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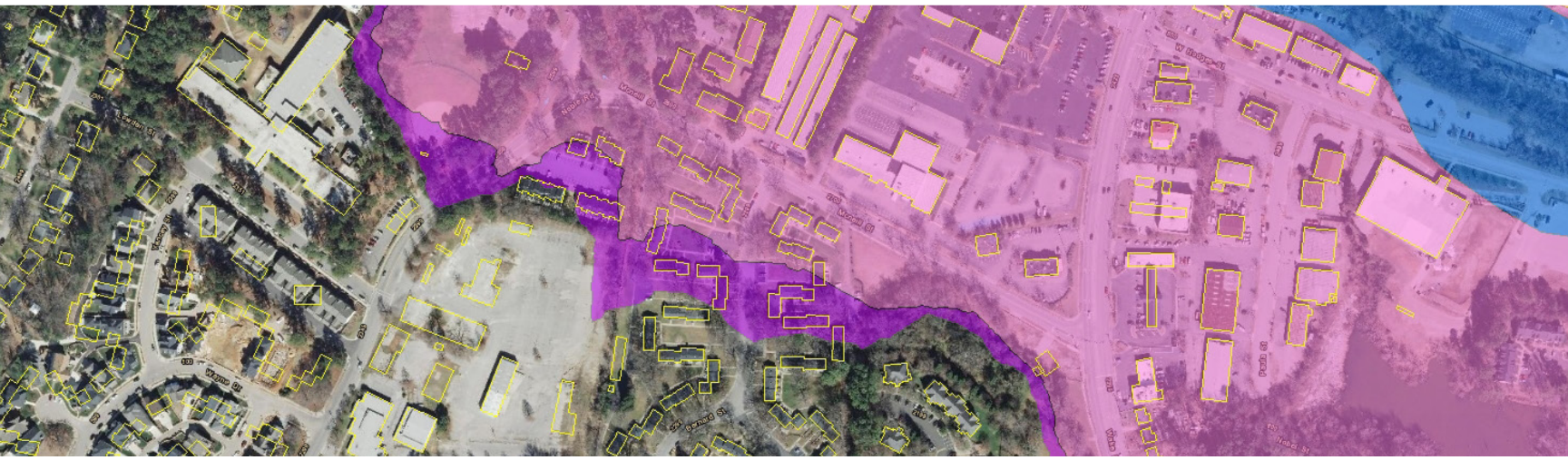
City of Bryan
Floodplain Management Plan



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EXECUTIVE SUMMARY

The purpose of this Floodplain Management Plan (FMP) is to reduce or eliminate risk to people and property from flood hazards. Every community faces different hazards and has different resources to draw upon in combating problems along with unique interests that influence the solutions to those problems. Because there are many ways to deal with flood hazards and many agencies that can help, there is no one solution for managing or mitigating their effects. Planning is one of the best ways to develop a customized program that will mitigate the impacts of flood hazards while accounting for the unique character of a community.

A well-prepared FMP provides a framework for all interested parties to work together and reach consensus on identifying priority risks and selecting the preferred activities to mitigate those risks. The FMP planning process supports a comprehensive review of all possible activities so that problems are addressed by the most appropriate and efficient solutions. It can also ensure that activities are coordinated with each other and with other local goals and activities, preventing conflicts and reducing the costs of implementing each individual activity.

The City of Bryan followed the planning process prescribed by the Federal Emergency Management Agency (FEMA) and the 2017 Community Rating System (CRS) Coordinator's Manual. This plan was developed under the guidance of a Floodplain Management Planning Committee (FMPC) comprised of representatives of City Departments, local residents, and other stakeholders. The FMPC conducted a risk assessment that identified and profiled flood hazards that pose a risk to the City, assessed the City's vulnerability to these hazards, and examined the capabilities in place to mitigate them. The flood hazards profiled in this plan are:

- Dam Failure
- Erosion
- Riverine Flooding
- Stormwater/Localized Flooding

This plan identifies activities that can be implemented for flood hazard reduction to protect the health and safety of the people of Bryan and reduce property damage caused by floods. To guide the review and selection of mitigation actions, the FMPC identified the following goals for flood risk and vulnerability reduction:

1. Protect the health, safety, and welfare of the public.
2. Increase outreach and public awareness to encourage citizens to responsibly protect property from flood damage.
3. Protect and enhance natural floodplain functions by preserving natural open space, green space, and drainage corridors.
4. Improve stormwater management including the impact of new development on stormwater runoff.
5. Protect critical facilities and infrastructure to maintain the continuity of critical and essential services.

To meet these goals, this plan recommends 50 mitigation actions, which are summarized in the table that follows. Note: Action number does not indicate an order of priority. Prioritization is discussed in Section 6 Mitigation Strategy.

This plan is an update to the City's first Floodplain Management Plan, originally developed and approved in 2018. Per CRS implementation and maintenance requirements, this plan will continue to be updated every five years.

Action No.	Action	Related to Goal	Addresses Current Development	Addresses Future Development	Continued Compliance with NFIP	Mitigation Category
1.1.a	Use the potential areas of high water information (2D model and public information) to make better planning decisions.	1,4		✓		Prevention
1.2.a	Add open channel inspections to regular maintenance programs.	4	✓		✓	Prevention
1.2.b	Perform a channel inventory including type, condition, and include in maintenance program.	4, 5	✓		✓	Prevention
1.2.c	Establish a closed-circuit television (CCTV) program for pipe inspections.	4, 5	✓			Prevention
1.2.d	Codify and continue requirement of detention pond bottom markers.	4	✓			Prevention
1.2.e	Annual review of detention ponds and require maintenance.	4, 5	✓		✓	Prevention
1.3.a	Monitor and update statistical rainfall numbers as soon as available.	4		✓		Prevention
1.4.a	Coordinate open space opportunities with flood control needs for new developments and repetitive loss areas.	1, 3	✓	✓	✓	Prevention
2.1.a	Perform a detailed review of flood insurance on city owned properties.	1, 5	✓		✓	Property Protection
2.2.a	Develop a voluntary property acquisition plan and program for repetitive loss areas	1	✓		✓	Property Protection
3.1.a	Continue to allow and promote the dedication of some floodplain acreage toward parkland. Work with Parks Board to establish guidelines for the consistent allowance of this type of dedication.	3		✓	✓	Natural Resource Protection
3.1.b	Train staff on maintenance practices that facilitate natural preservations.	3	✓			Natural Resource Protection
3.1.c	Continue the practice of requiring private drainage easements on all creeks.	3		✓		Natural Resource Protection
3.2.a	Explore developing ordinances/ criteria in the Drainage Design Guidelines that require erosion buffers along creeks.	3, 4		✓		Natural Resource Protection
3.2.b	Explore providing incentives to developers to preserve natural areas.	3, 4		✓	✓	Natural Resource Protection
3.2.c	Explore the use of Natural Area Preserved zoning districts in Bryan.	3, 4		✓	✓	Natural Resource Protection

Action No.	Action	Related to Goal	Addresses Current Development	Addresses Future Development	Continued Compliance with NFIP	Mitigation Category
3.2.d	Explore developing guidelines/criteria for compensatory storage.	4		✓	✓	Natural Resource Protection
4.1.a	Continue programs to conduct pre and post rain event inspections on known areas of issues.	1, 4, 5	✓		✓	Emergency Services
4.1.b	Continue to block streets that become flooded utilizing the flood prone streets list and revise/improve this list with more data.	1, 5	✓		✓	Emergency Services
4.1.c	Protect critical facilities and flood prone areas from debris by expanding the maintenance program to include trash pick-up (including bulk) prior to forecasted large events.	1, 5	✓			Emergency Services
4.2.a	Install more gauges to expand the B-FEWS system.	1, 2	✓		✓	Emergency Services
4.2.b	Explore use of city wide 2D model to consolidate rainfall data and produce real-time flood warning/forecasting system to notify residents and city staff for emergency access.	1, 2	✓		✓	Emergency Services
4.2.c	Create public information campaign to encourage participation in Code Red.	1, 2	✓		✓	Emergency Services
4.2.d	Explore installing "Street May Flood" signs to critical locations.	1, 2	✓		✓	Emergency Services
4.3.a	Investigate grant funding available for emergency services.	5	✓			Emergency Services
4.4.a	Work with organizations serving functional/access needs populations (elderly, wheelchair-bound, deaf, blind, such as Brazos Valley Council on Independent Living) that may require special assistance, that tie in with 9-1-1, GIS Systems, etc. so that vulnerable citizens can be checked on, notified, supported, or educated effectively in the event of disasters.	1	✓			Emergency Services
4.4.b	Update and maintain the City of Bryan Hazard Mitigation website with information promoting hazard mitigation and disaster awareness.	2	✓			Emergency Services
4.4.c	Develop a Substantial Damage Management Plan.	1	✓	✓	✓	Emergency Services
4.4.d	Develop/review/update the debris management plan.	1	✓			Emergency Services
5.1.a	Continue to implement Stormwater Master Plan projects as funding allows.	4	✓		✓	Structural Projects
5.1.b	Design, construct and maintain drainage improvement projects per the studies in the Stormwater Master Plan (Primary and Secondary Drainage Recommendations).	1, 4	✓		✓	Structural Projects

Action No.	Action	Related to Goal	Addresses Current Development	Addresses Future Development	Continued Compliance with NFIP	Mitigation Category
5.1.c	Provide update of the Stormwater Master Plan including revisions to the ranking criteria every 5 years.	4	✓			Structural Projects
5.2.a	Continue to construct local and regional stormwater detention facilities in flood prone areas.	4	✓		✓	Structural Projects
5.3.a	Develop a plan to upgrade existing low water crossings to improve service levels.	1, 5	✓			Structural Projects
5.3.b	Increase capacity of existing culverts and bridges on major thoroughfares (Old Reliance Rd., Broadmoor low water bridge, W. Villa Maria between Cavitt and Texas Avenue) and single access subdivisions (see 2D Report list) to allow passage during 100-year event.	1, 4, 5	✓			Structural Projects
5.3.c	Explore list of roads flooded during 2016/2017 rainfalls and research emergency access availability to residents given these flooded conditions.	1	✓			Structural Projects
5.4.a	Develop collaborative program between the stormwater and parks department to create opportunities for flood protection and recreation in open spaces.	3, 4	✓	✓	✓	Structural Projects
5.4.b	Explore creating a system for development incentives for improving city storm water infrastructure.	4		✓	✓	Structural Projects
5.4.c	Continue to pursue partnerships with BISD to complete stormwater projects on school sites.	4		✓		Structural Projects
6.1.a	Direct mail of FEMA flood protection information to targeted areas of high flood risk.	2	✓		✓	Public Information
6.1.b	Develop a dam safety public education and evacuation plan for at risk areas of the community, including routes, transportation, and housing.	1, 2	✓			Public Information
6.1.c	Educate realtors regarding real estate disclosure as relates to flooding.	2	✓	✓	✓	Public Information
6.1.d	Educate builders and landscape companies on how to properly grade new homes to protect from flood damage.	2	✓	✓	✓	Public Information
6.2.a	Hold a large community event dedicated to stormwater education annually (Earth Day).	2	✓			Public Information
6.2.b	Create adopt-an-inlet and adopt-a-creek programs.	2, 3, 4	✓			Public Information
6.2.c	Become more active in flood awareness week through additional social media outlets and community events.	2	✓			Public Information

Action No.	Action	Related to Goal	Addresses Current Development	Addresses Future Development	Continued Compliance with NFIP	Mitigation Category
6.2.d	Develop paid advertisements through public service announcements to educate the public about flood insurance and flood risk.	2	✓		✓	Public Information
6.2.e	Develop and improve communication regarding preparedness and mitigation actions to better inform developers, engineers, builders, and the public about ways they can avoid flood damage.	2	✓			Public Information
6.2.f	Develop and present citizen floodplain and flood insurance education programs.	2	✓		✓	Public Information
6.2.g	Create educational program for flood risk to schools and youth.	2	✓			Public Information

The following table provides the 10-step CRS planning credit activity checklist and the section/page number within this plan that describes the completion of each planning step in more detail.

CRS Planning Credit Activity Checklist

CRS Step	Section/Page
1. Organize to prepare the plan.	
a. Involvement of office responsible for community planning	Section 2.1 / p. 11
b. Planning committee of department staff	Section 2.1 / p. 11
c. Process formally created by the community's governing board	--
2. Involve the public.	
a. Planning process conducted through a planning committee	Section 2.2.1 / p. 13-14 Appendix A / pA1-A30
b. Public meetings held at the beginning of the planning process	Section 2.2.1 / p. 14-15 Appendix A / pA31-A40
c. Public meeting held on draft plan	Section 2.2.1 / p. 14-15 Appendix A / pA41-A46
d. Other public information activities to encourage input	Section 2.2.1 / p. 15-16 Appendix A / pA47-A71
3. Coordinate with other agencies.	
a. Review of existing studies and plans	Section 2.2.1 / p. 17-18
b. Coordinating with communities and other agencies	Section 2.2.1 / p. 16-17 Appendix A / pA72-A74
4. Assess the hazard.	
a. Plan includes an assessment of the flood hazard with:	
(1) A map of known flood hazards	Figure 4.8 / p68 Figure 4.9 / p73 Figure 4.18-4.22 / p.86-90 Figure 4.23 / p96
(2) A description of known flood hazards	Section 4.4.3 / p64-69 Section 4.4.4 / p85-91
(3) A discussion of past floods	Section 4.4.3 / p69-70 Section 4.4.4 / p92-93
b. Plan includes assessment of less frequent floods	Section 4.4.1 / p53-59
c. Plan includes assessment of areas likely to flood	Section 4.5.2 / p94-97
d. The plan describes other natural hazards	Section 4.4.2 / p60-63
5. Assess the problem.	
a. Summary of each hazard identified in the hazard assessment and their community impact	Section 4.4.1 / p58, 59 Section 4.4.2 / p62, 63 Section 4.4.3 / p69, 71-83 Section 4.4.4 / p91, 93
b. Description of the impact of the hazards on:	
(1) Life, safety, health, procedures for warning and evacuation	Sections 4.5.4 / p101-102
(2) Public health including health hazards to floodwaters/mold	Sections 4.5.4 / p100-101
(3) Critical facilities and infrastructure	Section 4.3.3 / p83
(4) The community's economy and tax base	Section 3.5 / p30-31
(5) Number and type of affected buildings	Section 4.3 / p47-51 Section 4.4.3 / p71-83
c. Review of all damaged buildings/flood insurance claims	Section 4.4.3 / p83-84 Section 4.5.2 / p95-96

CRS Step	Section/Page
d. Areas that provide natural floodplain functions	Section 3.3 / p26-29
e. Development/Redevelopment/Population Trends	Sections 3.9 / p35-39
f. Impact of future flooding conditions outlined in Step 4, item c	Sections 4.5.3 / p97-99
6. Set goals.	Section 6.2 / p115-116
7. Review possible activities.	
a. Preventive activities	Section 6.3 / p116-118 Appendix B.1.1 / pB1-B5
b. Floodplain Management Regulatory/current & future conditions	Section 6.3 / p116-118 Appendix B.1.1 / pB3-B5
c. Property protection activities	Section 6.3 / p116-118 Appendix B.1.2 / pB5-B8
d. Natural resource protection activities	Section 6.3 / p116-118 Appendix B.1.3 / pB8-B12
e. Emergency services activities	Section 6.3 / p116-118 Appendix B.1.4 / pB12-B15
f. Structural projects	Section 6.3 / p116-118 Appendix B.1.5 / pB15-B17
g. Public information activities	Section 6.3 / p116-118 Appendix B.1.6 / pB17-B19
8. Draft an action plan.	
a. Actions must be prioritized	Section 6.3.1 / p118 Appendix B / pB20
(1) Recommendations for activities from two of the six categories	
(2) Recommendations for activities from three of the six categories	
(3) Recommendations for activities from four of the six categories	
(4) Recommendations for activities from five of the six categories	Section 6.4 / p118-143 Appendix B / pB1-B19
b. Post-disaster mitigation policies and procedures	Sections 5.1.1 / p106-109
c. Action items for mitigation of other hazards	----
9. Adopt the plan.	Section 7 / p144-145
10. Implement, evaluate and revise.	
a. Procedures to monitor and recommend revisions	Section 8.2-8.3 / p146-150
b. Same planning committee or successor committee that qualifies under Section 511.a.2 (a) does the evaluation	Section 8.1 / p146

1 INTRODUCTION

Section 1 provides a general overview of hazard mitigation and floodplain management and an introduction to the Bryan, TX Floodplain Management Plan. This section contains the following subsections:

- 1.1 Purpose and Authority
- 1.2 Background
- 1.3 Scope
- 1.4 References
- 1.5 Plan Organization

1.1 PURPOSE AND AUTHORITY

As defined by FEMA, "hazard mitigation" means any sustained action taken to reduce or eliminate the long-term risk to life and property from a hazard event. Hazard mitigation planning is the process through which hazards are identified, likely impacts determined, mitigation goals set, and appropriate mitigation strategies determined, prioritized, and implemented. Floodplain management is a community-based effort to prevent or reduce the risk of flooding. The purpose of this plan is to identify, assess and mitigate flood risk to better protect the people and property of the City of Bryan from the effects of flood hazards. This plan documents Bryan's floodplain management planning process and identifies relevant flood hazards and vulnerabilities and strategies the City will use to decrease vulnerability and increase resiliency and sustainability.

This plan was developed in a joint and cooperative venture by members of a Floodplain Management Planning Committee (FMPC) which included representatives of City departments as well as local citizens and stakeholders. This plan will ensure the City of Bryan's continued eligibility for federal disaster assistance including the Federal Emergency Management Agency (FEMA) Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC), and the Flood Mitigation Assistance Program (FMA). This plan has been prepared in compliance with Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act or the Act), 42 U.S.C. 5165, enacted under Section 104 of the Disaster Mitigation Act of 2000, (DMA 2000) Public Law 106-390 of October 30, 2000, as implemented at CFR 201.6 and 201.7 dated October 2007.

1.2 BACKGROUND

The City of Bryan currently participates in the National Flood Insurance Program's (NFIP) Community Rating System (CRS) and qualifies for a Class 8 Rating. The CRS recognizes and encourages community floodplain management activities that exceed the minimum standards. Under the CRS, flood insurance premium rates are adjusted to reflect the reduced flood risk resulting from community activities that (1) reduce flood losses, (2) facilitate accurate insurance ratings, and (3) promote the awareness of flood insurance.

It is the goal of the FMPC to continue to work to make improvements to this plan so as to better serve the citizens of Bryan, and to strive to maintain or improve the Class 8 rating for the City, so that the highest reduction in flood insurance premium rates can be available for its citizens. Through the City's participation in the NFIP and Class 8 rating with the CRS, policyholders are currently entitled to a 10% discount on their flood insurance premiums.

1.3 SCOPE

This document comprises a Floodplain Management Plan for the City of Bryan, Texas. This plan is an update to the City's first Floodplain Management Plan, originally developed and approved in 2018.

Due to the small geographic scope of Bryan and the larger regional extent of many hazard events, many of the hazard profiles are prepared on a county level. This was done to ensure an accurate estimation of risk for the City. The subsequent vulnerability assessment and mitigation actions are specific to Bryan.

1.4 REFERENCES

The following FEMA guides and reference documents were used to prepare this document:

- FEMA 386-1: Getting Started. September 2002.
- FEMA 386-2: Understanding Your Risks: Identifying Hazards and Estimating Losses. August 2001.
- FEMA 386-3: Developing the Mitigation Plan. April 2003.
- FEMA 386-4: Bringing the Plan to Life. August 2003.
- FEMA 386-5: Using Benefit-Cost Review in Mitigation Planning. May 2007.
- FEMA 386-6: Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning. May 2005.
- FEMA 386-7: Integrating Manmade Hazards into Mitigation Planning. September 2003.
- FEMA 386-9: Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects. August 2008.
- FEMA. Local Mitigation Planning Handbook. March 2013.
- FEMA. Local Mitigation Plan Review Guide. October 1, 2011.
- FEMA. Local Mitigation Planning Policy Guide. April 19, 2023.
- FEMA Hazard Mitigation Assistance Unified Guidance. June 1, 2010.
- FEMA. Integrating Hazard Mitigation into Local Planning: Case Studies and Tools for Community Officials. March 1, 2013.
- FEMA. Mitigation Ideas. A Resource for Reducing Risk to Natural Hazards. January 2013.

Additionally, specific Disaster Mitigation Act requirements are referenced under each section heading, where applicable.

1.5 PLAN ORGANIZATION

- Section 2: Planning Process
- Section 3: Community Profile
- Section 4: Flood Risk Assessment
- Section 5: Capability Assessment
- Section 6: Mitigation Strategy
- Section 7: Plan Adoption
- Section 8: Plan Implementation and Maintenance
- Appendix A: Planning Process Documentation
- Appendix B: Mitigation Strategy
- Appendix C: References

2 PLANNING PROCESS

Requirement §201.6(b): An open public involvement process is essential to the development of an effective plan. To develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:
1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and nonprofit interests to be involved in the planning process; and
3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6(c)(1): The plan shall include the following:
1) Documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

This section reviews the process that was followed to develop this plan. It contains the following subsections:

- 2.1 Local Government Participation
- 2.2 The 10-Step Planning Process

This Floodplain Management Plan was developed in accordance with DMA and CRS planning process requirements under the guidance of a Floodplain Management Planning Committee (FMPC). The Committee included representatives of City Departments as well as local citizens and stakeholders. As a result of this process and the collective input of City staff, stakeholders, and the public, this plan analyzes flood risks and vulnerabilities, sets goals and objectives for mitigation, and identifies activities that can be undertaken by both public and private entities to reduce safety hazards, health hazards, and property damage caused by floods.

Appendix A provides additional information and documentation of the planning process that was implemented for the development of this FMP.

2.1 LOCAL GOVERNMENT PARTICIPATION

The DMA planning regulations and guidance stress that each local government seeking FEMA approval of their mitigation plan must participate in the planning effort in the following ways:

- Participate in the process as part of the planning committee;
- Detail where within the planning area the risk differs from that facing the entire area;
- Identify potential mitigation actions; and
- Formally adopt the plan.

These participation requirements were fulfilled by the FMPC, which included City staff representatives. For the City of Bryan FMPC, “participation” included the following:

- Providing facilities for meetings;
- Attending and participating in the FMPC meetings;
- Collecting and providing requested data (as available);
- Managing administrative details;
- Making decisions on plan process and content;
- Identifying mitigation actions for the plan;
- Reviewing and providing comments on plan drafts;

- Informing the public, local officials, and other interested parties about the planning process and providing opportunity for them to comment on the plan;
- Coordinating, and participating in the public input process; and
- Coordinating the formal adoption of the plan by the City Council.

Through the planning process, the FMPC met the above participation requirements. The FMPC included 11 representatives from City departments as well as 14 outside stakeholder representatives. The members comprising the City of Bryan FMPC are listed in Table. In keeping with CRS requirements, staff representation included the Planning and Development Services Department, which is responsible for community planning.

Table 2.1 – Floodplain Management Planning Committee (FMPC) Members

Name	Title/Position	Department/Organization
Greg Cox, CBO, CFM	Chief Building Officer	City of Bryan Planning and Development Services
Paul Kaspar, P.E., CFM	City Engineer	City of Bryan Engineering Services
Sam J. Vernon, P.E., CFM	Assistant City Engineer/ Floodplain Manager	City of Bryan Engineering Services
Brianna Groves, P.E., CFM	Civil Engineer	City of Bryan Engineering Services
Allison Kay, AICP	Senior Planner	City of Bryan Planning and Development Services
David Schmitz	Parks and Recreation Director	City of Bryan Parks and Recreation
Shawndra Green-Curry, P.E.	Distribution Engineer	Bryan Texas Utilities
Lacey Lively	Communications and Marketing Manager	City of Bryan Communications and Marketing
Jeanelle Johnson (Gottlob)	Emergency Management Coordinator	City of Bryan Fire Department
Stacy Liner	Streets and Drainage Supervisor	City of Bryan Streets and Drainage
Gary Harrison	GIS	City of Bryan GIS
Jacob Torres, PhD, P.E.	Managing Partner, Principal	J. M. Torres & Associates (Stakeholder)
Jeff Robertson, P.E.	Principal	McClure & Browne (Stakeholder)
Rabon Metcalf, P.E.	Owner	RME Consulting Engineers (Stakeholder)
Grant Carrabba	Developer	Developer (Stakeholder)
Steve Pittman	Developer	Developer/Homebuilder (Stakeholder)
Ricardo Reyna	Developer	RNL Homes (Stakeholder)
Ron Clary	Executive Director, Auxiliary Services	Bryan Independent School District (Stakeholder)
Sahai Fleurant	Staff	American Red Cross (Stakeholder)
Darick Chabot	Insurance Agent	Farm Bureau (Stakeholder)
Mynde Kessler	Insurance Agent	State Farm Insurance (Stakeholder)
Erin Marietta	VP Operations	CHI St. Joseph Health (Stakeholder)
Michele Meade	Emergency Management Coordinator	Brazos County Emergency Management (Stakeholder)
Jacqueline Rice	President	Greenbrier HOA (Stakeholder)
Mark Feldhake	Executive Director of Facilities, Planning & Construction	Blinn College (Stakeholder)

Table 2.2 details the FMPC meeting dates and the FMPC members in attendance. A more detailed summary of FMPC meeting dates including topics discussed and meeting locations follows in Table 2.4. Meeting agendas, minutes, and attendance records have been included in Appendix A.

Table 2.2 – FMPC Meeting Attendance Record

Member Name	Affiliation	Meeting Date			
		4/4/2023	5/2/2023	6/6/2023	8/15/2023
Greg Cox, CBO, CFM	City of Bryan	✓	✓	✓	
Paul Kaspar, P.E., CFM	City of Bryan	✓	✓	✓	
Sam J. Vernon, P.E., CFM	City of Bryan	✓	✓	✓	
Brianna Groves, P.E., CFM	City of Bryan		✓	✓	
Allison Kay, AICP	City of Bryan	✓	✓		
David Schmitz	City of Bryan	✓		✓	
Shawndra Green-Curry, P.E.	City of Bryan	✓			
Lacey Lively	City of Bryan	✓		✓	
Jeanelle Johnson (Gottlob)	City of Bryan	✓	✓	✓	
Stacy Liner	City of Bryan	✓			
Gary Harrison	City of Bryan	✓	✓	✓	
Jacob Torres, PhD, P.E.	Stakeholder	✓		✓	
Jeff Robertson, P.E.	Stakeholder	✓	✓	✓	
Rabon Metcalf, P.E.	Stakeholder	✓	✓	✓	
Grant Carrabba	Stakeholder		✓	✓	
Steve Pittman	Stakeholder	✓	✓	✓	
Ricardo Reyna	Stakeholder			✓	
Ron Clary	Stakeholder	✓	✓		
Sahai Fleurant	Stakeholder	✓			
Darick Chabot	Stakeholder				
Mynde Kessler	Stakeholder	✓		✓	
Erin Marietta	Stakeholder		✓	✓	
Michele Meade	Stakeholder	✓	✓	✓	
Jacqueline Rice	Stakeholder	✓	✓	✓	
Mark Feldhake	Stakeholder		✓		

Table 2.3 demonstrates the City staff's capabilities in the six mitigation categories (Prevention, Property Protection, Natural Resource Protection, Emergency Services, Structural Flood Control Projects, and Public Information) based on the areas of expertise of each City representative participating on the FMPC.

Table 2.3 – City of Bryan Staff Capability with Six Mitigation Categories

Community Department/Office	Prevention	Property Protection	Natural Resource Protection	Emergency Services	Structural Flood Control	Public Information
Engineering Services	✓	✓			✓	
Planning & Development Services	✓		✓			
Parks & Recreation	✓		✓			
Marketing & Communications						✓
Fire & EMS				✓		✓
Streets & Drainage		✓			✓	
Bryan Texas Utilities				✓		

2.2 THE 10-STEP PLANNING PROCESS

The planning process for preparing the City of Bryan Floodplain Management Plan was based on the Community Rating System (CRS) Activity 510 Floodplain Management Planning requirements as well as

Disaster Mitigation Act of 2000 (DMA 2000) planning requirements and FEMA's associated guidance. FEMA's guidance is structured around a four-phase process:

1) Planning Process;
2) Risk Assessment;
3) Mitigation Strategy; and
4) Plan Maintenance.

This four-phase process dovetails with the more robust 10-Step planning process established under CRS Activity 510. By integrating and following both of these planning processes, the City's modified 10-step process used for this plan meets the requirements of six major programs: FEMA's HMGP; BRIC Program; CRS Program; FMA Program; Severe Repetitive Loss Program; and new flood control projects authorized by the U.S. Army Corps of Engineers.

Table 2.4 shows how the 10-step CRS planning process aligns with the four phases of hazard mitigation planning pursuant to DMA 2000.

Table 2.4 – Mitigation Planning and CRS 10-Step Process Reference Table

DMA Process	CRS Process
Phase I – Planning Process	
§201.6(c)(1)	Step 1. Organize to Prepare the Plan
§201.6(b)(1)	Step 2. Involve the Public
§201.6(b)(2) & (3)	Step 3. Coordinate
Phase II – Risk Assessment	
§201.6(c)(2)(i)	Step 4. Assess the Hazard
§201.6(c)(2)(ii) & (iii)	Step 5. Assess the Problem
Phase III – Mitigation Strategy	
§201.6(c)(3)(i)	Step 6. Set Goals
§201.6(c)(3)(ii)	Step 7. Review Possible Activities
§201.6(c)(3)(iii)	Step 8. Draft an Action Plan
Phase IV – Plan Maintenance	
§201.6(c)(5)	Step 9. Adopt the Plan
§201.6(c)(4)	Step 10. Implement, Evaluate and Revise the Plan

2.2.1 PHASE I – PLANNING PROCESS

PLANNING STEP 1: ORGANIZE TO PREPARE THE PLAN

With the City of Bryan's commitment to participate in this CRS and DMA planning process, City officials worked to establish the framework and organization for development of the plan. An initial meeting was held with key community representatives to discuss the organizational aspects of the plan development process. The FMPC established for the development of the City's original Floodplain Management Plan was reconvened for this update. Membership of the committee was expanded to incorporate additional stakeholder involvement.

Committee meetings were organized to familiarize the FMPC with the planning process and facilitate discussion on CRS Steps 4 through 8. The FMPC kickoff was held on April 4, 2023, at 4:00 p.m. at Bryan City Hall. The meeting reviewed the CRS program and covered the scope of work and an introduction to the DMA and CRS requirements for planning. The committee also discussed the hazard identification and ways to involve the public throughout the planning process. The next two FMPC meetings, which took place on May 2, 2023 and June 6, 2023, were virtual meetings held via Microsoft Teams. At these meetings, the FMPC discussed the plan goals and objectives, local capability, mitigation action updates, new mitigation actions, and hazard risk and vulnerability assessment findings. The last FMPC meeting, held at

Bryan City Hall on August 15, 2023, provided the FMPC the opportunity to finalize the action plan and review the draft plan.

During the planning process, the FMPC communicated through in-person meetings, virtual meetings, email, and phone conversations. Draft documents were posted on the City's website so that the FMPC members could easily access and review them. The formal FMPC meetings followed the CRS Planning Steps. Agendas, minutes, and sign in sheets for the FMPC meetings are included in Appendix A. The meeting dates and topics discussed are summarized below in Table 2.5. All FMPC meetings were open to the public; however, separate public meetings were also held and are described below.

Table 2.5 – Summary of FMPC Meeting Dates and Topics

Meeting Title	Meeting Topic	Meeting Date	Meeting Location
FMPC Mtg. #1 – Project Kickoff	1) Introduction to DMA and CRS requirements and the planning process 2) Trends in disasters and justification for planning 3) Review of FMPC responsibilities and the project schedule 4) Preliminary hazard identification	April 4, 2023 4:00 p.m.	Bryan City Hall Downstairs Meeting Room, 300 S Texas Ave Bryan, TX
FMPC Mtg. #2	1) Discuss goals & objectives 2) Review mitigation action plan requirements 3) Discuss local capability 4) Review existing mitigation action progress	May 2, 2023 3:30 p.m.	Microsoft Teams Meeting
FMPC Mtg. #3	1) Review draft Hazard Identification & Risk Assessment (HIRA) 2) Discuss asset inventory, risk, and vulnerability 3) Discuss new mitigation action alternatives	June 6, 2023 3:00 p.m.	Microsoft Teams Meeting
FMPC Mtg. #4	1) Review the draft Floodplain Management Plan 2) Finalize the mitigation action plan 3) Solicit comments and feedback	August 15, 2023 3:00 p.m.	Bryan City Hall Downstairs Meeting Room, 300 S Texas Ave Bryan, TX

PLANNING STEP 2: INVOLVE THE PUBLIC

Two public meetings were held during the planning process, one at the beginning of the process to introduce the plan update and gather public input, and another at the end of the planning process to share the draft plan and solicit feedback. Meetings were publicized a variety of ways, including on the City website and social media, through various local news outlets, and through in person outreach events. Documentation of public outreach efforts is provided in Appendix A. The formal public meetings held during the planning process are summarized in Table 2.6.

Table 2.6 – Summary of Public Meeting Dates and Topics

Meeting Type	Meeting Topic	Meeting Date	Meeting Locations
Public Meeting #1	1) Introduction to DMA, CRS and the planning process 2) Introduction to hazard identification	April 4, 2023 5:30 – 6:30 p.m.	Bryan City Hall Downstairs Meeting Room, 300 S Texas Ave Bryan, TX

Meeting Type	Meeting Topic	Meeting Date	Meeting Locations
Public Meeting #2	1) Review draft Floodplain Management Plan 2) Solicit comments and feedback from the public	August 15, 2023 5:30 – 6:30 p.m.	Bryan City Hall Downstairs Meeting Room, 300 S Texas Ave Bryan, TX

INVOLVING THE PUBLIC BEYOND ATTENDING PUBLIC MEETINGS

Early discussions with the FMPC established the initial plan for public involvement. The FMPC agreed to an approach using established public information mechanisms and resources within the community. Public involvement activities for this plan update included a City webpage, social media outreach, stakeholder and public meetings, an outreach flyer, a public survey, and the collection of public and stakeholder comments on the draft plan.

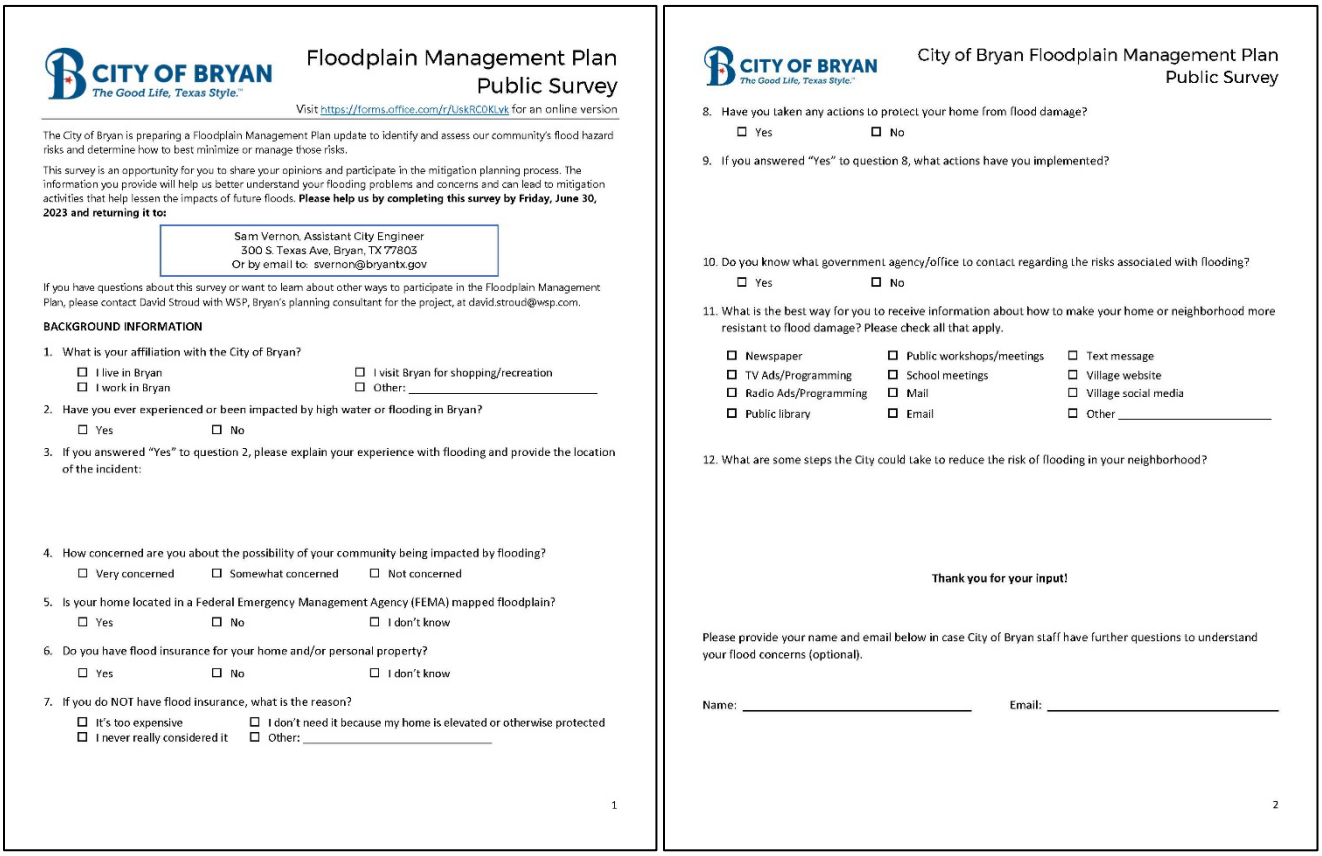
The FMPC found 10 different ways to involve the public beyond attending public meetings. Documentation to support the additional public outreach efforts can be found in Appendix A. The public outreach activities beyond the formal public meetings are summarized below in Table 2.7.

Table 2.7 – Public Outreach Efforts

Location		Event/Message	Date
1	City website	Webpage created on City website to announce the Floodplain Management Plan update and explain the planning process and ways to participate.	March 2023
2	City social media	Public meeting announcement posted online to encourage participation and comment.	March 2023
3	City Hall	Outreach flyer describing the planning process and ways to get involved made available in City Hall after the first public meeting.	April 2023
4	City website	Public survey responses requested with announcement and link to online version of the survey.	April 2023
5	City Hall	Hard copies of the public survey made available for public input on planning process after the first public meeting.	April 2023
6	First Friday Booth	Flood risk information and hard copies of the public survey made available for public education and input on the planning process.	May 2023
7	City website	Presentation slides and meeting minutes from Committee and public meetings posted on City website for public review.	April-August 2023
8	City website	Draft Hazard Identification and Risk Assessment posted on City website with request for public review/comment	June 2023
9	City website	Draft plan posted on City website for public review and comment.	August 2023
10	City social media	Public meeting announcement posted online to encourage participation and comment.	August 2023

The public survey which requested public input into the Floodplain Management Plan planning process and the identification of mitigation activities to lessen the risk and impact of future flood hazard events is shown in Figure 2.1. The City of Bryan website was updated to include a link to the survey. Hard copies were also distributed at City Hall and a City "First Friday" event. There were 137 responses received. A summary of the survey results is presented in Appendix A.

Figure 2.1 – Public Survey



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Floodplain Management Plan
Public Survey

Visit https://forms.office.com/r/UskRC0KLvk for an online version

The City of Bryan is preparing a Floodplain Management Plan update to identify and assess our community's flood hazard risks and determine how to best minimize or manage those risks.

This survey is an opportunity for you to share your opinions and participate in the mitigation planning process. The information you provide will help us better understand your flooding problems and concerns and can lead to mitigation activities that help lessen the impacts of future floods. **Please help us by completing this survey by Friday, June 30, 2023 and returning it to:**

Sam Vernon, Assistant City Engineer
300 S. Texas Ave, Bryan, TX 77803
Or by email to: svernon@bryantx.gov

If you have questions about this survey or want to learn about other ways to participate in the Floodplain Management Plan, please contact David Stroud with WSP, Bryan's planning consultant for the project, at david.stroud@wsp.com.

BACKGROUND INFORMATION

1. What is your affiliation with the City of Bryan?
   - ☐ I live in Bryan
   - ☐ I work in Bryan
   - ☐ I visit Bryan for shopping/recreation
   - ☐ Other: _____
2. Have you ever experienced or been impacted by high water or flooding in Bryan?
   - ☐ Yes ☐ No
3. If you answered "Yes" to question 2, please explain your experience with flooding and provide the location of the incident:
4. How concerned are you about the possibility of your community being impacted by flooding?
   - ☐ Very concerned ☐ Somewhat concerned ☐ Not concerned
5. Is your home located in a Federal Emergency Management Agency (FEMA) mapped floodplain?
   - ☐ Yes ☐ No ☐ I don't know
6. Do you have flood insurance for your home and/or personal property?
   - ☐ Yes ☐ No ☐ I don't know
7. If you do NOT have flood insurance, what is the reason?
   - ☐ It's too expensive
   - ☐ I never really considered it
   - ☐ I don't need it because my home is elevated or otherwise protected
   - ☐ Other: _____

1

CITY OF BRYAN
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City of Bryan Floodplain Management Plan
Public Survey

8. Have you taken any actions to protect your home from flood damage?
   - ☐ Yes ☐ No
9. If you answered "Yes" to question 8, what actions have you implemented?
10. Do you know what government agency/office to contact regarding the risks associated with flooding?
    - ☐ Yes ☐ No
11. What is the best way for you to receive information about how to make your home or neighborhood more resistant to flood damage? Please check all that apply.
    - ☐ Newspaper
    - ☐ TV Ads/Programming
    - ☐ Radio Ads/Programming
    - ☐ Public library
    - ☐ Public workshops/meetings
    - ☐ School meetings
    - ☐ Mail
    - ☐ Email
    - ☐ Text message
    - ☐ Village website
    - ☐ Village social media
    - ☐ Other _____
12. What are some steps the City could take to reduce the risk of flooding in your neighborhood?

Thank you for your input!

Please provide your name and email below in case City of Bryan staff have further questions to understand your flood concerns (optional).

Name: _____ Email: _____

2

PLANNING STEP 3: COORDINATE

Early in the planning process, the FMPC determined that the risk assessment, mitigation strategy development, and plan approval would be greatly enhanced by inviting outside agencies and organizations to participate in the process. Invitations to support the FMPC and the planning process were extended to federal, state, and local stakeholders that might have an interest in the City of Bryan's floodplain management efforts. The following stakeholder agencies and organizations were invited to provide data and technical information, review draft documents, and otherwise support the FMPC in the plan's development:

Neighboring Communities

- Brazos County
- College Station

State and Federal Government

- Texas Department of Emergency Management
- Texas Water Development Board
- Texas Commission for Environmental Quality
- Texas Floodplain Management Association
- Brazos River Authority
- FEMA Region 6
- ISO/CRS
- United States Geological Survey
- U.S. Army Corps of Engineers

Educational Institutions

- Texas A&M University
- Blinn College

Other Stakeholders

- Habitat for Humanity
- United Way of the Brazos Valley
- Bryan-College Station Chamber of Commerce
- Bryan Business Council
- Bryan-College Station Eagle
- Brazos Valley Council of Governments

A detailed list of stakeholders that were invited to participate is included in Appendix A.

Coordination began with notifying these agencies and organizations via email of the City's floodplain management planning process. These stakeholders were informed of opportunities to participate in the planning process and were asked for their assistance in the form of data or input on the plan's development. A sample coordination letter is provided in Appendix A. Further coordination with interested stakeholders included email correspondence to provide opportunities to review the draft HIRA, attend committee and public meetings, and offer input to the FMPC.

COORDINATION WITH OTHER COMMUNITY PLANNING EFFORTS AND HAZARD MITIGATION ACTIVITIES

Coordination with other community planning efforts is also paramount to the success of this plan. Mitigation planning involves identifying existing policies, tools, and actions that will reduce a community's risk and vulnerability to hazards. The City of Bryan uses a variety of planning mechanisms, such as a Comprehensive Plan, Building Code and Unified Design Guidelines, and other plans, policies, and ordinances to guide growth and development. Other regional and state plans and programs also influence planning and floodplain management in Bryan. Integrating existing planning efforts and policies into this plan establishes a credible and inclusive plan that ties into and supports other community programs. The development of this plan incorporated information from the plans, studies, reports, and other relevant data listed in Table 2.8.

Table 2.8 – Summary of Coordination with Other Community Planning Efforts

Resource Referenced	Use in this Plan
Blueprint 2040 City of Bryan 2016 Comprehensive Plan	Used to develop the Community Profile and incorporated into the assessment of growth and development trends in Section 3 and used to evaluate the impact of future conditions on flood risk in Section 4.
City of Bryan Comprehensive Zoning Ordinance	Used to evaluate mitigation capabilities in Section 5 and to inform the review of mitigation action alternatives in Section 6 and Appendix B.
City of Bryan Land & Site Development Ordinance	Used to evaluate mitigation capabilities in Section 5 and to inform the review of mitigation action alternatives in Section 6 and Appendix B.
City of Bryan Stormwater Management Ordinance	Used to evaluate mitigation capabilities in Section 5 and to inform the review of mitigation action alternatives in Section 6 and Appendix B.
Briar and Burton Creeks Erosion Master Plan, 2019	Used to evaluate erosion risk and vulnerability in Section 4 and to identify mitigation alternatives in Section 6 and Appendix B.
City of Bryan Floodplain Management Plan, 2018	Used to identify hazards and evaluate flood risk and vulnerability in Section 4 and to identify mitigation goals, objectives, and action alternatives in Section 6. Generally referenced for all sections as a basis for this plan update.
Brazos County Hazard Mitigation Plan, 2019	Used to develop the hazard identification and hazard profiles in Section 4 and to develop mitigation action alternatives in Section 6 and Appendix B.

Resource Referenced	Use in this Plan
Brazos County Emergency Management Plan, 2019	Used to develop the flood risk and vulnerability conclusions in Section 4 and to evaluate mitigation capabilities in Section 5.
Region 8 2023 Lower Brazos Regional Flood Plan	Used to evaluate flood risk and vulnerability in Section 4, review mitigation capabilities in Section 5, and inform the review of mitigation action alternatives in Section 6 and Appendix B.
State of Texas Hazard Mitigation Plan, 2018	Used to develop the hazard identification and hazard profiles in Section 4.

These and other documents were reviewed and considered, as appropriate, during the collection of data to support Planning Steps 4 and 5, which include the hazard identification, risk and vulnerability assessment, and capability assessment. The data was also used in Planning Steps 6, 7, and 8 to develop the mitigation strategy. Each source document is referenced where its data is used in this plan.

2.2.2 PHASE II – RISK ASSESSMENT

PLANNING STEPS 4 AND 5: IDENTIFY/ASSESS THE HAZARD AND ASSESS THE PROBLEM

The FMPC completed a comprehensive effort to identify, document, and profile all flood hazards that have, or could have, an impact on the planning area. Geographic information systems (GIS) were used to display, analyze, and quantify hazards and vulnerabilities. A draft of the risk and vulnerability assessment was posted on the City's website for FMPC and public review and comment. A detailed description of the risk assessment process and the results are included in Section 4 Flood Risk Assessment.

The FMPC also conducted a capability assessment to review and document the City's current capabilities to mitigate flood risk and vulnerability. By collecting information about existing government programs, policies, regulations, ordinances, and emergency plans, the FMPC could assess those activities and measures already in place that contribute to mitigating identified risks or that could be expanded or integrated with new efforts to support mitigation. These findings are summarized in Section 5 Capability Assessment.

2.2.3 PHASE III – MITIGATION STRATEGY

PLANNING STEPS 6 AND 7: SET GOALS AND REVIEW POSSIBLE ACTIVITIES

WSP facilitated brainstorming and discussion sessions with the FMPC that described the purpose and process of developing planning goals and objectives, a comprehensive range of mitigation alternatives, and a method of selecting and defending recommended mitigation actions using a series of selection criteria. This information is included in Section 6 Mitigation Strategy. Additional documentation on the process the FMPC used to set goals and develop the mitigation strategy has been included in Appendix B.

PLANNING STEP 8: DRAFT AN ACTION PLAN

A complete first draft of the plan was prepared based on input from the FMPC regarding the draft risk assessment and the goals, objectives, and actions identified in Planning Steps 6 and 7. This draft was posted for FMPC and public review and comment on the City's website. Outside stakeholders were also invited to comment on this draft. FMPC, public, and stakeholder comments were integrated into the final draft for the ISO to review and approve, contingent upon final adoption by the City.

2.2.4 PHASE IV – PLAN MAINTENANCE

PLANNING STEP 9: ADOPT THE PLAN

To secure public and political buy-in and officially implement the plan, the plan was reviewed and adopted by the City Council as documented in resolution in Section 7 Plan Adoption.

PLANNING STEP 10: IMPLEMENT, EVALUATE AND REVISE THE PLAN

Implementation and maintenance of the plan is critical to the overall success of floodplain management planning. Up to this point in the planning process, the FMPC's efforts have been directed at researching data, coordinating input from participating entities, and developing appropriate mitigation actions. Section 8 Plan Implementation and Maintenance provides an overview of the approach to be followed for plan implementation and maintenance and outlines the method and schedule for monitoring, updating, and evaluating the plan. Section 8 also discusses integration of the plan into existing planning mechanisms and how to address continued public involvement.

3 COMMUNITY PROFILE

This section provides an overview of past and current conditions in the planning area. It contains the following subsections:

- 3.1 Overview of the Community
- 3.2 Topography and Climate
- 3.3 Cultural, Historic, and Natural Resources
- 3.4 History
- 3.5 Economy
- 3.6 Housing
- 3.7 Population
- 3.8 Social Vulnerability
- 3.9 Growth and Development Trends

3.1 OVERVIEW OF THE COMMUNITY

The City of Bryan is located in the southeast portion of Texas in Brazos County and is part of the grater College Station-Bryan Metropolitan Statistical Area (MSA). The City is located in the center of Brazos County and the southern portion of the City shares a corporate boundary with the City of College Station. Brazos County is located in South Central Texas, between the Brazos and Navasota Rivers and is bordered by Robertson, Madison, Grimes, Washington, and Burleson counties. Bryan has a total land area of approximately 44 square miles.

The City and is served by several major metropolitan areas that are easily accessible from the City of Bryan. Houston is located 95 miles southeast, Austin 104 miles west, San Antonio 166 miles southwest, and Dallas 180 miles north. Highway 6 and Highway 21 cross through the City and also connect Bryan to Waco and Houston.

Figure 3.1 reflects the City of Bryan's location within Brazos County and in relation to the surrounding counties, cities, and towns. Figure 3.2 provides a base map for the City showing the City's limits.

Figure 3.1 – Location Map

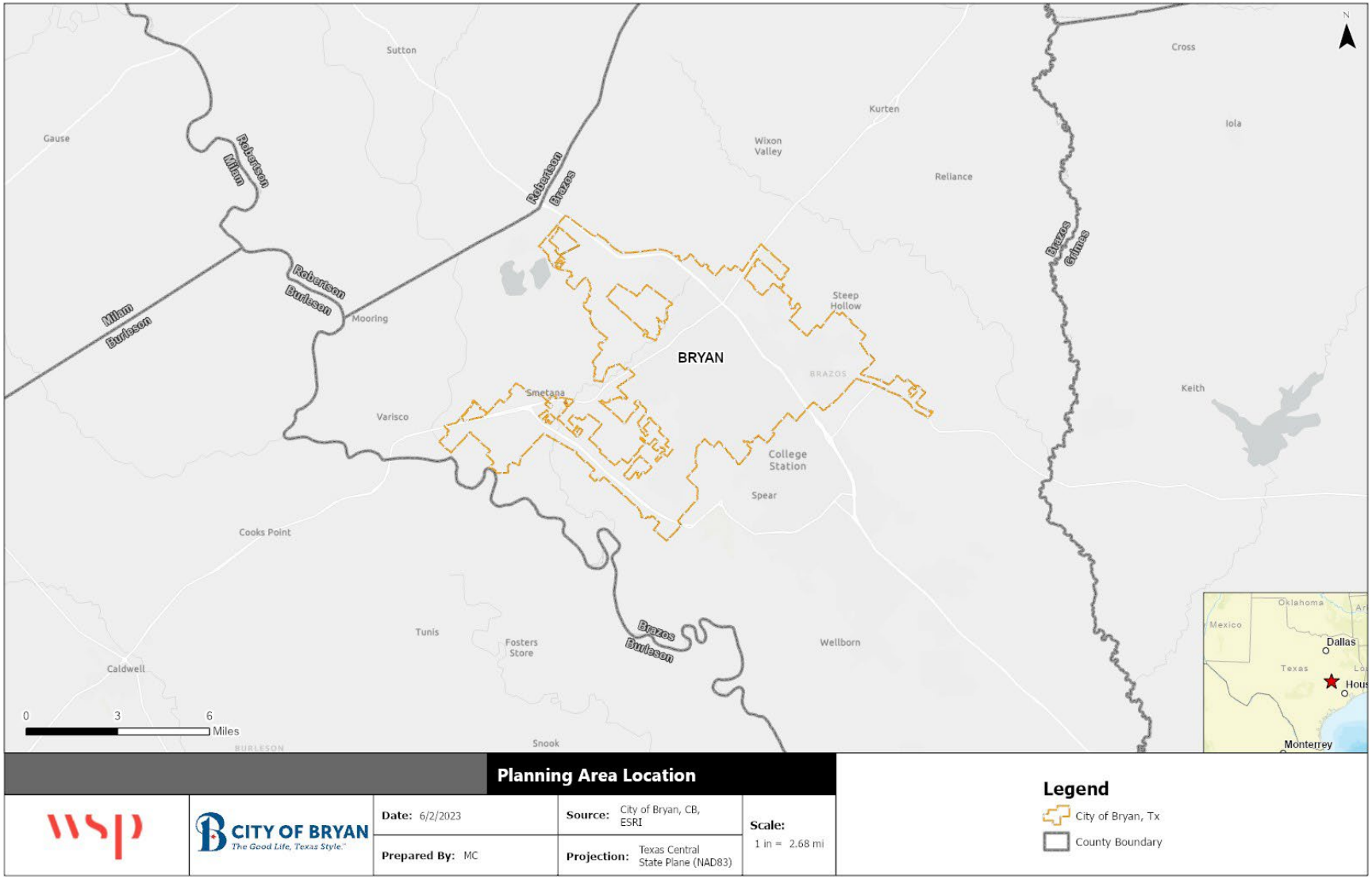
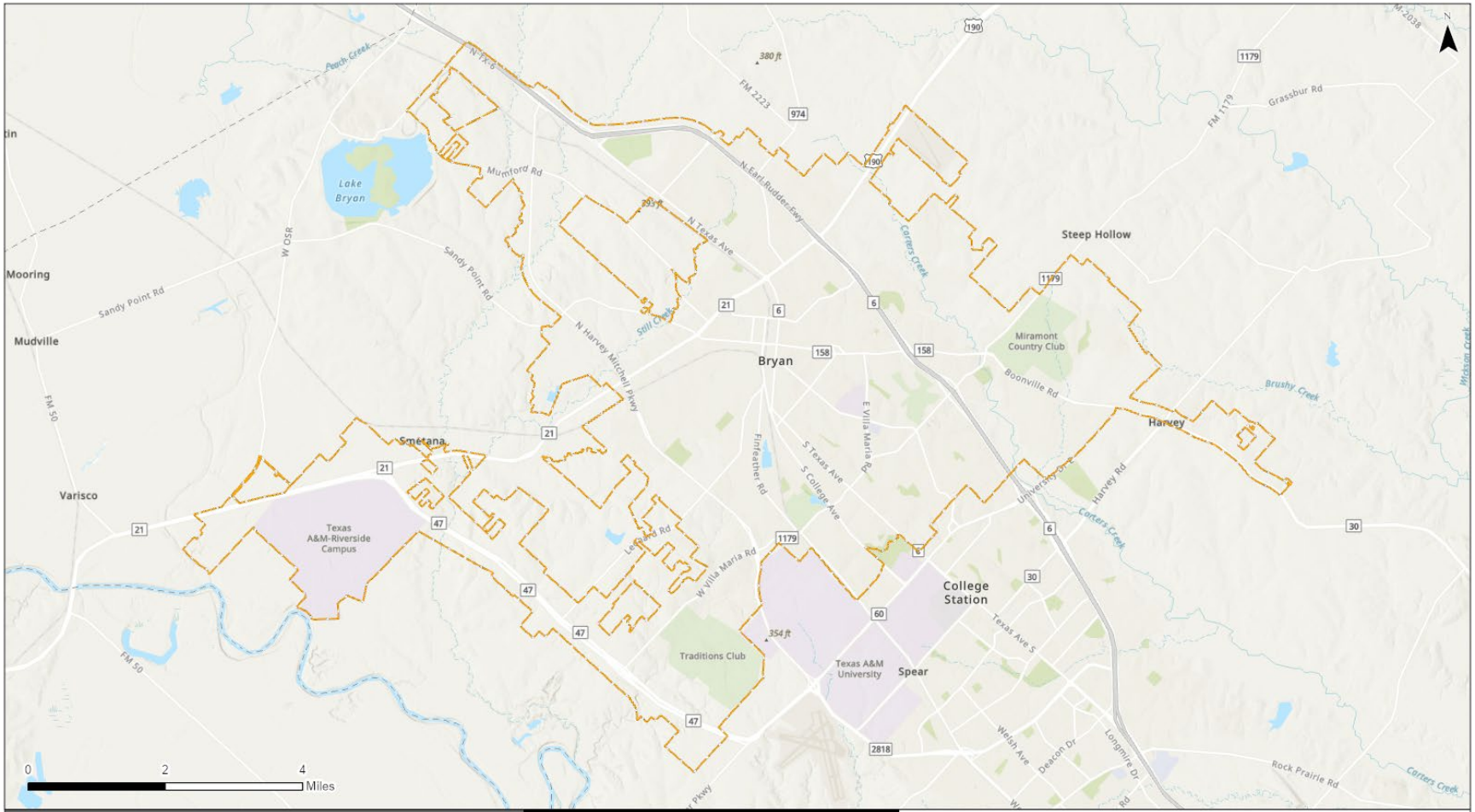


Figure 3.2 – Base Map, Bryan, TX

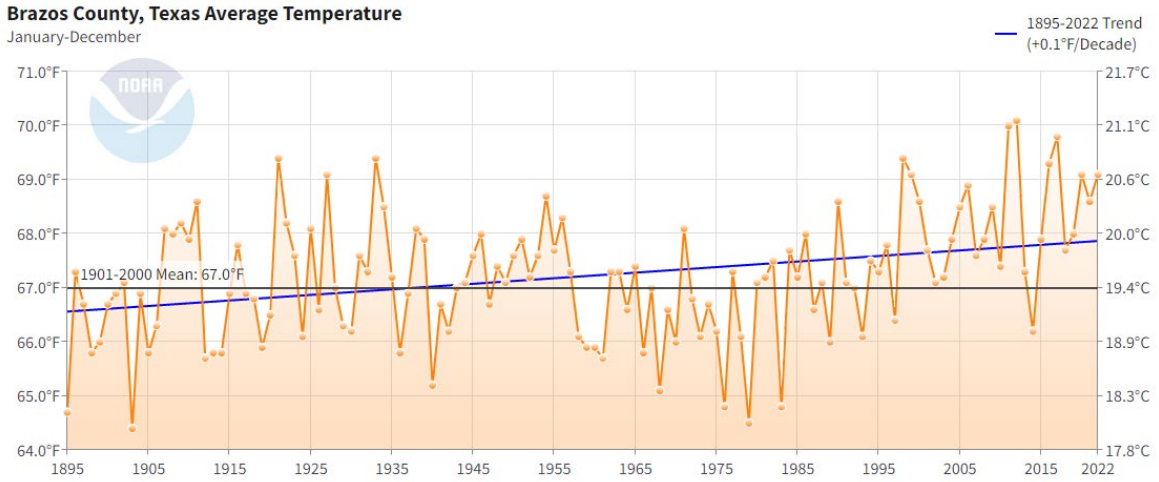


3.2 TOPOGRAPHY AND CLIMATE

For watershed planning purposes, Brazos County is located in the Lower Brazos Planning Region which covers an area of over 23,000 square miles, 43 counties, and 193 municipalities. The Lower Brazos Planning Region boundary is determined by the hydrologic characteristics of the Lower Brazos River basin and intersects with several counties and jurisdictions. The City of Bryan is located between two major rivers, the Brazos River and the Navasota River, and has an average elevation of 361ft. The drainage system divides the City in half, with creeks draining the land west to the Brazos and east toward the Navasota. The creek systems are in turn surrounded by their own smaller drainage basins.

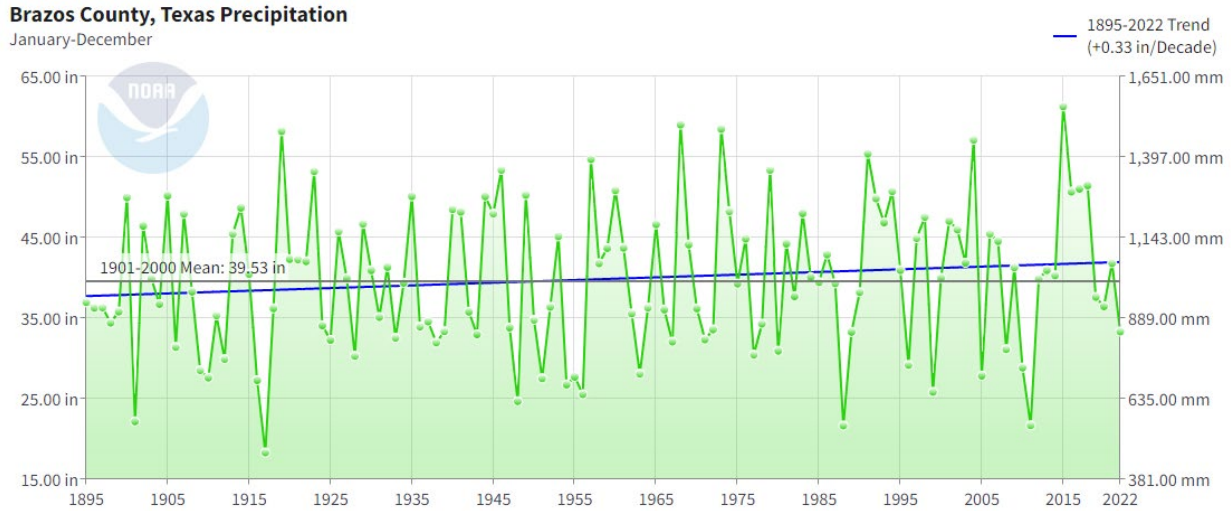
The City has a subtropical and temperate climate, with mild winters, hot summers, moderate rainfall, and sporadic drought. Brazos County's average annual temperature is 67 degrees Fahrenheit, and average annual precipitation is approximately 39.53 inches, as measured by NOAA data and shown in Figure 3.3 and Figure 3.4 below.

Figure 3.3 – Average Annual Temperature, Brazos County, TX



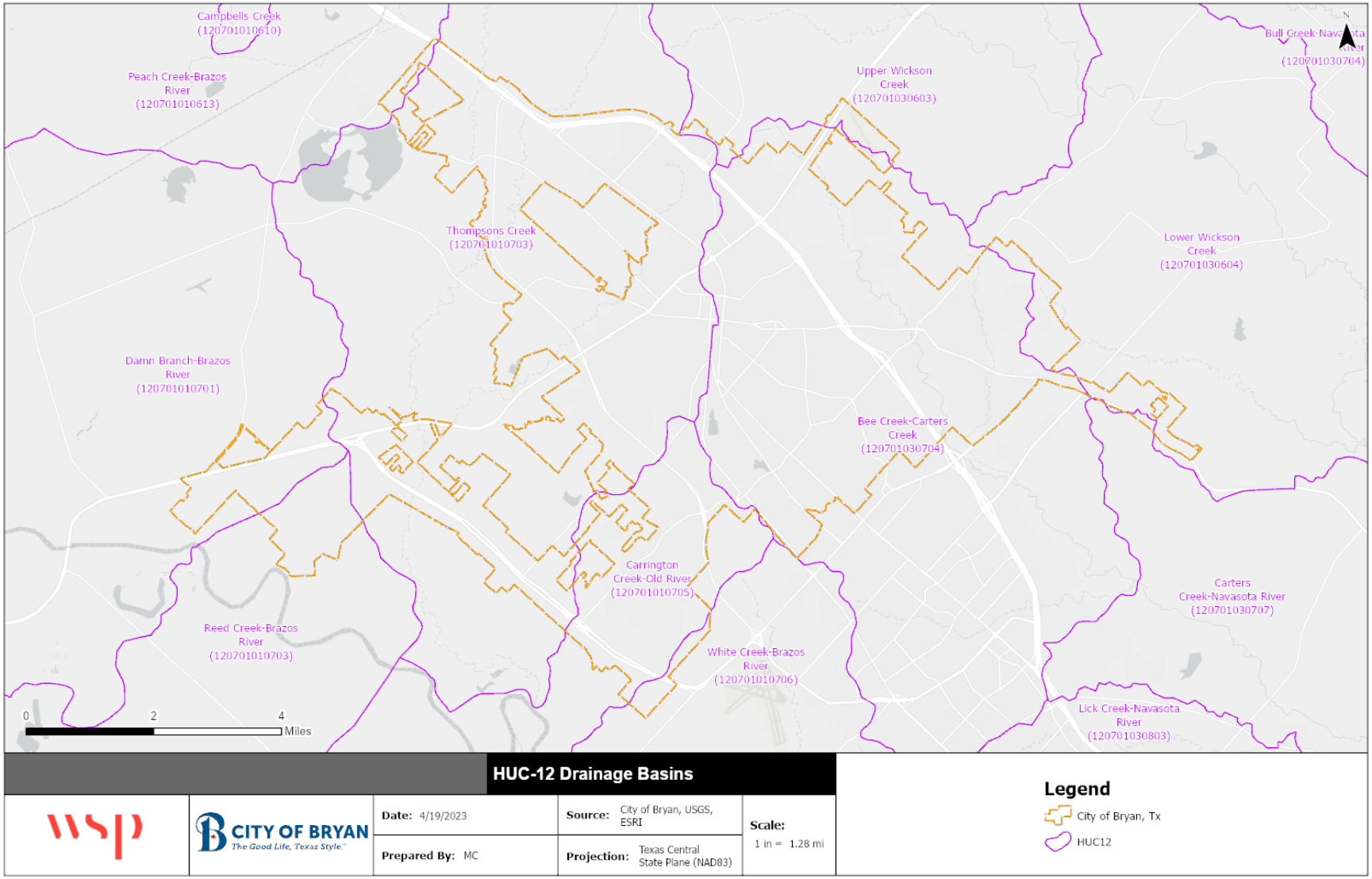
Source: NOAA Climate at a Glance

Figure 3.4 – Annual Precipitation, Brazos County, TX



Source: NOAA Climate at a Glance

Figure 3.5 – HUC-12 Drainage Basins



Source: USGS NHD

3.3 CULTURAL, HISTORIC AND NATURAL RESOURCES

HISTORIC RESOURCES

The City of Bryan has two historic districts listed on the National Register of Historic Places: the East Side Historic District and English-Dansby House. There are also 42 buildings listed on the register. Listing on the National Register signifies that these structures and districts have been determined to be worthy of preservation for their historical values.

Table 3.1 – Historic Property and District Listings in City of Bryan

	Name on the Register	Date Listed	Location
1	Allen Academy Memorial Hall	9/25/1987	1100 blk. of Ursuline
2	Allen Block	9/25/1987	400--422 N. Main
3	Allen, R. O., House-Allen Academy	9/25/1987	1120 Ursuline
4	Armstrong House-Allen Academy	9/25/1987	1200 Ursuline
5	Astin, R. Q., House	9/25/1987	508 W. Twenty-sixth
6	Blazek, E. J., House	9/25/1987	409 W. Thirtieth
7	Bryan Carnegie Library	10/27/1976	111 S. Main St.
8	Bryan Compress and Warehouse	9/25/1987	911 N. Bryan
9	Bryan Ice House	9/25/1987	107 E. Martin Luther King
10	Bryan Municipal Building	2/20/2002	111 E. 27th St.
11	Cavitt House	10/27/1976	713 E. 30th St.
12	Chance, James O., House	9/25/1987	102 S. Parker
13	CSPS Lodge-Griesser Bakery	9/25/1987	304 N. Logan
14	East Side Historic District	9/25/1987	Roughly bounded by Houston, Twenty-ninth, Haswell, and E. Thirtieth Sts.
15	Edge, Eugene, House	9/25/1987	609 S. Ennis
16	English-Dansby House	9/25/1987	204 W. Twenty-eighth
17	English-Poindexter House	9/25/1987	206 W. Twenty-eighth
18	First National Bank and Trust Building	9/25/1987	120 N. Main
19	First State Bank and Trust Building	9/25/1987	100 W. Twenty-fifth
20	Higgs, Walter J., House	9/25/1987	609 N. Tabor
21	House at 109 N. Sterling	9/25/1987	109 N. Sterling
22	House at 1401 Baker	9/25/1987	1401 Baker
23	House at 407 N. Parker	9/25/1987	407 N. Parker
24	House at 600 N. Washington	9/25/1987	600 N. Washington
25	House at 603 E. Thirty-first	9/25/1987	603 E. Thirty-first
26	House at 604 E. Twenty-seventh	9/25/1987	604 E. Twenty-seventh
27	Humpty Dumpty Store	9/25/1987	218 N. Bryan
28	Jenkins, Edward J., House	9/25/1987	607 E. Twenty-seventh
29	Jones, J. M., House	9/25/1987	812 S. Ennis
30	Kemp, E. A., House	9/25/1987	606 W. Seventeenth
31	La Salle Hotel	5/26/2000	120 S. Main St.
32	McDougal-Jones House	9/25/1987	600 E. Twenty-seventh

	Name on the Register	Date Listed	Location
33	Moore House	9/25/1987	500 E. Twenty-fifth
34	Noto House	9/25/1987	900 N. Parker
35	Oliver, Dr. William Holt, House	9/25/1987	602 W. Twenty-sixth
36	Parker Lumber Company Complex	9/25/1987	419 N. Main
37	Parker, Milton, House	9/25/1987	200 S. Congress
38	Saint Andrew's Episcopal Church	9/25/1987	217 W. Twenty-sixth
39	Saint Anthony's Catholic Church	9/25/1987	306 S. Parker
40	Sausley House	9/25/1987	700 N. Washington
41	Sinclair Station, (Old)	9/25/1987	507 S. Texas
42	Smith-Barron House	6/20/1988	100 S. Congress
43	Stone, Roy C., House	9/25/1987	715 E. Thirty-first
44	Temple Freda	9/22/1983	205 Parker St.
45	Zimmerman, Minnie Zulch, House	9/25/1987	308 N. Washington

Source: National Register of Historic Places Database

CULTURAL RESOURCES

Historic Downtown Bryan has a full arts scene, restaurants, hosts special events, and several boutiques & antique shops that create a cultural hub for the City and greater Brazos Valley. Downtown Bryan is recognized as a Texas Cultural District and characterized by Bryan as the "heart & soul of our community, home to the highest concentration of unique & locally owned shops and restaurants in Bryan-College Station."

