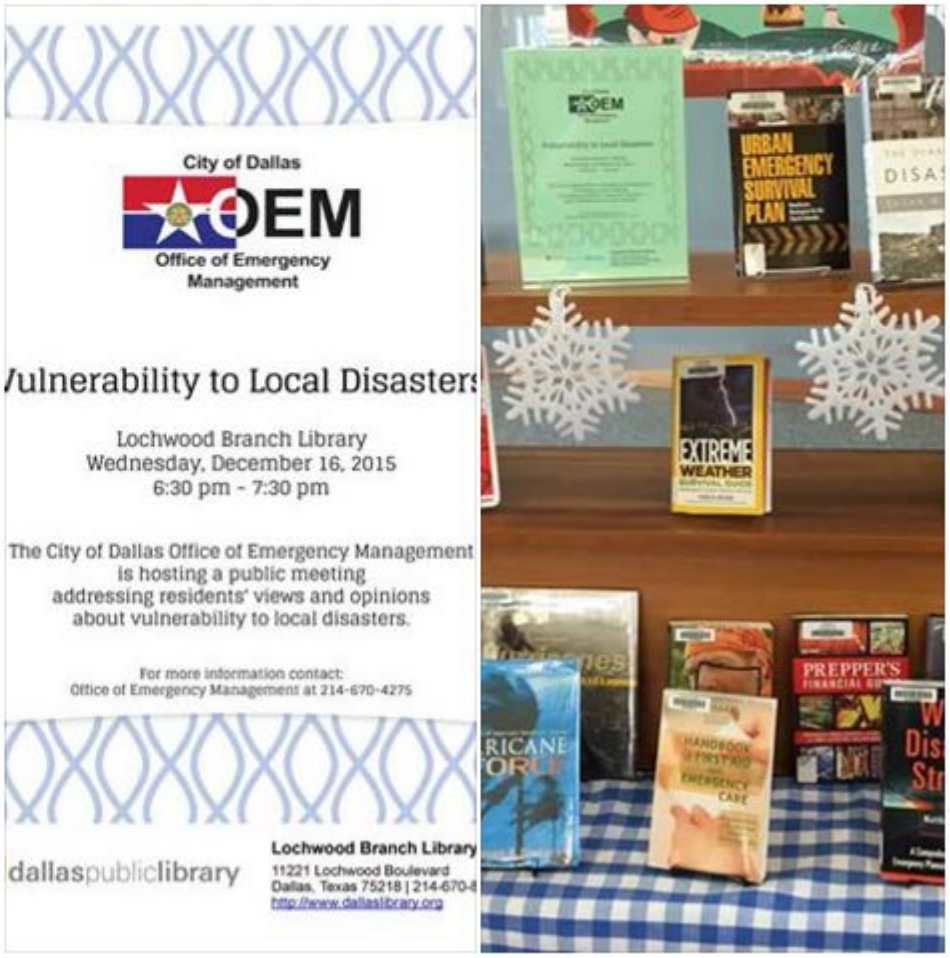
City of Dallas Office of Cultural Aff...

Write a comment...

Dallas Public Library added 2 new photos.
Published by Kjerstine Nielsen [?] · December 15 at 6:56pm · Dallas, TX ·

Disasters don't give fair warning before they hit. Be prepared before they do: come to a public meeting hosted by the Dallas Office of Emergency Management at the Lochwood Branch Library tomorrow night.

And while you're there, check out some of the helpful books on display!



203 people reached

Boost Post


Home
Moments
45
Notifications
Messages
Search Twitter
Tweet
Dallas PublicLibrary
@dallaslibrary
TWEETS
6,786
FOLLOWING
1,253
FOLLOWERS
3,187
LIKES
1,150
LISTS
1
Edit profile
Dallas PublicLibrary @dallaslibrary · Dec 15
Disasters don't give fair warning before they hit. Be prepared before they do: come to a public meeting hosted by... fb.me/OpA57i2Y

Public Forum Notice

City of Dallas

OEM

Office of Emergency Management

The City of Dallas Office of Emergency Management is hosting a **public meeting** addressing residents' views and opinions about vulnerability to local disasters.

Pleasant Grove Public Library
February 17, 2016
6:00pm to 7:00pm

For more information contact:
Office of Emergency Management at (214) 670-4275

Public Forum Notice

City of Dallas
OEM
Office of Emergency Management

The City of Dallas Office of Emergency Management is hosting a **public meeting** addressing residents' views and opinions about vulnerability to local disasters.

Hampton-Illinois Branch Library
April 13, 2016
5:30pm

For more information contact:
Office of Emergency Management at (214) 670-4275

Public Forum Notice

City of Dallas

OEM

Office of Emergency Management

The City of Dallas Office of Emergency Management is hosting a **public meeting** addressing residents' views and opinions about vulnerability to local disasters.

Oak Lawn Public Library
June 28, 2016
6:30pm

For more information contact:
Office of Emergency Management at (214) 670-4275

Appendix C – Sensitive Information

If you are reading this, you have received a publicly-distributed version of the City of Dallas Local Mitigation Action Plan. This copy does not contain sensitive information. To request a copy of Appendix C – Sensitive Information, please contact the Office of Emergency Management.

Appendix D – Consequence Analysis

City of Dallas

CONSEQUENCE ANALYSIS

2014

Dallas Office of Emergency Management

March 1st, 2015

City of Dallas Consequence Analysis (CA)

The Consequence Analysis (CA) and Appendices have been approved for implantation by

_____ _____

Rocky Vaz — Date

Director, Office of Emergency Management

Contents

Section 1: Purpose

The Consequence Analysis (CA) contained in this document is reflective of the hazards identified in the Hazard Identification and Risk Assessment (HIRA). This document considers the impact on the public; responders; continuity of operations; including delivery of services; property; facilities and infrastructure; the environment; the economic condition of the jurisdiction and public confidence in the jurisdictions governance.

Section 2: Objective

The objective of this Consequence Analysis (CA) is to model worst case hazard scenarios to identify the potential reach and effect of hypothetical worst case natural or human caused incidents that can cause serious harm to the public and the environment from short term exposures to mitigate the severity of the incidents that do occur.

Section 3: Relationship to the Emergency Operations Plan (EOP)

This document complies with the requirements of the Emergency Operations Plan. Users of this document should be familiar with the Emergency Operations Plan.

Section 4: Authority

Chapter 14B, City of Dallas Charter, Ordinance# 15983; 17226; 25834)

Section 5: Situation

The City of Dallas faces a variety of natural and human caused hazards. As such, Dallas shall conduct a Consequence Analysis (CA) to identify the risks and gaps the Dallas Office of Emergency Management will need to consider closely. This analysis will allow the City to prepare more effectively for hazards likely to cause negative impacts to residents, visitors, and businesses.

Section 6: Assumptions

- The City of Dallas is aware of the hazards that pose a threat to the City, and this Consequence Analysis (CA) will confirm that awareness and further clarify what hazards need to be paid special attention;
- Hazards identified as high risk will receive special attention but the City will continue to planning and preparedness for all hazards that pose a threat;
- Natural and human caused hazards are often relatively unpredictable, this assessment is conducted based on information currently available and the conclusions made are not definite.
- The Dallas Office of Emergency Management will use this Consequence Analysis (CA) as part of foundation for the Hazard Mitigation Plan.

Section 7: Functional Roles and Responsibilities

Emergency Management: The Office of Emergency Management is tasked with conduct a periodic Consequence Analysis (CA) based on the Hazard Identification and Risk Assessment.

All Departments: All supporting departments, via their Subject Matter Experts, are tasked to support the updating of the periodic Consequence Analysis (CA) based on the Hazard Identification and Risk Assessment (HIRA).

Section 8: Logistics Support ad Resource Requirements

The City of Dallas Office of Emergency Management will coordinate all logistical support and resource requirements necessary to implement and track the City's Emergency Management Plan.

Section 9: Plan Maintenance

All plans are maintained in accordance with the Emergency Management Plans Maintenance Policy (Policy Number 2015-01)

Section 10: Execution

The City of Dallas developed this consequence analysis in order to understand better its needs in particular hazard scenarios. Importantly this CA serves as a complement to the Hazard Identification and Risk Assessment.

Hazards

This version of the Consequence Analysis analyzes the following threats:

- Tornado
- Flooding
- Winter Storm
- Earthquake
- Drought
- Extreme Heat
- Severe Weather (Hail, High Winds, and Lightning)
- Hazardous Materials
- Biological
- Airport/Aircraft Crash
- Dam/Levee Failure
- Terrorism

Modeling

Quantitative modeling for flood utilizes information from the Trinity River Emergency Plan that was completed by Halff Associates Engineering, in addition to supplemental GIS analysis from past events. The analysis examines other hazards through use of past event data from projections from the City of Dallas, The State of Texas, Department of Homeland Security, National Climatic Data Center, Federal Aviation Administration, and other jurisdictions throughout the region.

Analysis of floods considers the consequences of each hazard based on a return period. These periods estimate the likelihood of an event exhibiting certain characteristics, which often dictate the severity of the event.

Approach

Each hazard specific consequence analysis addresses seven elements:

- Impacts on the public,
- Impacts on first responders,
- Impact on continuity of operations,
- Delivery of services,
- Impact on property, facilities, and infrastructure,
- Impact on the environment,
- Impact on the economy,
- Impact on the public confidence in jurisdictional governance.

Since hazard impacts can be difficult to quantify from a hypothetical standpoint, it provides a foundation from which to discuss potential operational or planning needs.

In the table below information is provided about the rubric for scoring the various hazards considered in this CA report. It is important to note that these rankings provide only an approximation of expected impacts. Mitigating and amplifying factors, such as location of the hazard, time of day, warming time, composition of impacted population, and hazard intensity play crucial roles in determining the harmful effects of each hazard event.

Table 1: Scoring rubric for CA hazard impact ranking

Impact	Minimal	Moderate	Severe
Public	Event effects less than 1% of City population	Effects 1% to 5% of City population	Effects 5% or more of City population
Responders	Hazard effects less than 1% of responders	Effects 1% to 5% of responders	Effects 5% or more of responders.
Continuity of Operations (COOP)*	No or limited need for COOP activation.	Potential need for COOP activation, but no longer than 30 days.	Potential need for COOP activation, may last beyond 30 days.
Service Delivery*	Little to no disruption of service delivery	Some disruption if service delivery	Service delivery majorly disrupted
Property, Facilities, Infrastructure	Damage to property localized, infrastructure no seriously affected	Damage to property observable and significant, infrastructure somewhat affected	Damage to property extensive and wide spread, infrastructure significantly affected
Environment	Limited or local impact to environment	Impacts reach beyond local area, requiring monitoring or cleanup	Extensive monitoring or cleanup operations are needed
Economy	Less than 1% of the City GDP	Between 1% to 3% of City GDP	3% or more of City GDP
Public Confidence	Mistakes or inefficiencies generate no perceptible impact.	Mistakes or inefficiencies generate some distrust	Mistakes or inefficiencies generate major distrust.

