Building Flood Resilience for Water and Wastewater Utilities

US Environmental Protection Agency (EPA)

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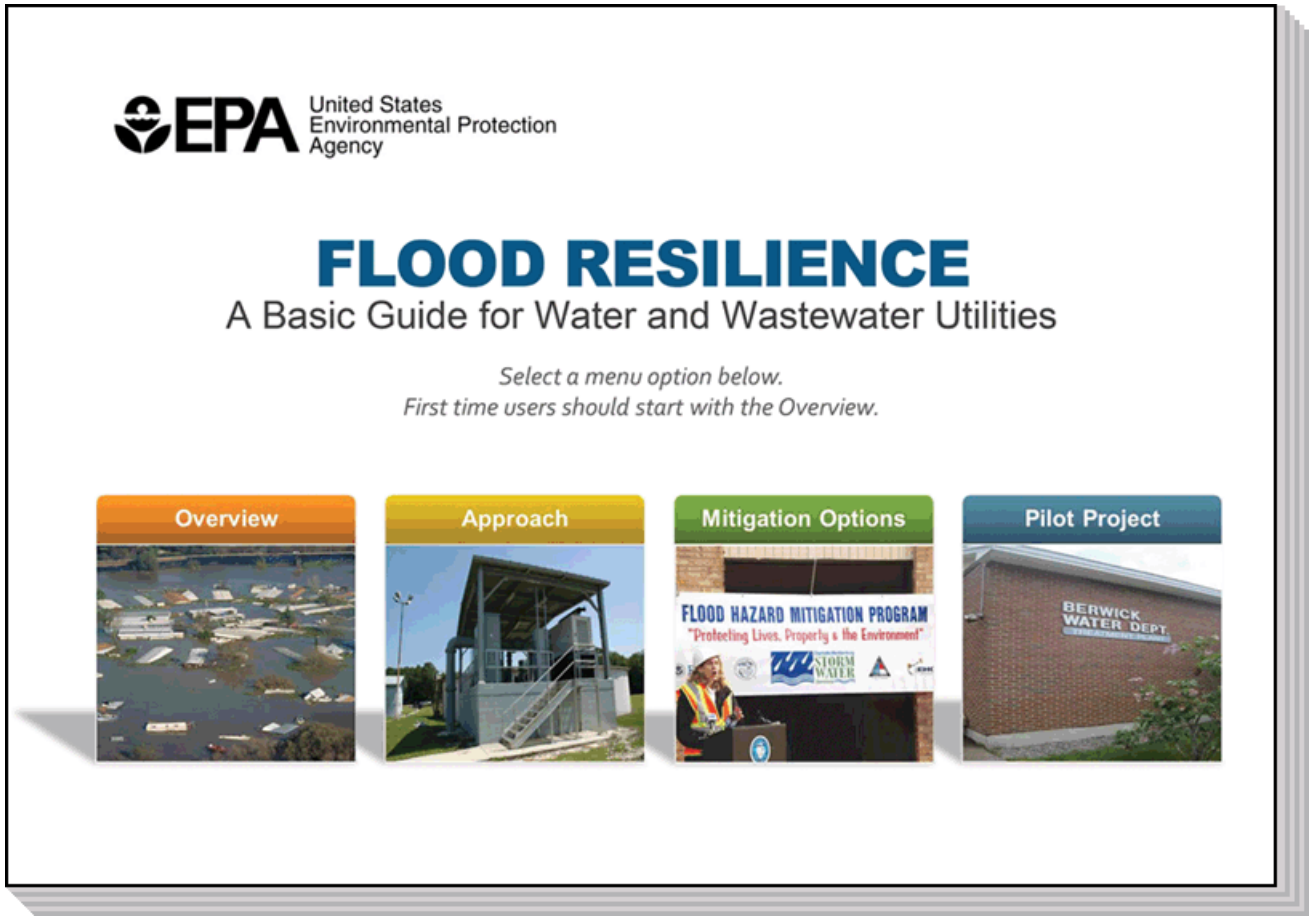

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Overview

Step 5. Update a Hazard Mitigation Plan

Use a Team Approach

Utility Staff

- operators
- supervisors
- field staff
- purchase dept.
- financial

Local Government

- town engineer
- public works staff
- flood plain managers
- hazard mitigation officers
- Emergency Management Team

Definitions

Flood Resilience

- ability to withstand a flood event and continue operations
- minimize damage
- rapidly recover from disruptions to service.