The Parks and Recreation Department also maintains Travis Bryan Midtown Park, a recreational center that includes outdoor athletic fields and an event center with large indoor courts and event space with space for up to 16 volleyball/8 basketball courts that can be used for a variety of activities. There is also a BigShots complex which is an entertainment center that has a mini golf course, a scratch kitchen, and meeting room space for groups.

NATURAL FEATURES AND RESOURCES

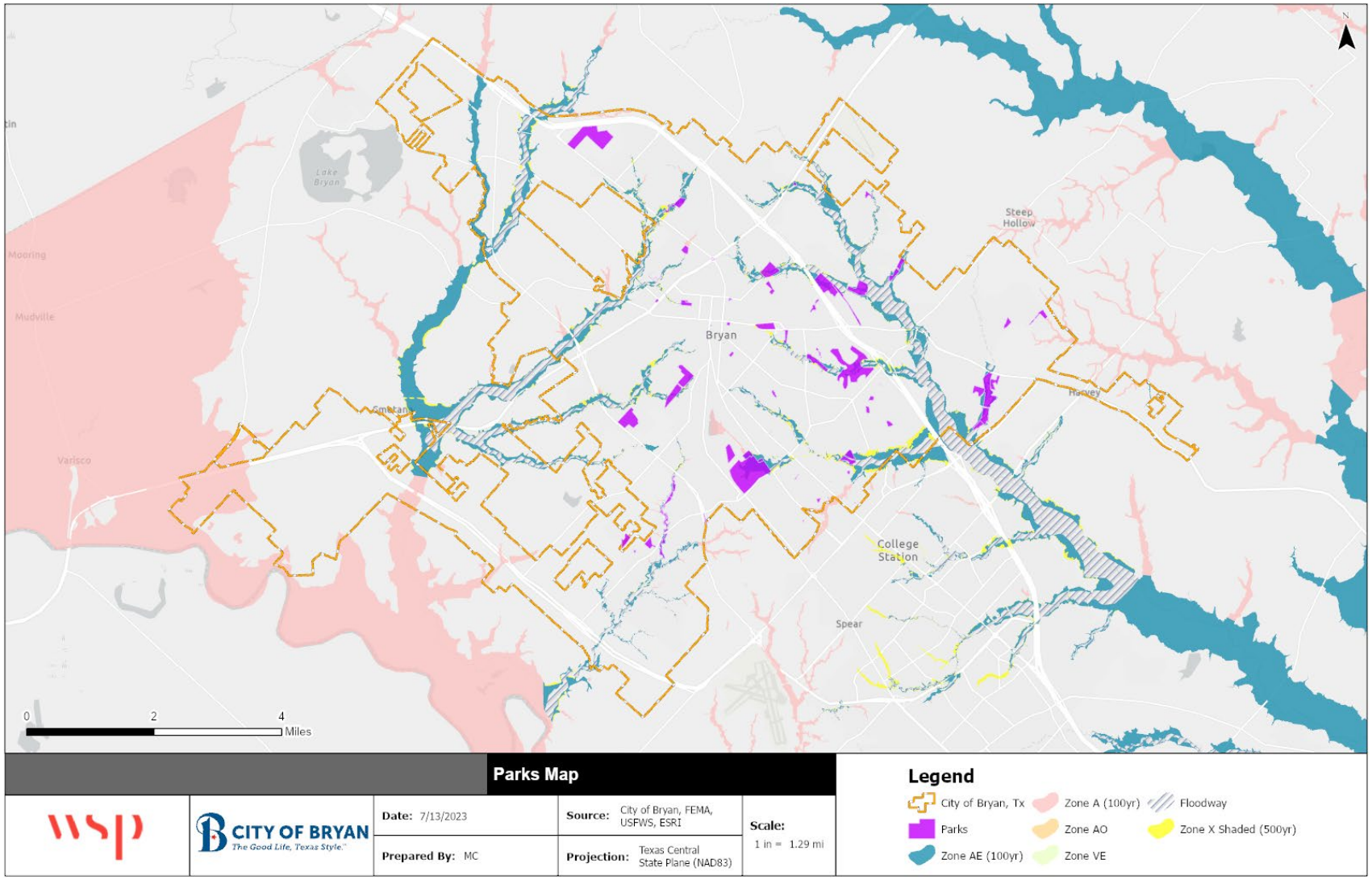
PARKS, PRESERVES, AND CONSERVATION

According to the Parks and Recreation Department website, the City's park system covers 56 properties totaling more than 2,400 acres and continues to expand. The parks provide a range of recreational amenities including baseball and soccer fields, indoor tennis court, inline hockey rinks, skateboard parks, splash pads, walking/hiking trails, two dozen pavilions for picnicking and reunions, and four pools.

Lake Bryan, just west of the City boundary, has more than 20 miles of hiking, biking, and running trails, swimming areas, campgrounds, and largemouth bass, crappie, catfish, and redfish stocked by Texas Parks & Wildlife.

Per the City's 2016 Comprehensive Plan, there are about 1,420 acres of parks and open space in the City, accounting for almost 5 percent of the City's current land use. Parks and open space are scattered throughout the City and are maintained in the City's Future Land Use designations, which describes these areas as parks, golf courses, and 100-year floodplain areas. The Comprehensive Plan recommends that floodplain areas be considered for conservation purposes. Many currently designated parks are located in or near flood prone areas, as shown in Figure 3.6.

Figure 3.6 – Parks and Floodplains



WATER BODIES AND FLOODPLAINS

The City of Bryan is located between two large Texas rivers. On the western side of the City is the Brazos River, which is the largest and longest river in Texas. The drainage basin is 45,000 square-miles and the river is 1,280 miles long, 840 miles are within Texas. On the eastern side of the Bryan is the Navasota River which is part of the Brazos drainage basin, and 125 miles long. The two rivers converge about 25 miles below Bryan at the southern portion of Brazos County. Several creeks drain toward the rivers creating a system of streams and channels. Most of the significant floodplain designations occur in the southwest and eastern portions of the Extraterritorial Jurisdiction (ETJ) where the creeks combine to flow into either the Brazos or Navasota.

The presence of these natural low-lying drainage areas provide ample open space that can be maintained to ensure proper floodplain functions. The City's comprehensive plan recognizes that planning for and utilizing these spaces for parks, and trails or open space preservation, would serve as useful community amenities.

According to the current Effective Flood Insurance Rate Map (FIRM) for Bryan, over 3,936 acres of the land within the City are located within a 1-percent-annual-chance floodplain and over 306 acres are within a 0.2-percent-annual-chance floodplain. A summary of acreage by flood zone is as follows: Zone A (827 acres); Zone AE (1,734 acres); Floodway (1,375); Zone X Shaded (306 acres); and Zone X Unshaded (30,949 acres).

Natural and Beneficial Floodplain Functions: Under natural conditions, a flood causes little or no damage in floodplains. Nature ensures that floodplain flora and fauna can survive the more frequent inundations, and the vegetation stabilizes soils during flooding. Floodplains reduce flood damage by allowing flood waters to spread over a large area. This reduces flood velocities and provides flood storage to reduce peak flows downstream.

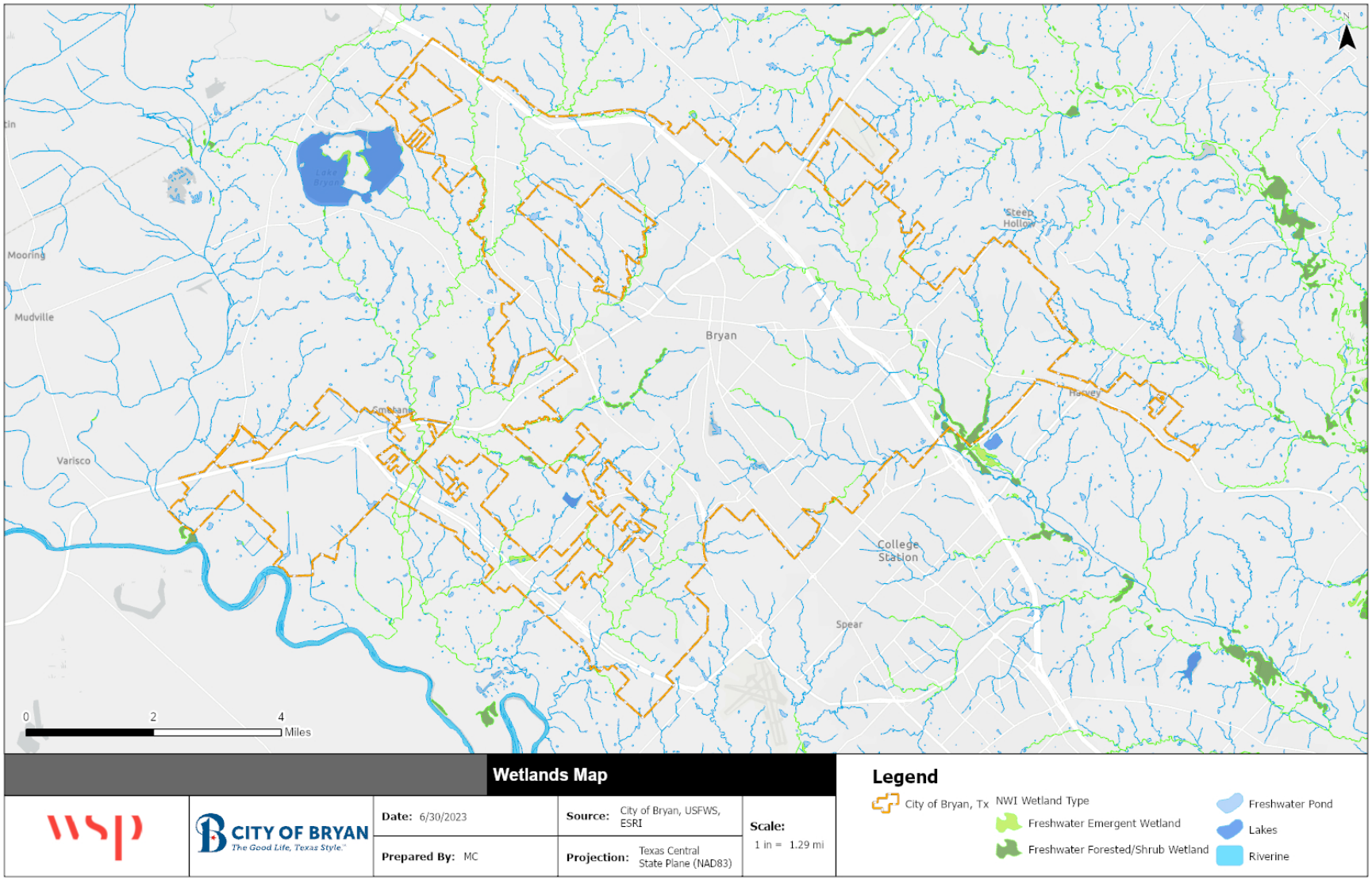
WETLANDS

Based on the U.S. Fish & Wildlife Service's National Wetlands Inventory (NWI), the wetlands in Bryan are characterized as riverine, freshwater forested or shrub wetlands, and freshwater ponds. There is a patchwork of freshwater pond wetlands primarily on the southern and eastern portions of the city that border the creeks that run around and throughout the City. There are some slightly larger and contiguous freshwater and forested shrub wetlands that run along the creeks in the southern boundaries of Bryan. In total, the City's planning jurisdiction contains approximately 741 acres of wetlands. Wetland areas are shown in Figure 3.6.

According to the Texas Water Development Board's Region 8 Lower Brazos Regional Flood Plan, there are over 249,000 acres of wetlands in the entire Lower Brazos basin, over 60 percent of which are freshwater forested and shrub wetlands, of which the largest percentage is in the Navasota HUC-8 watershed.

Natural and Beneficial Wetland Functions: The benefits of wetlands are hard to overestimate. They provide critical habitat for many plant and animal species that could not survive in other habitats. They are also critical for water management as they absorb and store vast quantities of storm water, helping reduce floods and recharge aquifers. Not only do wetlands store water like sponges, they also filter and clean water, absorbing toxins and other pollutants.

Figure 3.7 – Wetlands



Source: U.S. Fish & Wildlife Service National Wetlands Inventory

THREATENED AND ENDANGERED SPECIES

The U.S. Fish and Wildlife Service maintains a regular listing of threatened species, endangered species, species of concern, and candidate species for counties across the United States. Brazos County has eight species that are listed with the U.S. Fish and Wildlife Services, and one species under review. Table 3-2 below shows the species identified as threatened, endangered, or other classification in Brazos County.

Table 3.2 – Threatened and Endangered Species

Common Name	Scientific Name	Federal Status
Monarch butterfly	Danaus plexippus	Candidate
Navasota ladies-tresses (flowering plant)	Spiranthes parksii	Endangered
Red knot (Bird)	Calidris canutus rufa	Threatened
Smooth pimpleback (clam)	Cyclonaias houstonensis	Resolved Taxon
Sprague's pipit	Anthus spragueii	Resolved Taxon
Texas fawnsfoot (clam)	Truncilla macrodon	Proposed Threatened
Tricolored bat	Perimyotis subflavus	Proposed Endangered
Western Chicken turtle	Deirochelys reticularia ssp. miaria	Under Review
Whooping crane	Grus americana	Endangered

Source: U.S. Fish & Wildlife Service (https://ecos.fws.gov/ecp/report/species-listings-by-current-range-county?fips=48041)

3.4 HISTORY

Bryan's history is aligned with the development and progression of rail system in Texas. Rail expanded from the Gulf Coast to inland Texas around 1848. By 1860, rail construction had reached its northernmost expansion in southern Brazos County. Construction was halted during the Civil War, but when it resumed this spurred growth in a one square mile area that would become the City of Bryan. It took many attempts, but the City was incorporated by Texas Legislature in 1871. By 1866 Bryan served as the County seat. Bryan also became the transportation hub and center of commerce for Brazos County.

In 1871 the City underwent a land deal that established the Agricultural and Mechanical College of Texas – Texas A&M. In the early 20th century Bryan experienced a period of modernization with the development of a sanitary sewer system, and electric power plan, paved streets, streetlights, and a rail system that went between Bryan and the Agricultural and Mechanical College.

As seen across the county, reliance on cars transitioned the city away from a booming central business district and experienced strong suburban growth. In the 1990's the City began to focus on Downtown revitalization which continues to occur today.

3.5 ECONOMY

Per the 2017-2021 American Community Survey 5-Year Estimates, the median household income for the City of Bryan is $49,181. An estimated 23.5% of the population is considered to be living below the poverty level. Table 3.3 shows employment and unemployment rates along with industry employment by major classification for the City.

Table 3.3 – Employment and Occupation Statistics for City of Bryan, TX

Employment Status	Percentage
In labor force	62.2
Employed	58.8

Employment Status	Percentage
Unemployed	3.2
Armed Forces	0.2
Not in labor force	37.8
Occupation	
Management, business, science and arts	33.3
Service	19.6
Sales and office	20.6
Natural resources, construction and maintenance	12.6
Production, transportation and material moving	13.9

Source: U.S. Census Bureau, 2017-2021 American Community Survey 5-Year Estimates

Major employers for the City of Bryan, as identified by the Bryan Business Council, are listed in Table 3.4. The top five employers, which all fall into the education sector, account for over 25,000 jobs.

Table 3.4 – Major Employers in City of Bryan, TX

Corporation/Organization	Service/Product	# of Employees
Texas A&M System	Education	17,000+
Texas A&M HSC	Education	2,000+
Bryan ISD	Education	2,000+
College Station ISD	Education	2,000+
Blinn College	Education	2,000+
Reynolds and Reynolds	Software Development	1,500+
CHI St Joseph Health	Health Care	1,000+
Sanderson Farms	Agriculture – Livestock	1,000+
Walmart	Retail	1,000+
HEB	Supermarket	1,000+

Source: City of Bryan Business Council, 2023

As part of the Bryan's emergency management and preparedness planning, the City also identifies major employment centers, which include Colony Park, Tejas Center, Bryan Towne Center, and Park Hudson. These are primarily retail centers, but some include office space and nearby residential as well. These locations are shown in Figure 3.7 in relation to the mapped floodplain; several of these centers are in or adjacent to high-risk flood areas.

3.6 HOUSING

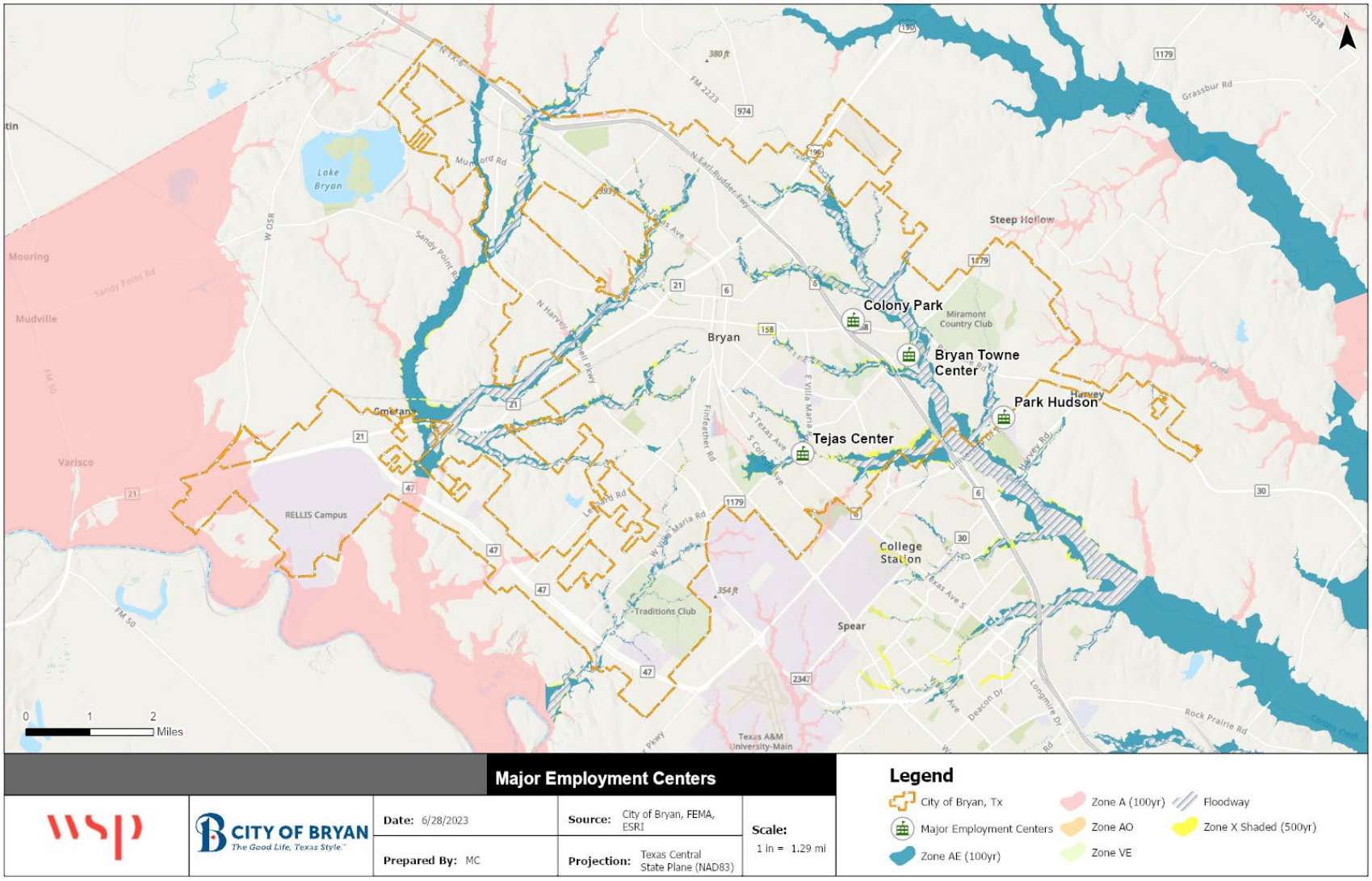
According to the 2017-2021 American Community Survey 5-Year Estimates, there are 34,919 housing units in Bryan, 88.9% of which are occupied. Approximately 50.5% of occupied units are renter-occupied, indicating a high level of pre- and post-disaster vulnerability.

Median home value in Bryan is $164,100. Of the City's owner-occupied housing units, 56.8% have a mortgage.

The majority of householders moved into their current homes since 2015; 14.7% moved in between 2010 and 2014, 38.9% moved in between 2015 and 2018, and 16.7% moved in in 2019 or later. About 6.3% of households have no vehicle available to them, which suggests these residents may have difficulty in the event of an evacuation.

Average household size in Bryan is 2.57 people per household.

Figure 3.8 – Major Employment Centers



3.7 POPULATION

The City of Bryan had 76,201 residents at the time of the 2010 U.S. Census and an estimated population of 85,204 in 2021. As of 2021, the City of Bryan population density is 1,936 persons per square mile, which is much higher than the state average density of 105 persons per square mile. Table 3.5 provides demographic profile data from the 2021 American Community Survey 5-Year Estimates.

Table 3.5 – City of Bryan Demographic Profile Data, 2021

Demographic	City of Bryan	Brazos County	Texas
Gender/Age			
Male	50.5%	50.5%	49.9%
Female	49.5%	49.5%	50.1%
Median Age (years)	31.3	27.1	35.0
Under 5 Years	7.1%	5.9%	6.8%
65 Years and Over	11.3%	9.4%	12.5%
Race/Ethnicity (One Race)			
White	37.7%	72.9%	40.7%
Black or African American	17.5%	11.1%	11.8%
Asian	2.1%	5.9%	5.0%
American Indian/Alaska Native	0.1%	0.3%	0.2%
Other Race	0.1%	3.0%	0.3%
Two or more Races	1.8%	6.7%	2.3%
Hispanic or Latino	40.6%	26.4%	39.8%
Education			
High School Graduate or Higher*	82.3%	88.7%	84.8%
Bachelor's Degree or Higher*	28.2%	42.2%	31.5%

Source: U.S. Census Bureau, 2017-2021 American Community Survey 5-Year Estimates

[1]Hispanic or Latino individuals may be of any race, so also are included in applicable race categories.

*Based on population 25 years and older

3.8 SOCIAL VULNERABILITY

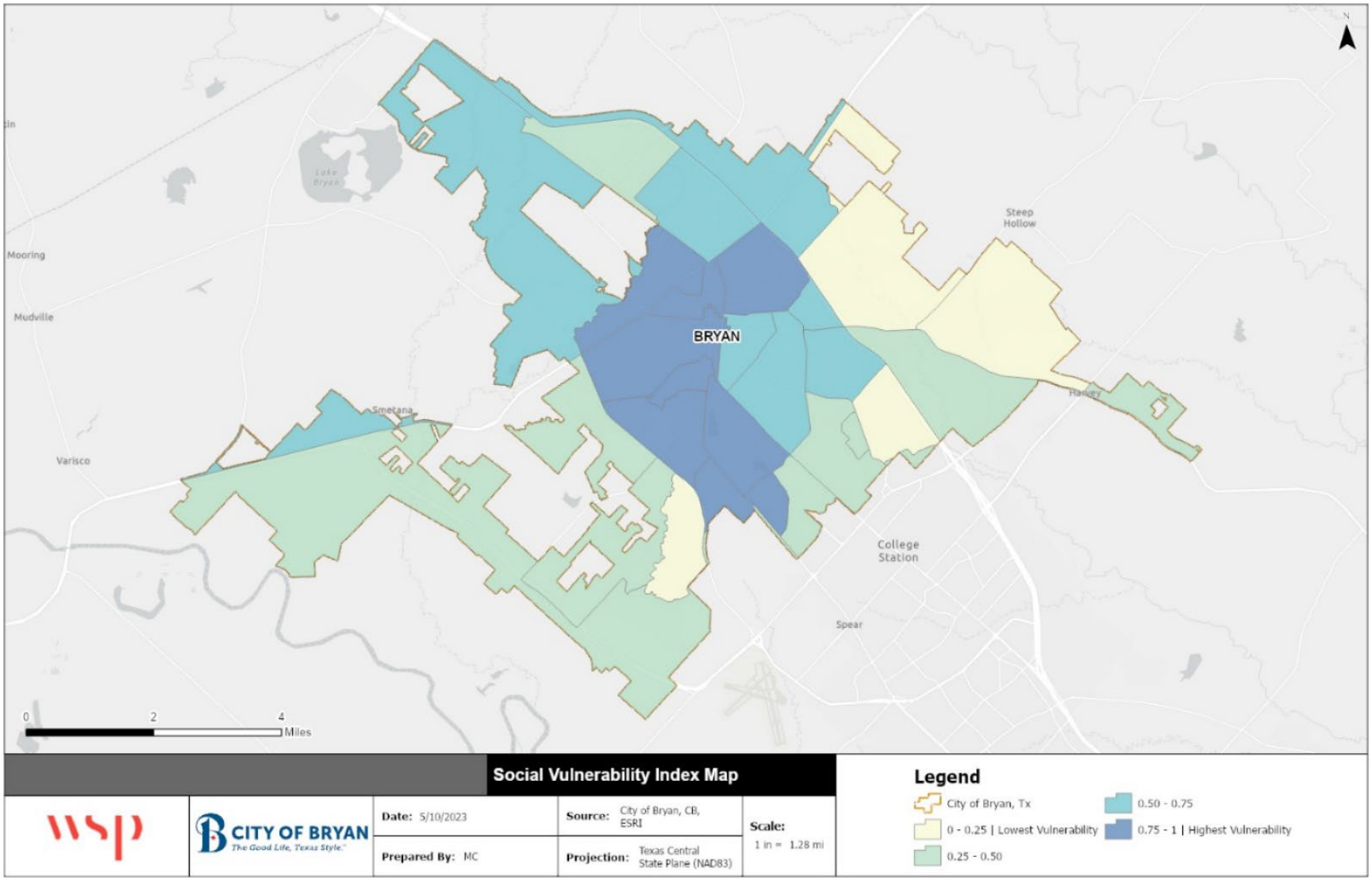
Social vulnerability refers to the factors that may weaken a community's capacity to prepare for and respond to hazard events. Understanding where social vulnerability is higher and what factors are contributing to it can enable the community to mitigate that vulnerability and improve local resilience.

The Center for Disease Control and Prevention (CDC) has developed a social vulnerability index (SVI) to measure the resilience of communities when confronted by external stresses such as natural hazards. The SVI indicates the relative vulnerability within Census tracts based on 15 social factors: poverty, unemployment, income, education, age, disability, household composition, minority status, language, housing type, and transportation access. These factors are summarized into four themes: socioeconomic status, household composition/disability, race/ethnicity/language, and housing type/transportation. Using this SVI information can help the Village to prioritize pre-disaster aid, allocate emergency preparedness and response resources, and plan for the provision of recovery support.

Figure 3.8 shows the relative social vulnerability for Bryan Census tracts according to SVI data.

Per the CDC SVI information, social vulnerability is highest in the central portion of the City, particularly in census blocks on the western side of the city center. The eastern half of central Bryan, along with many northern portions of the City have moderate to high vulnerability. The City fringe, particularly in the south and eastern parts of Bryan have low to low-moderate vulnerability scores.

Figure 3.9 – Social Vulnerability Index by Census Tract



Source: Centers for Disease Control and Prevention (CDC), 2018

3.9 GROWTH AND DEVELOPMENT TRENDS

As of 2021, the City of Bryan was ranked 44th in size (population) among Texas' 1,000-plus municipalities. From 2010 to 2020 the City grew at a rate of 10.21%. Bryan accounts for 36.9% of Brazos County's population, down slightly from 39.1% in 2010.

Based on the City's comprehensive plan, The Bryan-College Station area is still expected to experience growth consistent with the overall growth of Texas, and residential, commercial, and industrial development will also increase in Bryan. The comprehensive plan examined population projections using the Compound Annual Growth Rate (CAGR) to estimate overall growth of the community. It was established that Bryan has a growth rate of 1.5; thus, it is estimated that Bryan's population will increase to 117,219 by 2040. Based on the plan's growth scenario, greatest demand for land will be for single family residential and public/semi-public uses as well as land for right of ways.

The City's ETJ extends for three and a half miles from the City limits; with the exception of those boundaries shared with College Station. The ETJ itself covers an additional 80,937 acres, however most of the area is sparsely developed. The total developed area is estimated to be about 20%, the remaining 80% is either in agricultural use or is vacant. Other than possibly agriculture, single family residential is the largest individual land use within the ETJ, representing 40% of all developed land and 8% of the total land area within the ETJ. Annexation of the ETJ may support future growth and development in Bryan.

3.9.1 FUTURE GROWTH AND DEVELOPMENT

A land use plan is intended to provide a framework that will guide local government officials and private citizens as they make day-to-day and long-term decisions affecting growth and development. The 2016 Comprehensive Plan includes a Land Use Plan chapter that serves as an overall "blueprint" for the development of Bryan that when implemented results in the most suitable and appropriate use of the land and ensures efficient and orderly growth.

EXISTING LAND USE

The National Land Cover Database summarizes existing land cover across the U.S. and is a useful resource to distinguish between developed and undeveloped land. Table 3.6 summarizes the acreage in each land cover category. Around 60.8% of the land in the City is developed. Much of that development is in the City center, but there is some level of development spread throughout the City. Dense development often equates to a concentration of impervious surface, which means stormwater runoff is more likely to contribute to flooding issues in these areas.

Table 3.6 – Land Cover in Bryan, TX

NLCD Category	Acreage	Percent of Total (%)
Open Water	93.0	0.3%
Developed, Open Space	5,842.5	16.6%
Developed, Low Intensity	6,391.8	18.2%
Developed, Medium Intensity	6,888.9	19.6%
Developed, High Intensity	2,282.2	6.5%
Barren Land (Rock/Sand/Clay)	62.7	0.2%
Deciduous Forest	2,045.4	5.8%
Evergreen Forest	399.0	1.1%
Mixed Forest	978.8	2.8%
Shrub/Scrub	185.9	0.5%
Herbaceous	229.5	0.7%
Pasture/Hay	8,422.7	23.9%

NLCD Category	Acreage	Percent of Total (%)
Woody Wetlands	1,313.9	3.7%
Emergent Herbaceous Wetlands	57.2	0.2%
Total	**35,193.4**	--

Source: National Land Cover Database 2019

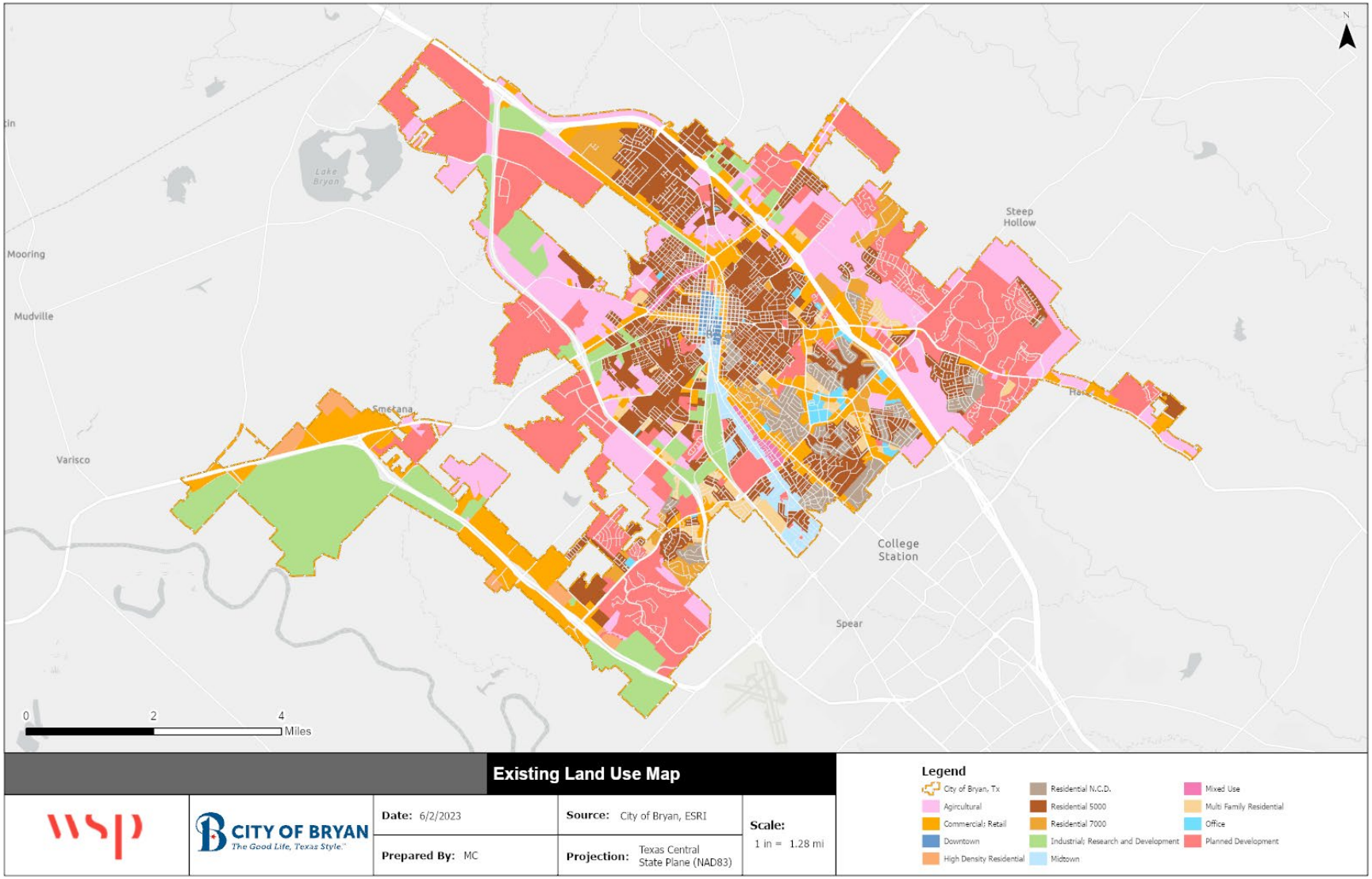
According to the NLCD data, vacant or undeveloped land, including open water, makes up approximately 39% of the total area within the Bryan planning jurisdiction. The City's zoning, summarized by acreage in Table 3.7, provides an estimate of existing land use. Table 3.7 shows that approximately 26% of land within the Bryan planning jurisdiction is zoned for residential use. Commercial and mixed uses represent approximately 13% of existing land use. Agriculture and open space represent approximately 22% of land use, planned development represents 22% and office and industrial make up about 15% of the planning area. On the following page, Figure 3.9 shows the current zoning for each parcel in the planning area.

Table 3.7 – Existing Zoning (Acreage)

Existing Land Use Category	Acreage	Percent of Total (%)
Agricultural Open	7,720.7	22.2%
Commercial	1,783.0	5.1%
Downtown Civic	25.1	0.1%
Downtown North	32.7	0.1%
Downtown South	19.3	0.1%
Industrial	1,563.1	4.5%
Innovation Corridor - High-Density Residential	171.2	0.5%
Innovation Corridor - Research and Development	3,549.9	10.2%
Innovation Corridor - Retail Services	1,610.5	4.6%
Midtown - Corridor	293.6	0.8%
Midtown - High Density	79.0	0.2%
Mixed Use	115.9	0.3%
Multi Family	609.5	1.8%
Office	161.5	0.5%
Planned Development	7,622.1	22.0%
Residential N.C.D	1,293.8	3.7%
Residential District 5000	6,095.3	17.6%
Residential District-7000	1,011.8	2.9%
Retail	966.4	2.8%
Total	**34,724.5**	--

Source: City of Bryan, TX

Figure 3.10 – Zoning Map



FUTURE LAND USE

The purpose of the Future Land Use Map is to graphically depict Bryan's policies for growth and land development and the proposed patterns of future land use. The Future Land Use Map was prepared with consideration given to land development objectives and policies, natural constraints and limitations, overall land suitability, and the ability to provide the infrastructure to support growth and development.

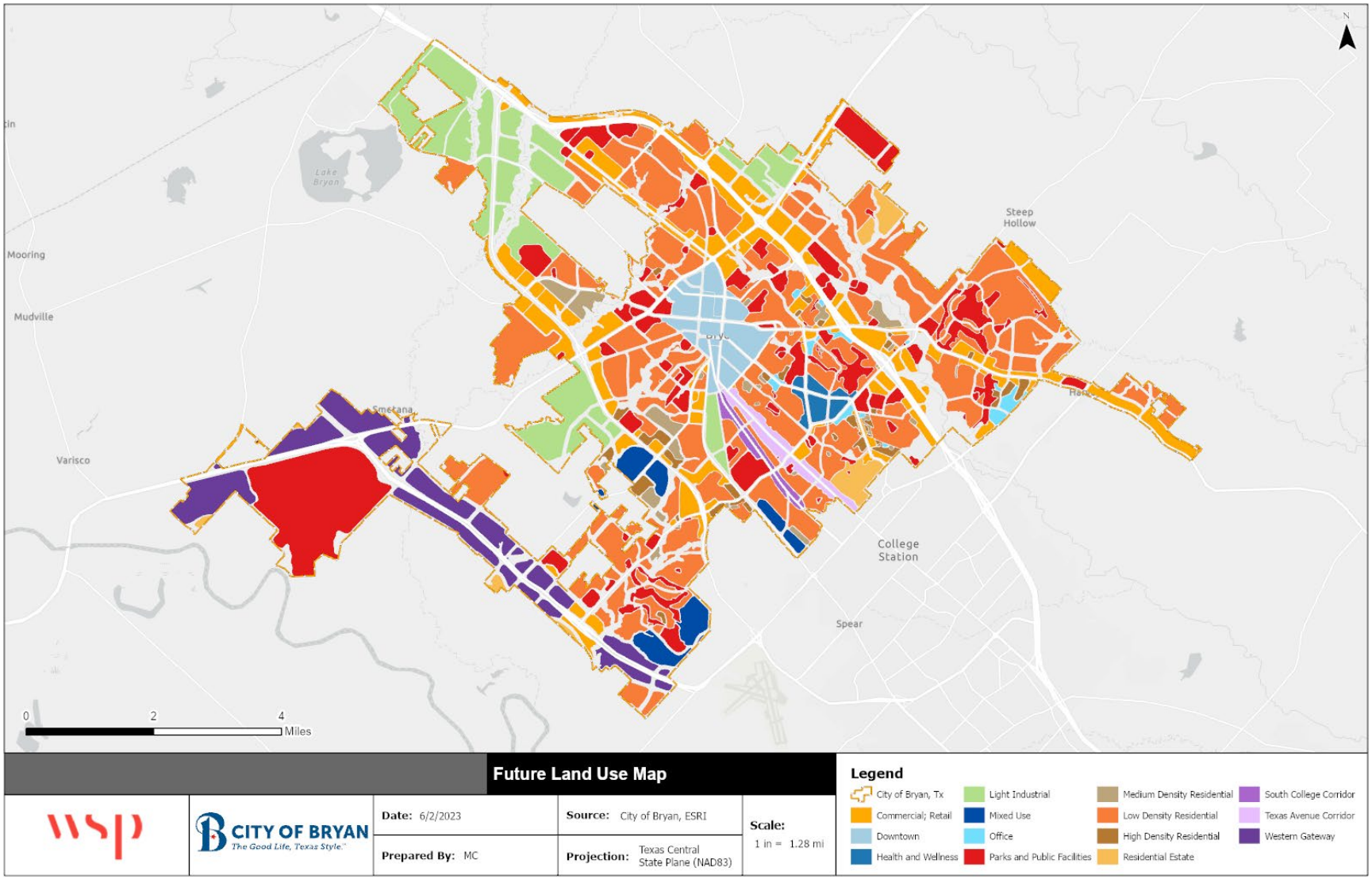
The City's Future Land Use Map classifications include the following categories:

- Residential Estate
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Retail
- Neighborhood Center
- Regional Retail
- Downtown
- Central Urban
- Mixed-Use
- Office
- Commercial/High Intensity Office
- Light Industrial
- Public/Semi-Public/Institutional
- Parks and Open Space
- Special Districts
    - Health and Wellness District
    - Texas Avenue Corridor
    - South College Corridor
    - Western Gateway
    - Agricultural/Farming/Ranching

Generally, growth and land development is anticipated to occur in all future land use categories except for the parks and open space classification where the City intends to expand parks and open space as other areas develop and consider the 1% annual chance flood as conservation areas. The type and intensity of projected development varies within each future land use map classification, however various types of residential uses are expected to increase. Future Land Use designations are shown in Figure 3.8.

In terms of the location of future growth, there are significant tracts of vacant undeveloped land, so most future development is expected to be new development as opposed to redevelopment. New development is anticipated in the west side of the City. Sewer and water infrastructure are being expanded in these areas to accommodate growth. Additionally, the City is preparing to conduct watershed studies in these areas to plan for the potential impacts of growth on stormwater and flooding.

Figure 3.11 – Future Land Use



4 FLOOD RISK ASSESSMENT

Requirement §201.6(c)(2): [The plan shall include] A risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

This section describes the Hazard Identification and Risk Assessment process for the development of the City of Bryan Floodplain Management Plan. It describes how the City met the following requirements from the 10-step planning process:

- Planning Step 4: Assess the Hazard
- Planning Step 5: Assess the Problem

As defined by FEMA, risk is a combination of hazard, vulnerability, and exposure. "It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage."

This flood risk assessment covers the entire geographical area of the City of Bryan. The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, critical facilities and infrastructure, and other assets to these hazards. The process allows for a better understanding of the community's potential risk to natural hazards and provides a foundation for developing and prioritizing mitigation actions to reduce risk from future hazard events. This risk assessment followed the methodology described in the FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (FEMA 386-2, 2002), which breaks the assessment down to a four-step process:

Data collected through this process has been incorporated into the following subsections of this section:

- **Section 4.1 Hazard Identification** identifies the flood hazards that threaten the planning area.
- **Section 4.2 Risk Assessment Methodology** reviews the methodology for evaluating risk and outlines the organization of each hazard profile.
- **Section 4.3 Asset Inventory** summarizes overall asset exposure, including people; buildings; critical facilities; and future growth and development. Cultural, historic, and natural resources and the local economy are detailed in Section 3.
- **Section 4.4 Hazard Profiles, Analysis, and Vulnerability** discusses the threat to the planning area, describes previous occurrences of flood hazard events, and estimates the likelihood of future occurrences. For all moderate and high priority flood hazards, this section assesses the planning area's exposure and potential losses that may occur.
- **Section 4.5 Risk and Vulnerability Conclusions** summarizes areas likely to flood, discusses the potential impact of future flooding conditions, and evaluates the health and safety consequences of the flood hazards.

4.1 HAZARD IDENTIFICATION

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type…of all natural hazards that can affect the jurisdiction.

4.1.1 METHODOLOGY

To identify flood hazards relevant to the planning area, the FMPC reviewed existing state and local plans, disaster declarations and past flood occurrences, flood hazard data, and input from committee members and the public. Observations and projections of climate change were also evaluated to better identify and understand potential future hazards.

Table 4.1 below provides a list of flood-related hazards from the State Hazard Mitigation Plan, the Brazos County Hazard Mitigation Plan, and the previous City of Bryan Floodplain Management Plan, which provided a starting point for a review of local hazards and ensured consistency across these planning efforts.

Table 4.1 – Summary of Flood Hazard Evaluation

Flood Hazard	Included in 2018 State HMP?	Included in 2019 Brazos County HMP?	Included in 2018 City of Bryan FMP?
Erosion	✓		Discussed with Riverine Flooding
Dam Failure	✓	✓	✓
Riverine Flooding	✓	✓	✓
Stormwater/Localized Flooding			✓

All hazards listed above were evaluated for this plan. Flood hazard data from the 2019 Brazos County Hazard Mitigation Plan, the State of Texas Hazard Mitigation Plan, the Texas Department of Emergency Management (FDEM), FEMA, NOAA's National Centers for Environmental Information (NCEI), and other sources were examined to assess the significance of these hazards to the planning area. For the purpose of the hazard identification, significance was measured in general terms and focused on key criteria such as frequency and resulting damage, which includes deaths and injuries, as well as property and economic damage.

4.1.2 DISASTER DECLARATION HISTORY

The FMPC researched past events that resulted in a federal disaster declaration for the planning area in order to identify known flood hazards. Federal and/or state disaster declarations may be granted when the Governor certifies that the combined local, county and state resources are insufficient and that the situation is beyond their recovery capabilities. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. If the disaster is so severe that both the local and state government capacities are exceeded, a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

Details on flood-related federal disaster declarations were obtained from FEMA and are summarized in Table 4.2. This list contains all major disaster declarations that included Brazos County, and thus the City of Bryan, as a designated area. This table reflects the historic patterns of flood hazards for the planning area. Brazos County first received a flood-related major disaster declaration in 1991. Since then, Brazos County has received seven flood-related major declarations and three emergency declarations.

Table 4.2 – FEMA Emergency and Major Disaster Declarations for Brazos County since 1953

Hazard Type	Disaster #	Date
Severe Thunderstorms	DR-930	December 26, 1991
Severe Thunderstorms and Flooding	DR-1041	October 10, 1994
Tropical Storm Charley	DR-1239	August 8, 1998
Hurricane Katrina Evacuation	DR-3216	September 2, 2005
Hurricane Rita	DR-1606	September 24, 2005
Hurricane Rita	EM-3261	September 21, 2005

Hazard Type	Disaster #	Date
Hurricane Ike	DR-1791	September 13, 2008
Hurricane Ike	EM-3294	September 10, 2008
Hurricane Gustav	EM-3290	August 29, 2008
Severe Storm and Flooding	DR-4272	June 11, 2016

Source: FEMA Disaster Declaration Summaries – v2; April 3, 2023
Note: The date column indicates the date of the disaster declaration, which may not coincide with the actual date of the event.

4.1.3 FLOOD EVENT HISTORY

The National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) has been tracking various types of severe weather since 1950. Flood-related events have been tracked since 1996. The NCEI Storm Events Database contains an archive of destructive storm or weather data and information which includes local, intense and damaging events. NCEI receives storm data from the National Weather Service (NWS), which compiles information from a variety of sources, including but not limited to: county, state and federal emergency management officials, local law enforcement officials, SkyWarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry and the general public. This database contains 45 flood related severe weather events that occurred in Brazos County between January 1996 and December 2022. Table 4.3 summarizes these events.

Table 4.3 – NCEI Severe Weather Reports for Brazos County, January 1996 – December 2022

Type	# of Events	Property Damage	Crop Damage	Deaths	Injuries
Flash Flood	42	$2,979,000	$0	0	0
Flood	3	$10,000	$0	0	0
Tropical Storm	1	$15,000,000	$0	0	0
Total	**46**	**$17,989,000**	**$0**	**0**	**0**

Source: NCEI Storm Events Database, April 2023
Note: Losses reflect totals for all impacted areas.

4.1.4 CLIMATE CHANGE

Climate change refers to long-term shifts in temperature and weather patterns. Climate change can be due to natural internal processes or external forces such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC, 2014). However, the recent and rapid warming of the earth that has been observed over the past century has been cause for concern, as this warming is due to the accumulation of human-caused greenhouse gases, such as CO_2, in the atmosphere (IPCC, 2007). Global average temperature is estimated to have increased by about 1 degree Celsius since the pre-industrial period, and it is currently increasing by about 0.2 degrees Celsius per decade. This global increase in temperatures is having broad range of effects on global, regional and local climates. According to the IPCC, the extent of climate change effects on individual regions will vary over time and with the ability of different societal and environmental systems to mitigate or adapt to change.

The Fourth National Climate Assessment, provides a summary of trends and predictions for the Southern Great Plains, composed of Kansas, Oklahoma, and Texas. The Southern Great Plains experience a range of extreme weather that can have severe impacts, like hurricanes, flooding, severe storms with large hail and tornadoes, blizzards, ice storms, relentless winds, heat waves, and drought. The people and economies in the region are often at the mercy of some of the most diverse and extreme weather hazards on the planet.

The role of climate change in altering the frequency of the types of severe weather most typically associated with the Southern Great Plains, such as severe local storms, hailstorms, and tornadoes, remains difficult to quantify, however, climate change is expected to lead to an increase in average temperatures as well as

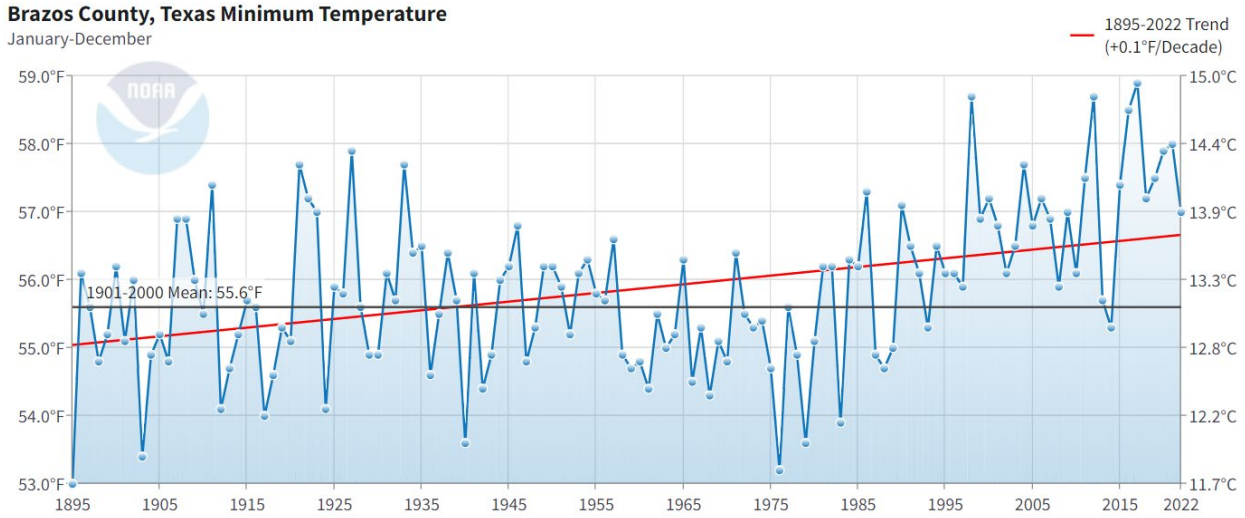
frequency, duration, and intensity of extreme heat events and a reduction in extreme cold events, but changes are unlikely to be uniform across the region.

Climate predictions summarized by the EPA indicate that in the eastern two-thirds of Texas, average annual rainfall is increasing, yet the soil is becoming drier. Rainstorms are becoming more intense, and floods are becoming more severe. Along much of the coast, the sea is rising almost two inches per decade. In the coming decades, storms are likely to become more severe, deserts may expand, and summers are likely to become increasingly hot and dry, creating problems for agriculture and possibly human health.

TEMPERATURE

Records of minimum annual temperature show an increasing annual trend. Most of Texas has warmed between one-half and one degree (F) in the past century. In Brazos County, average minimum annual temperature has increased at a rate of 0.1 degrees Fahrenheit per decade, as shown in Figure 4.1.

Figure 4.1 – Brazos County Minimum Annual Temperature, 1895-2023



Source: NOAA Climate at a Glance

According to the Fourth National Climate Assessment, climate change is expected to lead to an increase in average temperatures as well as frequency, duration, and intensity of extreme heat events. Annual average temperatures in the Southern Great Plains region, where Bryan is located, are projected to increase by 3.6°–5.1°F by the mid-21st century and by 4.4°–8.4°F by the late 21st century, based on higher levels of greenhouse gas emissions leading to greater and faster temperature increases. By late in the 21st century, if no reductions in emissions take place, the region is projected to experience an additional 30–60 days per year above 100°F than it does now.

PRECIPITATION

Average annual precipitation projections suggest small changes in the South Great Plains region, with slightly wetter winters, particularly in the north of the region, and drier summers. However, the frequency and intensity of heavy precipitation are anticipated to continue to increase, particularly under higher scenarios and later in the century. Based on the studies summarized in the National Climate Assessment, the expected increase of precipitation intensity predicts fewer soaking rains with more time to dry out between events, resulting in less soil moisture.

However, over the past 50 years, one-third of the of the drought-affected periods in the region have been followed by significant flooding and rainfall events. Understanding this rapid swing from extreme drought to flood is an important and ongoing area of research in the region. Yet, even while record-breaking flooding events increased over the past 30 years, the Southern Great Plains experienced an overall decrease in flood

frequency, possibly related to the decrease in total precipitation over the same period. While past hydrologic extremes have been driven largely by climate variability, climate change is likely to exacerbate aridity in the Southern Great Plains, largely associated with drying soils due to increased evapotranspiration caused by higher temperatures.

4.1.5 IDENTIFIED HAZARDS

Based on preliminary review of disaster declaration history, flood event history, and discussion by the FMPC, the following hazards were identified for full risk and vulnerability analysis in this plan:

- Dam Failure
- Erosion
- Riverine Flooding
- Stormwater/Localized Flooding

4.2 RISK ASSESSMENT METHODOLOGY

The hazards identified in Section 4.1 Hazard Identification, are profiled individually in Section 4.4. Information provided by members of the FMPC has been integrated into this section with information from other data sources.

Each hazard is profiled in the following format:

HAZARD DESCRIPTION

This section provides a description of the hazard including any applicable details specific to the planning area. Where available, this section also includes information on seasonal patterns, speed of onset/duration, and any secondary effects.

LOCATION

This section describes or visualizes where the hazard may occur within the planning area.

EXTENT

This section provides information on the magnitude of the hazard and describes how the severity of the hazard can be measured. If known, the most severe event on record is noted.

PAST OCCURRENCES

This section contains information on historical events, including the date, extent, and/or location of past hazard events within or near the planning area.

PROBABILITY OF FUTURE OCCURRENCE

This section gauges the likelihood of future occurrences based on past events and existing data. The frequency is determined by dividing the number of events observed by the number of years on record and multiplying by 100. This provides the percent chance of the event happening in any given year (e.g. 10 flooding events over a 30-year period equates to a 33 percent chance of experiencing a flood in any given year).

CLIMATE CHANGE AND FUTURE CONDITIONS

This section discusses the potential impacts of any changes in future conditions, including climate change, future development, or other changes.

PRIORITY RISK INDEX

The findings from the above sections of the hazard profiles are summarized using the Priority Risk Index (PRI) to score and rank each hazard's significance to the planning area. The PRI provides a standardized numerical value so that hazards can be compared against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk in five categories (probability, impact, spatial extent, warning time, and duration). Each degree of risk is assigned a value (1 to 4) and a weighting factor as summarized in Table 4.4.

Table 4.4 – Priority Risk Index

RISK ASSESSMENT CATEGORY	LEVEL	DEGREE OF RISK CRITERIA	INDEX	WEIGHT
PROBABILITY What is the likelihood of a hazard event occurring in a given year?	**UNLIKELY**	LESS THAN 1% ANNUAL PROBABILITY	1	30%
	POSSIBLE	BETWEEN 1 & 10% ANNUAL PROBABILITY	2	
	LIKELY	BETWEEN 10 &100% ANNUAL PROBABILITY	3	
	HIGHLY LIKELY	100% ANNUAL PROBABILTY	4	
IMPACT In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?	**MINOR**	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	1	30%
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1 DAY	2	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR > 1	3	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES > 30 DAYS.	4	
SPATIAL EXTENT How large of an area could be impacted by a hazard event? Are impacts localized or regional?	**NEGLIGIBLE**	LESS THAN 1% OF AREA AFFECTED	1	20%
	SMALL	BETWEEN 1 & 10% OF AREA AFFECTED	2	
	MODERATE	BETWEEN 10 & 50% OF AREA AFFECTED	3	
	LARGE	BETWEEN 50 & 100% OF AREA AFFECTED	4	
WARNING TIME Is there usually some lead time associated with the hazard event? Have warning measures been implemented?	**MORE THAN 24 HRS**	SELF DEFINED	1	10%
	12 TO 24 HRS	SELF DEFINED	2	
	6 TO 12 HRS	SELF DEFINED	3	
	LESS THAN 6 HRS	SELF DEFINED	4	
DURATION How long does the hazard event usually last?	**LESS THAN 6 HRS**	SELF DEFINED	1	10%
	LESS THAN 24 HRS	SELF DEFINED	2	
	LESS THAN 1 WEEK	SELF DEFINED	3	
	MORE THAN 1 WEEK	SELF DEFINED	4	

The sum of all five risk assessment categories equals the final PRI value, demonstrated in the equation below (the lowest possible PRI value is a 1.0 and the highest possible PRI value is 4.0).

PRI = [(Probability x .30) + (Impact x .30) + (Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

The purpose of the PRI is to categorize and prioritize all flood hazards as high, moderate, or low risk. This process and these criteria allowed the FMPC to focus on the hazards of greatest significance and to prioritize mitigation actions appropriately, allowing Bryan to focus resources where they are most needed.

PRI ratings are provided by category throughout each hazard profile, and a summary of each hazard's PRI score is provided at the beginning of each hazard profile. The results of the risk assessment and overall PRI scoring are provided in Section 4.5.

VULNERABILITY ASSESSMENT

The FMPC conducted a vulnerability assessment to assess the impact that each hazard would have on the City. The vulnerability assessment quantifies assets at risk and estimates potential losses to the extent feasible using best available data.

Vulnerability assessments followed the methodology described in the FEMA publication *Understanding Your Risks—Identifying Hazards and Estimating Losses*. Total exposure and values at risk are summarized in the Asset Inventory in Section 4.3. An evaluation of vulnerability by hazard, based on this asset inventory, is provided in each relevant hazard profile.

Data used to support this assessment included the following:

- Brazos Central Appraisal District parcel data
- City of Bryan building footprints
- County and City GIS data (hazard layers, base layers, critical facility points, and other data)
- Hazard layer GIS datasets from federal agencies
- Written descriptions of risks and vulnerability provided by the 2019 Brazos County Hazard Mitigation Plan and 2018 State of Texas Hazard Mitigation Plan
- Other existing plans and studies provided by the City of Bryan

Vulnerability is summarized in general, qualitative terms and encompasses the potential impact based on past occurrences, spatial extent, and damage and casualty potential. It is categorized into the following classifications:

- **Extremely Low** – The occurrence and potential cost of damage to life and property is very minimal to non-existent.
- **Low** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **High** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
- **Extremely High** – Very widespread with catastrophic impact.

Vulnerability was also quantified in instances where there is a known, defined hazard area, such as a mapped floodplain. In these instances, the number and types of buildings subject to the identified hazard were counted and their values tabulated. Additional information, such as the location of critical community facilities (e.g., a fire station), historic structures, and valued natural resources (e.g., an identified wetland or endangered species habitat) can also be evaluated in relation to known hazard areas. Together, this information conveys the exposure and vulnerability of the planning area to that hazard.

4.3 ASSET INVENTORY

An inventory of assets within the City of Bryan was compiled in order to identify structures and, as a result, people, potentially at risk to the identified hazards. This asset inventory is divided into property, people, critical facilities and infrastructure, and future land use. By understanding the type and number of assets that exist and where they are located relative to known hazard areas, the risk and vulnerability for such assets can be assessed.

4.3.1 PROPERTY

Building footprint data and parcel data retrieved between March and May 2023 were used to identify all improved properties in the City of Bryan. Property exposure is summarized by occupancy in Table 4.5.

Table 4.5 – Summary of Improved Property

Occupancy Type	Building Count	Total Building Value	Estimated Content Value	Total Value
Agriculture	1,091	$247,971,657	$247,971,657	$495,943,314
Commercial	4,519	$1,174,139,534	$1,174,139,534	$2,348,279,068
Government	23	$75,545,722	$75,545,722	$151,091,444
Industrial	361	$81,752,299	$122,628,449	$204,380,748
Residential	24,711	$4,938,759,238	$2,469,379,619	$7,408,138,857
Total	**30,705**	**$6,518,168,450**	**$4,089,664,981**	**$10,607,833,431**

Source: BCAD parcel data, 2023; City of Bryan building footprints, 2023

Note that in some cases, building footprints were located on parcels that did not have improved values in the parcel data. Building footprints less than or equal to 400 square feet or that existed on vacant parcels, new development parcels, or other parcels without associated improvement values were removed from the vulnerability assessment, as a building value is require for Hazus loss estimates. As a result, the total building and content values in the property inventory are likely an underestimate of actual exposure.

Of the parcels with building footprints but no associated values, City staff identified that 528 parcels were new lots with no house yet built. These buildings were evaluated with a spatial overlay in GIS to consider the potential for future flood risk and exposure. See Section 4.5 for more information.

It should also be noted that another 126 parcels without values were identified as locations of mobile homes. Buildings on these parcels could not be accounted for in the Hazus loss estimates but are nonetheless important to consider when evaluating vulnerability because they can be more susceptible to damage from flooding. These buildings were evaluated with a spatial overlay in GIS; more detail is provided in Section 4.4.3.

Content value estimations are based on the FEMA Hazus methodology of estimating value as a percent of improved structure values by property type. The residential property type assumes a content replacement value equal to 50% of the building value. Agricultural, commercial, education, government, and religious property types assume a content replacement value equal to 100% of the building value. The industrial property type assumes a content replacement value equal to 150% of the building value.

4.3.2 PEOPLE

An estimate of people at risk by location was derived using residential property data and the average household size in the City of Bryan as estimated by the U.S. Census. Table 4.6 shows the total population at risk according to this methodology.

Table 4.6 – Estimated People at Risk

Residential Property Count	Average Household Size	People at Risk
24,711	2.61	64,496

Source: American Community Survey 2017-2021 5-Year Estimates; BCAD parcel data, 2023

4.3.3 CRITICAL FACILITIES AND INFRASTRUCTURE

Of significant concern with respect to any disaster event is the location of critical facilities and infrastructure in the planning area. Critical facilities are often defined as those essential services and facilities in a major emergency which, if damaged, would result in severe consequences to public health and safety or a facility which, if unusable or unreachable because of a major emergency, would seriously and adversely affect the health, safety, and welfare of the public. Critical facilities are summarized by type and total structure value in Table 4.7. A full inventory of identified critical facilities and infrastructure is provided in Table 4.8 and their locations are shown Figure 4.2.

Table 4.7 – Summary of Critical Facilities and Infrastructure

FEMA Lifeline	Count	Structure Value
Energy	1	$771,874
Food, Water, Shelter	11	$117,988,388
Health and Medical	24	$137,366,754
Safety and Security	32	$141,295,683
Transportation	2	$542,379
Total	**70**	**$397,965,079**

Source: City of Bryan

Table 4.8 – Inventory of Critical Facilities and Infrastructure

FEMA Lifeline	Facility Type	Facility Name
Safety and Security	Municipal/Gov	City Office
Safety and Security	Municipal/Gov	City Office
Safety and Security	Municipal/Gov	City Office
Safety and Security	Municipal/Gov	City Office
Safety and Security	Municipal/Gov	City Office
Safety and Security	Municipal/Gov	Police
Safety and Security	Municipal/Gov	Brazos Valley Council of Gov.
Safety and Security	Municipal/Gov	Brazos County Office
Safety and Security	Municipal/Gov	Brazos County Office
Safety and Security	Municipal/Gov	Brazos County Office
Safety and Security	Municipal/Gov	Brazos County Office
Safety and Security	Municipal/Gov	Brazos County Office
Safety and Security	Municipal/Gov	Brazos County Office
Safety and Security	Municipal/Gov	Brazos County Office
Safety and Security	Municipal/Gov	Sheriff's & Constable Offices
Safety and Security	Municipal/Gov	Brazos County Office
Safety and Security	Municipal/Gov	Emergency Operations Center
Safety and Security	Municipal/Gov	Brazos County Court House

FEMA Lifeline	Facility Type	Facility Name
Safety and Security	Municipal/Gov	Federal Prison Camp
Safety and Security	Municipal/Gov	Brazos County Detention Center
Safety and Security	Municipal/Gov	Brazos County Juvenile Justice
Safety and Security	Municipal/Gov	Bryan Fire Station 4
Safety and Security	Municipal/Gov	Bryan Fire Station 1
Safety and Security	Municipal/Gov	Bryan Fire Station 3
Safety and Security	Municipal/Gov	Bryan Fire Station 2
Safety and Security	Municipal/Gov	Bryan Fire Station 5
Safety and Security	Municipal/Gov	Bryan Animal Center
Safety and Security	Municipal/Gov	Texas Department of Transportation
Safety and Security	Municipal/Gov	Department Of Public Safety
Safety and Security	Municipal/Gov	Post Office
Safety and Security	Municipal/Gov	Post Office
Safety and Security	Municipal/Gov	Post Office
Safety and Security	Municipal/Gov	Texas National Guard FMS 11
Food, Water, Shelter	Municipal/Gov - Emergency Shelter/Operations	Brazos Expo Center
Food, Water, Shelter	Municipal/Gov - Emergency Shelter/Operations	Brazos Center
Energy	Utilities - Electrical Plants	Dansby Power Plant
Food, Water, Shelter	Educational - Texas A&M University	RELLIS
Food, Water, Shelter	Educational - Texas A&M University	Texas A&M Health Science Center
Food, Water, Shelter	Educational - Texas A&M University	Texas A&M School Of Medicine
Food, Water, Shelter	Educational - Blinn College	Blinn College Main Campus
Food, Water, Shelter	Educational - Blinn College	Blinn College RELLIS Campus
Health and Medical	Medical - Hospital	CHI St. Joseph Health Regional Hospital
Health and Medical	Medical - Hospital	CHI St. Joseph Health Rehabilitation Hospital
Health and Medical	Medical - Hospital	The Physicians Centre Hospital
Health and Medical	Medical - Emergency Care	CapRock Hospital
Health and Medical	Medical - Emergency Care	CHI St. Joseph Health Emergency & Trauma Center
Health and Medical	Medical - Emergency Care	Physicians Premier
Health and Medical	Medical - Urgent Care	CHI St. Joseph Health Express Care
Health and Medical	Medical - Urgent Care	Health Point Acute Care
Health and Medical	Medical - Primary Care	CHI St. Joseph Health Primary Care - Austin's Colony
Health and Medical	Medical - Primary Care	CHI St. Joseph Health Primary Care - Bryan
Health and Medical	Medical - Primary Care	CHI St. Joseph Health Primary Care - University Dr
Health and Medical	Medical - Primary Care	CHI St. Joseph Health Primary Care - W Villa Maria
Health and Medical	Medical - Clinic	Baylor Scott & White Clinic - Boonville
Health and Medical	Medical - Clinic	Baylor Scott & White Clinic - Bryan W Villa Maria
Health and Medical	Elder Care	Broadmore Place
Health and Medical	Elder Care	Carriage Inn - Bryan
Health and Medical	Elder Care	Crestview Retirement Community
Health and Medical	Elder Care	Dansby House

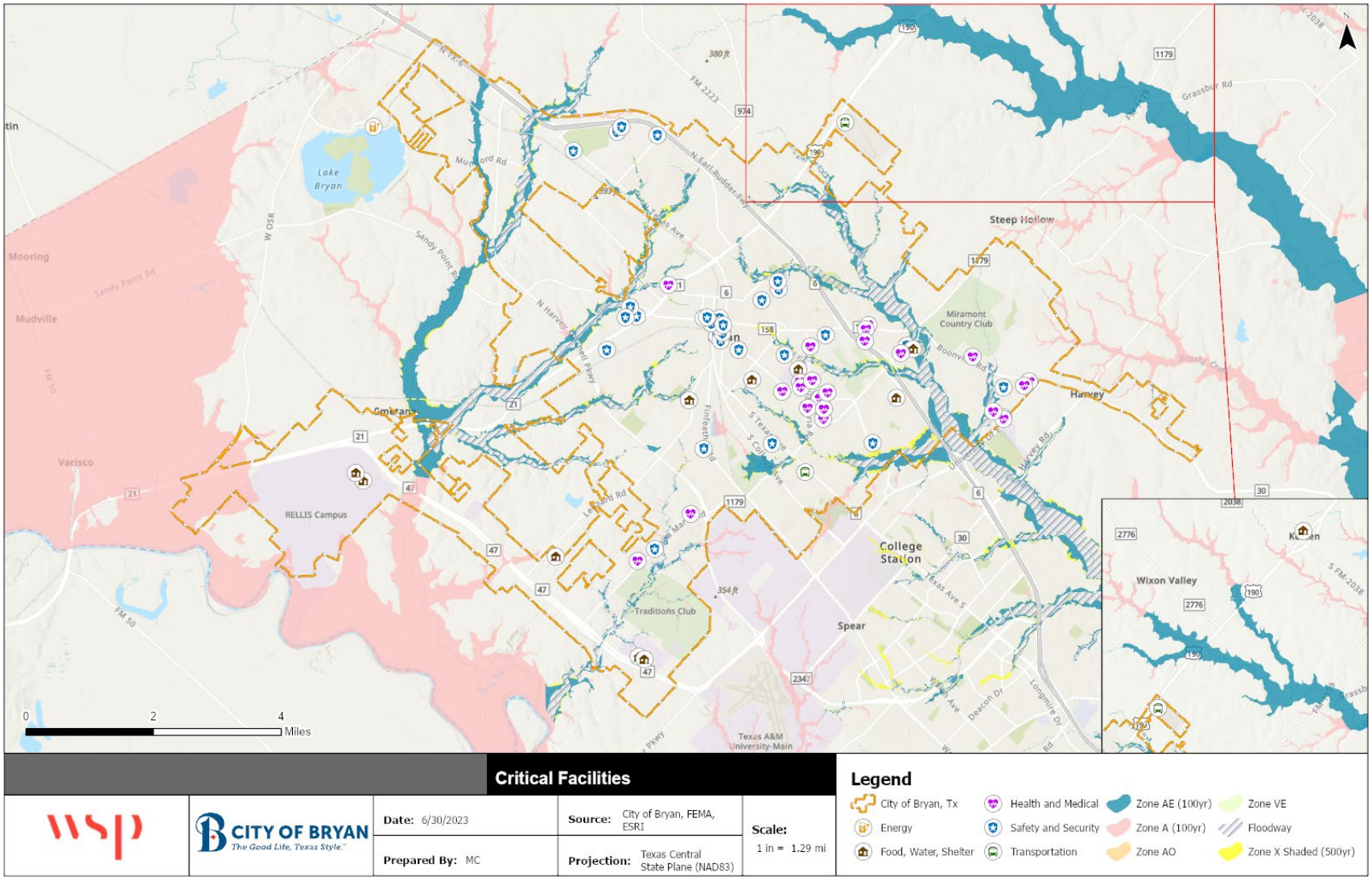
FEMA Lifeline	Facility Type	Facility Name
Health and Medical	Elder Care	Generation Center For Senior Living
Health and Medical	Elder Care	Hudson Creek Alzheimer's Special Care Center
Health and Medical	Elder Care	Isle at Watercrest - Bryan
Health and Medical	Elder Care	Lampstand Health & Rehab of Bryan
Health and Medical	Elder Care	Waldonbrooke Estates
Health and Medical	Elder Care	Watercrest At Bryan Tx
Food, Water, Shelter	Place of Worship - Emergency Shelter	First Baptist Church of Bryan
Food, Water, Shelter	Place of Worship - Emergency Shelter	Frist Presbyterian Church
Food, Water, Shelter	Place of Worship - Emergency Shelter	Save Our Street Ministries
Food, Water, Shelter	Place of Worship - Emergency Shelter	Zion Church Of Kurten
Transportation	Transportation Center	Brazos Transit
Transportation	Transportation Center	Coulter Field Airport

Source: City of Bryan

Regarding significant changes to the asset inventory since the development of the previous FMP, the City recently completed a new $40 million event center facility in the Midtown Park district and another $20 million indoor recreation facility is planned. Additionally, two other facilities will become city-owned in the coming years after their private leases end.