*This analysis combines Continuity of Operations and Service Delivery under the same heading.

Section 11: Consequence Analysis

11.1.1 Tornado

Impact on the Public

Science peer website Science.com states that tornadoes are ranked among the most the public as the most ferocious and feared weather event; Tornadoes are known for both there destruction and devastation that they can cause. The effects on public can include loss of life and destruction of their home or property. Impact of a tornado depends on its strength. Low rated tornadoes (EF0-EF1) may cause only minor damage to property while higher rated tornadoes (EF2-EF5) may devastate large portions of the City.

The effect of a tornado on the public depends not only on its strength but also where it touches down. Tornadoes that touchdown in a more remote area will have less impact than one that touches down in a crowded urban area. Tornadoes occur around the world but are most common in the area known as Tornado Alley where the City of Dallas is located.

Tornadoes rank fourth among the most deadly weather pattern following heat, hurricanes and floods. In the United States death tolls from tornadoes vary from one year to the next. Since 2000 deaths associated with tornadoes have ranged from 21 in 2009 to 553 in 2011, with an average of 94 deaths a year during that time period. The high death toll in 2011 was due to the 2011 tornado outbreak in which 748 tornadoes occurred in the month of April, followed by a devastating tornado strike on Joplin Missouri in May. Tornadoes that occur at night tend to be the deadliest because the public who are asleep may not hear the tornado warning in time.

In the wake a large tornado event, residents may be in need of mental health services. The tornado outbreak in Joplin, Missouri and Moore, Oklahoma proved that terrible disasters cause severe mental harm, resulting in mental illness and development of Post-Traumatic Stress Disorder (PTSD). These services may be too expensive for low income residents to afford independently, which can lead to the problems remaining untreated. To ensure the public can get the help it needs, the City should work with the American Red Cross and other agencies to make mental health services available to residents after the event.

Impact on the Responder

After a severe to strong tornado responders may see increased demand for their services. Responders may be required to work extended shifts after an event, which could ultimately lead to fatigue and burnout. The activation of local and state mutual aid agreements to supplement responders may be required. Responders, especially law enforcement, may need additional personnel to help expedite search and rescue operations by blocking roads to keep onlookers out or directing traffic in the affected area.

After a tornado management of the event may need to be routed through the Emergency Operations Center (EOC) to assist the on scene Incident Command (IC). During and after a tornado, responders may face extreme difficulties when responding. Tornadoes can destroy critical infrastructures such as city buildings, fire stations, police substations, and communications infrastructure. Downed wires and trees will slow response to certain areas and damage to water lines could limit the amount of water needed for fire suppression operations.

A destructive tornado event may require the City to open shelters to house displaced residents. Shelter plan activations will require coordination with the Parks and Recreation Department,

American Red Cross (ARC), Volunteers Active in Disasters (VOAD), with ARC taking the primary role in most shelter operations. Depending on the size of the event the opening of a Mega Shelter may be required and will require additional coordination with Non-Government Organizations and with county and state emergency management.

Finally, severe tornadoes can take a significant toll on the mental states of responders. Past events in the United States demonstrate that the combination of long hours, personal stresses related to family or property, and traumas associated with response in a major event can lead to serious mental complications, including suicidal tendencies. As such, the City will need to establish and maintain a mental health program to support responders during and after the event, possibly for a period of months.

Continuity of Operations/Delivery of Services

After a tornado passes it is possible that the Emergency Operations Center (EOC) is impacted. If the EOC is damage or otherwise inoperable, it may be necessary to move to the Alternate EOC location or function from another location to maintain operations during the event. In a severe event, COOP activation may be necessary and me be kept active for weeks until normal operations are reestablished.

Power outages, downed trees, and debris could complicate delivery of services. Transportation or contractors will need to clear debris from roads in order to resume service delivery to some areas, and the need for government provided essential (sucah as food and water) will increase. In order to manage this type request the City will require state and federal support in setting up Points of Distribution (POD) to distribute the demand for these essentials.

Property, Facilities, and Infrastructure

Severe winds associated with a tornado may severely damage or destroy structures and property. Structures can be completely destroyed or completely obliterated by winds and debris. Manufactured homes and vehicles can be carried several miles by a tornado. Manufactured homes can be severely damage by weak tornadoes and could potentially drive up residential losses and increase displacement.

Tornados could potentially damage or destroy critical infrastructure such as utilities, bridges, hospitals, airports, EOC, or responder stations and buildings. Depending on its location air traffic at Dallas Love Field could result in a ground stop of departing and arriving flights potentially stranding passengers. Power lines and transformers could be knocked out by falling debris and may be out for days while crews remove debris and repair the damage. Power loss is problematic not only for residents and businesses, but for critical infrastructure as well. Extensive disruptions to energy infrastructure can cause complications throughout critical infrastructure. Water supply and wastewater assets, for example, rely on energy to process water for public consumption. Health and telecommunications infrastructure are also heavily reliant on energy to operate. Therefore, even if winds or debris leave these assets undamaged, their operation could still be compromised or significantly affected.

Impact on the Environment

A path of a tornado can rip apart building and man-made structures. Older buildings built before regulations were put in place may contain lead paint and asbestos that can cause contamination of waterways and soil. The downing of electrical transformers runs the risk of leaking carcinogenic oil and highly toxic polychlorinated biphenyls (PCB). These chemicals can cause

soil erosion, water pollution, and flooding risk contamination. The biggest environmental threat from tornadoes stem from human activity. Waste storage or treatment facilities can be damaged polluting surrounding areas. Damage to chemical plants can release toxic chemicals into ground water.

Impact on the Economy

Economic impact from a tornado can vary depending on the size and location of the event. In a large tornado event employment and wages can be impacted due to physical damages to businesses and infrastructure, especially if economic activity is sufficiently impeded across a region or if it affects a large enough percentage of the population or an important industry. The effect to the local economy from these temporary disruptions will probably be minor but there is the possibility that a sector of the economy may never recover to pre-disaster levels. Dallas has a diverse economy and no longer relies on one industry a lesson learned from the 1980's oil downturn. A large tornado would have temporary impact to the local economy. Due to the size and diversification of the local and regional economy the City does not depend on a single industry.

Public Confidence in Governance

Confidence from the public will be determined in the initial response of the government. The actions of government must be immediate and effect maintain confidence. Actions needed during the response phase includes timely reentry by the public into affected areas upon the area being deemed safe. Response must be equitable and ensure resources are available to low income and special needs populations. Past events like Hurricane Katrina is an example how delays in decisions can have a profound impact on confidence for all levels of government.

Summary Table

Impact	Level	Disruption
Public	Moderate - Severe	Based on historical data most tornados that occur in Dallas are confined to a small area. The area impacted could experience significant damage to structures and significant risk of injury or death based on the intensity of the tornado.
Responder	Moderate - Severe	Debris blocking roadway, downed power lines, and delay in response delay response. Responders may have to work longer shifts leading to stress and work fatigue.
COOP/DOS	Minimal - Moderate	Activation of COOP would most likely happen only if strategic city facilities were impacted. Delivery of services may be delayed by a few days as debris on roadways are cleared.
Property, Facilities, Infrastructure	Moderate - Severe	Depending on the strength and location of the tornado damage could range from light to significant.
Environment	Moderate - Severe	Strong tornadoes could cause release of dangerous chemicals, uproot trees and damage vegetation.

Economy	Minimal – Moderate	Physical damage to infrastructure and businesses could interrupt operations and delay wages impacted local merchants.
Public Confidence	Minimal – Severe	The appropriate response and recovery actions will drive public confidence. Failure to restore basic services in a timely manner and no clear direction can quickly erode public confidence.

11.1.2 Flood/Dam Levee Failure

Impact on the Public

Floodwaters can damage homes, businesses, and roadways. The severity of the flood will determine the recovery time, recovery can take a few weeks to several months. The adverse impacts depends on the vulnerability of population and the frequency, intensity, and duration of the flooding. Immediate impacts from flooding include loss of life, damage to property, damage to infrastructure facilities and deterioration of health conditions due to waterborne diseases. Flash floods that occur with little or no warning cause more deaths than slow rising riverine flooding. Psychological effects on flood victims and their families can traumatize them for long periods of time. The loss of their home, family members, livelihood or business can cause continuing stress. The stress associated with these losses can overwhelm individuals and produce lasting psychological impacts.

The most likely impact to the public will be the evacuation of endangered populations. According to the Trinity River Federal Levee System Emergency Action Plan the case of a 100 year flood event will require the evacuation of roughly 25,000 people, with 10,000 – 15,000 of those individuals requiring food, water, and shelter until they are able to reoccupy their homes.

If evacuation is deemed necessary it will be necessary that the City uses all outlets available to warn residents and the City will be required to options for sheltering this will include the use of social media, broadcast media, mass notification systems, and door to door notifications. Communications during evacuations must make clear to the public that they take their pets with them, coordination with animal welfare groups will be important to ensure there is sheltering options for their animals. In 2006, the federal Pets Evacuation and Transportation Standards Act requires state and local plans to take into account needs of individuals with pets and service animals during a major disaster or emergency.

The risk during most flood events comes from drivers ignoring barricades or high water warnings. The National Weather Service reported that over 50% of flood related deaths occur from individuals driving into flooded roadways. Casualties will depend on the length of time between issuance of warnings and the onset of flood water.

Impact on the Responder

Flooding events will increase the number of stranded motorist's calls. The most likely increase in calls will occur during a heavy rain event that causes flash flooding throughout the city. A historical flood event could inundate city hall, police headquarters and substations, fire stations, and require the relocation of government operations to alternate facilities. In the Trinity River Levee System Emergency Action Plan there are several critical facilities and infrastructure that reside the protected levee system.

