# BUILDING RESILIENT WATER INFRASTRUCTURE

## CLIMATE CHANGE RESILIENCE GUIDANCE

for New Jersey's Clean Water & Drinking Water State Revolving Funds

**APRIL 2023**

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South Monmouth Regional Sewerage Authority used a loan from the New Jersey Water Bank to fund rehabilitation and upgrades to the Brielle and Glimmer Glass Pump Stations. Work included the shutdown and isolation of existing sewage pumps and wet wells and the implementation of a bypass pumping system. All interior surfaces were cleaned, repaired, and coated with epoxy, and flood protection measures were installed.

## Executive Summary

The New Jersey Department of Environmental Protection (Department) developed this guidance to support users and administrators of the New Jersey Water Bank in deploying water infrastructure investments that are resilient to the state's changing climate.

As a result of atmospheric levels of carbon dioxide and other climate pollutants, New Jersey is experiencing significant direct and secondary changes in its environment, many of which are projected to worsen in future years. These climate changes include increases in temperature, increases and variability in precipitation, frequency and intensity of storms, sea-level rise, ocean acidification, and associated impacts to both natural and built environments, ecological systems, human health, and the economy. The State has undertaken an iterative process of developing and implementing strategies to reduce and respond to the impacts of climate change, including through measures that promote the resilience of water infrastructure.

Water infrastructure project sponsors seeking financing from the New Jersey Water Bank are expected to utilize this guidance to evaluate potential climate change impacts in their analysis of project alternatives within the Project Report/Facilities Plan (N.J.A.C. 7:22-3.11d). This guidance provides its users with the best available New Jersey-specific climate science, details use of climate impact projections with a focus on those anticipated to be the most disruptive to New Jersey's water infrastructure and enables users to prepare the Resilience Assessment required by the Water Bank.

As part of the State's broader efforts to improve and promote climate resilience, the Department strongly encourages decision-makers, including water infrastructure project sponsors, determining the planning horizon for asset siting and improvement to critically evaluate the expected life of assets, their supporting systems, and the services the assets provide. With attention to the impact of present-day decisions on future generations, the Department strongly recommends the use of a 2100 planning horizon under most circumstances.

The Water Bank will require project sponsors to present a Resilience Assessment that demonstrates consideration of potential climate impacts and long-term resilience goals consistent with a 2100 planning horizon, while recognizing that a shorter planning horizon may be appropriate due to the nature of a project or other relevant circumstances. In such instances, this guidance sets forth minimum standards keyed to the end of a subject loan term, which may be applied subject to a well-reasoned justification for the selected project alternative.

This guidance is intended to serve as a practical tool that enables project sponsors to identify maximum feasible resilience measures that ensure the success of publicly-funded water infrastructure. Based on the best available and most recent New Jersey-specific climate science, the means and methods of assessment presented here will support project sponsors in the careful evaluation of project alternatives that account for potential impacts from extreme precipitation, flooding, sea-level rise, and storm surge—some of New Jersey's most significant climate change risks.

## Introduction

The New Jersey Water Bank is a partnership between the Department and the New Jersey Infrastructure Bank (I-Bank) to provide low-cost financing for the design, construction, and implementation of water quality infrastructure projects that enhance ground and surface water resources, ensure the safety of drinking water supplies, protect the public health, and make responsible and sustainable economic development possible.

The Department administers a combination of Federal State Revolving Fund (SRF) capitalization grants, as well as the State's matching funds, loan repayments, State appropriations and interest earned on such funds through the Water Bank. The Water Bank finances projects by utilizing two funding sources as the I-Bank issues revenue bonds which are used in combination with zero percent interest funds to provide very low interest loans for water infrastructure improvements. President Biden signed the Bipartisan Infrastructure Law (BIL) on November 15, 2021, which will provide NJ with nearly $1 billion in funding over the next 5 years. These funds will be administered through the Water Bank. BIL funding comes at a crucial time as climate impacts to New Jersey worsen and the State responds by continuing to prioritize the development and implementation of climate-conscious policy based on sound science. Clean water and drinking water systems represent some of the most critical infrastructure and the Water Bank recognizes the importance of resilience to maintain safe clean water and drinking water systems that help communities adapt to a changing climate.