In terms of changes to critical facilities over the next five years, it is possible that the City will build a new fire station and rehab another fire station. A new Bryan Texas Utilities office is under construction, as is a new wastewater treatment plant. No other major facility projects are planned at this time.

Figure 4.2 – Critical Facilities & Infrastructure



4.4 HAZARD PROFILES, ANALYSIS, AND VULNERABILITY

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the…location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

44 CFR Subsection D §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. Plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:
A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;
(B): An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate; and
(C): Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

The following sections, detailed in the table below, provide profiles of the flood hazards that the FMPC identified for inclusion in this plan.

Table 4.9 – Flood Hazard Profile Organization and PRI Summary

Section	Hazard	PRI Score	PRI Rating
4.4.1	Dam Failure	2.1	Medium
4.4.2	Erosion	2.3	Medium
4.4.3	Riverine Flooding	3.0	High
4.4.4	Stormwater/Localized Flooding	3.1	High

4.4.1 DAM FAILURE

Hazard	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Dam Failure	Possible	Limited	Negligible	Less than 6 hrs	Less than 1 week	2.1

HAZARD DESCRIPTION

A dam is a barrier constructed across a watercourse that stores, controls, or diverts water. Dams are usually constructed of earth, rock, or concrete. The water impounded behind a dam is referred to as the reservoir and is measured in acre-feet. One acre-foot is the volume of water that covers one acre of land to a depth of one foot. Dams can benefit farmland, provide recreation areas, generate electrical power, and help control erosion and flooding issues.

A dam failure is the collapse or breach of a dam that causes downstream flooding. Dam failures may be caused by natural events, human-caused events, or a combination. Due to the lack of advance warning, failures resulting from natural events, such as hurricanes, earthquakes, or landslides, may be particularly severe. Prolonged rainfall and subsequent flooding is the most common cause of dam failure.

Dam failures usually occur when the spillway capacity is inadequate and water overtops the dam or when internal erosion in dam foundation occurs (also known as piping). If internal erosion or overtopping cause a full structural breach, a high-velocity, debris-laden wall of water is released and rushes downstream, damaging or destroying anything in its path. Overtopping is the primary cause of earthen dam failure in the United States.

Dam failures can result from any one or a combination of the following:

- Prolonged periods of rainfall and flooding;
- Inadequate spillway capacity, resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage or piping;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross-section of the dam and abutments, or maintain gates, valves, and other operational components;
- Improper design, including the use of improper construction materials and construction practices;
- Negligent operation, including the failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway; and
- High winds, which can cause significant wave action and result in substantial erosion.

Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property. A catastrophic dam failure could challenge local response capabilities and require evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major casualties and loss of life could result, as well as water quality and health issues. Potentially catastrophic effects to roads, bridges, and homes are also of major concern. Associated water quality and health concerns could also be issues. Factors that influence the potential severity of a full or partial dam failure are the amount of water impounded; the density, type, and value of development and infrastructure located downstream; and the speed of failure.

Dam failure can occur with little warning. Intense storms may produce flash flooding within a few hours or even minutes of the beginning of heavy rainfall, and dam failure may occur within hours of the first signs of breaching. Other failures and breaches can take much longer to occur, from days to weeks, as a result of debris jams or the accumulation of melting snow. The duration of the flood will vary but may last as long as a week.

The National Inventory of Dams (NID) is a database of dams in the United States which was developed and is maintained by the USACE. Congress authorized the USACE to inventory dams as part of the 1972 National Dam Inspection Act. Several subsequent acts have authorized maintenance of the NID and provided funding. The USACE collaborates with FEMA and state regulatory offices to collect data on dams.

Warning Time: 4 – Less than 6 hours

Duration: 3 – Less than 1 week

LOCATION

Table 4.10 provides details for the 37 dams included in the National Inventory of Dams that are located within Brazos County. The City of Bryan is listed as the closest city to the following dams: Terry Lake Dam, Leisure Lake Dam, Midtown Park Lake Dam, and Fin-Feather Lake Dam. Bryan is about 15 miles downstream from Terry Lake Dam and one mile from the other three dams. Brazos County Emergency Management also noted that Bryan Utilities Lake Dam could impact the city. All five of these dams are identified as high or significant hazard dams in the 2019 Brazos County Hazard Mitigation Plan.

Figure 4.3 shows the dams that are within five miles of the City of Bryan and notes the location of those that are high or significant hazard dams.

Dam inundation areas were not available for evaluation for this planning process. The 2019 Brazos County Hazard Mitigation Plan evaluated exposure to failure of the Midtown Park Lake Dam (formerly Country Club Dam) and concluded that 94 residential and commercial parcels were located within the estimated inundation area. Using the Midtown Park Lake Dam as a baseline, the inundation area of any individual dam upstream or in Bryan is not expected to affect more than 1% of the total planning area.

Spatial Extent: 1 – Negligible

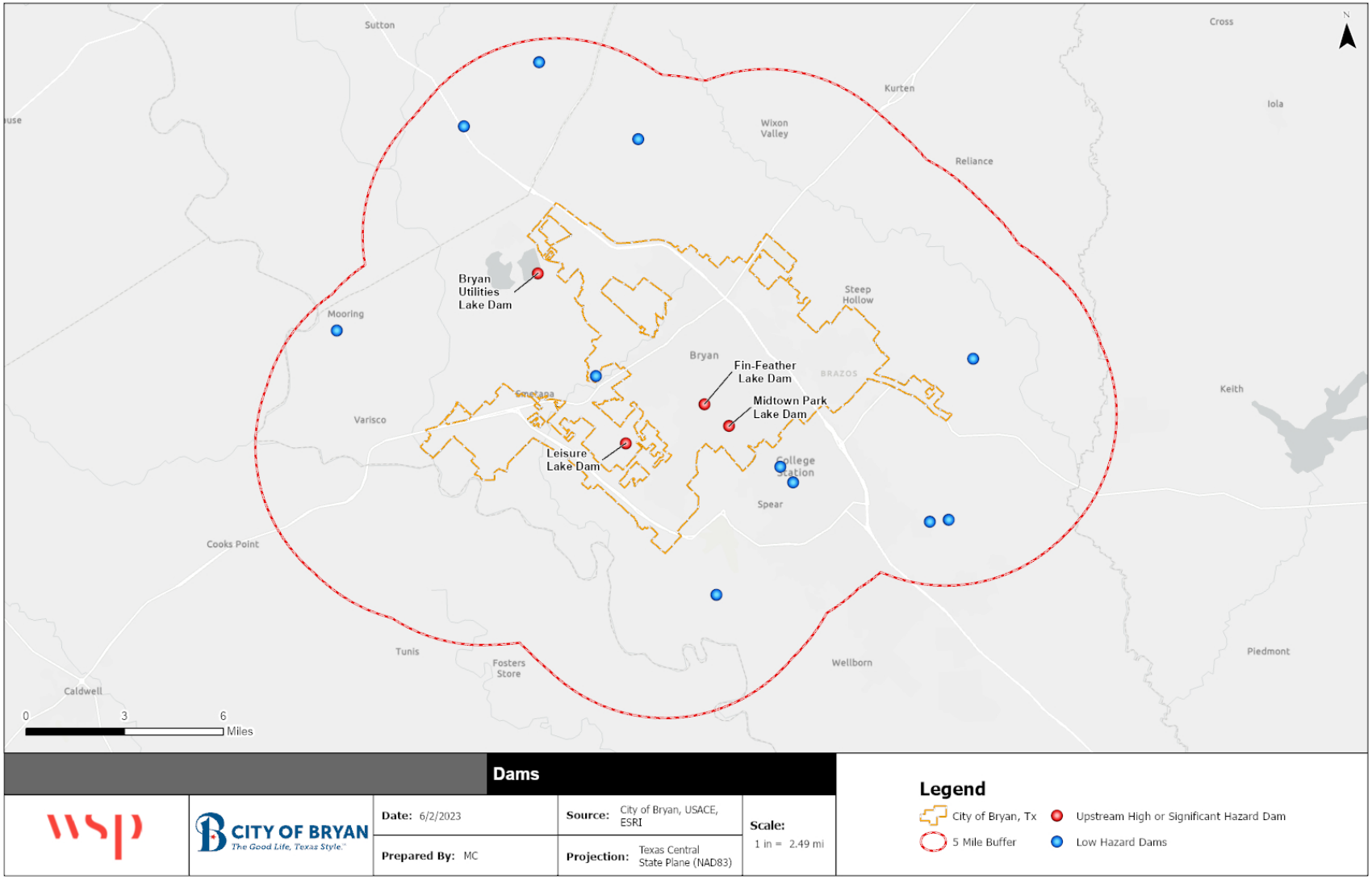
Table 4.10 – National Dam Inventory for Brazos County, TX

Dam Name	NIDID	Year Built	Height (Ft.)	NID Storage (acre-feet)	Hazard Classification	Primary Purpose	River Or Stream
Big Creek WS SCS Site 6 Dam	TX04504	1974	25	418	-	Flood Risk Reduction	Big Creek
Big Creek WS SCS Site 5 Dam	TX04503	1968	30	252	-	Flood Risk Reduction	Big Creek
Terry Lake Dam	TX07197	2004	17.5	21	High or Significant	Debris Control	N/A
Frierson Lake No 3 Dam	TX01864	1966	30	550	-	Recreation	Pin Oak Creek
Weaver Lake Dam	TX04365	1965	11	228	-	Water Supply	Navasota River
Tennessee Lake Dam	TX01857	1956	19	180	-	Recreation	Franks Creek
Clifty Creek Lake Dam	TX01858	1962	25	520	-	Fire Protection, Stock, Or Small Fish Pond	Clifty Creek
Smith Lake Dam	TX01870	1962	17	116	-	Irrigation	Still Creek
Pasture Lake Dam	TX01878	1967	27	257	-	Recreation	Navasota River
Stuewe Lake Dam	TX01875	1965	20	61	-	Recreation	Cedar Creek
Hare Lake Dam	TX01874	1963	12	96	-	Water Supply	Iron Creek
Brooke Lake Dam	TX04366	1973	21	290	-	Recreation	Brushy Creek
Herrling Lake 2 Dam	TX01877	1956	13	800	-	Recreation	Navasota River
Railroad Lake Dam	TX01859	1940	10	120	-	Fire Protection, Stock, Or Small Fish Pond	Big Creek
Frierson No 2 Lake Dam	TX05727	1971	25	110	-	Fire Protection, Stock, Or Small Fish Pond	Peach Creek
Mooring Slough Lake Dam	TX05838	1961	18	170	-	Irrigation	Mooring Slough
Prescott Lake Dam	TX01861	1955	24	399	-	Water Supply	Peach Creek
Cawthorn Lake Dam	TX01860	1950	20	90	-	Water Supply	Big Creek
Rotello Lake Dam	TX05723	1959	12	96	-	Fire Protection, Stock, Or Small Fish Pond	Jones Creek
Peters Lake Dam	TX01873	1968	10	52	-	Water Supply	Wickson Creek
Bryan Utilities Lake Dam	TX01869	1975	59	20763	High or Significant	Other	Thompsons/Peach Creeks
Texas A&M University Lake No 1 Dam	TX05724	1961	15	84	-	Recreation	White Creek
Frierson Lake No 1 Dam	TX05726	1971	20	112	-	Fire Protection, Stock, Or Small Fish Pond	Peach Creek
Leisure Lake Dam	TX01868	1964	25	322	High or Significant	Flood Risk Reduction	Thompsons Creek

Dam Name	NIDID	Year Built	Height (Ft.)	NID Storage (acre-feet)	Hazard Classification	Primary Purpose	River Or Stream
Lake Arapaho Dam	TX07109	2004	37	924	High or Significant	Recreation	Peach Creek
Midtown Park Lake Dam (formerly Country Club Lake Dam)	TX01871	1920	10	128	High or Significant	Recreation	Burton Creek
Pond C9 Dam	TX07543	N/A	13	60	-		Tributary Of Alum Creek River
CSISD At Anderson St Detention Structure No 3	TX09633	N/A	11.7	9	High or Significant		Wolf Pen Creek
TAMU Detention Dam No 8	TX07355	2002	8	101	High or Significant		Unnamed Tributary Of Wolf Pen Creek
Tower Point Detention Dam No 6	TX07354	2001	10	164	-		Off-Channel Of Spring Creek
Spearman Lake Dam	TX01863	1963	15	126	-	Recreation	Peach Creek
Lake Placid Dam	TX01865	1962	19	320	-	Recreation	Carters Creek
Fin-Feather Lake Dam	TX01872	1930	16.1	300	High or Significant	Flood Risk Reduction	Burton Creek
Oakland Lake Dam	TX01876	1962	32	550	High or Significant	Recreation	Allcorn Creek
Nantucket Dam	TX06372	1977	20	428	High or Significant	Recreation	Alum Creek
Carter Lake Dam	TX01862	1966	32	2196	High or Significant	Recreation	Carters Creek
Thousand Oaks Dam No 11	TX06880	1987	22	120	High or Significant	Recreation	Alum Creek

Source: U.S. Army Corps of Engineers National Inventory of Dams, April 2023;
Hazard classification ratings came from the 2019 Brazos County Hazard Mitigation Plan

Figure 4.3 – Dams Within 5 Miles of Bryan, TX



EXTENT

Each state has definitions and methods to determine the hazard potential of a dam. In Texas, dams are exempt from state evaluation if they meet all of the following criteria: privately owned, max capacity is less than 500 acre-feet, hazard classification is low or significant, the dam is located in a county with population less than 350,000, and the dam is located outside of city limits. All high and significant hazard dams are required to have an Emergency Action Plan (EAP). Non-exempt damns must undergo regular maintenance and schedule an inspection with Texas Commission on Environmental Quality every five years.

Dam Safety Program engineers determine inspect the dams based on the probable damage that would occur if the structure failed, in terms of loss of human life and economic loss or environmental damage. Dams are assigned one of three classes based on the nature of their hazard potential:

1. **Low Hazard:** no loss of human life expected (no permanent habitable structures in the breach inundation area downstream of the dam); and minimal economic loss (located primarily in rural areas where failure may damage occasional farm buildings, limited agricultural improvements, and minor highways.
2. **Significant Hazard:** loss of human life possible (one to six lives or one or two habitable structures in the breach inundation area downstream of the dam); or appreciable economic loss, located primarily in rural areas where failure may cause damage to isolated homes; damage to secondary highways, damage to minor railroads; or interruption of service or use of public utilities, including the design purpose of the utility.
3. **High Hazard:** loss of life expected (seven or more lives or three or more habitable structures in the breach inundation area downstream of the dam); or excessive economic loss, located primarily in or near urban areas where failure would be expected to cause extensive damage to: public facilities; agricultural, industrial, or commercial facilities; public utilities, main highways, and railroads used as a major transportation system.

Table 4.11 – Dam Hazards Classification

Hazard Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None Expected	Low and generally limited to rural areas
Significant	Possible; None Expected	Yes
High	Probable. One or more expected	Yes

Source: Texas Commission on Environmental Quality; FEMA Guidelines for Dam Safety

Terry Lake Dam, Leisure Lake Dam, Midtown Park Lake Dam, Fin-Feather Lake Dam, and Bryan Utilities Lake Dam are all located in or upstream of the City of Bryan and all five of these dams are recognized as high or significant hazard dams in the 2019 Brazos County Hazard Mitigation Plan. In the unlikely event of their failure, each of these dams would be expected to cause possible loss of human life, excessive economic loss, and damage or disruption to public facilities and infrastructure, including roadways.

Extent: 2 – Limited

PAST OCCURRENCES

Based on the Association of State Dam Safety Officials, there have been three dam failures in Brazos County. In 2017 Hurricane Harvey impacted the Clifty Creek Lake Dam and caused the emergency spillway to wash out. The Bryan Utilities Lake Dam failure occurred in 2015. Structural instability caused major slope failure. In 2009, Leisure Lake Dam experienced a failure due to the dam's deterioration and poor conditions. This caused the dam's spillway pipe to fail and partially drained the lake.

The FMPC also reported that the Lake Linda dam failed around 2000-2001. No structures were impacted, but the downstream area flooded. This was a permanent breach, and the dam no longer has an impoundment.

PROBABILITY OF FUTURE OCCURRENCE

There are five high or significant hazard dams in or upstream of the City of Bryan. Given past incidents it is possible that the City could experience a dam failure. The Bryan Utilities Lake Dam, one of the closest upstream dams from the City, is regulated by the state and regularly inspected. The last inspection was in 2018 and the condition assessment was satisfactory. Terry Lake Dam, about 15 miles from Bryan, was last inspected in 2016 and there is no condition rating available. Fin-Feather Lake Dam and Midtown Park Lake Dam, both one mile from Bryan, were inspected in 2019 and received Fair condition ratings. Leisure Lake Dam was inspected most recently in 2022 and received a satisfactory condition rating.

Based on recent inspections, failure due to poor conditions is not expected, but despite the absence of major maintenance concerns associated with any of these dams, dam breaches can also happen when a dam reaches maximum pool and water overtops the dam and flows downstream. The several historical occurrences of failures or near failures near Bryan suggest that it is possible that failure would occur.

Probability: 2 – Possible

CLIMATE CHANGE AND FUTURE CONDITIONS

Future development may increase the overall risk of dam failure by increasing downstream exposure of people and property. Regular inspection and evaluation of dam hazard potential can ensure appropriate safety precautions, such as the preparation of an Emergency Action Plan and the establishment of procedures for warning and evacuation of all at-risk structures should a failure occur.

Dam failure is already tied to flooding and the increased pressure that flooding places on dams. Climate change impacts on dam failure will most likely be those related to changes in precipitation and flood probability. The Fourth National Climate Assessment indicates that heavy precipitation events are already becoming more frequent and intense and that this trend is likely to continue. This change may increase risk of flooding, putting stress on dams and increasing likelihood of dam failure. A recent study evaluated the safety of dams for the future climate based on an evaluation of changes in design floods and the freeboard available to accommodate an increase in flood levels. The study results indicated that the design floods and the corresponding outflow floods and flood water levels will increase in the future, and this increase will affect the safety of the dams in the future. The study concluded that the total hydrological failure probability of a dam will increase in the future climate and that the extent and depth of flood waters will increase by the future dam break scenario (Chernet, 2013).

VULNERABILITY ASSESSMENT

Vulnerability – Medium

Although uncommon, dam failure events can occur, and regular monitoring is necessary to minimize their probability. As noted above, there are four high or significant hazard dams in or upstream of the City of Bryan. Failure of any of these dams could be expected to impact the City, but due to limitations on dam inundation area data, no property exposure analysis could be conducted to quantify vulnerability.

The 2019 Brazos County Hazard Mitigation Plan evaluated exposure to failure of the Midtown Park Lake Dam and indicated that 44 residential structures valued at $4.6 million and 36 commercial structures valued at $12.2 million were located within the estimated inundation area. Dam inundation areas were also evaluated during development of the 2018 Floodplain Management Plan. This analysis found that Midtown Park Lake Dam would inundate two blocks downstream with one foot of water and would impact 279 citizens and 93 structures. Failure of Bryan Utilities Lake Dam would release 102,087 gallons of water that would flow 24 miles downstream. Failure of Fin-Feather Lake Dam would send 50.8-97.8 gallons of water 2.8 miles downstream.

Based on this limited data, vulnerability from dam failure is considered medium for Bryan due to the potential for isolated incidents with property damage and possible loss of life.

4.4.2 EROSION

Hazard	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Erosion	Likely	Limited	Negligible	12 to 24 hours	More than 1 week	2.3

HAZARD DESCRIPTION

Streambank erosion refers to the removal of soil and other material, such as rock and vegetation, from the streambank. Streambank erosion is a natural process, but the rate at which it occurs is often increased by anthropogenic or human activities such as urbanization and agriculture. Acceleration of this natural process can lead to a disproportionate sediment supply, stream channel instability, land loss, habitat loss and other adverse effects.

Erosion can intensify flooding by clogging waterways with sediment and preventing normal flows. When soil is destabilized on stream banks, this sediment gets suspended in the water and as sediment builds up in stream beds, it can reduce capacity of those natural drainage features to carry floodwaters, instead forcing floodwaters out into surrounding floodplains. Erosion also occurs as a result of flooding, and suspended sediment is often deposited by floodwater. This can clog storm drains, culverts, and ditches, potentially increasing the amount of property damage done by a flood.

Streams erode by a combination of direct stream processes, like down cutting and lateral erosion and indirect processes, like mass-wasting accompanied by transportation. When the channel bends, water on the outside of the bend (the cut-bank) flows faster and water on the inside of the bend (the point) flows slower as shown in Figure 4.4. This distribution of velocity results in erosion occurring on the outside of the bend and deposition occurring on the inside of the bend.

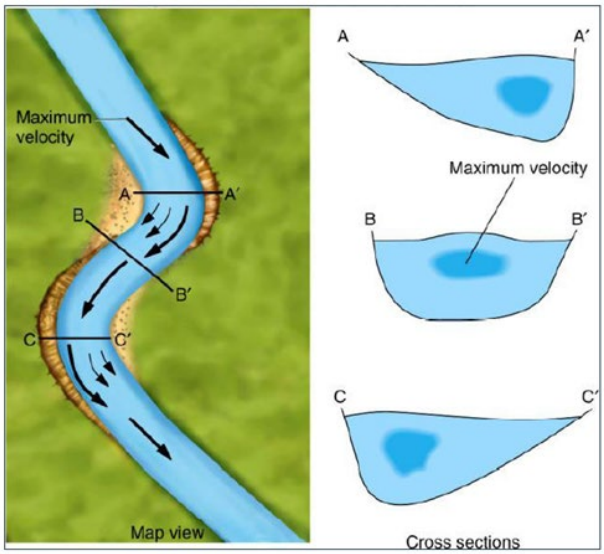
Streambank erosion processes, although complex, are driven by two major components: stream bank characteristics (erodibility) and hydraulic/gravitational forces. Many land use activities can affect both of these components and lead to accelerated bank erosion. Vegetation can protect banks from erosion and collapse and provide internal bank strength. When riparian vegetation is changed from woody species to annual grasses and/or forbs, the internal strength is weakened, causing acceleration of mass wasting processes. When land use changes occur in a watershed, such as clearing land for agriculture or development, runoff increases. With this increase in runoff the stream channel will adjust to accommodate the additional flow, increasing streambank erosion. Streambank aggradation or degradation is often a response to stream channel instability. Since bank erosion is often a symptom of a larger, more complex problem, the long-term solutions often involve much more than just bank stabilization.

If streams are monitored, unstable areas and the potential for erosion can be identified well in advance. However, a heavy rain event could cause substantial erosion with limited warning. The effects of erosion are long lasting, as permanent changes to the stream occur, including channel alterations and downstream sedimentation.

Warning Time: 2 – 12 to 24 hours

Duration: 4 – More than 1 week

Figure 4.4 – Stream Meanders



LOCATION

Erosion can occur anywhere along the stream, rivers, and other waterbodies in Bryan, however, banks with certain characteristics may be more vulnerable to potential erosion. For example, lack of floodplain access is a major factor contributing to stream bank erosion. Streams with low levels of streambank erosion often have good access to their surrounding floodplains (Figure 4.5, example A). This means that the waters in the channel regularly spill out onto the adjacent lands or floodplain. These streams tend to have low bank heights, meaning that water depths and hence stress remains low.

For streams with high banks (Figure 4.5, example B), floodwaters rarely escape the confines of the channel. Such streams are considered incised. Waters become deep with incised channels, creating high potential for stresses and erosion. Figure 4.5 shows an example of a stream with less erosion potential and good floodplain access and an example of stream with high potential for erosion.

Figure 4.5 – Example of Floodplain Access and Streambank Erosion Potential

A. Stream with good floodplain access and low erosion potential **B.** Stream with poor floodplain access and high erosion potential

Source/Photo by: Carmen Agouridis, Streambank Erosion, University of Kentucky College of Agriculture, Food and Environment

Any instance of erosion will generally be localized within the stream and reach where it occurs, although upstream and downstream impacts may also occur.

Spatial Extent: 1 – Negligible

EXTENT

Streambank erosion can occur at both at the watershed level (large-scale) as well as the stream level (small-scale). Urbanization is a large-scale activity that results in an increase in the amount of impervious surface cover such as parking lots, buildings, and roads within a watershed. Impervious surfaces create runoff, which in turn flows to streams. Consequently, streams in urbanized watersheds convey larger amounts of stormwater than undeveloped areas. Larger volumes of stream flow mean that the waters in these streams are deeper, which creates increased levels of stress on the bed and banks and higher streambank erosion rates.

At the stream scale, streambank erosion is increased largely by activities that impact riparian vegetation, soil stability, and channel sinuosity.

Impacts can also depend on topography, soils, farming practices, engineering and construction types and materials. Erosion can remove topsoil, scour riverbanks and collapse bridges and roads. It can also result in the siltification of lakes and reservoirs, reducing their usefulness as flood control features and as sources of water supply.

Extent: 2 – Limited

PAST OCCURRENCES

It is difficult to record specific instances of streambank erosion as it is typically a slow and ongoing process. However, it occurs naturally in every stream and channel. Areas with accelerated erosion have likely experienced loss of vegetation and/or increased development.

The City of Bryan prepared an Erosion Master Plan for Briar and Burton Creeks in February 2019, which evaluated the full length of Briar Creek, Burton Creek, and an unnamed tributary of Burton Creek. The streams were divided into reaches based on their geomorphic properties and the severity of erosion in each reach was categorized as follows:

- Severe – Banks unvegetated and severely undercut, tree falls common, mass wasting and bank slough frequent, channel is deeply incised, imminent threat to infrastructure, scour on more than 75% of the channel bank.
- Moderate – Scour is extensive, banks undercut, vegetation present but sparse, channel is moderately incised, scour on 50-75% of the stream bank.
- Slight – Banks mostly vegetated, some exposed roots, minor undercutting and rare evidence of mass wasting or sloughing, scour on less than 50% of the stream bank.
- Minimal – Vegetated banks, no evidence of mass wasting or sloughing, minimal scour present only at the toe of stream banks.

Areas with severe erosion identified through that process include:

- Briar Creek (Reach 3) near Emmett Street and Bob Bond Park
- Briar Creek (Reach 5) near Cherry Creek Circle
- Burton Creek (Reach 2) near Woodland Drive
- Burton Creek (Reach 3) near Sharon Drive and Esther Boulevard
- Unnamed Burton Creek Tributary near Carter Creek Parkway and Briar Oaks Drive

PROBABILITY OF FUTURE OCCURRENCE

Given that streambank erosion is a natural process, it is expected to occur in the future. The identification of multiple areas of severe erosion on Briar and Burton Creeks indicates an imminent threat to infrastructure as a result of erosion. Without mitigation, damaging erosion is likely.

Probability: 3 – Likely

CLIMATE CHANGE AND FUTURE CONDITIONS

The frequency and intensity of rainfall events is expected to increase across the U.S., and total precipitation amounts are expected to increase in the Southeast. Such increases in precipitation will likely increase the amount of stress on streambanks, due to increased volume and velocity, which could lead to increased erosion.

New development can also affect the occurrence of streambank erosion by increasing the amount of runoff into streams creating larger volumes of stream flow which contribute to bank stress and higher streambank erosion rates. Similar loss of vegetation can weaken bank stability creating greater vulnerability.

VULNERABILITY ASSESSMENT

Vulnerability – Medium

Streambank erosion can cause many challenges like loss of valuable land and damage to infrastructure. When streambanks erode, valuable land, such as crop or livestock fields, can be lost and critical infrastructure such as bridges, roads, and underground utilities may be damaged. Eroding streambanks can also often be harmful to humans and animals, as overhanging banks can collapse from the weight of a person or animal. Streambank erosion can also negatively impact water quality by increasing the amount of suspended sediment in the stream water.

Specific vulnerabilities identified within the Briar and Burton Erosion Master Plan include the following:

- Exposed utility lines at risk of damage and/or structural failure
- Damage to concrete stream linings compromising structural integrity, including under a bridge and near residential properties and roads
- Powerlines exposed and threatened
- Downcutting and undermining of channel banks threatening nearby townhomes
- Potential bank failure threatening nearby residential structures
- Silted in detention ponds with reduced capacity and performance

Areas with increased development and/or loss of riparian (deep-rooting) vegetation may be more vulnerable to streambank erosion. Lack of pervious surface and minimal floodplains around streams can increase risks of erosion. According to the University of Kentucky College of Agriculture, Flood and Environment, streambanks are best stabilized through one or a combination of the following three methods: 1) providing floodplain access, 2) establishing a dense cover of deep-rooting riparian vegetation, and/or 3) redirecting stream flows away from the streambanks and towards the center of the channel. Additional structural mitigation may be needed to protect existing infrastructure that is threatened by ongoing erosion.

4.4.3 RIVERINE FLOODING

Hazard	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Riverine Flooding	Likely	Critical	Moderate	6 to 12 hours	Less than 1 week	3.0

HAZARD DESCRIPTION

Flooding is the rising and overflowing of a body of water onto normally dry land. As defined by FEMA, a flood is a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties. Flooding can result from an overflow of inland waters or an unusual accumulation or runoff of surface waters from any source.

Flooding is the most frequent and costly of all natural hazards in the United States. Ninety percent of all natural disasters in the U.S. involve flooding.

TYPES AND SOURCES OF FLOODING

Two types of flooding generally occur in Bryan, described below.

Riverine/Overbank Flooding: The City of Bryan sits between the Navasota River to the east and the Brazos River to the west. The City contains several major tributaries of these rivers, which are susceptible to overflowing their banks during and after heavy or prolonged rain events. These creeks are tributaries, listed below, are the primary sources are flooding in the City of Bryan.

- Carters Creek
- Burton Creek
- Briar Creek
- Hudson Creek
- Turkey Creek
- Still Creek
- Thompson's Branch
- Cottonwood Branch

These creeks and tributaries are shown on Figure 4.6 on the following page. Flooding within the City of Bryan associated with these systems was evaluated using the Effective Flood Insurance Study (FIS) Report, revised April 2, 2014. This section focuses primarily on riverine/overbank flooding.

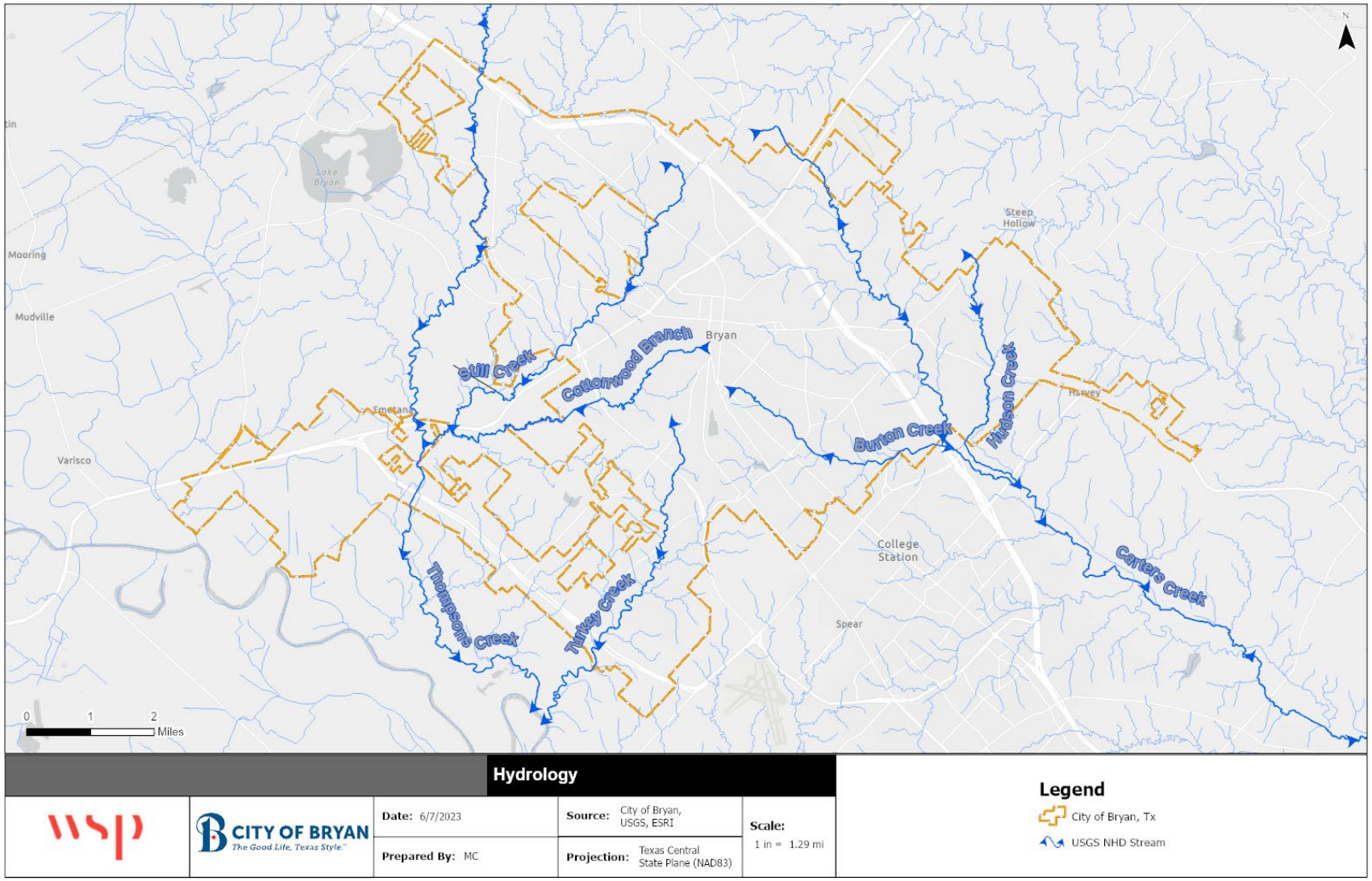
Localized or Flash Flooding: Flash flooding is the result of heavy, localized rainfall, possibly from slow-moving intense thunderstorms that cause small streams and drainage systems to overflow within six hours or less of the beginning of the rainfall. Flash flooding can happen in Special Flood Hazard Areas (SFHAs) as delineated by FEMA and can also happen in areas not associated with floodplains. Flash flood hazards are generally associated with surface water runoff in steep terrain, which is not a concern in Bryan. However, this rapid flooding can also occur in urbanized areas, where greater population density generally equates to more impervious surface (e.g., pavement and buildings) which reduces infiltration and increases the amount of surface water generated. In this case, flash flooding occurs when the capacity of the stormwater system is exceeded or if conveyance is obstructed by debris, sediment and other materials that limit the volume of drainage. This type of localized flooding is discussed in more detail in Section 4.4.4 Stormwater/Localized Flooding.

Warning time can vary significantly depending on the source and type of flooding but can be as little as six hours in the case of flash flooding. Flooding can often last longer than 24 hours but is typically cleared in less than 1 week.

Warning Time: 3 – 6 to 12 hours

Duration: 3 – Less than 1 week

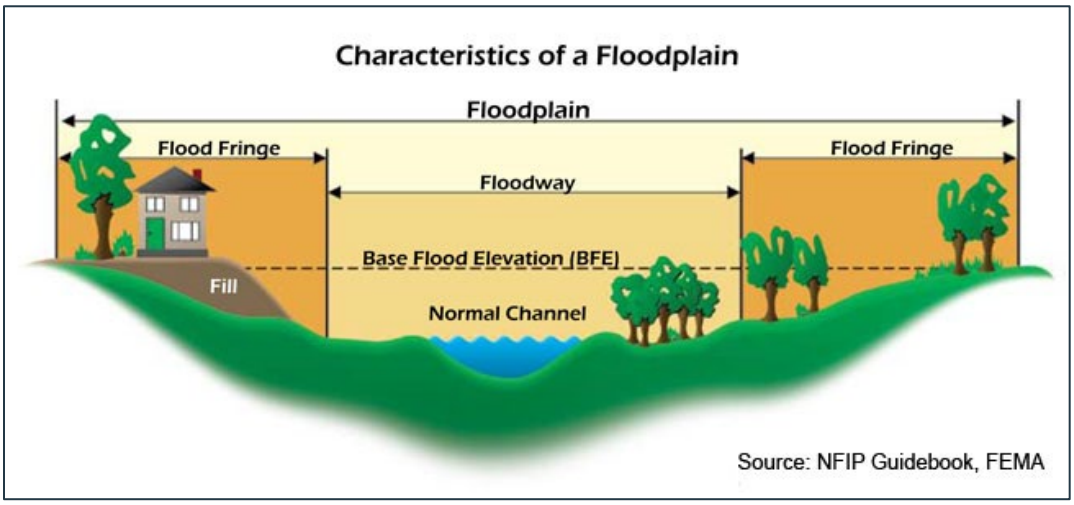
Figure 4.6 – Primary Flood Source Creeks and Tributaries



FLOODING AND FLOODPLAINS

In the case of riverine flooding, the area adjacent to a channel is the floodplain, as shown in Figure 4.7. A floodplain is flat or nearly flat land adjacent to a stream or river that experiences occasional or periodic flooding. It includes the floodway, which consists of the stream channel and adjacent areas that carry flood flows, and the flood fringe, which are areas covered by the flood, but which do not experience a strong current. Floodplains are made when floodwaters exceed the capacity of the main channel or escape the channel by eroding its banks. When this occurs, sediments (including rocks and debris) are deposited that gradually build up over time to create the floor of the floodplain. Floodplains generally contain unconsolidated sediments, often extending below the bed of the stream.

Figure 4.7 – Characteristics of a Riverine Floodplain



In its common usage, the floodplain most often refers to that area that is inundated by the "100-year flood," which is the flood that has a 1-percent chance in any given year of being equaled or exceeded. The 500-year flood is the flood that has a 0.2-percent chance of being equaled or exceeded in any given year. The potential for flooding can change and increase through various land use changes and changes to land surface, which result in a change to the floodplain. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining natural drainage channels. These changes are often created by human activity.

The 1-percent-annual-chance flood, which is the minimum standard used by most federal and state agencies, is used by the NFIP as the standard for floodplain management and to determine the need for flood insurance. Participation in the NFIP requires adoption and enforcement of a local floodplain management ordinance which is intended to prevent unsafe development in the floodplain, thereby reducing future flood damages. Participation in the NFIP allows for the federal government to make flood insurance available within the community as a financial protection against flood losses. Since floods have an annual probability of occurrence, have a known magnitude, depth and velocity for each event, and in most cases, have a map indicating where they will occur, they are in many ways the most predictable and manageable hazard.

LOCATION

Regulated floodplains are illustrated on inundation maps called Flood Insurance Rate Maps (FIRMs). The FIRM is the official map for a community on which FEMA has delineated both the SFHAs and the risk premium zones applicable to the community. SFHAs represent the areas subject to inundation by the 1-percent-annual-chance flood event. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Flood prone areas were identified within Bryan

using the Effective FIS and FIRMs revised April 2, 2014. Table 4.12 summarizes the flood insurance zones identified by the DFIRMs.

Table 4.12 – Mapped Flood Insurance Zones within Bryan, TX

Zone	Description
AE	Corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. This zone includes the "regulatory floodway," which is defined as the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height
A	Corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (1-percent-annual-chance) flood elevations (BFEs) or depths are shown within this zone.
Zone X (Shaded)	Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.)
Zone X (Unshaded)	Minimal risk areas outside the 1-percent and 0.2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. (Zone X (unshaded) is used on new and revised maps in place of Zone C.)

Source: FEMA

Figure 4.15 reflect the effective mapped flood insurance zones for the City of Bryan. Approximately 11.2% of the City of Bryan falls within the 1-percent-annual-chance floodplain in the Effective FIRMs. Table 4.13 summarizes the City's acreage by flood zone according to the FIRM.

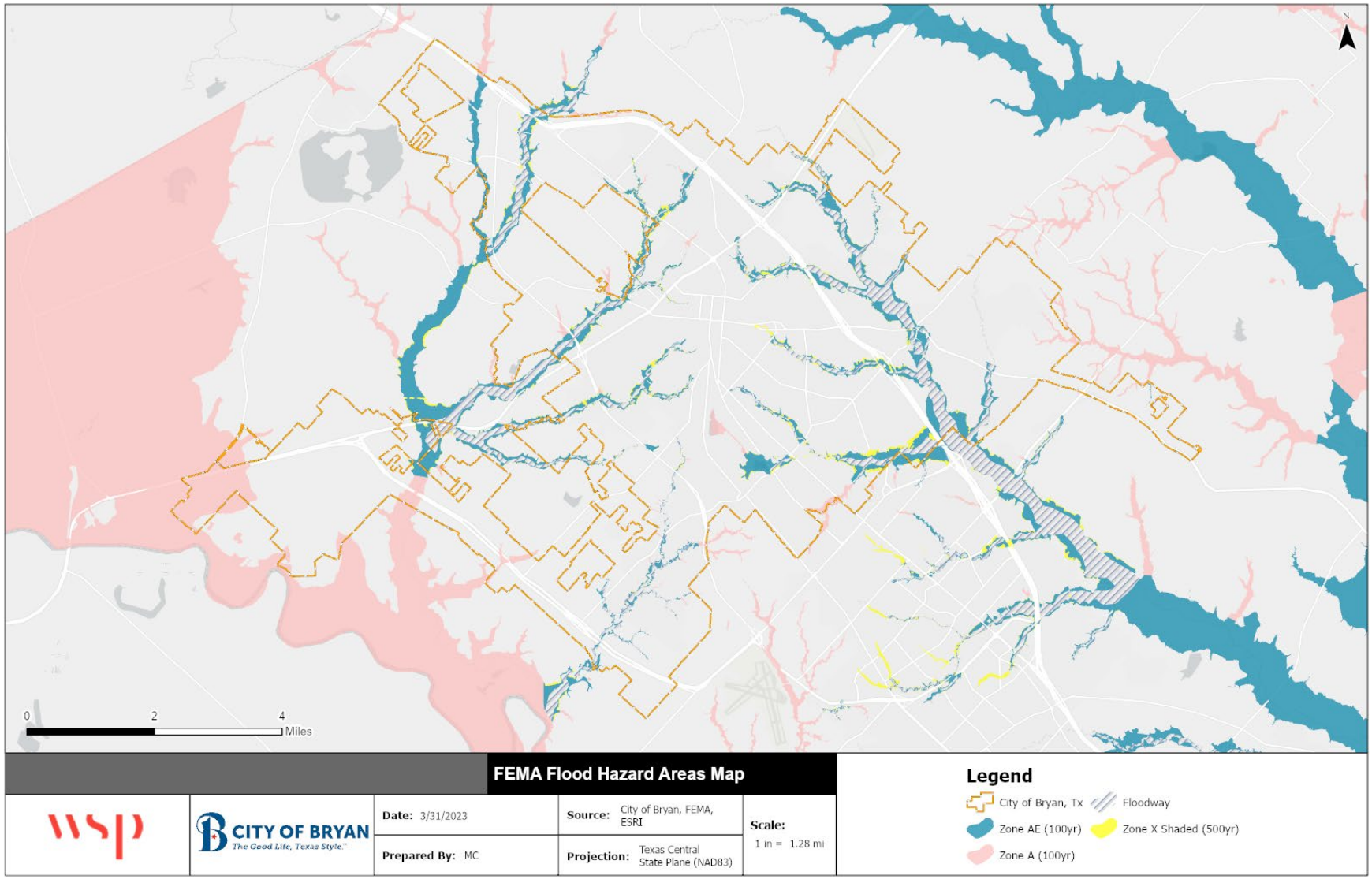
Table 4.13 – Flood Zone Acreage, 2014 Effective FIRM

Flood Zone	Acreage	Percent of Total
A	827.39	2.4%
AE	1,734.51	4.9%
Floodway	1,375.60	3.9%
X (Shaded)	306.26	0.9%
X (Unshaded)	30,949.67	87.9%
Total	**35,193.42**	-
SFHA Total	**3,937.50**	**11.2%**

Source: FEMA 2014 Effective DFIRM

Spatial Extent: 3 – Moderate

Figure 4.8 – City of Bryan 2014 Effective DFIRM Flood Zones



EXTENT

The severity of a flood can be measured by its depth and velocity. The depth of flooding that impacts a property is correlated with the property damages that result, where greater depths cause more substantial damages.

Figure 4.9 shows the flood depths throughout the City of Bryan for the 1-percent-annual-chance flood event, as derived from the Effective FIRMs and elevation data for the City.

Flood extent varies throughout the floodplain, but overall flooding impacts can be critical, with the potential for severe damage and destruction of property and the possibility of injuries and deaths.

Impact: 3 – Critical

PAST OCCURRENCES

Table 4.14 summarizes the 42 flash flood events, 3 flood events, and 1 tropical storm event reported in the NCEI Storm Events Database since 1996 for Brazos County. A review of event narratives indicates that 29 of the reported flash flood events reflect small scale, localized street flooding; these events are reported in Section 4.4.4 Stormwater/Localized Flooding. The remaining 13 events are associated with larger scale events involving overbank flooding and impacts beyond street flooding. Table 4.15 lists these events by location and date of occurrence.

Table 4.14 – Summary of NCEI Flooding Events in Brazos County (1996 – 2022)

Type	# of Events	Property Damage	Crop Damage	Deaths (Direct)	Injuries (Direct)
Flash Flood	13	$1,564,000	$0	0	0
Flood	3	$10,000	$0	0	0
Tropical Storm	1	$15,000,000	$0	0	0
Total	**17**	**$16,574,000**	**$0**	**0**	**0**

Source: NCEI Storm Events Database, April 2023

Table 4.15 – NCEI Flooding Events in Brazos County (January 1996 – December 2022)

Location	Date	Event Type	Injuries/ Deaths	Property Damage	Crop Damage
BRAZOS (ZONE)	10/17/1998	Flood	0/0	$0	$0
BRAZOS (ZONE)	11/12/1998	Flood	0/0	$0	$0
BRAZOS CO.	5/9/2013	Flood	0/0	$10,000	$0
BRAZOS CO.	11/3/2000	Flash Flood	0/0	$1,000,000	$0
BRAZOS CO.	7/14/2002	Flash Flood	0/0	$20,000	$0
BRAZOS CO.	2/20/2003	Flash Flood	0/0	$8,000	$0
BRAZOS CO.	5/13/2004	Flash Flood	0/0	$250,000	$0
BRAZOS CO.	11/22/2004	Flash Flood	0/0	$0	$0
BRAZOS CO.	5/1/2007	Flash Flood	0/0	$130,000	$0
BRAZOS CO.	4/25/2009	Flash Flood	0/0	$1,000	$0
BRAZOS CO.	2/3/2012	Flash Flood	0/0	$100,000	$0
BRAZOS CO.	7/17/2014	Flash Flood	0/0	$50,000	$0
BRAZOS CO.	5/25/2015	Flash Flood	0/0	$5,000	$0
BRAZOS CO.	10/24/2015	Flash Flood	0/0	$0	$0
BRAZOS CO.	10/13/2018	Flash Flood	0/0	$0	$0
BRAZOS CO.	10/14/2018	Flash Flood	0/0	$0	$0
BRAZOS (ZONE)	8/25/2017	Tropical Storm	0/0	$15,000,000	$0
Total	-	-	**0/0**	**$16,574,000**	**$0**

Source: NCEI Storm Events Database, April 2023

The following provides details on select flood events recorded in the NCEI database. These scenarios represent the types of riverine flood events that can be expected in the future in the City of Bryan.

November 12, 1998 – Moderate lowland flooding occurred on the Lower Brazos River below Rosharon to Below West Columbia. Moderate flooding was also observed on East and Middle Yegua Creeks with minor lowland flooding on the Navasota River near Normangee. Significant flooding occurred on Mill Creek in Austin County with several roads inundated and closed. Significant rises were also observed on the Brazos River in the channel above Bryan to below Richmond and on the Colorado River above Columbus to below Bay City. However, flood stages were not exceeded and only minor inundation of low areas along these rivers was reported.

May 1, 2007 – Severe thunderstorms produced heavy rainfall. Enhanced development of these thunderstorms was aided by daytime heating. Approximately 12 homes in North Bryan were flooded with 2 to 3 inches of water. These homes were located at the intersection of Louisiana Avenue and McHaney Drive. Reports of 4 to 5 feet of water covered Old San Antonio Road a mile west of Highway 6.

February 3, 2012 – A potent upper level disturbance moved across the region producing several strong to severe thunderstorms across the northern half of southeast Texas. After several thunderstorms produce flash flooding early in the day a strong thunderstorm produced two tornadoes and numerous hail and flash flood reports that evening. Heavy rains caused flooding across portions of the Bryan/College Station area including significant impacts on the Texas A&M University campus, where Bizzell Road was inundated with 2 to 3 feet of water and the basement of the commons dormitory was flooded. Road closures included FM 60 at Jones Road and the intersection of Boonville Road and FM 1179.

July 17, 2014 – A southern plains shortwave disturbance moving into a very moistened central and eastern Texas environment allowed clusters of central Texas thunderstorms to form and move eastward. These storms produced locally heavy rainfall that caused flash flooding across portions of southeast Texas. Heavy rains caused area roads to flood in and around the College Station area, including portions of SH 6 and Tauber Road. Some water rescues were reported along with water in some cars and homes.

August 25, 2017 – Slow moving Tropical Storm Harvey brought heavy rains and flooding to portions of Brazos, Burleson, Austin, Grimes, Washington and Madison Counties. Moderate to major lowland flooding occurred along rivers and numerous creeks and tributaries. This includes the Brazos at San Felipe, Davison Creek, etc.

October 13, 2018 – A swath of slow moving training thunderstorms produced radar-estimated 4 to near 10 inches of rain. This caused flooding across the Brazos River Valley eastward to the Trinity River. There were 11 water rescues from vehicles stranded within the flood waters.

PROBABILITY OF FUTURE OCCURRENCE

By definition of the 1-percent-annual-chance flood event, SFHAs are defined as those areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. Properties located in these areas have a 26 percent chance of flooding over the life of a 30-year mortgage. Flooding of other magnitudes can occur with varying frequency. Less severe flooding could be expected to occur more frequently, while more severe flooding could occur but may be less probable or frequent.

Based on the historical record of 17 riverine flood related events over the 27-year period from 1997 through April 2023, the City of Bryan has an annual probability of flooding of approximately 63 percent. Using historical frequency as an indicator of future probability, riverine flooding has between a 10% and 100% annual probability of occurrence.

Probability: 3 – Likely

CLIMATE CHANGE AND FUTURE CONDITIONS

Per the Fourth National Climate Assessment, the frequency and intensity of heavy precipitation events is expected to increase across the country. Specifically, it is "very likely" (90-100% probability) that most areas of the United States will exhibit an increase of at least 5% in the maximum 5-day precipitation by late 21st century. For the Great Plains regions, average annual precipitation projections suggest small changes in the region, with slightly wetter winters, particularly in the north of the region, and drier summers. However, the frequency and intensity of heavy precipitation are anticipated to continue to increase, particularly under higher scenarios and later in the century.

The Fourth National Climate Assessment summarizes that over the past 50 years, significant flooding and rainfall events followed drought in approximately one-third of the drought-affected periods in the region when compared against the early part of the 20th century. Heavy rain after dry periods can cause significant flash flooding. While record-breaking flooding events increased over the past 30 years, the Southern Great Plains experienced an overall decrease in flood frequency, possibly related to the decrease in total precipitation over the same period.

VULNERABILITY ASSESSMENT

Flood damage is directly related to the depth of flooding and can be estimated by the application of a depth damage curve. In applying the curve, a specific depth of water translates to a percentage of damage to the structure, which translates to the same percentage of the structure's replacement value. Figure 4.9 depicts the depth of flooding that can be expected within the City during the 1-percent-annual-chance flood event based on the Effective DFIRM.

Vulnerability to flooding was evaluated using GIS analysis and version 6.0 of FEMA's Hazus software. To estimate exposure to flood risk, parcel counts by FEMA flood zone were determined using a spatial intersection of building footprints, associated values from 2023 Brazos Central Appraisal District (BCAD) tax parcel data, and the FEMA DFIRM database. In the case of buildings affected by multiple zones, the entire parcel value was applied to the highest risk flood zone that intersected the building. Occupancy types were derived from parcel data and translated into occupancy classes used in Hazus to facilitate an accurate loss estimate. An occupancy class is required in Hazus to apply the correct depth damage factor which ensures the most accurate damage assessment.

Content value estimations are based on FEMA Hazus methodologies of estimating value as a percent of improved structure values by property type. Table 4.16 shows the breakdown of the different occupancy types in Hazus and their estimated content replacement value percentages.

Table 4.16 – Content Replacement Factors

Property Type	Content Replacement Values
Residential	50%
Commercial	100%
Education	100%
Government	100%
Religious	100%
Industrial	150%

Source: Hazus 6.0

PROPERTY

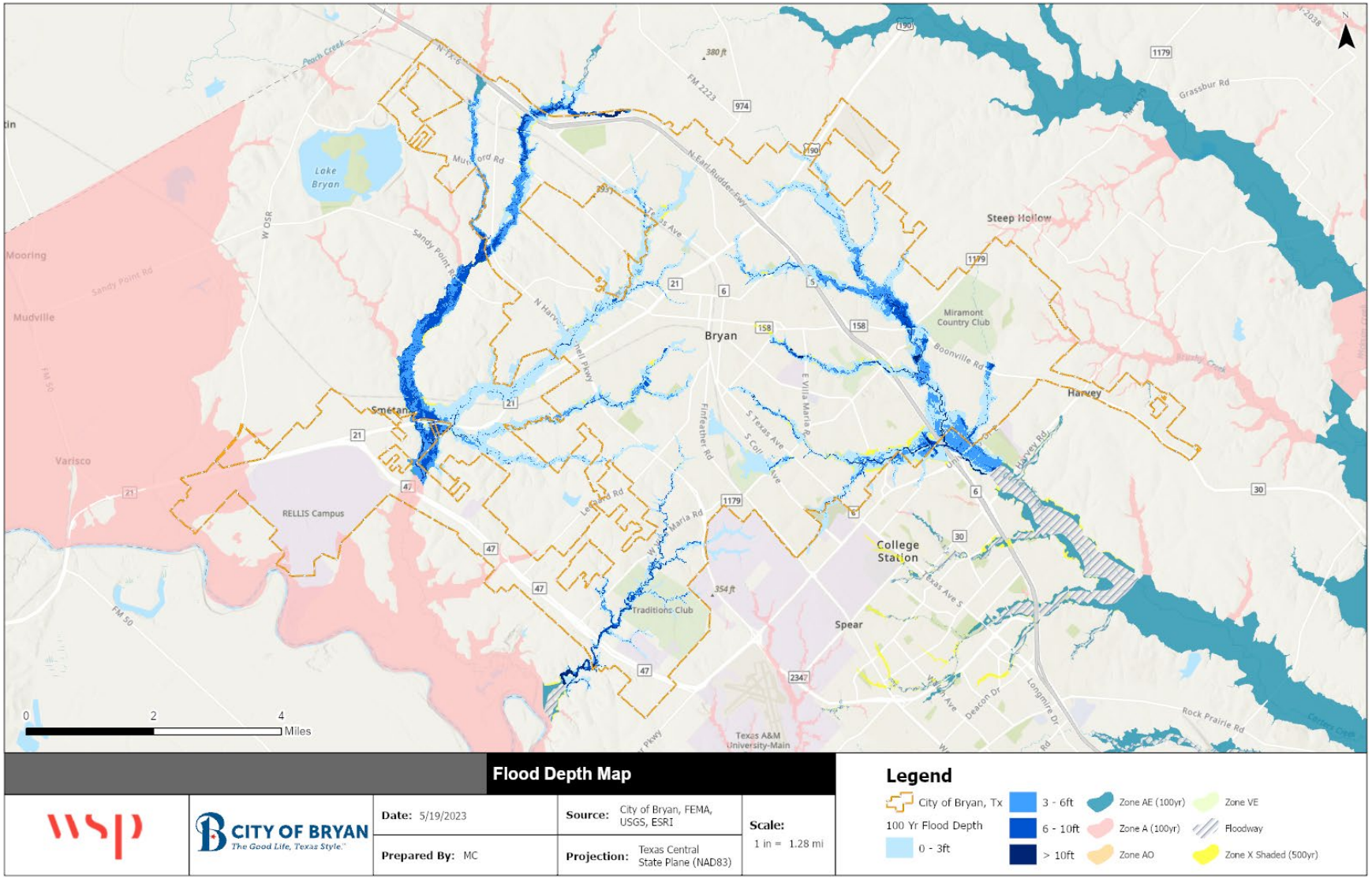
Property exposure is summarized in Table 4.17 based on the flood zones in the Effective FIRM. Buildings are counted with the highest risk flood zone that they intersect. Risk information is detailed in terms of the number of buildings by flood zone, occupancy type, and total assessed value of improvements that may be exposed to the identified hazards.

Table 4.17 – Property at Risk

Occupancy Type	Building Count Exposed	Total Building Value	Estimated Content Value	Total Value
Zone A				
Agricultural	0	$0	$0	$0
Commercial	8	$184,416	$184,416	$368,832
Government	0	$0	$0	$0
Industrial	0	$0	$0	$0
Residential	30	$3,880,775	$1,940,387	$5,821,162
Total	**38**	**$4,065,191**	**$2,124,803**	**$6,189,994**
Zone AE				
Agricultural	31	$4,612,900	$4,612,900	$9,225,800
Commercial	77	$7,285,456	$7,285,456	$14,570,912
Government	0	$0	$0	$0
Industrial	5	$649,273	$973,909	$1,623,182
Residential	541	$86,523,358	$43,261,679	$129,785,038
Total	**654**	**$99,070,987**	**$56,133,945**	**$155,204,932**
Zone X (Shaded)				
Agricultural	11	$2,553,202	$2,553,202	$5,106,404
Commercial	28	$5,764,530	$5,764,530	$11,529,060
Government	0	$0	$0	$0
Industrial	2	$235,377	$353,065	$588,442
Residential	224	$33,096,445	$16,548,223	$49,644,668
Total	**265**	**$41,649,554**	**$25,219,020**	**$66,868,574**
Zone X (Unshaded)				
Agricultural	1,049	$240,805,555	$240,805,555	$481,611,110
Commercial	4,406	$1,160,905,132	$1,160,905,132	$2,321,810,264
Government	23	$75,545,722	$75,545,722	$151,091,444
Industrial	354	$80,867,649	$121,301,474	$202,169,123
Residential	23,916	$4,815,258,660	$2,407,629,330	$7,222,887,989
Total	**29,748**	**$6,373,382,718**	**$4,006,187,213**	**$10,379,569,930**

Source: City of Bryan building footprints, BCAD parcel data, 2023; FEMA Effective DFIRM

Figure 4.9 – 1-Percent-Annual-Chance Flood Depths



WSP performed a Level 2 flood loss analysis in Hazus 6.0 by leveraging the 2023 BCAD parcel data and City of Bryan building footprints. WSP developed a depth raster for all areas of the SFHA using FEMA DFIRM database data and loaded this raster as well as the parcel data into Hazus. Losses were calculated based on Hazus standard depth damage functions. In all, there are approximately 30,705 buildings in the Bryan. Of these, 692 fall within the SFHA.

The following assumptions were made as part of this analysis:

- Where foundation type was not provided in the parcel data, foundation types were estimated as follows according to input from the City of Bryan Engineering Services Department:
  - Residential: 87% slab on grade, 10% crawl space, 3% basement
  - Commercial: 80% slab on grade, 12% basement, 8% crawlspace
- Parcels with unknown occupancy were treated as residential properties.
- Where year built was not provided in the parcel data, a standard year built of 1950 was assigned.
- Buildings were assumed to be single story if not otherwise defined in the parcel data.

Table 4.18 shows the building count, total value, estimated damages and loss ratio for buildings that fall within the 1-percent-annual-chance floodplain of the Effective FIRM by flood zone and land use type. The loss estimate for flood is based on the total of improved building value and contents value. Land value is not included in any of the loss estimates as generally the land is not subject to loss from floods.

The loss ratio is the loss estimate divided by the total potential exposure (i.e., total of improved and contents value for all buildings located within the 100-year floodplain) and displayed as a percentage of loss. FEMA considers loss ratios greater than 10% to be significant and an indicator a community may have more difficulties recovering from a flood.

Table 4.18 – Estimated Building Damage and Content Loss

Occupancy Type	Total Number of Buildings with Loss	Total Value (Building & Contents)	Estimated Building Damage	Estimated Content Damage	Loss Estimate	Loss Ratio
Agriculture	30	$8,043,538	$27,907	$152,789	$180,696	2%
Commercial	77	$14,570,912	$111,491	$348,568	$460,058	3%
Industrial	5	$1,623,182	$982	$0	$982	0%
Residential	563	$134,907,504	$6,407,203	$3,758,058	$10,165,261	8%
Total	**675**	**$159,145,137**	**$6,547,583**	**$4,259,415**	**$10,806,997**	**7%**

Source: Hazus 6.0, City of Bryan building footprints, 2023 BCAD parcel data, FEMA Effective DFIRM

Based on the Hazus analysis using the Effective DFIRM, the City of Bryan would sustain approximately $10.8 million in property damages from a 1-percent-annual-chance flood event. This level of flooding would not exceed a 10 percent loss ratio. However, impacted areas could still face significant challenges to recover from this level of flooding.

Areas of primary concern include the Burton Creek and Carters Creek floodplain, which contain most of the structures in the City's floodplain and comprise several older developments constructed under older drainage regulations.

Figure 4.10 through Figure 4.17 show the location of buildings with estimated losses according to the Hazus loss estimate. Figure 4.10 is an overview of the entire City, and the remaining Figures show detail of areas with high concentrations of estimated losses.