Mitigation Measure

- to reduce loss of life and property (equipment / capital investment) by lessening the impact of disasters.

100 Year Flood – 1 percent probability of a flood event

500 Year Flood - .2 percent probability of a flood event

Impacts from Flooding

What are some impacts from flooding?

Impacts from Flooding

Loss of power

Damage to assets

Dangerous conditions to personnel

Disruption of service

Public Heath Impacts

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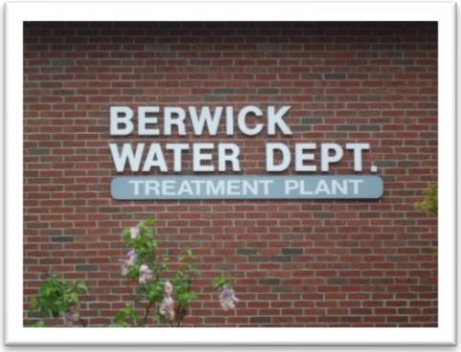


Understanding the Threat of Flooding

https://www.youtube.com/watch?v=PhY5mP4ZJJk

Step 1

Understanding the Threat of Flooding

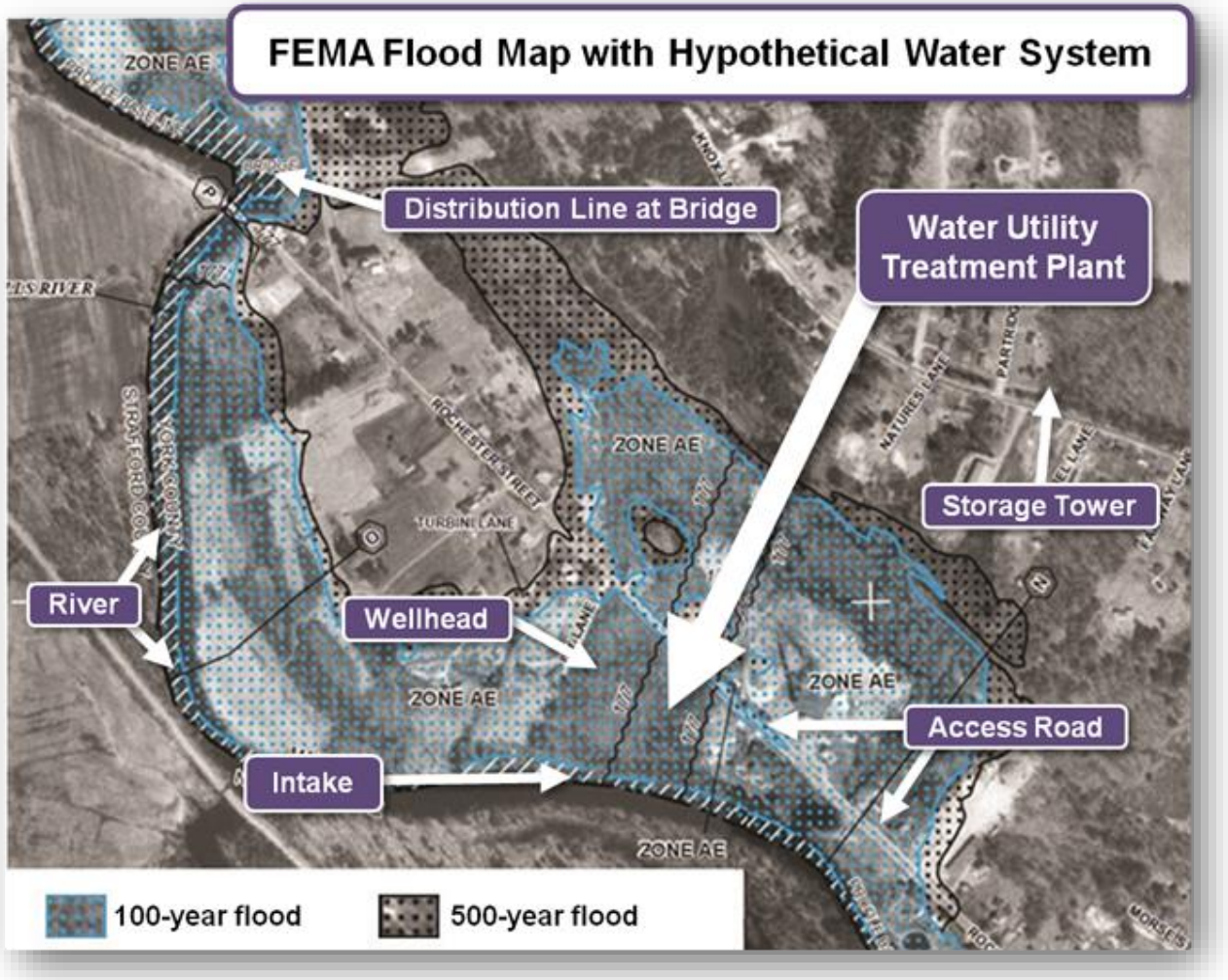
- Utility records of past flooding events
- Identify potential sources of flooding
- Use of FEMA Flood Maps
- Identify where your utility system is located.