Response efforts may be impacted due to damage, debris blockage, or washout to roads and bridges, responders may be required to find alternate routing, increasing the response times. Fire responders will be tasked with performing swift and high water rescues and support evacuations. Law enforcement will be tasked with securing areas that are evacuated and blocking traffic access to these areas. Non-emergency personnel will see increased inspections of levee and pump systems. Calls for debris removal and sewer overflow will increase putting additional pressure on response personnel. During high flood events the Trinity River becomes an attraction and often people will walk on the levee becoming dangerously close to the floodwaters, this will increase the work load of responders assigned to monitoring these areas.

Continuity of Operations/Service Delivery

Temporary relocations of city services may be necessary it inundation affects critical facilities or infrastructure. Facilities may be inaccessible in severe flood events. Historically the City of Dallas has not experienced a flood event that has required the relocation of city hall or city services. City hall is located in the Government area of downtown and is located with the 100 year flood plain. The area is protected by a levee system and in the event of a failure the City's COOP plan would need to be activated because essential departments located within city hall and in the downtown area would need to be relocated. Departments would conduct essential functions at their alternate facility listed in the COOP plan.

The delivery of services would be impacted in a similar way that affected responders. Neighborhoods in the city may be inaccessible due to high water, roads may be damaged or washed out, and fallen power lines would cause hazardous conditions for city workers. Flood waters could damage railroad tracks impacting operations to passenger and freight rail service and disrupt bus routes. Flood damage, while potentially devastating within the floodplain, will not affect the entire city.

Property, Facilities, and Infrastructure

In terms of property damage, floods are just behind tornados as the top natural disaster. In the United States, flood damages totaled $8.41 billion is 2011. Floods can affect any area to some degree; wherever rain falls, flooding can occur.

The services and functions provided by critical facilities are essential to a community, especially during and after a disaster. For a critical facility to function, it must be supplied with essential utilities. The loss of city operated utilities may prevent some critical facilities from operating. For example the loss of water and waste disposal can prevent a facility from operating long after the flood waters have receded. Major flooding could damage the City's 24 dams, releasing water and causing further damage downstream. Damage to private sector communications towers could result in loss of communication abilities throughout the city, further complicating response.

Impact on Environment

The environmental impacts of flooding can be quite wide-ranging, from the dispersion of low-level household wastes into the storm water system to contamination of community water supplies and wildlife habitats with extremely toxic substances. The actions undertaken prior to the event will have repercussions on the level of damages accruing from the flood. Effective remedial actions can significantly reduce losses, and with planning, prevent some of these secondary environmental impacts. Specifically, the removal of fuel tanks and attention to hazardous wastes would eliminate some of the potential problems. During a flood variables such as depth of water, velocity of flows, and duration of inundation, in combination with land-

use attributes, all contribute to the relative severity of flood impact (Tobin and Montz, 1994). Floods of greater depth are likely to result in greater environmental damage than floods of lesser severity, in part because more area has been flooded. Long duration floods will exacerbate environmental problems because clean-up will be delayed and contaminants may remain in the environment for much longer time. During the post-flood phase many other environmental impacts can become apparent. The volume of the debris to be collected, the extent to which public utilities such as water supply systems and sewage operations have been damaged, and the quantity of agricultural and industrial pollutants entering the river system might present pressing problems.

Impact on Economy

Flooding can have a devastating impact on the local and regional economy and the livelihood of its people. Loss of human life, property damage, non-functioning infrastructure, and the possibility of waterborne disease are just some the ways flooding can impact a community.

The NOAA National Climatic Database shows that from July 1994 to July 2015, Dallas County has experienced $45 million worth of property damage from flooding events, an average of $700,000 per event. City sponsored studies estimate that a 100 year flood would cause roughly 1.2 Billion dollars in damage and that a 500 year event could cause over $3.0 billion dollars in losses. Mitigation efforts, including acquisition of property with Repetitive Flood Loss claims, could reduce the impact of flood events on the economy. Participation in the National Flood Insurance Community Rating System (CRS) reduces insurance burdens on residents and businesses within the City. As of 2014, The City of Dallas does participate in the CRS with a current rating of 5. The city is working on achieving a class rating of 4 in the next two years.

Impacts on the economy will greatly depend on the severity of the flood, area flooded, depth of water, and the length of time before water fall back past flood stage. If flood waters take utilities off line, businesses can lose productivity. Inaccessible roads also have an effect on business revenues and costs, increasing the number of lost trips (dampening consumer activity) and lengthening others (increase shipping time and costs).

Public Confidence in Governance

Confidence from the public will be determined in the initial response of the government. The actions of government must be immediate and effect maintain confidence. Actions needed during the response phase includes timely reentry by the public into affected areas upon the area being deemed safe. Response must be equitable and ensure resources are available to low income and special needs populations. Past events like Hurricane Katrina is an example how delays in decisions can have a profound impact on confidence for all levels of government. While smaller floods are likely to escape notice, larger floods will likely become the focus of the local or even national media. Slow warning time, unclear instructions, or complications with evacuation or sheltering could compromise public trust. If the flooding is the cause of a dam or levee failure, it could result in reduced public confidence as it raises questions regarding government oversight of these assets.

Summary Table

Impact	Level	Disruption
Public	Moderate - Severe	Based on historical data most floods that occur in Dallas are confined to within the levee system. Areas that are known to flood during flash flood events are closely monitored and have a flood warning system installed. Impact to residents and infrastructure occur when waters inside the Trinity River reach 40 ft.
Responder	Moderate - Severe	Impassible roads, impacted infrastructure, and delay in response. Responders may have to work longer shifts leading to stress and work fatigue.
COOP/DOS	Minimal - Moderate	Activation of COOP would most likely happen only if strategic city facilities were impacted. Delivery of services may be delayed by a few days as water recedes and roadways are cleared.
Property, Facilities, Infrastructure	Moderate - Severe	Depending on the depth and duration of the flood, damage could range from light to significant.
Environment	Moderate - Severe	**Impact**
Economy	Minimal – Moderate	Physical damage to infrastructure and businesses could interrupt operations and delay wages impacted local merchants. Flooded roads can cause delivery delays and lost shopping days from consumers.
Public Confidence	Minimal – Severe	The appropriate response and recovery actions will drive public confidence. Failure to restore basic services in a timely manner and no clear direction can quickly erode public confidence.

11.1.3 Winter Weather

Impact on the Public

Winter weather occurs every year in Dallas but not every storm in severe. Each year, the City experiences some level of ice accumulation and dangerous environmental conditions. The main impact from winter weather to the City is icy roads and loss of power. In 2011, while hosting the Super Bowl, the region experienced a historical winter weather event. Historical snow accumulations blanketed the area and most jurisdictions did not have sufficient snow removal equipment.

Direct impacts on the public during a winter weather event are power outages, injury or death from traffic accidents, and fires caused by space heaters. Power outages in are normally caused by ice accumulation on power lines, fallen trees from ice, and heavy demand on the electrical grid. In 2014 The Electric Reliability Council of Texas stated impact to the electrical grid was driven by demand and not from damage to the grid system. Deaths and injuries during a winter weather event are predominantly caused by traffic accidents. The Texas Department of Public Safety states that 75% of fatalities during winter weather are traffic accident related. Another potential danger to the public is a fire from space heaters. In 2014 the City attributed 6 civilian deaths to fires that were caused by space heaters.

Impact on the Responder

Responders are at risk for auto accident related injuries as the respond on untreated roads to emergencies. In 2014 a Dallas Fire Rescue Line of Duty Death was attributed to icy road conditions that caused a vehicle to strike a fire fighter while he was working a stranded motorist call. Emergency Medical Services may find it difficult to operate on roads that have not been treated with ice melting materials.

Continuity of Operations/Delivery of Services

The COOP plan would not necessarily be activated for a winter weather event. Delivery of services could be impacted due to icy or impassible roads and may complicate movement in some areas of the City. Key employees may be unable to make it in or have a delayed start. Services such as Sanitation may be cancelled or delayed until road conditions improve. Based on past events the only services impacted during winter weather are those that require being in the field.

Property, Facilities, and Infrastructure

The major impact during winter weather are to roads. In ice and snow events, the roads in Dallas could be hazardous to navigate until the area is treated. Streets Department may need to work around the clock to treat city streets clear and available for use. Ice and snow can damage power lines by weighing them down or causing trees to fall from the weight of the ice onto active lines. Subfreezing temperatures can cause pipes to freeze and burst causing damage to the inside of the building or home. In rare occurrences the City experiences heavy snow which can put stress on a structures roof and support structure.

Impact on the Environment

Most damage done to the environment by winter weather is often temporary. Winter precipitation such as freezing rain can cause damage to plants and trees. Ice, in particular, can cause trees to fall and cause water pipelines to burst. Ultimately, a winter storm may generate a massive amount of vegetative debris, with cubic yards potentially reaching into the hundreds of thousands. Depending on the amount of debris, the City may have to increase collection times in neighborhoods.

Impact on the Economy

Winter weather-related property damage in the City of Dallas is rare. NCDC reports that winter weather events cost Dallas, on average, just under $5,000 per event. A heavy ice event on the other hand, can disrupt economic activity. Residents that rely on public transportation may be unable to report to work due to delayed or cancelled routes, grocery stores may run low on supplies due to delay in delivery's. Airlines at Love Field could see many flight delayed or cancelled stranding travelers. The Convention Center could lose revenue from cancelled conventions and events. If the weather forces businesses to close, employees are unable to earn wages. These impacts could become increasingly worse if weather forces the City's residents to remain in their homes for an extended period.

Public Confidence in Governance

There is little risk that the public will lose confidence in governance in most events. In more severe winter weather, confidence rests upon the jurisdiction's ability to treat roads of ice in a timely fashion. A more serious but less frequent challenge will be power restoration should an

event knock it offline. Delays in treating roads or restoring key services without cause or communication could have a substantial impact in public confidence.