Figure 4.10 – Buildings with Estimated Building Damage and Contents Loss (1%-Annual-Chance Flood Event)

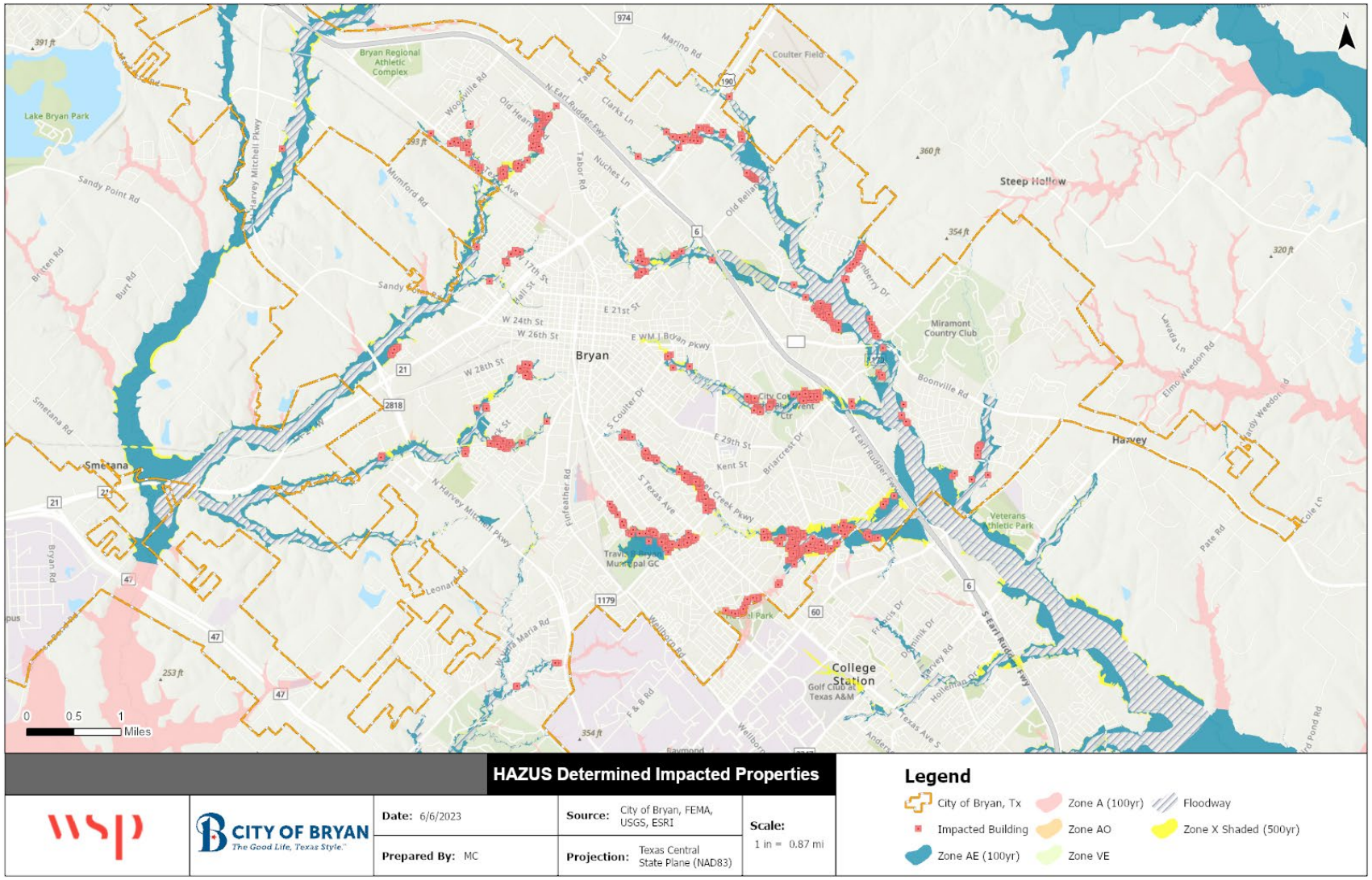


Figure 4.11 – Buildings with Estimated Loss, Inset 1 (Still Creek and Thompson's Branch)

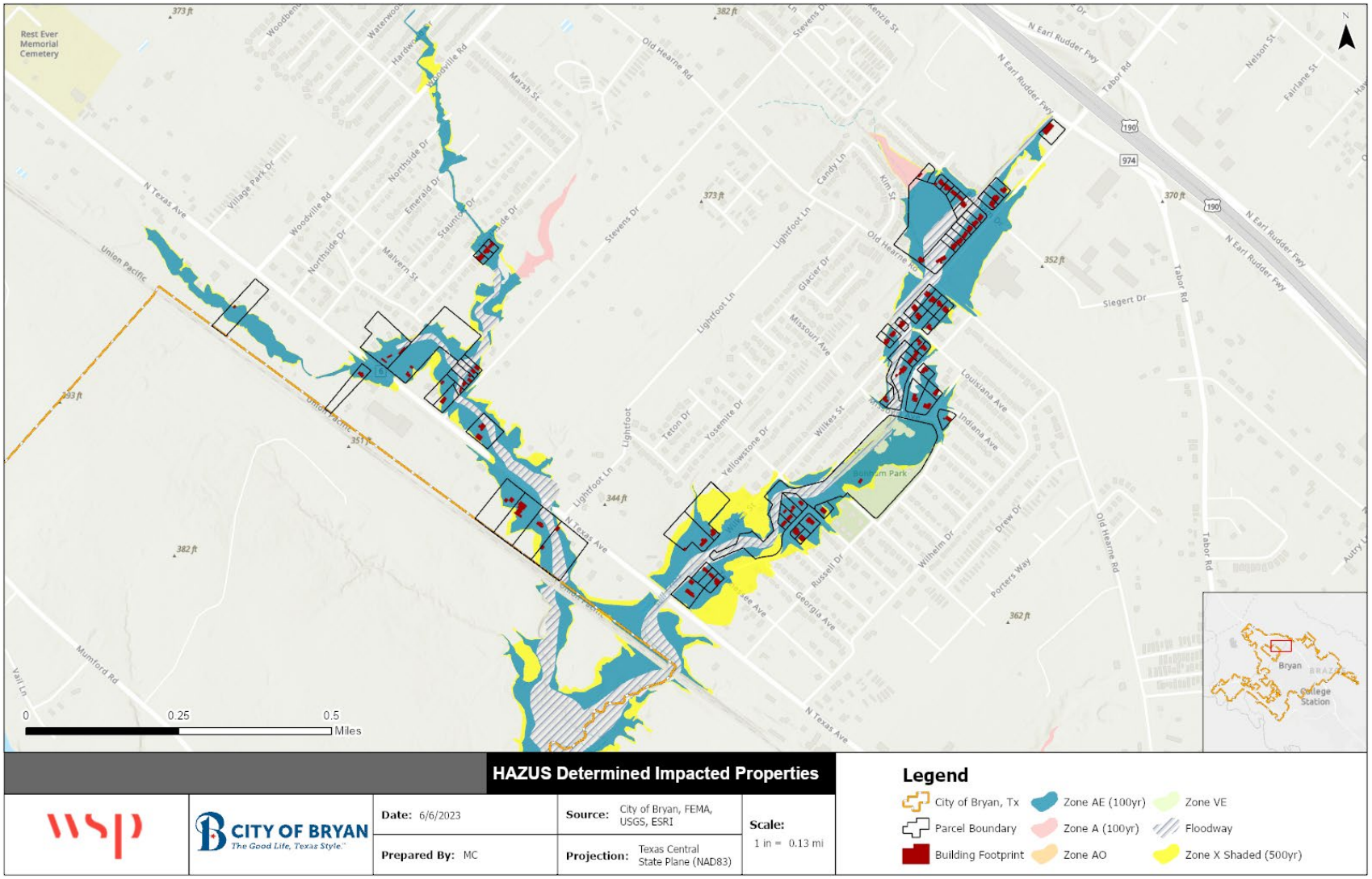


Figure 4.12 – Buildings with Estimated Loss, Inset 2 (Carters Creek)

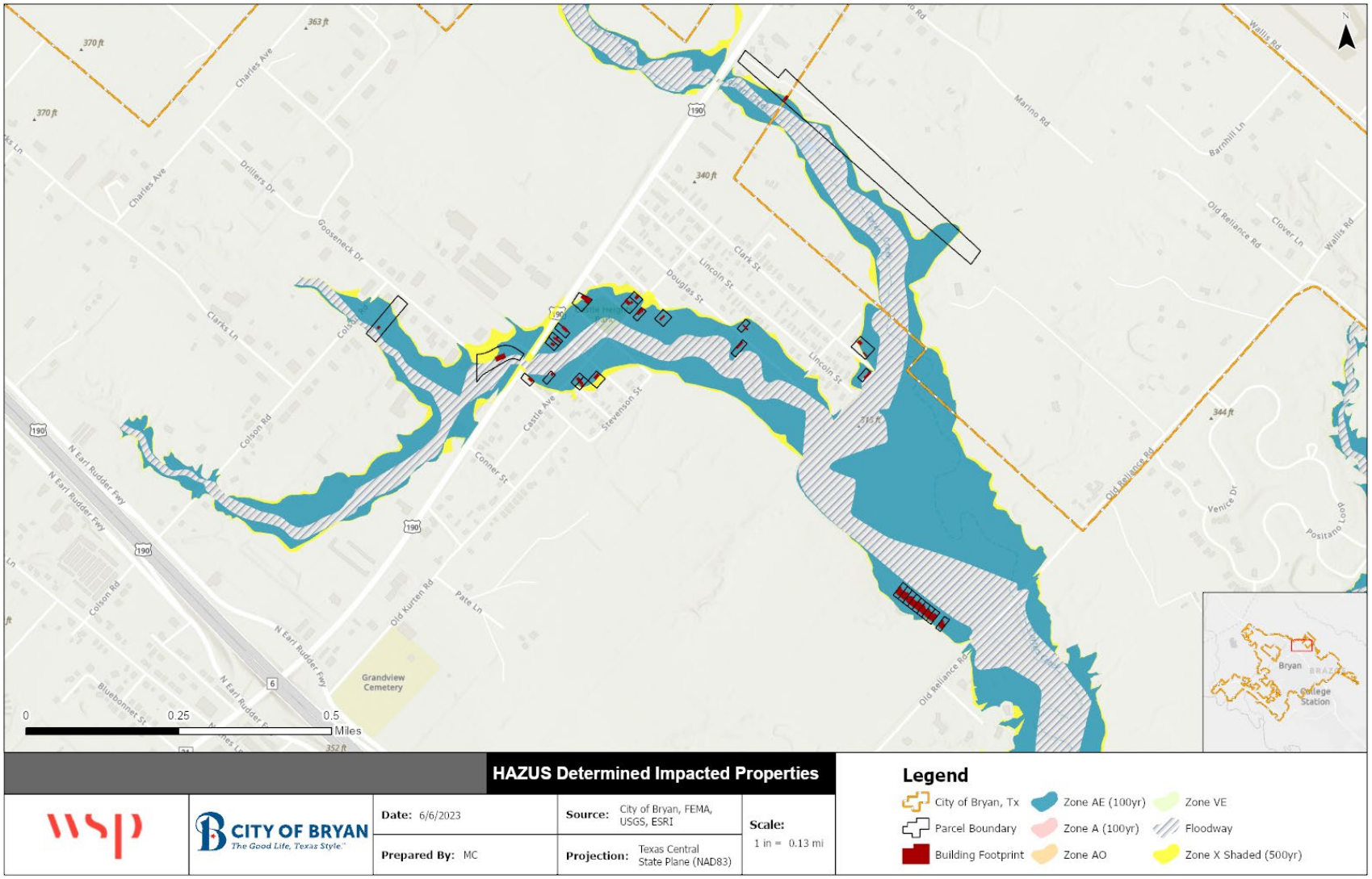


Figure 4.13 – Buildings with Estimated Loss, Inset 3 (Carters Creek)

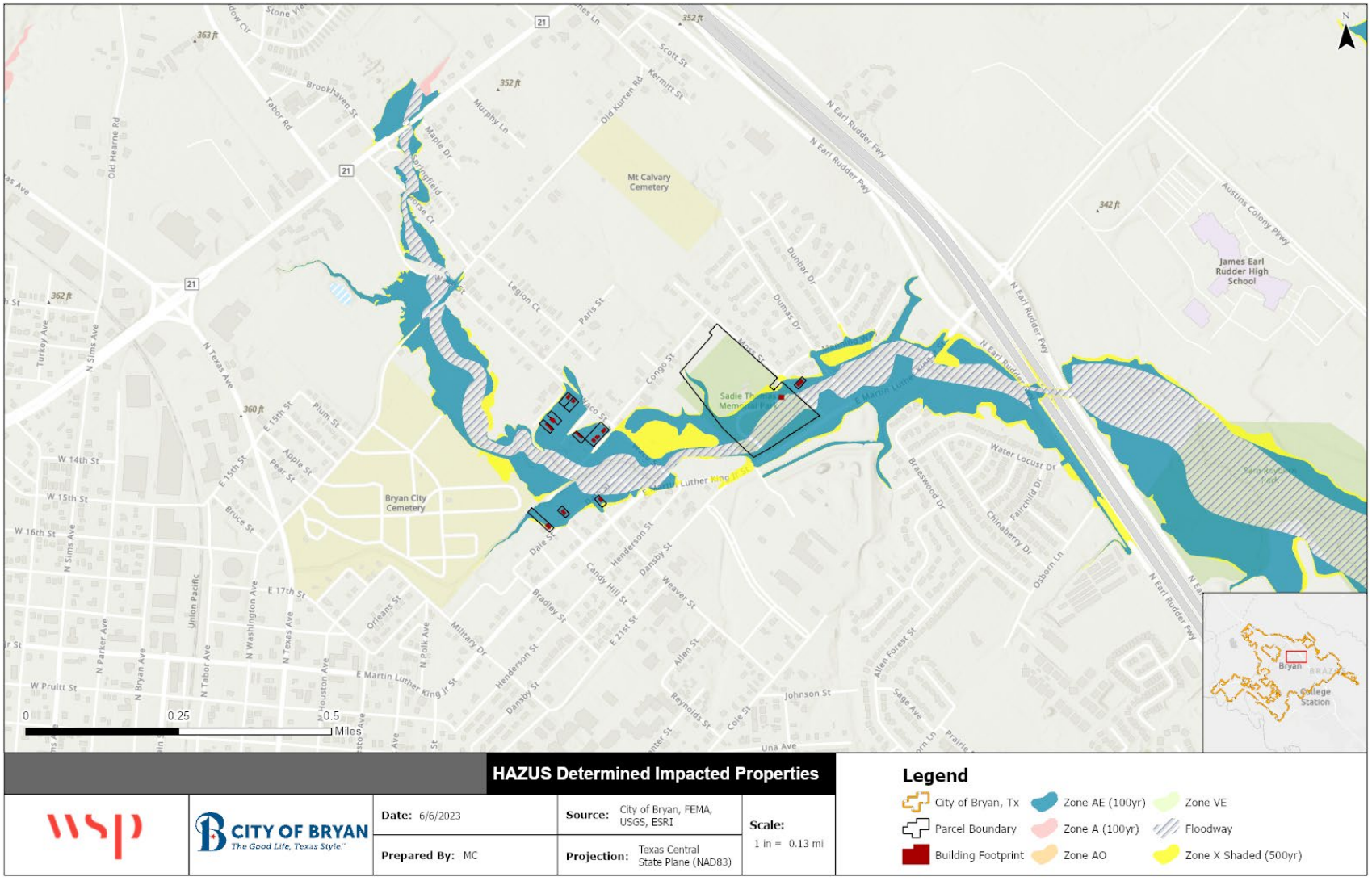


Figure 4.14 – Buildings with Estimated Loss, Inset 4 (Carters Creek)

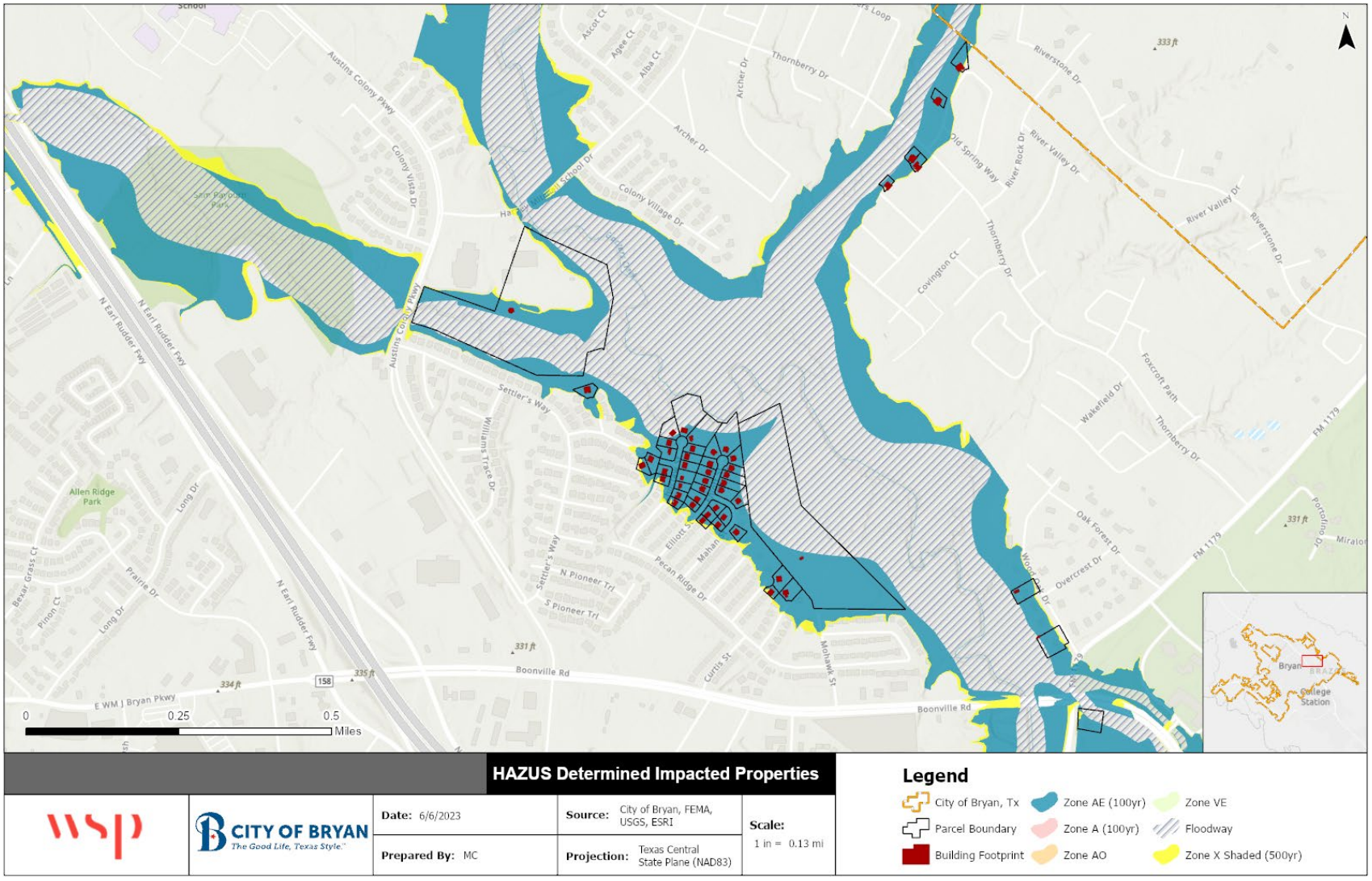


Figure 4.15 – Buildings with Estimated Loss, Inset 5 (Briar Creek)

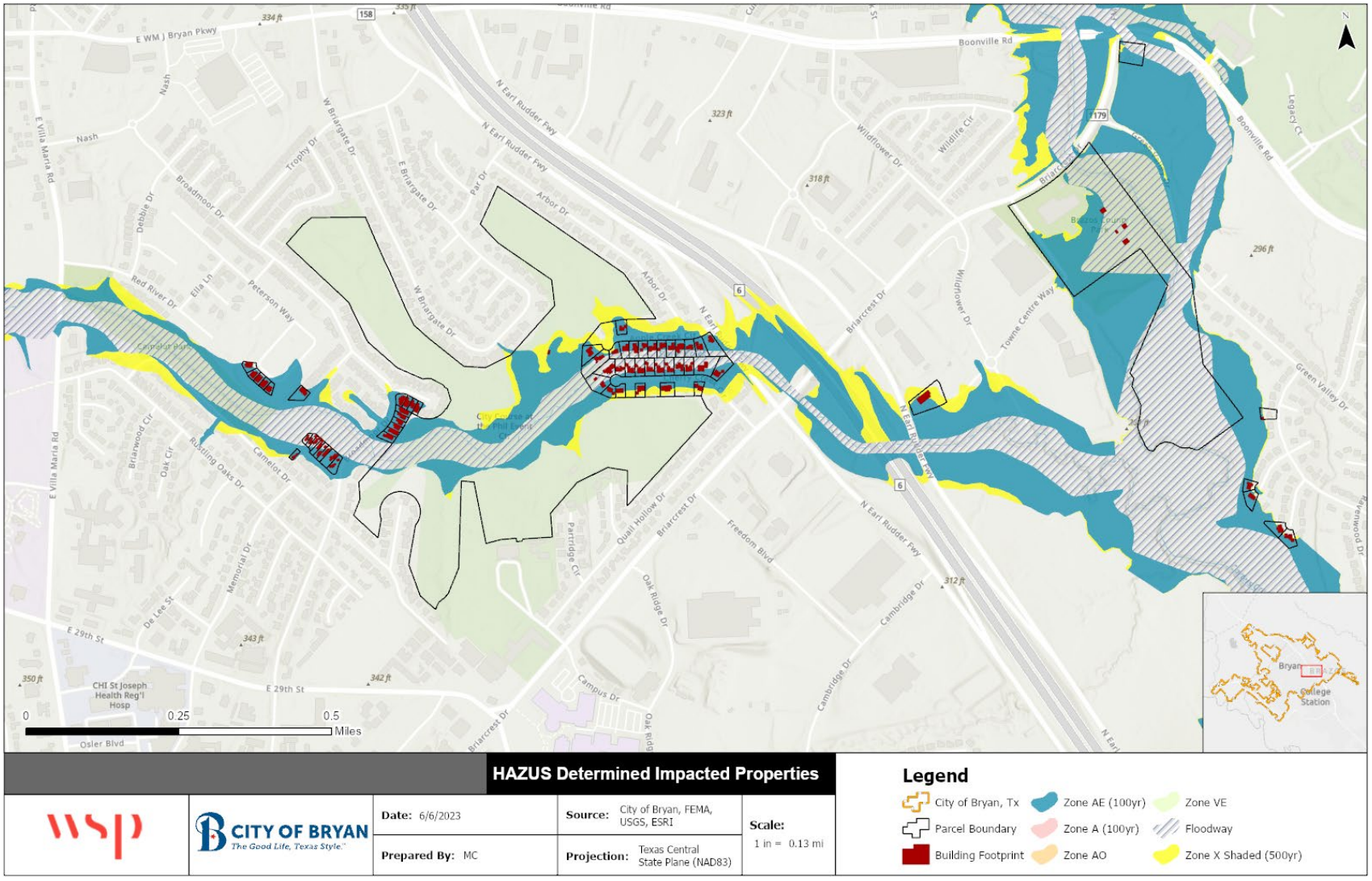


Figure 4.16 – Buildings with Estimated Loss, Inset 6 (Burton Creek)

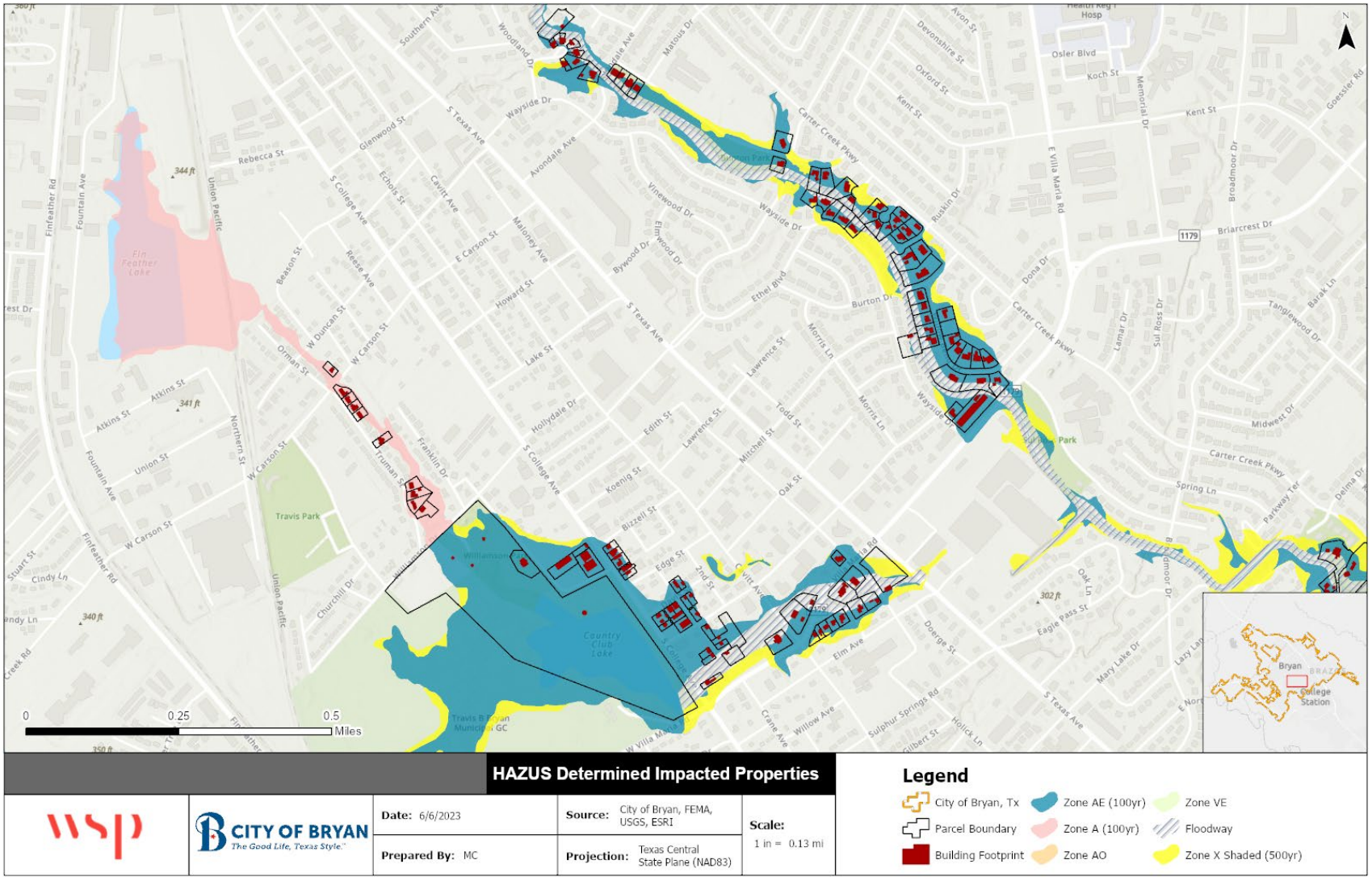
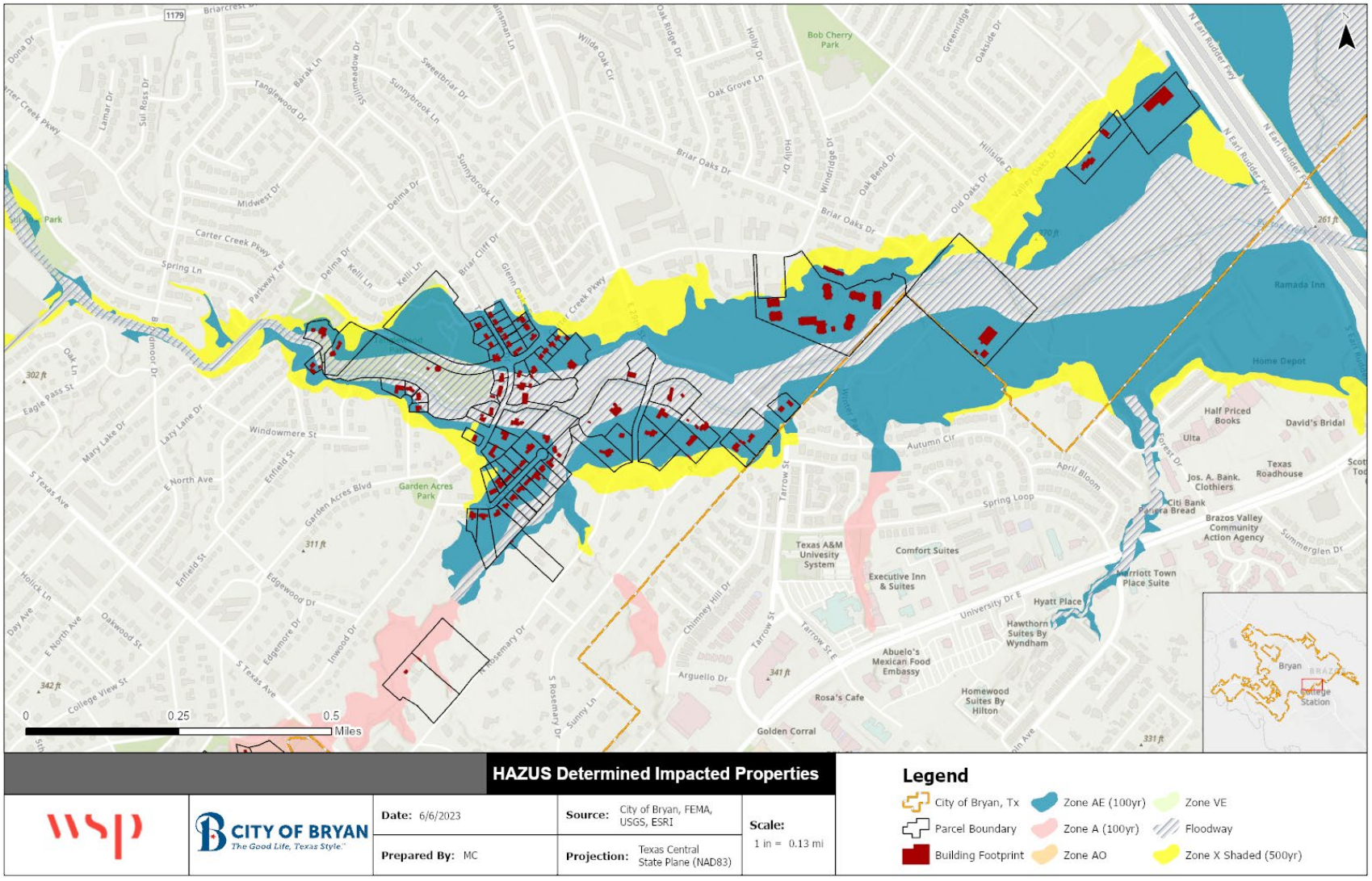


Figure 4.17 – Buildings with Estimated Loss, Inset 7 (Burton Creek)



PEOPLE

A separate analysis was performed to determine the population at risk in the individual FEMA flood zones based on the exposure of residential property and the average household size in the City of Bryan of 2.61 people per household according to U.S. Census Bureau 2021 estimates. The resulting estimate of population at risk by flood zone is shown in Table 4.19. See Section 4.5.4 for discussion on the impacts of flooding on life, safety, warning, evacuation, and public health.

Table 4.19 – Population at Risk to Flood

Flood Zone	Residential Property Count	Population at Risk
Zone A	30	79
Zone AE	541	1,412
Zone X (Shaded)	224	585
Zone X	23,916	62,421
SFHA Total	**571**	**1,491**

Source: FEMA Effective DFIRM; 2023 BCAD parcel data; American Community Survey 5-Year Estimates (2017-2021)

Per the results of the Hazus loss estimate, reported above, approximately 571 residential structures are expected to sustain damage from the 1% annual chance flood. Based on the average household size in Bryan, an estimated 1,491 residents are at risk of flooding impacting their homes.

Hazus models the potential displaced population and shelter needs based on households within or near inundated areas and estimates that 777 households, or 2,330 people, would be displaced by a 1%-annual-chance flood event, and 843 of these people would seek temporary shelter in public shelters.

Another measure of vulnerability is the degree to which flooding may impact mobility and access throughout the planning area. The TWDB's Region 8 Lower Brazos Regional Flood Plan evaluates low water crossings, which are roadway crossings that can quickly be inundated during a flood event and that pose a risk to people who try to cross them during a flood. Per the plan, there are 98 low water crossings in the Lower Brazos-Little Brazos basin and 106 low water crossings in the Navasota basin.

CRITICAL FACILITIES

A separate GIS analysis was performed to identify critical facilities located in the 1-percent-annual-chance and 0.2-percent-annual-chance floodplains. Critical facility data was overlaid with the DFIRM flood zones to determine exposure by flood zone. Facilities in Zone AE were also compared to flood depth raster data to estimate the depth of flooding that would occur at the facility. Based on this analysis, all but one of the identified critical facilities is in Zone X Unshaded. One elder care critical facility, the Hudson Creek Alzheimer's Special Care Center, is located in Zone AE. Flood depth during a 1-percent-annual-chance flood event is estimated at 0.1 feet at this facility, which suggests that impacts to the structure would likely be minimal, but there could be issues with facility access.

Overall, vulnerability to flood is considered high. There are approximately 692 buildings located in the SFHA and an additional 265 buildings located in the moderate risk Shaded Zone X. A 1% annual chance flood event is estimated to impact 675 buildings and cause approximately $10.8 million in property damages. Additional impacts on the estimated 1,491 residents of these buildings are not quantified, but include impacts to their physical, mental, and financial health and safety. Further damages could be sustained by infrastructure, and additional economic impacts could result from direct physical impacts as well as business interruption.

Vulnerability – High

FLOOD INSURANCE ANALYSIS

Flood insurance data on active policies and past claims in a valuable source of information on flood hazards. Flood insurance is available in communities that participate in the National Flood Insurance Program

(NFIP) and is required as a condition for federal aid or for a mortgage or loan that is federally insured for a building located in a FEMA flood zone. The City of Bryan has been a Regular participant in the NFIP since May 1981 and has participated in the Community Rating System (CRS) since 2019. Bryan is currently a Class 8 community. Table 4.21 through Table 4.24 reflect NFIP policy and claims data for the City categorized by structure type, flood zone, Pre-FIRM and Post-FIRM. It should be noted that there are 157 policies in force in AE Zones and 7 in A Zones, but there are 654 buildings in AE zones and 38 in A Zones. This means only 24% of properties in AE Zones and 18% in A Zones are covered by flood insurance.

Table 4.20 – NFIP Policy and Claims Data by Occupancy Type

Occupancy	Number of Policies in Force	Total Premium	Insurance in Force	Number of Closed Paid Losses	Total of Closed Paid Losses
Single Family	449	$235,974	$127,702,000	275	$4,081,473.02
2-4 Family	20	$9,368	$3,410,000	20	$403,208.83
All Other Residential	7	$4,385	$2,159,000	2	$64,733.23
Non-Residential	21	$24,184	$8,285,000	10	$131,381.20
Total	**497**	**$273,911**	**$141,556,000**	**307**	**$4,680,796.28**

Source: FEMA Community Information System as of 04/10/2023

Table 4.21 – NFIP Policy and Claims Data by Flood Zone

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	157	$104,948	$36,729,000	138	$2,699,144.22
A Zones	7	$3,750	$1,461,000	6	$18,886.85
B, C & X Zone					
Standard	333	$165,213	$103,366,000	35	$505,711.61
Preferred	0	$0	$0	116	$1,357,432.25
Total	**497**	**$273,911**	**$141,556,000**	**295**	**$4,581,174.93**

Source: FEMA Community Information System as of 04/10/2023

Table 4.22 – NFIP Policy and Claims Data Pre-FIRM

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	101	$67,513	$20,594,000	126	$2,331,787.78
A Zones	5	$2,425	$871,000	6	$18,886.85
B, C & X Zone					
Standard	144	$74,298	$42,297,000	26	$364,912.59
Preferred	0	$0	$0	89	$1,173,618.65
Total	**250**	**$144,236**	**$63,762,000**	**247**	**$3,889,205.87**

Source: FEMA Community Information System as of 04/10/2023

Table 4.23 – NFIP Policy and Claims Data Post-FIRM

Flood Zone	Number of Policies in Force	Total Premium	Total Coverage	Number of Closed Paid Losses	Total of Closed Paid Losses
A01-30 & AE Zones	56	$37.435	$16,135,000	12	$367,356.44
A Zones	2	$1,325	$590,000	0	$0
B, C & X Zone					
Standard	189	$90,915	$61,069,000	9	$140,799.02
Preferred	0	$0	$0	27	$183,813.60
Total	**247**	**$129,675**	**$77,794,000**	**48**	**$691,969.06**

Source: FEMA Community Information System as of 04/10/2023

4.4.4 STORMWATER/LOCALIZED FLOODING

Hazard	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Stormwater/ Localized Flooding	Highly Likely	Limited	Moderate	Less than 6 hours	Less than 24 hours	3.1

Hazard Description

Localized stormwater flooding can occur throughout the City of Bryan. Stormwater flooding occurs when heavy rainfall and an accumulation of runoff overburden the stormwater drainage system causing flooding in the areas where drainage is insufficient or otherwise underperforming. Localized flooding may be caused by the following issues:

- **Inadequate Capacity –** An undersized/under capacity pipe system can cause water to back-up behind a structure which can lead to areas of ponded water and/or overtopping of banks.
- **Clogged Inlets** – Debris covering the asphalt apron and the top of grate at catch basin inlets may contribute to an inadequate flow of stormwater into the system. Debris within the basin itself may also reduce the efficiency of the system by reducing the carrying capacity.
- **Blocked Drainage Outfalls** – Debris blockage or structural damage at drainage outfalls may prevent the system from discharging runoff, which may lead to a back-up of stormwater within the system.
- **Improper Grade** – Poorly graded asphalt around catch basin inlets may prevent stormwater from entering the catch basin as designed. Areas of settled asphalt may create low spots within the roadway that allow for areas of ponded water.

Localized stormwater flooding in Bryan can be attributed to the density of developed and impervious land, which limits ground absorption and increases surface water runoff, and to undersized storm sewer systems and a lack of overland flow paths. The City had 2-dimensional hydraulic modeling of the secondary drainage system performed in order to understand and evaluate flood risk to property as a result of secondary drainage flooding. The City found that several repetitive loss properties are not a result of riverine flooding but of insufficient capacity in the secondary system.

Localized flooding can result from smaller rain events, and it typically occurs with little warning. Although the flooding may drain quickly, it can still amount to significant damages. While it may not impact as large an area or produce damaging velocities, it is, nonetheless, a chronic problem. Repetitive losses caused by localized flooding can add up.

Warning Time: 4 – Less than 6 hours

Duration: 3 – Less than 24 hours

LOCATIONS

Areas of localized flooding identified by the City of Bryan are shown on the following pages in Figure 4.20 through Figure 4.23, which indicate where residents have reported flooding complaints to the City, and Figure 4.24, which indicates flood prone streets and intersections. Note that Figure 4.22 illustrates that many drainage complaints have been received in areas vulnerable to riverine overbank flooding. It's possible that some property owners don't understand their riverine flood risk and attribute flooding to drainage issues.

While individual instances of stormwater flooding may affect only a very small area, localized flooding related to drainage issues has been identified throughout much of the City limits and the FMPC considers it a widespread issue.

Spatial Extent: 3 – Moderate

Figure 4.18 – Areas of Localized Flooding Complaints

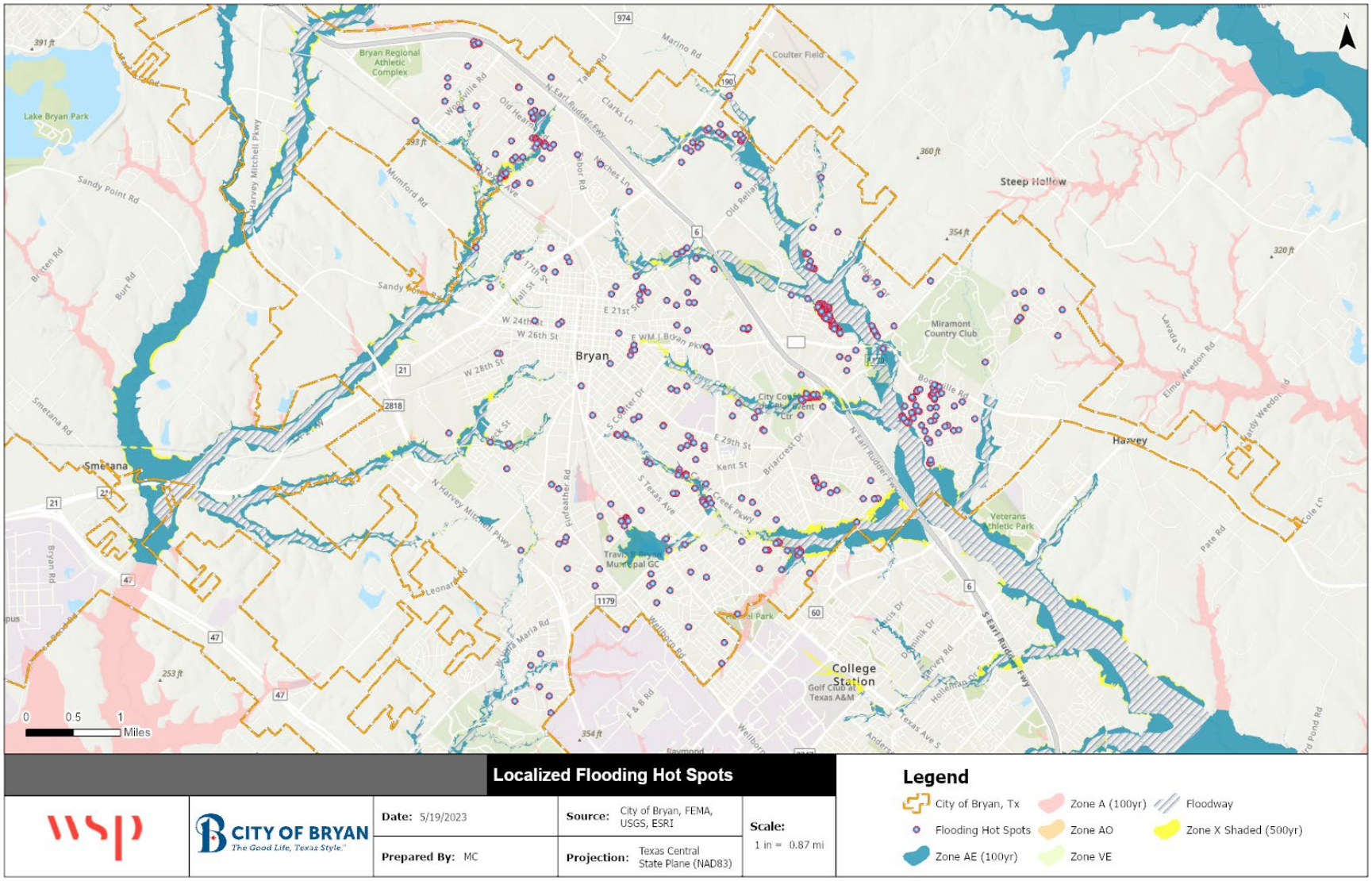


Figure 4.19 – Areas of Localized Flooding Complaints, Inset 1

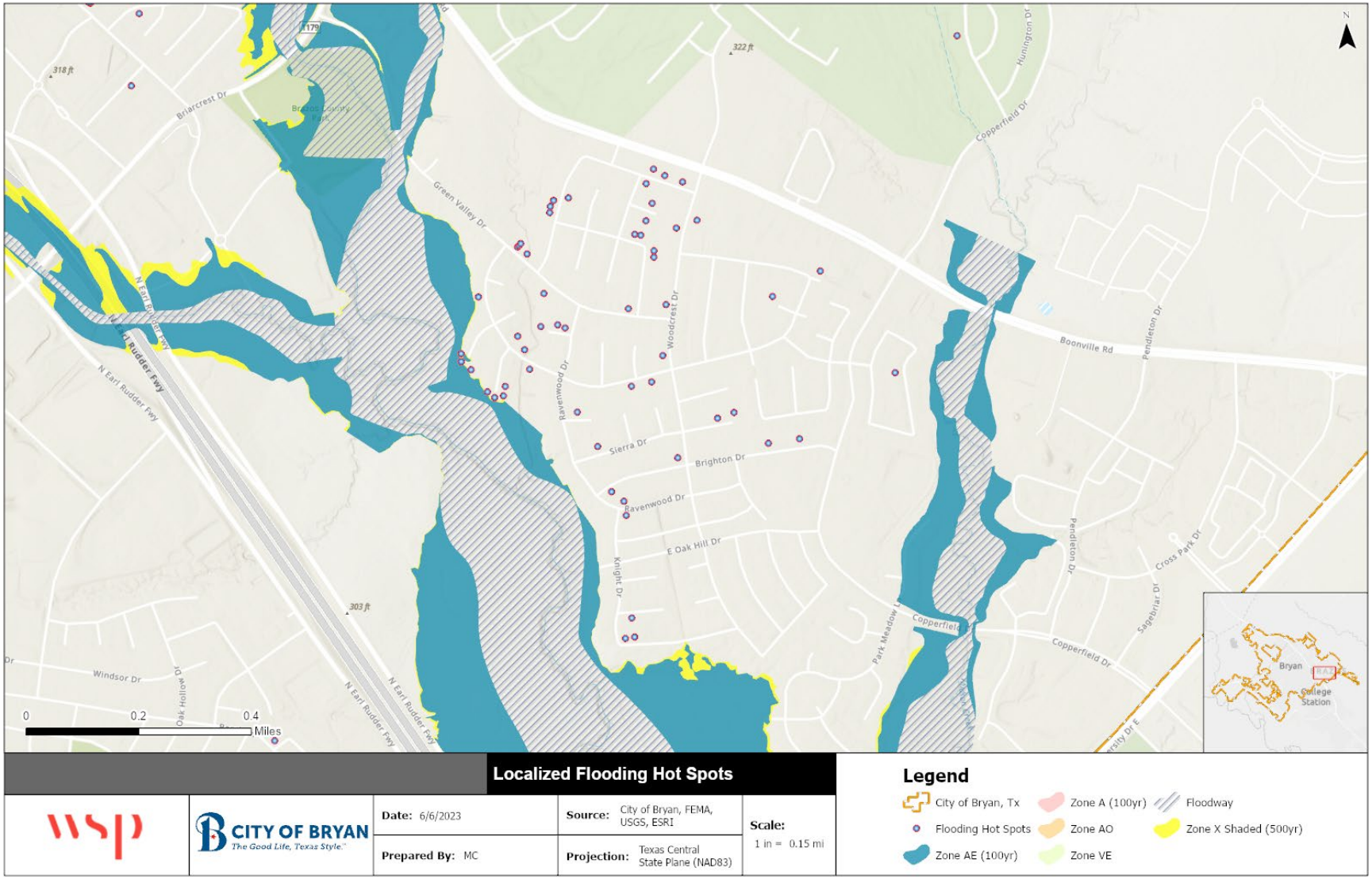


Figure 4.20 – Areas of Localized Flooding Complaints, Inset 2

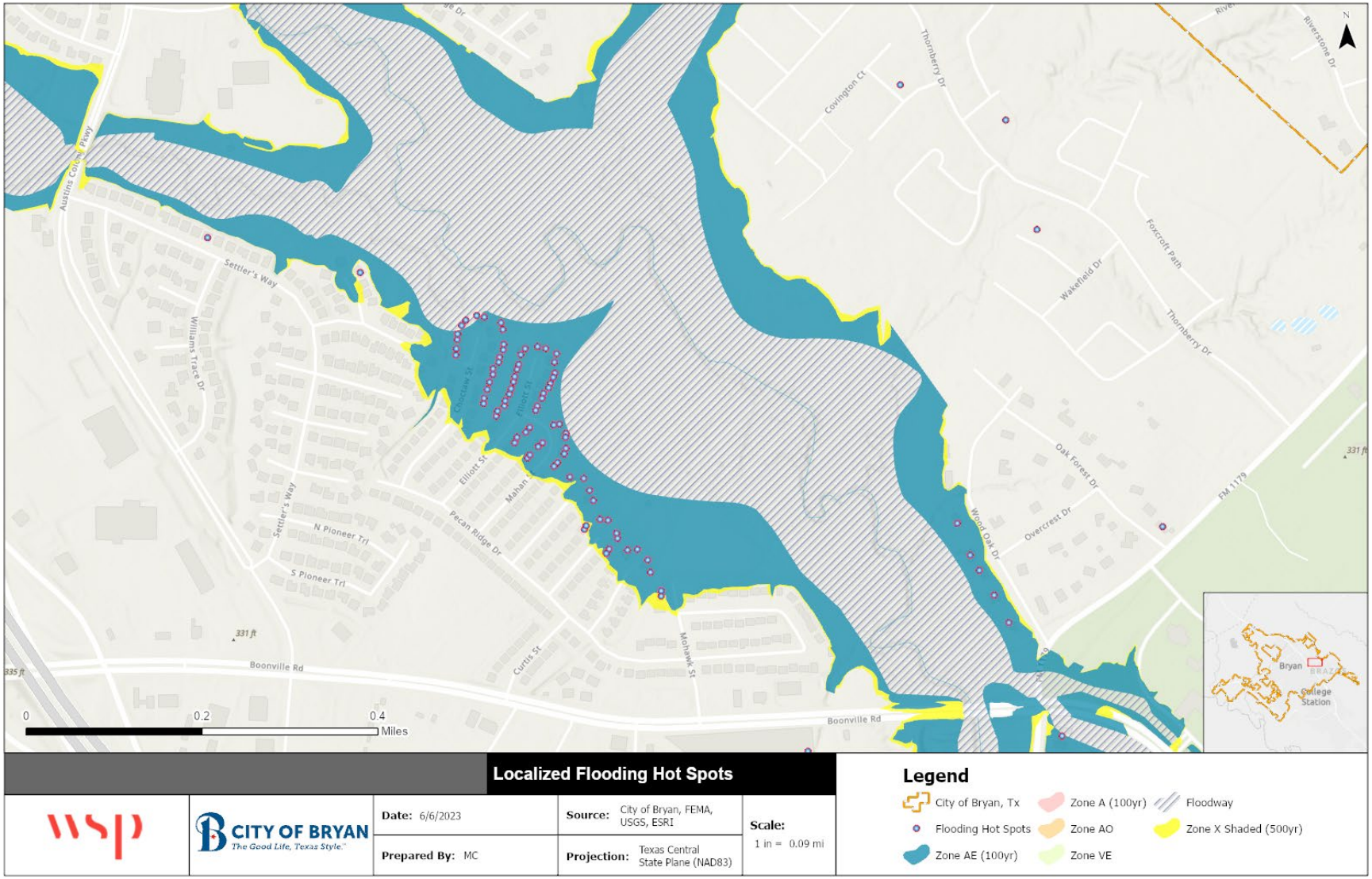


Figure 4.21 – Areas of Localized Flooding Complaints, Inset 3

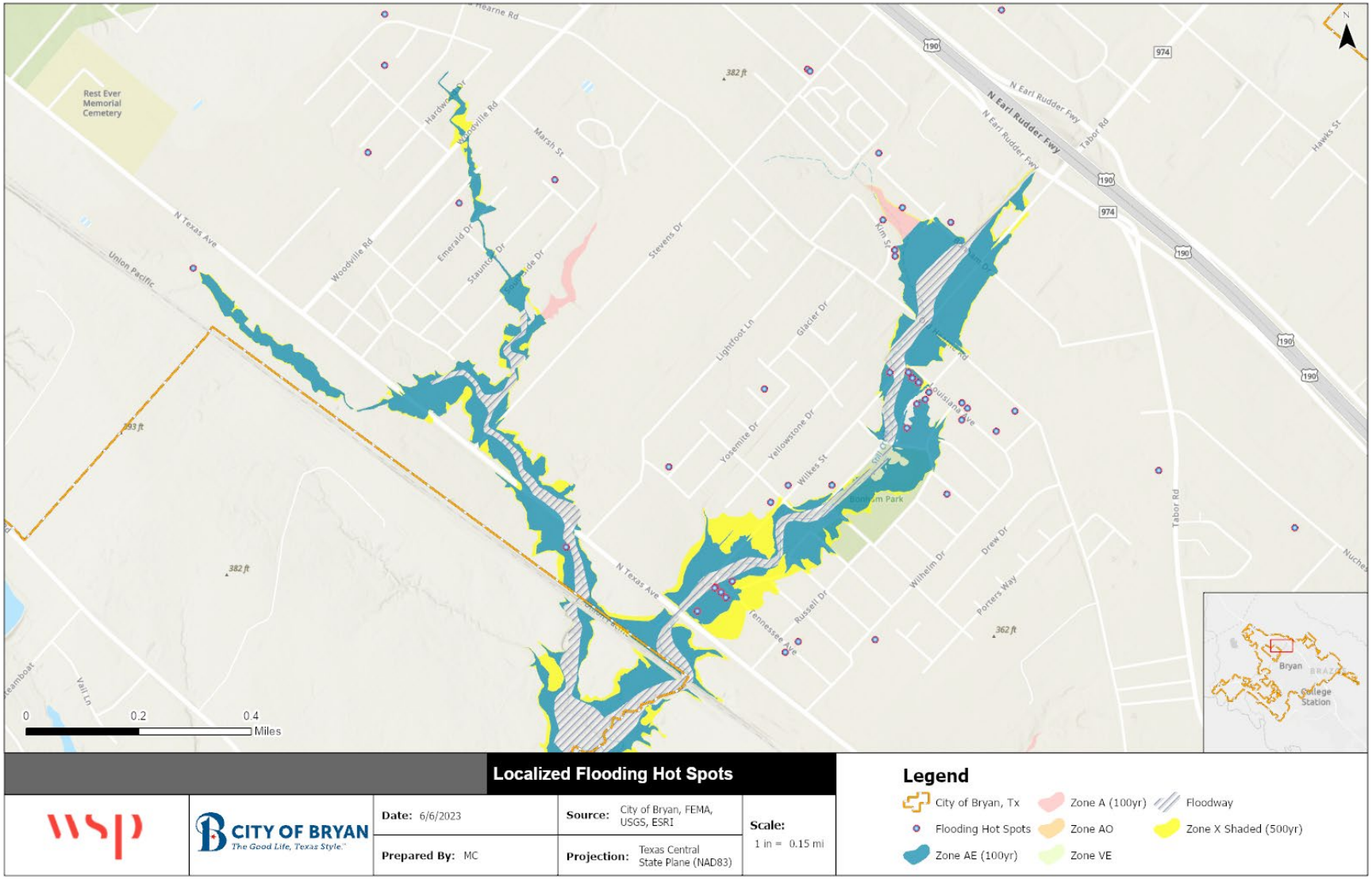
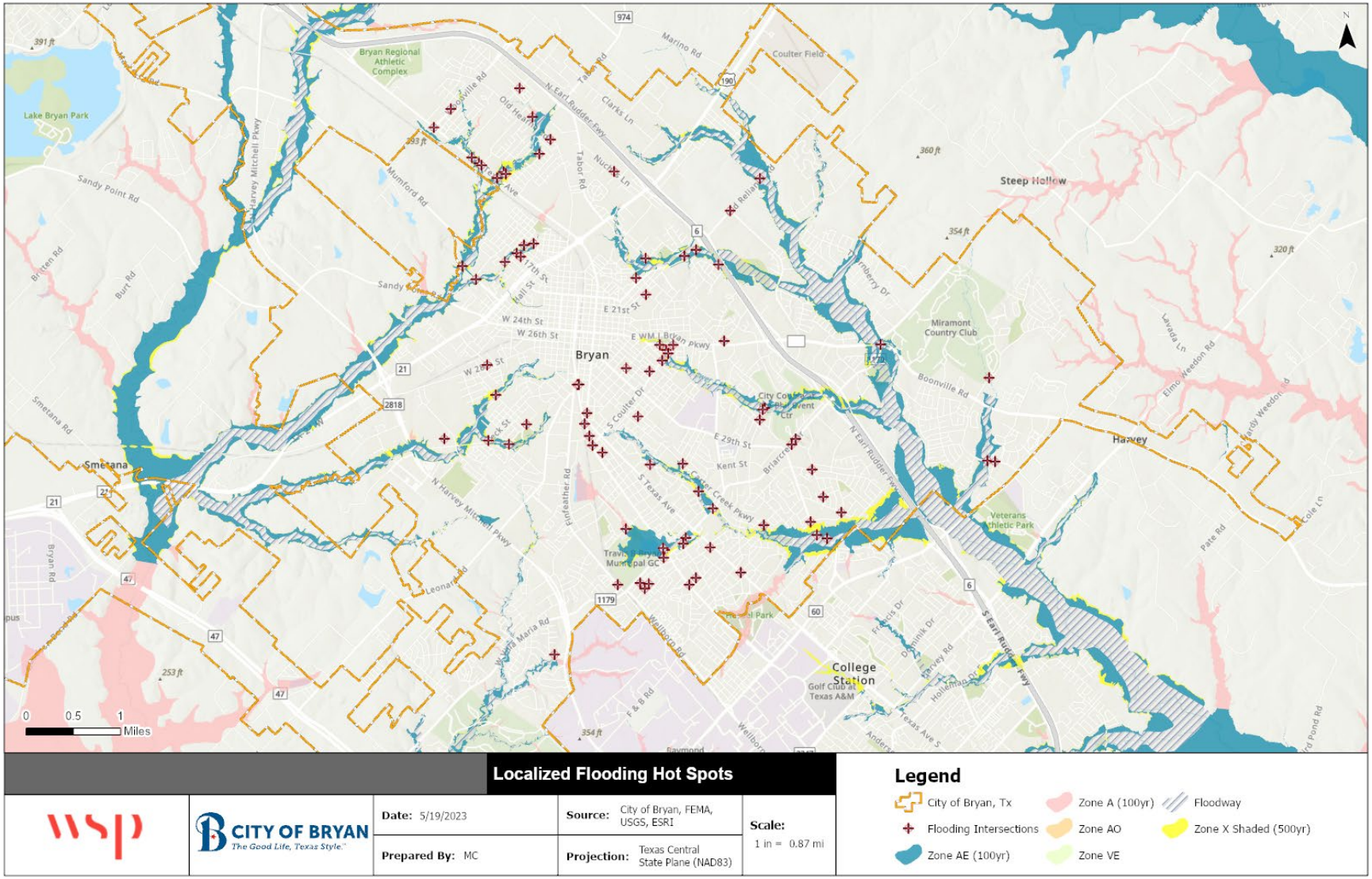


Figure 4.22 – Flood Prone Streets



Public input received through the survey noted issues with stormwater flooding at the following locations:

- Outer lanes of South College Street and Villa Maria Road
- Carter Creek Parkway near Tanglewood Drive
- Esther Boulevard and Bristol Street
- 24th Street and Sims Ave
- Old Oaks townhome complex
- East 25th Street and North Coulter Drive near Blinn College
- Vine Street
- Chelsea Circle
- Wheeler Ridge neighborhood
- Lake Street east of Cavitt Avenue
- South Rosemary Drive and Park Lane
- Colony Village Drive
- Teton Drive and Big Horn Drive
- FM 1179
- Mary Lake Drive and Lazy Lane
- Baker Avenue
- Pioneer Circle
- Oxford Street
- Highway 6 and Osborn Road
- Woodville Road and Texas Avenue
- McAshan Street, Ursuline Avenue, and Cole Street
- Highway 21
- Meadowbrook Drive
- Cherry Creek Circle
- Skrivanek Drive
- Kent Street
- Upper Burton Creek neighborhood
- Elmo Street
- Streamside Way
- Briton Dive and Bedford Court
- Valley Oaks Drive
- Rose Hill Lane
- Courtney Circle
- Thornberry Drive
- Bullinger Creek Drive
- South Hutchins Street
- Copperfield Drive
- Briarcrest Drive
- Woodville Road
- Barak Lane and Oak Hill Drive

EXTENT

The severity of flooding is generally linked to the flood depth, velocity, and how rapidly it occurs. However, unlike with the mapped floodplain, there is limited data on flood depths and recurrence intervals for localized flooding because it is highly variable based on stormwater system maintenance, development and runoff management, recent weather patterns, and each rain event. Localized flooding typically refers to smaller scale events that are less severe than riverine flooding but can present a nuisance and generate substantial losses over repeated occurrences.

Impact: 2 – Limited

PAST OCCURRENCES

Table 4.25 shows detail for the 29 flash flood events associated with localized stormwater flooding since 1996, as reported in the NCEI Storm Events Database for Brazos County.

Table 4.24 – NCEI Flash Flooding Events in Brazos County (January 1996 – December 2022)

Location	Date	Event Type	Injuries/ Deaths	Property Damage	Crop Damage
Countywide	2/20/1997	Flash Flood	0/0	$5,000	$0
North Portion	10/13/1997	Flash Flood	0/0	$5,000	$0
College Station	1/6/1998	Flash Flood	0/0	$5,000	$0
College Station	10/17/1998	Flash Flood	0/0	$5,000	$0
Countywide	10/18/1998	Flash Flood	0/0	$15,000	$0
College Station	10/18/1998	Flash Flood	0/0	$2,000	$0
Countywide	11/2/2000	Flash Flood	0/0	$1,000,000	$0
Countywide	11/3/2000	Flash Flood	0/0	$25,000	$0
Countywide	11/3/2000	Flash Flood	0/0	$25,000	$0
Countywide	9/9/2001	Flash Flood	0/0	$50,000	$0
Countywide	11/4/2002	Flash Flood	0/0	$95,000	$0
College Station	6/15/2004	Flash Flood	0/0	$55,000	$0
Bryan	6/30/2004	Flash Flood	0/0	$15,000	$0
(CLL)Easterwd Fld Co	12/15/2007	Flash Flood	0/0	$5,000	$0
Sims	4/28/2009	Flash Flood	0/0	$2,000	$0
Millican	6/9/2010	Flash Flood	0/0	$0	$0
Bryan	6/9/2010	Flash Flood	0/0	$1,000	$0
Millican	6/9/2010	Flash Flood	0/0	$0	$0
College Station	6/9/2010	Flash Flood	0/0	$0	$0
College Station	6/9/2010	Flash Flood	0/0	$0	$0
College Station	6/9/2010	Flash Flood	0/0	$0	$0
College Station	6/9/2010	Flash Flood	0/0	$0	$0
Edge	2/3/2012	Flash Flood	0/0	$2,000	$0
Wellborn	9/28/2013	Flash Flood	0/0	$0	$0
Bryan	6/25/2014	Flash Flood	0/0	$0	$0
Bryan	9/12/2014	Flash Flood	0/0	$3,000	$0
Millican	12/27/2015	Flash Flood	0/0	$0	$0
Smetana	5/26/2016	Flash Flood	0/0	$100,000	$0
Kurten	10/13/2018	Flash Flood	0/0	$0	$0
Total			**0/0**	**$1,415,000**	**$0**

Source: NCEI Storm Events Database, April 2023

The following provides details on select flood events recorded in the NCEI database. These scenarios represent the types of localized stormwater and flash flood events that can be expected in the future in the City of Bryan.

December 15, 2007 – Thunderstorms that developed along a slow-moving front produced some flash flooding and wind damage. Widespread street flooding occurred in the Bryan and College Station areas. Water was up to the doors of cars and businesses, and some vehicles were stranded.

June 9, 2010 – A slow moving upper level low pressure system over the Hill Country helped to generate numerous showers and thunderstorms that rotated around the storm center. While the heaviest and most damaging rainfall and associated flooding was in the Hill Country, some significant flooding did develop

in and around the College Station area. High water was reported in Bryan near West 28th Street and South Bryan Ave due to heavy rainfall. Flooding was also reported along Peach Creek Road, the intersection of Southwest Parkway and Welsh Avenue, Deacon Drive, Arroyo Court, King Cole Street, and Southwood Drive.

September 12, 2014 – Deep tropical moisture in combination with a slowly southward moving cold front helped to generate numerous showers and thunderstorms that produced heavy rainfall and flooding in and around the Bryan and College Station areas. A record rainfall total of 4.26 inches was recorded. Flash flooding occurred in and around the Bryan and College Station areas. Water reached up to cars near the intersection of East Villa Maria Road and Rustling Oaks Drive, and there was high water near the intersection of South College Avenue and Davis Street.

May 26, 2016 – Strong upper level disturbances combined with above average moisture levels and favorable upper level wind patterns to produce a round of severe thunderstorms that eventually trained and produced excessive rainfall and flash flood during the afternoon hours of the 26th and on into the overnight and early morning hours of the 27th. Rainfall totals of 6 to 10 inches were common with much of the rain falling in a 3 to 6 hour period.

PROBABILITY OF FUTURE OCCURRENCE

Given the 29 flash flood events recorded in NCEI over a 27-year period, there is a near 100 percent chance of occurrence within any given year. Precipitation resulting from heavy rainstorms and thunderstorms makes it highly likely that unmitigated areas will continue to experience localized flooding.

Probability: 4 – Highly Likely

CLIMATE CHANGE AND FUTURE CONDITIONS

Increased droughts followed by heavy rain, mentioned in Section 4.1.4, can create flooding conditions as water can fail to penetrate dry soils and increase risk of flash flood. New development can also affect the occurrence of localized flooding.

As green open space areas are developed, impervious surface increases, putting additional strain on existing stormwater infrastructure. Incorporating low-impact development techniques and other on-site stormwater management, and designing those systems for greater stormwater volumes, can help to mitigate the impacts of new development. Several resident comments expressed the desire that the City reduce the use of impervious paving and implement development regulations that mitigate stormwater flooding.

The risk of localized flooding to future development can also be minimized by accurate recordkeeping of repetitive localized storm activity and an evaluation of local and regional drainage issues. Mitigating the root causes of the localized flooding or choosing not to develop in areas that often are subject to localized flooding will reduce future risks of losses due to this hazard. If new development does not incorporate adequate on-site stormwater management, not only will more property be exposed due to new construction, but an associated increase in impervious surface and reduction in flood storage areas could increase the vulnerability of existing property within these watersheds. This is especially true for sub-basins where localized flooding is already noted as a problem.

VULNERABILITY ASSESSMENT

Vulnerability – Medium

PROPERTY

Localized flooding occurs at various times throughout the year with several areas of primary concern to the City. Localized flooding and ponding affect streets and property. Loss estimates for localized flooding cannot be created because the frequency and depth of localized flooding is unknown. However, all properties in an around the known localized flooding areas may be at risk of future flood damages.

4.5 RISK AND VULNERABILITY CONCLUSIONS

4.5.1 FLOOD HAZARDS PROFILE SUMMARY

Table 4.26 summarizes the results of the hazard profile for the City of Bryan based on hazard identification data and input from the FMPC. For each hazard profiled within Section 4.4, this table includes the relative risk for the City according to the results of the Priority Risk Index (PRI).

Table 4.25 – Summary of Flood Hazard Profile Results

Hazard	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Dam Failure	Possible	Limited	Negligible	Less than 6 hrs	Less than 1 week	2.1
Erosion	Likely	Limited	Negligible	12 to 24 hours	More than 1 week	2.3
Riverine Flooding	Likely	Critical	Moderate	6 to 12 hours	Less than 1 week	3.0
Stormwater/ Localized Flooding	Highly Likely	Limited	Moderate	Less than 6 hrs	Less than 24 hrs	3.1

The results from the PRI have been classified into three categories based on the assigned risk value which are summarized in Table 4.27 below:

- **Low Risk** – Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium Risk** – Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **High Risk** – Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread.

Table 4.26 – Summary of Hazard Risk Classification

High Risk (≥ 3.0)	Stormwater/Localized Flooding Riverine Flooding
Medium Risk (2.0 – 2.9)	Erosion Dam Failure
Low Risk (< 2.0)	*none*

4.5.2 ASSESSMENT OF AREAS LIKELY TO FLOOD

The following targeted areas are identified as areas likely to flood in the future.

SFHAS AND 0.2%-ANNUAL-CHANCE FLOODPLAINS

Approximately 11% of the City of Bryan falls within the 1-percent-annual-chance floodplain and only 0.9% located in the 0.2%-annual-chance floodplain. Regardless, the SFHA and the moderate-risk 0.2%-annual-chance floodplain are likely to continue flooding in the future. Changes in floodplain development and future development within the watershed in general as well as climate change-driven changes in rainfall probabilities and intensities may increase the size of the SFHAs in the future. See Section 4.4.3 and Figure 4.8 for a description and map of the SFHA and 0.2 percent annual chance floodplain.

AREAS OF LOCALIZED STORMWATER FLOODING

It is highly likely that underperforming drainage infrastructure and unmitigated properties will continue to experience localized flooding problems. An increase in impervious area due to future development in the drainage basins where localized flooding is already a noted problem could exacerbate existing localizing flooding issues. Increases in future flooding and new areas of localized flooding may arise if additional development and increases in impervious surface occur without measures taken to reduce the volume of runoff. See Section 4.4.4 and Figure 4.18 for a description and map of localized flooding hotspots throughout the City.

The City has several Capital Improvement Program (CIP) projects currently funded that are related to drainage, including Still Creek culvert replacements, Bristol Street & Esther Boulevard drainage improvements, Hillside Oaks and Old Oaks drainage improvements, Wayside and Carter Creek storm sewer rehabilitation, and floodplain modeling of Briar Creek. The City maintains a database of CIP projects that are evaluated every two years for implementation through the next five-year plan; additional drainage projects will continue to be identified and implemented through this process.

REPETITIVE LOSS AREAS

It is very likely that unmitigated repetitive loss properties will continue to flood in the future. Repetitive loss properties have a greater need for flood protection. Repetitive loss can be attributed to development within the SFHA as well as localized stormwater flooding. As mentioned above, riverine flooding and localized stormwater flooding could increase in the future if measures are not taken to mitigate the effects of development.

REPETITIVE LOSS ANALYSIS

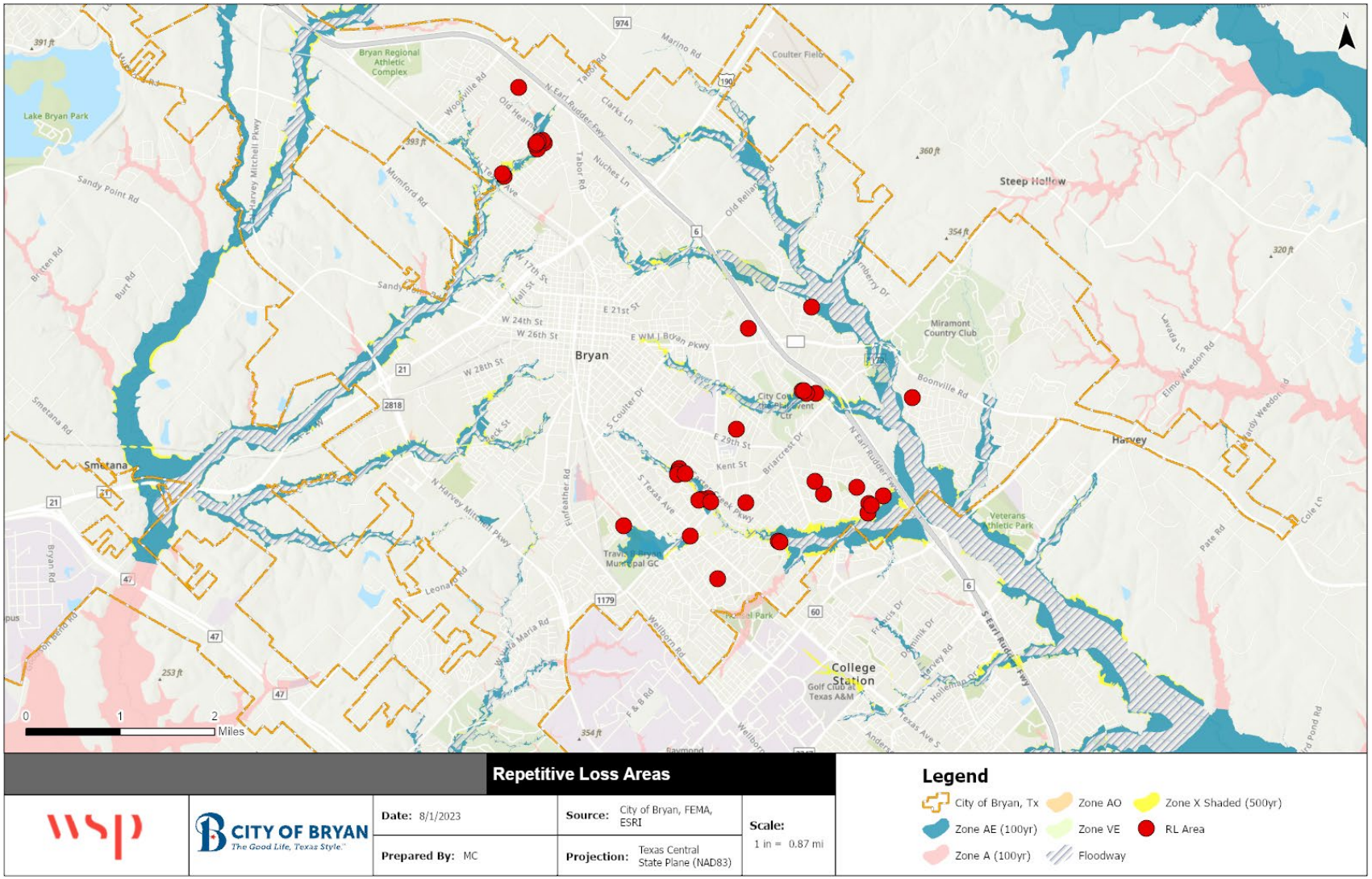
A repetitive loss property is a property for which two or more flood insurance claims of more than $1,000 have been paid by the NFIP within any 10-year period since 1978. An analysis of repetitive loss was completed to examine repetitive loss properties against FEMA flood zones.

According to July 2023 NFIP records, there are a total of 38 unmitigated repetitive loss properties within the City of Bryan. Of these properties, 95% are residential and 5% are non-residential.

REPETITIVE LOSS AREA MAPPING

The NFIP list of unmitigated repetitive loss properties is not a complete list of properties at risk to repeat flood events, as there are likely other properties that have not filed flood insurance claims but that have flood conditions similar to those on the repetitive loss list. The FMPC identified repetitive loss areas in Bryan in accordance with the principles outlined in the CRS guidance titled Mapping Repetitive Loss Areas dated August 15, 2008. To define repetitive loss areas, the FMPC mapped the above list of FEMA-identified repetitive loss properties along with historical claim properties (those with one claim paid against the NFIP) and identified additional surrounding properties with similar flood conditions. The resulting repetitive loss areas are shown in Figure 4.19 in relation to FEMA flood hazard areas.

Figure 4.23 – Overview of Repetitive Loss Areas



Source: City of Bryan, July 2023 NFIP Repetitive Loss data

4.5.3 IMPACT OF FUTURE FLOODING

Changes in floodplain development, development in the Thompsons Creek, Bee Creek-Carters Creek, or Carrington Creek-Old River watersheds, and changes associated with climate change could make future flood problems worse in the above identified areas that are likely to flood.

CHANGES IN FLOODPLAIN DEVELOPMENT

New development or redevelopment, if it occurs in or near the SFHA or localized flooding areas, could increase exposure of people and property to flood impacts.

To evaluate the potential for new development in the SFHA, unimproved parcels (those that are vacant, have no building footprint, or have no improved value) were compared with the SFHA and the City's future land use. There are approximately 1,750 parcels with 2,183 acres of unimproved area within SFHA in Bryan; 21% of that acreage is in Zone A and 79% is in Zone AE. Within Zone AE, most of the unimproved acreage is planned for low density residential, light industrial, and retail uses. Within Zone A, most unimproved acreage is planned for residential estate and Western Gateway uses.

Low density residential use and residential estate uses are likely to maintain larger areas of pervious surface and green space, which could minimize potential increases in flooding and associated impacts on existing development. Cluster development, stream buffers, and other growth management techniques could be used in these areas to minimize the exposure of the new development. Without preventive mitigation, exposure to flood risk within the SFHA could increase in the future.

The City has several regulatory tools in place, including the City of Bryan Stormwater Design Guidelines, which help City staff minimize the potential for new development in the floodplain.