## Historical Background of Climate Change Vulnerability

Climate Change poses a clear and present danger to New Jersey's communities, ecosystems, infrastructure, and economy with impacts including rising sea levels, increasing temperatures, more frequent and intense storms, and chronic flooding. Since the end of the 1890s, New Jersey has experienced a 3.5°F increase in average temperature (more warming than the rest of the Northeast region and the global average) and is expected to increase by another 4.1°F to 5.7° F by 2050. This unusual increase in temperature is due to high urbanization in the state, causing heat island effect, and is predicted to increase the number of days per year in which human health is adversely affected by temperature. Increased temperatures affect precipitation patterns, leading to a decrease in summer and an increase during rainy season. Over the past 10 years (2010-2019), estimates have found that annual precipitation in New Jersey has risen 7.9% and may increase by 4% to 11% by 2050[1]. In the Northeast, very heavy rainfall events were shown to have increased by 71% over the period of 1958-2012, faster than any other region in the United States.[2] Rainfall associated with extreme events is projected to increase, with some

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[1] New Jersey Department of Environmental Protection. 2020. New Jersey Scientific Report on Climate Change.
[2] Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, J. Willis, D. Anderson, S. Doney, R. Feely, P. Hennon, V. Kharin, T. Knutson, F. Landerer, T. Lenton, J. Kennedy, and R. Somerville. 2014. Our changing climate. Pages 19–67 in J. M. Melillo, T.C. Richmond, and G. W. Yohe, editors. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, Washington, DC.

counties expected to receive up to 40% more precipitation in those events by mid-century and up to 50% by the end of the century (Table 1).[3] Such increases will increase the size and frequency of flood events burdening the state's water infrastructure.

Sea levels are also rising faster than other parts of the world due to local changes in the Gulf Stream, land subsidence, and geologic changes, presenting an immediate threat. New Jersey is expected to see an increase in sea levels of 0.9 to 2.1 feet by 2050 and likely a 2.0 to 5.1-foot increase by 2100 under a moderate emissions scenario. The New Jersey coast is home to more than half the current population (over 4.6 million), contributes $400 billion in economic output, and is a hallmark of the state's culture.[4] Almost two thirds of the coastline is at high or very high risk to coastal erosion as well as 579,000 acres of wetlands, 197,000 of which are tidal flats and marshes that provide for water quality and flood storage.

The effects of climate change are interconnected and affect communities in compounding ways. Water demand becomes higher with increasing temperatures and longer growing seasons, water quality is impaired by increased runoff from extreme precipitation events, while rising sea levels threaten ground and surface water with intruding salt fronts, and combined sewer overflows can be completely overwhelmed by extreme precipitation and sea-level rise resulting in contamination of waterways and the surrounding environment.

New Jersey suffered severe impacts from Hurricane Irene in 2011, which cost New Jersey between $4 billion and $6 billion worth in damage, not including the additional costs to improve infrastructure resilience to mitigate future losses. One year later, Superstorm Sandy struck the New Jersey coast and significantly damaged the largest wastewater pumping station in the state, which required a Fund loan of $77 million for restoration, construction of a flood wall, and installation of standby generators for increased resilience. The storm cost New Jersey $29.4 billion in repair, response, and restoration and $11.7 billion in lost GDP.[5] Most recently, the heavy rains in the summer of 2021, including the remnants of tropical storm Ida caused flash flooding across New Jersey. Some residents of Paterson, Clifton, and parts of Passaic were issued boil water advisories for several weeks after runoff entered a nearby reservoir. The issue persisted until remedial actions and sampling were completed several weeks later.