Summary Table

Impact	Level	Disruption
Public	Moderate	Residents who are not accustomed to winter weather may attempt to navigate icy roads increasing the risk of automobile related injury or death.
Responder	Minimal	Responding to accidents and medical calls on icy roads could increase stress levels. As long as appropriate precautions are taken there is no greater risk to responders.
COOP/DOS	Minimal	COOP activation should not be necessary. Impacts to city services would be minimal.
Property, Facilities, Infrastructure	Moderate	Damage to power lines and structures could occur from ice accumulations
Environment	Minimal	Ice accumulation could damage outside trees and plants. Damaged trees could cause an increase in bulk trash or debris clean up.
Economy	Minimal – Moderate	Extreme ice events could disrupt economic activity for a period of days as icy roads make driving hazardous and public transportation routes are cancelled or delayed.
Public Confidence	Minimal – Moderate	The City of Dallas experiences little difficulty in responding to winter weather. A delay in information could lead to questions from the public

11.1.4: Earthquake

Impact on the Public

Earthquakes in the City of Dallas is considered a low risk. Large scale earthquakes are considered to be an isolated event, however will cause widespread damage due to a low risk of high magnitude earthquakes in the area. Earthquakes have only been recently recorded in Dallas County, to date there have been no injuries or fatalities or major damage recorded. The magnitudes experienced in the City of Dallas are considered minor only felt by humans and do not cause damage. Additionally there is currently not a significant amount of data for earthquakes in the City of Dallas and will need to be researched and studied. No data to support the change of building codes and engineering standards for high magnitude levels can affect buildings, transportation routes, and pipelines.

Impact on the Responder

Responders are not at risk from the current magnitude of earthquakes. If the earthquakes begin to increase in magnitude responders may be called upon to perform search and rescue operations. Responders may be required to use heavy equipment to assist in rescue operations and clearing of debris from roadways.

Continuity of Operations/Delivery of Services

While not necessarily requiring the activation of the COOP plans, earthquakes may cause minor damage to building facilities. These facilities may be required to temporarily close while repairs are made impacting employees who would report to those facilities. Delivery of Services would

not be majorly impacted at the current magnitude of earthquakes being experienced in the City of Dallas.

Property, Facilities, and Infrastructure

The most obvious effects would be damage to foundations and walls. Minor earthquakes can damage floor tiles and may shift foundations. The magnitude currently experienced in the City of Dallas has not caused significant damages to Property, Facilities, and Infrastructure.

Impacts on the Environment

Earthquakes can cause damage to utilities that are located near the epicenter. Depending on the size of the earthquake will determine the impacts to the environment. Based on the current magnitude impacts to the environment are low in the City of Dallas.

Impacts on the Economy

Earthquake related damage in the City of Dallas is rare. If the earthquake magnitudes increase the impacts to the economy could be impacted. Depending on the magnitude damage from earthquakes could cause significant damage. A catastrophic earthquake could cause disruption to supply lines, shocks to financial markets, and an impact on the insurance industry.

Public Confidence in Governance

There is little risk that the public will lose confidence in governance in most events. In more severe earthquake magnitudes, confidence rests upon the jurisdiction's ability to respond to emergencies and provide information in a timely fashion.

Summary Table

Impact	Level	Disruption
Public	Moderate	Dallas residents are not accustomed to earthquakes and will want to know what is being done to find out the cause.
Responder	Minimal	There is no reason to suspect greater risk to responders.
COOP/DOS	Minimal	COOP activation should not be necessary. Impacts to city services would be minimal.
Property, Facilities, Infrastructure	Moderate	Damage to foundations and walls would have minimal impacts. If stronger earthquakes occur damage may be more widespread and cause greater impacts.
Environment	Moderate	Earthquakes could damage or rupture underground pipelines
Economy	Minimal – Moderate	Stronger earthquakes than are currently being experienced could have longer term effects on the economy
Public Confidence	Minimal – Moderate	The City of Dallas experiences little difficulty in responding to earthquakes. A delay in information could lead to questions from the public

11.1.5: Drought

Impact on the Public

As drought conditions are normally widespread across a significant geographic area, the entire City of Dallas would be affected by drought. The population would be vulnerable to the effects of drought, reduction of available water, wildfires, and structure fires. Impacts of drought to the public may include an increase in anxiety about economic losses cause by the drought and the reduction of recreational activities. Droughts have either direct or indirect impacts on the public. A direct drought impact, for example, would be crops dying due to lack of water. This will mean there is not enough produce available at the local grocery store causing the store to lose money. If enough produce is lost, the store might not be able to employ as many people or may even have to close down. The loss of the produce would be the "direct" impact of drought. The store losing money and would be the "indirect" impacts of drought. The City of Dallas ended its Signiant drought in May 2015.

Impact on the Responder

The increase of risk for grass or wildland fires are higher during drought conditions. Depending on the severity of the event fire, police, and other emergency responders may be required to evacuate nearby residents and businesses. Resources from the state may be required if wildfire spreads faster than fire fighters can contain it.

Continuity of Operations/Delivery of Services

The impacts from drought would not require the activation of the COOP plans. Impact to services would be minimal to none.

Property, Facilities, and Infrastructure

Damages to property may be contained to vegetation losses. The lack of water and restrictions to watering may cause grass or other vegetation to dry. Facilities may experience foundation shifts due to the dry soil underneath causing doors not to close and cracks in walls. The drying and cracking soil could damage water pumps and cause underground water pipes to burst. Decreasing water levels in lakes could increase the need for additional weed control. Drought can cause cracks in roads increasing the chances for pot holes.

Impact on Environment

Impacts of drought on the natural environment with the City of Dallas vary depending upon the severity of the drought. Environmental concerns would be loss of vegetation and risk of erosion in areas that are affected by drought and reduced availability of water supply. Environmental conditions, such as dry weeds or grass, might provide fuel for wildfires. The loss of plants and trees leaves soil loose, which can then lead to the loss of topsoil or increased erosion during precipitation events.

Drought also affects the environment in many different ways. Plants and animals depend on water, just like people. When a drought occurs, their food supply can shrink and their habitat can be damaged. Sometimes the damage is only temporary and their habitat and food supply return to normal when the drought is over. But sometimes drought's impact on the environment can last a long time.

Impact on the Economy

Depending on the duration of a drought, the degree of economic loss could range from minimal to severe. Lowering lake levels reduce the amount of recreational activities and could impact the livelihood of residents who rely on those activities. Food prices can increase due to the reduction of available stock.

Public Confidence in Governance

There is little risk that the public will lose confidence in governance in most events. In more severe droughts, confidence rests upon the jurisdiction's ability to respond to emergencies and manage the limited water resources they have.

Summary Table

Impact	Level	Disruption
Public	Moderate	Water restrictions and loss of recreational activities would be the direct impact felt by the public.
Responder	Minimal	There is no reason to suspect greater risk to responders. Increase in the number of wildland fires may increase
COOP/DOS	Minimal	COOP activation should not be necessary. Impacts to city services would be minimal.
Property, Facilities, Infrastructure	Moderate	Damage to foundations and walls would have minimal impacts. Foundations may shift due to drying out of underground soil.
Environment	Moderate	Loss of water supply due to lowering lake levels. Dry vegetation provides ample fuel for wildland or grass fires.
Economy	Minimal – Moderate	Revenue lost by lower lake levels and increase in the price of food could dampen consumer spending.
Public Confidence	Minimal – Moderate	The City of Dallas experiences little difficulty in managing drought conditions. Delayed response to citizens regarding watering violations or infrastructure damage could lead to questioning from the public.

11.1.6: Extreme Heat

Impact on the Public

Prolonged exposure to excessive heat potentially leads to severe health problems, including heat exhaustion and heat stroke. The stress of extreme heat can make chronic health conditions worse, including asthma and heart disease. Children and the elderly are more susceptible to extreme heat. Though injuries or deaths from extreme heat have been recorded at different locations throughout the city, there is no specific geographic scope to the extreme heat hazard. Extreme heat could occur at any area of the city. In 2014 the City of Dallas had two heat related deaths. The importance of the City to make available cooling centers is high during extreme heat events, so that residents may escape the extreme temperature.

Impact on the Responder

In extreme heat responders will have to take precautions to ensure their own safety from temperature-related illness and ensuring they stay hydrated in extreme heat. This is especially true for those who spend extended periods outside as they execute their duties. Precautions may lead to slightly slower response times, or require an increased amount of rest time to ensure responder safety. With these precautions in place, the consequences for responders should be non-existent to minimal.

Continuity of Operations/Delivery of Service

Extreme heat rarely has an impact on the day-to-day operations of the City. Government facilities and agencies will operate as they normally do, and will not experience a situation that is dangerous to employees. Therefore, a COOP activation should be unnecessary and such an event should have a minimal impact on of delivery of services, even over an extended period.

Property, Facilities, and Infrastructure

Property, Facilities, and Infrastructure should experience few impacts from extreme heat events. Extended heat events may cause streets to incur damage, which may get progressively worse as the event persists. One potentially impacted sector would be energy, as increased energy demand for cooling may put a greater demand on the state's energy grid. Increased demand could cause parts of the grid to fail could cause ERCOT to implement "Brown Outs" in order to avoid a full outage of the electrical grid. Prolonged heat events coupled with drought conditions could be detrimental to water assets, as residents and critical infrastructure compete for dwindling water resources.

Prolonged extreme heat events will likely require the City to activate its cooling centers at recreation centers for economically disadvantaged residents who do not have air conditioning in their homes. These sites provide daytime cooling assistance to populations in need. The City will have to work with the Parks department, Red Cross, and Volunteers Organizations Active in Disaster (VOAD).

Impact on the Environment

Risks to the environment are high should an extreme temperature incident occur, and the frequency of extreme temperatures in Dallas is high. Environmental concerns include interruption of water supply and increased fire danger. Plants can become damaged or even die during episodes of extreme heat. The stress of heat can also have an impact on wildlife and domestic animals.

Times of extreme heat could have a substantial impact on plant and animal life within the City. Extreme heat can have disastrous impacts on plants as the event persists, as the temperatures overwhelm watering capabilities. Wildlife, in addition to the potential for dehydration or heat illness, are more likely to contract disease or infection as heat persists. In a prolonged heat event, however, natural areas and parks could have an increased fire ignition potential as trees and vegetation lose moisture and begin to dry out.

Impact on Economy

Extreme heat should have a minimal impact on economic activity. Workers may take extra breaks or work at a slower pace because of the extreme temperatures, particularly those whose professions keep them working outdoors. Generally, the most concerning impacts from extreme temperature events is the possibility of power outages dues to increased demand on the electrical grid.

Public Confidence in Governance

The key concerns for maintaining public confidence in an extreme heat event will be ensuring that utilities remain functional through the duration of the event or that any failures are short-lived. In prolonged events, the City will have to ensure that its elderly and other vulnerable populations (particularly those with limited financial means) have access to climate-controlled environments through continued use of cooling centers during extreme heat events.