Table 4.27 – Future Land Use of Unimproved Parcels in the SFHA

Future Land Use	Zone AE		Zone A	
	Parcel Count	Total Acreage	Parcel Count	Total Acreage
Central Urban Area	13	0.5	0	0
Commercial	78	141.0	9	28.9
High Density Residential	24	40.5	12	28.4
Light Industrial	68	252.2	0	0
Low Density Residential	816	751.6	60	47.6
Medium Density Residential	66	39.2	0	0
Mixed Use	89	11.7	2	0.2
Neighborhood Center	27	16.2	0	0
Office	11	5.9	0	0
Parks and Open Space	109	76.5	10	2.9
Public/Semi-Public	60	40.8	2	26.1
Regional Retail	63	82.9	2	0.1
Residential Estate	37	9.8	4	206.3
Retail	99	175.7	7	9.2
South College Corridor	10	2.9	0	0.0
Texas Avenue Corridor	16	1.6	8	3.4
Western Gateway	14	75.6	33	104.9
Total	**1,600**	**1,724.5**	**149**	**458.0**

CHANGES IN THE WATERSHED

Changes in the watershed, particularly an increase in impervious area, could make these identified areas even more likely to flood in the future. As noted in Section 3.9.1, the City's current zoning reflects that over 7,600 acres (22% of the City) is zoned for planned development. Future land use designations in these

areas include primarily low density residential, light industrial, and parks and public facilities. Lower densities may minimize the potential for increases in runoff.

In developing the asset inventory, City staff identified 528 parcels where new residential development is planned to occur but there is no building yet. All of these buildings are located outside of the SFHA; one of these planned buildings is located in the Shaded Zone X and the remainder are in the Unshaded Zone X.

Figure 4.24 shows the location of these planned developments, which are dispersed across both the Lower Brazos River and the Navasota River watersheds, within with the City of Bryan is located. No single watershed is experiencing the brunt of new development.

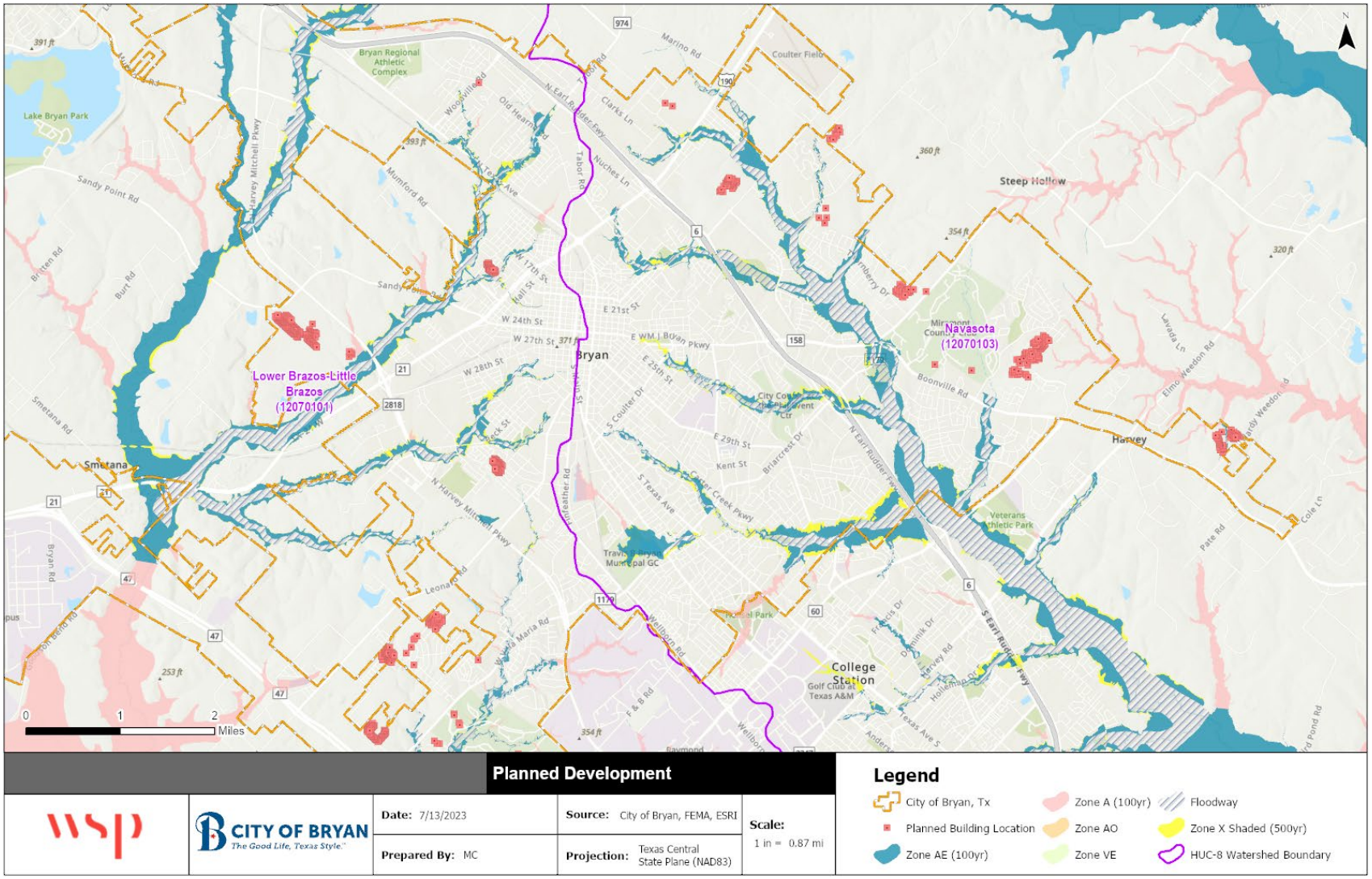
The City's Stormwater Design Guidelines allow City staff to regulate development both in and out of the floodplain in an effort to protect the watersheds. Within these watersheds there are requirements for detention to mitigate new development increased impervious cover within the watersheds. As long as these rules are in place, development in the watershed should be controlling their increased runoff to pre-existing levels and not adversely affect the flood prone areas.

CLIMATE CHANGE

As discussed in Section 4.1.4, climate change is expected to cause an increase in the frequency and intensity of heavy precipitation events as well as more rapid swings from extreme drought to heavy rainfall and flooding. Future flood conditions in all identified areas would be impacted by these changes, as intense rainfall after periods of severe drought may result in greater runoff volumes which could overwhelm natural channels and floodplains as well as stormwater drainage systems.

While individual weather events cannot be attributed to climate change, there have been numerous record-breaking rainfall events in the Lower Brazos region within the last several years, which could be indicative of a trend. For example, the as noted in the Lower Brazos Regional Flood Plan, Memorial Day floods of 2015 saw the Brazos River reach its third-highest stage near Hempstead, south of Bryan, since flood control reservoirs were implemented in the upper watershed. In the following spring of 2016, widespread heavy rainfall occurred and 17 inches of rain in 24 hours was measured in Brenham, southwest of Bryan. This rainfall translated to river stages on the Brazos near Hempstead that had not been seen since the flood of 1913. The following year, rainfall and flooding associated with Hurricane Harvey broke those records again. Flood insurance claims associated with these three events are among the top five events on record for the Lower Brazos watershed.

Figure 4.24 – Planned Residential Development



4.5.4 HEALTH & SAFETY CONSEQUENCE ANALYSIS

Flooding poses a significant risk to life and safety, including the threat of injury or drowning during a flood event as well as numerous health risks during and after an event.

PUBLIC HEALTH

In addition to the threat to life safety that people face during flood events, certain health hazards are also common. While such problems are often not reported, the following general types of health hazards may arise during and after floods:

- Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt; oil; human and livestock waste; household, medical, and industrial hazardous waste; coal ash waste that can contain carcinogenic compounds; or lawn, farm and industrial chemicals. Pastures and areas where farm animals are kept or their wastes are stored can contribute polluted waters to the receiving streams.
- Flood-borne debris, including lumber, vehicles, or smaller sharp objects such as glass or metal fragments, can cause injury and subsequent infection. Debris can also present the risk of tetanus.
- Floodwaters saturate the ground, which leads to infiltration into sanitary sewer lines. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as e.coli and other disease causing agents. Waterborne diseases of concern include Norovirus, Rotavirus, Hepatitis A and E, Cholera, and Typhoid. These diseases typically pose an acute risk of outbreak, occurring within 0-7 days.
- Stagnant pools can become breeding grounds for mosquitoes and other disease vectors. Vector-borne diseases of concern include Yellow fever, West Nile Fever, and Dengue. Vector-borne diseases pose a long-term risk of greater than four weeks.
- Floodwaters can also displace insects, rodents, snakes, and other animals, potentially bringing them into contact with people. Animals can spread disease and can bite people and pets. They may also cause asthma or allergic reactions in some people. Rodent-borne disease outbreaks pose a mid-term risk of 1-4 weeks.
- Wet areas of a building that have not been properly cleaned breed mold and mildew. Mold and mildew can pose a severe a health hazard, especially for small children and the elderly.
- Building utilities can harbor health hazards if not properly cleaned. When a furnace or air conditioner is turned on after a flood, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If the City water system loses pressure, a boil order may be issued to protect people and animals from contaminated water.
- Flooding can affect mental health due to trauma or stress. People can experience a long-term psychological impact of having been through a flood and seen their home damaged and personal belongings destroyed. The cost and labor needed to repair a flood-damaged home puts a severe strain on people, especially the unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.
- Overcrowding in shelters can lead to possible disease outbreaks. Respiratory diseases of concern include Influenza, RSV, and COVID-19. Respiratory diseases pose an acute risk of outbreak, typically occurring within 0-7 days.

Brazos County Health District undertakes the following activities before, during, and after floods to minimize public health impacts:

- Vector control programs in flood prone areas.

- Vaccination programs for preventable diseases in areas susceptible to and other natural disasters
- Rapid risk assessment and data collection to identify interventions needed.
- Designation of evacuation sites for healthcare facilities and affected long-term care facilities.
- Provision of shelters, nutrition, water, hygiene, and sanitation facilities.
- Provision of disease prevention and control measures including insecticide sprays and repellents, masks, hand sanitizers.
- Protective clothing against insect bites.

LIFE SAFETY

Flood waters may prevent access to areas in need of response or to the critical facilities themselves which may prolong response time. The public must understand that they should never drive through flooded streets. The Centers for Disease Control and Prevention report that over half of flood-related drownings occur when a vehicle is driven into flood water, and the next highest percentage of deaths is due to people walking into or near flood waters. The National Weather Service warns that just 6 inches of fast-moving flood water can knock down an adult, 12 inches can carry away a small car, and 2 feet can carry away most vehicles. When someone drives through floodwaters, they put their life and the lives of first responders at risk. First responders are at risk when attempting to rescue people from floodwaters. They are subject to the same hazards as the public and are more likely to be exposed to these hazards during response efforts.

Residential, commercial, and public buildings, as well as critical infrastructure such as transportation, water, energy, and communication systems may be damaged or destroyed by flood waters. Floods can severely disrupt normal operations, especially when there is a loss of power. This can affect the operations of critical facilities, which affects response times. Loss of power also puts the public at risk. Downed power lines pose a serious hazard and should always be treated as if they are still energized. When a building loses power during a flood, electricity should be turned off and not used until the wiring can be inspected, to avoid risk of electrocution or fire. Damage to electrical equipment can also result from exposure to flood waters contaminated with chemicals, sewage, oil, and other debris.

WARNING AND EVACUATION

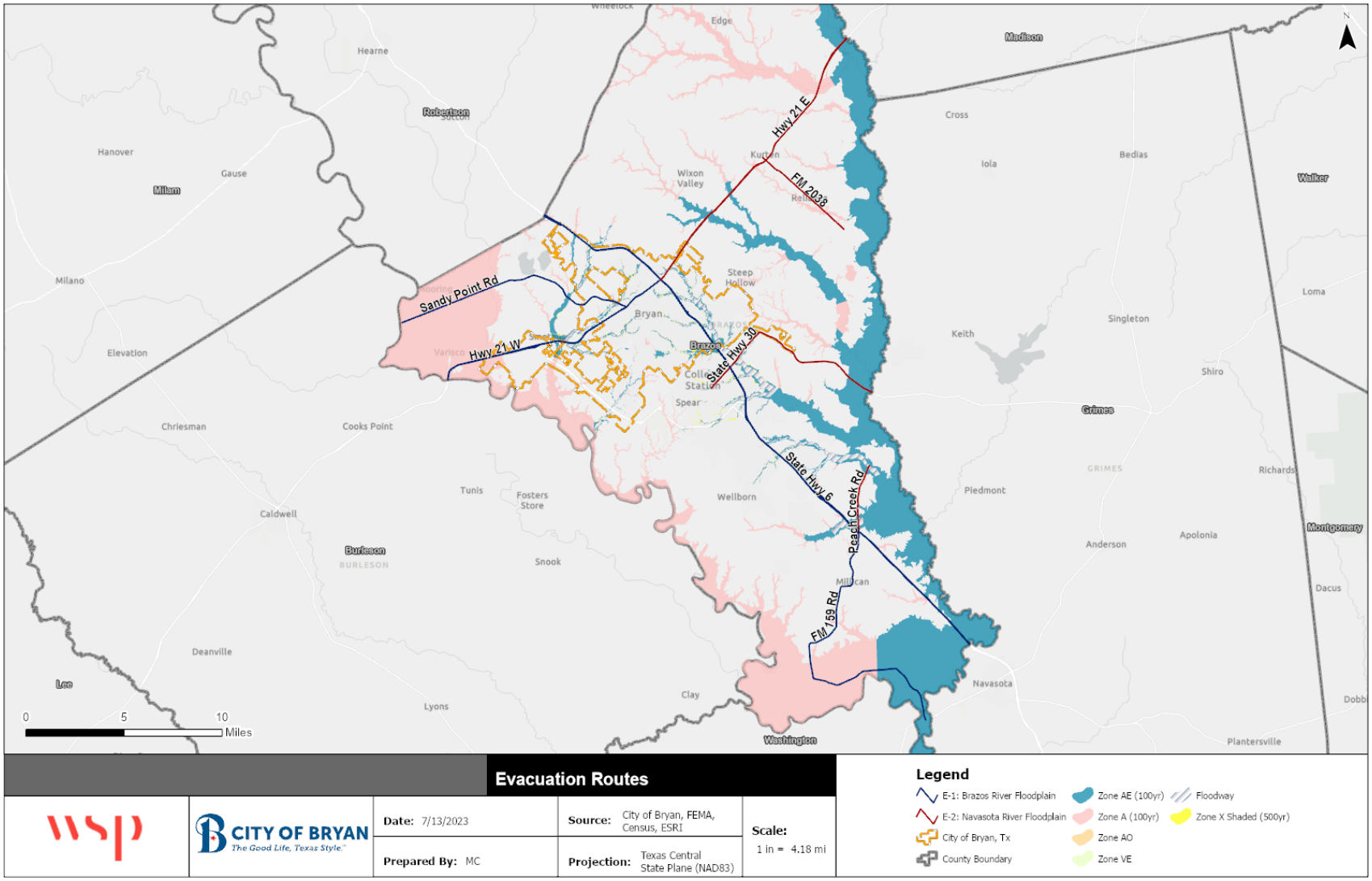
Bryan coordinates with Brazos County Emergency Management and the National Weather Service in issuing public warnings concerning expected floods and storms. The Brazos County Emergency Management Plan includes a Warning Annex to coordinate procedures and operations for emergency warnings. Warnings are provided to the public via the Emergency Alert System, route alerting and door-to-door warning, NOAA weather radios, cable television interruption, and CodeRed emergency telephone and information systems warnings. Methods are also prepared for warning special populations, including visually impaired, hearing impaired, and non-English speaking populations as well as special facilities.

Brazos County Emergency Management plans for and coordinates evacuation as needed for the City of Bryan. The County Emergency Management Plan includes an Evacuation Annex, which identifies the potential need for limited evacuation of specific geographic areas during localized flash flooding or large-scale evacuation in the event of extensive flooding. Brazos County is not in a hurricane evacuation zone. The plan includes two potential evacuation areas for flooding, including evacuation routes for each area, listed in Table 4.28. These routes are shown in relation to all of Brazos County and the mapped floodplain in Figure 4.25.

Table 4.28 – Evacuation Routes

Route Name	Description	Estimated Population	Estimated Evacuation Time	Evacuation Routes
E-1	Brazos River Floodplain	1,905	2.5 hours	Sandy Point Rd, Hwy 21, F.M. 159, Hwy 6
E-2	Navasota River Floodplain	646	2.5 hours	F.M. 2038, Peach Creek Rd, Hwy 21, Hwy 30

Figure 4.25 – Evacuation Routes



5 CAPABILITY ASSESSMENT

This section provides a summary of the City of Bryan's capability to implement flood mitigation projects and reduce flood hazard risk. The assessment reviews existing mitigation activities, policies, regulations, and plans that pertain to mitigation and can affect net vulnerability as well as administrative, technical and fiscal resources that may support mitigation project implementation. This section comprises the following subsections:

- 5.1 Regulatory Mitigation Capabilities
- 5.2 Administrative and Technical Mitigation Capabilities
- 5.3 Fiscal Mitigation Capabilities
- 5.4 Education and Outreach Capabilities

5.1 REGULATORY MITIGATION CAPABILITIES

Table 5.1 lists regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the City of Bryan. Additional details on key identified regulatory tools are provided below.

Table 5.1 – Regulatory Mitigation Capabilities

Regulatory Tool (ordinances, codes, plans)	In Place? Y/N	Comments
Comprehensive Plan	Y	Blueprint 2040 City of Bryan 2016 Comprehensive Plan
Land Use Plan	Y	Existing and future land use are included in the comprehensive plan.
Zoning ordinance	Y	City of Bryan Comprehensive Zoning Ordinance (Ch 130)
Subdivision ordinance	Y	City of Bryan Subdivision Ordinance (Ch 110)
Floodplain ordinance	Y	Updated in 2021; aligns with the model ordinance; includes some higher standards
Erosion, Sedimentation and Pollution Control ordinance	Y	City of Bryan Subdivision Ordinance (Ch 110) City of Bryan Stormwater Management Ordinance (Ch 46)
Other special purpose ordinance (stormwater, growth management, wildfire)	Y	City of Bryan Stormwater Management Ordinance (Ch 46)
Building code	Y	IBC 2021
Fire Department ISO rating	Y	Class 1
BCEGS rating	Y	3/3
Stormwater Management Program	Y	2020 Stormwater Master Plan; 2020 Unified Stormwater Design Guidelines, Drainage Utility Fee
Site Plan Review Requirements	Y	City of Bryan Land & Site Development Ordinance (Ch 62)
Capital Improvements Plan	Y	5-Year plan, also includes unfunded projects
Economic Development Plan	N	No plan, but the City has an Economic Development Director who chairs the Bryan Business Council with membership from local businesses
Local Emergency Operations Plan	Y	Brazos County Emergency Management Plan, 2019

Regulatory Tool (ordinances, codes, plans)	In Place? Y/N	Comments
Flood Insurance Study or Other Engineering Study for Streams	Y	Have completed studies for most creeks in the city limits. Additional studies underway and/or planned for future growth areas
Other special plans (i.e. Repetitive Loss Plan)	Y	Briar and Burton Creeks Erosion Master Plan, 2019
Elevation certificates	Y	Copies of all final ECs are maintained and available through Open Record requests

Below is a summary of key regulatory tools in place in Bryan that already provide for flood risk reduction and/or could support the implementation of additional flood mitigation activities.

COMPREHENSIVE PLAN

The City of Bryan Comprehensive Plan, "Blueprint 2040," was developed in 2016. The plan identifies 21 goals across 8 topic areas as well as 13 priority actions to help meet those goals. Several of the identified priority actions can be linked to flood mitigation, including the following:

- Target infrastructure improvements along South College Avenue and Texas Avenue to increase their attractiveness and desirability to businesses and customers.
- Investigate maintenance programs and encourage the replacement of dilapidated manufactured homes with site built homes.
- Explore future trail linkages through utility easements, Right of Ways, and creek corridors to connect existing and future parks, schools, Downtown Bryan, and retail as the City develops.
- Seek the acquisition of land as permanent open space designated for minimal development to be preserved for future generations.
- Reference and implement the improvements identified in the recently updated water, wastewater, and stormwater utility plans.

In addition to these specific actions, the plan outlines future land use categories and development guidelines and provides a future land use map to guide future development and zoning decisions throughout the City. Guidelines for the Parks & Open Space category indicate that 100-year floodplain areas should be considered for conservation purposes where possible. This supports mitigation by reducing the potential for development within high-risk areas.

The Comprehensive Plan was reviewed for the development of this FMP to identify opportunities for plan integration and mitigation measures.

LAND & SITE DEVELOPMENT ORDINANCE

The Land & Site Development Ordinance, found in Chapter 62 of the Code of Ordinances, establishes standards for residential and non-residential development, site development, building setbacks and lots, encroachments, access, landscaping, and building design. Included with these standards are requirements for site development plans and plan review. These requirements help the City to enforce development standards, including development-related mitigation, such as setbacks, erosion and sedimentation control, stormwater control, site grading, driveway elevation and grading, and foundation design.

FLOODPLAIN MANAGEMENT REGULATIONS

The City of Bryan's Floodplain Management Regulations are part of the Stormwater Management Ordinance, found in Chapter 46 of the Code of Ordinances. The City has been a participant in the NFIP since 1986 and has amended the floodplain management regulations several times, most recently in 2021.

In addition to meeting the NFIP's minimum standards, the City's floodplain management regulations include the following higher regulatory standards:

- One foot of freeboard is required in the SFHA for residential building elevation and non-residential building elevation or floodproofing.
- Two feet of freeboard is required for manufactured homes in the SFHA.
- The definition for substantial damage includes a cumulative substantial damage threshold by including properties that meet the definition of a repetitive loss property.
- Critical facilities are discouraged in the SFHA and the 0.2 percent annual chance floodplain. If built in the SFHA due to no other alternative, they must be elevated three feet above the base flood elevation (BFE) with access elevated to or above the BFE.

The City's floodplain management regulations were reviewed for the development of this FMP to assist in the identification of potential mitigations strategies and projects.

CAPITAL IMPROVEMENTS PROGRAM

The City of Bryan maintains a 5-Year Capital Improvements Program (CIP) which involves identification, management, and implementation of CIP projects to balance infrastructure demand with funding availability. Drainage projects are a major component of the CIP and are regularly identified and implemented through this process. Current CIP projects include Still Creek culvert replacements, Bristol Street & Esther Boulevard drainage improvements, Hillside Oaks and Old Oaks drainage improvements, Wayside and Carter Creek storm sewer rehabilitation, and floodplain modeling of Briar Creek.

The City maintains a database of CIP projects that are evaluated every two years for implementation through the next five-year plan. Additional drainage projects will continue to be identified and implemented through this process.

The city routinely issues debt in the form of bonds and certificates of obligation to pay for CIPs over a 20- or 25-year period. Certificates of obligation use a portion of the taxes collected by the city to pay the debt each year. Projects typically funded in this fashion are new city facilities, such as fire stations, and major road extensions or improvements. Drainage projects are typically funded through the City's Drainage Fee or through the Transportation Fee or the general fund.

FLOOD INSURANCE STUDY (2014)

A Flood Insurance Study (FIS) dated April 2014 was prepared by FEMA for Brazos County, Texas and Incorporated Areas which includes the City of Bryan. The FIS and associated Flood Insurance Rate Maps (FIRMs) identify areas within Bryan that are subject to flooding from the 1%-annual-chance flood event. This information is used by Bryan to implement floodplain regulations as part of participation in the NFIP and to promote sound land use and floodplain development within the community. The FIS was used in the development of this FMP to identify FEMA flood hazard areas and to calculate the associated flood depths for the 1%-annual-chance flood event.

INTERNATIONAL BUILDING CODE (2021)

The City of Bryan enforces the 2021 version of the International Building Code. Adopting new codes helps maintain or improve the City's Insurance Services Office (ISO) rating and National Flood Protection Association (NFPA) rating. Other benefits include options for the latest technology, additional energy cost savings, and adding the latest safety requirements to our built environment. The City also implements a robust inspection program for both residential and commercial construction to ensure that construction proceeds according to submitted and approved development plans and meets all current and applicable laws, ordinances, regulations, and building codes.

BRAZOS COUNTY HAZARD MITIGATION PLAN (2019)

The City of Bryan adopted the 2019 Brazos County Hazard Mitigation Plan (HMP), which is a multi-jurisdictional, multi-hazard mitigation plan. The HMP includes floods and dam failures among its identified hazards. Goals from the HMP are as follows:

1. Develop new, and upgrade existing capabilities for identifying the need for and implementing hazard mitigation activities.
2. Generate support for and increase public awareness of the need for hazard mitigation.
3. Increase awareness of public officials, community and business leaders of the need for hazard mitigation, and support actions to protect public health and safety.
4. Promote resource-sharing and increase coordination and cooperation among governmental entities in conducting hazard mitigation activities.
5. Mitigate damage to and losses of new and existing real property.
6. Promote sustainable growth.

The plan identifies several flood-related mitigation actions for the City of Bryan, including modeling flood risk, mapping low water crossings, performing detailed studies of areas prone to flooding, acquiring or elevating repetitive loss properties, and replacing drainage culverts.

The Brazos County HMP was used in the development of this FMP to evaluate hazard risk and vulnerability, review and update the plan goals, and identify potential mitigations strategies and projects.

REGION 8 LOWER BRAZOS REGIONAL FLOOD PLAN (2023)

The Region 8 Lower Brazos Regional Flood Plan is the result of the regional and state flood planning process established by the Texas Legislature in 2019 through Senate Bill 8, which created 15 regional flood planning groups to represent and plan for the major river basins in Texas. Bryan is located in the Lower Brazos watershed and as such is a stakeholder in the Region 8 planning effort, which encompasses all or part of 43 counties and 193 municipalities. The plan's development was led by the Lower Brazos Regional Flood Planning Group, which comprises 12 voting members and 10 non-voting members to represent the region. The plan also involved extensive public outreach and participation.

The plan includes an assessment of existing and future flood exposure, goals for managing and preventing flood risk within the region, the identification, evaluation, and recommendation of flood management and mitigation actions, estimated impacts of those actions, and a financing analysis for flood infrastructure. The plan recommends a variety of evaluations, strategies, and projects, including the following:

- Drainage master plans
- Feasibility assessments and preliminary engineering
- Erosion control
- Early flood warning systems
- Structural and non-structural protection for flood infrastructure and critical facilities
- Property acquisition and structural elevation
- Regional channel improvements
- Regional detention
- Structural improvements to bridges, culverts, and other infrastructure at low water crossings

5.1.1 POST-DISASTER MITIGATION POLICIES AND PROCEDURES

Brazos County Emergency Management is responsible for post-disaster response and recovery in Bryan. The 2018 Brazos County Emergency Management Plan establishes policies and procedures for post-disaster mitigation in Annex P Hazard Mitigation. Annex P outlines the concept of operations and the organization and assignment of responsibilities related to hazard mitigation.

Relevant policies and procedures from the 2018 Brazos County Emergency Management Plan Annex P Hazard Mitigation are as follows:

A. General

1. This annex is not intended to describe in detail all aspects of our mitigation program, The achievement of hazard mitigation objectives is a high governmental priority, and all departments will seek out and implement risk reduction measures.

2. The Hazard Mitigation Coordinators (HMCs) are responsible for the coordination of all mitigation activities of their respective jurisdiction. To achieve mitigation objectives, the HMC(s) will be assisted by a HMT composed of public and private sector partners that represent the local population.

3. The data collection process described in this annex provides a systematic means to identify hazards and assess their impact on this jurisdiction and will facilitate the development and maintenance of our local Hazard Analysis by the HMT.

4. The "Notice of Interest and Hazard Mitigation Team Report" (Appendix 3 to this annex) provides a means to develop a multi-disciplined, on-going mitigation planning and implementation process and facilitates the development and maintenance of our Mitigation Action Plan by the HMT. It also facilitates the development, and expedited submission of applications for mitigation grants to implement mitigation projects.

5. Consistent with capabilities, the Texas Division of Emergency Management (TDEM) and the State HMT will provide coordination, technical assistance, and guidance to help us achieve effective risk reduction objectives.

6. Our mitigation planning and implementation process is intended to facilitate the identification and implementation of appropriate mitigation actions. This process, in turn, facilitates the development of a joint federal, state, and local government partnership dedicated to the achievement of effective risk reduction objectives.

7. Consistent with capabilities, the HMC(s) and members of the HMT will participate in appropriate training and exercises related to their hazard mitigation responsibilities.

8. Consistent with capabilities, we will utilize the most current information and guidance provided by TDEM to include web-based assistance available.

B. Overview of Mitigation Process

Hazard mitigation is an on-going process that begins with the establishment of a local based planning group referred to as the local HMT. The team's first job is development of the local Hazard Analysis that provides a means for prioritizing mitigation and preparedness needs based on levels of vulnerability and risk. The next step in the process is the development of our Mitigation Action Plan that defines specific mitigation measures designed to address the needs identified in the hazard analysis, to include actions that are to be taken, who will take them, how much they will cost, and how they will be funded. The third step is to implement the measures identified in the Mitigation Action Plan using a variety of funding sources identified through an on-going and active search for funding opportunities. The final step is to monitor and evaluate the effectiveness of implemented mitigation measures and to repeat the process-review and update the Hazard Analysis and the Mitigation Action Plan, continue the active search for funding opportunities, implement mitigation measures consistent with availability of funds, and monitor and evaluate their effectiveness.

C. Pre-Event and Post-Event Relationships.

1. General

Hazard mitigation activities are not only a response to an event and a known hazard but are also an active search for ways to prevent or reduce the impact from newly discovered hazards. The mitigation process is long-term in nature and, therefore, is an on-going element of the emergency

management program that directly influences preparedness, response, and recovery requirements. Mitigation activities can be initiated at any time but are classified as either pre-event or post-event actions. These actions are not mutually exclusive and will be merged into a coordinated, continuous mitigation process.

2. Pre-Event Mitigation

Activities that take place prior to the occurrence of an emergency situation. This time frame provides a more relaxed atmosphere for the development and implementation of long-term, multi-hazard oriented mitigation measures. This time frame is preferred and is the most appropriate for reducing risks and potential damages.

3. Post-Event Mitigation

Activities that take place after an emergency situation has occurred and already adversely affected this jurisdiction. These activities are a response and are too late to prevent or reduce impacts already suffered. Heightened hazard awareness and a desire for speedy recovery, provide an emphasis for conducting mitigation activities during this time frame. Mitigation opportunities can be identified and implemented which can be very effective in reducing potential damages from future events.

D. Activities by Phases of Emergency Management

Hazard mitigation actions are an on-going process, and are more appropriately classified and associated with the time frames before, during, and after occurrence of an emergency situation caused by a hazard. The following is a sequenced set of actions that should be taken by the HMT during each time frame:

1. Pre-Event Period

a. Develop and maintain Hazard Analysis.

b. Develop and maintain hazard Mitigation Action Plan.

c. Apply for grants and loans to conduct studies and implement mitigation projects.

d. Conduct studies and implement mitigation projects.

e. Provide vulnerability and risk data for use in community development planning, exercise design, emergency preparedness planning, and floodplain management.

2. Incident Response Period

a. Assist decision makers and emergency responders to better understand potential impact consequences and emergency response needs by providing detailed vulnerability and risk data for all areas impacted or likely to be impacted by the incident.

b. Assist decision makers and emergency responders to answer "what if" questions through use of appropriate real-time and model based damage assessment tools such as HAZUS and other programs.

3. Post-Incident Period

a. Conduct site surveys to record damage "footprint" and record and map high-water marks and other benchmarks to verify inputs and results of damage assessment tools. Inspect and evaluate effectiveness of previously implemented mitigation measures. Evaluate accuracy of floodplain maps and studies and identify any mapping needs.

b. Complete Hazard Mitigation Team Reports based on observations and findings from site inspections. Begin development of potential mitigation project application(s) based on team reports.

c. Provide assistance to decision makers for prioritization of damage assessment operations, conducting substantial damage determinations, and preparation of request for a state and/or federal disaster declaration by providing detailed incident impact data.

d. Provide assistance to state and federal mitigation team activities once a disaster is declared.

e. Assist designated Local Project Officer(s) to prepare and submit Hazard Mitigation Grant Program (HMGP) Notice of lnterest(s) (NOls), and application(s), and monitor Public Assistance (PA) projects for inclusion of mitigation components once a state or federal disaster is declared.

f. Review Hazard Mitigation Team Reports and update hazard analysis and the mitigation action plan.

g. Assist designated Local Project Officer(s) in implementing projects and administer HMGP and other mitigation grant programs.

BRAZOS COUNTY EMERGENCY MANAGEMENT PLAN (2019)

The Brazos County Emergency Management Plan outlines the approach to emergency operations for the County and incorporated areas and assigns responsibilities for varies emergency management tasks. It provides general guidance for emergency management activities and an overview of methods for mitigation, preparedness, response, and recovery. The plan includes functional annexes for specific topics related to emergency management, such as warning, evacuation, and mitigation. The objective of the emergency management program is to protect public health and safety and preserve public and private property.

The Brazos County Emergency Management Plan was used in the development of this FMP to assist in the development of the risk assessment, the identification of potential mitigations strategies and projects, and the evaluation of plan integration.

5.2 ADMINISTRATIVE AND TECHNICAL MITIGATION CAPABILITIES

Table 5.2 identifies personnel responsible for activities related to flood mitigation in the City of Bryan.

Table 5.2 – Administrative/Technical Capabilities

Resource	In Place? Y/N	Responsible Department
Planner/Engineer with knowledge of land development/land management practices	Y	Planning & Development Services Department – multiple certified planners on staff *Allison Kay, AICP, Senior Planner*
Engineer/Professional trained in construction practices related to buildings/infrastructure	Y	Planning & Development Services Department, Engineering Services Department – Building Official, multiple building inspectors, engineers
Planner/Engineer/Scientist with an understanding of natural hazards	Y	Multiple Certified Floodplain Managers on staff
Personnel skilled in GIS	Y	GIS Mapping Services Department *Gary Harrison, GIS Supervisor*

Resource	In Place? Y/N	Responsible Department
Full time Building Official	Y	Planning & Development Services Department, Building Services *Greg Cox, Chief Building Official*
Floodplain Manager	Y	Engineering Services Department *Sam Vernon, P.E., CFM*
Emergency Manager	Y	Fire Department *Jeanelle Johnson, MPA, Emergency Management Coordinator*
Grant Writer	Y	Fire Department *Lauren McGrath, MPA, Grant Coordinator & Deputy Emergency Management Coordinator*
Public Information Officer	Y	Communications and Marketing Department *Lacey Lively, CPC, Communications and Marketing Director*
Warning Systems	Y	Bryan Flood Early Warning System (BFEWS)
GIS data: flood zones / hazard areas	Y	
GIS data: critical facilities	Y	
GIS data: current and/or future land use	Y	
GIS data: building footprints	Y	
GIS data: links to Assessor's data	Y	

Based on City staff input on administrative resources and departments with responsibilities related to mitigation, the City is well-equipped to implement flood mitigation. The City has staff across multiple departments that can support a variety of mitigation projects through planning, development regulations and code enforcement, engineering, public education and outreach, grant writing, and emergency preparedness, response, and recovery.

5.3 FISCAL MITIGATION CAPABILITIES

Table 5.3 identifies financial tools or resources that the City could use to fund mitigation activities.

Table 5.3 – Fiscal Mitigation Capabilities

Resource	Accessible/Eligible Y/N	Comments
Community Development Block Grants	Y	Have used
Capital improvements project funding	Y	Funded through certificates of obligation
Authority to levy taxes for specific purposes	N	
Fees for water, sewer, gas, or electric services	N	
Impact fees for new development	N	
Incur debt through general obligation bonds	Y	Not typically used since certificates of obligation became an option
Incur debt through special tax bonds	Y	Tax Increment Reinvestment Zones (used for drainage and streets improvement projects)
Incur debt through private activities	N	
Withhold spending in hazard prone areas	N	

Resource	Accessible/Eligible Y/N	Comments
Other	Y	Available funding for related projects: Drainage Utility Fee, Street Maintenance Fee

Based on City staff input on fiscal resources, the City has a several sources of local funding to support flood mitigation. Outside funding will likely be needed to supplement these resources. Potential sources for outside grant funding include CDBG funds, Texas Water Development Board Flood Infrastructure Fund, and FEMA Hazard Mitigation Assistance grants, including the Hazard Mitigation Grant Program, Flood Mitigation Assistance program, and Building Resilient Infrastructure & Communities program.

5.4 EDUCATION AND OUTREACH CAPABILITIES

This section summarizes the City's flood-related outreach activities. As previous noted, the City has a Public Information Officer that can support flood-related outreach efforts. The City currently undertakes annual outreach activities which are credited under Activity 330 in the CRS program and maintains a City webpage on flooding and flood-related information. Information is also made available in the public library. The 2018 FMP identified multiple mitigation actions related to public information and outreach, several of which were completed, including creating a Facebook group for stormwater, creating a post-flood public information program, and expanding the City's social media program during flood events.

6 MITIGATION STRATEGY

Requirement §201.6(c)(3): [The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

This section describes the mitigation strategy development process and presents the mitigation action plan for the City of Bryan Floodplain Management Plan. It describes how the City met Steps 6, 7, and 8 of the 10-step planning process. This section contains the following subsections:

- 6.1 Mitigation Strategy Overview
- 6.2 Goals and Objectives
- 6.3 Identification and Analysis of Mitigation Activities
- 6.4 Mitigation Action Plan
- 6.5 Mitigation Action Details

6.1 MITIGATION STRATEGY OVERVIEW

After organizing and collecting data and assessing risks, vulnerabilities, and capabilities, the FMPC used the reported findings to develop a mitigation strategy. The mitigation strategy is designed to be comprehensive, strategic, and functional, in that it includes a thorough review of all possible mitigation alternatives, achieves multiple local objectives, is consistent with other long-term planning goals, and facilitates implementation of the identified actions. The FMPC considered the following approaches to mitigation planning when preparing this mitigation strategy:

- Communicate the hazard information collected and analyzed through this planning process as well as mitigation success stories so that the community better understands what can happen where and what they themselves can do to be better prepared.
- Use existing rules, regulations, policies, and procedures to support new mitigation efforts.
- Consider multi-objective management opportunities so that funding may be shared and packaged and broader constituent support may be garnered.

The first step in designing the mitigation strategy is the identification of mitigation goals, which are presented in Section 6.2. Goals represent broad statements of intent and are realized through the implementation of specific mitigation actions.

The second step involves the identification and analysis of available mitigation alternatives that could achieve the identified goals. Alternatives must then be prioritized for implementation. An alternatives analysis was conducted by the FMPC in the development of this plan, but continuous evaluation and consideration of alternatives is a process to be sustained through the plan's implementation and maintenance. Alternative mitigation measures will continue to be considered as future capabilities change and opportunities arise. Section 6.3 describes the analysis of mitigation action alternatives and the criteria for action prioritization.

The third and final step of the mitigation strategy is the selection of mitigation actions to pursue within the planning timeframe. Selected actions are detailed in the Mitigation Action Plan in Section 6.4. Section 6.5 provides additional details for each mitigation action.

6.1.1 CONTINUED COMPLIANCE WITH THE NFIP

Through this planning process and the review of mitigation action alternatives, an emphasis was placed on continued compliance with the NFIP and participation in the CRS. Compliance activities involve adopting current effective FIRMS, adopting and enforcing an acceptable flood damage prevention ordinance, maintaining records of floodplain development, and helping residents obtain information on flood hazards, floodplain map data, flood insurance, and proper construction measures.

The City of Bryan's Development Services Department is responsible for the review and approval of all building permit applications in the City. During permit application review, the Floodplain Administrator reviews development plans to determine the applicability of floodplain management regulations. Once a development begins construction, multiple, on-site inspections are performed by Development Services inspection staff to ensure compliance with applicable regulations, including the floodplain management regulations as well as the building code.

COMMUNITY RATING SYSTEM PARTICIPATION

Beyond the NFIP minimum requirements, the City also participates in the Community Rating System (CRS). The CRS was created in 1990. It is designed to recognize floodplain management activities that are above and beyond the NFIP's minimum requirements. As of 2023, the City of Bryan is classified as a Class 8 community, which gives policyholders a 10% premium discount. The following is a summary of the CRS Activities for which the City currently receives credit based on the 2021 verification visit:

Activity 310 – Elevation Certificates: The City has written construction certificate management procedures for all new buildings and substantially improved/substantially damaged buildings.

Activity 320 – Map Information Service: The City receives credit for furnishing inquirers with basic flood zone information from the community's latest Flood Insurance Rate Map (FIRM), information about the floodway, other flood problems not shown on the FIRM, and historical flood information.

Activity 330 – Outreach Projects: Credit is provided for informational outreach projects, general outreach projects, and targeted outreach projects that are disseminated at least annually.

Activity 340 – Hazard Disclosure: Credit is provided for state regulations requiring landlords to disclose whether a dwelling is in the SFHA or has flooded in the last five years.

Activity 350 – Flood Protection Information: The City receives credit for having documents related to floodplain management available in the reference section of the public library and for providing information on flood protection messages as well as real-time gage information on the City's website.

Activity 360 – Flood Protection Assistance: The City provides advice and assistance to property owners regarding flooding and drainage issues on their property and will make a site visit to evaluate flood problems and provide this advice.

Activity 420 – Open Space Preservation: The City receives credit for preserving approximately seven percent of the SFHA as open space. Additional credit is provided for the City's land use plan recommending open space in flood-prone areas.

Activity 430 – Higher Regulatory Standards: Credit is provided for enforcing regulations that require freeboard for new construction and substantial improvement, foundation protection, and local drainage protection. The City also receives credit for adoption of the international building code, for the City's Building Code Effectiveness Grading Schedule (BCEGS®) Classification, and for having Certified Floodplain Managers on staff.

Activity 440 – Flood Data Maintenance: Credit is provided for maintaining and using additional map data in the day-to-day management of the floodplain and for maintaining copies of all FIRMs.

Activity 450 – Stormwater Management: The City enforces stormwater management regulations as well as regulations for soil and erosion control and water quality.

Activity 510 – Floodplain Management Planning: Credit is provided for the City's previous FMP, adopted in 2018.

Activity 520 – Acquisition and Relocation: Credit is provided for the acquisition of four severe repetitive loss properties.

Activity 540 – Drainage System Maintenance: The City receives credit for annual inspection and regular maintenance of natural channels within the community as well as for adopting and enforcing regulations that prohibit dumping in the City's streams and drainage system.

Activity 630 – Dams: Credit is provided for the state's dam safety program.

6.1.2 POST-DISASTER RECOVERY AND MITIGATION

As noted in Section 5.1.1 of the Capability Assessment, the City of Bryan aims to incorporate mitigation during response and recovery phases and has policies and procedures in place that determine post-disaster activities for hazard mitigation. Incorporating flood mitigation and prevention into post-disaster recovery includes measures such as public information activities to educate residents about property protection that can be incorporated into reconstruction, evaluating damaged public buildings and infrastructure for retrofit options, acquiring substantially damaged or repetitive loss structures from willing sellers, and providing education on and enforcement of floodplain management regulations.

Post-disaster redevelopment and mitigation procedures can also tie to emergency services actions, including measures such as providing safe drinking water, monitoring for diseases, vaccinating residents for tetanus and other diseases, clearing streets and drainage infrastructure, and cleaning up debris.

The FMPC has considered options for post-disaster mitigation in identifying mitigation action alternatives related to flood prevention, property protection, and emergency services. Following a flood event, the City will evaluate damages and recommend appropriate mitigation options from this plan.

6.1.3 PLANNING FOR CRITICAL FACILITY PROTECTION

Critical facility and infrastructure protection was also emphasized during goal setting and while reviewing mitigation action alternatives. The City of Bryan has several options to consider in planning to reduce the vulnerability of critical facilities and infrastructure. Per FEMA guidance, of primary concern is the protection of essential systems and equipment to maintain the function of these critical facilities and their ability to serve the community during and after hazard events. One way to protect critical facilities is to ensure that electrical systems, mechanical systems, and other essential equipment are sufficiently elevated above the base flood elevation. Another option is to install dry floodproofing to protect these critical components from floodwaters, flood forces, and leakage. Among the components that should be considered for protection are electrical service and distribution systems; data systems; heating, ventilation, and air conditioning systems; water and wastewater systems; emergency power systems, and elevators. Providing backup power systems will also help these facilities continue operating during power outages.

Alternatively, Bryan can consider relocating vulnerable critical facilities to new locations outside the floodplain. However, additional protection may still be required because areas outside the 1%-annual-chance and 0.2%-annual-chance floodplain are still at risk of flooding. According to FEMA, properties outside of high-risk flood areas account for over 20 percent of NFIP claims and one-third of disaster assistance for flooding.

The City of Bryan FMPC considered these concerns in developing their mitigation strategies.

6.2 MITIGATION GOALS

Requirement §201.6(c)(3)(i): [The mitigation strategy section shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Section 4 documents the flood hazards risks that threaten the City of Bryan and assesses the vulnerability of the City's structures, infrastructure, and critical facilities. Section 5 evaluates the capacity of the City to reduce the impact of those hazards. The intent of goal setting is to bring these findings together to identify how existing capabilities can be employed or improved to reduce community risk and vulnerability.

Goals are general guidelines that explain what is to be achieved. They are usually broad-based policy type statements that represent long term aims and help define the benefits that the plan is trying to achieve. Goals are also necessary to guide the review of possible mitigation measures and to ensure that recommended actions are consistent with what is appropriate for the City. Mitigation goals need to reflect community priorities and should be aligned with other City plans.

6.2.1 COORDINATION WITH OTHER PLANNING EFFORTS

The goals of this plan need to be consistent with and complement the goals of other planning efforts, especially the City's 2016 Comprehensive Plan Blueprint 2040. Comprehensive plans are important because they are developed and designed to guide future growth within the community. Therefore, to effectively pursue preventative flood mitigation for future development, this floodplain management plan should be integrated with the comprehensive plan. Likewise, the goals of the Brazos County Hazard Mitigation Plan (HMP) are important to consider for integration, as the countywide plan plays an important role in local flood hazard mitigation. Goals from both of these plans were reviewed during the development of the goals of this plan.

6.2.2 GOAL SETTING EXERCISE

At the second FMPC meeting, committee members participated in an exercise to brainstorm and recommend goals for this plan. This process began with a review of the goals from the previous plan and discussion on potential gaps and ways to improve these goals. The FMPC also reviewed relevant strategies from the City's Stormwater Management Program as well as goals from the Brazos County HMP and draft updates to those goals. The goals from the previous FMP were as follows:

1. Develop and improve outreach and public awareness.
2. Protect and enhance natural floodplain and stormwater resources.
3. Provide fiscally responsible funding.
4. Protect the health and safety of the public.

The committee discussed the need for continued public education and awareness. It was suggested that goal two be split to address natural resource protection separate from stormwater infrastructure improvements. These are both priorities of the FMPC, as greenfield development and impervious surface increases are causing many flood problems for existing development. It was noted that the City is regularly seeking grant funding and many action items already address funding mechanisms, so this topic may not need to be a goal of the plan. Finally, there was discussion concerning the need for critical facility protection and ensuring continuity of essential services during flood events.

This exercise helped the committee consider what they want the City to achieve through mitigation. Based on this discussion, revised goals were drafted, reviewed, and approved by the committee.

6.2.3 RESULTING GOALS

The FMPC agreed upon the following five goals for the City's floodplain management planning effort:

- **Goal 1:** Protect the health, safety, and welfare of the public.
- **Goal 2:** Increase outreach and public awareness to encourage citizens to responsibly protect property from flood damage.
- **Goal 3:** Protect and enhance natural floodplain functions by preserving natural open space, green space, and drainage corridors.
- **Goal 4:** Improve stormwater management including the impact of new development on stormwater runoff.
- **Goal 5:** Protect critical facilities and infrastructure to maintain the continuity of critical and essential services.

6.3 IDENTIFICATION AND ANALYSIS OF MITIGATION ACTIVITIES

Requirement §201.6(c)(3)(ii): [The mitigation strategy section shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. All plans approved by FEMA after October 1, 2008, must also address the jurisdiction's participation in the NFIP, and continued compliance with NFIP requirements, as appropriate.

To identify and select mitigation projects that support the mitigation goals and achieve the greatest risk reduction, the FMPC considered the Priority Risk Index ratings determined for each hazard in Section 4. While mitigation alternatives were considered to address risks associated with all identified hazards, an emphasis was placed on high and moderate priority flood-related hazards.

The FMPC analyzed viable mitigation options that supported the identified goals and addressed the risks and vulnerabilities associated with each hazard. The following list of mitigation categories, which are utilized as part of the CRS planning process, was used to organize the evaluation of mitigation alternatives:

- Prevention
- Property Protection
- Natural Resource Protection
- Emergency Services
- Structural Projects
- Public Information

A facilitated discussion then took place to examine and analyze the options for new actions. The FMPC was presented with examples of mitigation actions for each of the above categories and considered opportunities to alter, avert, adapt to, or avoid the flood hazard. Additionally, the FMPC thought about both existing and future buildings in evaluating possible mitigation actions. Appendix B Mitigation Strategy provides a detailed discussion organized by CRS mitigation category of mitigation alternatives considered. The City can continue to reference these alternatives in the review and identification of new mitigation activities. This comprehensive review of possible mitigation activities details why some actions were appropriate for implementation and why others were not. As promoted by CRS, mitigation alternatives across all categories were discussed and considered. This discussion also involved a review of the status and continued applicability of existing mitigation actions. The FMPC generated a list of preferred new and existing mitigation actions through a subsequent brainstorming session. Actions from the previous FMP that were completed or not carried forward in this plan are summarized in Table 6.1.

Actions are organized by objective in the mitigation action plan. For ease of organization, objectives and action items were renumbered, as appropriate, in the updated mitigation action plan.

Table 6.1 – Completed and Deleted Actions from the 2018 FMP

2018 Action #	Action Description	Status
1.1.a	Maintain GIS inventory of stormwater assets	Completed
1.1.c	Development review	Delete. Development review is an established, required practice.
1.3.a	Add to and improve stormwater inventory and GIS data	Completed
1.3.b	Create flood risk overlays for areas outside the FEMA floodplain that are subject to the flooding (using the 2D model) and develop local regulations for those areas	Completed
1.3.c	Improve flood study mapping available to the public online	Completed
1.3.d	Review and update existing floodplain maps	Delete. The City requires developers to map the floodplain, delineate floodway, and determine BFE on unstudied tributaries and submit data to FEMA for LOMR.
1.3.e	Adopt and implement sustainable flood-management policies	Delete. This is done through the flood protection ordinance.
2.3.b	Pursue grants to complete property acquisition projects	Completed
2.3.c	Explore development of a program to assist property owners with elevation and relocation projects for residential structures	Delete. City Council prefers to support targeted acquisitions rather than elevation projects.
4.1.c	Continue social media campaign through Twitter, Facebook, Nextdoor, City website to notify public of emergency situations	Completed
4.2.a	Expand social media program during flood events	Completed
4.4.e	Review and assess the use of the Brazos Center and other shelters during flooding events	Delete. Sufficient shelter locations have been identified.
5.2.a	Prioritize drainage studies and improvements to maximize flood risk reduction	Delete. This is established and ongoing through the CIP.
5.3.a	Perform study to determine locations ideal for regional detention	Completed
5.3.c	Perform study to determine if lowering the lake level at Regional Park would be beneficial to reduce flooding	Completed
5.5.d	Identify opportunities for public and private (developer) partnerships to complete needed storm improvements	Delete. The City will pursue developer support for improvements through an incentive program.
6.3.a	Participate in First Fridays with flood risk educational material	Delete. This effort is covered by another existing action.
6.3.b	Create Facebook group for stormwater	Completed
6.3.e	Continue to hold public meetings during stormwater capital improvement projects	Completed
6.3.k	Provide technical assistance to the public on how to interpret flood data	Completed
6.3.l	Create public information program to be used after flooding events that discusses the following: mold cleanup, hazards in the water, trash debris cleanup, mosquito/bug infestation, TADD, electrocution, and citizen safety	Completed

6.3.1 PRIORITIZATION PROCESS

Once the mitigation actions were identified, the FMPC was provided with several decision-making tools, including FEMA's recommended prioritization criteria, STAPLEE, and others, to assist in deciding why one recommended action might be more important, more effective, or more likely to be implemented than another. STAPLEE criteria were used to generate preliminary prioritization scores, by rating projects as positive (+1), neutral (0), or negative (-1) against each of the criteria. STAPLEE stands for the following:

- **Social:** Will the measure have equitable outcomes? Does it benefit vulnerable populations?
- **Technical:** Will it work? Does it solve the problem? Is it feasible?
- **Administrative:** Does the community have the capacity to implement and manage project?
- **Political:** Is there public and stakeholder support? Is political leadership willing to support?
- **Legal:** Does the community have the authority to implement it? Are there liability implications?
- **Economic:** Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?
- **Environmental:** Does it comply with environmental regulations? Does it benefit or protect existing natural resources?

Next, the FMPC considered each action's potential efficacy based on the following criteria:

- Contribution of the action to save life or property
- Availability of funding and perceived cost-effectiveness
- Available technical and administrative resources for implementation
- Ability of the action to address the problem

In accordance with the DMA requirements, an emphasis was placed on the importance of cost effectiveness in determining action priority, as reflected in the prioritization criteria above. For each action, the FMPC considered the benefit-cost analysis in terms of:

- Ability of the action to address the problem
- Contribution of the action to save life or property
- Available technical and administrative resources for implementation
- Availability of funding and perceived cost-effectiveness

Note that the consideration of these criteria helped to prioritize and refine mitigation actions but did not constitute a full benefit-cost analysis. The cost-effectiveness of any mitigation alternative will be considered in greater detail through performing benefit-cost project analyses when seeking FEMA mitigation grant funding for eligible actions associated with this plan.

The FMPC also considered sustainable disaster recovery principles and smart growth principles when considering, refining, and evaluating mitigation project alternatives. Using these criteria, the FMPC was able to prioritize the importance of each mitigation project based on whether the project should be a low, medium, or high priority. The FMPC agreed that using the subjective criteria described above and prioritizing the actions collectively enabled the actions to be grouped in order of relative importance and helped steer the development of additional actions that meet the more important objectives while eliminating some of the actions which did not garner much support.

6.4 MITIGATION ACTION PLAN

Requirement §201.6(c)(3)(iii): [The mitigation strategy section shall include an] action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

This action plan was developed to present the recommendations developed by the FMPC for how the City of Bryan can reduce the risk and vulnerability of people, property, infrastructure, and natural and cultural resources to future disaster losses. Emphasis was placed on both existing and future development. The action plan summarizes who is responsible for implementing each of the actions as well as when and how the actions will be implemented. Each action's priority is also noted based on the criteria in Section 6.3.1 as well as the benefit-cost review discussion conducted to meet the regulatory requirements of the Disaster Mitigation Act. Table 6.1 identifies the mitigation actions.

It is important to note that the City of Bryan has many existing, detailed action descriptions, which include benefit-cost estimates, in other planning documents, such as capital improvement plans and the countywide Hazard Mitigation Plan. These actions are considered part of this plan, and the details, to avoid duplication, should be referenced in their original source document. The FMPC also realizes that new needs and priorities may arise as a result of a disaster or other circumstances and reserves the right to support new actions, as necessary, as long as they conform to the overall goals of this plan.

Further, it should be clarified that the actions included in this mitigation strategy are subject to further review and refinement; alternatives analyses; and reprioritization due to funding availability and/or other criteria. The City is not obligated by this document to implement any or all of these projects. Rather, this mitigation strategy represents the community's overall intentions to mitigate flood risks and vulnerabilities.

The following fields are included in the mitigation action plan summary table:

- **Action Item:** Provides an ID number for each action. Actions carried forward from the previous FMP may be renumbered, where appropriate, in this updated mitigation action plan.
- **Project:** Describes the mitigation activity.
- **Hazards Addressed:** Lists the hazards mitigated against. Abbreviated as follows: Dam Failure (DF), Erosion (E), Riverine Flooding (RF), Stormwater Flooding (SF). See Section 4.
- **Goals Met:** Lists the mitigation goals the action supports. See Section 6.2.
- **Priority:** Lists the action's overall priority rating of high, medium, or low. See Section 6.3.
- **Funding Source:** Lists potential sources of funding.
- **Timeframe:** Lists the estimated timeframe for the action to be completed.
- **Responsible Department:** Lists the department(s) that will lead implementation and report on progress at plan evaluation meetings.
- **Status:** Provides an update on the progress towards implementation for carried forward actions and indicates new actions, where appropriate.

Additional information on each action is provided in Section 6.5 Mitigation Action Details.

Table 6.2 – Mitigation Action Plan Summary Table

Action Item	Project	Hazards Addressed	Goals Met	Priority	Funding Source	Timeframe	Responsible Department	Status
1.1 Improve ongoing preventive activities.								
1.1.a	Use the potential areas of high water information (2D model and public information) to make better planning decisions.	RF, SF	1, 4	High	General Fund	Ongoing	Engineering	Ongoing action with development projects. There are issues with the 2d modeling including lack of TDOT data. Applied for a grant to improve modeling so that it will be reliable and used regularly.
1.2 Improve Stormwater Maintenance Program.								
1.2.a	Add open channel inspections to regular maintenance programs.	E, RF	4	High	General Fund	Year 2	Transportation, Drainage	S&D has SOP for this activity. An update to the SOP is underway.
1.2.b	Perform a channel inventory including type, condition, and include in maintenance program.	E, RF	4, 5	Medium	General Fund, Drainage Utility Fund	Ongoing, Year 5	Transportation, Drainage	In the planning stages.
1.2.c	Establish a closed-circuit television (CCTV) program for pipe inspections.	SF	4, 5	High	General Fund, Drainage Utility Fund	Year 5	Transportation, Drainage	Funding and workforce limitations do not currently allow for said program.
1.2.d	Codify and continue requirement of detention pond bottom markers.	SF	4	High	General Fund	Year 2	Engineering	Designs were chosen; discussion is on-going regarding Design Guidelines.
1.2.e	Annual review of detention ponds and require maintenance.	RF, SF	4, 5	High	General Fund	Ongoing	Transportation, Drainage	Detention ponds are inspected as time allows. COB is looking to allocate more resources, when identified.
1.3 Expand floodplain mapping and data availability.								
1.3.a	Monitor and update statistical rainfall numbers as soon as available.	DF, RF, SF	4	High	General Fund	As soon as data is available	Engineering	Information has been incorporated into draft documents but has not been approved due to development community concerns (Atlas-14).
1.4 Preserve open space.								
1.4.a	Coordinate open space opportunities with flood control needs for new developments and repetitive loss areas.	RF, SF	1, 3	Medium	General Fund	Ongoing	Engineering	Ongoing action. The City received 2023 repetitive loss data which can be used to target high-risk areas for open space preservation.
2.1 Increase flood insurance participation								
2.1.a	Perform a detailed review of flood insurance on city owned properties.	All	1, 5	Medium	General Fund	Year 2	Engineering, Risk Management	No action to date. Engineering will coordinate with Risk Management.

Action Item	Project	Hazards Addressed	Goals Met	Priority	Funding Source	Timeframe	Responsible Department	Status
2.2 Pursue and encourage relocation, acquisition, and capital improvement projects to reduce flood losses.								
2.2.a	Develop a voluntary property acquisition plan and program for repetitive loss areas	RF, SF	1	High	Grants, Drainage Utility Fund, General Fund	Ongoing	Engineering	Current direction is to consider only RL and SRL properties through federal grant programs.
3.1 Maintain natural preserved areas.								
3.1.a	Continue to allow and promote the dedication of some floodplain acreage toward parkland. Work with Parks Board to establish guidelines for the consistent allowance of this type of dedication.	RF	3	High	General Fund, Park fees	Ongoing	Parks, Development Services Staff, Engineering	Currently, Parks Dept is working with development community to construct trail in floodplains; with associated park infrastructure in nearby areas. No guidelines have been developed.
3.1.b	Train staff on maintenance practices that facilitate natural preservations.	E, RF	3	High	General Fund	Year 3	Transportation, Drainage	Training programs are provided by Texas A&M and the Texas Water Resources Institute.
3.1.c	Continue the practice of requiring private drainage easements on all creeks.	E, RF	3	High	General Fund	Ongoing	Engineering	Ongoing action that will continue to be pursued as development occurs.
3.2 Develop regulations focused on natural areas preservation.								
3.2.a	Explore developing ordinances/ criteria in the Drainage Design Guidelines that require erosion buffers along creeks.	E, RF	3, 4	High	General Fund	Year 1	Engineering	Draft language has been developed. Need to vet this with Development Community.
3.2.b	Explore providing incentives to developers to preserve natural areas.	E, RF	3, 4	Medium	General Fund	Year 3	Engineering	Development Services is evaluating the merit of creating a conservation district zoning to this effect. There has been one approved Planned Development District that has designated some natural areas to preserve the floodplain/floodway. This development will be used as a "case study" for this action.
3.2.c	Explore the use of Natural Area Preserved zoning districts in Bryan.	RF	3, 4	Medium	General Fund	Year 4	Planning	See 3.2.b. Development Services is evaluating the creation of a conservation zoning district based on a planning development case study.
3.2.d	Explore developing guidelines/criteria for compensatory storage.	SF	4	Medium	General Fund	Year 4	Engineering	No action to date.
4.1 Support ongoing emergency services.								
4.1.a	Continue programs to conduct pre and post rain event inspections on known areas of issues.	SF	1, 4, 5	High	General Fund	Ongoing	Transportation, Drainage	Ongoing action. A record of these inspections needs to be developed.

Action Item	Project	Hazards Addressed	Goals Met	Priority	Funding Source	Timeframe	Responsible Department	Status
4.1.b	Continue to block streets that become flooded utilizing the flood prone streets list and revise/improve this list with more data.	RF, SF	1, 5	High	General Fund	Ongoing	Transportation, Traffic	Action revised. Received grant to construct and install flood gauges (BFEWS) that will support proactive blocking of streets. Construction is in progress.
4.1.c	Protect critical facilities and flood prone areas from debris by expanding the maintenance program to include trash pick-up (including bulk) prior to forecasted large events.	All	1, 5	Medium	General Fund, Stormwater	Year 4	Transportation, Drainage, Stormwater	Need plan from Solid Waste.
4.2 Expand the flood warning system.								
4.2.a	Install more gauges to expand the B-FEWS system.	RF, SF	1, 2	High	Grant, General Fund	Year 5	Engineering, Traffic, Street Drainage	New action.
4.2.b	Explore use of city wide 2D model to consolidate rainfall data and produce real-time flood warning/forecasting system to notify residents and city staff for emergency access.	All	1, 2	Medium	General Fund, Drainage Utility Fund, Grant	Year 5	Police, Fire, Engineering, Traffic	B-FEWS collects rainfall intensities in 20 locations within the City. We have a grant application submitted that would allow us to create a more accurate 2D model. These two actions are essential for the development of real-time flood warning/forecasting system. In the meantime, we have met with Community Emergency Operations Center staff about ways to share flood overtopping at the 20 locations monitored by B-FEWS.
4.2.c	Create public information campaign to encourage participation in Code Red.	All	1, 2	High	General Fund	Ongoing	Fire	Working with Community Emergency Operations Center staff to develop this. Currently verbal outreach has been the method.
4.2.d	Explore installing "Street May Flood" signs to critical locations.	RF, SF	1, 2	High	General Fund	Ongoing	Engineering, Traffic, Street Drainage	Construction is underway on B-FEWS. Continue to evaluate/monitor low-lying road crossings.
4.3 Improve hazard response operations.								
4.3.a	Investigate grant funding available for emergency services.	All	5	Low	Grant, General Fund	Ongoing	Fire	Ongoing action. New staff person in EM that works on grants part-time.

Action Item	Project	Hazards Addressed	Goals Met	Priority	Funding Source	Timeframe	Responsible Department	Status
4.4 Implement additional emergency operation plans and services for areas of high risk of flooding.								
4.4.a	Work with organizations serving functional/access needs populations (elderly, wheelchair-bound, deaf, blind, such as Brazos Valley Council on Independent Living) that may require special assistance, that tie in with 9-1-1, GIS Systems, etc. so that vulnerable citizens can be checked on, notified, supported, or educated effectively in the event of disasters.	All	1	High	General Fund	Year 4	Fire	No action to date.
4.4.b	Update and maintain the City of Bryan Hazard Mitigation website with information promoting hazard mitigation and disaster awareness.	All	2	High	General Fund	Year 2	Fire	Ongoing by Community Emergency Operations Center staff.
4.4.c	Develop a Substantial Damage Management Plan.	All	1	Medium	General Fund	Year 3	Fire	New action. Replaced existing pre-disaster recovery planning action to reflect intention to plan for substantial damage management.
4.4.d	Develop/review/update the debris management plan.	All	1	Medium	General Fund, Solid Waste	Year 3	Solid Waste	No action to date.
5.1 Reduce flood risk through storm drain capital improvements								
5.1.a	Continue to implement Stormwater Master Plan projects as funding allows.	RF, SF	4	High	Drainage Utility Fund, Bonds, Grants	Ongoing	Engineering	Ongoing. Some projects included in CIP.
5.1.b	Design, construct and maintain drainage improvement projects per the studies in the Stormwater Master Plan (Primary and Secondary Drainage Recommendations).	RF, SF	1, 4	High	Drainage Utility Fund, Bonds, Grants	Ongoing	Engineering	Various projects listed in the Stormwater Master Plan are included in the 5 year CIP program. Examples are Wayside/Carter Creek Storm Sewer, Bristol/Esther Storm Sewer, and Hillside/Oaks Drainage.
5.1.c	Provide update of the Stormwater Master Plan including revisions to the ranking criteria every 5 years.	RF, SF	4	High	General Fund	Year 2	Engineering	Proposal requested, not yet received from design consultant.

Action Item	Project	Hazards Addressed	Goals Met	Priority	Funding Source	Timeframe	Responsible Department	Status
5.2 Reduce flood impacts through detention								
5.2.a	Continue to construct local and regional stormwater detention facilities in flood prone areas.	RF, SF	4	High	Drainage Utility Fund, Bonds	Ongoing	Engineering	We continue to identify potential Regional Detention Facilities and evaluate their effectiveness. A regional detention pond is currently be constructed near S College Avenue. Our current CIP shows has funding to purchase property for another regional detention site.
5.3 Reduce flood risk at hazardous road crossings.								
5.3.a	Develop a plan to upgrade existing low water crossings to improve service levels.	RF, SF	1, 5	Low	General Fund, Bonds, Drainage Utility Fund	Year 5	Engineering	Received grant money through the TWDB for flood early warning system at 20 low water crossings. Construction of these are now underway.
5.3.b	Increase capacity of existing culverts and bridges on major thoroughfares (Old Reliance Rd., Broadmoor low water bridge, W. Villa Maria between Cavitt and Texas Avenue) and single access subdivisions (see 2D Report list) to allow passage during 100-year event.	RF, SF	1, 4, 5	High	General Fund, Bonds, Drainage Utility Fund	Ongoing	Engineering	Briar Creek Channel, South College and Commerce St are projects are underway. Increasing culvert capacity cannot be done without assurance that there are no adverse effects downstream. Engineering modeling is used to evaluate the capacity and downstream effects of proposed culverts. The 1% annual probability event is the goal in key locations (such as single access roads) and lower events that comply with BCS Design Manual in other areas. Proposed improvements to the regional detention pond at Travis Bryan park will improve conditions along the major arterial, W. Villa Maria, downstream of the pond. The City is actively working with TxDOT on proposed improvements to the East bypass that will increase the size of several culverts. B-FEWS will serve as an interim solution to the noted problem crossings.
5.3.c	Explore list of roads flooded during 2016/2017 rainfalls and research emergency access availability to residents given these flooded conditions.	RF, SF	1	High	General Fund	Year 2	Engineering	On-going with BFEWS.

Action Item	Project	Hazards Addressed	Goals Met	Priority	Funding Source	Timeframe	Responsible Department	Status
5.4 Pursue partnerships to complete stormwater projects.								
5.4.a	Develop collaborative program between the stormwater and parks department to create opportunities for flood protection and recreation in open spaces.	RF, SF	3, 4	High	Parks, Drainage Utility Fund	Ongoing	Engineering	Ongoing. Parks Dept is working with development community to construct trail in floodplains; with associated park infrastructure in nearby areas.
5.4.b	Explore creating a system for development incentives for improving city storm water infrastructure.	SF	4	Low	General Fund	Year 5	Engineering, Development Services	No action to date.
5.4.c	Continue to pursue partnerships with BISD to complete stormwater projects on school sites.	SF	4	Medium	Parks, General Fund	Ongoing	Engineering, Parks	Ongoing action.
6.1 Create a targeted outreach program.								
6.1.a	Direct mail of FEMA flood protection information to targeted areas of high flood risk.	All	2	Medium	General Fund	Ongoing	Engineering	Ongoing action.
6.1.b	Develop a dam safety public education and evacuation plan for at risk areas of the community, including routes, transportation, and housing.	DF	1, 2	High	General Fund	Year 3	Engineering, Communications, Fire, Streets and Drainage	Coordination meeting held but no action since then. Possible duplication of services from the EOC plan.
6.1.c	Educate realtors regarding real estate disclosure as relates to flooding.	RF	2	High	General Fund	Ongoing, Year 2	Engineering	No action to date.
6.1.d	Educate builders and landscape companies on how to properly grade new homes to protect from flood damage.	E, RF, SF	2	High	General Fund	Ongoing, Year 2	Engineering, Building	Ongoing.
6.2 Provide general outreach to the community regarding flood risk.								
6.2.a	Hold a large community event dedicated to stormwater education annually (Earth Day).	SF	2	High	General Fund	Ongoing, Year 3	Engineering, Streets and Drainage	Not completed due to COVID; will be resumed and continued moving forward.
6.2.b	Create adopt-an-inlet and adopt-a-creek programs.	E, RF, SF	2, 3, 4	Medium	General Fund	Year 5	Streets, Drainage	No action to date.
6.2.c	Become more active in flood awareness week through additional social media outlets and community events.	All	2	Low	General Fund	Year 5	Engineering, Communications and Marketing	Participated in "Wear Blue Wednesday". Communications sent out several messages throughout the week.

Action Item	Project	Hazards Addressed	Goals Met	Priority	Funding Source	Timeframe	Responsible Department	Status
6.2.d	Develop paid advertisements through public service announcements to educate the public about flood insurance and flood risk.	All	2	Medium	General Fund	Year 4	Engineering, Communications and Marketing	No action to date.
6.2.e	Develop and improve communication regarding preparedness and mitigation actions to better inform developers, engineers, builders, and the public about ways they can avoid flood damage.	All	2	Medium	General Fund	Year 4	Engineering, Communications and Marketing	No action to date.
6.2.f	Develop and present citizen floodplain and flood insurance education programs.	All	2	High	General Fund, Drainage Utility Fund	Year 2	Engineering	Ongoing with continued First Friday outreach.
6.2.g	Create educational program for flood risk to schools and youth.	All	2	Low	General Fund	Year 5	Engineering	No action to date.