Step 1

Understanding the Threat of Flooding

- Identify what flooding threat to prepare for:
  - 100 year 500 year Other

- Get FEMA Maps at Texas Water Development Board – Texas Natural Resources Information System (TNRIS)


FEMA Flood Map with Hypothetical Water System
Distribution Line at Bridge
Water Utility Treatment Plant
Storage Tower
River
Wellhead
Access Road
Intake
ZONE AE
ZONE AE
ZONE AE
ZONE AE
ZONE AE
YORK COUNTY
ROCHESTER STREET
TURBINE LANE
100-year flood
500-year flood

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Blank Data Tables for Step 1:

TABLE 2 – UTILITIES SYSTEMS WITHIN FLOODPLAIN

IMPORTANT NOTE: Use the tables to fill in data from your utility. Be sure to save these Word files to your computer by going to File > Save As. Otherwise, you could lose the data you have entered. To return to the Flood Resilience Guide, minimize this window.

Utility Systems	100-year Floodplain Elevation (177 ft)	500-year Floodplain Elevation (180 ft)
Treatment Facility (177 ft)	✓	✓
Intake (175 ft)	✓	
Distribution/Collection (177 ft)		
Finished Water Storage Tank (183 ft)		
Access Road (176-179 ft)		
Lift Stations (176 ft)		

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Identify Vulnerable Assets & Determine Consequences

https://www.youtube.com/watch?v=eOlFPQA6POw

Step 2

Identify Vulnerable Assets & Determine Consequences

- Measure elevations - utility assets vulnerability to flooding
- Determine consequences - replacement costs and impacts to facility operations
- Determine priority - mitigation to improve flood resilience.

On-Site Asset Inspection Form

Use this form to document important information you will need later to complete your resilience assessment. Each asset that you inspect should have its own form.

Facility Name: _____ **Date Prepared:** _____
Inspector's Name: _____
Inspector's Phone Number: _____

Asset Information

Circle the applicable asset category:

Buildings *Chemical and Other Storage* *Lift Stations* *Headworks*
Instrumentation/Electrical Controls *Power Supply* *Treatment Plant*
Booster Stations and Other Pumps *Water Intake, Distribution and Storage*

Asset Name/Type: _____

Street Address/Coordinates: _____

	Yes	No
Has the asset been renovated/received maintenance more recently than record drawings? If so, when and what actions were taken? _____		
Does the utility have plans to renovate/perform maintenance on this asset in the near future? If yes, when and what actions are planned? _____		

Flooding Impacts and Information

Flood elevation of concern for this asset (from FEMA Flood Map): _____ ft
Asset elevation is _____ ft, which equals floor elevation _____ ft plus asset height above floor _____ ft

Compare flood elevation and asset elevation. Can flood water reach this asset for the following flood levels?