Summary Table

Impact	Level	Disruption
Public	Minimal to Moderate	The duration of the event would dictate the level of impact. Cooling centers would need to be made available for vulnerable populations.
Responder	Minimal	There is no reason to suspect greater risk to responders. Proper hydration during extreme heat will be important.
COOP/DOS	Minimal	COOP activation should not be necessary. Impacts to Delivery of Services would be minimal.
Property, Facilities, Infrastructure	Minimal	Extreme temperature events will most likely affect energy and water assets the most as demand spikes.
Environment	Minimal	Loss of water supply due to lowering lake levels. Loss of temperature sensitive vegetation.
Economy	Minimal	The City's economic structure suggest that residents would not feel the impacts directly.
Public Confidence	Minimal – Moderate	Ensuring utilities remain online and that the most vulnerable populations are cared for should ensure the public's confidence. Failure to do so could result in negative public opinion.

11.1.7 Severe Weather (Hail, High Wind & Lightning)

Impact on the Public

Sever weather in terms of size, location, intensity and duration are considered to be frequent occurrences throughout the City of Dallas. Impacts to the public from severe weather may include power outages, damage to property, and life threatening conditions. For example lightning strikes can cause fires and down power lines. High winds can knock down power lines and damage moderately constructed structures.

According to the National Weather Service the peak time for lightning deaths in the United States occurs in June, July, and August. Almost two thirds of lightning strike victims were participating in an outdoor activity. Between 2006 and 2015, fisherman accounted for more than three times as many deaths as golfers. On average, lightning strikes are fatal to about 10 percent of people who are struck. The remaining percent survive, however they often suffer from an array of long-term, often debilitating symptoms.

Impact on the Responders

Responders face similar threats from severe weather as the public. However, responders face a greater danger because of the effects of severe weather, i.e. downed power lines, debris blocked roadways, structure fires caused by lightning strikes. Impacts to responders should be minimal if proper procedures are followed.

Continuity of Operations/Delivery of Service

Severe weather, other than tornadoes, rarely has an impact on the day-to-day operations of the City. Government facilities and agencies will operate as they normally do, and will not experience a situation that is dangerous to employees. Therefore, a COOP activation should be unnecessary and such an event should have a minimal impact on of delivery of services, even over an extended period.

Property, Facilities, and Infrastructure

Property, Facilities, and Infrastructure should experience few impacts from severe weather events. Some severe weather events may cause damage to city owned facilities or to electrical delivery equipment. Prolonged power outages may require the city to open cooling centers or warming centers depending on the time of year. Historical events have shown that impact from this type of event usually last less than 24 hours.

Impact on the Environment

Risks to the environment are minimal in a severe weather event. Lightning strikes may cause grass fires or in some instances structure fires. Discharge from fire suppression equipment may cause containments from the fire to enter into storm drainage systems.

Impact on Economy

Severe weather should have a minimal impact on economic activity. Generally, the most concerning impacts from severe weather events is the possibility of power outages dues to damage to electrical delivery equipment. Power outages may be confined to a small area of the city.

Public Confidence in Governance

The key concerns for maintaining public confidence in a severe weather event will be ensuring that utilities remain functional through the duration of the event or that any failures are short-lived. In prolonged events, the City will have to ensure that debris or damage caused by the event is cleaned up quickly and removed.

Summary Table

Impact	Level	Disruption
Public	Minor – Severe	Based on historical data most severe weather events that occur in Dallas are confined to a small area. The area impacted could experience significant damage to structures due to high winds, hail, or lightning strikes.
Responder	Moderate - Severe	Debris blocking roadway, downed power lines, and delay in response delay response. Responders may have to work longer shifts leading to stress and work fatigue.
COOP/DOS	Minimal - Moderate	Activation of COOP would most likely happen only if strategic city facilities were impacted. Delivery of services may be delayed by a few days as debris on roadways are cleared.
Property, Facilities, Infrastructure	Moderate - Severe	Depending on the strength and location of the severe weather damage could range from light to significant.
Environment	Moderate - Severe	Lightning strikes could cause structure fires and the burning of the contents inside the structure. High winds can uproot trees and large hail can damage vegetation.
Economy	Minimal – Moderate	Physical damage to infrastructure and businesses could interrupt operations and delay wages impacted local merchants.
Public Confidence	Minimal – Severe	The appropriate response and recovery actions will drive public confidence. Failure to restore basic services in a timely manner and no clear direction can quickly erode public confidence.

11.1.8 Hazardous Materials Incident

Impact on the Public

April 2013, an ammonium nitrate explosion occurred at the West Fertilizer Company storage and distribution facility in West, Texas while emergency services personnel were responding to a fire at the facility. At least 15 people were killed, more than 160 were injured and more than 150 buildings were damaged or destroyed. Investigations confirmed that ammonium nitrate was the trigger for the explosion. On the 23rd, March 2005, a hydrocarbon vapor cloud explosion occurred at the isomerization process unit at BP's Texas City refinery in Texas City, Texas, killing 15 workers and injuring more than 170 others. The Texas City Refinery was the second-largest oil refinery in the state, and the third-largest in the United States with an input capacity of 437,000 barrels per day as of January 1, 2000. Both incidents occurred in Texas. Although incidences of this size are rare, smaller scale incidents, those requiring a response and evacuation or other protective measures, are relatively common. Depending on the severity of the incident, the potential impact to life and property is great in Dallas. Incidents can cause multiple fatalities.

Impact on the Responder

A hazardous material event will place additional stress to responders. The dawning of specialized equipment and the need for specialized training will require assistance beyond the normal response calls in the city. Roadways near the incident will need to be closed and neighborhoods may require evacuation. Precautions may lead to slightly slower response times, or require an increased amount of rest time to ensure responder safety. With these precautions in place, the consequences for responders should be minimal.

Continuity of Operations/Delivery of Service

While not necessarily requiring the activation of the COOP plans, a hazardous materials incident may require the temporary closing of facilities. Delivery of Services may be delayed due to closing of streets and evacuation of neighborhoods. DOS may be rescheduled or rerouted depending on the size and scope of the incident.

Property, Facilities, and Infrastructure

Property, Facilities, and Infrastructure should experience few impacts from hazardous material events. A hazardous materials event would have little impact to structures that are outside of the immediate accident/incident area. Exception for this will depend on what type of chemical is involved and how close structures are to the location. For example, the 2013 West Fertilizer event was located outside the city limits of West but the blast zone for the ammonium nitrate was enough to level the structures in the immediate area. The temporary closing of city facilities may be required if they are located in or near an evacuation area. Prolonged evacuations may require the city to open shelters for residents who were ordered to evacuate.

Impacts on Environment

While large-scale environmental disasters are rare, smaller occurrences happen regularly in Dallas, often as cascading events in conjunction with other hazards. Based on local knowledge and expertise, the impact on environment is moderate. Release of chemicals in the air can decrease air quality and runoff into storm water drains can contaminate drinking water and have disastrous effects on wildlife and vegetation.

Impacts on Economy

Residents that rely on public transportation may be unable to report to work due to delayed or cancelled routes, grocery stores may run low on supplies due to delay in delivery's. If the hazardous materials event forces businesses to close, employees are unable to earn wages. Impacts to the economy should be minimal unless the event causes mass evacuation for an extended period of time.

Public Confidence in Governance

There is little risk that the public will lose confidence in governance in most events. In more severe hazardous materials events, confidence rests upon the jurisdiction's ability to respond and manage the incident in a timely matter. A more serious but less frequent challenge will be power restoration should an event knock it offline. Delays in lifting evacuations or restoring key services without cause or communication could have a substantial impact on public confidence.

Summary Table

Impact	Level	Disruption
Public	Minor - Severe	The size of the hazardous materials incident will determine the impact to the public. A small event generally will have no impact to the public, a large event with volatile chemical may cause a severe impact to the public due to evacuations.
Responder	Moderate - Severe	Specialized equipment and training will be required and mutual aid may be activated. Responders may have to work longer shifts leading to stress and work fatigue.
COOP/DOS	Minimal - Moderate	Activation of COOP would most likely happen only if strategic city facilities were impacted. Delivery of services may be delayed by while evacuation orders are in place.
Property, Facilities, Infrastructure	Moderate - Severe	A hazardous materials event would have little impact to structures that are outside of the immediate accident/incident area.
Environment	Moderate - Severe	Air quality may be affected and storm water systems may be impacted due to run off from fire suppression equipment.
Economy	Minimal – Moderate	Physical damage to infrastructure and businesses could interrupt operations and delay wages impacted local merchants.
Public Confidence	Minimal – Severe	The appropriate response and recovery actions will drive public confidence. Failure to restore basic services in a timely manner and no clear direction can quickly erode public confidence.

11.1.9 Biological

Impact on the Public

According to the Centers for Disease Control (CDC) occurrences of a biological event hazard are fairly common. In 2012 the city managed a West Nile Virus Outbreak resulting in 400 human cases and 20 fatalities. In 2014 the City was the location of the first confirmed Ebola Case in the United States. That event resulted in the in 4 human cases and 1 fatality. The overall threat to the population is low but any outbreak, depending on the disease, could quickly spread affecting the entire community.

Impact on the Responder

All responders would be subject to the same sort of risks as the public. A Biological incident will disproportionately affect responders, particularly healthcare workers, since they cannot avoid exposure. Responders will have to wear protective equipment and receive any available and effective antivirals. As responders become ill, it will fall to others to take on additional responsibilities and hours. These additional hours could lead to increased stress and burnout on the part of the responder. Other responders may refuse to report, fearing the potential ramifications of contracting the biological hazard further reducing the number of responders available. Overcrowded hospitals may require additional law enforcement support to maintain order, potentially incorporating State and Federal Response units.

Responders will have to prepare procedures for a mass casualty event, and mortuary services will require additional resources to process the numerous dead as their existing capacities are overwhelmed. This includes on-site capacity improvements as well as requiring the use of facilities with additional refrigeration capability.

Continuity of Operations/Delivery of Services

There is a possibility in an extreme event that facilities may be contaminated, necessitating relocation of government services and emergency personnel to alternate sites. Infected staff being unable to report may complicate operations. However, if a larger proportion of City staff is affected or otherwise keeps employees from reporting, essential functions may be negatively affected.

A Biological event will severely hamper the delivery of services, as personnel get sick and are unable to work. Populations receiving specialized home care may see their quality of care decrease because of their healthcare worker becoming ill and being unable to attend to them. The event may force the closure of homeless shelters due to worker absenteeism or threat of infection, complicating the delivery all services to the homeless population.