The social, environmental, and economic costs of these disasters force us to reexamine the current trend of development and redevelopment in the state. It is projected that continued hurricane wind and flood damage will cost the state an estimated $1.3 to $3.1 billion in average annual state-wide losses by 2050.[6] Studies have shown that each dollar spent to mitigate hazards results in a six-fold decrease in spending on recovery. The federal government and the State of New Jersey discourage development in floodplains by avoiding direct and indirect

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[3] DeGaetano, A. 2021. Projected Changes in Extreme Rainfall in New Jersey based on an Ensemble of Downscaled Climate Model Projections. Prepared for New Jersey Department of Environmental Protection. 79 pages. https://www.nj.gov/dep/dsr/publications/projected-changes-rainfall-model.pdf
[4] New Jersey Department of Environmental Protection. 2021. Sea-Level Rise Guidance for New Jersey.
[5] Ibid.
[6] Ibid.

support of development wherever there is a practicable alternative. New Jersey has a long regulatory history of flood management that focuses on avoidance, elevation, or floodproofing. New climate science, particularly relating to sea-level rise and extreme rainfall, as well as reoccurrence of severe extreme weather events and disasters have highlighted a need for greater scrutiny regarding resilience of infrastructure to the compounding issues of worsening storms, increasing temperature, changing precipitation patterns, and sea-level rise.

New Jersey defines "climate resilience" as the ability of social and ecological systems to absorb and adapt to shocks and stresses resulting from a changing climate, while becoming better positioned to respond in the future. To ensure public health and safety, the Governor of New Jersey signed Executive Order No. 89 in 2019 to establish a Chief Resilience Officer within the Department and set up the Interagency Council on Climate Resilience to coordinate Executive Branch departments and agencies to develop consistent statewide policies, actions, and plans. Executive Order No. 100 in 2020 went further to require the Department to adopt Protecting Against Climate Threats (NJPACT) regulations to integrate climate change considerations into regulatory and permitting programs, notably water supply, stormwater, and wastewater planning and permitting.

## Purpose of this Guidance

The Department recognizes that the cost of climate change impacts will continue to increase into the future and has mandated the incorporation of climate change considerations throughout the Department, including the Water Bank program. This guidance aligns the Water Bank program with the best available and most geographically relevant climate information, projections, and standards such as, but not limited to, the 2020 New Jersey Scientific Report on Climate Change (Scientific Report), Sea-Level Rise Guidance for New Jersey, New Jersey Climate Change Resilience Strategy, and studies describing recent[7] and projected changes[8] in extreme precipitation events (Precipitation Studies). The purpose of this guidance is to help applicants evaluate project alternatives using the procedures described in this document and demonstrate the resilience of selected project alternatives considering climate change impacts. The following section will outline relevant mandates and scientific resources that serve as the foundation for the objectives and standards set by this guidance.

[7] DeGaetano, A. 2021. Changes in Hourly and Daily Extreme Rainfall Amounts in NJ since the Publication of NOAA Atlas 14 Volume. Prepared for the New Jersey Department of Environmental Protection. 46 pages. https://www.nj.gov/dep/dsr/publications/nj-atlas-14.pdf

[8] DeGaetano, A. 2021. Projected Changes in Extreme Rainfall in New Jersey based on an Ensemble of Downscaled Climate Model Projections. Prepared for the New Jersey Department of Environmental Protection. 79 pages. https://www.nj.gov/dep/dsr/publications/projected-changes-rainfall-model.pdf

## The Department & Water Bank Authority

The Department and the Water Bank have the authority to impose requirements for addressing climate change as N.J.A.C. 7:22 lays out the requirements for applying for funds and evaluating projects. Given federal and state direction to consider climate change, the Department can require additional information to be submitted as part of the application (N.J.A.C. 7:22-3.11(d)24). Additionally, the Department will review any application to determine if it meets the merit of these directives to address climate change impacts.

At any stage during the evaluation process, the Department may require supplemental documents or information necessary to complete full review of the application. The Department may suspend its evaluation until such additional information or documents have been received (N.J.A.C. 7:22-3.14 Supplemental information).

Similarly, the I-Bank has the same authority to require other or supplemental information (N.J.A.C. 7:22-4.11(d)24 and 4.14). The I-Bank has the authority to establish a loan condition (N.J.A.C. 7:22-3.17(a)9 and 7:22-4.17(a)9) that requires applicants to set aside funds into a repair and replacement fund to finance repairs or replacements beyond the scope of normal operation and maintenance during the term of the loan. The repair and replacement fund should include funds to cover any repair or replacement of components that might be subject to the impacts of climate change.