6.5 MITIGATION ACTION DETAILS

PREVENTION

1.1.a. Use the potential areas of high water information (2D model and public information) to make better planning decisions.	
Issue/Background:	The ordinance states to use best available data, but the current 2D modelling has known issues that need to be resolved.
Alternatives Considered:	Planning decisions could rely on FEMA data but would leave gaps.
Existing Planning Mechanism(s) to Support Implementation:	2D modelling exists and needs to be improved. Once improved, data will be used during development process per ordinance requirements.
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Improved data will enable development decisions to prevent flood exposure.
Timeframe for Completion:	Ongoing implementation. Improve modelling by Year 5.
Additional Notes:	There are issues and gaps in the existing 2D modelling, so it is not used regularly. Updates will make it a more reliable data source.

1.2.a. Add open channel inspections to regular maintenance programs.	
Issue/Background:	Open channels are not currently inspected as part of the drainage maintenance program.
Alternatives Considered:	No action; would mean blockages, erosion, and other drainage issues would go undetected.
Existing Planning Mechanism(s) to Support Implementation:	There is an existing drainage inspection and maintenance program that this could be incorporated into.
Responsible Department/Agency:	Transportation, Drainage
Priority:	High
Cost Estimate:	Less than $100k
Benefits (Losses Avoided):	Regular inspections and maintenance can identify and remedy erosion, debris blockages, and other issues, supporting drainage.
Timeframe for Completion:	Year 2
Additional Notes:	Streets & Drainage has an SOP for this activity that is currently being updated with input from Engineering.

1.2.b. Perform a channel inventory including type, condition, and include in maintenance program.	
Issue/Background:	Open channels are not currently included in the City's drainage maintenance program. An inventory will identify and establish baseline conditions of natural channels in the city.
Alternatives Considered:	No action; would leave the City lacking data needed to conduct regular inspections and maintenance.
Existing Planning Mechanism(s) to Support Implementation:	There is an existing stormwater system inventory that this could be incorporated into.
Responsible Department/Agency:	Transportation, Drainage
Priority:	Medium
Cost Estimate:	Less than $100k
Benefits (Losses Avoided):	Inspections and maintenance can identify and remedy erosion, debris blockages, and other issues, supporting drainage.
Timeframe for Completion:	Establish by Year 5 to support ongoing implementation of 1.2.a.
Additional Notes:	Implementation is in the planning stages.

1.2.c. Establish a closed-circuit television (CCTV) program for pipe inspections.	
Issue/Background:	Due to limitations from staff time and pipe access, it can be difficult to conduct timely pipe inspections.
Alternatives Considered:	Inspecting pipes manually could result in less frequent inspections.
Existing Planning Mechanism(s) to Support Implementation:	None identified.
Responsible Department/Agency:	Transportation, Drainage
Priority:	High
Cost Estimate:	Less than $250k
Benefits (Losses Avoided):	A CCTV pipe inspection program for critical locations would enable rapid identification of maintenance issues.
Timeframe for Completion:	Year 5
Additional Notes:	Implementation is on hold due to funding and workforce limitations.

1.2.d. Codify and continue requirement of detention pond bottom markers.	
Issue/Background:	Detention pond bottom markers will enable improved monitoring of sediment accumulation and associated maintenance.
Alternatives Considered:	More frequent monitoring and inspections could identify sediment accumulation but would require more staff time.
Existing Planning Mechanism(s) to Support Implementation:	This requirement could be codified as part of the stormwater regulations and design guidelines.
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Markers will improve inspection and maintenance efficiency.
Timeframe for Completion:	Year 2
Additional Notes:	Designs for markers were chosen and discussion is ongoing regarding how to incorporate requirements into existing Design Guidelines.

1.2.e. Annual review of detention ponds and require maintenance.	
Issue/Background:	Detention ponds require regular maintenance to ensure proper function and continued storage capacity.
Alternatives Considered:	No action would mean sedimentation, erosion, and other drainage issues would go undetected.
Existing Planning Mechanism(s) to Support Implementation:	There is an existing drainage inspection and maintenance program that this could be incorporated into.
Responsible Department/Agency:	Transportation, Drainage
Priority:	High
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Regular inspections and maintenance can identify and remedy issues, supporting efficient drainage and avoiding potential failures.
Timeframe for Completion:	Establish regular inspections by Year 2 for ongoing implementation
Additional Notes:	Detention ponds are inspected as time allows, but the City is looking to allocate more resources for more regular maintenance.

1.3.a. Monitor and update statistical rainfall numbers as soon as available.	
Issue/Background:	Stormwater management systems are dependent on accurate rainfall statistics for proper design. Changing rainfall frequencies should be accounted for as best as possible in statistics used for this purpose.
Alternatives Considered:	Stormwater designs could continue to be based on older rainfall statistics, but this may produce undersized infrastructure.
Existing Planning Mechanism(s) to Support Implementation:	Updated Atlas-14 data can be incorporated into stormwater design guidelines.
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	This will enable accurate sizing and design of stormwater infrastructure investments.
Timeframe for Completion:	Year 2 with ongoing improvements as data becomes available
Additional Notes:	Information has been incorporated into draft documents but has not been approved due to development community concerns.

1.4.a. Coordinate open space opportunities with flood control needs for new developments and repetitive loss areas.	
Issue/Background:	Open space preservation can reduce exposure in highest risk areas.
Alternatives Considered:	The City could rely on building codes and property protection measures to limit risk, but open space will prevent new exposure.
Existing Planning Mechanism(s) to Support Implementation:	Could be incorporated with City parks development or with development incentives.
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Preservation will prevent new property exposure in high risk areas.
Timeframe for Completion:	Ongoing implementation will occur as opportunities arise.
Additional Notes:	No specific sites are identified for preservation at this time.

PROPERTY PROTECTION

2.1.a. Perform a detailed review of flood insurance on city owned properties.	
Issue/Background:	Publicly owned properties are typically self-insured. Evaluation of insurance may enable identification of mitigation needs.
Alternatives Considered:	City buildings could be inspected for mitigation potential.
Existing Planning Mechanism(s) to Support Implementation:	None identified.
Responsible Department/Agency:	Engineering, Risk Management
Priority:	Medium
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Better understanding of potential losses can be used to justify property protection investments.
Timeframe for Completion:	Year 2
Additional Notes:	Implementation has not yet begun due to staff time limitations.

2.2.a. Develop a voluntary property acquisition plan and program for repetitive loss areas.	
Issue/Background:	Repetitive loss and severe repetitive loss properties are likely to continue to sustain damages without mitigation.
Alternatives Considered:	Property elevation was considered but does not have Council support at this time. Acquisition provides much greater risk reduction.
Existing Planning Mechanism(s) to Support Implementation:	This can be pursued according to recommended processes supported by FEMA Hazard Mitigation Assistance grant programs.
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Less than $5m
Benefits (Losses Avoided):	Acquisition will remove risk and prevent further flood exposure.
Timeframe for Completion:	Establish program by Year 3 for ongoing implementation.
Additional Notes:	The City plans to consider only RL and SRL properties for acquisition and demolition with federal grant funding.

NATURAL RESOURCE PROTECTION

3.1.a. Continue to allow and promote the dedication of some floodplain acreage toward parkland. Work with Parks Board to establish guidelines for the consistent allowance of this type of dedication.	
Issue/Background:	Floodplain land is well suited to use for parks, which minimizes structure exposure and maintains natural floodplain functions.
Alternatives Considered:	Private acquisition and preservation of floodplain land
Existing Planning Mechanism(s) to Support Implementation:	Parks Board
Responsible Department/Agency:	Parks, Development Services Staff, Engineering
Priority:	High
Cost Estimate:	Less than $500k
Benefits (Losses Avoided):	This action will prevent increases in exposure in high risk areas.
Timeframe for Completion:	Ongoing
Additional Notes:	Parks Dept is working with development community to construct trail in floodplains with associated park infrastructure in nearby areas. No guidelines have been developed to formalize this effort.

3.1.b. Train staff on maintenance practices that facilitate natural preservations.	
Issue/Background:	Creeks and streams may require regular maintenance to support proper function.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Natural stream maintenance will be integrated with existing stormwater inspections and maintenance.
Responsible Department/Agency:	Transportation, Drainage
Priority:	High
Cost Estimate:	Less than $100k
Benefits (Losses Avoided):	Maintaining floodplains in a natural state can support drainage, infiltration, water quality, and other beneficial functions.
Timeframe for Completion:	Year 3
Additional Notes:	Training programs are provided by Texas A&M and the Texas Water Resources Institute.

3.1.c. Continue the practice of requiring private drainage easements on all creeks.	
Issue/Background:	Development too close to creeks may cause erosion and water quality degradation. Easements create a buffer along creeks and give access for regular maintenance but the City.
Alternatives Considered:	Setback requirements would provide for a buffer along creeks but would not give the City access to perform maintenance.
Existing Planning Mechanism(s) to Support Implementation:	This is not formalized in regulations but has been implemented with support from the FMP.
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Minimizes property exposure, prevents erosion, and enables creek maintenance.
Timeframe for Completion:	Ongoing implementation as part of the development process.
Additional Notes:	This is not a regulatory requirement but has become regular practice due to identification in this plan.

3.2.a. Explore developing ordinances/criteria in the Drainage Design Guidelines that require erosion buffers along creeks.	
Issue/Background:	Development activities can generate erosion and sedimentation, affecting drainage and water quality in creeks.
Alternatives Considered:	Encouraging erosion and sedimentation control through education would not be as effective.
Existing Planning Mechanism(s) to Support Implementation:	Drainage Design Guidelines, Stormwater Ordinance, Subdivision Ordinance
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Design guidelines will provide straightforward instructions to minimize erosion and sedimentation, protecting water quality and drainage capacity of creeks.
Timeframe for Completion:	Year 1
Additional Notes:	Draft language has been developed and needs to be vetted.

3.2.b. Explore providing incentives to developers to preserve natural areas.	
Issue/Background:	Natural floodplain and wetland areas are most suitable as open space, but this may limit ability to develop a parcel. Providing incentives to developers to preserve natural areas, such as allowing higher levels of development on other portions of a parcel, may be a win-win solution.
Alternatives Considered:	Pursue acquisition of natural areas, which may be cost prohibitive.
Existing Planning Mechanism(s) to Support Implementation:	Subdivision ordinance, land & site development ordinance
Responsible Department/Agency:	Engineering
Priority:	Medium
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Prevents exposure increases in high-risk areas; preserves beneficial functions of natural areas.
Timeframe for Completion:	Year 3
Additional Notes:	Development Services is evaluating the merit of creating a conservation district zoning to this effect. There has been one approved Planned Development District that has designated some natural areas to preserve the floodplain/floodway. This development will be used as a "case study" for this action.

3.2.c. Explore the use of Natural Area Preserved zoning districts in Bryan.	
Issue/Background:	Natural floodplain and wetland areas are most suitable as open space. The City could use zoning to preserve natural areas.
Alternatives Considered:	Pursue acquisition of natural areas, which may be cost prohibitive.
Existing Planning Mechanism(s) to Support Implementation:	Zoning ordinance
Responsible Department/Agency:	Planning
Priority:	Medium
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Prevents exposure increases in high-risk areas and preserves beneficial functions of natural areas.
Timeframe for Completion:	Year 4
Additional Notes:	See 3.2.b. Development Services is evaluating the creation of a conservation zoning district.

3.2.d. Explore developing guidelines/criteria for compensatory storage.	
Issue/Background:	New development and impervious surface can increase stormwater runoff or affect existing stormwater capacity.
Alternatives Considered:	Establish requirements for low-impact development.
Existing Planning Mechanism(s) to Support Implementation:	Stormwater ordinance, stormwater design guidelines
Responsible Department/Agency:	Engineering
Priority:	Medium
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Reduces the stormwater impact of new development on existing development.
Timeframe for Completion:	Year 4
Additional Notes:	Implementation has not started, but the City still wants to pursue this action.

EMERGENCY SERVICES

4.1.a. Continue programs to conduct pre and post rain event inspections on known areas of issues.	
Issue/Background:	Inspections pre- and post-event enable timely identification of maintenance needs.
Alternatives Considered:	None identified.
Existing Planning Mechanism(s) to Support Implementation:	Inspections are conducted by Streets and Drainage but procedures are needed to formally log inspections and maintenance.
Responsible Department/Agency:	Transportation, Drainage
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Stormwater flooding issues may be avoided by timely maintenance.
Timeframe for Completion:	Inspections log to be developed by Year 2. Inspections will be ongoing.
Additional Notes:	Ongoing action. A record of these inspections needs to be developed.

4.1.b. Continue to block streets that become flooded utilizing the flood prone streets list and revise/improve this list with more data.	
Issue/Background:	Street flooding is common and poses a significant threat to life safety for motorists who don't understand the risk.
Alternatives Considered:	Public education on "turn around don't drown" topics
Existing Planning Mechanism(s) to Support Implementation:	Streets closures are already part of the City's flood response activities.
Responsible Department/Agency:	Transportation, Traffic
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Avoids rescue operations and loss of life
Timeframe for Completion:	Updates should be made to the flood prone streets list as data becomes available; response operations will be ongoing as needed.
Additional Notes:	Action revised. Received grant to construct and install flood gauges (BFEWS) that will support proactive blocking of streets. Construction is in progress.

4.1.c. Protect critical facilities and flood prone areas from debris by expanding the maintenance program to include trash pick-up (including bulk) prior to forecasted large events.	
Issue/Background:	Flood-borne debris can exacerbate flood damages.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Solid waste collection equipment and procedures can be leveraged to support this action.
Responsible Department/Agency:	Transportation, Drainage, Stormwater
Priority:	Medium
Cost Estimate:	Less than $400k
Benefits (Losses Avoided):	Reducing potential for flood borne debris may reduce flood-related damages.
Timeframe for Completion:	Year 4
Additional Notes:	Need a plan for debris management from Solid Waste.

4.2.a. Install more gauges to expand the B-FEWS system.	
Issue/Background:	Gauges enable early flood threat recognition and warning.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	B-FEWS is established, and additional gauges could be integrated.
Responsible Department/Agency:	Engineering, Traffic, Street Drainage
Priority:	High
Cost Estimate:	Less than $400k
Benefits (Losses Avoided):	Earlier detection and warning can enable better preparedness, support life safety.
Timeframe for Completion:	Year 5
Additional Notes:	New action.

4.2.b. Explore use of city wide 2D model to consolidate rainfall data and produce real-time flood warning/forecasting system to notify residents and city staff for emergency access.	
Issue/Background:	Better data will improve flood forecasting, warning, and response.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Existing 2D modelling can be improved with additional data.
Responsible Department/Agency:	Police, Fire, Engineering, Traffic
Priority:	Medium
Cost Estimate:	Less than $100k
Benefits (Losses Avoided):	Earlier detection and warning can enable better preparedness, support life safety.
Timeframe for Completion:	Year 5
Additional Notes:	The City has submitted a grant application to create more accurate 2D modelling. Along with B-FEWS data, this will enable development of a real-time flood warning/forecasting system.

4.2.c. Create public information campaign to encourage participation in Code Red.	
Issue/Background:	The City provides flood warning and other emergency notifications via CodeRed, which requires participant sign up.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Communications and Marketing Department
Responsible Department/Agency:	Fire
Priority:	High
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	More widespread warning will improve preparedness, supporting life
Timeframe for Completion:	Implementation is ongoing.
Additional Notes:	Working with Community Emergency Operations Center staff to expand methods beyond verbal outreach.

4.2.d. Explore installing "Street May Flood" signs to critical locations	
Issue/Background:	Street flooding is common and poses a significant threat to life safety for motorists who don't understand the risk.
Alternatives Considered:	Public education on "turn around don't drown" topics
Existing Planning Mechanism(s) to Support Implementation:	B-FEWS, inventory of streets with flooding problems, inventory of low water crossings
Responsible Department/Agency:	Engineering, Traffic, Street Drainage
Priority:	High
Cost Estimate:	Less than $500k
Benefits (Losses Avoided):	Avoids rescue operations and loss of life
Timeframe for Completion:	Initiate sign installation by Year 3 and continue ongoing implementation as problem streets are identified.
Additional Notes:	Construction underway on B-FEWS, which will enable identification of streets that should be marked with signage.

4.3.a. Investigate grant funding available for emergency services.	
Issue/Background:	Funding is a limitation to project implementation.
Alternatives Considered:	No action; pursue low-cost projects or those that can be implemented with only local funding
Existing Planning Mechanism(s) to Support Implementation:	Emergency Management staff capabilities can support this action.
Responsible Department/Agency:	Fire
Priority:	Low
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Projects can be implemented that may otherwise be cost-prohibitive.
Timeframe for Completion:	Ongoing as grant funding becomes available.
Additional Notes:	A new staff person was hired in EM that works on grants part-time.

4.4.a. Work with organizations serving functional/access needs populations (elderly, wheelchair-bound, deaf, blind, such as Brazos Valley Council on Independent Living) that may require special assistance, that tie in with 9-1-1, GIS Systems, etc. so that vulnerable citizens can be checked on, notified, supported, or educated effectively in the event of disasters.	
Issue/Background:	Some individuals may need support to prepare for and/or evacuate during a flood event.
Alternatives Considered:	No action; rely on existing outreach programs without targeted support.
Existing Planning Mechanism(s) to Support Implementation:	None identified.
Responsible Department/Agency:	Fire
Priority:	High
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Providing support to vulnerable populations can protect life safety.
Timeframe for Completion:	Year 4
Additional Notes:	No action to date.

4.4.b. Update and maintain the City of Bryan Hazard Mitigation website with information promoting hazard mitigation and disaster awareness.	
Issue/Background:	Education and outreach prepares the public to help and protect themselves and their property during flood events. Web outreach is highly accessible and cost-efficient.
Alternatives Considered:	Rely on annual mailings and existing website information.
Existing Planning Mechanism(s) to Support Implementation:	Communications and Marketing Department
Responsible Department/Agency:	Fire
Priority:	High
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Education will improve awareness and preparedness, supporting life safety and property protection.
Timeframe for Completion:	Year 2
Additional Notes:	Implementation will continue, with updates as appropriate.

4.4.c. Develop a Substantial Damage Management Plan.	
Issue/Background:	After a flood event, the City must enforce the substantial damage and substantial improvement regulations. Preparing in advance for this process will streamline and simplify compliance.
Alternatives Considered:	No action. Procedures would need to be developed post-flood.
Existing Planning Mechanism(s) to Support Implementation:	Floodplain regulations, development review process, damage assessment process
Responsible Department/Agency:	Fire
Priority:	Medium
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Ensures compliance with the NFIP and brings damaged property up to current development standards to protect against additional flooding in the future.
Timeframe for Completion:	Year 3
Additional Notes:	This action replaced an existing pre-disaster recovery planning action to better reflect the City's planning needs for post-disaster recovery.

4.4.d. Develop/review/update the debris management plan.	
Issue/Background:	Flooding can produce a significant amount of debris that will need to be cleaned up and removed as part of the response and recovery process. Debris presents a risk to the public and should be removed promptly.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Solid waste collection equipment and procedures can be leveraged to support this action.
Responsible Department/Agency:	Solid Waste
Priority:	Medium
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Advance planning enables quicker response and clean up which reduces the public's exposure to hazards associated with debris.
Timeframe for Completion:	Year 3
Additional Notes:	No action to date.

STRUCTURAL PROJECTS

5.1.a. Continue to implement Stormwater Master Plan projects as funding allows.	
Issue/Background:	Stormwater flooding can be caused by undersized infrastructure, which can be remedied through structural improvements.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Capital improvements program
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Less than $5m
Benefits (Losses Avoided):	Reduced stormwater flooding severity and frequency in mitigated areas.
Timeframe for Completion:	Ongoing
Additional Notes:	The City has already identified a database of stormwater projects to be implemented through the capital improvements program.

5.1.b. Design, construct and maintain drainage improvement projects per the studies in the Stormwater Master Plan (Primary and Secondary Drainage Recommendations).	
Issue/Background:	New watershed studies will provide data to identify stormwater improvement projects.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Capital improvement program, stormwater master plan
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Over $5m
Benefits (Losses Avoided):	Reduced stormwater flooding severity and frequency in mitigated areas.
Timeframe for Completion:	Ongoing
Additional Notes:	Projects can be pursued in phases as funding allows.

5.1.c. Provide update of the Stormwater Master Plan including revisions to the ranking criteria every 5 years.	
Issue/Background:	Projects and ranking in the Stormwater Master Plan should be regularly reviewed and reevaluated to ensure the highest priority projects are pursued for implementation.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	None identified.
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Less than $250k
Benefits (Losses Avoided):	Maintains support and buy-in for stormwater improvement projects.
Timeframe for Completion:	Year 2
Additional Notes:	

5.2.a. Continue to construct local and regional stormwater detention facilities in flood prone areas.	
Issue/Background:	Stormwater detention manages large amounts of runoff by allowing slower infiltration over a period of days from a maintained pond.
Alternatives Considered:	Require on-site stormwater management
Existing Planning Mechanism(s) to Support Implementation:	Capital improvement program, stormwater master plan
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Less than $5m
Benefits (Losses Avoided):	Mitigates stormwater flooding of streets and property by reducing peak flows and volumes on a large scale, benefiting a wide area.
Timeframe for Completion:	Ongoing
Additional Notes:	

5.3.a. Develop a plan to upgrade existing low water crossings to improve service levels.	
Issue/Background:	Low water crossings present a risk to motorists who may not realize how deep floodwaters are or understand the risk of driving through flood water.
Alternatives Considered:	Public education on “turn around don’t drown” topics
Existing Planning Mechanism(s) to Support Implementation:	Capital improvement program
Responsible Department/Agency:	Engineering
Priority:	Low
Cost Estimate:	Less than $100k
Benefits (Losses Avoided):	Reduced flooding of streets, supporting service continuity of transportation infrastructure
Timeframe for Completion:	Year 5
Additional Notes:	

5.3.b. Increase capacity of existing culverts and bridges on major thoroughfares (Old Reliance Rd., Broadmoor low water bridge, W. Villa Maria between Cavitt and Texas Avenue) and single access subdivisions (see 2D Report list) to allow passage during 100-year event.	
Issue/Background:	Undersized culverts and other stormwater infrastructure can lead to drainage issues and flooding.
Alternatives Considered:	Implement stream restoration projects to encourage infiltration throughout the floodplain and reduce flows during the 100-year event.
Existing Planning Mechanism(s) to Support Implementation:	Capital improvement program
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Over $5m
Benefits (Losses Avoided):	Reduced flooding of streets and surrounding property
Timeframe for Completion:	Ongoing
Additional Notes:	

5.3.c. Explore list of roads flooded during 2016/2017 rainfalls and research emergency access availability to residents given these flooded conditions.	
Issue/Background:	Residents may become stranded and unable to evacuate if their access roads are flooded.
Alternatives Considered:	Public education regarding flooded roads and need for early evacuation.
Existing Planning Mechanism(s) to Support Implementation:	None identified
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Will protect life safety and reduce the need for rescues.
Timeframe for Completion:	Year 2
Additional Notes:	

5.4.a. Develop collaborative program between the stormwater and parks department to create opportunities for flood protection and recreation in open spaces.	
Issue/Background:	Floodplain land is well suited to use for parks, which minimizes structure exposure and maintains natural floodplain functions.
Alternatives Considered:	Private acquisition and preservation of floodplain land
Existing Planning Mechanism(s) to Support Implementation:	None identified
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Less than $1m
Benefits (Losses Avoided):	Prevents exposure increases in high-risk areas and preserves beneficial functions of natural areas.
Timeframe for Completion:	Ongoing
Additional Notes:	Parks Dept is working with development community to construct trail in floodplains; with associated park infrastructure in nearby areas.

5.4.b. Explore creating a system for development incentives for improving city storm water infrastructure	
Issue/Background:	An incentive program can provide win-win benefits to the City and developers, reducing stormwater flooding while enabling safe and smart growth.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Code of ordinances, stormwater design guidelines, development review process
Responsible Department/Agency:	Engineering, Development Services
Priority:	Low
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Reduces stormwater flooding and the impact of new development.
Timeframe for Completion:	Year 5
Additional Notes:	No action to date, but the City still wants to pursue implementation. Engineering is reviewing examples of incentive programs for strategies that could be effective in Bryan.

5.4.c. Continue to pursue partnerships with BISD to complete stormwater projects on school sites	
Issue/Background:	Open space on school properties may be well suited to use for stormwater management that provides recreation opportunity while reducing stormwater flooding.
Alternatives Considered:	Private acquisition and preservation of floodplain land
Existing Planning Mechanism(s) to Support Implementation:	Previous collaboration between Engineering, Parks, and BISD
Responsible Department/Agency:	Engineering, Parks
Priority:	Medium
Cost Estimate:	Less than $500k
Benefits (Losses Avoided):	Reduced stormwater flooding
Timeframe for Completion:	Ongoing
Additional Notes:	The City built a regional detention pond over five years ago. BISD wants to build some new campuses and the City is looking for opportunities for partnership and applicable projects.

PUBLIC INFORMATION

6.1.a. Direct mail of FEMA flood protection information to targeted areas of high flood risk.	
Issue/Background:	Survey responses indicated the need for more outreach regarding flood risk and mitigation opportunities. Direct mailing to high risk areas ensures information is delivered to those who need it most.
Alternatives Considered:	No action
Existing Planning Mechanism(s) to Support Implementation:	BTU mailings
Responsible Department/Agency:	Engineering
Priority:	Medium
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Education and outreach support improved awareness and preparedness to protect property and life safety from flooding.
Timeframe for Completion:	Ongoing
Additional Notes:	Outreach brochures already developed

6.1.b. Develop a dam safety public education and evacuation plan for at risk areas of the community, including routes, transportation, and housing.	
Issue/Background:	Many residents do not know that they are downstream of a dam or understand the flood risk related to dams.
Alternatives Considered:	General outreach about dam safety.
Existing Planning Mechanism(s) to Support Implementation:	Emergency operations plan
Responsible Department/Agency:	Engineering, Communications, Streets and Drainage
Priority:	High
Cost Estimate:	Less than $100k
Benefits (Losses Avoided):	Education and outreach support improved awareness and preparedness to protect property and life safety from flooding.
Timeframe for Completion:	Year 3
Additional Notes:	This effort can be coordinated with existing emergency response planning.

6.1.c. Educate realtors regarding real estate disclosure as relates to flooding.	
Issue/Background:	Realtors can effectively educate potential buyers about flood risk.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Local realtors association
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Education and outreach support improved awareness and preparedness to protect property and life safety from flooding. Targeted outreach to realtors enables realtors to provide flood risk information to their clients.
Timeframe for Completion:	Develop presentation by Year 2 and continue to present annually.
Additional Notes:	The local realtors association meets regularly. Engineering Department is developing a presentation to give to this group.

6.1.d. Educate builders and landscape companies on how to properly grade new homes to protect from flood damage.	
Issue/Background:	Builders and landscapers can inadvertently cause flooding issues on-site or on neighboring properties if they improperly grade lots.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Local builders organization
Responsible Department/Agency:	Engineering, Building
Priority:	High
Cost Estimate:	Little to no cost
Benefits (Losses Avoided):	Education and outreach will reduce improper landscaping and grading and enable property owners and contractors to implement effective, safe on-site drainage maintenance projects without negatively impacting surrounding properties.
Timeframe for Completion:	Develop presentation by Year 2 and continue to present annually.
Additional Notes:	Engineering Department is developing a presentation to give to the local builders group.

6.2.a. Hold a large community event dedicated to stormwater education annually (Earth Day).	
Issue/Background:	Survey responses indicated the need for more outreach regarding flood risk and mitigation opportunities.
Alternatives Considered:	No action
Existing Planning Mechanism(s) to Support Implementation:	Communications and Marketing Department
Responsible Department/Agency:	Engineering, Streets and Drainage
Priority:	High
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Education and outreach support improved awareness and preparedness to protect property and life safety from flooding.
Timeframe for Completion:	Ongoing, Year 3
Additional Notes:	Not completed due to COVID; will be resumed and continued moving forward.

6.2.b. Create adopt-an-inlet and adopt-a-creek programs.	
Issue/Background:	Removing debris from creeks supports drainage. Citizens can support this effort and learn the importance of drainage maintenance in the process.
Alternatives Considered:	Use City resources to maintain creeks and inlets.
Existing Planning Mechanism(s) to Support Implementation:	Other communities have adopt-a-creek programs that can be used as a model.
Responsible Department/Agency:	Streets, Drainage
Priority:	Medium
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Citizen involvement in creek maintenance provides education and fosters a sense of community responsibility for the drainage system.
Timeframe for Completion:	Year 5
Additional Notes:	Participated in "Wear Blue Wednesday". Communications sent out several messages throughout the week.

6.2.c. Become more active in flood awareness week through additional social media outlets and community events.	
Issue/Background:	Survey responses indicated the need for more outreach regarding flood risk and mitigation opportunities. Multiple forms of outreach and repeated messaging are proven public education strategies.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Communications and Marketing Department
Responsible Department/Agency:	Engineering, Communications and Marketing
Priority:	Low
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Education and outreach support improved awareness and preparedness to protect property and life safety from flooding.
Timeframe for Completion:	Year 5
Additional Notes:	

6.2.d. Develop paid advertisements through public service announcements to educate the public about flood insurance and flood risk.	
Issue/Background:	Less than 24% of buildings in the SFHA are covered by a flood insurance policy. Property owners without flood insurance will have greater difficulty recovering post-flood.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Communications and Marketing Department, FEMA and NFIP outreach materials
Responsible Department/Agency:	Engineering, Communications and Marketing
Priority:	Medium
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Increasing flood insurance coverage will reduce the local economic impact of flooding.
Timeframe for Completion:	Year 4
Additional Notes:	

6.2.e. Develop and improve communication regarding preparedness and mitigation actions to better inform developers, engineers, builders, and the public about ways they can avoid flood damage.	
Issue/Background:	Survey responses indicated the need for more outreach regarding flood risk and mitigation opportunities. Targeted outreach and repeated messaging are proven public education strategies.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Communications and Marketing Department
Responsible Department/Agency:	Engineering, Communications and Marketing
Priority:	Medium
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Education and outreach support improved awareness and preparedness to protect property and life safety from flooding.
Timeframe for Completion:	Year 4
Additional Notes:	

6.2.f. Develop and present citizen floodplain and flood insurance education programs.	
Issue/Background:	Less than 24% of buildings in the SFHA are covered by a flood insurance policy. Property owners without flood insurance will have greater difficulty recovering post-flood.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	FEMA and NFIP outreach materials
Responsible Department/Agency:	Engineering
Priority:	High
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Increasing flood insurance coverage will reduce the local economic impact of flooding.
Timeframe for Completion:	Year 2
Additional Notes:	Implementation is ongoing. The City attends First Friday events to provide outreach.

6.2.g. Create educational program for flood risk to schools and youth.	
Issue/Background:	School children can bring information home and education their families about flood risk and preparedness.
Alternatives Considered:	No action.
Existing Planning Mechanism(s) to Support Implementation:	Collaboration between Engineering and BISD.
Responsible Department/Agency:	Engineering
Priority:	Low
Cost Estimate:	Less than $50k
Benefits (Losses Avoided):	Education and outreach support improved awareness and preparedness to protect property and life safety from flooding.
Timeframe for Completion:	Year 5
Additional Notes:	

7 PLAN ADOPTION

Requirement §201.6(c)(5): [The plan shall include] documentation that the plan has been formally approved by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).

The purpose of formally adopting this plan is to secure continued buy-in from the City of Bryan, raise awareness of the plan, and formalize the plan's implementation. The adoption of this plan completes Planning Step 9 of the 10-step planning process: Adopt the Plan, in accordance with the requirements of CRS Activity 510 and DMA 2000. The Bryan City Council adopted the Floodplain Management Plan by passing a resolution. A copy of the executed resolution is provided below.

[Placeholder]

8 PLAN IMPLEMENTATION & MAINTENANCE

Requirement §201.6(c)(4): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Implementation and maintenance, which is Step 10 of the 10-step planning process, is critical to achieve the intended outcomes of this floodplain management plan. This section provides an overview of the approach for plan implementation and maintenance and outlines the method and schedule for monitoring, updating, and evaluating the plan. This section also discusses integration of the plan into existing planning mechanisms and continued public involvement. It contains the following subsections:

- 8.1 Implementation
- 8.2 Maintenance

8.1 ROLE OF FMPC IN IMPLEMENTATION, MONITORING AND MAINTENANCE

With adoption of this plan, the City will be responsible for plan implementation and maintenance. The FMPC identified in Section 2 will reconvene quarterly to ensure that mitigation strategies are being implemented and that the City continues to maintain compliance with the NFIP. As such, the City agrees to continue its relationship with the FMPC and:

- Act as a forum for flood mitigation issues;
- Disseminate flood mitigation ideas and activities to all participants;
- Pursue the implementation of high-priority, low/no-cost recommended actions;
- Ensure flood mitigation remains a consideration for community decision makers;
- Maintain a vigilant monitoring of multi-objective cost-share opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Monitor and assist in implementation and update of this plan;
- Report on plan progress and recommended revisions to the City Council; and
- Inform and solicit input from the public.

The FMPC's primary duty moving forward is to see the plan successfully carried out and report to the City Council, TDEM, FEMA, and the public on mitigation opportunities and the status of plan implementation. Other duties include reviewing and promoting mitigation proposals, considering stakeholder concerns about flood mitigation, passing concerns on to appropriate entities, and posting relevant information on the City's website to support continued public involvement.

8.2 IMPLEMENTATION

Once adopted, the plan must be implemented to be effective in mitigating flood risk. While this plan contains many worthwhile actions, the City of Bryan will need to decide which action(s) to undertake first. That decision will be informed by the priority assigned the actions in the planning process as well as funding availability. Low or no-cost actions can easily demonstrate progress toward successful plan implementation while the City works to secure funding for more costly high-priority actions.

Constant monitoring of funding opportunities that can be leveraged to implement some of the costlier recommended actions will be necessary. This includes creating and maintaining a bank of ideas on how to meet local match or participation requirements. With this preparation, when funding does become

available, the City will be positioned to capitalize on the opportunity. Funding opportunities to be monitored include special pre- and post-disaster funds, state and federal earmarked funds, benefit assessments, and other grant programs, including those that can serve or support multi-objective applications.

Mitigation is also successful when it is incorporated into the day-to-day functions and priorities of government. Implementation will be accomplished by adhering to the schedules identified for each action and through constant, pervasive, and energetic efforts to network and highlight the multi-objective, win-win benefits to the community. This effort is achieved through the routine actions of monitoring agendas, attending meetings, and promoting a safe, sustainable community. Ongoing implementation and maintenance of mitigation strategies may include consistent enforcement of existing policies and vigilant review of programs for coordination and multi-objective opportunities.

8.2.1 RESPONSIBILITY FOR IMPLEMENTATION OF GOALS AND ACTIVITIES

Elected officials, community department heads, and community staff are charged with implementation of various activities in the plan. During the quarterly reviews as described later in this section, an assessment of progress on each of the goals and activities in the plan will be determined and noted. At that time, recommendations may be made to modify timeframes for completion of activities, funding resources, and responsible entities. On a quarterly basis, the priority standing of various activities may also be changed. Some activities that are found not to be feasible may be deleted from the plan entirely and activities addressing problems unforeseen during plan development may be added.

8.2.2 INCORPORATION INTO EXISTING PLANNING MECHANISMS

An important implementation mechanism that is highly effective and low-cost is incorporation of the Floodplain Management Plan recommendations and their underlying principles into other plans and mechanisms. Where possible, plan participants will use existing plans and/or programs to implement flood mitigation actions. As described in the capability assessment in Section 5, the City already implements policies and programs that reduce losses to life and property from hazards. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other planning mechanisms, including the following:

- Comprehensive Plan
- Capital Improvement Program
- Code of Ordinances
- Hazard Mitigation Plan
- Emergency Management Plan
- Other plans, regulations, and practices with a mitigation focus

Integration of the FMP with these planning mechanisms has already occurred over the last five years. FMPC members involved in these other planning mechanisms will be responsible for continuing integration of the FMP with these plans and programs as they are updated or revised in the future. Integration into existing planning mechanisms will be achieved through the routine actions of:

- Monitoring other planning/program agendas;
- Attending other planning/program meetings;
- Participating in other planning processes; and
- Monitoring community budget meetings for other integration opportunities.

Efforts will continuously be made to monitor the progress of mitigation actions implemented through other planning mechanisms and, where appropriate, priority actions from other plans will be incorporated into updates of this Floodplain Management Plan.

8.3 MAINTENANCE

Plan maintenance implies an ongoing effort to monitor and evaluate plan implementation and to update the plan as progress, roadblocks, or changing circumstances are recognized. Maintenance will occur on an established schedule according to the process discussed below.

8.3.1 MAINTENANCE SCHEDULE

The City of Bryan Engineering Services Department is responsible for initiating plan reviews. To monitor progress and update the mitigation strategies identified in the action plan, the FMPC will review this plan quarterly and following a hazard event. Quarterly reviews will be documented with meeting minutes and summarized in an annual status report that will be shared with the City Council and the public. The City will submit a five-year written update to ISO and TDEM, unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule. With this plan update anticipated to be fully approved and adopted in 2023, the next plan update will be completed in 2028.

8.3.2 MAINTENANCE EVALUATION PROCESS

Regular review and maintenance of this plan will seek to facilitate implementation, track progress towards achieving goals, and monitor changes that should be incorporated into the next plan update. Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions;
- Increased vulnerability as a result of failed or ineffective mitigation actions; and/or
- Increased vulnerability as a result of new development.

Updates to this plan will:

- Consider changes in vulnerability due to action implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Incorporate new data or studies on hazards and risks;
- Incorporate new capabilities or changes in capabilities;
- Incorporate growth and development-related changes to infrastructure inventories; and
- Incorporate new action recommendations or changes in action prioritization.

Changes will be made to the plan during the update process to accommodate for actions that have failed or are not considered feasible after a review of their consistency with established criteria, time frame, community priorities, and/or funding resources. Actions that were not ranked high but were identified as potential mitigation activities will also be reviewed during the monitoring and update of this plan to determine feasibility of future implementation. Updating of the plan will be by written changes and submissions, as is appropriate and necessary, and as approved by the City Council. In keeping with the five-year update process, the FMPC or similar committee will convene public meetings to solicit public input on the plan and its routine maintenance and the final product will be adopted by the City Council.

To inform the plan update process and to maintain and implement the plan during the interim five-year period, the FMPC will conduct plan reviews quarterly and following a hazard event. Specifically, the City will adhere to the following process for the regular review and maintenance of this FMP:

QUARTERLY PLAN REVIEW PROCESS

For the quarterly plan review process, the City of Bryan Engineering Services Department will be responsible for facilitating, coordinating, and scheduling reviews and maintenance of the plan. The quarterly reviews of the FMP will be conducted as follows:

- The City will reconvene the FMPC or similar committee to meet and review the progress toward implementation of the plan's mitigation action plan. This review will evaluate the progress made on implementation of each mitigation action listed in Section 6.4 Mitigation Action Plan.
- Meetings of the FMPC shall be published in accordance with local rules regarding public notice.
- Prior to the review, department heads and others tasked with implementation of the various activities will be queried concerning progress on each activity in their area of responsibility and asked to present a report at the review meeting.
- After each quarterly meeting, minutes of the meeting will be prepared by the City's Engineering Services Department.
- The Engineering Services Department will prepare an annual report summarizing the discussions and decisions made during these meetings.
- The results of these quarterly FMPC meetings, in the form of the annual reports, will be made available to the local news media and the City Council for informational purposes.
- The City's Engineering Services Department will maintain copies of minutes and annual reports to provide to ISO/FEMA as part of the City's annual recertification to the CRS program.

QUARTERLY PLAN REVIEW CRITERIA IN PREPARATION FOR 5-YEAR UPDATE

The criteria recommended in 44 CFR 201 and 206 will also be utilized in reviewing and updating the plan. At quarterly review meetings, the FMPC will monitor and report on changes to the following information:

- Community growth or change in the past quarter.
- The number of substantially damaged or substantially improved structures by flood zone.
- The renovations to public infrastructure including water, sewer, drainage, roads, bridges, gas lines, and buildings.
- Natural hazard occurrences that required activation of the Emergency Operations Center (EOC) and whether the event resulted in a presidential disaster declaration.
- Natural hazard occurrences that were not of a magnitude to warrant activation of the EOC or a federal disaster declaration but were severe enough to cause damage in the community or closure of businesses, schools, or public services.
- The dates of hazard events descriptions.
- Documented damages due to the event.
- Closures of places of employment or schools and the number of days closed.
- Road or bridge closures due to the hazard and the length of time closed.
- Assessment of the number of private and public buildings damaged and whether the damage was minor, substantial, major, or if buildings were destroyed. The assessment will include residences, mobile homes, commercial structures, industrial structures, and public buildings, such as schools and public safety buildings.
- Review of any changes in federal, state, and local policies to determine the impact of these policies on the community and how and if the policy changes can or should be incorporated into the Floodplain Management Plan. Review of the status of implementation of projects (mitigation strategies) including projects completed will be noted. Projects behind schedule will include a reason for delay of implementation.

8.3.3 CONTINUED PUBLIC INVOLVEMENT

Continued public involvement is imperative to the overall success of the plan's implementation. The update process provides an opportunity to solicit participation from new and existing stakeholders and to publicize success stories from the plan implementation and seek additional public comment. The plan maintenance and update process will include continued public and stakeholder involvement and input through attendance at designated committee meetings, web postings, press releases to local media, and through public meetings.

PUBLIC INVOLVEMENT PROCESS FOR QUARTERLY REVIEWS

The public will be notified by placing an advertisement on the City's website specifying the date and time for the review and inviting public participation. The minutes of each quarterly review meeting and annual status reports will be made available to the local news media and the City Council.

PUBLIC INVOLVEMENT FOR FIVE-YEAR UPDATE

When the FMPC reconvenes for the five-year update, they will coordinate with all stakeholders participating in the planning process—including those that joined the committee since the planning process began—to update and revise the plan. In reconvening, the FMPC will be responsible for coordinating the activities necessary to involve the greater public, including disseminating information through a variety of media channels detailing the plan update process. As part of this effort, public meetings will be held and public comments will be solicited on the plan update draft.

APPENDIX A PLANNING PROCESS DOCUMENTATION

A.1 PLANNING STEP 1: ORGANIZE RESOURCES

FMPC MEETING DATES, TOPICS, AND LOCATIONS

Meeting Title	Meeting Topic	Meeting Date	Meeting Location
FMPC Mtg. #1 – Project Kickoff	1) Introduction to DMA and CRS requirements and the planning process 2) Trends in disasters and justification for planning 3) Review of FMPC responsibilities and the project schedule 4) Preliminary hazard identification	April 4, 2023 4:00 p.m.	Bryan City Hall Downstairs Meeting Room, 300 S Texas Ave Bryan, TX
FMPC Mtg. #2	1) Discuss goals & objectives 2) Review mitigation action plan requirements 3) Discuss local capability 4) Review existing mitigation action progress	May 2, 2023 3:30 p.m.	Microsoft Teams Meeting
FMPC Mtg. #3	1) Review draft Hazard Identification & Risk Assessment (HIRA) 2) Discuss asset inventory, risk, and vulnerability 3) Discuss new mitigation action alternatives	June 6, 2023 3:00 p.m.	Microsoft Teams Meeting
FMPC Mtg. #4	1) Review the draft Floodplain Management Plan 2) Finalize the mitigation action plan 3) Solicit comments and feedback	August 15, 2023 3:00 p.m.	Bryan City Hall Downstairs Meeting Room, 300 S Texas Ave Bryan, TX

FMPC MEETING 1 AGENDA, MINUTES, AND ATTENDANCE

CITY OF BRYAN FLOODPLAIN MANAGMENT PLAN UPDATE

FMPC MEETING 1: APRIL 4, 2023

AGENDA

1. Introductions
2. Community Rating System Overview
3. Why Plan?
4. Project Overview
   a. Disaster Mitigation Act (DMA) Requirements
   b. CRS Activity 510 Requirements
5. Floodplain Management Plan (FMP) Planning Process
   a. Review of the 10 Step Process
6. Project Schedule
7. Next Steps

City of Bryan, TX Floodplain Management Plan (FMP)
Floodplain Management Planning Committee Meeting #1
Tuesday, April 4, 2023, 4:00 p.m.
Bryan City Hall Downstairs Meeting Room

David Stroud from WSP, the City's consultants, was in attendance to facilitate the meeting according to the following agenda:

- Introductions
- Community Rating System (CRS) Overview
- Why Plan?
- Project Overview
  - Disaster Mitigation Act (DMA) Requirements
  - CRS Activity 510 Requirements
- FMP Planning Process
  - Stakeholder Coordination
  - Public Outreach
  - Risk Assessment Update
- Project Schedule
- Next Steps

There were nineteen people in attendance, nine members of City staff and 10 stakeholders:

- Sam J. Vernon, P.E., CFM, Asst. City Engineer/Floodplain Manager
- Paul Kaspar, P.E., CFM City Engineer
- Allison Kay, AICP Senior Planner
- David Schmitz, Parks and Recreation Director
- Shawndra Green-Curry, P.E., Bryan Texas Utilities
- Lacey Lively, Communications and Marketing Manager
- Jeanelle Gottlob, Emergency Management Coordinator
- Stacy Liner, Streets and Drainage Supervisor
- Gary Harrison, GIS
- Greg Cox, CBO, CFM, Chief Building Officer
- Jacqueline Rice, Greenbrier HOA
- Michele Meade, Brazos County Emergency Management Coordinator
- Sahai Fleurant, American Red Cross
- Jacob Torres, PhD, P.E., J. M. Torres & Associates
- Mynde Kessler, State Farm Insurance
- Rabon Metcalf, P.E, RME
- Jeff Robertson, P.E., McClure & Browne
- Steve Pittman, Developer/Homebuilder
- Ron Clary, Bryan Independent School District

CRS Program Overview

The CRS Program, in which the City of Bryan participates, is a voluntary, point-based program that provides a 5% premium discount to flood insurance policyholders for every 500 points that the City earns.

Currently, the City is a Class 8, which provides a 10% discount to policyholders in the SFHA. The annual savings to all policyholders in the community is $21,394, with an average annual per policy discount of $79 in the SFHA. If the City has enough credit points through this Activity 510 Floodplain Management Plan and additional CRS activities of credit, the City could lower its classification to 7 and 15% reduction in flood insurance premiums. This would raise the average discount for policies in the SFHA to $119.

Trends in Disasters

David discussed that there have been more disaster declarations in recent years as well as increased cost for disaster response and recovery, in part due to population growth and development in hazardous areas which has increased exposure. In 2022 there were 18 disaster events with losses exceeding $1 billion. Three of the costliest disasters across the US have been in Texas, two of which were flood related.

David explained that we must plan for mitigation because the costs of response and recovery are growing, many events are predictable or repetitive, loss reduction works, and there are funds available to help. The average benefit-cost ratio for a federally funded mitigation project is 6:1.

DMA Planning Requirements

David reviewed the intent of DMA planning and explained the basis of DMA planning requirements in the Code of Federal Regulations, which establish the four-phase planning process. This process dovetails with the CRS Program's 10-Step planning process. The completed plan will meet all the requirements of both programs.

CRS Requirements

Activity 510 FMP 10-Step Process

The purpose of a floodplain management plan is to reduce potential losses from future disasters. David reviewed the FMP planning process noting that the planning requirements of the DMA outline four ordered phases: 1) organize resources, 2) risk assessment, 3) develop a mitigation plan, and 4) adoption and implementation. These phases outline a ten-step planning process reflected in both DMA and CRS planning requirements. David reviewed the 10-Step planning process, which is as follows:

1. Organize to Prepare the Plan
2. Involve the Public
3. Coordinate
4. Assess the Hazard
5. Assess the Problem
6. Set Goals
7. Review Possible Activities
8. Draft an Action Plan
9. Adopt the Plan
10. Implement, Evaluate, and Revise the Plan

Phase 1: Organize Resources

Step 1 – Organize to Prepare the Plan

In this step the City convened the FMPC which includes local staff, citizens, and stakeholders. Additionally, the City can organize existing resources and inventory what tools, data, and services are available to create the plan.

Step 2 – Plan for Public Involvement

Prepare and develop ways to engage the public in the planning process. This could include integrating the public on the planning team, posting information on websites, developing press releases, and implementing surveys and questionnaires. The City can receive 5 points for every additional public information activity implemented (up to 30 points).

2

The WSP planning team has developed a public survey that will help the Committee better understand the community's experiences and concerns with flooding. The survey can be accessed at the link HERE.

Step 3 – Coordinate with Other Departments and Agencies

The FMPC should seek the support of other departments for assistance with plan development. These agencies can help connect with the public, provide critical information and data, and provide important insight that enriches the FMP. Please see the presentation for a list of potential departments and agencies.

Phase 2: Risk Assessment

Step 4 – Identify the Hazards

Hazard identification explores what types of events may occur within the City. Hazards are profiled based on their extent, past occurrences, seasonal patterns, magnitude, and other factors.

Step 5 – Assess the Risks

The risk assessment considers what assets will be affected as well as the location a hazard can occur, previous occurrences, potential impacts, probability, and extent of the evaluated hazards. This step also considers the City's existing local capability to implement mitigation projects.

David briefly discussed the range of data and tools used to evaluate assets and assess risk including building footprint and parcel data, and FEMA's Hazus loss estimation tool.

Phase 3: Develop a Mitigation Plan

Step 6 – Set Planning Goals

The FMPC will evaluate the goals from the current plan and decide if any changes need to make to them or if additional goals need to be added. These goals will guide the creation and implementation of the Plan's mitigation strategy.

Step 7 – Review Mitigation Alternatives

The FMPC will review and choose mitigation activities that reflect the goals and capability of the City.

Step 8 – Draft Action Plan

The FMPC along with City staff will identify and prioritize action and determine which department is responsible for particular mitigation actions, when the actions will be completed, and how they will be financed.

Phase 4: Adoption and Implementation

Step 9 – Adopt the Plan

At this step, the plan will be adopted by City Council. The public will have the opportunity to review and provide input that will be incorporated into the plan before adoption.

Step 10 – Implement, Evaluate and Revise the Plan

Plan implementation requires several steps including assigning an overall project manager and integrating actions into staff work plans. Overtime, the FMPC should monitor changes in vulnerability, report on progress, publicize successes, and revise the plan as necessary. The DMA and CRS program require updates every 5 years. After the plan is adopted the FMPC can maximize CRS credit by meeting quarterly to review plan progress.

Discussion

David reviewed the hazards that have been identified for the FMP and asked the Committee if there were any additional hazards that should be evaluated for the City. The Committee agreed that the list below was comprehensive.

- Riverine and Stream Flooding
- Stormwater/Urban/Localized

- Dam Failure
- Erosion

City staff agreed there were certain locations subject to erosion but there were also capital improvement projects in place to address some the areas of concern.

Mr. Stroud asked if subsidence was an issue locally and the FMPC indicated it was more of issue further south in the state and in other adjoining states to Texas.

A question was raised on insurance discounts and how were they applied. Mr. Stroud indicated they are applied annually to each flood insurance policy.

Jeanelle Gottlob indicated that Bryan would be starting the process to become a StormReady community under NOAA and asked if they could receive credit under CRS activity 610. Mr. Stroud indicated that they would receive credit; however, a prerequisite is that the community would need to stand up a Flood Warning and Response program first before StormReady credit could be applied.

Michele Meade indicated that she is seeing more flooding outside of the Special Flood Hazard Area (SFHA). Mr. Stroud indicated that country-wide approximately 30% of all flood losses occurs outside of any floodplain in a C or X-Zone on the map.

Mynde Kessler indicated that more people are buying flood insurance outside of the SFHA.

Several other comments were provided on the impacts of flood and other hazards throughout the area.

Next Steps

David described the various ways that the public can be involved in the planning process including a public meeting at 5:30 PM in the Council Chambers.

The next FMPC meeting will focus on mitigation action updates as the primary focus for the meeting. The minutes of the meeting along with the Power Point presentation will be sent to the FMPC.

CITY OF BRYAN
The Good Life, Texas Style.

Meeting Sign-in Sheet
2023 Flood Mitigation Plan Committee

PROJECT # 425-D1-2303
April 4, 2023 - 3:30 P.M. CST
City of Bryan Municipal Office Building

NAME	E-MAIL
Sam Vernon	svernon@bryantx.gov
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Lacey Lively	llively@bryantx.gov
Jacob Torres	jmtorres@torresassociatesllc.com
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RABON MITCHELL	RABON CRMENGINEER.COM

Jeff Robertson	jeffr@mcclurebrowne.com
Steve Pitman	Steve@stevepitman.info
Ron Clary	ron.clary@bryanisd.org

FMPC MEETING 2 MINUTES AND ATTENDANCE

City of Bryan, TX Floodplain Management Plan (FMP)
Floodplain Management Planning Committee Meeting #2
Tuesday, May 2, 2023, 3:30 p.m.
Microsoft Teams

David Stroud and Ranger Ruffins from WSP, the City's consultants, facilitated the meeting according to the following agenda:

- Introductions
- Discuss Feedback from Public
  - Public Meeting
  - Survey Update
  - Resident Email
- Review and Set Goals and Objectives
- Discuss Mitigation Capability
- Review Existing Mitigation Actions
- Next Steps

There were nineteen people in attendance:

- Sam J. Vernon, P.E., CFM, Asst. City Engineer/Floodplain Manager
- Paul Kaspar, P.E., CFM City Engineer
- Brianna Groves, P.E., CFM, Civil Engineer
- Allison Kay, AICP, Senior Planner
- Jeanelle (Gottlob) Johnson, Emergency Management Coordinator
- Gary Harrison, GIS
- Greg Cox, CBO, CFM, Chief Building Officer
- Jacqueline Rice, Greenbrier HOA
- Rabon Metcalf, P.E, RME
- Jeff Robertson, P.E., McClure & Browne
- Steve Pittman, Developer/Homebuilder
- Ron Clary, Bryan Independent School District
- Erin Marietta, CHI St. Joseph Health
- Grant Carrabba, Developer
- Mark Feldhake, Blinn College
- Michele Bailey-Meade, Brazos County Emergency Management
- David Stroud, WSP
- Ranger Ruffins, WSP
- Abby Moore, WSP

Discuss Feedback from Public

David began by reviewing feedback from the public that was received at the public meeting, via the survey, and via email. At the public meeting, flooding along Turkey Creek was stressed. Sam Vernon confirmed that this is one tributary where water flows into Bryan from College Station, as opposed to most creeks which from out of Bryan toward College Station and elsewhere. Creek erosion was also discussed as a potential source of flooding, especially in residential areas behind homes where property

owners may not understand the impact of yard debris on the drainage system or may not be completing proper care and maintenance of streams. The cumulative impact of new developments was also discussed, highlighting the impact of increased impervious surface. Buffer zones, increase stormwater management requirements, and increased effort to maintain open space were all suggested as potential mitigation measures.

From the survey there have been 85 responses so far. Suggested steps for the City to take to address flood problems include a more robust drainage program, clearing debris from drainage system and waterways, maintaining green space, and providing more information to homeowners on how to take preventative measures.

Goals and Objectives

Ranger presented the existing goals for a discussion on whether they are still appropriate and relevant or whether any changes are needed. The existing goals are as follows:

1. Develop and improve outreach and public awareness
2. Protect and enhance natural floodplain and stormwater resources
3. Provide fiscally responsible funding
4. Protect the health and safety of the public

Ranger noted that at least one project will be needed for each goal. Goals are meant to be broad-based and comprehensive. To get more specific about ways to pursue each goal, we can develop objectives; however, the current setup of the mitigation action plan already achieves this to some degree, so new objectives are not necessary. Ranger presented some recommendations for potential revisions to the goals and asked for feedback from the committee on these recommendations or other thoughts on updates or changes.

David suggested revising Goal 1 to include educating the public on opportunities for homeowner responsibility to protect property and reduce risk.

Regarding Goal 2, Ranger and David suggested that natural resources and stormwater infrastructure should be addressed separately. Ranger presented two strategies from the City's MS4 that relate to preserving and protecting natural open space, green space, and other natural resources, which could be appropriate to integrate into the FMP. Michele Meade indicated that continued growth in green space and increases in impervious surface have put the brunt of impacts on existing homeowners and businesses and there is a need to consider how future development can minimize these negative impacts.

Sam Vernon indicated that the City is always looking for external grant funding and suggested the existed Goal 3 be revised to focus on searching for additional external funding mechanisms. Ranger noted that there are existing action items that reference seeking grant funding.

David suggested that Goal 4 could be revised to include health, safety, and welfare of the public.

David also noted that there is not any mention of protection of critical facilities in the existing goals. Erin Marietta indicated that she wants to ensure that there are protections for access to the hospital. Sam Vernon and Janelle Gottlob supported adding a goal related to critical facility protection and continuity of critical and essential services.

Ranger presented the goals from the Brazos County Hazard Mitigation Plan to provide additional ideas for potential new or revised goals that the FMPC may want to add to this plan update.

Michele Meade supported the idea of homeowner education, property protection, flood insurance, and other steps that people can learn and take to protect themselves from flood hazards. David noted that several homeowners asked about this type of information at the first public meeting. Michele added that

this type of solution could be something as simple as a landscaping issue that could be easily mitigated by an individual homeowner.

David indicated that WSP can provide a set of revised draft goals based on this discussion for the committee to review and provide comments on.

Sam asked what a good number of goals would be; David suggested four or five goals is an ideal target, and six should be a maximum, as more than that may become cumbersome and repetitive. David also noted that some goal topics may be interrelated and can be integrated into a single goal. The aim should be to ensure that the goals are broad-based and to not repeat the same ideas. If the FMPC wants to add additional details related to the goals, this can be done with objectives which can be used to identify more specific intended outcomes for each goal.

Capability Assessment

Ranger discussed the capability assessment and the types of plans, policies, staff and technical resources, and fiscal resources, that the consultant team will review to understand current local capacity for project implementation as well as gaps in capability and potential opportunities for improvement. The WSP team will coordinate with City of Bryan staff to gather this information.

Mitigation Actions

David discussed mitigation actions and how to distinguish between a true mitigation project and a regular floodplain management duty. Mitigation is a sustained action taken to reduce or eliminate long-term risk to people and property, whereas floodplain management duties are ongoing efforts that are part of City staff's regular responsibilities. For example, conducting annual reviews of the flood damage prevention ordinance or conducting ongoing maintenance of drainage channels are not considered mitigation. However, a revision to the standards in the flood damage prevention ordinance or a new drainage improvement project would be considered mitigation projects.

The aim of the FMP update is to identify mitigation actions that are concrete projects with a set beginning and end and measurable results. There are four general approaches to mitigation. Altering the hazard to change how or where it occurs, averting the hazard such as with flood walls or barriers, adapting to the hazard with building codes or land use tools that protect new development, or avoiding the hazard by moving people and property out of harm's way.

Another way to think about mitigation actions is through FEMA's six mitigation categories, which are prevention, property protection, natural resource protection, emergency services, structural projects, and public information.

Existing Mitigation Actions

David began to present on the 64 existing mitigation actions, which are included in the presentation slides. David encouraged the FMPC to remove ongoing floodplain management activities and other staff duties that will be completed regardless of whether they are included in the action plan. He provided action 1.1.c as an example of a project that is likely an ongoing floodplain management activity. Sam Vernon confirmed that 1.1.c is a normal staff duty.

Paul Kaspar added that some of the actions could be combined into a single action rather than being deleted entirely. Paul cautioned about deleting actions and risking losing CRS credit from the plan. David clarified that the mitigation action plan will still maximize CRS credit, but there are some actions will be completed such as 1.1.a and 1.1.c that would be completed regardless of whether they are included in the mitigation action plan or not.

David noted that rather than spend time during this meeting going through each mitigation action, WSP will work with the appropriate staff assigned for project implementation to review action statuses and determine whether actions can be deleted, whether they have been completed and can be removed, or whether they should be carried forward for future implementation. The aim is to get the action plan

updated prior to the next FMPC meeting to have a clear picture of what actions will be carried forward and what gaps may exist in the action plan. Paul also noted that many of the actions will be able to be marked as completed.

David explained that to review possible activities, the FMPC will consider ideas from each of the FEMA mitigation categories, review the existing mitigation actions, review the risk and vulnerability assessment and any new mitigation needs, and consider public feedback. These topics will be discussed at the next meeting.

Project Schedule

David provided an update on the project schedule. The next meeting will be on the first Tuesday of June to review the draft Hazard Identification and Risk Assessment and discuss new mitigation action ideas.

There may be a pause in the meeting schedule depending on progress on the full draft plan. The final meeting will be on the first Tuesday of either July or August.

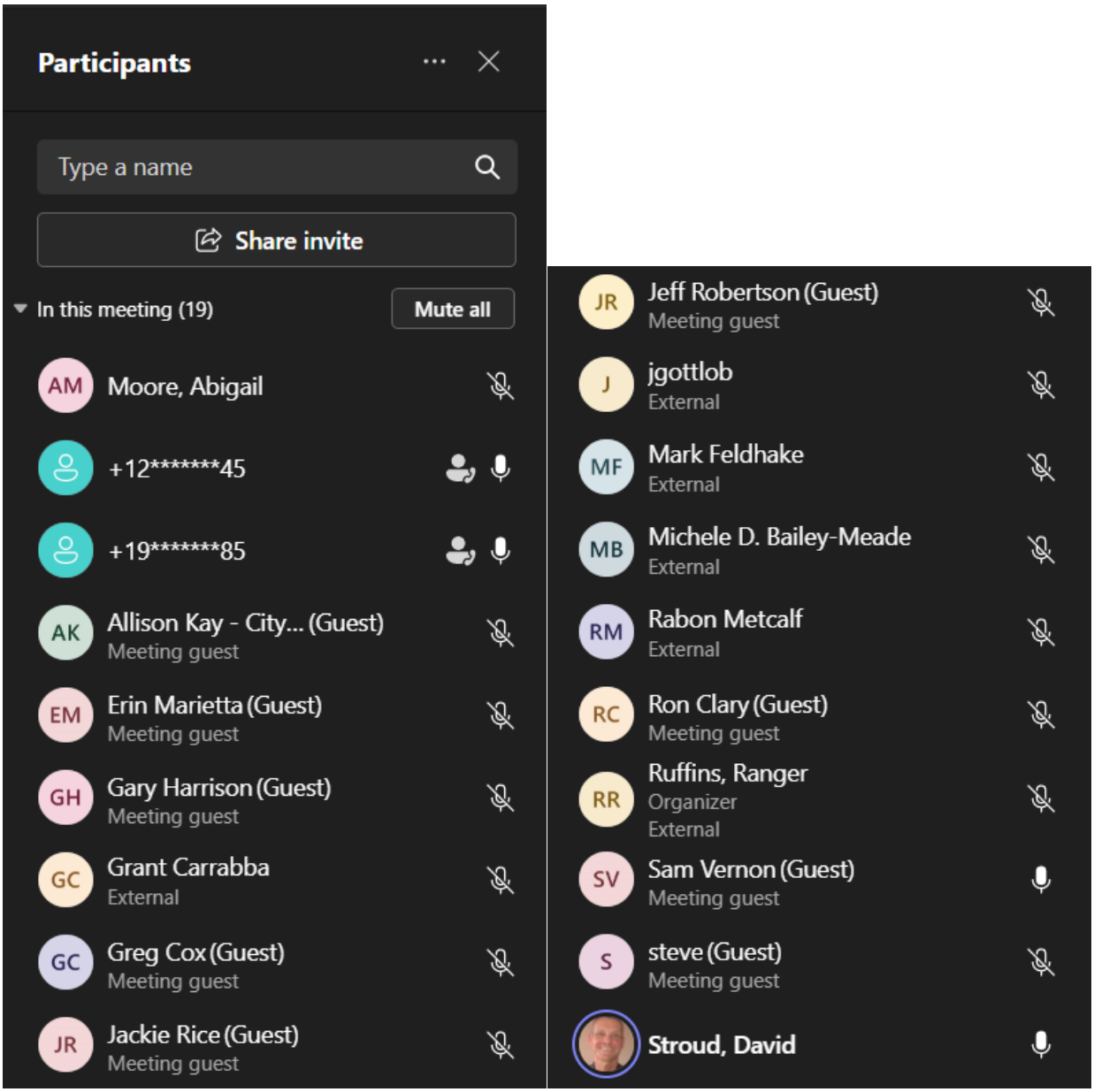
What's Next & Discussion

Ranger reiterated that the WSP is working on the risk and vulnerability assessment, which will be presented at the next FMPC meeting. WSP will also schedule a meeting with staff to discuss capability.

David noted that next FMPC meeting will focus on mitigation action updates as the primary focus for the meeting. The minutes of the meeting along with the Power Point presentation will be sent to the FMPC.

Requests for FMPC input include reviewing the existing mitigation actions and brainstorming new actions. Regarding new mitigation action ideas, David also emphasized the importance of including projects from other related plans such as the Capital Improvements Plan, which underlines to FEMA that the City is serious about the project.

The FMPC is also asked to review the draft goals that will be sent out separately following the meeting. Feedback can be sent to Sam Vernon or David Stroud.


Participants
Type a name
Share invite
In this meeting (19)
Mute all
AM Moore, Abigail
+12*******45
+19*******85
AK Allison Kay - City... (Guest)
Meeting guest
EM Erin Marietta (Guest)
Meeting guest
GH Gary Harrison (Guest)
Meeting guest
GC Grant Carrabba
External
GC Greg Cox (Guest)
Meeting guest
JR Jackie Rice (Guest)
Meeting guest
JR Jeff Robertson (Guest)
Meeting guest
J jgottlob
External
MF Mark Feldhake
External
MB Michele D. Bailey-Meade
External
RM Rabon Metcalf
External
RC Ron Clary (Guest)
Meeting guest
RR Ruffins, Ranger
Organizer
External
SV Sam Vernon (Guest)
Meeting guest
S steve (Guest)
Meeting guest
Stroud, David

FMPC MEETING 3 AGENDA, MINUTES, AND ATTENDANCE

CITY OF BRYAN FLOODPLAIN MANAGMENT PLAN UPDATE

FMPC MEETING 3: JUNE 6, 2023

AGENDA

1. Where we are in the Planning Process
2. Hazard Identification & Risk Assessment (HIRA) Review
   a. HIRA process and organization in the plan
   b. Hazard Identification
   c. Asset Inventory
   d. Hazard Profiles: Risk & Vulnerability Assessment
3. Public Survey Update
4. Mitigation Goals
5. Mitigation Action Plan
   a. Evaluate Existing Mitigation Strategy
   b. Brainstorm New Possible Activities
6. Next Steps

City of Bryan, TX Floodplain Management Plan (FMP)
Floodplain Management Planning Committee Meeting #3
Tuesday, June 6, 2023, 3:00-5:00 p.m.
Microsoft Teams

David Stroud, Ranger Ruffins, and Abby Moore from WSP, the City's consultants, facilitated the meeting according to the following agenda:

- Introductions
- Where we are in the Planning Process
- Hazard Identification & Risk Assessment (HIRA) Review
  - HIRA process & organization in the plan
  - Hazard Identification
  - Asset Inventory
  - Hazard Profiles: Risk & Vulnerability Assessment
- Public Survey Update
- Mitigation Goals
- Mitigation Action Plan
  - Evaluate Existing Mitigation Strategy
  - Brainstorm New Possible Activities
- Next Steps

There were 21 people in attendance:

- Brianna Groves, P.E., CFM, City of Bryan Civil Engineer
- David Schmitz, Director of Parks & Recreation
- Erin Marietta, CHI St. Joseph Health
- Gary Harrison, City of Bryan IT & GIS Supervisor
- Grant Carrabba, Developer
- Greg Cox, CBO, CFM, City of Bryan Chief Building Officer
- Jacqueline Rice, Greenbrier HOA
- Jacob Torres, Torres & Associates
- Jeanelle (Gottlob) Johnson, City of Bryan Emergency Management Coordinator
- Jeff Robertson, P.E., McClure & Browne
- Lacey Lively, City of Bryan Marketing & Communications Manager
- Michele Bailey-Meade, Brazos County Emergency Management
- Mynde Kessler, Farmer's Insurance
- Paul Kaspar, P.E., CFM City of Bryan City Engineer
- Sam J. Vernon, P.E., CFM, City of Bryan Asst. City Engineer/Floodplain Manager
- Rabon Metcalf, P.E, RME Engineering
- Ricardo Reyna, RNL Homes
- Steve Pittman, Developer/Homebuilder
- David Stroud, WSP
- Ranger Ruffins, WSP
- Abby Moore, WSP

After reviewing the agenda, David asked attendees to introduce themselves and then explained that Slido polling would be used throughout the meeting to encourage participation and feedback from attendees. Poll results are included at the end of the minutes.

Where we are in the Planning Process

David explained that we are in the middle of the planning process. We have completed initial data collection from a variety of sources and have evaluated hazard risk and vulnerability according to Step 4 Assess the Hazard and Step 5 Assess the Problem. Step 6 Set Goals began at our last meeting when we reviewed the existing plan goals. The goals are now finalized based on FMPC feedback and verification of the revised goals. In this meeting we are moving toward Step 7 Review Possible Activities. At our next meeting we will have a draft plan, which will complete Step 8. The plan will be reviewed for CRS credit prior to adoption in Step 9. After adoption, City staff and mitigation action leads will be responsible for Step 10 Implement, Evaluate, and Revise the Plan.

HIRA Review

David explained the four-step process used to develop the HIRA, which is to identify hazards, profile hazard events, inventory assets, and estimate losses. Jacob Torres asked for clarification on the difference between vulnerability and exposure. David explained that exposure is the total inventory of assets within the City whereas vulnerability reflects what could be impacted or damaged by each hazard. Depending on the hazard and the data and tools available to evaluate it, vulnerability may be presented as a quantitative and/or qualitative assessment.