Property, Facilities, and Infrastructure

There would be very few direct consequences to property, facilities, and infrastructure from a biological event. Rather, the most damaging aspects on these elements is indirect. Private sector firms who own and operate critical infrastructure within Dallas may see work force absenteeism increase. Therefore, critical assets could be short-staffed for extended periods, reducing their usefulness. Properties may go untended due to an extended event.

Loss of staff to infection or fear of infection will force primary care practices to close, resulting in infected residents flooding hospital emergency departments. A biological event will potentially cause a shortfall in bed space. This will force hospitals to turn away new admissions or outsource certain services in order to segregate sick patients from non-sick patients.

Impact on Environment

There would be very few direct consequences to the environment from a pandemic, unless the influenza strain could spread from humans to animals. Aerial spraying needed to control mosquito populations could impact air quality for individuals with chronic respiratory conditions. Hospitals and other medical providers may see an increase in biohazardous waste collection and disposal.

Impact to Economy

During the 2014 Ebola response economic impacted showed a mixed result. Studies conducted by Aon Risk solutions following the incident showed most companies were concerned with employee care and emergency planning. Companies were working on contingency plans on how to deal with a widespread infection. As news spread about the Ebola case Dallas based Southwest Airlines saw a drop in stock prices drop. Airlines and hospitals saw a drop off of travelers wary of staying in certain places.

The World Health Organization stated even in the unlikely event that the Ebola virus spreads to infect tens of thousands of adults in the United States, the financial impact will likely be quite manageable. This is because perhaps one-third of adults in the U.S. have life insurance only through their employment, and the amount is typically equal to one year's income. Another one-third have individual life insurance, with the average death benefit in the $200,000 range. In a typical year life insurers pay about 2 million death claims, so another 100,000 would be only 5 percent more than typical. Moreover, most life insurers are well capitalized, and even the largest life insurers have reinsurance to prevent a surge in death claims from imperiling their solvency, so that the net effect would likely be, at most, a reduction in the profit they would otherwise record.

Public Confidence in Governance

The quality of governmental response to the event and its ability to provide actionable information and key services will have an impact on public confidence. During the Ebola outbreak in 2014, Americans' confidence in the governmental response to the disease decreased as media coverage focused on the relatively few cases within the country. Missteps during the response to the disease, long wait times, and delayed distribution of antiviral medications could have an adverse impact on public perception of the government.

Summary Table

Impact	Level	Disruption
Public	Severe	A biological event will have a substantial impact on the physical and mental conditions of residents. Many could be infected and some could die depending on how long it takes to develop and deploy an effective treatment.
Responder	Severe	Responders could be exposed or infected in the course of their duties. Others will be just as susceptible as the rest of the public, limiting the number of available personnel. Some responders may refuse to report for duty out of fear or due to an ill family member.
COOP/DOS	Moderate	A biological event will significantly affect the City's ability to deliver any service as workers become ill and unable to report. Activation of the COOP could be possible if contamination is a concern.
Property, Facilities, Infrastructure	Severe	Critical infrastructure may be understaffed, limiting their function and creating shortages throughout the system. ILL patients will overwhelm healthcare facilities and require substantial changes to facilities operations.
Environment	Minimal to Severe	If the disease is capable of crossing between humans and animals, or vice versa, it could have serious impacts to response and recovery.
Economy	Minimal – Moderate	Consumer confidence could be impacted resulting in less consumer spending as people stay home. Shipping and receiving of resources could come to a halt creating a shortfall in needed supplies and further impacting consumer spending.
Public Confidence	Minimal – Severe	Providing clear direction and information is necessary to maintain credibility. The public may see any disease outbreak as a failure by the medical community. Vaccines may not exist or be depleted if one exists, further eroding public confidence.

11.1.10 Airport/Aircraft Crash

Impact on the Public

Any part of the population of the City that is located in the departure or arrival tracts of Dallas Love Field or Dallas/Fort Worth International Airport are at greatest risk from an aircraft crash. The City of Dallas is located within the Standard Instrument Departure and Instrument Departure routes for both Dallas Love Field and Dallas/Fort Worth Airport. The probability of future occurrence can be rated as low and therefore have no to minimal impact to the public.

Impact on the Responder

Responders are not at risk from an airport/aircraft crash hazard. Responders assigned to Aircraft Rescue and Fire Fighting (ARFF) and Rescue may be required to use heavy equipment to assist in rescue operations and clearing of debris. After initial Firefighting and Rescue operations are completed the scene would be turned over to federal authorities. The impact to responders would be non-existent to low.

Continuity of Operations/Delivery of Services

Activation of COOP would most likely not occur. Operations at the airport are confined to the Aircraft Operations Area (AOA) and the Terminal operations area. Historically most aircraft incidents occur within the airport boundary. Delivery of Services should not be impacted.

Property, Facilities, and Infrastructure

Building or structure vulnerability would be limited to the crash site. If the accident occurred on airport grounds perimeter fences could be damaged, as well as runway asphalt, and navigation aids located near the runway. Since historically aircraft incidents occur during the takeoff and landing phase the terminal most likely would not be physically affected. The terminal may reach capacity due to the influx of passengers inside the terminal due to suspension of air operations at the airport.

Impact to Environment

An airport/aircraft crash would have limited impact on the environment overall, as most of the impacts would be confined to the crash location. The environment at the crash site would be damaged due to fire, chemical leaks (hydraulic fluid, jet fuel, etc..) biohazard, and human remains.

Impact to Economy

Economic impact due to an airport/airplane crash could be moderate. Airline traffic bound for Dallas Love Field would have to be diverted to Dallas/Fort Worth International Airport. Dallas Love Field may be required to operate with only one runway for departures and arrivals, severely impacting operations. Conventions could be impacted if attendees are delayed due to the closure of the airport. Hotel occupancy may drop and reservations may be cancelled as visitors cancel trips due to closure of the airport. The impact would be short lived as arriving and departing passengers can be rerouted to the larger Dallas/Fort Worth International Airport.

Public Confidence in Governance

There is little risk that the public will lose confidence in governance in most events. The City would assist the airline in meeting the requirement of the 1996 Aviation Disaster Family Assistance Act.

Summary Table

Impact	Level	Disruption
Public	Minor	Impacts to public would be minor as aircraft incidents impact a small area. Debris from the aircraft could damage or injure people on the ground.
Responder	Moderate	An aircraft crash brings with it the possibility of being a Mass Causality Incident. Stress from working this kind of incident can add additional stress to responders. Specially trained personnel in ARFF would be required to work additional shifts until all rescue operations are completed.
COOP/DOS	Minor	Activation of COOP would most likely not happen.
Property, Facilities, Infrastructure	Minor	Facility impact would be limited to the airport operation areas.
Environment	Minor – Moderate	Fires following a crash can burn contents inside the aircraft. The burning of these contents may impact air quality around the crash site.
Economy	Minor	Operations to airline operations could impact hospitality and travel related businesses.
Public Confidence	Minimal – Severe	The appropriate response and recovery actions will drive public confidence. The airline serves as the lead for information about the crash. Proper coordination between airline and government reps will required to ensure correct information is being given to the public.

11.1.10 Terrorism

Impact on the Public

Depending on the method chosen, the impact of a terrorist act on life in Dallas could be devastating. People are potentially at risk to devastating impacts. People are vulnerable to terrorist events through physical injury or disease, power outages, effects on transportation routes, effect of incident on mental state of public, confidence in government to protect them, etc.

The following terrorism scenario, developed for the DFW UASI 2014 Threat and Hazard Identification and Risk Assessment (THIRA), maximizes the human consequences of a terrorist attack within the Dallas/Fort Worth region, by incorporating simultaneous attacks during special events at three high-capacity public assembly venues:

At approximately 11:45 a.m., a man enters the crowded Parkland Hospital in Dallas. He detonates a suicide vest in the emergency room (ER) waiting room. More than 30 patients and staff in the waiting room and the triage area are killed instantly by flying shrapnel.

At approximately 12:25 p.m., about 60 people are waiting for trains and buses at the Dallas Area Rapid Transit (DART) West Transfer Center in downtown Dallas. A man places a backpack on the ground and sprints away, leaving the backpack behind. Several bystanders notice the suspicious activity and call 9-1-1.

Impact on the Responder

Impacts on local responder will include a surge in demand for response operations and operational coordination. National Incident Management System (NIMS) compliant organizational structures may be activated, staffed, and equipped. The Emergency Operations Centers (EOC) should be activated to coordinate operations amongst homeland security/emergency management, law enforcement, medical personnel, and related disciplines. A Unified Command may be formed with appropriate local, state, and federal stakeholders. Command posts and staging areas will be set up to coordinate operations near the affected venue(s). Local agencies should present relevant and actionable information to the whole community to inform the public of the attack, including warnings for the public to stay away from the attack site(s) and allow first responders to operate. Law Enforcement personnel will be needed to coordinate critical transportation and to allow first responders access to the affected site(s). Debris removal and evidence collection teams will be needed to coordinate the removal and collection of debris from the site.

Continuity of Operations/Delivery of Services

The government of the City of Dallas may be disrupted for days, weeks, or longer in the event of a terrorist attack within the City. Operational coordination will require sustained resources for the duration of the incident response, as well as recovery. The duration of EOC activation will rely upon the magnitude and duration of attack(s), and the extent of damage and impacts to the City that must be addressed during recovery. First responder resources and steady-state operations may be strained for days, weeks, or months. Some level of overtime and backfill will likely be required for local first responder agencies. An incident-specific short-term recovery plan should be developed in the first 48-to-72 hour's post-event, utilizing incident-specific initial damage assessments. As initial response operations wind down, the transition to a recovery focus will begin. The Dallas EOC will likely remain activated during initial days of short-term recovery.

Property, Facilities, Infrastructure

Terrorist incidents may have impact on structure throughout the City of Dallas, particularly those located in close proximity to the target(s). Impacts to buildings may include external structure damage to residences in close proximity to an attack site, due to fires, blast impacts including glass fragmentation, interruption of utilities due to damaged utility lines, or damaged sewer and water main lines. The type and extent of damage may be localized, as in a pipe bomb or active shooter event, or more widespread in the event of a vehicle born IED.

Impact on Environment

In general, the environmental impacts of terrorist attacks tend to be less severe than those of natural disasters or technological accidents, such as hazardous materials releases, which affect larger geographical areas. However, depending upon the nature of the attack, terrorist attacks may have moderate to severe impacts on the natural environment within the immediate and surrounding areas.