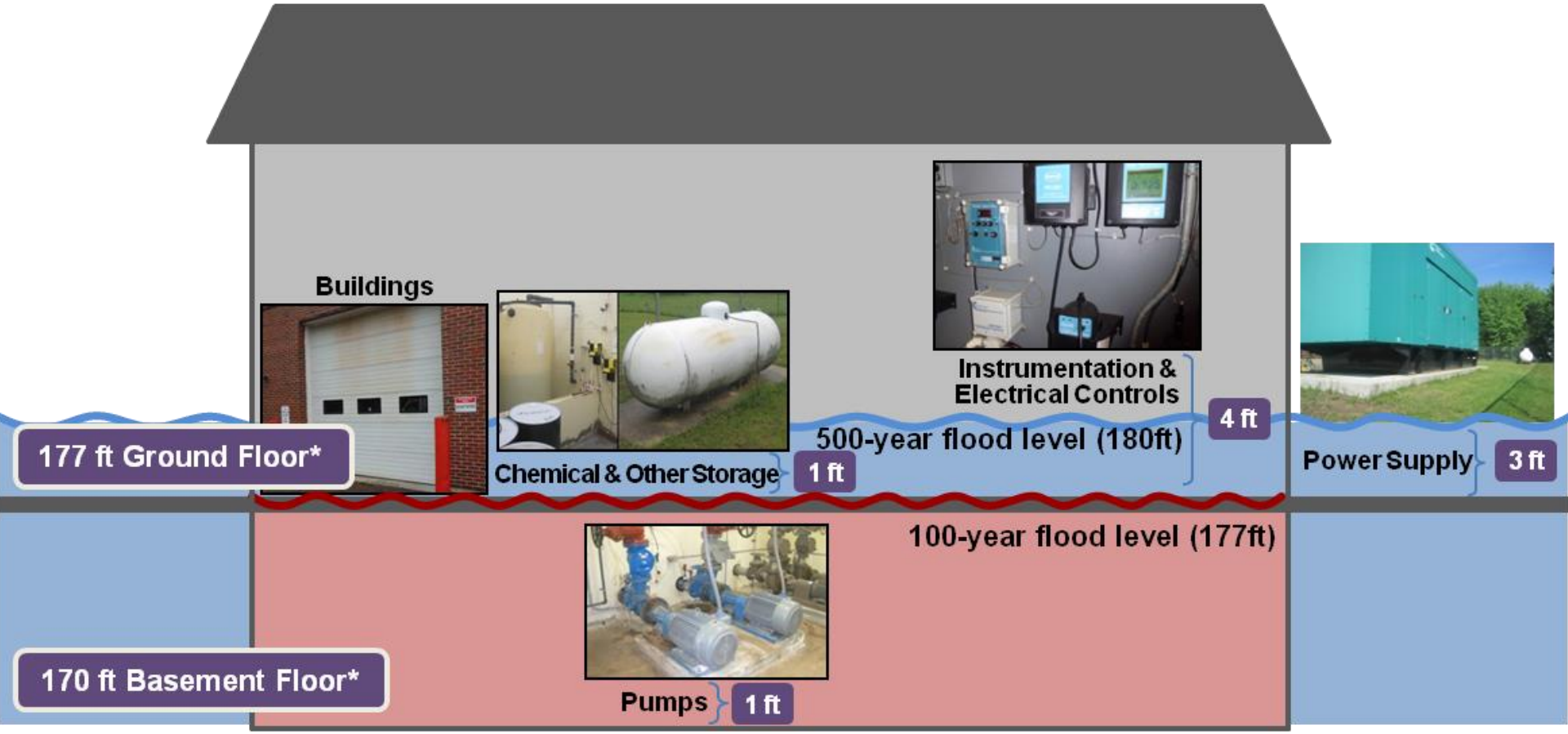
- ☐ 100-year flood
- ☐ 500-year flood
- ☐ Other flood level: _____