David provided an overview of the organization of the HIRA in the plan. Everything is consolidated in Section 4 of the plan, Flood Risk Assessment, which is broken into the following sub-sections:

- 4.1: Hazard Identification
- 4.2: Risk Assessment Methodology
- 4.3: Asset Inventory
- 4.4: Hazard Profiles, Analysis, and Vulnerability
- 4.5: Risk and Vulnerability Conclusions

Hazard Identification

Abby explained that to identify the hazards included in the plan, WSP reviewed the 2018 TX Hazard Mitigation Plan (HMP), the 2019 Brazos County HMP, and the 2018 City of Bryan Floodplain Management Plan (FMP). Dam failure and riverine flooding were included in all three plans. Erosion was included in the state plan and discussed as a component of riverine flooding in the FMP. Stormwater flooding was also discussed in the FMP. This plan update includes all four of these hazards with separate profiles of risk and vulnerability for each hazard. Abby also presented information on past hazard events, including past major disaster declarations and emergency declarations as well as reported storm events from NOAA's National Centers for Environmental Information (NCEI) Storm Events Database, which were reviewed as part of the identification and evaluation of the hazards. Bryan has experienced flooding and received disaster declarations for both severe thunderstorms and tropical storm systems. It was noted that NCEI data is at the county level and may be incomplete in terms of event counts, damage estimates, and death and injury estimates, but that event narratives provide useful context on the local occurrences and impacts of flooding.

Asset Inventory

Abby presented the building inventory, which was compiled using City of Bryan building footprint data and Brazos County parcel and appraisal data. Building exposure in the city includes over 30,000 buildings with total value of over $10 million. Total building value is over $6.5 million and content values were estimated using Hazus methodology.

Hazard Profiles

Abby presented the methodology for profiling each hazard in the plan. She also presented the Priority Risk Index methodology, which was used to provide a general rating of overall risk for each hazard. The FMPC was encouraged to provide feedback regarding the PRI scoring and whether any ratings should be adjusted.

Abby presented an overview of findings and PRI ratings for each of the four hazards.

Dam Failure: There are 37 High hazard dams in Brazos County including 5 high/significant hazard dams that are in or upstream of Bryan. There have been three separate failures of dams in the area, which were at Leisure Lake Dam (2009), Bryan Utilities Lake Dam (2015), and low hazard Clifty Creek Dam (2017). The average age of dams in 58 years old, which could suggest the need for maintenance and repairs; however, there were no poor inspection records on the high/significant hazard dams. Exposure estimates from the 2018 FMP and 2019 Brazos County HMP were presented. These numbers could not be updated as we do not have access to inundation area data in GIS.

- Michelle Bailey-Meade shared that the Lake Linda dam located at 47 and Leonard failed in approximately 2000-2001; Sam Vernon confirmed that based on aerial/satellite imagery it occurred between 1999 and 2002. No homes or structures were damaged, but it flooded the area and was a permanent breach; there is no longer any impoundment at the dam.

Erosion: Data for the erosion hazard was largely pulled from the 2019 Briar and Burton Creeks Erosion Master Plan and is limited to these stream reaches. Five areas of severe erosion were identified. Specific vulnerabilities include: exposed utility lines at risk of damage and/or structural failure; damage to concrete linings in multiple areas, compromising structural integrity, including under a bridge and near residential properties and roads; powerlines exposed and threatened; downcutting and undermining of channel banks threatening nearby townhomes; potential bank failure threatening nearby residential structures; and silted in detention ponds with reduced capacity and performance.

Riverine Flooding: Approximately 11% of Bryan is located within the Special Flood Hazard Area (SFHA) which is vulnerable to flooding from the 1%-annual-chance flood. NCEI reports 17 events related to riverine flooding which have caused a total estimated $16.6M in property damages. Using a Level 2 Hazus analysis, WSP evaluated flood vulnerability and estimates that 675 buildings would sustain damage from the 1%-annual-chance flood, totaling $10.8M in damages. This equates to a 7% loss estimate, which is below FEMA's 10% loss estimate threshold for estimating potential for severe difficulty in recovering from a flood event. Abby showed the location of buildings with losses, which are primarily concentrated along Burton Creek, Briar Creek, Carters Creek, Still Creek, and Thompsons Branch.

- Jacob asked how first floor elevations for structures were determined for the Hazus loss estimate. Abby explained that first floor elevations were an assumption in Hazus. David added that these assumptions are affected by input assumptions of foundation type, which were estimated by City of Bryan Engineering staff.

Stormwater/Localized Flooding: There are 29 storm event reports and $1.4M in property damages in NCEI with event narratives that mention street flooding or drainage issues. Additionally, the City has received numerous drainage complaints and has identified areas of street flooding which have been mapped to identify stormwater flooding problem areas. Some drainage complaints are located in the floodplain and may reflect that some people are unaware of their riverine flood risk and incorrectly associated with drainage issues; other drainage complaints all located across the City and outside the SFHA. There were also about 40 locations of stormwater flooding noted in the public survey for this plan. Stormwater flooding is typically less deep than riverine flooding but can still impact structures.

Abby summarized areas likely to continue flooding and changes that may affect flooding in the future. The PRI ratings and scores shown below were presented for discussion.

Hazard	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
Dam Failure	Possible	Limited	Negligible	Less than 6 hours	Less than 1 week	2.1
Erosion	Likely	Limited	Negligible	12 to 24 hours	More than 1 week	2.3
Riverine Flooding	Likely	Critical	Moderate	6 to 12 hours	Less than 1 week	3.0
Stormwater/ Localized Flooding	Highly Likely	Limited	Small	Less than 6 hours	Less than 24 hours	2.9

Abby summarized areas likely to continue flooding and changes that may affect flooding in the future. The PRI ratings and scores shown below were presented for discussion along with a poll asking FMPC to indicate which hazards, if any, should have their scoring adjusted.

- Several people, including Jacob and Sam, indicated that Stormwater Flooding should be adjusted to reflect a higher priority. It was agreed that the spatial extent should be increased to moderate to reflect that these floods can be widespread across the city.
- Dam failure was also discussed. Jeanelle Johnson suggested that it might be appropriate to increase the extent rating to critical given the proximity of Bryan Utilities Lake Dam. Michelle Bailey-Meade shared that older inundation maps did not show flooding in Bryan from failure of this dam but that may have changed now based on annexation. It was decided that the magnitude rating would be adjusted depending on the risks to the City presented in the Emergency Action Plan. Sam has requested the EAP for Bryan Utilities Lake Dam.
- One vote was cast for revising the Erosion rating but there was no discussion on these changes.

Abby provided some tips for reviewing the HIRA and asked that FMPC members provide comments and feedback, including any other suggested changes to the PRI scores. She also noted that we still need critical facility and infrastructure data as well as repetitive loss data to finish the HIRA.

Public Survey Update

Ranger presented preliminary results from the public survey. About 75% of respondents have experienced flooding. Most comments reflect flooding in backyards, driveways, and neighborhood streets, with several reports of difficulty driving due to flooded streets, including at low water crossings. Many comments also noted storm drains being blocked.

About 57% of respondents are very concerned about being impacted by flooding and 52% have taken action to protect their property from floods, including with sandbags, elevation, retention, improved drainage, and grading their property. About 56% of respondents do not have flood insurance and another 12% do not know if they have flood insurance. Reasons provided for not having insurance include having never considered it (21%), not needing it due to other property protection (41%), or other reasons including not being in the floodplain, only considering it now that flooding has increased, or not having had issues so far (25%). Some of these answers reflect a lack of information or understanding of flood insurance, and outreach on the topic may be effective to increase coverage.

Many responses were received from the public on ideas for mitigation. Ranger presented a variety of suggestions and opened a poll asking FMPC members to rank the top three suggestions that they would most like to see incorporated into the mitigation action plan. The resulting top three actions and discussion on these actions are as follows:

- Clean out drainage infrastructure regularly.

- Clean up waterways (Burton & Carters Creek).
    - Jackie Rice indicated that this is important to her because her neighborhood drains to Carters Creek and its drainage is important to mitigating flooding for her area.
- Provide information to property owners on ways to address/protect against flooding in their neighborhoods and homes.
    - Michele noted that from an EM perspective there are a lot of things happening around TX that can be applied here and shared through workshops with property owners.

Ranger concluded by presenting results on preferred outreach; email is the best way for most people to receive information, following be mail and the City website.

Mitigation Goals

Ranger presented the updated goals which were discussed at the last meeting and finalized based on FMPC feedback and verification of the proposed revisions. The plan goals are as follows:

1. Protect the health, safety, and welfare of the public.
2. Increase outreach and public awareness to encourage citizens to responsibly protect property from flood damage.
3. Protect and enhance natural floodplain functions by preserving natural open space, green space, and drainage corridors.
4. Improve stormwater management including the impact of new development on stormwater runoff.

Mitigation Action Plan

Ranger discussed important steps and considerations for generating new mitigation actions, including reviewing FEMA's six mitigation categories, existing mitigation actions, risk & vulnerability findings, input from stakeholders, and public feedback. She asked that FMPC members consider what may be missing from the existing action plan, what challenges are unique to their field of expertise, and personal challenges with flooding and how those issues could be addressed. For more context, she reviewed examples of the types of projects that fall within each of the six FEMA mitigation categories.

Evaluate Existing Mitigation Strategy

Ranger summarized the 70 actions from the existing mitigation action plan by FEMA mitigation category. Some of these actions have been completed or will be deleted. Public Education and Prevention are most heavily represented; property protection and natural resource protection have the fewest existing actions. Ranger opened up a poll asking FMPC members to rank the FEMA mitigation categories based on how important they think it is to pursue projects in each category. The resulting ranking was as follows:

1. Prevention
2. Property Protection
3. Public Education
4. Emergency Services
5. Natural Resource Protection
6. Structural Projects

David noted that there were only four property protection projects in the existing plan, so this ranking is a sign that we need to identify more property protection measures for the updated plan.

Existing Projects

David reviewed existing mitigation objectives and actions from the 2018 plan for the top three ranked categories from the poll. Regarding property protection projects, two of the projects are more closely associated with public education on how property owners can protect their properties. The other project is

for acquisition and/or elevation, which requires a property owner be a willing participant. Existing prevention projects include floodplain management activities/regulations, open space preservation, improving data availability, and ongoing maintenance efforts. Existing public information projects include targeted outreach and general outreach regarding flood risk. There are already numerous existing public education projects.

Possible Actions

David reviewed some possible new mitigation actions for each hazard identified in the plan.

Dam Failure: Most people don't realize they are downstream of a dam. Reviewing or developing inundation areas to better educate the public and identify opportunities for property protection or open space preservation

Erosion: Possible actions include vegetative management around creeks, implementing projects from the Erosion Master Plan, updating and expanding the Erosion Master Plan to evaluate additional creeks, and reviewing community complaints to inventory eroded areas on additional stream reaches.

Riverine Flooding: Recommendations included developing an open space acquisition, reuse, and preservation plan; adopting a post-disaster recovery ordinance and/or plan; and preparing a CRS Substantial Damage Plan, RLAA, and/or PPI.

Stormwater/Localized Flooding: Possible new activities include working with local organizations to develop a stream clean up program; adopting a zero discharge policy for new subdivision design; notifying residents of road closures or flood prone streets to avoid; limiting allowable impervious surface; and incorporating LID techniques in new development and/or incentivizing homeowners to implement LID techniques on their properties.

Stakeholder Input

Abby asked that stakeholders consider opportunities for new mitigation actions related to their areas of expertise that can be led by their organization or by the City. She presented this list of questions to help stakeholders brainstorm action ideas relevant to them:

- Engineers: What types of studies and/or structural projects would you like to see completed in the long-term?
- Developers: What are some flood mitigation techniques you would like to see used more often in new development? How can the City provide support? What are your challenges with implementation?
- Insurance: What advice would you give homeowners in order to protect their homes (outside of purchasing insurance)? Are there gaps in people's understanding of flood insurance?
- Response agencies: What types of emergencies are you most often responding to during flood events? What trainings, tools, other resources would be useful?
- Schools: Are there opportunities for education/outreach to your students and community?
- Residents/community: What successful mitigation projects have you observed in your community that could be expanded across the City?
- Public health/medical: Who have you found to be most vulnerable/in need of support during flood events and what could be done to aid them?

Abby shared that an online form has been created in Microsoft Teams to allow FMPC members to submit mitigation action ideas for inclusion in the plan. The FMPC was asked to submit mitigation actions by Friday, July 14th. The mitigation action plan will be finalized at the fourth and final FMPC meeting in August.

The link to submit mitigation actions is https://forms.office.com/r/J6avWw55vC.

Next Steps & Discussion

Abby indicated that the draft HIRA will be sent to the FMPC for review by the end of the week if not sooner. The FMPC is asked to provide comments and feedback by Friday, June 30th. Comments can be sent to Abby at abigail.moore@wsp.com.

The FMPC is asked to submit mitigation actions via the Forms link by Friday, July 14th.

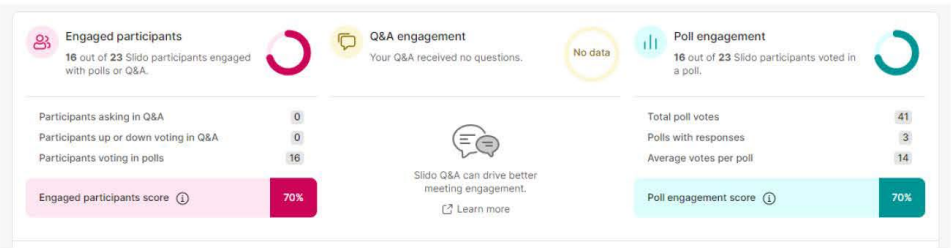
A separate meeting will be scheduled with Sam and other relevant staff to update the capability assessment.

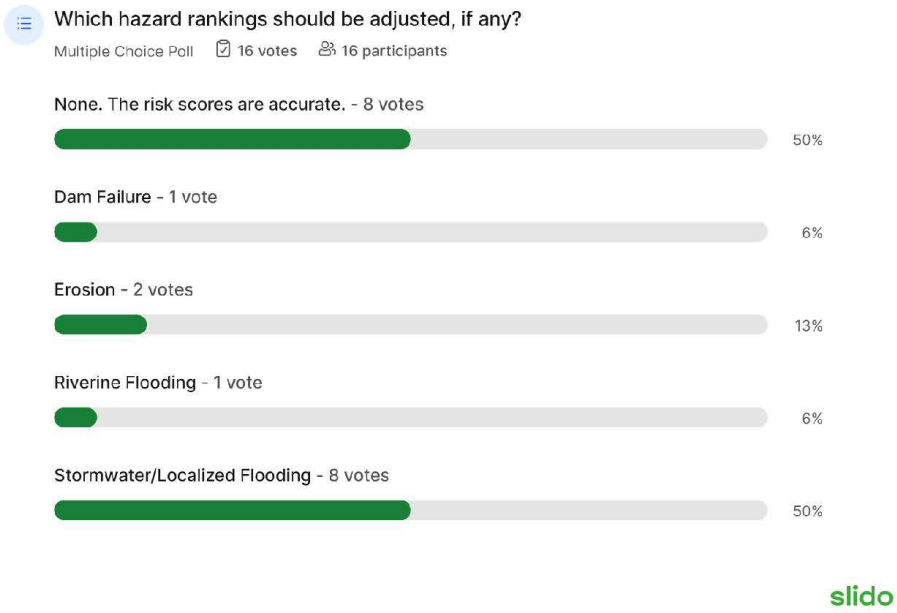
The public survey will be closed on Friday, June 30th.

There will not be an FMPC meeting in July. The next FMPC meeting will be in August. At this meeting we will review the draft plan and finalize the mitigation strategy.

There was some discussion on a potential new mitigation action related to stormwater flooding and watershed timing analyses. Rabon Metcalf asked about replicating what the City of College Station has done with a small-scale watershed timing analysis to better understand flows, volumes, etc. Sam noted the City has asked for an evaluation in some areas but is unfamiliar with College Station's example. Rabon indicated he will provide Sam with the document College Station is using that provides useful guidance on detention and where and when it is needed. Paul Kaspar noted that it is a study done 8-10 years ago by Water Earth for College Station and said that Bryan's evaluations are more of a big picture within each watershed. This may be discussed further for inclusion in the mitigation strategy.

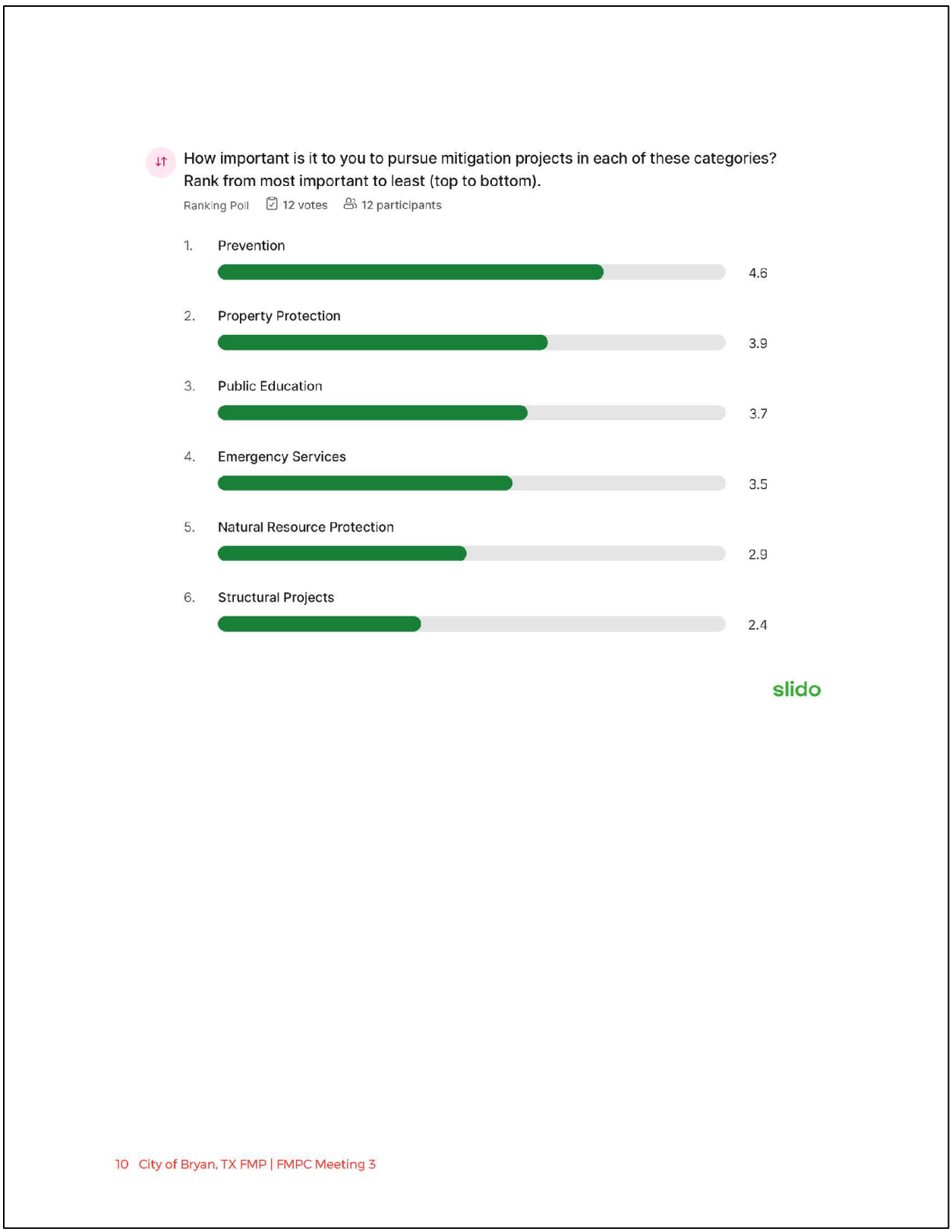
Poll Results

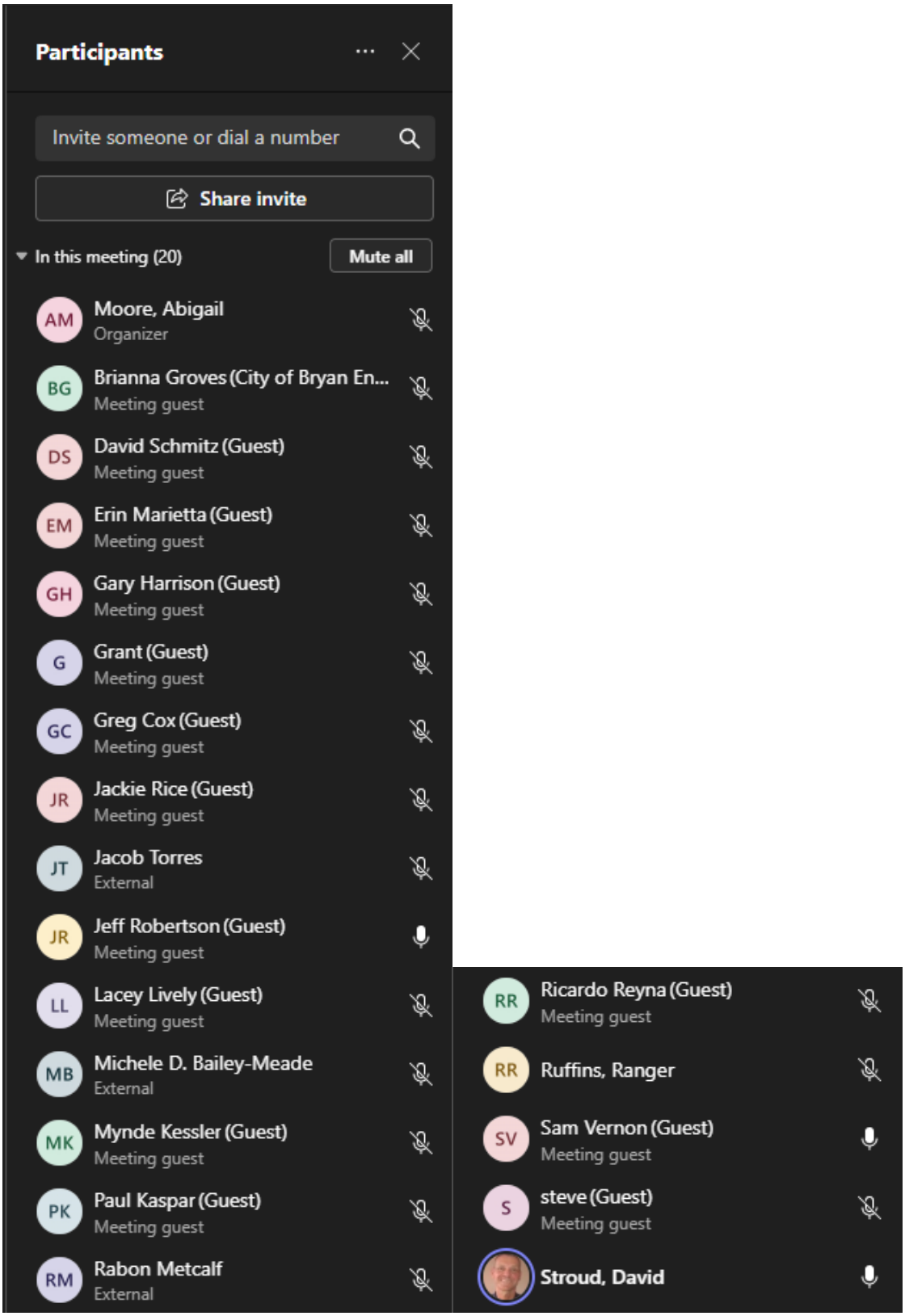




8 City of Bryan, TX FMP | FMPC Meeting 3


Which projects would you most like to see incorporated into the Mitigation Action Plan? Please rank your top three.
Ranking Poll
13 votes
13 participants
1. Clean out drainage infrastructure regularly (inlets, pipes, culverts) 1.6
2. Provide information to property owners on ways to address/protect flooding in their neighborhoods and homes 0.9
3. Clean up waterways (trash and vegetation) (Burton Creek and Carter Creek) 0.8
4. Reduce impervious surface cover for new developments and re-development 0.7
5. Expand drainage capacity near creeks and update existing infrastructure 0.6
6. Further manage runoff from new construction 0.5
6. Seek further opportunities for green space and open space 0.5
8. Additional warning signs for flooded areas and frequently flooded areas 0.3
slido
9 City of Bryan, TX FMP | FMPC Meeting 3


How important is it to you to pursue mitigation projects in each of these categories? Rank from most important to least (top to bottom).
Ranking Poll
12 votes
12 participants
1. Prevention
4.6
2. Property Protection
3.9
3. Public Education
3.7
4. Emergency Services
3.5
5. Natural Resource Protection
2.9
6. Structural Projects
2.4
slido
10 City of Bryan, TX FMP | FMPC Meeting 3


Participants
Invite someone or dial a number
Share invite
In this meeting (20)
Mute all
AM Moore, Abigail Organizer
BG Brianna Groves (City of Bryan En... Meeting guest
DS David Schmitz (Guest) Meeting guest
EM Erin Marietta (Guest) Meeting guest
GH Gary Harrison (Guest) Meeting guest
G Grant (Guest) Meeting guest
GC Greg Cox (Guest) Meeting guest
JR Jackie Rice (Guest) Meeting guest
JT Jacob Torres External
JR Jeff Robertson (Guest) Meeting guest
LL Lacey Lively (Guest) Meeting guest
MB Michele D. Bailey-Meade External
MK Mynde Kessler (Guest) Meeting guest
PK Paul Kaspar (Guest) Meeting guest
RM Rabon Metcalf External
RR Ricardo Reyna (Guest) Meeting guest
RR Ruffins, Ranger
SV Sam Vernon (Guest) Meeting guest
S steve (Guest) Meeting guest
Stroud, David

FMPC MEETING 4 AGENDA, MINUTES AND ATTENDANCE

CITY OF BRYAN FLOODPLAIN MANAGMENT PLAN UPDATE

FMPC MEETING 4: AUGUST 15, 2023

AGENDA

1. Where we are in the Planning Process
2. Review of the Draft FMP
   a. Organization of the Plan
   b. Key Plan Components
      i. Planning Process
      ii. Public Survey
      iii. Risk Assessment
      iv. Mitigation Strategy
3. Discussion and Next Steps
   a. Plan Adoption
   b. Plan Implementation & Maintenance
   c. Draft Plan Review Deadline

Minutes placeholder

Minutes placeholder

Minutes placeholder

Attendance placeholder

A.2 PLANNING STEP 2: INVOLVE THE PUBLIC

PUBLIC MEETING DATES, TOPICS, AND LOCATIONS

Meeting Type	Meeting Topic	Meeting Date	Meeting Locations
Public Meeting #1	1) Introduction to DMA, CRS and the planning process 2) Introduction to hazard identification	April 4, 2023 5:00 – 6:00 p.m.	Bryan City Hall Downstairs Meeting Room, 300 S Texas Ave Bryan, TX
Public Meeting #2	1) Review draft Floodplain Management Plan 2) Solicit comments and feedback from the public	August 15, 2023 5:30 – 6:30 p.m.	Bryan City Hall Downstairs Meeting Room, 300 S Texas Ave Bryan, TX

PUBLIC MEETING 1 AGENDA, MINUTES, ATTENDANCE, AND OUTREACH

CITY OF BRYAN FLOODPLAIN MANAGMENT PLAN UPDATE

PUBLIC MEETING 1: APRIL 4, 2023

AGENDA

1. Introductions
2. Community Rating System Overview
3. Why Plan?
4. Project Overview
   a. Disaster Mitigation Act (DMA) Requirements
   b. CRS Activity 510 Requirements
5. Floodplain Management Plan (FMP) Planning Process
   a. Review of the 10 Step Process
6. Project Schedule
7. Opportunities to Stay Involved

City of Bryan, TX Floodplain Management Plan (FMP)
Floodplain Management Planning Public Meeting #1
Tuesday, April 4, 2023, 5:30 PM.
Council Chambers

David Stroud from WSP, the City's consultants, was in attendance to facilitate the meeting according to the following agenda:

- Introductions
- Community Rating System (CRS) Overview
- Why Plan?
- Project Overview
  - Disaster Mitigation Act (DMA) Requirements
  - CRS Activity 510 Requirements
- FMP Planning Process
  - Stakeholder Coordination
  - Public Outreach
  - Risk Assessment Update
- Project Schedule
- Next Steps

There were more than fourteen residents in attendance, and five staff members from the City of Bryan.

CRS Program Overview

The CRS Program, in which the City of Bryan participates, is a voluntary, point-based program that provides a 5% premium discount to flood insurance policyholders for every 500 points that the City earns. Currently, the city is a Class 8, which provides a 10% discount to policyholders in the SFHA. The annual savings to all policyholders in the community is $21,394, with an average annual per policy discount of $79 in the SFHA. If the City were to lower their CRS classification to 7 the annual average savings in the SFHA would rise to $119.

Trends in Disasters

David discussed that there have been more disaster declarations in recent years as well as increased cost for disaster response and recovery, in part due to population growth and development in hazardous areas which has increased exposure. In 2022 there were 18 disaster events with losses exceeding $1 billion. Three of the costliest disasters across the US have been in Texas, two of which were flood related.

David explained that we must plan for mitigation because the costs of response and recovery are growing, many events are predictable or repetitive, loss reduction works, and there are funds available to help. The average benefit-cost ratio for a federally funded mitigation projects is 6:1.

DMA Planning Requirements

David reviewed the intent of DMA planning and explained the basis of DMA planning requirements in the Code of Federal Regulations, which establish the four-phase planning process. This process dovetails with the CRS Program's 10-Step planning process. The completed plan will meet all the requirements of both programs.

CRS Requirements

Activity 510 FMP 10-Step Process

1 City of Bryan, TX FMP | Public Meeting 1

The purpose of a floodplain management plan is to reduce potential losses from future disasters. David reviewed the FMP planning process noting that the planning requirements of the DMA outline four ordered phases: 1) organize resources, 2) risk assessment, 3) develop a mitigation plan, and 4) adoption and implementation. These phases outline a ten-step planning process reflected in both DMA and CRS planning requirements. David reviewed the 10-Step planning process, which is as follows:

1. Organize to Prepare the Plan
2. Involve the Public
3. Coordinate
4. Assess the Hazard
5. Assess the Problem
6. Set Goals
7. Review Possible Activities
8. Draft an Action Plan
9. Adopt the Plan
10. Implement, Evaluate, and Revise the Plan

Phase 1: Organize Resources

Step 1 – Organize to Prepare the Plan

In this step the City convened the FMPC which includes local staff, citizens, and stakeholders. Additionally, the City can organize existing resources and inventory what tools, data, and services are available to create the plan.

Step 2 – Plan for Public Involvement

Prepare and develop ways to engage the public in the planning process. This could include integrating the public on the planning team, posting information on websites, developing press releases, and implementing surveys and questionnaires. The City can receive 5 points for every additional public information activity implemented besides the public attending a meeting. (Up to 30 points). Mr. Stroud explained different ways to involve the public in the planning process.

The WSP planning team in cooperation with City of Bryan staff developed a public survey that will help the Committee better understand the community's experiences and concerns with flooding. The survey can be accessed at the link HERE.

Step 3 – Coordinate with Other Departments and Agencies

The FMPC should seek the support of other departments and outside stakeholders for assistance with plan development. These agencies can help connect with the public, provide critical information and data, and provide important insight that enriches the FMP. Please see the presentation for a list of potential departments and agencies.

Phase 2: Risk Assessment

Step 4 – Identify the Hazards

Hazard identification explores what types of events may occur within the City. Hazards are profiled based on their extent, past occurrences, seasonal patterns, magnitude, and other factors.

Step 5 – Assess the Risks

The risk assessment considers what assets will be affected as well as the location a hazard can occur, previous occurrences, potential impacts, probability, and extent of the evaluated hazards. This step also considers the City's existing local capability to implement mitigation projects.

David briefly discussed the range of data and tools used to evaluate assets and assess risk including building footprint and parcel data, and FEMA's Hazus loss estimation tool.

2

Phase 3: Develop a Mitigation Plan

Step 6 – Set Planning Goals

The FMPC will develop a set of goals that will guide the creation and implementation of the Plan's mitigation strategy.

Step 7 – Review Mitigation Alternatives

The FMPC will review and choose mitigation activities that reflect the goals and capability of the City.

Step 8 – Draft Action Plan

At this step, the City will identify and prioritize action and determine which department is responsible for particular mitigation actions, when the actions will be completed, and how they will be financed.

Phase 4: Adoption and Implementation

Step 9 – Adopt the Plan

At this step, the plan will be adopted by City Council. The public will have the opportunity to review and provide input that will be incorporated into the plan before adoption.

Step 10 – Review Mitigation Alternatives

Plan implementation requires several steps including assigning an overall project manager and integrating actions into staff work plans. Overtime, the FMPC should monitor changes in vulnerability, report on progress, publicize successes, and revise the plan as necessary. The DMA and CRS program require updates every 5 years. After the plan is adopted the FMPC can maximize CRS credit by meeting quarterly to review plan progress.

Discussion

David reviewed the hazards that have been identified for the FMP and by the Floodplain Management Planning Committee. The following are the hazards that will be profiled in the Floodplain Management Plan,

- River and Stream Flooding
- Stormwater/Urban/Localized Flooding
- Dam Failure
- Erosion

Mr. Stroud encourage the public to complete either the online or hard copy survey so that we could gather as much information on specific flooding problems. Once the survey has ended the data will be aggregated and analysed and brought forward to the Floodplain Management Planning Committee for consideration.

This public presentation was to provide an overview of the floodplain management planning process and was not intended to provide any recommendations for projects or solutions. That work will take place over the next several months.

Many were concerned about flooding along Turkey Creek and water flowing into Bryan from College Station. Paul Kaspar the City's engineer pointed out that the majority of water flows from Bryan into College Station.

Some were concerned about a City of College Station proposed sanitary sewer project that could impact some Residents within Bryan.

Other residents were concerned about what they could do to protect their buildings from flooding and what could be done along creeks behind their homes to reduce the potential from flooding and erosion of the creek banks.

Three large tables were setup with floodplain maps and noted areas of reported flooding. These tables were manned by City engineering staff to answer specific questions about attendees flooding concerns.

Next Steps

David noted that WSP would work with the City to find other ways to involve the public and planning process and the City's website would be used to inform the public of the work of the FMPC and that minutes and presentations would be posted online for review. A final public meeting will be held at the end of the planning process.

4

CITY OF BRYAN
The Good Life, Texas Style.

Public Meeting Sign-In Sheet
Flood Mitigation Plan Public Meeting

PROJECT # 425-D1-2303
April 4, 2023 - 5:30-7:00 P.M. CST
City of Bryan Municipal Office Building

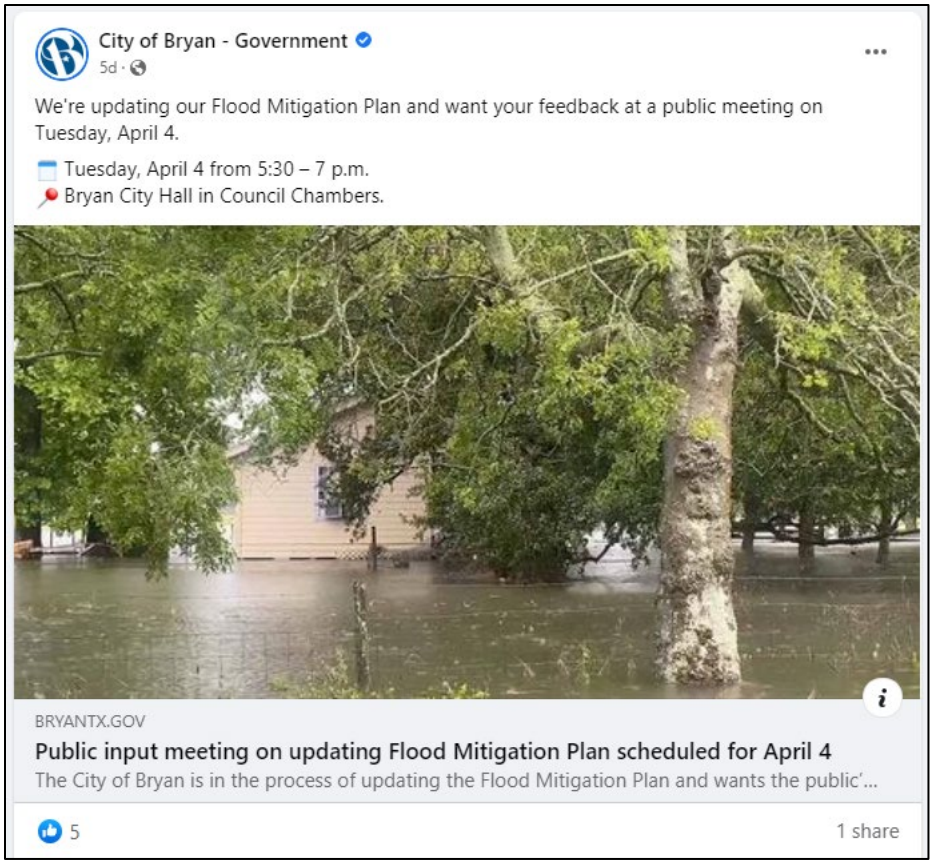
NAME	ADDRESS	PHONE NUMBER	E-MAIL
JOHN COLVIN	824 VINE ST. BRYAN	979-218-2570	SEC.JCOLVIN@GMAIL.COM
LORI COLVIN	824 VINE ST. BRYAN	979-218-2387	lmccolori@gmail.com
Dustin Pedretti	813 Vine St. Bryan	979-402-0535	Dustin.Pedretti@gmail.com
Charles Coats	119 Lake St.	979 823 7200	ccoats@habitatbcs.org
Christine Lipsmeyer	809 S. Rosemary Dr.	979-676-3484	cslips@gmail.com
Jenafer R Weber	810 S Rosemary Dr	979 204 9475	jweber@mwishop.com
Mary Linne	729 Shady Lane	979-571-9654	jmlinne@gmail.com
Guy Whitten	809 S Rosemary	9795759021	guyclwhitten@yahoo.com
Brent and Candice Kelm	719 Inwood Dr.	469-222-7888	cmkelm07@gmail.com
David Deutsch	2417 Norton	469-834-3803	david@stonesidehomes.com
James Mulvey	809 Vine St.	832 651-6549	Jamesmulvey08@gmail.com

CITY OF BRYAN
The Good Life. Texas Style.

Public Meeting Sign-In Sheet
Flood Mitigation Plan Public Meeting

PROJECT # 425-D1-2303
April 4, 2023 - 5:30-7:00 P.M. CST
City of Bryan Municipal Office Building

NAME	ADDRESS	PHONE NUMBER	E-MAIL
Charles O. Hadduff	3923 Old Oaks 25		
Claire Haddock	3923 Old Oaks 25 77802		
Kathleen Shuddell	3923 old Oaks	979-846-5684	Shudhad59@gmail.com


City of Bryan - Government
5d ·
We're updating our Flood Mitigation Plan and want your feedback at a public meeting on Tuesday, April 4.
Tuesday, April 4 from 5:30 – 7 p.m.
Bryan City Hall in Council Chambers.
BRYANTX.GOV
Public input meeting on updating Flood Mitigation Plan scheduled for April 4
The City of Bryan is in the process of updating the Flood Mitigation Plan and wants the public'...
5
1 share


THE GOOD LIFE
CITY OF BRYAN NEWSLETTER
Get the latest news and events information from the City of Bryan delivered straight to your inbox.
enter your email address here
Submit
Are you new to Bryan? Check out our New Resident Guide.
March 29, 2023
Home / Articles / Engineering / Public input meeting on updating Flood Mitigation Plan scheduled for April 4
Public input meeting on updating Flood Mitigation Plan scheduled for April 4
The City of Bryan is in the process of updating the Flood Mitigation Plan and wants the public's input at a kickoff meeting on Tuesday, April 4 from 5:30 – 7 p.m. at Bryan City Hall in Council Chambers.
The meeting will provide an overview of the plan's purpose and give an opportunity for residents and stakeholders to provide feedback to help

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TOP STORY

Bryan residents asked to share flooding concerns

Bailey Brown Apr 3, 2023 0

1 of 2

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00:00 05:18

Bailey Brown

Bryan residents are invited to give feedback about flooding concerns to city engineers, in an effort to make updates to the city's Flood Mitigation Plan from 5:30-7 p.m. Tuesday at Bryan City Hall's council chambers.

According to city staff, the meeting will provide an overview of the plan's purpose and give an opportunity for residents and stakeholders to provide feedback to help the planning committee identify flood risks, understand vulnerabilities and select achievable mitigation strategies to protect from flood impacts.

"The city of Bryan participates in a Community Rating System program, which is a voluntary incentive program that encourages good flood plain management practices, that exceed the National Flood Insurance Program standards," Sam Vernon, the city's assistant city engineer, told The Eagle on Monday. "And with that, citizens within the city limits of Bryan can purchase flood insurance through the NFIP; and because of our enforcement of flood plan ordinances and managing our flood plain, citizens actually enjoy a 10% discount in their insurance premiums because of these efforts."

KBTX | 60° Bryan, TX

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City of Bryan hosts public meeting to update flood mitigation plan

Updated: Apr. 4, 2023 at 11:00 PM EDT

KBTX News 3 at Ten(Recurring)

PUBLIC MEETING 2 AGENDA, MINUTES, ATTENDANCE, AND OUTREACH

CITY OF BRYAN FLOODPLAIN MANAGMENT PLAN UPDATE

PUBLIC MEETING 2: AUGUST 15, 2023

AGENDA

1. Where we are in the Planning Process
2. Review of the Draft FMP
   - a. Organization of the Plan
   - b. Key Plan Components
     - i. Planning Process
     - ii. Public Survey
     - iii. Risk Assessment
     - iv. Mitigation Strategy
3. Next Steps
   - a. Plan Adoption
   - b. Plan Implementation & Maintenance
   - c. Draft Plan Review Deadline
4. Discussion and Feedback

Minutes placeholder

Minutes placeholder

Attendance placeholder

Publicity placeholder

Publicity placeholder

OTHER PUBLIC OUTREACH EFFORTS

PUBLIC SURVEY

1. What is your affiliation with the City of Bryan

More Details

I live in Bryan	124
I work in Bryan	4
I visit Bryan for shopping/recrea...	2
Other	6

2. Have you ever experienced or been impacted by high water or flooding in Bryan?

More Details

Yes	102
No	35

3. If you answered "Yes" to question 2, please explain your experience with flooding and provide the location of the incident.

104 Responses

1	anonymous	Water accumulates along the outer lanes of S College and Villa Maria streets during heavy rains.
2	anonymous	High water on Esther st. coming up driveway, caused by blockage of storm drain to creak and filling in of drainage dips across Carter Creek Parkway.
3	anonymous	The water drainage is poor in the area of 24th and Sims. Water rises very high when it rains. When flooding occurs the water backs up and pushes towards home. There are no curbing on the street to prevent flooding .
4	anonymous	I live at 3923 Old Oaks in the Old Oaks townhome complex. I have had the parking lot flood and could not leave the complex because of the high water.
5	anonymous	My neighborhood is in the area of Blinn College 25th/N. Coulter area. We do not have many issues with flooding unless we experience a heavy rain event and then a number of the streets between Downtown Bryan (where I work) and home flood due to rainfall rates and sheer volume of the water trying to drain off.
6	anonymous	Home has never flooded, but yard and street (Vine Street) have making exit from property only possible with high clearance vehicles such as pickup truck.
7	anonymous	5605 Chelsea Circle Creek runs thru our property in Copperfield. In heavy rains the water covers our backyard and has gone under our pier and beam house on several occasions.
8	anonymous	Flood from creek over roadway and yard
9	anonymous	As a real Estate developer I experience this in my neighborhoods
10	anonymous	Villa Maria near McDonald's water over road. Carter creek parkway near tangle wood intersection similar water over road and stalled car.
11	anonymous	Driveway does not drain properly (Wheeler Ridge Neighborhood)
12	anonymous	Flooding on Lake St. east of Cavitt
13	anonymous	I live in front of Pin Oak creek. During high rain occasions, the creek floods my back yard.
14	anonymous	Too many to list. There are many areas impacted by heavy rains.
15	anonymous	809 S Rosemary Dr The lowest level of the house has flooded three times since 2008. The last time in 2016.

16	anonymous	809 S Rosemary We last flooded in 2016
17	anonymous	I have lived at the corner of Tanglewood & Carter Creek for 10 years. We have experience significant flash flooding in this intersection and there are no warning signs. We have helped pull out dozens of cars over the years or worse woken up to stranded vehicles when the rain/flooding was overnight
18	anonymous	Home flooded twice in 2018
19	anonymous	I have lived on Park Lane (Rosemary) for 18 years and have experienced high water once in that time. The banks of Carter Creek overflowed above the cul de sac on Park Lane.
20	anonymous	I live in Austin's Colony on 2701 Colony Village Dr. . We had a substantial rain event several years ago. Our street flooded some homes had these folks had to replace flooring. Heard from neighbors it was due to construction in the area. We live near Carter's Creek that runs through the park.
21	anonymous	At the end of Teton Dr. and Big Horn Dr. In north Bryan. In front of our House the street and curb is sunken and when we get heavy rains it accumulates a huge puddle in front of our mailbox and eventually starts to flood the street bc the storm drains can't keep up.
22	anonymous	I live in the Lester addition where Bristol and Esther flood frequently.
23	anonymous	The location is my driveway. With minimal rain as long as its for longer than an hour the street will flood and overflow to my driveway
24	anonymous	Today. Our backyard floods
25	anonymous	Tornado/heavy rain event - Flooding in all parts of the city. Swiftwater conditions at low water crossings across the eastern part of the county/city.
26	anonymous	Ever since the city dug a trench behind my house to help flooding up the street, it now pushes water onto my property and floods my backyard to the point where water reaches the weepholes of the house.
27	anonymous	Neighbors down the street have had their homes flooded. Water from the creek has reached our deck and our back door because it cannot flow under the Burton Dr. bridge fast enough and gets backed up into our yard.
28	anonymous	Flooding at 1179 and grassbur road.

29	anonymous	Our property at 803 mary lake dr will flood anytime we get a lot of rain- especially if it is rapid accumulation. The reservoir on lazy lane will overflow and spill over into our yard as well as from the front of the street on Mary lake as it overflows into our yard as well. The drainage on Mary lake and lazy lane is too small and cannot hold large amounts of water at one time. I've brought this up to the city planning office and water/sewer departments many time since buying my house about 7 years ago. I've made extensive changes to prevent my house from flooding but the issues in the reservoir and drainage on the streets remain and continue to spill over onto my property.
30	anonymous	My backyard floods every time it rains
31	anonymous	There's always high water on Baker Ave when it rains.
32	anonymous	3506 Pioneer Circle, Bryan, TX. Heavy rain run-off from the Boonville Cemetery floods into my backyard then runs through the yard onto Pioneer Circle.
33	anonymous	Frequent flooding in my back yard at 2301 Oxford Street.
34	anonymous	FM1179 & Grassbur Road, Democrat Road, Hwy 21 near Wixon Valley.
35	anonymous	In my neighborhood Austin's Colony. My back yard floods during the rainy season
36	anonymous	Hwy 6 access road & Osborn intersection in front of Napa Auto & Crawford electric supply in Bryan floods during heavy rain. There's several potholes in the road due to saturation issues. During heavy rainfall in May 2016, water backed up to between Weatherly Dr & Chinaberry Dr. on Osborn Ln.
37	anonymous	Woodville Road near texas Avenue flooding. And we have to re route when it rains because it is really high on the street and around the homes.
38	anonymous	General. road flooding
39	anonymous	flooded roads. McAshan Street, Ursuline, Cole St
40	anonymous	North Bryan by the H-E-B on 21 will get really bad specially when picking up kids from school. Also right be palasota will also flood I've seen it get into the vehicles
41	anonymous	Flood on roads and yards throughout greenbrier and austin colony neighborhoods
42	anonymous	4208 Meadowbrook Dr May 2016
43	anonymous	I live in Vine Street, When it rain the back yard become a lake..
44	anonymous	Vine St. near Pin Oak Creek

45	anonymous	2303 Kent St., Bryan, TX 77802 Incident happened in 2017 during an extended period of multiple rounds of heavy, quick rain. Due to the quickness and multiple down pours, water from multiple neighboring back yards flowed into my side and back yard at a rate that was too fast for the water to adequately drain out of the back yard and into the street (via low ditch areas & multiple french drains) which led to a backup the water on the side of the house. The water rose above the weep holes at the foundation of the house and then proceeded to leak inside the house after the water had risen 2-3 inches above the foundation.
46	anonymous	Our home flooded October of 2013 or 2014 when living in the cul de sac of Skrivanek. The street flooded and came into our home while we were away out of town. Came home to find the flooded home. We had to pull up carpet on the ground floor of our home and remediate the mold and then we remodeled the house. We no longer live on Skrivanek.
47	anonymous	Flooding on Cherry Creek Circle in Bryan
48	anonymous	I love on Kent St at the intersection of Oxford St. I am a professor emeritus in civil engineering at TAMU. I have studied and photographed several flood events in the Upper Burton Creek neighborhood.
49	anonymous	After heavy rains, our yard floods and is slow in draining. Our house is right on E WJB and there is very little grading to allow for water runoff. We live near Sue Haswell Park on E WJB and the park sometimes floods as well (although I believe that is by design).
50	anonymous	The green area by the creek behind the residence at 3221 Rose Hill Lane. Water remains after heavy rains.
51	anonymous	In regard to the creek that runs behind Rose Hill Lane in the Greenbrier addition. There are highs and lows in the creek. In addition the creek needs dredged to eliminate water backing up and sitting for long periods of time.
52	anonymous	My backyard floods when it rains more than a few hours or a large amount falls in a short interval. The flood waters are also eroding the ground. My backyard is against a public utility easement and I have considered putting in a retaining wall to block the water but worry about the erosion.
53	anonymous	Elmo street is always flooding
54	anonymous	The intersection of Carter Creek and Tanglewood Dr.
55	anonymous	809 S Rosemary Dr. The creek next to our house overruns its banks and floods our driveway. The first floor of our house has flooded three times since we've owned the house (2008). The water in our creek flows from College Station into Bryan. In heavy rain, the water in the creek backs up and floods. Our house is not in a FEMA floodplain, although part of our property is in a 100 year floodplain.

56	anonymous	My street Strwamside Way has flooded preventing me from coming or going from my property in the past.
57	anonymous	There is no drainage at the corner of Briton Drive and Bedford Court. All of the rain from both streets flows to the corner and down the driveways of 2621 & 2625 (both homes have driveways that slope downward) with the majority of the water flowing to 2625 Briton Drive. At 2625 sometimes the floodwater is so great that it enters 2-3 ft into the garage. Even if it's a short rainfall, the amount of water is great and doesn't take long to flood. It also eroded the grassy areas at 2625 from the force of the water and dumped the eroded soil and whatever the rainwater brings with it (oil, leaves, debris, etc.) into the driveway. If there are multiple days of rain, the amount of cleanup every time is overwhelming. It is definitely a biohazard issue. Even though there is a very large sewer drain at the corner of Bedford Court and Oak Hill Drive, the water does not flow that way! The drain is needed at the Briton/Bedford corner desperately! The standing water after it rains at the corner (from the top to the driveway into the street) is about 2-4 ft and 4 inches deep, sometimes reaching as far as the mailbox at 4101 Bedford Court. Last summer after days of rain, we first had thousands of tadpoles in the standing water in the street, which (with more rain), flowed down the driveway and 2625 Briton had thousands of dead/dying tadpoles in front of the garage (could not open garage until the water evaporated).
58	anonymous	I live at 4018 Woodbriar Dr. in Bryan, Texas and there's a drain in front of our house in the street but when it rains all the rain pours from other neighbors yards down into our back yard and out the front. It literally floods a little river around our house I've even had people stop and tell me that I have massive amounts of water coming out of my house, and I would just say no that is just flooding. We did buy flood insurance because of this and it has come in the house before but only a couple of times. It comes from Woodcrest behind us.
59	anonymous	I just want to make a correction to the previous server. There is no drain in the cul de sac in front of 4018 Woodbriar Dr. But that is not the problem. Water runs thru the backyards from Woocrest thru the. backyard of 4018 Woodbriar Dr.
60	anonymous	3506 oak valley circle. Flooding reached from creek into 4 homes on our street and has to replace floors, cabinets, walls.
61	anonymous	Old reliance road flooding
62	anonymous	Been here 8 months, rain not bad enough YET, but when it does, it is only time. My backyard has your easyway behind it & it is terrible condition, especially when it also get tires & other dumps in it.
63	anonymous	Valley Oaks drive Water flooded to the back door

64	anonymous	water runs over the street at the drainage ditch culverts each time it rains hard. it gets so deep that cars cannot drive through the water and the water comes up into our yard and driveway. It has not reached our cars yet, but if it rained for longer, it could get to our cars parked in the driveway. There are 4 culverts under the street but the water stills flows over the top of the street
65	anonymous	Greenbelt area behind the homes on Rose Hill lane. Water accumulates and standing water. Does not drain. Result is a breeding ground for mosquito larvae. A French drain needs to be installed to drain the water to the creek. Also downed trees and debris needs to be cleared from the creek.
66	anonymous	Live behind Burton Creek. Started in 2013 with water entering home. Have 1960's drainage and too much water at our drains from multiple points (from Avondale and Texas Avenue). 2016 was another event where house flooded. Any heavy rain event must prepare with sand bags. We need french drains like on Melba and/or another drain to take this excess water. 2021 had another event to water entered home and had to make extensive repairs to damaged walls from standing water.
67	anonymous	I had to use a different route due to high water over the road in order to get home.
68	anonymous	The creek next to our house leaves its banks several times a year. It has entered our house twice since 2015.
69	anonymous	roadway flooding as a result of flashy high volume rainfall events.
70	anonymous	We live at 3801 Courtney Cir. For the last 8yrs flooding has been horrible. We get all run off water from all back properties. The city did construction on our street to make the drains bigger but this has had little to no effect on the flooding. All neighbors will say the same.
71	anonymous	Austin's Creek off of Old Reliance Rd.
72	anonymous	My yard regularly floods during heavy rains. The runoff isn't usually very quick.
73	anonymous	Culvert behind my house overflowed
74	anonymous	The creek behind my home has been flooding my backyard in heavy rains for over 10 years. the culvert downstream (under North Street) is too small and causes water to back up. I have a sloped yard and water will get over 4 ft high in heavy rains by my back fence. Because of this, the back part of my yard is not usable and I have to have a type of fencing to allow the water to drain.
75	anonymous	2601 Melba Circle. Carter Creek Pkwy side the house sits lower than the street, so all the water flows toward the house. I know this isn't a problem the city can help with, it's a problem with the original builders to position the house so much lower than the street level, but in 1962, they may not have figured those things out yet.

76	anonymous	We live on Westwood Main. Years sho we had a drainage ditch that was behind our house. When they started building houses behind us they did away with this ditch. Now the water runs down to our property and our neighbors also. It is like a river between the houses. It has came into our house also. Have talked to the city and was told to do what ever we had to to protect our house. Nothing they could do. I think we need this ditch behind our houses again.
77	anonymous	Water in my home on more than one occasion after the city repaved my street several years ago. 3520 Midwest. I've contacted the city to no avail.
78	anonymous	Heavy rains flood our gravel parking area. It seems like the vacant lot on our front left side of the house just drains straight to our and our neighbors yard. 1121 E 23rd St.
79	anonymous	2811 Thornberry Drive, large amount of flooding with heavy rain. Bullinger creek near the school, road was covered by water a few years ago.
80	anonymous	Yard floods due to poor elevations in my sub division
81	anonymous	During very heavy rains, the area surrounding the intersection at Carter Creek and Tanglewood Drive flood so badly that my pickup truck can't even drive through it. It's horrendous and dangerous!
82	anonymous	Oak Ridge Dr - Bryan 77802 Problem with water with every hard rain. Had to reconstruct entrance at front to keep water out, but still get water in garage and back door area. Our drive, sidewalks and home have settled badly due to water.
83	anonymous	Our property is on Williamsburg Drive in Copperfield Subdivision and backs up to Hudson Creek. There are trees and brush in the creek which impede the flow of water during heavy and/or fast rains, causing the creek to overflow the banks. Our house is on high ground and has not been affected but the rising water covers our back yard about two feet deep at such times. Our neighbor has had rising water come into his garage. The impact for our house has been water standing in the street which does not run off quickly enough and being pushed toward our front door by passing cars.
84	anonymous	We live on south Hutchins, and most of the storm drains on our street are blocked by sediment and overgrown lawns. This causes our street to become flooded during heavy rains.
85	anonymous	Flooding on my street, in my backyard on Esther Blvd.
86	anonymous	I live at 1117 Edgewood Dr. My house side's Burton Creek which has overflowed many times. A good bit of my yard floods as well as my garage. To date my house itself has not gotten water in it but very close

87	anonymous	The street is higher than the finish floor elevation of my garage. Water sheet flows down my driveway and has flooded my garage with a depth of 2". During significant rain events, it also has risen to the same level as the threshold of the front door.
88	anonymous	303 Brookside Dr E the creek behind our house comes out of its banks at times of heavy rain.
89	anonymous	Home flooded in 2016 (7252 wood oaks dr) - about 1 foot of water. Could not live at home for 5 weeks until repairs were complete
90	anonymous	Our backyard fills with water from the front of our property every time it rains because of the sewer at our back fence. Also, two other houses drain into our backyard at the back because of the sewer.
91	anonymous	S. College at Villa Maria, Haswell Park area where creek crosses under the road, Coulter where creeks cross. This was while driving, and I just found a way around the water, or drove partly in the turn lane.
92	anonymous	3109 Rolling Glen
93	anonymous	The small creek which divides our property has overflowed many times in the past 20 years. Several years ago, the water completely covered the portion of our yard on Ennis and flooded the street
94	anonymous	I own the property at 4708 Williamsburg Dr in Bryan. On multiple occasions flooding from Hudson creek has flooded my detached garage. This impacts at least three other properties next to me. Copperfield drive has been closed when it floods. I just saw where they are planning a development and convened the run off will make the situation worse.
95	anonymous	My yard floods extensively. I get all my surrounding neighbors water including from the street during any heavy down pour or continual rain. We've contracted landscapers and have worked on this problem for years. They've paved our roads in the past couple years raising our street height and now we get more water and more flooding in the front even. We lost many of our post oaks due to standing water. Have had extensive mosquitos and many toads/frogs and snakes. Our house has flooded due to the water coming inside on multiple occasions. We have 3 pumps in our yard and still the last rain pour a few weeks ago took about 2 days to pump out all the water. I live in north Bryan on Woodbend.
96	anonymous	4519 woodbend dr. All neighbors water , including property owned by city of bryan floods into my backyard. even with mild rains, i get a large amount of water. Moderate rain fills my entire backyard, and heavy rains I have a lake. water gets to my foundation.
97	anonymous	2520 Willow Bend Dr. Run off water from e villa Maria and Willow Bend would flood my property instead of going into drains.

98	anonymous	I have seen flooding on the roadway near Kemp Elementary along Saunders, close to the intersection at Bruin Trace. Since then I've chosen to go different routes to work to avoid this during heavy rains due to safety concerns. Our home is on Inwood Drive and our property goes across Pin Oak Creek. Portions of our property are in the floodplain, however our home is not in the designated floodplain. Thankfully our section of the creek is very deep and it hasn't breached the bank of the side of creek that our home is built near, but we have had water raise above the bank on the back portion of our property towards our backyard neighbor's property on Rosemary. We do, however, have problems with the banks of the creek eroding and have lost some vegetation and trees along our section of the creek over the last 8 years. We're concerned for our neighbors downstream who have problems with the aerial crossing of the sewer line getting backed up with debris during storms/heavy rainfall and wonder how many other areas of the creek are eroding and adding to debris that could be caught and thus cause more problems with flooding for our neighbors downstream, especially on Vine Street. We have neighbors who have had flooding come close to or into their homes on Vine Street numerous times. We've also seen flooding over roadways in Beverly Estates as well. Additionally, we are very concerned about how the flooding problems could be affected by the sewer trunk line the City of College Station is considering to put down Rosemary Drive. We were glad to hear that the creek option is off the table, but they are still looking at Rosemary as an option. The City of Bryan is working hard for us, it's citizens, to mitigate flooding and while the City of College Station insists that there won't be loss of trees along Rosemary nothing can be quaranteed. How could this construction, which could take up to two years, impac the plans our city has worked hard to put in place to midgate flooding. What would happen when the 30 foot diameter bore pits are dug along the proposed path? How would they impact the flow of water once they are filled back in after construction? Though it has been said they'd restore them to the original condition, this would obviously be impossible if large trees are in fact lost.
99	anonymous	Briarcrest + Oakhill, South College
100	anonymous	Quail Creek Villas, Briarcrest/Hw6
101	anonymous	On Woodville water gets very high cars can't go through
102	anonymous	High water while driving on Texas Ave
103	anonymous	Barak Lane corner of Oakhill across from Bryan High
104	anonymous	Lake St + Cavitt - Lake St towards Texas Ave floods every time it rains hard

4. How concerned are you about the possibility of your community being impacted by flooding?

More Details Insights

Very concerned	77
Somewhat concerned	54
Not concerned	5

5. Is your home located in a Federal Emergency Management Agency (FEMA) mapped floodplain?

More Details Insights

Yes	27
No	67
I don't know	42

6. Do you have flood insurance for your home and/or personal property?

More Details Insights

Yes	44
No	77
I don't know	16

7. If you do NOT have flood insurance, what is the reason?

More Details Insights

It's too expensive	11
I never considered it	18
I don't need it because my hom...	36
Other	21

8. Have you taken any actions to protect your home from flood damage?

More Details Insights

Yes	69
No	65

9. If you answered "Yes" to question 8, what actions have you implemented?

67 Responses

1	anonymous	TAKING CARE OF PROPERTY WITH UP KEEP & REPAIRS; PRECATIOUNARY MAINTENANCY; AND SECURING SUPPLIES SHOULD AN IMMINENT DISASTER SHOULD COME TO PASS. I KNOW I'll be told to go away IF my home is destroyed because "I have TOO much, and I should shsre". Punish the well behaved and prepared.
2	anonymous	Sandbags
3	anonymous	I have purchased quick dams to protect the back of my house in the event we have another heavy rain event. Problems due to landscaping issues as of yet unresolved.
4	anonymous	Small retaining wall to slow down flow across yard and minimize damage
5	anonymous	Home is elevated even though I'm not in a flood prone area at all.
6	anonymous	Rain collection
7	anonymous	Water dispersion through improved drainage
8	anonymous	Improved drainage
9	anonymous	Extensive Drainage
10	anonymous	Dug drainage channels and have sand bags stored
11	anonymous	Installed french drains in several places throughout the landscape.
12	anonymous	Chose safe location - high and above flood pond nearby. Made sure that the house was constructed with the right grading.
13	anonymous	had the backyard sloped away from the house, elevated fences and shed to allow water to flow freely.

14	anonymous	Gutters on all sides of our roof and French drains
15	anonymous	installed French drains in yard
16	anonymous	Rain gutters to divert water from back of house.
17	anonymous	I report it to the city help page of bryan but they always ignore me. When i can to follow up they say they dont see nothing with my address
18	anonymous	We keep leaves and debris away from storm drains. Our neighbors keep adding dirt to their yards and we get more water.
19	anonymous	There's not really anything we can do to other than move our more valuable belongings to the highest areas of our living space.
20	anonymous	We have dug a drainage ditch and instal additional drains to try to divert the rain away from where it will accumulate and have to clean it out and maintain patency of it which is a lot of work considering how many trees we have on our property and have to open gates everytime we get a heavy rain, otherwise it will drain into our garage and if we didn't have the drainage ditch we dug it would flow from Mary lake and lazy lane and flood our house- even though our house is not in a flood zone.
21	anonymous	We have put sandbags outside our porch. We are paying to have another drain system put in as well.
22	anonymous	Created a drainage path for the flood water to flow more quickly through the yard onto Pioneer Circle.
23	anonymous	I spent almost $15,000 to install a large dirt berm around my house, French drains and other measures to protect my house, but the flooding from drainage of several neighbors persists in my back yard. I am concerned that eventually water will get into my house.
24	anonymous	Installed drainage to direct some of the water to the street
25	anonymous	Tried planting more plants that could help and tried making a water garden for certain areas.
26	anonymous	I've made a more stable foundation by applying concrete to my home avoiding those areas when in a car
27	anonymous	French drain
28	anonymous	On the side of the house that where water has come in via the weep holes, I have caulked the weep holes, preventing any additional water from entering the house via the weep holes. Thus far the "Through the Roof" caulk has prevented water from entering the house through the weep holes.

29	anonymous	Worked with city engineering when drainage improvements were made in my area. I have repeatedly recommended that the City employ the services of a professional grant writer to pursue outside funding.
30	anonymous	We've tried to increase grading around our house to help with keeping water away from the house.
31	anonymous	I requested the city to come out and dredge the creek in 2022. The city did some excavating, that created more of a back up when there is a hard rain. I have emailed Kelly Sullivan with the City of Bryan in April of 2023 to convey my concerns.
32	anonymous	moved certain belongings to storage or to the second floor of my condo
33	anonymous	I would like to put in a retaining wall but am unsure who to talk about my backyard being next to a public utility easement. Do I need permission and how do I mitigate the erosion that is happening in the ditch otherwise known as an easement.
34	anonymous	We make deep entrance to prevent the water came in the house
35	anonymous	We have made improvements to water management on our property, as well as made improvements to our lower level.
36	anonymous	Tried to replace the eroded soil so that it would slow down the water, but the force was too great and all of the soil ended up in the driveway.
37	anonymous	Installed a French drain.
38	anonymous	Put in French drain.
39	anonymous	Other paths out and generator hookups
40	anonymous	House elevation
41	anonymous	We had a little culvert made to catch water and drain away from home along with tubing buried to drain water away from front of house. We must have sandbags and other flood mitigation products out in the event of heavy rain. We have provided feedback to the City of these issues and guess we are not enough of a squeaky wheel as other neighborhoods that have been given attention.
42	anonymous	Installed a sump pump.
43	anonymous	Graded property to move water away from the structure.
44	anonymous	Increased grading of yard to keep water away from house.
45	anonymous	Had yard graded away from house

46	anonymous	positioned barriers in front of the garage to prevent water to come into the garage. installed french drain in the bed on the Carter Creek side to connect to existing drain to the Melba Circle street.
47	anonymous	Ensure water drainage is away from the house.
48	anonymous	We have put concrete blocks to try and stop the water from coming in our property. But it doesn't work.
49	anonymous	New driveway to help the water flow elsewhere, berm in front of the door, use flood dams when we get heavy rain.
50	anonymous	French drains
51	anonymous	I have talked to City of Bryan employees numerous times because much of our damage has been caused by a main water line breaking (at least 7 times) and causing major deterioration under our drive. City finally move the line across the street and I have seen it being worked on there also. Sewer Dept had a truck in back of our drive years ago pumping for about 3 days. Immediately our drive started being lower than our sidewalk. I Know this because I was pushing my Mother in a wheelchair every morning before going to work as I took her to healthcare. I also talked to Sewer personnel to no avail.
52	anonymous	Removed brush from creek area behind our house and cut out a passage at the bottom of our wooden fence to allow the water to run underneath the fence. During a previous run-off, the force of the water took out most of the fence.
53	anonymous	Keeping debris from collecting but unsure what else I can do
54	anonymous	I had concrete work performed to help redirect the storm water.
55	anonymous	Someone had built dams on the creek. So it slowed the water and it backed up. We tore those dams down which has helped move the water out faster and deepened the creek. My husband constantly is cleaning out downed trees and trash in our stretch of creek.
56	anonymous	I purchased some flood barriers that expand when wet to place around doors. They will only be effective if the water is less than 3" deep. I had new gutters and drains installed in my yard which helps reduce standing water next to the house. They will not be effective in a flood, however
57	anonymous	We have tried several ways to divert the water but nothing works.
58	anonymous	installed french drains to keep water from going under the house.
59	anonymous	French drains around house. About to build some gabion walls for the creek behind my house.

60	anonymous	We attempt to keep the creek cleared of trash, limbs, etc., but we are older now and my husband is disabled.
61	anonymous	Basically there is no way to stop the flood waters. They cover about a third of my property and have flooded the garage. 9" deep in the garage. I have spoken with Bryan, Texas, and US gov personnel that all have a say in the creek and planning related to the creek but say the creek belongs to Mirramont.
62	anonymous	Water dams Sand bags Water pumps x 3 Landscaping
63	anonymous	3 sump pumps working nonstop for 8 hours for light to medium rains, and they work up to 16 hours on heavy rains. Huge ditch in the middle if my yard to gather rain into sump pumps. another ditch to direct back section of yard.
64	anonymous	French drains, elevated driveway, worked with Tx Dot to clear a forgotten drainage ditch and flume behind my property
65	anonymous	We've worked to protected the creek and have gutters, french drains, etc. to move water away from the home.
66	anonymous	Had our back yard worked on and they graded it down to back yard doesn't flood anymore
67	anonymous	Rain capture

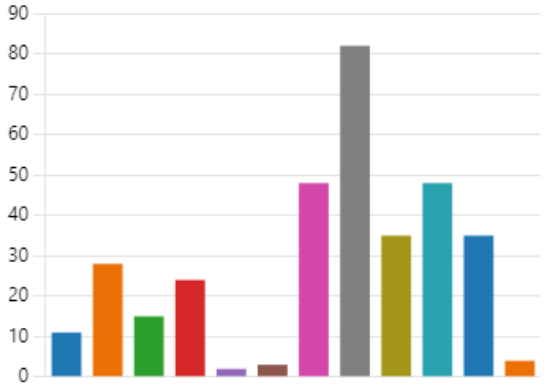
10. Do you know what government agency/office to contact regarding the risks associated with flooding?

More Details Insights

11. What is the most effective way for you to receive information about how to make your home or neighborhood more resistant to flood damage?

More Details

Newspaper	11
Television advertising or progra...	28
Radio advertising or programs	15
Public workshops/meetings	24
Public library	2
School meetings	3
Mail	48
Email	82
Text message	35
City website	48
City social media	35
Other	4



12. What are some steps the City could take to reduce the risk of flooding in your neighborhood?

109 Responses

1	anonymous	Ensure impervious cover is not excessive in new developments as well as re-development in existing areas.
2	anonymous	MAKE SURE THE DRAINAGE AREAS ARE KEPT CLEAR AND CLEANED OUT PERIODICALLY.
3	anonymous	Fix the roaDs and hire QUALIFIED engineers & workers to 'foresee' possible obsticles that CAN be addressed NOW. (Some workers have made things worse: look no further than the Carter Creek that USED to FLOW; however, an unqualified worker PLUGGED IT and now it doesn't flow).
4	anonymous	Put drainage dips back in across Carter Creek Parkway.
5	anonymous	Install better drainage pipes and curbing
6	anonymous	We need a plan to expand the drainage capacity of the creeks near us. We need more control of the water entering our area.
7	anonymous	Lift the older neighborhoods to the current city standards.

