

EPA REGION 1 RECOMMENDED PROCEDURES AND RESOURCES FOR THE DEVELOPMENT OF ADAPTATION PLANS FOR WASTEWATER TREATMENT SYSTEMS AND/OR SEWER SYSTEMS

I. Overview

Wastewater Treatment Systems (WWTS) and/or sewer systems encounter many challenges related to major storm and floods events, aging infrastructure, natural hazards, and other critical priorities. Each WWTS and sewer system should consider many different options and the range of possible benefits in order to develop a comprehensive plan that satisfies utility needs without overstressing resources. Resilience planning is not a new or separate effort for WWTS and sewer systems. Strategies can provide greater resilience along with other benefits, such as more sustainable and efficient operations, cost savings, and protection of surface water designated uses, including recreational, aquatic life and drinking water uses. Implementing strategies that provide multiple benefits can be integrated into current asset management, permit compliance, emergency response planning, capacity development and other decision-making processes at utilities.

In the recent past, storm events have led to the failures of multiple wastewater treatment systems in Vermont and Rhode Island. WWTS and sewer systems are particularly vulnerable due to their locations, which are often at the lowest level in a community and adjacent to water bodies. For example, in July 2023, the state of Vermont experienced a major storm and flooding event with upwards of seven inches of rain falling in about 24 hours. Operations at 33 WWTS were disrupted, and several facilities were rendered inoperable and in need of significant rebuilding.

Resilience planning involves more than just a review of options for facility owners and operators to consider. Several technical and informational resources are required to support planning. For example, storm surge maps¹, and FEMA Flood Maps² and local data sources^{3,4} may all need to be employed in the determination of thresholds for flooding and the assessment of adaptive measures to mitigate losses. An integral part of increasing WWTS and/or sewer system resilience is to properly assess the risk of potential major storm and flood events, evaluate options for addressing the risks and adopt a plan for implementing options that minimize those risks.

Resiliency planning should be an iterative process of identifying impacts and challenges, assessing risks from these impacts, selecting and implementing adaptive measures and then revisiting assessments when new information is available or when additional capacity to implement options is in place.

¹ <https://www.epa.gov/waterutilityresponse/storm-surge-map>

² <https://www.fema.gov/flood-maps>

³ For MA: <https://resilientma-mapcenter-mass-eoea.hub.arcgis.com/>

⁴ For NH: <https://nhdes.maps.arcgis.com/apps/webappviewer/index.html?id=21173c9556be4c52bc20ea706e1c9f5a>

The purpose of this document is to assist owners and operators of wastewater treatment systems and/or sewer systems develop adaptation plans as required in Region 1 NPDES permits. The document provides recommendations and procedures for the use of free EPA tools developed specifically for water utilities. However, as described in the permit itself, other approaches providing equivalent analysis may also be used.

II. Recommended Approach

EPA Region 1 recommends the use of EPA's Flood Resilience: A Basic Guide for Water and Wastewater Utilities,⁵ along with EPA's Resilient Strategies Guide,⁶ and technical assistance through EPA's Strengthening Water Infrastructure for Tomorrow (SWIFT)⁷ for conducting the risk and adaptive measures assessments required as part of the Adaption Plan in EPA Region 1 NPDES permits.

Flood Resilience: A Basic Guide for Water and Wastewater Utilities ("Basic Guide") is a guide and methodology that introduces water sector utilities to the steps necessary to identify risks from natural disasters and service disruptions, then review strategies to build resilience and limit impacts. As the user works through the Basic Guide's four components, users consider the threat of flooding, identify vulnerable assets and identify and evaluate adaptive measures to increase resilience. The modules are:

1. **Understand the Threat of Flooding** – Flooding depends on various factors including rainfall, topography, river-flow, drainage and tidal-surge.
2. **Identify Vulnerable Assets & Determine Consequences** – Often located in low lying areas, water and wastewater utilities are particularly vulnerable to flooding.
3. **Identify & Evaluate Mitigation Measures** – A mitigation measure can be any emergency planning activity, equipment modification or new capital construction project.
4. **Develop Plan to Implement Mitigation Measures** -

Incorporating the Basic Guide results into best management practices and capital investment decisions builds customer and stakeholder confidence that a utility is being proactive in identifying significant weather-related risks.

EPA's SWIFT initiative can provide technical assistance including location-specific natural hazard data and practical risk assessment tools to identify and evaluate adaptive measures. It can be used in conjunction with the Basic Guide and potential technical assistance from EPA's SWIFT initiative.