What are the flood water entry points for this asset (e.g., floor drains, doors, windows) and how could this asset be damaged by flood water (e.g., physical damage, power outages)? _____
_____
_____

How would utility operations be impacted if this asset is out of service (e.g., duration of service interruptions, impacts to treatment processes)? _____
_____

Additional Notes

Measuring Elevation of Assets within Treatment Facility



*Based on as-built design drawings

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TABLE 3 – SUMMARY OF VULNERABLE ASSETS, CONSEQUENCES OF FAILURE & PRIORITY FOR MITIGATION

IMPORTANT NOTE: Use the tables to fill in data from your utility. Be sure to save these Word files to your computer by going to File > Save As. Otherwise, you could lose the data you have entered. To return to the Flood Resilience Guide, minimize this window.

	Vulnerability				Consequences		Priority for Mitigation[5]		
1	2	3	4	5	6	7	8		
Asset/ Operation	Height of Asset Above Floor (ft)[1]	Elevation of Asset (ft)[2]	Elevation of Flood Threat (ft)[3]	Vulnerable to Flooding? (Yes/No)[4]	Replacement Costs ($) for Asset	Impact to Facility Operations from Asset Failure	Low (✓)	Moderate (✓)	High (✓)
Treatment Facility Entrance	0	177	180	Yes	$500	Water damages doors, but more importantly, water entering facility can find lower level through chases, drains causing damage to key assets (e.g., pumps) for operations.			✓
Pumps					$200,000	Floodwaters could damage motors and electrical components, taking pumps offline and making utility inoperable.			
Chemical Storage					$5,000	Storage tanks not bolted down; could be carried away. Facility could operate depending on which storage tank is lost. Chemicals could spill and cause additional facility and environmental damage.			
Instrumentation/ Controls					$20,000	Key operational assets would be taken offline without controls. Facility could not operate.			

[1] The distance between the floor and the bottom of the utility asset.
[2] Elevation of the asset = elevation of floor (based on design drawing of utility) plus height of asset above floor (column 2).
[3] Elevation of flood threat is obtained from Step 1.5.
[4] If elevation of flood (column 4) is larger than elevation of asset (column 3), then yes.
[5] Based on qualitative judgment considering both vulnerability and consequences.

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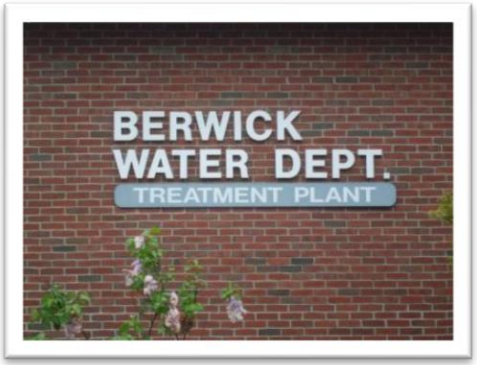

Identify Vulnerable & Evaluate Mitigation Measures

https://www.youtube.com/watch?v=Dj46VFl13nY

Step 3 Identify & Evaluate Mitigation Measures

- Short-Term
- Long-Term
- Prevent damage to key assets
- Prevent disruptions to critical operations

Return to Step 3 Worksheet

Mitigation Options

IDENTIFY MITIGATION MEASURES

This guide provides two ways to identify mitigation measures:

1. Practical Mitigation Measures. Click the clipboard icon for a one-page list of practical mitigation measures to help your utility prevent flood water intrusion, protect assets/operations if flooding does occur and ensure power reliability.

2. Mitigation Options for Specific Assets/Operations. Click the photographs of assets/operations at drinking water (DW) and wastewater (WW) utilities and get tables of flood mitigation measures for those assets/operations. The tables also provide relative costs for various mitigation options.

Remember, before you select the mitigation measures to implement, know the vulnerabilities of the assets/operations and the costs and effectiveness of those mitigation measures (Step 3 Worksheet). You may be able to relocate certain assets/operations outside of the floodplain. Also, find out if your local government requires critical infrastructures to elevate assets to certain heights (e.g., 2 feet above 100-year floodplain).