Newark Mayor Ras J. Baraka was joined by DEP Commissioner Shawn M. LaTourette, Licensed Operator of Treatment and Distribution, Jerry Notte and Newark Water & Sewer Utilities Director, Kareem Adeem to celebrate the launch of $23 million in new upgrades for a facility at the Pequannock Water Treatment Plant in West Milford, New Jersey.

## Federal Mandates and Resources

The SRF program is a partnership with the USEPA that replaced the USEPA's Construction Grants program established by the Clean Water Act. Federal funding requirements matriculated into the SRF program when the Federal grants program was absolved. The SRF program also obtains the bulk of its funds from federal capitalization grants. As such, funding assistance provided under the SRF program is subject to the same federal requirements as federal funding programs, such as EO 11988 and EO 14008, outlined below. This section also includes a summary of USEPA Climate Adaptation Plan that forms an example to the objectives that New Jersey and the Department aim to achieve.

### Executive Order 11988 Floodplain Management, May 1977

Executive Order 11988 (EO 11988) addresses the potential loss of the natural and beneficial functions of the nation's floodplains as well as the increased cost to Federal, state, and local governments from flooding disasters caused or exacerbated by development in vulnerable areas. When funding actions, federal agencies are required to avoid, to the extent possible, adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Projects awarded Federal funding assistance for any project must avoid or be elevated above the Federal Emergency Management Agency (FEMA) 500-year flood elevation. Any critical action for which Federal funding assistance is provided is required to avoid or be elevated above the 500-year flood elevation. There is a rebuttable presumption that this standard must be met unless impacts cannot be avoided, whereby minimization of impacts to, restoration, and preservation of the floodplain must be considered. This includes, but is not limited to, actions that are eligible for Federal Emergency Management Agency (FEMA), Public Assistance (PA), or other disaster relief or mitigation assistance from the Housing and Urban Development, USEPA, and the Army Corps of Engineers.

### President Biden Executive Order 14008, January 2021

Executive order 14008 reinstates the Presidential Memorandum on Climate Change and National Security, creates the Climate Policy Office, and establishes a National Climate Task Force. It also establishes domestic and global federal policies to promote safe global temperature, increase climate resilience, and support financial pathways towards low greenhouse gas emissions and climate resilient development by:

- Scaling-up international climate finance and enhancing its input
- Mobilizing private finance internationally
- Ending international official financing for carbon-intensive fossil fuel-based energy
- Making capital flows consistent with low-emissions, climate-resilient pathways
- Defining, measuring, and reporting U.S. international climate finance

## USEPA Climate Adaptation Action Plan, October 2021

This Climate Action Plan sets priority actions to be taken by the USEPA in response to Executive Order 14008, including integration of climate adaptation considerations into discretionary and nondiscretionary financial mechanisms (agency grants, cooperative agreements, loans, technical assistance, contracts, and awards where the project's desired outcomes are sensitive to climate change).

## State & Department Mandates and Resources

The State of New Jersey has made significant efforts to plan and implement policies to increase climate resilience statewide. Relevant initiatives are referenced below, followed by the consequential publications intended to guide climate resilience actions, including the Sea-Level Rise Guidance and Precipitation Studies[9,10] that will guide future Water Bank resilience considerations pursuant to this guidance. The Precipitation Studies reflect new information regarding statewide precipitation patterns beyond that already described in the Scientific Report.

## State of New Jersey Executive Order 89, October 2019

State of New Jersey Executive Order 89 directs the appointment of a Chief Resilience Officer within the Department to lead and implement the Statewide Climate Change Resilience Strategy, which shall, among other things, "identify financing mechanisms, strategies, and opportunities for coordination to support climate resilience to climate change from a fiscal perspective, such as uncertainty, high capital costs, and competing needs for limited funding, measures, mitigation, and adaptation."

## State of New Jersey Executive Order 100, January 2020

State of New Jersey Executive Order 100 directs the state to take climate change actions, including the integration of climate change considerations into its regulatory and permitting programs. The order also required the Department's Commissioner to issue an administrative order (see below).