EPA's SWIFT initiative works directly with drinking water, wastewater, and stormwater (water

⁵ https://www.epa.gov/sites/default/files/2015-08/documents/flood_resilience_guide.pdf

⁶ <https://www.epa.gov/waterutilityresponse/resilient-strategies-guide-water-utilities-0#/?region=101&utilityType=4&utilitySize=1315&assets=&priorities=&strategies=&fundingSources=>

⁷ <https://www.epa.gov/waterutilityresponse/strengthening-water-infrastructure-tomorrow-swift>

sector) utilities with practical tools, and technical assistance to increase resilience to natural hazards and disasters. With this support, SWIFT helps promote a better understanding of natural hazard threats and their impacts on vulnerable assets, providing the guidance needed to make risk-informed infrastructure and investment decisions. SWIFT also offers approaches to infrastructure financing and helps to make the necessary connections that help utilities fund the implementation of their disaster resilience projects.

SWIFT works directly with drinking water, wastewater, and stormwater utilities, technical assistance providers and other water sector stakeholders across the Nation to increase system resilience to natural hazards and disasters.

<https://www.epa.gov/waterutilityresponse/strengthening-water-infrastructure-tomorrow-swift>

To request technical assistance from SWIFT visit:

<https://www.epa.gov/waterutilityresponse/forms/request-technical-assistance>

SWIFT Resources:

- **VSAT:** An online tool for water sector utilities pursuing comprehensive risk assessment and resilience planning.
- **Resilient Strategies Guide:** An introductory tool to adaptation planning where utilities can explore and gather basic information on extreme weather readiness and adaptation.
<https://www.epa.gov/waterutilityresponse/resilient-strategies-guide-water-utilities-0#/?region=101&utilityType=4&utilitySize=1315&assets=&priorities=&strategies=&fundingSources=>
- **Case Studies** are available at: <https://www.epa.gov/waterutilityresponse/case-studies-water-utilities>

III. Recommended Assumptions

Baseline Conditions

“Baseline Conditions” are the current flood elevations. EPA recommends assuming that baseline conditions are equivalent to the FEMA 100-year flood elevation when assessing the vulnerability of critical assets.

Future Conditions

Freeboard Value and 500-year floodplain Approach: The flood elevations that result from adding an additional 2 feet to the 100-year flood elevation for non-critical actions and by adding an additional 3 feet to the 100-year flood elevation for critical actions compared to the flood elevations that result from 500-year flood (the 0.2% -annual-chance flood) and selecting the higher of the two flood elevations. Federal Emergency Management Agency

(FEMA) develops flood maps that delineate Special Flood Hazard Areas (SFHAs) based on flood insurance studies. There are two levels of SFHAs, the 100 and 500-year flood plain. The 100-year flood plain contains areas that are subject to inundation by a flood that has a 1 percent or greater chance of being equalized or exceeded during any given year. Areas within the 100-year flood plain are considered high risk. Between the limits of the 100-year and 500-year flood plain is an area with a 0.2 percent (or 1 in 500 chance) annual chance of flooding. These areas are considered moderate risk and subject to shallow flooding.

Infrastructure Life Expectancy

For the purposes of the development of the Adaptation Plans, users should consider component/system life expectancy to be as follows:

- Twenty (20) years for mechanical and electrical systems;
- Fifty (50) years for tankage and similar structures; and
- New infrastructure should consider longer life expectancies, especially in coastal areas subject to sea level rise and coastal erosion.

IV. Developing an Adaptation Plan

The following outlines the steps permittees can take to develop an Adaptation Plan, consistent with the permit requirements. The document, *Flood Resilience: A Basic Guide for Water and Wastewater Utilities*⁸ provides permittees with guidance for completing the Components and also provides worksheet that can aid permittees in completing each Component.

Definitions are provided in Section V of this document.

Component 1: *Identification of Vulnerable Critical Assets*

Step 1: Asset Inventory

Inventory all critical assets (e.g. treatment units, WWTS, outfall, septage collection facilities, pump stations etc.) and related operations (referred to collectively herein as “assets”) and the elevation of each asset (above sea level).

Step 2: Identify Vulnerable, Critical Assets

- a) Compare the asset elevation to both the baseline condition flood elevation and the future condition flood elevation. See example table below.
- b) Assets that are identified in Step 2 as vulnerable to flooding should be carried forward into Step 4.

⁸ https://www.epa.gov/sites/default/files/2015-08/documents/flood_resilience_guide.pdf

Refer to EPA's Flood Resilience: A Basic Guide for Water and Wastewater Utilities, Step 2: Identify Vulnerable Assets & Determine Consequences

Table 1: Example of Summary of Vulnerable Critical Assets Table

		Vulnerability		
Asset	Elevation of Asset (ft) ^a	Elevation of baseline condition flood (ft)	Elevation of future Condition Flood (ft)	Vulnerability to Flooding (ft) ^b (Yes/No)
Pump Station (floor)	52'	60.7'	63.7'	Yes
Non-submersible pump	52'	60.7'	63.7'	Yes
Power supply	62'	60.7'	63.7	No/Yes

^a Elevation of the Asset = elevation of floor, above sea level.