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Return to Mitigation Options

Mitigation Options

BUILDINGS (page 1 of 2)

- ☑ Drinking water
- ☑ Wastewater

It is important for drinking water and wastewater utilities to protect their buildings and other structures from floods. This includes any entryways, both obvious (e.g., doors, windows, floor drains) and not so obvious (e.g., wiring conduits, overflow drains, cracks) where water can enter structures. Significant damage can result from flood waters entering a building; water can damage or destroy the structure, process equipment, communications and controls, records and field and administrative equipment. Flood waters can also restrict access to the facility. These impacts could result in loss of service for your customers and significant repair costs for the utility. Utilities should establish emergency monitoring and warning systems (alarm systems where possible), emergency preparedness protocols and evacuation procedures for all buildings and facilities.

See the following checklist for potential flood mitigation options for your utility buildings.

✓	Mitigation Options for Buildings	Cost
1. Prevent buildings from flooding.		
	a. Caulk and/or seal wall and floor penetrations.	$
	b. Install backflow prevention devices on sewers, drains and other buildings.	$
✓	c. Install waterproof protection (e.g., removable/semi-permanent structures, sealed doors, shields) for building entry points (e.g., windows, doors, garages).	$$
	d. Install floodwalls, levees or berms around buildings.	$$$
2. Protect critical components if buildings do flood.		
	a. Train staff how and when to shut down and start up power and gas supplies, electrical controls, operating systems and other equipment in system facilities.	$
	b. Identify locations outside the flood zone where utility equipment (e.g., heavy equipment, vehicles, replacement parts, backup generators, pumps) can be stored safely, permanently or temporarily, to prevent damage from flood waters or debris.	$
	c. Have an alternative access plan in case normal access to buildings is blocked. Consult with other entities (e.g., Department of Transportation) to consider alternate road/transportation options (e.g., watercraft).	$

Select Option C

Booster Stations and Other Pumps

What are some mitigation measures?

Mitigation Measures for Booster Stations and Other Pumps

- Prevent flooding – sandbags
- Install permanent barriers – floodwalls, levees, sealed doors
- Safely store or remove - vulnerable components
- Waterproof, relocate or elevate - motor controls, variable frequency drives
- Elevate booster station - be higher than the flood stage.

Chemical and Other Storage

What are some mitigation measures?

Mitigation Measures for Chemical and Other Storage

- Elevate or relocate - tank platforms above flood levels
- Secure - bolt tanks down
- Install larger capacity - chemical storage tanks
- Establish emergency contract provisions - fuel vendors
- Top off - chemicals and fuels

Instrumentation and Electrical Controls

What are some mitigation measures?

Mitigation Measures for Instrumentation and Electrical Controls

- Elevate - instrument and control panels
- Relocate - to remote locations outside of the flood zone
- Purchase portable - equipment
- Shut down - electrical equipment prior to a flood

Power Supply, Energy and Fuel

What are some mitigation measures?

Mitigation Measures for Power Supply, Energy, and Fuel

- Power restoration - prepare a list of utility facilities
- Provide information to the power company
- Secure backup generators – size, voltage, phase configuration, horse power/amperage, fuel
- Secure a source of fuel for backup generators

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TABLE 5 – IDENTIFY & EVALUATE MITIGATION MEASURES TO ENHANCE FLOOD RESILIENCE

IMPORTANT NOTE: Use the tables to fill in data from your utility. Be sure to save these Word files to your computer by going to File > Save As. Otherwise, you could lose the data you have entered. To return to the Flood Resilience Guide, minimize this window.

Mitigation Measures		Evaluation Criteria			Recommendation	
1	2	3	4	5	6	7
Assets/ Operations	Possible Mitigation Measures	Effectiveness (Low, Med, High)	Practicality (Low, Med, High)	Estimated Cost ($)	Evaluation of Mitigation Measure	Recommend Mitigation Measure (Yes/No)?
Treatment Facility Entrance	Install waterproof protection for entry points (sandbags, removable structures)	High	High	$2,000 – $5,000	Use of sandbags as a short-term solution. Consider more effective options (removable or semi-permanent structures) in the future to prevent floodwaters from entering building. Will protect ground floor assets.	Yes

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Develop Plan to Implement Mitigation Measures

https://www.youtube.com/watch?v=ETqHQ3ibcII

Develop Plan

What are some things to consider in developing a mitigation plan?