Impact on Economy

The city of Dallas is the largest economic center of the 12-county Dallas–Fort Worth–Arlington metropolitan area (commonly referred to as DFW), with a 2013 real GDP of $448 billion. The city's economy is primarily based on banking, commerce, telecommunications, computer technology, energy, healthcare and medical research, and transportation and logistics. Dallas is home to the third-largest concentration of Fortune 500 companies in the nation and a terrorist attack aimed at one of these organizations would have severe economic consequences.

Public Confidence in Governance

Public confidence in governance during and after the response to any terrorist attack will likely depend on the efficiency and effectiveness of governmental response, on all levels local, county and state. Among the factors that might enhance public confidence are prompt response from first responders, accurate and accessible messaging delivered through consistent communications with the public, and speedy restoration of any impacted services, such as power and water, with minimal disruption. Any government response, including support to impacted communities, must be equitable, and must ensure the same level of resources are available to low-income populations and those populations with functional needs, as are available to the majority of the population.

Terrorism attacks in the United States are not limited to international terror organizations. Lone wolf and domestic terrorism attacks, most recently the June attack on the Dallas Police Departments Headquarters, have reflected that public confidence relies heavily on public perception of government competency throughout response operations. Successful delivery of services, including security, search and rescue, forensics, apprehension of suspects, and triage of casualties, can enhance public confidence in governance. Conversely, any failure to provide adequate support, such as security, healthcare, and/or sheltering services, in the aftermath of a major incident, can significantly decrease public confidence.

Summary Table

Impact	Level	Disruption
Public	Minor - Severe	Impacts will depend on the nature of the attack. IED and Vehicle IED can result in high death tolls. These type of attacks may also generate fear or behavioral changes in Dallas residents.
Responder	Moderate - Severe	Surge in demand for response operations and operational coordination will require activation of the EOC. Responders will have to perform rescues, medical services, while preserving evidence and the crime scene.
COOP/DOS	Minimal - Moderate	Activation of COOP would most likely happen only if strategic city facilities were impacted. Delivery of services may be impacted due to impact area.
Property, Facilities, Infrastructure	Moderate - Severe	Terrorist attacks may destroy targeted structures. Generally impacts do not extend beyond the immediate impacted area.
Environment	Moderate - Severe	The relatively localized nature of terrorist attacks should minimize environmental impacts. The possibility of degraded air quality and release of harmful materials are possible.
Economy	Minimal – Moderate	Dallas's status as a major business center provides a number of targets that could have direct impact on the local and national economy. Behavioral changes may impact consumer confidence.
Public Confidence	Severe	Factors that will enhance public confidence are response from first responders, consistent quality messaging, and speedy restoration of any impacted services. Failure to provide adequate support in the aftermath of a major incident can significantly decrease public confidence.

Appendix E – CRS Overview and Executive Summary

Overview

The Community Rating System (CRS) is a nation-wide program sponsored by the Federal Emergency Management Agency (FEMA) through the National Flood Insurance Program (NFIP). This program has been in existence since 1990 and emphasizes reducing flood losses, facilitating accurate insurance ratings, and promoting awareness of flood insurance. The CRS program is administered by Insurance Services Office (ISO), the same organization which provides fire department rating services for insurance companies throughout the United States.

The CRS program is a voluntary program. It accomplishes its objectives by providing incentives in the form of flood insurance premium discounts for the citizens of communities which participate in the program. Participating in the CRS program involves performing activities which exceed minimal FEMA requirements for participating in the National Flood Insurance Program. Credit points are assigned according to a schedule, which is periodically revised, based on the types and level of activities performed by a community. These activities include but are not limited to such items as providing flood related information to citizens, conducting inspections and performing needed maintenance of drainage-ways, providing emergency warning to the citizens in the event of a flood, and conducting floodplain management planning. The six categories of potential activities addressed are preventive measures, property protection activities, activities to promote natural and beneficial functions of floodplains/preserve resources, emergency service activities, structural projects, and public information activities.

There are 10 classifications to the CRS program (1 to 10) with premium reductions for the properties in the Special Flood Hazard Area ("AA" and "V" flood zones) ranging from 0 to 45% depending upon the rating received by the community. The lower the rating in the CRS program the higher the insurance premium reduction (e.g. a Class 8 community receives a 10% reduction whereas a Class 9 receives a 5% reduction and a Class 10 receives a 0% reduction). The participating communities within Charleston County are currently Class 4, Class 5, Class 6, Class 7, Class 8 or Class 9 communities.

The benefits of participating in the CRS program include but are not limited to reduced flood insurance rates, enhanced floodplain management planning, national recognition, incentives to maintain flood programs, and becoming qualified for certain types of federal assistance (e.g. Flood Mitigation Assistance grant funding, Hazard Mitigation Grant Program funding, and Pre-Disaster Mitigation Grant Program funding) as a result of having an approved hazard mitigation plan. One of the potentially most important benefits is the enhanced preparedness for hazard events that occurs through better educating the citizens and the community officials regarding how to address the inevitable hazard events that will occur.

City of Dallas CRS Executive Summary

The City of Dallas has been a part of the CRS program since 1991. In 2014, the City went through a cycle verification visit with the Insurance Services Office, Inc. (ISO), FEMA's CRS management contractor. As a result of the visit, the City of Dallas was granted a CRS Class 5 which equated to a flood insurance premium reduction of 25% for its residents.

Below is a summary of the activities the City of Dallas received credit for in the 2014 cycle visit. The activities referenced are from the 2013 CRS Coordinator's Manual.

Activity 310 (Elevation Certificates) – The City of Dallas of Dallas does not permit new construction of substantial improvement to structures in the floodplain. The City requires that elevation certificates be obtained in cases in which structural improvements are proposed and the floodplain status in not clear. The City maintains all elevation certificates received.

Activity 320 (Map Information Service) – The City of Dallas Trinity Watershed Management (TWM) department provides information about the local flood hazard to residents and businesses so they can potential take steps to avoid problems and/or reduce their exposure to flooding. The Map Information Service includes information on the following items: FEMA Flood Insurance Rate Map (FIRM) information, Floodways, flood problems not shown on the FIRM, flood depth data, special flood-relation hazard (erosion and urban stormsewer flooding), and historical flooding. The service is publicized once a year

Activity 330 (Outreach Projects) – The objective of this activity is to provide the public with information needed to increase flood hazard awareness and to motivate actions to reduce flood damage, encourage flood insurance coverage, and protect the natural functions of floodplains. The City of Dallas has developed a comprehensive outreach plans which focuses on reaching residents through mailings, social media, and public meetings. These messages are delivered annually in English and in Spanish.

Activity 340 (Hazard Disclosure) - Section 5.008 of the Texas Property Code requires all sellers to disclose a property's potential flood hazard to prospective buyers before the lender notifies them of the need for flood insurance.

Activity 350 (Flood Protection Information) – The City of Dallas has resources available to the public on flood protection measures that extend beyond the annual outreach activities. The City of Dallas Library System has a number of local and FEMA publications related to protection of people and property from flood related hazards. The information is also available on the TWM website.

Activity 360 (Flood Protection Assistance) – The objective of this activity is to provide one-on-one help to people who are interested in protecting their property from flooding. The TWM staff are well qualified to provide advice on flood hazard, flood protection measures and/or possible financial assistance through meetings, phone calls, and site visits.

Activity 410 (Floodplain Mapping) – The key to reducing flood related hazards is to accurately determine the location of the hazard. The City of Dallas is constantly improving the quality of the floodplain mapping used for mitigation projects, citizen outreach, and to identify and regulate floodplain development. The City has developed new floodplain studies for nearly the entire City through FEMA's Map Modernization Program and Cooperating Technical Partners (CTP) Program. These studies utilized higher study standards than those required by FEMA at the time of the study.

Activity 420 (Open Space Preservation) – The objectives of this activity are to prevent flood damage by keeping flood-prone lands free of development and to protect and enhance the natural functions of floodplains. The City of Dallas preserves 69% of the current regulatory floodplain as open space through public ownership and floodway easements. Construction is prohibited in these areas to reduce potential increased flood damages from future development.

Activity 430 (Higher Regulatory Standards) – The City of Dallas has regulations in place to protect existing and future development and natural floodplain functions from flood related hazards. The following is a summary of the codes as they relate to the CRS Manual.

Development limitations (DL) - The City does not permit development within the regulatory floodplain but has criteria and a permitting system for floodplain reclamation. These criteria include compensatory storage for fill, structural freeboard, and velocity and water surface limitations.

Freeboard (FRB) – The City requires that all new or substantial improved structures have a building pad filled to an elevation of at least two feet above the design flood elevation and a the lowest floor be constructed three feet above the design flood elevation.

Cumulative substantial improvements (CSI) – The City requires that all improvements to a structure location in or adjacent to the regulatory floodplain do not exceed 50% of the building's pre-improvement value without meeting the current flood protection requirements. This value is calculated cumulatively for the last 10 years in order to reduce the potential for repetitive loss structures.

Building code (BC) – The City has adopted the entire 2012 International Code Series (I-Codes) including the International Building Code, International Residential Code, International Pluming Code, International Mechanical Code, and International Fuel Gas Code. Coordinating floodplain management with local building code has helped the City reduce losses from natural hazards. Additionally, the City is rated a Class 5 by ISO for the Building Code Effectiveness Grading Schedule (BCEGS). The BCEGS asses the building codes in effect in a community and how a community enforces them, with special emphasis on mitigation of losses from natural disasters.

Local Drainage Protection (LDP) – The City regulations require that all development provide positive drainage away from building sites in an effort to reduce localized flooding.

Activity 440 (Flood Data Maintenance) – The objective of this activity is to make community floodplain data more accessible, current, useful, and/or accurate so that the information contributes to the improvement of local regulations, insurance rating, planning, disclosure, and property appraisals. The City of Dallas maintains a GIS database containing all applicable information related to flood hazards. The information is used to for informational purposes with residents and in emergency situations. The City also maintains copies of all pervious FIRM maps and FIS reports for use with mitigation projects, substantial improvement requirements, and insurance determinations.

Activity 501 (The Repetitive Loss List) – Repetitive Loss data is gathered by FEMA and sent to the communities to review and update for use in mitigation projects. The City has created a Repetitive Loss Plan to guide the flood hazard mitigation efforts and to be used during flood event response. The plan contains an inventory of the properties, a mitigation strategy, outreach materials, and detailed maps of the respective loss areas. Thirty-one percent of the properties on the inventory have been mitigated to date. The City has performed multiple repetitive loss area analyses to determine alternatives to mitigate the remaining properties. These alternatives are added to the City's Needs Inventory for inclusion in future bond programs.