[9] DeGaetano, A. 2021. Changes in Hourly and Daily Extreme Rainfall Amounts in NJ since the Publication of NOAA Atlas 14 Volume. Prepared for the New Jersey Department of Environmental Protection. 46 pages. https://www.nj.gov/dep/dsr/publications/nj-atlas-14.pdf

[10] DeGaetano, A. 2021. Projected Changes in Extreme Rainfall in New Jersey based on an Ensemble of Downscaled Climate Model Projections. Prepared for the New Jersey Department of Environmental Protection. 79 pages. https://www.nj.gov/dep/dsr/publications/projected-changes-rainfall-model.pdf

## NJDEP Administrative Order No. 2020-01, January 2020

NJDEP Administrative Order No. 2020-01 orders the Department to respond to Executive Order No. 100 by proposing new regulatory action that incorporates climate change considerations, revise the Environmental Assessment and Impact Statement guidelines, and incorporate climate change considerations into programs and materials. It also directs the creation of the sea-level rise guidance to determine appropriate sea-level rise projections for projects and relevant adaptation measures. Relevant to this guidance, the Order required the Department to "incorporate climate change considerations into all relevant grant, loan and contracting programs implemented by the Department," as well as "all relevant planning, policy, guidance, communications and educational materials issued by the Department."

## 2020 New Jersey Scientific Report on Climate Change, June 2020

The New Jersey Scientific Report on Climate Change (Scientific Report) summarizes the best available science on climate change and its anticipated impacts to New Jersey. The report is required to be updated every two years to reflect the latest climate change science. The Scientific Report describes the current and predicted trends in climate change effects for temperature, precipitation, sea-level rise, and ocean acidification. It explains the anticipated impacts of these effects on resources and ecosystems, including:

- Air quality
- Water resources: supply and quality
- Agriculture
- Forests
- Wetlands
- Terrestrial carbon sequestration
- Terrestrial systems
- Freshwater systems
- Marine systems
- Cyanobacteria

## State of New Jersey Climate Change Resilience Strategy, October 2021

The Climate Change Resilience Strategy provides policy options to promote long-term resilience within New Jersey. It recommends policy, regulatory, and operational changes to New Jersey's Executive Branch to build resilient and healthy communities, strengthen resilience of the ecosystem, promote coordinated governance, invest in information, and increase public understanding, and promote climate- informed investments and innovative financing.

Priority 5 stresses the importance of promoting climate-informed investments and innovative financing as an effective climate resilience strategy. The strategies outlined in this priority aim to (1) integrate climate change into existing state investments and funding decisions, (2) expand the availability of financing for resilience investments from public and private sources, and (3) ensure equity and transparency in resilience investments.

The Coastal Resilience Plan, which is a part of the Resilience Strategy, is of particular importance. The plan aims to:

- Incentivize and Support Community Resilience Planning
- Update Coastal Management Regulations and Policies to Reflect Sea-Level Rise and Other Climate Change Projections
- Sustain and Strengthen Tidal Marshes to Provide Ecological and Community Resilience
- Manage Shoreline Stabilization with Nature-based Features
- Manage Coastal Beaches and Dunes to Reduce Erosion and Storm Damage
- Reduce Flood Risk to Existing Buildings and Infrastructure
- Make Smarter and More Coordinated Investments in Coastal Resilience
- Share Financial Responsibility for Resilience
- Support and Incentivize Movement to Safer Areas

## Sea-Level Rise Guidance for New Jersey, June 2021

The Sea-Level Rise (SLR) Guidance for New Jersey is intended to guide decision makers in planning, mitigating for, and adapting to SLR. In the guidance, the Department recommends using SLR projections from the 2019 Scientific and Technical Advisory Panel (STAP) Report based on a moderate greenhouse gas emissions scenario and determine the planning horizon based on the expected life of an activity, their supporting systems, and the services provided. For most infrastructure activities, probability of SLR exceedance less than 17% should be utilized while impacts to infrastructure resulting in catastrophic consequences should use less than 5% probability. The guidance states that decision makers should:

- *determine future areas of vulnerability due to storm-induced flooding, using the geographic extents of the sum of the SLR projections and the most current FEMA base flood elevations;*
- *determine future coastal areas subject to permanent inundation that will render these areas difficult to inhabit, or to receive routine essential services without significant flood management projects, using the SLR projections alone;*
- *provide a margin of safety when determining structural heights in SLR-impacted areas, adding a minimum of one foot of freeboard to the projected SLR.*