Step 4 Develop Plan to Implement Mitigation Measures

Specific timeframes

Coordinate: - Use a team approach
- Utility Board
- Local Government
- Emergency Management Agencies
- State Hazard Mitigation Officer
- Other Utilities

Key Items

Communication – names, phone numbers, emails.

Conduct briefings, training, and exercises

Develop an emergency drinking water supply plan

Include photos of system

Think regionally

Money on hand for temporary equipment, etc.

Funding Sources

FEMA Hazard Mitigation Grant Program (HMGP) Funding – Texas Department of Emergency Management (TDEM)

USDA Rural Development

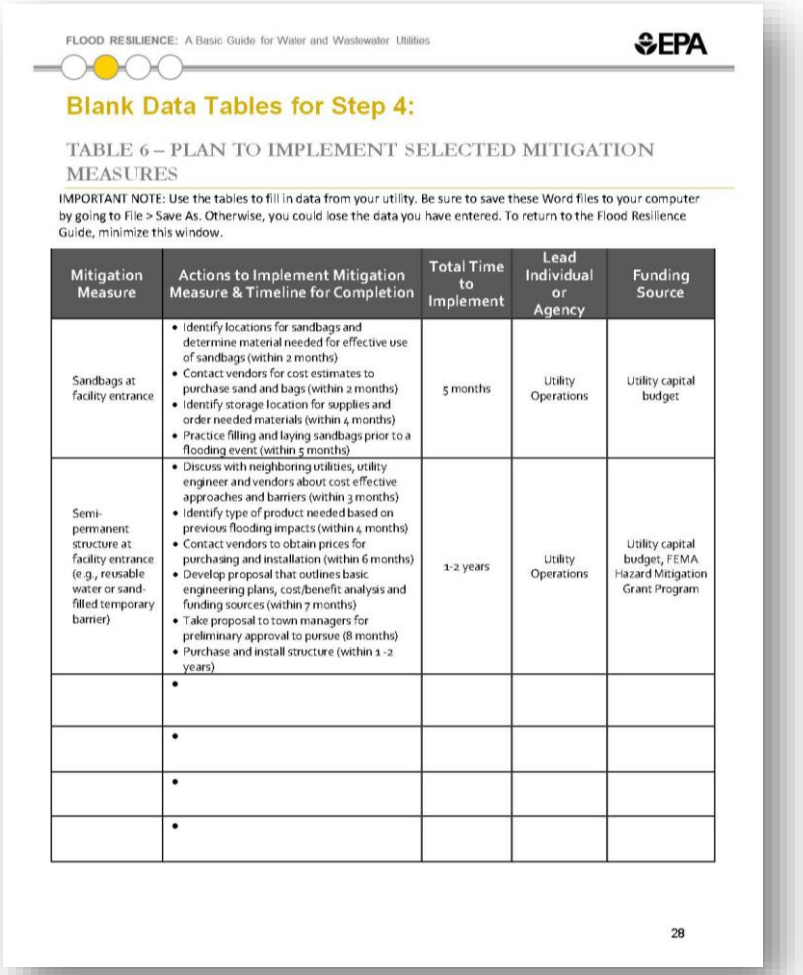
Texas Water Development Board State Revolving Fund (SRF) Program

Rate increases

Capital Improvement Fund / Reserve Fund

Step 4

Develop Plan to Implement Mitigation Measures



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Blank Data Tables for Step 4:

TABLE 6 – PLAN TO IMPLEMENT SELECTED MITIGATION MEASURES

IMPORTANT NOTE: Use the tables to fill in data from your utility. Be sure to save these Word files to your computer by going to File > Save As. Otherwise, you could lose the data you have entered. To return to the Flood Resilience Guide, minimize this window.