8	anonymous	I am not sure what could be done to reduce the risk of flooding in my neighborhood. I am not sure what makes sense to improve the problem of moving water during heavy rain events. There are other areas of Bryan that have much greater needs.
9	anonymous	Clear and repair Burton Creek concrete lined channel from Tanglewood Bridge to 29th Street Bridge.
10	anonymous	Keep waterways clear of debris. Manage runoff from new construction areas
11	anonymous	Address the reasons for the flooding in the first place - back up of Pin Oak Creek and down drainage from College Station Reduce Trash and vegetation that gets caught by the sewer line in Pin Oak Creek Limit changes to the environment that would increase flooding
12	anonymous	Update storm sewer inlets and repair broken ones, dredge many of the old town bar ditch systems
13	anonymous	Fix drainage system
14	anonymous	Encourage Rain collection and rain gardens to slow water
15	anonymous	I dont really know.
16	anonymous	My neighborhood is old, so better drainage would be only mitigation measure to reduce potential for flooding, or workshops to raise awareness for my neighbors. (Turn around, don't drown.) For other areas in the city, we need stricter zoning considerations and better planning to ensure storm water drains are adequate for potential runoff and absorption. A perfect example of failure is Rudder Pointe, where I have friends whose yards flood every time there is heavy rain.
17	anonymous	Move the water in the creek more quickly through the area.
18	anonymous	Expand current culverts, clear creeks of debris, stop College Station from building sewer lines through our neighborhood that include aerial sewage pipes
19	anonymous	-Keep the drainage creeks cleared. -Additional warning signage
20	anonymous	Keep creeks, streams, and larger clean from trash, debris, and anything else that impedes natural flow.
21	anonymous	Reevaluate road height compared to area homes
22	anonymous	Dredge or clear debris existing under and around aerial sewer line routes along Pin Oak Creek to prevent flooding in the Garden Acres neighborhood.

23	anonymous	Carter"s Creek that runs through is very clogged with debris. There are damned up areas that hold water. This does not allow water to flow. If the creek where to be widened in it's flow through the city would help. I know the cost would be very high, but could be done in segments.
24	anonymous	Clean out city owned creek areas between Greenbrier and Austin's Colony
25	anonymous	Make sure the new neighborhoods being built have adequate drainage and storm drains. A new neighborhood is being build behind ours. And when they first started construction when it rained we got alot of thier water runoff from the end of thier street and flooded a lot of our backyards. Lots of dirty brown water. We are still experiencing some of this issue.
26	anonymous	Do not remove all green space. Drive around proposed development areas and observe drainage before committing to project.
27	anonymous	Have a qualified engineering firm complete an updated study.
28	anonymous	Fix the street to aim all the water into the creek thats in our atreet
29	anonymous	The city should review the drainage to Burton Creek. It never backed up as much until neighbors added fill to their backyards and reversed the flow towards Carter Creek Drive. The house with the bridge catches all of the water when some used to flow to Burton creek.
30	anonymous	It would take a total revamp of city drainage and infrastructure. For county flooding, more retention ponds needed per neighborhoods being built.
31	anonymous	I've let the city know, they pretty much ignored me and didn't do anything.
32	anonymous	CLEAN OUT BURTON CREEK. There's too much buildup in the creek. FIX EROSION of creek banks. Enlarge the culverts as recommended by the engineers that did the study of flooding issues years ago. Add more/larger storm drains. Monitor the impact of increased pavement/parking lots upstream on street flooding and take action. In other areas of Bryan/CS - Ensure that no new homes are being built in flood-prone areas.
33	anonymous	Improve the street drainage on Mary lake and the size/drainage of the reservoir on lazy lane so it does not overflow into our yard/house.
34	anonymous	Clean the drains and fix the streets.
35	anonymous	Fix drainage.Don't build on other side of 6. It will effect the creek.
36	anonymous	Please do not give permission to the City of College Station to construct a large sewer pipe along Rosemary Drive or Pin Oak Creek. Increased runoff from Northgate and Hensel Park coupled with future erosion and loss of large trees along the waterway will likely lead to increased flooding for Garden Acres and Beverly Estates. A far better alternative is a new, larger lift station in Hensel Park.

37	anonymous	I don't know. The slope of the cemetery causes flood water to drain directly into my backyard.
38	anonymous	I need expert recommendations as to how to alleviate the flooding in my back yard.
39	anonymous	Maintain Roads and clear the ditches from debri
40	anonymous	Provide assistance residents can apply for to help with the cost of fixing flooding issues (ex. Cover a portion of cost to re-grade low yards)
41	anonymous	Install proper drainage
42	anonymous	Unclog rain covered areas and find a way to reroute the water when it is to much
43	anonymous	Unknown - I don't know about downstream route of Carter Creek.
44	anonymous	Bettering the roads
45	anonymous	Walk the creek line that runs next to my home that goes through the wooded area to ensure it is clear of debris and fallen trees.
46	anonymous	Not putting the lift station in burton creek
47	anonymous	Clean out the creek to keep it clear of debris.
48	anonymous	After looking at the flood reporting map from the May 2018 report, it appears that I was the only one who had reported flooding in my home from my surrounding neighbors. I am not sure what the City could do to reduce my flooding risk other than somehow increasing the drainage of water from the neighbor's yards into the street for those who are next to and up from me. This would then reduce the overall amount of water running into my yard during these types of frequent, heavy down pours.
49	anonymous	Ensure there is adequate infrastructure to handle water drainage when building new subdivisions.
50	anonymous	Work on the creek behind the backyards on Cherry Creek so it drains water properly when we get heavy rains. Typically gets plant over-growth & fallen trees in it.
51	anonymous	Employ a qualified engineering firm to update the flood control plan and develop funding recommendations.
52	anonymous	New sidewalks and roads with better drainage systems built
53	anonymous	I have walked the creek and debris needs to be cleared to assist the creek to flow better. A ditch to the creek to alleviate standing water.

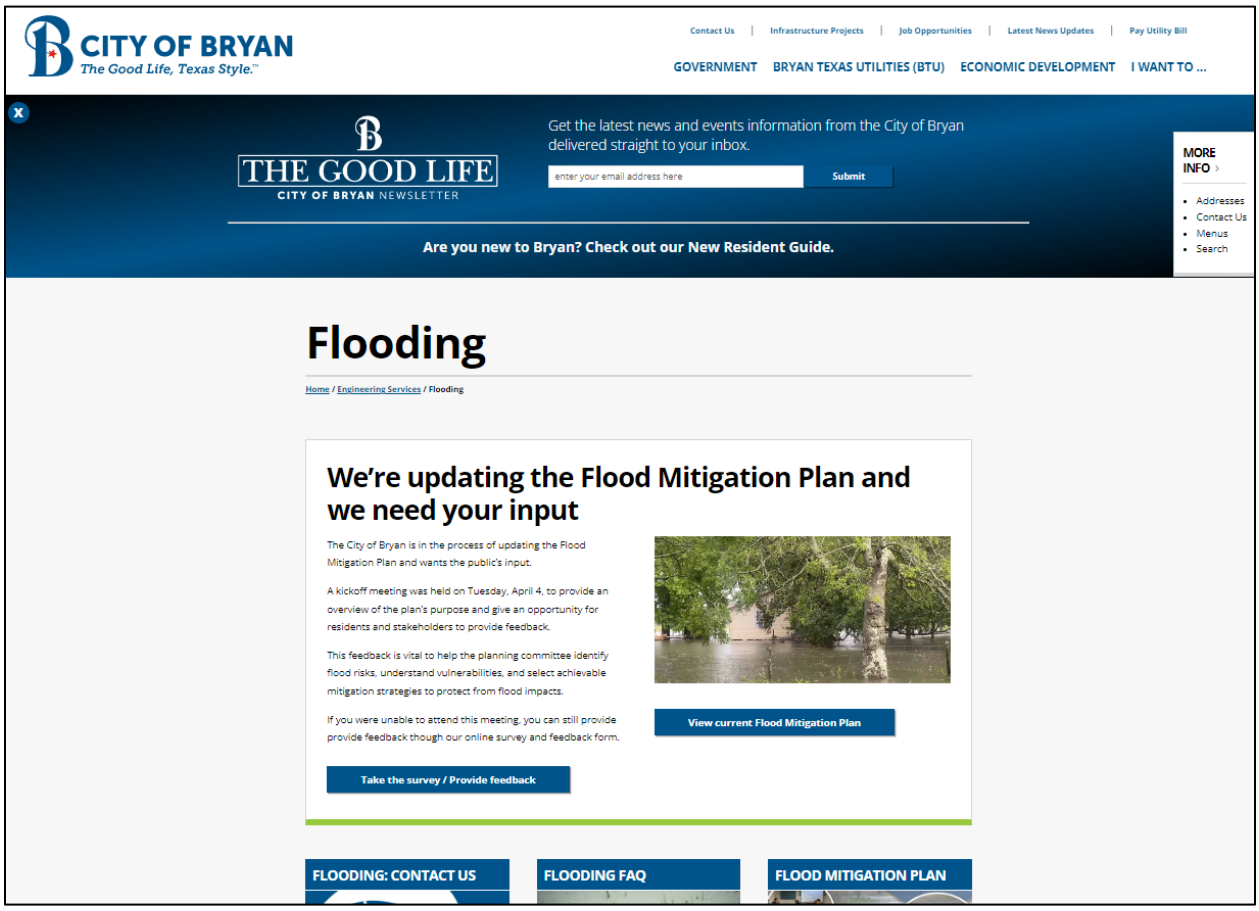
54	anonymous	Dredge the creek behind Rose Hill Lane to insure water flow. Level the high and low areas of the creek to eliminate standing water that's held in several areas.
55	anonymous	I'm not sure but would like to know for sure if we are in the flood plain or on the edge and what we could do. Is this something that changed after our houses were built?
56	anonymous	I live in a condo that is part of a homeowner's association, but all the owners are absentee. The drainage creek that bisects our property is not a public easement, so the HOA is responsible, but the City doesn't seem interested in encouraging storm water runoff mitigation here. In addition, finding the property where I live on the floodplain maps, and understanding my risk, is nearly impossible.
57	anonymous	Fix the easement behind my house and line it with concrete similar to the houses to the right of my house.
58	anonymous	Street renewal
59	anonymous	I think keeping the creeks in the Tanglewood park area flowing would be a good place to start.
60	anonymous	Increase the size of the culvert under the street, so water from the creek can move faster. Press upon our neighbors on the other side of the street to keep their part of the creek barrier free. Yes, the city does not have an easement on the creek, but it does have an easement on the street.
61	anonymous	Clean out the drainage ditches. Help clear out the channel of Turkey Creek east of FM2818
62	anonymous	Drainage at Briton Drive/Bedford Court corner.
63	anonymous	reserve low land or areas as ponds
64	anonymous	Maybe more drainage on Woodcrest so in does not all run down through our back and front yard to cul de sac on Woodbriar.
65	anonymous	Not sure.
66	anonymous	Pay attention to watersheds and floodplains and not build parking lots and shopping centers without requiring watershed and flood mitigation plans.
67	anonymous	Fix old reliance road
68	anonymous	Keep ditches & easyways clear and upkept, some have very nice cement sides, mine has large broken concrete JUNK pieces & overgrown trees, ready to clog or cause breakage damage.

69	anonymous	Fix the drainage problem, and lack of sewers
70	anonymous	clean out the culverts under the road near 3616 Sunnybrook lane, Bryan
71	anonymous	French drain to the creek. Clear trees and debris from the creek.
72	anonymous	Evaluate our drainage pipes, find ways to route excess drainage that overwhelms the drains. There is water coming off Texas Avenue that never existed until 2013 that when it becomes to much overwhelms the drainage capacity and comes over our curb. French Drains installed in the street as like on Melba and Dona Streets off Carter Creek. Add another drain to take the excess water. There was talk of retention in the park across from Henderson Elementary. I know of other homes down Wayside Drive that have flooded.
73	anonymous	How can I get more involved in this effort? My qualifications are as former City of Lago Vista Council Member 2010-2018, I have worked to two revisions to the Pre-Disaster Hazard Mitigation Plans, two revisions to the Comprehensive Master Plans, and chaired the Colorado River Floodplain Coalition for two years. Ron Smith, Address 2902 Gentle Wind Ct, Bryan 77808. Phone: 979-450-7129.
74	anonymous	Deepen ditches and replace culverts as needed.
75	anonymous	Deepen, widen the creek. Remove the pipe that restricts the flow under the bridge on Esther.
76	anonymous	The City of Bryan should take inspiration from the Exploration Green project in Clear Lake (https://www.explorationgreen.org/), where a defunct golf course is being excavated and developed to be a series of retention ponds that greatly reduces the impact of flooding in the community. Not only does it provide excellent flood mitigation, but it also provides valuable community and ecological value by providing paved paths for visitors to recreate on, and rookery islands in the retention ponds for birds to nest--providing both habitat and additional opportunities for visitors to experience nature. While a defunct golf course is an ideal template for this type of project, it can also be emulated by providing paths around other constructed retention ponds. Interpretive panels around the retention ponds can also educate residents on types of flood mitigation methods and their importance.
77	anonymous	Fix the issue or let us fix the issue.
78	anonymous	Bioswales. These are great because they can double as pedestrian/bike safety infrastructure (which the city of Bryan desperately needs more of). https://twitter.com/TimFWelch/status/1656063815220613120?s=20 https://nacto.org/publication/urban-street-design-guide/street-design-elements/stormwater-management/bioswales/
79	anonymous	I have asked them to assess the culvert size and have not received a response.

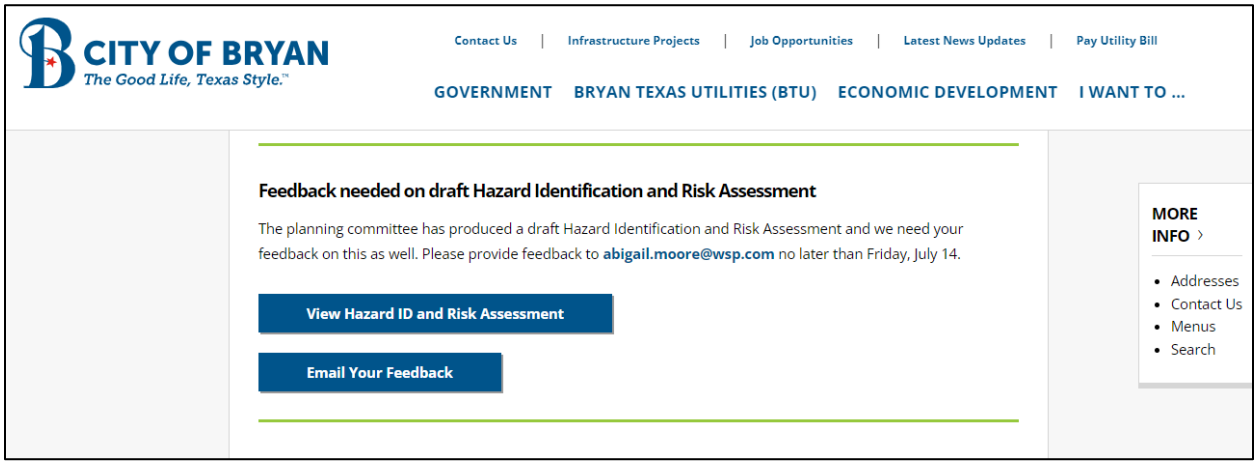
80	anonymous	Raise the level of my house...;)
81	anonymous	Keep creeks clear of debris and sand buildup.
82	anonymous	Put the drainage ditch back behind our house.
83	anonymous	Grade down and properly repave my street. Let's put it like this...a surveor told me the crown of the center of the street is 4 inches higher than the curb. I've submitted video and no one seems to care.
84	anonymous	Clear the bar ditches, culverts, and storm drains of grass, branches and debris. My neighborhood on E 27th is not curbed & guttered. There is a storm/bar ditch on either side of the street that runs downhill to Coulter storm drains. However, on the south side of the street, that ditch is overgrown, culverts under driveways are clogged or missing, and overgrowth clogs it on some properties, especially near Coulter. The city came last week and dug out a portion of it, but it hasn't improved the flow of water. Now many houses have standing water in a mud ditch in front of their house and a couple of residents cannot drive into their driveways without driving through mud or water.
85	anonymous	increase spillover capacity near tanglewood park
86	anonymous	Do not allow more large volume neighborhoods to be built in this area, changing the water drainage and impacting our waterways. Do not pave the rest of Thornberry to old reliance.
87	anonymous	More proactive on builders and developers
88	anonymous	Add extra drainage to the streets that often flood.
89	anonymous	I think the City Engineers may be the best to ask, but old weak pipes and joints may need replacing to help your older neighborhoods. It seems the new development areas get the attention while the rest of our areas deteriorate. When the work was done at our door entrance, the surveyor said our home is already lower than the street.
90	anonymous	Regularly check storm drains to make sure they are not blocked
91	anonymous	Follow through on proposed drainage changes for Esther Blvd.
92	anonymous	Keep debris from accumulating
93	anonymous	Add storm water drainage structures, or lower the finish elevation of the street.
94	anonymous	Clean the creek!
95	anonymous	Install drain pipe under my driveway that would direct sone water to a drainage ditch along 1179. Maybe install flood basins upstream of my neighborhood? This is a question for an engineer.

96	anonymous	The city installing a french drain would help tremendously and we would be able to use our backyard without mud and mosquitos.
97	anonymous	Sweep the streets more often, clean the creeks, start fining landscape companies and others who blow lawn debris into the street! They make such a mess, and have a detrimental effect on the drainage. It happens every week near my house.
98	anonymous	See if there is a way to control the erosion problem in our neighborhood.
99	anonymous	Raise the properties that are flooding along the creek or widen the creek to accommodate the needed capacity or stop developing properties that dump into this creek.
100	anonymous	More drainage provided on the streets.
101	anonymous	Please put sewer drains up hill from me to catch the water from the street. Please put a water retention in the woods behind my property that is lower than my land so the water goes that way not stay in my property. Thanks.
102	anonymous	build retention ditch so I don't keep receiving everyone's rain water, including property owned by city of Bryan.
103	anonymous	Talk to property owners and listen to them. Invest in infrastructure, construct roads properly so water moves in the curb into a drain that then goes into a creek.
104	anonymous	Help keep the aerial creek crossings along Pin Oak Creek clear of debris and help to mitigate erosion upstream that could contribute to more debris downstream. Tell the City of College Station they cannot use the City of Bryan's right of way on Rosemary Drive to install the sewer trunkline due to the possibility of negative environmental impacts and potential increased flood risks to Bryan citizens.
105	anonymous	No idea
106	anonymous	Just actually fix the problem
107	anonymous	Drainage clearing
108	anonymous	Could the city financially incentivize residents to capture water at their residences?
109	anonymous	Burton Creek should be cleaned out and dredged and drainage to the creeks should be corrected.

CITY WEBSITE



DRAFT DOCUMENTS FOR PUBLIC REVIEW



A.3 PLANNING STEP 3: COORDINATE

STAKEHOLDER LETTER

This planning step credits the incorporation of other agencies' plans and efforts into the development of the hazard mitigation plan. Other agencies and organizations must be contacted to determine if they have studies, plans and information pertinent to the plan, to determine if their programs or initiatives may affect the community's program, and to see if they could support the community's efforts. To incorporate stakeholder input into this plan, the City and the FMPC identified a variety of stakeholders and emailed a letter inviting each stakeholder to provide data or information relevant to the planning process, review draft plan documents, and provide feedback and comments. The emailed coordination letter sent to stakeholders is provided below. A list of the stakeholders who were contacted is provided on the following pages.

From: Vernon, Sam <SVernon@bryantx.gov>
Sent: Thursday, July 27, 2023 2:20 PM
To: Vernon, Sam
Cc: Moore, Abigail
Subject: City of Bryan Floodplain Management Plan Update

Good Afternoon,

The City of Bryan is updating the 2018 Floodplain Management Plan and we are seeking your input in the planning process. The purpose of the plan is to address flood hazard risks and vulnerabilities and identify achievable mitigation actions to make our community safer and more resilient to flooding. This planning process incorporates the four phases of the Disaster Mitigation Act (DMA) of 2000 as well as the 10 steps of Activity 510 Floodplain Management Planning of the National Flood Insurance Program's (NFIP) Community Rating System (CRS) Program.

Our objective in reaching out to other agencies and stakeholders is to coordinate with those who may bring additional information to the planning process regarding flood risks and vulnerability issues within the City of Bryan. Any information, studies, etc. that may supplement the work of the established Floodplain Management Planning Committee (FMPC) would be welcomed. Additionally, we invite your input on our draft Hazard Identification & Risk Assessment, which can be found on the City's website at https://www.bryantx.gov/engineering-services/flooding/. The full draft plan will also be available for review and comment on this webpage once it's completed. We encourage you to attend the final public meeting for the planning process, which is scheduled for Tuesday, August 15th at 5:30 pm at the City Hall Downstairs Meeting Room. This meeting will provide an overview of the planning process and the draft plan.

If you have any questions, would like to submit data or information for the FMPC's consideration, or would like to receive a notice about opportunities to attend future planning meetings or review the draft plan, please contact the City's planning consultant for this project, David Stroud with WSP, at david.stroud@wsp.com.
We thank you for your support of this important planning process.

Sam J. Vernon, P.E., CFM
Bryan Assistant City Engineer
979-209-5030
svernon@bryantx.gov

STAKEHOLDER LIST

FIRST NAME	LAST NAME	TITLE/DEPARTMENT/ORGANIZATION	EMAIL
Non-Profit/Community Organizations			
Andy	York	Executive Director, Habitat for Humanity	ayork@habitatbcs.org
Peggi	Goss	President & CEO, United Way of the Brazos Valley	pgoss@uwbv.org
Educational Institutions			
Michelle	Meyer	Director, Hazard Reduction and Recovery Center, Texas A&M University	michelle.meyer@tamu.edu
Monica	Martinez	Manager, Environmental Health and Safety, Texas A&M University	mmartinez@tamu.edu
Richard	O'Malley	Assistant Vice Chancellor for Facilities, Buildings, Planning, and Construction, Blinn College District	richard.omalley@blinn.edu
Bryan	Carlisle	Director, Safety and Risk Management, Blinn College District	bryan.carlisle@blinn.edu
Surrounding Communities			
Gary	Balmain	Director, College Station Public Works	pubworks@cstx.gov
Linda	McGuill	Manager, Public Safety Planning, Brazos Valley Council of Governments	linda.mcguill@bvcog.org
Prarthana	Banerji	County Engineer, Brazos County Road & Bridge Department	pbanerji@brazoscountytx.gov
Federal Government			
Gilbert	Giron	FEMA CRS Regional Coordinator, Region 6	gilbert.giron@fema.dhs.gov
Brian	Bartley	FEMA Region 6, Floodplain Management & Insurance Specialist	brian.bartley@fema.dhs.gov
Charlie	Cook	FEMA Region 6, Mitigation Division	charles.cook4@fema.dhs.gov
Larry	Voice	FEMA Region 6, Texas Coordinator	larry.voice@fema.dhs.gov
Stephanie	Weeks	ISO/CRS Specialist	stephanie.weeks@verisk.com
Joe	Capesius	Austin Data Chief, USGS Oklahoma Texas Water Science Center	capesius@usgs.gov
Claire	DeVaughan	Geospatial Liaison for Texas, USGS	cdevaugh@usgs.gov
Bryon	Haney	US Army Corps of Engineers Fort Worth District Office	bryon.m.haney@usace.army.mil
		US Army Corps of Engineers Fort Worth District Emergency Management	Ceswf-em@usace.army.mil
State Government			
Josh	Davies	State Hazard Mitigation Officer	josh.davies@tdem.texas.gov
Yi	Chan	State NFIP Coordinator	yi.chan@twdb.texas.gov

FIRST NAME	LAST NAME	TITLE/DEPARTMENT/ORGANIZATION	EMAIL
Kathy	Hopkins	Flood Mitigation Assistance Program, Texas Water Development Board	kathy.hopkins@twdb.texas.gov
Shaun	Miller	Assistant Chief, Texas Division of Emergency Management, Region 2	shaun.miller@tdem.texas.gov
Trina	Lancaster	Manager, Texas Dam Safety Program	damsinfo@tceq.texas.gov
Wayne	Wilson	Texas Regional Water Planning Group Chair, Region G	wlwilsoncattlecompany@gmail.com
Pam	Hannemann	Texas Regional Water Planning Group Sponsor, Region G	pamela.hannemann@brazos.org
Brad	Burnett	Lower/Central Basin Region Manager, Brazos River Authority	brad.burnett@brazos.org
Stephanie	Griffin	President, Texas Floodplain Management Association	sgriffin@GPTX.org
James Travis	Wilson	Region 5 Director, Texas Floodplain Management Association	travis.wilson@miller-gray.com
Business Community			
Glen	Brewer	President, Bryan-College Station Chamber of Commerce	glen@bcschamber.org
Sam	Harrison	President, Bryan Business Council	sam.h.harrison@gmail.com
Rick	Weegman	Managing Editor, Bryan-College Station Eagle	rick.weegman@theeagle.com

APPENDIX B MITIGATION STRATEGY

B.1 ALTERNATIVE MITIGATION MEASURES

The FMPC reviewed mitigation measures within each of the following mitigation categories defined within the Community Rating System (CRS) 2017 Coordinator's Manual.

- Prevention
- Property Protection
- Natural Resource Protection
- Emergency Services
- Structural Projects
- Public Information and Outreach

Alternative mitigation measures discussed and considered by the FMPC are summarized in the following sections by category.

B.1.1 PREVENTATIVE AND REGULATORY MEASURES

Preventative measures are designed to keep a problem - such as flooding - from occurring or from getting worse. The objective of preventative measures is to ensure that future development is not exposed to damage and does not cause an increase in damages to other properties. Building, zoning, planning and code enforcement offices usually administer preventative measures. Some examples of types of preventative measures include:

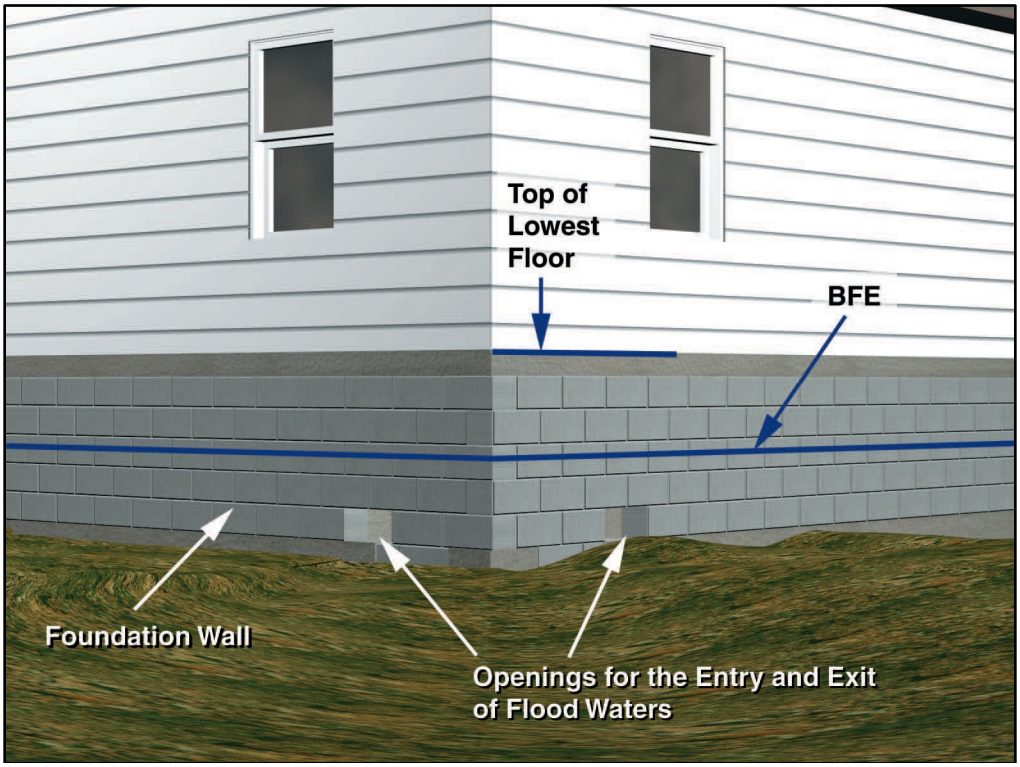
- Building codes
- Comprehensive and land use plan
- Zoning ordinance
- Open space preservation
- Floodplain regulations
- Stormwater management regulations

BUILDING CODES

Building codes provide one of the best methods for addressing natural hazards. Building codes provide guidance on how to build more safely in hazardous areas. When properly designed and constructed according to code, the average building can withstand many of the impacts of natural hazards. Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. For example, building codes can ensure that the first floors of new buildings are constructed to be higher than the elevation of the 1-percent-annual-chance flood. This is shown in Figure B.1. The City of Bryan has adopted the *2021 International Building Code*.

Just as important as having code standards is the enforcement of the code. Adequate inspections are needed throughout construction to ensure that the builder understands the requirements and is following them. Making sure a structure is properly elevated and anchored requires site inspections at each step. The City of Bryan requires inspections for residential and commercial buildings at multiple stages of construction, from foundation to building frame to final inspections.

Figure B.1 – Building Codes and Flood Elevations



Source: FEMA Publication: *Above the Flood: Elevating Your Floodprone House, 2000*

COMPREHENSIVE OR LAND USE PLAN

Planning and zoning activities direct development away from hazardous areas, particularly floodplains and wetlands. They do this by designating land uses that are suitable to the natural conditions of land that is prone to flooding, such as open space or recreation. Planning and zoning activities can also prevent exposure to flood hazards by simply allowing developers more flexibility in arranging improvements on a parcel. Planned developments, cluster developments, and transfer of development rights are among the tools planners can use to encourage placement of structures outside of known hazard areas.

These tools can be coordinated with other development policies and goals as part of a community's comprehensive plan. A comprehensive plan, in broad terms, is a policy statement to guide the future growth of a community. It is the basis for a community's zoning, subdivision and design regulations and any amendments to those regulations.

The City of Bryan Comprehensive Plan: Blueprint 2040 was adopted in October 2016. The plan includes a Future Land Use Map which represents the City's long-term vision and serves as a decision-making tool to evaluate proposals for land use and zoning changes for their consistency with that vision. The plan also provides a framework for identifying and scheduling public and private capital projects. The plan is flexible and able to be amended as future conditions warrant.

ZONING ORDINANCE

Zoning is legal method of designating land uses geographically, separating incompatible land uses, and supporting safe and responsible growth through the designation of zones and associated regulations. The City of Bryan zoning ordinance, found in Chapter 130 of the Code of Ordinances, was first adopted in 1989 and subsequently replaced in 2015. Bryan's zoning consists of an official zoning map and multiple zoning districts, as well as several special purpose districts. The zoning regulations describe what type of land use and specific activities are permitted in each district, and how buildings and other construction may be sized and placed on a lot. The zoning regulations also provide procedures for rezoning and other planning

applications. The zoning map and zoning regulations provide properties in Bryan with certain development rights. Several districts could be employed to support safe development in and around floodplain areas, including the Agricultural-Open District, the Planned Development District, and the Residential-Neighborhood Conservation District.

OPEN SPACE PRESERVATION

Keeping the floodplain and other hazardous areas open and free from development is the best approach to preventing damage to new developments. Open space can be maintained in agricultural use or can serve as parks, greenway corridors and golf courses.

Comprehensive and capital improvement plans should identify areas to be preserved by acquisition and other means, such as purchasing an easement. With an easement, the owner is free to develop and use private property, but property taxes are reduced or a payment is made to the owner if the owner agrees to not build on the part set aside in the easement.

Although there are some federal programs that can help acquire or reserve open lands, open space lands and easements do not always have to be purchased. Developers can be encouraged to dedicate park land and required to dedicate easements for drainage and maintenance purposes.

The City of Bryan has several parks and other public lands designated as open space. Many existing parks are already located in or near mapped floodplain areas.

FLOODPLAIN REGULATIONS

The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA). As a condition of making flood insurance available for their residents, communities that participate in the NFIP agree to regulate new construction in the area subject to inundation by the 1-percent-annual-chance (base) flood. The floodplain subject to these requirements is shown as an A or AE Zone on the Flood Insurance Rate Map (FIRM).

There are five major floodplain regulatory requirements. Additional floodplain regulatory requirements may be set by state and local laws.

1) All development in the 1-percent-annual-chance floodplain must have a permit from the community. The NFIP regulations define "development" as any manmade change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

2) Development along a river or other channel cannot obstruct flows so as to cause an increase in flooding on other properties. An analysis must be conducted to demonstrate that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community.

3) New buildings may be built in the floodplain, but they must be protected from damage from the base flood. In riverine floodplains, the lowest floor of residential buildings must be elevated to be at or above the base flood elevation (BFE). Nonresidential buildings must be either elevated or floodproofed.

4) Under the NFIP, a "substantially improved" building is treated as a new building. The NFIP regulations define "substantial improvement" as any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure before the start of construction of the improvement. This requirement also applies to buildings that are substantially damaged.

5) Communities are encouraged to adopt local ordinances that are more comprehensive or provide more protection than the federal criteria. The NFIP's Community Rating System provides insurance premium credits to recognize the additional flood protection benefit of higher regulatory standards.

The City of Bryan meets the above requirements to maintain continued compliance with the NFIP, and has exceeded the minimum requirements of the NFIP through some provisions of the current flood protection ordinance.

STORMWATER MANAGEMENT REGULATIONS

Stormwater runoff is increased when natural ground cover is replaced by urban development. Development in the watershed that drains to a river can aggravate downstream flooding, overload the community's drainage system, cause erosion, and impair water quality. There are three ways to prevent flooding problems caused by stormwater runoff:

1) Regulating development in the floodplain to ensure that it will be protected from flooding and that it won't divert floodwaters onto other properties;
2) Regulating all development to ensure that the post-development peak runoff will not be greater than it was under pre-development conditions; and
3) Setting construction standards so buildings are protected from shallow water.

The City prepared a Stormwater Master Plan in 2010 to assist in evaluating the existing conditions of storm water infrastructure and develop a storm water capital improvement program to address existing problems. The plan identified 122 capital improvement projects categorized into four different project types: flooding, erosion, maintenance, and water quality. The project database continues to serve as a "living document" with which new projects have been identified and prioritized.

LOCAL IMPLEMENTATION AND CRS CREDIT

The CRS encourages strong building codes. It provides credit in two ways: points are awarded based on the community's Building Code Effectiveness Grading Schedule (BCEGS) classification and points are awarded for adopting the International Code series. Bryan's BCEGS rating is a Class 3 for residential and a Class 3 for commercial. The City has adopted the 2021 International Building Code (IBC) which is based on national consensus for building standards to protect public health and safety. The IBC is updated every three years.

CRS credits are available for regulations that encourage developers to preserve floodplains or other hazardous areas away from development. There is no credit for a plan, only for the enforceable regulations that are adopted pursuant to a plan. Bryan currently receives credit for Activity 430 – Higher Regulatory Standards for requiring freeboard, foundation protection, and local drainage protection. Additionally, Bryan currently receives credit for Activity 420 – Open Space Preservation. Preserving flood prone areas as open space is one of the highest priorities of the CRS. The City also currently receives credit for Activity 450 – Stormwater Management for enforcing stormwater management regulation as well as regulations for soil and erosion control and water quality. Adopting additional higher standards and stormwater management regulations and preserving more floodplain area as open space would further support preventative mitigation in the City. The FMPC recommended continued improvements to the City's stormwater maintenance program, expanded floodplain mapping and data collection, and additional open space preservation.

CONCLUSIONS

Future flood losses in Bryan will be reduced through the implementation of the International Building Code and the City's regulations for flood protection, stormwater management, and erosion and sedimentation control. Zoning and comprehensive planning will also work together to prevent future flood losses by directing development away from hazard prone areas. Continued hazard mitigation planning can further identify specific projects to reduce risk. Maintaining these regulatory, administrative and technical capabilities, continuing to support plan integration, and working collaboratively with the County, surrounding communities, and the broader Lower Brazos Region will support the City's ability to implement preventative mitigation measures. Additionally, creating or maintaining open space will expand

opportunities for the public to benefit from education and recreation while limiting potential for future flood exposure.

MITIGATION ALTERNATIVES EVALUATED

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Recommended?
1.2.b	Perform a channel inventory including type, condition, and include in maintenance program	Data collection will support improved drainage inspections and maintenance to prevent problems from arising.	Yes
1.2.c	Establish a closed-circuit television (CCTV) program for pipe inspections	This will improve monitoring capabilities, enabling faster identification and correction of problems.	Yes
1.4.a	Coordinate open space opportunities with flood control needs for new developments and repetitive loss areas	Pursuing open space acquisitions in areas of known high flood risk will provide the greatest benefit.	Yes
-	Update the flood protection ordinance to include additional higher regulatory standards.	Additional higher standards were pursued during the 2021 update of the ordinance and were not approved at that time.	No

B.1.2 PROPERTY PROTECTION MEASURES

Property protection measures are used to modify buildings or property subject to damage. Property protection measures fall under three approaches:

- Modify the site to keep the hazard from reaching the building;
- Modify the building (retrofit) so it can withstand the impacts of the hazard; and
- Insure the property to provide financial relief after the damage occurs.

Property protection measures are normally implemented by the property owner, although in many cases technical and financial assistance can be provided by a government agency.

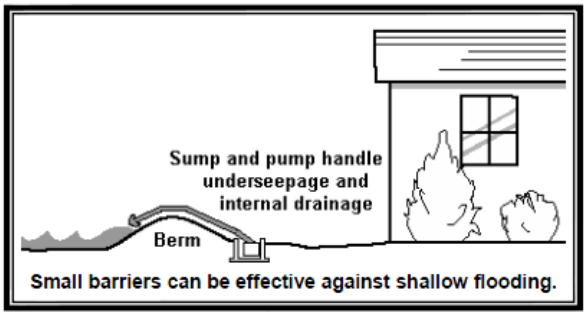
KEEPING THE HAZARD AWAY

Generally, floods do not damage vacant areas. As noted earlier, the major impact of hazards is to people and improved property. In some cases, properties can be modified so the hazard does not reach the damage-prone improvements. For example, a berm can be built to prevent floodwaters from reaching a house. There are five common methods to keep a flood from reaching and damaging a building:

- Erect a barrier between the building and the source of the flooding.
- Move the building out of the flood-prone area.
- Elevate the building above the flood level.
- Demolish the building.
- Replace the building with a new one that is elevated above the flood level.

Demolition, elevation, reconstruction, and retrofitting are the most effective types to consider in Bryan. The City has already completed several buyouts of severe repetitive loss properties.

BARRIERS



Small barriers can be effective against shallow flooding.

A flood protection barrier can be built of dirt or soil (a "berm") or concrete or steel (a "floodwall"). Careful design is needed so as not to create flooding or drainage problems on neighboring properties. Depending on how porous the ground is, if floodwaters will stay up for more than an hour or two, the design needs to account for leaks, seepage of water underneath, and rainwater that will fall inside the perimeter. This is usually done with a sump or drain to collect the internal groundwater and surface water and a pump and pipe to pump the internal drainage over the barrier.

Barriers can only be built so high. They can be overtopped by a flood higher than expected. Barriers made of earth are susceptible to erosion from rain and floodwaters if not properly sloped, covered with grass, and properly maintained.


This low floodwall has landscaping to minimize the adverse impact on the property's appearance.

RELOCATION

Moving a building to higher ground is the surest and safest way to protect it from flooding. While almost any building can be moved, the cost increases for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings. Relocation is also preferred for large lots that include buildable areas outside the floodplain or where the owner has a new flood-free lot (or portion of the existing lot) available.


Small, wood frame buildings are the easiest to relocate

Source: Kennedy House Movers, Huntsville, AL

BUILDING ELEVATION

Raising a building above the flood level can be almost as effective as moving it out of the floodplain. Water flows under the building, causing little or no damage to the structure or its contents. Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. Elevation has proven to be an acceptable and reasonable means of complying with floodplain regulations that require new, substantially improved, and substantially damaged buildings to be elevated above the base flood elevation.

DEMOLITION

Some buildings, especially heavily damaged or repetitively flooded ones, are not worth the expense to protect them from future damages. It is cheaper to demolish them and either replace them with new, flood protected structures, or relocate the occupants to a safer site. Demolition is also appropriate for buildings that are difficult to move, such as larger, slab foundation or masonry structures, and for dilapidated structures that are not worth protecting.

Demolishing a repetitively flooded home

PILOT RECONSTRUCTION

If a building is not in good shape, elevating it may not be worthwhile or it may even be dangerous. An alternative is to demolish the structure and build a new one on the site that meets or exceeds all flood protection codes. FEMA funding programs refer to this approach as "pilot reconstruction." It is still a pilot program, and not a regularly funded option. Certain rules must be followed to qualify for federal funds for pilot reconstruction.

RETROFITTING

An alternative to keeping the hazard away from a building is to modify or retrofit the site or building to minimize or prevent damage. There are a variety of techniques to do this, as described below.

- **Dry Floodproofing**
  Dry floodproofing means making all areas below the flood protection level watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings, such as doors, windows and vents, are closed, either permanently, with removable shields, or with sandbags. Dry floodproofing of new and existing nonresidential buildings in the regulatory floodplain is permitted under state, FEMA and local regulations. Dry floodproofing of existing residential buildings in the floodplain is also permitted as long as the building is not substantially damaged or being substantially improved. Owners of buildings located outside the regulatory floodplain can always use dry floodproofing techniques.
  Dry floodproofing is only effective for shallow flooding, such as repetitive drainage problems. It does not protect from the deep flooding along lakes and larger rivers caused by hurricanes or other heavy rainstorms.
- **Wet Floodproofing**
  The alternative to dry floodproofing is wet floodproofing: water is let in and everything that could be damaged by a flood is removed or elevated above the flood level. Structural components below the flood level are replaced with materials that are not subject to water damage. For example, concrete block walls are used instead of wooden studs and gypsum wallboard. The furnace, water heater and laundry facilities are permanently relocated to a higher floor. Where the flooding is not deep, these appliances can be raised on blocks or platforms.

INSURANCE

Technically, insurance does not mitigate damage caused by a natural hazard. However, it does help the owner repair, rebuild, and hopefully afford to incorporate some of the other property protection measures in the process. Insurance offers the advantage of protecting the property, so long as the policy is in force, without requiring human intervention for the measure to work.

- **Private Property**
  Although most homeowner's insurance policies do not cover a property for flood damage, an owner can insure a building for damage by surface flooding through the NFIP. Flood insurance coverage is provided for buildings and their contents damaged by a "general condition of surface flooding" in the area. Most people purchase flood insurance because it is required by the bank when they get a mortgage or home improvement loan. Usually, these policies just cover the building's structure and not the contents. Contents coverage can be purchased separately. Renters can buy contents coverage, even if the owner does not buy structural coverage on the building. Most people don't realize that there is a 30-day waiting period to purchase a flood insurance policy and there are limits on coverage.
- **Public Property**
  Governments can purchase commercial insurance policies. Larger local governments often self-insure and absorb the cost of damage to one facility, but if many properties are exposed to

damage, self-insurance can drain the government's budget. Communities cannot expect federal disaster assistance to make up the difference after a flood.

LOCAL IMPLEMENTATION AND CRS CREDIT

The CRS provides the most credit points for acquisition and relocation under Activity 520, because this measure permanently removes insurable buildings from the floodplain. Bryan currently receives credit for Activity 520 – Acquisition and Relocation for the acquisition of several severe repetitive loss properties. The City does not currently receive credit for Activity 530 – Flood Protection, which credits barriers and elevating existing buildings based on the combination of flood protection techniques used and the level of flood protection provided and provide bonus points for the protection of repetitive loss buildings and critical facilities. The FMPC recommended that the City continue to pursue acquisition of repetitive loss properties.

The City also supports property protection by providing advice to property owners who can then implement projects on their own. City staff have the technical expertise to conduct site visits to properties and advise property owners who may want to floodproof or otherwise protect their home or business. The City receives credit for these efforts under Activity 360 Flood Protection Assistance.

Flood insurance information for the City is provided in Section 4.4.3. Bryan publicizes flood insurance through direct mailings and information on the City's website.

There is no credit for purchasing flood insurance, but the CRS does provide credit for local public information programs that explain flood insurance to property owners and preparing plans to increase coverage. The CRS also reduces the premiums for those people who do buy NFIP coverage. Bryan currently receives credit for Activity 330 – Outreach Projects.

CONCLUSIONS

There are several ways to protect properties from flood damage. The advantages and disadvantages of each should be carefully examined for each situation.

Property owners can implement some property protection measures at little cost, especially for sites in areas of low-level flooding. The City can promote and support this type of property protection through outreach, advice and assistance, and financial incentives.

MITIGATION ALTERNATIVES EVALUATED

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Recommended?
2.1.a	Perform a detailed review of flood insurance on city owned properties	A flood insurance assessment will enable the City to target outreach to improve coverage.	Yes
2.2.a	Develop a voluntary property acquisition plan and program for repetitive loss areas	Federal grant funding is available to support this activity and it will mitigate risk from the most vulnerable buildings.	Yes
-	Explore development of a program to assist property owners with elevation and relocation projects for residential structures	Acquisition and demolition is the City's preferred mitigation alternative because elevation leaves more residual risk.	No

B.1.3 NATURAL RESOURCE PROTECTION

Resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas. These activities enable the naturally beneficial functions of fields, floodplains, wetlands, and other natural

lands to operate more effectively. Natural and beneficial functions of watersheds, floodplains and wetlands include:

- Reduction in runoff from rainwater and stormwater in pervious areas
- Infiltration that absorbs overland flood flow
- Removal and filtering of excess nutrients, pollutants and sediments
- Storage of floodwaters
- Absorption of flood energy and reduction in flood scour
- Water quality improvement
- Groundwater recharge
- Habitat for flora and fauna
- Recreational and aesthetic opportunities

As development occurs, many of the above benefits can be achieved through regulatory steps for protecting natural areas or natural functions. This section covers the resource protection programs and standards that can help mitigate the impact of natural hazards, while they improve the overall environment. Six areas were reviewed:

- Wetland protection
- Erosion and sedimentation control
- Stream/River restoration
- Best management practices
- Dumping regulations
- Farmland protection

WETLAND PROTECTION

Wetlands are often found in floodplains and topographically depressed areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as a natural filter, which helps to improve water quality, and they provide habitat for many species of fish, wildlife and plants. Bryan contains over 700 acres of wetlands and floodplains.

EROSION AND SEDIMENTATION CONTROL

Farmlands and construction sites typically contain large areas of bare exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Erosion also occurs along stream banks and shorelines as the volume and velocity of flow destabilize and wash away the soil. Sediment suspended in the water tends to settle out where flowing water slows down. This can clog storm drains, drain tiles, culverts and ditches and reduce the water transport and storage capacity of river and stream channels, lakes and wetlands.

There are two principal strategies to address these problems: minimize erosion and control sedimentation. Techniques to minimize erosion include phased construction, minimal land clearing, and stabilizing bare ground as soon as possible with vegetation and other soil stabilizing practices. Sedimentation controls include sedimentation ponds, silt fences, and other temporary barriers that allow sediment to settle out of runoff.

STREAM/RIVER RESTORATION

There is a growing movement that has several names, such as "stream conservation," "bioengineering," or "riparian corridor restoration." The objective of these approaches is to return streams, stream banks and adjacent land to a more natural condition, including the natural meanders. Another term is "ecological restoration," which restores native indigenous plants and animals to an area.

A key component of these efforts is to use appropriate native plantings along the banks that resist erosion. This may involve retrofitting the shoreline with willow cuttings, wetland plants, or rolls of landscape material covered with a natural fabric that decomposes after the banks are stabilized with plant roots.

In all, restoring the right vegetation to a stream has the following advantages:

- Reduces the amount of sediment and pollutants entering the water
- Enhances aquatic habitat by cooling water temperature
- Provides food and shelter for both aquatic and terrestrial wildlife
- Can reduce flood damage by slowing the velocity of water
- Increases the beauty of the land and its property value
- Prevents property loss due to erosion
- Provides recreational opportunities, such as hunting, fishing and bird watching
- Reduces long-term maintenance costs

The FMPC recommended training staff on maintenance practices that facilitate natural preservation. Resources are available through Texas A&M and the Texas Riparian Association.

BEST MANAGEMENT PRACTICES

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. They are regulated by the US EPA. Nonpoint source pollutants come from non-specific locations and harder to regulate. Examples of nonpoint source pollutants are lawn fertilizers, pesticides, other chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams.

The term "best management practices" (BMPs) refers to design, construction and maintenance practices and criteria that minimize the impact of stormwater runoff rates and volumes, prevent erosion, protect natural resources and capture nonpoint source pollutants (including sediment). They can prevent increases in downstream flooding by attenuating runoff and enhancing infiltration of stormwater. They also minimize water quality degradation, preserve beneficial natural features onsite, maintain natural base flows, minimize habitat loss, and provide multiple usages of drainage and storage facilities.

DUMPING REGULATIONS

BMPs usually address pollutants that are liquids or are suspended in water that are washed into a lake or stream. Dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' abilities to convey or clean stormwater.

Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations need to also apply to "non-objectionable" materials, such as grass clippings or tree branches, which can kill ground cover or cause obstructions in channels. Regular inspections to catch violations should be scheduled.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard without realizing that is needed to drain street runoff. They may not understand how regarding their yard, filling a wetland, or discarding leaves or branches in a watercourse can cause a problem to themselves and others. Therefore, a dumping enforcement program should include public information materials that explain the reasons for the rules as well as the penalties.

Bryan prohibits dumping of refuse, fill, garbage, grass clippings, brush, waste concrete, or other objectionable material in existing drainage facilities including swales, ditches, storm drains, inlets, watercourses, gutters, or culverts as part of the stormwater management ordinance.

FARMLAND PROTECTION

Farmland protection is an important piece of comprehensive planning and zoning throughout the United States. The purpose of farmland protection is to provide mechanisms for prime, unique, or important agricultural land to remain as such, and to be protected from conversion to nonagricultural uses.

Frequently, farm owners sell their land to residential or commercial developers and the property is converted to non-agricultural land uses. With development comes more buildings, roads and other infrastructure. Urban sprawl occurs, which can lead to additional stormwater runoff and emergency management difficulties.

Farms on the edge of cities are often appraised based on the price they could be sold for to urban developers. This may drive farmers to sell to developers because their marginal farm operations cannot afford to be taxed as urban land. The Farmland Protection Program in the United States Department of Agriculture's 2002 Farm Bill (Part 519) allows for funds to go to state, tribal, and local governments as well as nonprofit organizations to help purchase easements on agricultural land to protect against the development of the land.

LOCAL IMPLEMENTATION AND CRS CREDIT

Bryan currently receives credit for Activity 420 – Open Space Preservation for preserving open space and for open space recommendations in the comprehensive plan. Credit for preserved areas is based on the percentage of the floodplain that can be documented as protected from development by ownership or local regulations. The FMPC recommended protecting existing open space resources through use of zoning and by providing incentives to developers.

Credit is available for the Erosion and Sediment Control (ESC) element under Activity 450 for regulating activities throughout the watershed to minimize erosion on construction sites that could result in sedimentation and water pollution. Bryan currently receives credit for soil and erosion control regulations and water quality regulations included under the City's subdivision ordinance and stormwater management ordinance. The FMPC proposed training staff on stream maintenance practices that facilitate preservation and natural floodplain functions.

CONCLUSIONS

Flood hazard mitigation projects can achieve multiple benefits by using resource protection programs to support protecting natural features that also mitigate the impacts of flooding.

The City of Bryan's code of ordinances prohibits dumping in waterways and sets standards for erosion and sedimentation control and water quality. The City already preserves floodplain areas as open space and will continue to pursue further preservation, as it will benefit the natural resource areas, support natural floodplain functions, and help to protect certain species of plants and animals.

MITIGATION ALTERNATIVES EVALUATED

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Recommended?
3.1.c	Continue the practice of requiring private drainage easements on all creeks	This action supports preservation of floodplain areas and protects natural floodplain functions.	Yes
3.2.a	Explore developing ordinances/criteria in the Drainage Design Guidelines that require erosion buffers along creeks	This action will formally establish a buffer requirement to protect stream quality.	Yes
3.2.b	Explore providing incentives to developers to preserve natural areas	The City can encourage greater preservation by partnering with developers through an incentive program.	Yes

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Recommended?
3.2.c	Explore the use of Natural Area Preserved zoning districts in Bryan	A zoning district could formally establish the City's intent to preserve certain areas as open space.	Yes

B.1.4 EMERGENCY SERVICES MEASURES

Emergency services measures protect people during and after a disaster. A good emergency management program addresses all hazards, and it involves all local government departments. This section reviews emergency services measures following a chronological order of responding to an emergency. It starts with identifying an impending problem (threat recognition) and continues through post-disaster activities.

THREAT RECOGNITION

The first step in responding to a flood is to know when weather conditions are such that an event could occur. With a proper and timely threat recognition system, adequate warnings can be disseminated.

The National Weather Service (NWS) is the prime agency for detecting meteorological threats. Severe weather warnings are transmitted through NOAA's Weather Radio System. Local emergency managers can then provide more site-specific and timely recognition after the Weather Service issues a watch or a warning. A flood threat recognition system predicts the time and height of a flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels.

On smaller rivers and streams, locally established rainfall and river gauges are needed to establish a flood threat recognition system. The NWS may issue a "flash flood watch." This is issued to indicate current or developing hydrologic conditions that are favorable for flash flooding in and close to the watch area, but the occurrence is neither certain nor imminent. These events are so localized and so rapid that a "flash flood warning" may not be issued, especially if no remote threat recognition equipment is available. In the absence of a gauging system on small streams, the best threat recognition system is to have local personnel monitor rainfall and stream conditions. While specific flood crests and times will not be predicted, this approach will provide advance notice of potential local or flash flooding.

WARNING

The next step in emergency response following threat recognition is to notify the public and staff of other agencies and critical facilities. More people can implement protection measures if warnings are early and include specific detail.

The NWS issues notices to the public using two levels of notification:

- Watch: conditions are right for flooding, thunderstorms, tornadoes or winter storms.
- Warning: a flood, tornado, etc., has started or been observed.

A more specific warning may be disseminated by the community in a variety of ways. The following are the more common methods:

- CodeRED countywide mass telephone emergency communication system
- Commercial or public radio or TV stations
- The Weather Channel
- Cable TV emergency news inserts
- Telephone trees/mass telephone notification
- NOAA Weather Radio
- Tone activated receivers in key facilities
- Outdoor warning sirens

- Sirens on public safety vehicles
- Door-to-door contact
- Mobile public address systems
- Email notifications

Multiple or redundant systems are most effective; if people do not hear one warning, they may still get the message from another part of the system.

Just as important as issuing a warning is telling people what to do in case of an emergency. A warning program should include a public information component.

STORMREADY

The National Weather Service established the StormReady program to help local governments improve the timeliness and effectiveness of hazardous weather related warnings for the public. To be officially StormReady, a community must:

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

Being designated a StormReady community by the National Weather Service is a good measure of a community's emergency warning program for weather hazards. Neither Bryan nor Brazos County are currently credited by NOAA as a StormReady community.

RESPONSE

The protection of life and property is the most important task of emergency responders. Concurrent with threat recognition and issuing warnings, a community should respond with actions that can prevent or reduce damage and injuries. Typical actions and responding parties include the following:

- Activating the emergency operations center (emergency preparedness)
- Closing streets or bridges (police or public works)
- Shutting off power to threatened areas (utility company)
- Passing out sand and sandbags (public works)
- Holding children at school or releasing children from school (school superintendent)
- Opening evacuation shelters (the American Red Cross)
- Monitoring water levels (public works)
- Establishing security and other protection measures (police)

An emergency action plan ensures that all bases are covered and that the response activities are appropriate for the expected threat. These plans are developed in coordination with the agencies or offices that are given various responsibilities.

Emergency response plans should be updated annually to keep contact names and telephone numbers current and to ensure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and of changing conditions. The end result is a coordinated effort implemented by people who have experience working together so that available resources will be used in the most efficient manner possible.

EVACUATION AND SHELTER

There are six key components to a successful evacuation:

- Adequate warning
- Adequate routes
- Proper timing to ensure the routes are clear
- Traffic control
- Knowledgeable travelers
- Care for special populations (e.g., the handicapped, prisoners, hospital patients, and schoolchildren)

Those who cannot get out of harm's way need shelter. Typically, the American Red Cross will staff a shelter and ensure that there is adequate food, bedding, and wash facilities. Shelter management is a specialized skill. Managers must deal with problems like scared children, families that want to bring in their pets, and the potential for an overcrowded facility. City of Bryan Emergency Management has identified schools and churches throughout the City that can serve as shelters if needed. Additionally, Brazos County Emergency Management plans for evacuation support for individuals with access and functional needs. The County has identified evacuation routes for both the Brazos River floodplain and the Navasota River floodplain which can be publicized during a flood response as needed.

POST-DISASTER RECOVERY AND MITIGATION

After a disaster, communities should undertake activities to protect public health and safety and facilitate recovery. Appropriate measures include:

- Patrolling evacuated areas to prevent looting
- Providing safe drinking water
- Monitoring for diseases
- Vaccinating residents for tetanus and other diseases
- Clearing streets
- Cleaning up debris and garbage

Following a disaster there should be an effort to help prepare people and property for the next disaster. Such an effort would include:

- Public information activities to advise residents about mitigation measures they can incorporate into their reconstruction work.
- Evaluating damaged public facilities to identify mitigation measures that can be included during repairs.
- Identifying other mitigation measures that can lessen the impact of the next disaster.
- Acquiring substantially or repeatedly damaged properties from willing sellers.
- Planning for long-term mitigation activities.
- Applying for post-disaster mitigation funds.

REGULATING RECONSTRUCTION

Requiring permits for building repairs and conducting inspections are vital activities to ensure that damaged structures are safe for people to reenter and repair. There is a special requirement to do this in floodplains, regardless of the type of disaster or the cause of damage. The NFIP requires that local officials enforce the substantial damage regulations. These rules require that if the cost to repair a building in the mapped floodplain equals or exceeds 50% of the building's market value, the building must be retrofitted to meet the standards of a new building in the floodplain. In most cases, this means that a substantially damaged building must be elevated above the base flood elevation.

LOCAL IMPLEMENTATION AND CRS CREDIT

Flash flood warnings are issued by National Weather Service Offices, which have the local and county warning responsibility. Flood warnings are forecasts of coming floods and are distributed to the public by the NOAA Weather Radio, commercial radio and television, and through local emergency agencies. The

warning message tells the expected degree of flooding, the affected area, when and where flooding will begin, and the expected maximum flood height at specific forecast points during flood crest. In addition to this resource, the City of Bryan has installed several flood gauges which provide data on stream heights, rainfall amounts, and rainfall intensity as part of the Bryan Flood Early Warning System (BFEWS).

Bryan does not currently receive credit for Activity 610 – Flood Warning and Response, but credits are available based on the number and types of warning media that can reach the community's flood prone population. Depending on the location, communities can receive credit for the telephone calling system and more credits if there are additional measures, like telephone trees. Being designated as a StormReady community can provide additional credits.

CONCLUSIONS

Emergency management functions for Bryan are provided by the City's Emergency Management Department and Brazos County Emergency Management. These entities will continue to coordinate on emergency preparedness and response. Bryan can support improved emergency response capabilities with additional flood recognition and warning information. The FMPC recommended a project for the City to expand the BFEWS with additional flood and rainfall gauges.

MITIGATION ALTERNATIVES EVALUATED

Action #	Mitigation Action	Reason for Pursuing/Not Pursuing	Recommended?
4.2.b	Explore use of city wide 2D model to consolidate rainfall data and produce real-time flood warning/forecasting system to notify residents and city staff for emergency access.	Real-time data will support improved warning and response.	Yes
4.2.c	Create public information campaign to encourage participation in Code Red	The City provides this service to support warning and preparedness. Outreach will increase participation.	Yes
4.2.d	Explore installing "Street May Flood" signs to critical locations	Signage will help residents understand areas of risk and plan alternate routes.	Yes

B.1.5 STRUCTURAL PROJECTS

Four general types of flood control projects are reviewed here: levees, reservoirs, diversions, and dredging. These projects have three advantages not provided by other mitigation measures:

- They can stop most flooding, protecting streets and landscaping in addition to buildings.
- Many projects can be built without disrupting citizens' homes and businesses.
- They are constructed and maintained by a government agency, a more dependable long-term management arrangement than depending on many individual private property owners.

However, as shown below, structural measures also have shortcomings. The appropriateness of using flood control depends on individual project area circumstances.

Advantages

- They may provide the greatest amount of protection for land area used
- Because of land limitations, they may be the only practical solution in some circumstances
- They can incorporate other benefits into structural project design, such as water supply and recreational uses

- Regional detention may be more cost-efficient and effective than requiring numerous small detention basins

Disadvantages

- They can disturb the land and disrupt the natural water flows, often destroying wildlife habitat
- They require regular maintenance
- They are built to a certain flood protection level that can be exceeded by larger floods
- They can create a false sense of security
- They promote more intensive land use and development in the floodplain

LEVEES AND FLOODWALLS

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

RESERVOIRS AND DETENTION

Reservoirs reduce flooding by temporarily storing flood waters behind dams or in storage or detention basins. Reservoirs lower flood heights by holding back, or detaining, runoff before it can flow downstream. Flood waters are detained until the flood has subsided, and then the water in the reservoir or detention basin is released or pumped out slowly at a rate that the river can accommodate downstream.

Reservoirs can be dry and remain idle until a large rain event occurs. Or they may be designed so that a lake or pond is created as shown here in the image of the retention pond. The lake or pond may provide recreational benefits or water supply (which could also help mitigate a drought).

Retention pond

Flood control reservoirs are commonly built for one of two purposes. Large reservoirs are constructed to protect property from existing flood problems. Smaller reservoirs, or detention basins, are built to protect property from the stormwater runoff impacts of new development.

DIVERSION

A diversion is a new channel that sends floodwaters to a different location, thereby reducing flooding along an existing watercourse. Diversions can be surface channels, overflow weirs, or tunnels. During normal flows, the water stays in the old channel. During floods, the floodwaters spill over to the diversion channel or tunnel, which carries the excess water to a receiving lake or river.

LOCAL IMPLEMENTATION AND CRS CREDIT

Bryan does not currently receive credit for Activity 530 – Flood Protection. Structural flood control projects that provide 100-year flood protection and that result in revisions to the Flood Insurance Rate Map are not credited by the CRS so as not to duplicate the larger premium reduction provided by removing properties from the mapped floodplain.

CONCLUSIONS

There are many areas identified throughout Bryan that experience flooding due to overburdened channels and/or inadequate drainage systems. The City's CIP project database includes already identified structural improvements to the stormwater system that can alleviate some flood risk in the City.

MITIGATION ALTERNATIVES EVALUATED

Action #	Mitigation Action	Reason for Pursuing/Not Pursuing	Recommended?
5.2.a	Continue to construct local and regional stormwater detention facilities in flood prone areas	Detention will reduce downstream flows and support flood reduction.	Yes
5.3.a	Develop a plan to upgrade existing low water crossings to improve service levels	Low water crossings are a high priority for mitigation.	Yes
5.4.b	Explore creating a system for development incentives for improving city storm water infrastructure	Incentivizing stormwater improvements will reduce the impacts of new development.	Yes
-	Identify opportunities for public and private (developer) partnerships to complete needed storm improvements	Stormwater improvements on new development can be better accomplished through an incentive program.	No

B.1.6 PUBLIC INFORMATION

OUTREACH PROJECTS

Outreach projects are the first step in the process of orienting property owners to the hazards they face and to the concept of property protection. They are designed to encourage people to seek out more information in order to take steps to protect themselves and their properties.

Awareness of the hazard is not enough; people need to be told what they can do about the hazard. Thus, projects should include information on safety, health, and property protection measures. Research has shown that a properly run local information program is more effective than national advertising or publicity campaigns. Therefore, outreach projects should be locally designed and tailored to meet local conditions.

Community newsletters/direct mailings: The most effective types of outreach projects are mailed or distributed to everyone in the community. In the case of floods, they can be sent only to floodplain property owners. Bryan sends direct mailings to all City residents through utility mailers and sends additional targeted outreach to floodplain residents.

News media: Local newspapers, radio stations, and cable TV can be strong allies in efforts to inform the public. These media offer interview formats and cable TV may be willing to broadcast videos on the hazards.

LIBRARIES AND WEBSITES

Outreach activities tell people that they are exposed to a hazard. The next step is to provide information to those who want to know more. The community library and local websites are widely accessible places for residents to seek information on hazards, hazard protection, and protecting natural resources.

Books and pamphlets on hazard mitigation can be given to libraries, and many of these can be obtained for free from state and federal agencies. Libraries also have their own public information campaigns with displays, lectures and other projects, which can augment the activities of the local government. Websites provide fast access to a wealth of public and private sites for information. Through links to other websites, there is almost no limit to the amount of information that can be accessed on the Internet. In addition to

online floodplain maps, websites can link to information for homeowners on how to retrofit for floods or a website about flood education for children. Bryan maintains flood related information in the public library and on the community website.

TECHNICAL ASSISTANCE

HAZARD INFORMATION

Residents and business owners that are aware of the potential hazards can take steps to avoid problems or reduce their exposure to flooding. Communities can easily provide map information from FEMA's FIRMs and Flood Insurance Studies. They may also assist residents in submitting requests for map amendments and revisions when they are needed to show that a building is located outside the mapped floodplain.

Some communities supplement what is shown on the FIRM with information on additional hazards, flooding outside mapped areas, and zoning. When the map information is provided, community staff can explain insurance, property protection measures, and mitigation options that are available to property owners. They should also remind inquirers that being outside the mapped floodplain is no guarantee that a property will never flood.

PROPERTY PROTECTION ASSISTANCE

While general information provided by outreach projects or the library is beneficial, most property owners do not feel ready to retrofit their buildings without more specific guidance. Local building and engineering department staff are experts in construction and floodplain management. They can provide free advice, not necessarily to design a protection measure, but to steer the owner onto the right track. City staff can provide the following types of assistance:

- Visit properties and offer protection suggestions
- Recommend or identify qualified or licensed contractors
- Inspect homes for anchoring of roofing and the home to the foundation
- Explain when building permits are needed for home improvements.

The City of Bryan provides map information and property protection advice and assistance to City residents.

PUBLIC INFORMATION PROGRAM

A Program for Public Information (PPI) is a document that receives CRS credit for planning and coordinating a community's flood related outreach. It is a review of local conditions, local public information needs, and a recommended plan of activities. A PPI frequently includes the following information, much of which is incorporated into this plan:

- The local flood hazard
- The property protection measures appropriate for the flood hazard
- Flood safety measures appropriate for the local situation
- The public information activities currently being implemented within the community, including those being carried out by non-government agencies
- Goals for the community's public information program
- The outreach projects that will be done each year to reach the goals
- The process that will be followed to monitor and evaluate the projects

LOCAL IMPLEMENTATION AND CRS CREDIT

Bryan currently receives credit under Activity 330 – Outreach Projects as well as Activity 350 – Flood Protection Information. A community brochure is mailed to all Bryan Texas Utilities customers citywide and an additional mailing is sent to properties in the SFHA. Documents relating to floodplain management

are available in the public library and information about flooding is posted on the City's website. The City may consider developing a Program for Public Information to further plan and coordinate this outreach.

CONCLUSIONS

Bryan provides a variety of public outreach and has a Communications Department to support outreach efforts. The City will continue existing annual outreach projects and has plans for new initiatives to reach additional audiences and involve stakeholders in disseminating outreach.

MITIGATION ALTERNATIVES EVALUATED

Action #	Mitigation Action	Reason for Pursuing / Not Pursuing	Recommended?
6.1.a	Direct mail of FEMA flood protection information to targeted areas of high flood risk	Direct mailing to the SFHA will ensure residents of high-risk areas receive information on flood risk and mitigation.	Yes
6.1.d	Educate builders and landscape companies on how to properly grade new homes to protect from flood damage	Many public survey responses indicated localized flooding problems related to lot drainage. Targeted education can enable builders and landscapers to mitigate these problems and prevent them in the future.	Yes
6.2.b	Create adopt-an-inlet and adopt-a-creek programs	These programs will increase awareness and education of stormwater and flooding while also involving volunteer support in drainage maintenance.	Yes

B.2 MITIGATION ALTERNATIVE SELECTION CRITERIA

The process for evaluating mitigation alternatives is described in Section 6.3. The following criteria were considered during the selection and prioritization of proposed mitigation measures:

STAPLEE

- **Social:** Will the measure have equitable outcomes? Does it benefit vulnerable populations?
- **Technical:** Will it work? Does it solve the problem? Is it feasible?
- **Administrative:** Does the community have the capacity to implement and manage project?
- **Political:** Is there public and stakeholder support? Is political leadership willing to support?
- **Legal:** Does the community have the authority to implement it? Are there liability implications?
- **Economic:** Is it cost-beneficial? Is there funding? Does it contribute to the local economy or economic development?
- **Environmental:** Does it comply with environmental regulations? Does it benefit or protect existing natural resources?

SUSTAINABLE DISASTER RECOVERY

- Quality of life
- Social equity
- Hazard mitigation
- Economic development
- Environmental protection and enhancement
- Community participation

SMART GROWTH PRINCIPLES

- Infill versus sprawl
- Efficient use of land resources
- Full use of urban resources
- Mixed uses of land
- Transportation options
- Detailed, human-scale design

OTHER

- Does measure address area with highest risk?
- Does measure protect…
    - The largest # of people exposed to risk?
    - The largest # of buildings?
    - The largest # of jobs?
    - The largest tax income?
    - The largest average annual loss potential?
    - The area most frequently impacted?
    - Critical infrastructure?
- When will funding be available?
- How visible is the project?
- Does the project have community credibility?

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