Activity 510 (Floodplain Management Planning) – The City of Dallas participates in the Dallas County Multi-Hazard Multi-Jurisdictional Mitigation Action Plan. The City participates in the County wide Mitigation Advisory Committee, reviewed all portions of the previous hazard mitigation plan pertaining to the City, and incorporated relevant components into the City of Dallas Hazard Mitigation Annex. The annex serves as a complete hazard mitigation planning tool for the City of Dallas. It contains updated capability assessment information, a new vulnerability assessment, and an updated/revised mitigation strategy. The annex contains a number of ongoing and planned flood hazard mitigation projects derived from the City's Needs Inventory.

Activity 520 (Acquisitions and Relocations) – Acquisition and relocation projects remove people and property from harm's way and reduce the community's costs for disaster response, recovery, and repair. Additionally, these properties create additional open space in the floodplain and allow the lands to return to their natural function. The City of Dallas has actively acquired and relocated properties to mitigate repetitive loss properties and for structural flood control projects. The City has acquires fifty-eight properties since 1983.

Activity 530 (Flood Protection) – In addition to acquisitions and relocation projects, the City of Dallas has constructed a number of small flood control projects that reduce the flood hazard risk to people and property. These projects were identified through Floodplain Master Plans and added to the City's Needs Inventory. The mitigation projects were prioritized based on the potential reduction of flood risk and funded through the Capital Improvement Program (CIP). The constructed projects include bypass channels, dams, bridge/culvert improvements, and diversion systems. Many of these projects were constructed to mitigate the risk to repetitive loss properties.

Activity 540 (Drainage System Maintenance) – Trinity Watershed Management is responsible for the inspection and maintenance of the City owned drainage system, which includes natural and human-made creeks and open channels, underground storm sewer pipes, floodway management areas (FMA's), detention/retention basins, improved drainage easements, and Flood Control systems. The City of Dallas TWM has created a Standard Operating Procedure Manual for Drainage System Maintenance which details procedures for annual inspection and regular and post-storm maintenance of the system. The goal of the program is to keep the system free of debris so that the system can maintain the designed flood carrying and storage capacity. Problems areas identified through the maintenance program that can cause a flood hazard increase are added to the City's Needs Inventory list and funded through the CIP.

Activity 610 (Flood Warning and Response) – The City of Dallas is recognized as a StormReady Community. The City has several procedures in place to monitor riverine flood levels, especially along the Trinity River. This monitoring system is used for emergency response and road closures. The real-time information is displayed on the City's website for use by the public.

Activity 620 (Levees) – The City of Dallas has created a Trinity River Levee Emergency Action Plan (EAP) and Operation and Maintenance (O&M) manual. These documents outline procedures to properly inspect and maintain levees and to identify impending levee failures in a timely manner, disseminate warnings to appropriate floodplain occupants, and coordinate emergency response activities to reduce the threat to life and property.

Activity 630 (Dams) – The City of Dallas has created a Dallas Dams Emergency Action Plan (EAP) and Operation and Maintenance (O&M) manual. These documents outline procedures to properly inspect and maintain dams and to identify impending dam failures in a timely manner, disseminate warnings to appropriate floodplain occupants, and coordinate emergency response activities to reduce the threat to life and property.

AGENDA ITEM # 30

STRATEGIC PRIORITY:	Public Safety
AGENDA DATE:	February 14, 2018
COUNCIL DISTRICT(S):	All
DEPARTMENT:	Police Department Court & Detention Services Fire-Rescue Department
CMO:	Jon Fortune, 670-1204
MAPSCO:	N/A

SUBJECT

Authorize **(1)** an application for and acceptance of the Rifle-Resistant Body Armor Grant in the amount of $1,764,300 (Grant No. 3483001) from the Office of the Governor, Criminal Justice Division to provide funding for the purchase of the rifle-resistant body armor for the Dallas Police Department, Dallas City Marshal's Office, and Dallas-Fire Rescue Department for the period January 1, 2018 to December 31, 2018; **(2)** establishment of appropriations in an amount not to exceed $1,764,300 in the CJD-Rifle-Resistant Body Armor Grant Program 2018 Fund; **(3)** receipt and deposit of grant funds in an amount not to exceed $1,764,300 in the CJD-Rifle-Resistant Body Armor Grant Program 2018 Fund; and **(4)** execution of the grant agreement - Total not to exceed $1,764,300 - Financing: Office of the Governor, Criminal Justice Division State Grant Funds

BACKGROUND

The safety of first responders is a high priority and providing them with equipment and tools that mitigate the dangers and hazards to protect the public from harm is critical.

Body armor enhances the survivability of officers subjected to hostile fire from various forms of ballistic rounds. The National Institute of Justice (NIJ) has developed a series of nationally accepted ratings for the body armor worn by law enforcement officers. These ratings define the level of ballistic performance.

To meet this safety need, ballistic resistant body armor is issued to each officer in the Dallas Police Department. A concealable vest with soft ballistic plates is sized and tailored to fit each officer and intended for daily wear while on duty. This concealable vest offers protection rated by NIJ as level IIIA.

BACKGROUND (continued)

In response to events like the tragedy that took place in downtown Dallas on July 7, 2016, a higher level of body armor protection is needed to defend against high velocity rifle rounds. Another type of ballistic vest and plates are required in this case and is rated by NIJ as level IV. This ballistic vest and plates are not intended for normal daily wear while on duty as the sheer weight and restriction on mobility of this protective but cumbersome equipment is not reasonable. Instead they are donned when there is an active shooter or in preparation for an event that could evolve into a life-threatening incident.

To address this equipment need, on September 13, 2017, by Resolution No. 17-1399, City Council passed a three-year master agreement for the purchase of ballistic harnesses, trauma plates, and helmets for police officers. The Dallas Police Department has ordered 2,000 level IIIA helmets and carriers (level IV) and 4,000 (level IV) trauma plates. This equipment is currently being shipped, delivered and soon will be prepped for anticipated issuance to police officers in the first and second quarter of 2018. These items were purchased through a combination of U.S. Homeland Security Grant Funds and General Fund dollars.

However, the City continued to research and seek various avenues and funding sources to further enhance our safety efforts. In response to the safety needs for officers across the State of Texas, the Office of the Governor developed a $25M grant solicitation for rifle resistant body armor for award to law enforcement agencies. The City of Dallas applied and was awarded $1,764,300. The submitted grant application requested funding to purchase 2,500 level III ballistic plates inserts and carriers that will be worn in conjunction with the level IIIA concealable vest issued to every Dallas police officer. NIJ level III protection is rated to stop multiple rifles rounds. The grant will also fund 65 level IV ballistic plates and carriers for the Dallas Marshal's Office and Dallas Fire Rescue Department - Arson/Bomb Squad officers. The intended issuance is broken down between the Dallas Police Department (2,435 level III), Dallas Marshal's Office (40 level III and 40 level IV) and Dallas Fire-Rescue Department – Arson/Bomb Squad (25 level III and 25 level IV).

The City has begun the procurement process for the purchase of the awarded equipment and anticipates completion by late summer 2018.

PRIOR ACTION/REVIEW (COUNCIL, BOARDS, COMMISSIONS)

The Public Safety and Criminal Justice Committee will be briefed by memorandum regarding this matter on February 12, 2018.

FISCAL INFORMATION

Office of the Governor, Criminal Justice Division State Grant Funds - $1,764,300

February 14, 2018

WHEREAS, the State of Texas, Office of the Governor, Criminal Justice Division (CJD) has made funds available to aid agencies with the purchase of rifle-resistant body armor during FY 2017-18; and

WHEREAS, the increased program and funding source would benefit the City of Dallas in its endeavor to increase officer safety; and

WHEREAS, the City of Dallas agrees that in the event of loss or misuse of the CJD funds, the City of Dallas assures that the funds will be returned to the CJD in full; and

WHEREAS, the City of Dallas designates the City Manager or an Assistant City Manager as the grantee's authorized official. The authorized official is given the power to apply for, accept, reject, alter or terminate the grant on behalf of the applicant agency; and

WHEREAS, it is in the best interest of the City of Dallas to accept such funding.

Now, Therefore,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF DALLAS:

SECTION 1. That the City Manager or designee is hereby authorized to apply for and accept the Rifle-Resistant Body Armor Grant in the amount of $1,764,300 (Grant No. 3483001) from the Office of the Governor, Criminal Justice Division to provide funding for the purchase of rifle-resistant body armor for the Dallas Police Department, Dallas City Marshal's Office, and Dallas-Fire Rescue Department for the period January 1, 2018 to December 31, 2018 and sign the grant agreement.

SECTION 2. That the City Manager is hereby authorized to establish appropriations in an amount not to exceed $1,764,300 in the CJD-Rifle-Resistant Body Armor Grant Program 2018 Fund, Fund S321, Department DPD, Unit 3570, Object 2890.

SECTION 3. That the Chief Financial Officer is hereby authorized to receive and deposit grant funds in an amount not to exceed $1,764,300 into the CJD-Rifle-Resistant Body Armor Grant Program 2018 Fund, Fund S321, Department DPD, Unit 3570, Revenue Code 6516.

SECTION 4. That the Chief Financial Officer is hereby authorized to disburse funds in an amount not to exceed $1,764,300 from the CJD-Rifle-Resistant Body Armor Grant Program 2018 Fund, Fund S321, Department DPD, Unit 3570, Object 2890.

SECTION 5. That in the event of loss or misuse of funds, the City of Dallas will return all grant funds to the Office of the Governor, Criminal Justice Division, in full.

SECTION 6. That the City Manager is hereby authorized to reimburse the Office of the Governor, Criminal Justice Division in the event of loss, or misuse of funds, in full. The City Manager shall notify the appropriate City Council Committee of any return of grants funds not later than 30 days after the reimbursement.

SECTION 7. That the City Manager shall keep the appropriate City Council Committee informed of all Criminal Justice Division final monitoring reports not later than 30 days after receipt of the report.

SECTION 8. That this contract is designated as Contract No. DPD-2018-00005274.

SECTION 9. That this resolution shall take effect immediately from and after its passage in accordance with the provisions of the Charter of the City of Dallas, and it is accordingly so resolved.