Mitigation Measure	Actions to Implement Mitigation Measure & Timeline for Completion	Total Time to Implement	Lead Individual or Agency	Funding Source
Sandbags at facility entrance	• Identify locations for sandbags and determine material needed for effective use of sandbags (within 2 months) • Contact vendors for cost estimates to purchase sand and bags (within 2 months) • Identify storage location for supplies and order needed materials (within 4 months) • Practice filling and laying sandbags prior to a flooding event (within 5 months)	5 months	Utility Operations	Utility capital budget
Semi-permanent structure at facility entrance (e.g., reusable water or sand-filled temporary barrier)	• Discuss with neighboring utilities, utility engineer and vendors about cost effective approaches and barriers (within 3 months) • Identify type of product needed based on previous flooding impacts (within 4 months) • Contact vendors to obtain prices for purchasing and installation (within 6 months) • Develop proposal that outlines basic engineering plans, cost/benefit analysis and funding sources (within 7 months) • Take proposal to town managers for preliminary approval to pursue (8 months) • Purchase and install structure (within 1 -2 years)	1-2 years	Utility Operations	Utility capital budget, FEMA Hazard Mitigation Grant Program
	•			
	•			
	•			
	•			

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Summary


STEP 1
Understand the Threat of Flooding
STEP 2
Identify Vulnerable Assets & Determine Consequences
STEP 3
Identify & Evaluate Mitigation Measures
STEP 4
Develop Plan to Implement Mitigation Measures

Access the guide here: **https://www.epa.gov/sites/production/files/2016-08/documents/160815-hazardmitigationfornaturaldisasters.pdf**

HAZARD MITIGATION
FOR NATURAL DISASTERS

A Starter Guide for Water and Wastewater Utilities

Select a menu option below. New users should start with Overview Hazard Mitigation.

Overview
Hazard Mitigation

Join Local Mitigation
Efforts

Develop Mit
Projects

Click on **Join Local Mitigation Efforts** to learn how to get involved in local mitigation efforts and plans in your community

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Join Local Mitigation Efforts

Partner with your Local Mitigation Planner

Talk to your local mitigation planner because he or she is responsible for developing the hazard mitigation plan to decrease the risk to your community from various hazards. Since your utility is critical to the community, your local planner wants to help you mitigate hazards and list your proposed mitigation projects in the local plan.

- **How do I contact my Local Mitigation Planner?**
  - Contact your State Hazard Mitigation Officer, who can then connect you to your county or local mitigation planner.
- **What should I say to the Local Mitigation Planner?**
  - Introduce yourself and express interest in learning more about mitigation efforts.
  - Ask about what hazards are of most concern and what local mitigation efforts are currently underway in your town, city, or county.
  - Share your concerns about certain hazards and possible mitigation actions you are considering.
  - Ask how your utility can be included in the next local mitigation plan update (5-year cycle for updates).
  - Ask how your utility can become involved: how you can become a participating member in the local hazard mitigation process; are there upcoming meetings; can your utility participate in the update process and provide a mitigation project to list in the plan?

Click for Other Helpful Local Partners in Hazard Mitigation

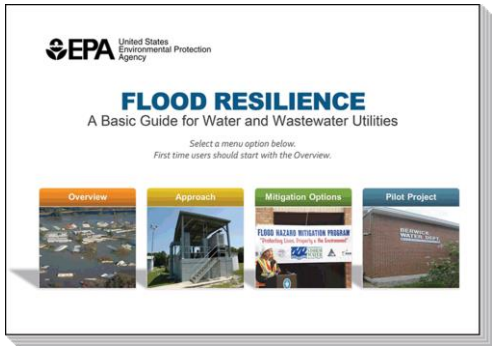
Texas Water/Wastewater Agency Response Network (TXWARN)

The mission to support and promote:

- statewide emergency preparedness
- disaster response
- mutual aid assistance for public and private water and wastewater utilities.

https://www.txwarn.org 866-989-9276

Resources



https://www.epa.gov/waterutilityresponse/flood-resilience-basic-guide-water-and-wastewater-utilities

https://www.epa.gov/waterresilience

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