^b If the elevation of Flood Threat is higher than the elevation of the asset, then yes.

Component 2: Adaptive Measures Assessment

Step 3: Identify possible mitigation measures that can protect the key vulnerable assets and operations prioritized in Step 2.

Refer to EPA's Flood Resilience: A Basic Guide for Water and Wastewater Utilities, Step 3: Identify & Evaluate Mitigation Measures.

To improve your utility's flood resilience, you should identify and evaluate which mitigation measures to pursue based on cost, effectiveness and practicality. It is possible that some mitigation measures could be implemented at little to no cost to your utility.

- Determine your utility's requirements to maintain a minimum level of service during a flood.
- Identify flood mitigation measures that can prevent to key assets and disruptions to critical operations.
- Evaluation mitigation measures.

Component 3: Implementation and Maintenance Schedule

Refer to EPA's Flood Resilience: A Basic Guide for Water and Wastewater Utilities, Step 4: Develop a Plan to Implement Mitigation Measures.

V. Definitions

For the purposes of this document, the following definitions apply.

Adaptive measures – physical infrastructure or actions and strategies that a utility can use to protect their assets and mitigate the impacts of threats. They may include but are not limited to building or modifying infrastructure, utilization of models (including but not limited to: flood, coastal flooding and storm surge, sewer/collection system, system performance), monitoring and inspecting (including but not limited to: flood control, infrastructure, treatment) and repair/retrofit.

Asset related operations - are elements of an asset that are critical to the function of that asset. For example, pumps and power supply are a critical operation of a pump station.

Baseline conditions – current flood elevations. See recommended assumptions above.

Critical asset – an asset necessary to ensure the safe and continued operation of the wastewater treatment system and/or the sewer systems and ensure forward flow and treatment of wastewater in accordance with the limits set forth in an NPDES permit.

Extreme/heavy precipitation - instances during which the amount of rain or snow experienced in a location substantially exceeds what is normal according to location and season.

Future conditions - Freeboard value or 500-year flood elevation. See recommended assumptions above.

Impact – a strong effect on an asset and/or asset-related operation that may include destruction, damage or ineffective operation of the asset and/or asset operation. Impacts may be categorized as economic, environmental, or public health related.

Major storm and flood events - instances resulting from major storms such as hurricanes, extreme/heavy precipitation events, and pluvial, fluvial, and flash flood events such as high-water events, storm surge, and high-tide flooding.

Non-critical assets - all structures and systems not necessary for the operation of the wastewater treatment system and/or sewer systems.

Sewer System - sewers, pump stations, manholes and other infrastructure use to convey sewage to the wastewater treatment facility from homes or other sources.

Threats – climatic, hydrologic, geophysical, and geochemical changes in terrestrial and aquatic ecosystems that alter the operating environment of utility facilities and operations.

VI. Other Resources

EPA. 2009. Synthesis of Adaptation Options for Coastal Areas.

https://www.epa.gov/sites/default/files/2014-04/documents/cre_synthesis_1-09.pdf

Massachusetts Executive Office of Energy and Environmental Affairs, Resilient MA. Accessed October 8, 2025. Climate Resilience Design Standards Tool, Version 1.3.

https://resilientma.mass.gov/rmat_home/designstandards/index.html

Massachusetts Executive Office of Energy and Environmental Affairs, Resilient MA. Accessed October 8, 2025, Maps and Data Center. <https://resilientma-mapcenter-mass-eoeea.hub.arcgis.com/>

Massachusetts Executive Office of Energy and Environmental Affairs, Resilient MA. Accessed October 8, 2025, Climate Resilience Funding.

<https://experience.arcgis.com/experience/fd26505b82bc49b1bac525dc95a2a50a/page/Welcome!/>

NEIWPPC. 2016. TR-16 Guides for the Design of Wastewater Treatment Works. <https://neiwppc.org/learning-center/tr-16-guides-design-wastewater-treatment-works/>

NEIWPPC. 2016. Preparing for Extreme Weather at Wastewater Utilities: Strategies and Tips. <https://payments.neiwppc.org/product/preparing-for-extreme-weather-at-wastewater-utilities-strategies-and-tips/>

U.S. Climate Resilience Toolkit, Northeast Climate Hub. Accessed October 8, 2025. <https://toolkit.climate.gov/region/northeast>

U.S. Global Change Research Program (USGCRP). 2018. Fourth National Climate Assessment, Volume II: <https://www.nrc.gov/docs/ML1900/ML19008A414.pdf>

U.S. Global Change Research Program (USGCRP). In development. Fifth National Climate Assessment: https://toolkit.climate.gov/sites/default/files/2025-07/NCA5_2023_FullReport.pdf