## Precipitation Studies[11][12]

The Precipitation Studies reflect new information regarding statewide precipitation patterns beyond that already described in the Scientific Report. Design standards and regulations in New Jersey currently use precipitation data from NOAA Atlas 14, which ends in 2000 and likely underestimate rainfall extremes. The first study analyzes data from recent years to indicate an increase in 2-,5-,10-,25-,50-, and 100-year recurrent daily interval rainfall since 2000 at over

[11] DeGaetano, A. 2021. Changes in Hourly and Daily Extreme Rainfall Amounts in NJ since the Publication of NOAA Atlas 14 Volume. Prepared for the New Jersey Department of Environmental Protection. 46 pages. https://www.nj.gov/dep/dsr/publications/nj-atlas-14.pdf
[12] DeGaetano, A. 2021. Projected Changes in Extreme Rainfall in New Jersey based on an Ensemble of Downscaled Climate Model Projections. Prepared for the New Jersey Department of Environmental Protection. 79 pages. https://www.nj.gov/dep/dsr/publications/projected-changes-rainfall-model.pdf

75% of the observing stations. Extreme precipitation amounts are at least 2.5% higher than they were in 2000 at more than half of the stations. The second study projects rainfall extreme increases in 2-, 10-, and 100-year average recurrence interval (ARI) under moderate and high emissions scenario through mid-century (2020-2069) and the end of the century (2050-2099). These studies are the best available climate informed projections on future changes in extreme rainfall for New Jersey. Applicants must consider the predicted extreme rainfall amounts using the geographically appropriate projections indicated by these studies, which can be determined using the New Jersey Extreme Precipitation Tool. Applicants must use the most up to date science if future studies indicate a change in projected precipitation.

**Table 1: Extreme Daily Rainfall under Moderate RCP 4.5 Emissions Scenario**

| | Mid Century (2020-2069) | | | End of Century (2050-2099) | | |
|---|---|---|---|---|---|---|
| Likelihood | 2-year | 10-year | 100-year | 2-year | 10-year | 100-year |
| Median | 4.4% - 9.8% | 5.9% - 10.6% | 6.0% - 14.4% | 7.8% - 13.4% | 7.4% - 14.7% | 4.4% - 22.0% |
| High | 13.8% - 19.4% | 13.7% – 23.6% | 22.6% - 43.6% | 15.6% - 24.0% | 17.3% – 29.2% | 22.9% - 50.0% |

*Median Likelihood reflects a 50% likelihood that the projected increase in precipitation will exceed the given amount. High likelihood reflects a 17% chance that the projection will be exceeded. The ranges of precipitation increase reflect the range across all New Jersey counties. Data for 5-, 25-, and 50-year storms can be found in the report or the Supplemental Excel Tables on the Department's Climate Change website.

## Existing SRF Resilience Guidance

Previously, the Clean Water and Drinking Water SRF programs required funding recipients to use a tiered approach in the planning, design, and construction of environmental infrastructure, while justifying lower tiered actions. This approach followed USEPA guidelines as directed by EO 11988. The approach is shown in descending order:

1. Avoidance of the FEMA 500-year flood zone
2. Elevation of infrastructure to the FEMA 500-year plus one foot elevation (FEMA 500 + 1)
3. Elevation of critical infrastructure components to FEMA 500 + 1
4. Flood-proofing of facilities (e.g., walls, berms)
5. Flood-proofing of facility components (elevation of individual components, flood-proofing of infrastructure with watertight doors, windows, manhole covers, etc.)
6. Elevation or flood-proofing of individual components such as motor control centers, emergency generators).

Given the development of the Statewide Climate Change Resilience Strategy for New Jersey state government to follow and implement, this previous guidance is being updated to reflect the goals of the Strategy and meet the orders and rules mentioned above.

## What This Guidance Covers

The NJSRF regulations have referenced the FEMA 500-year floodplain, followed by flood proofing when necessary. These generally follow FEMA minimum design thresholds for critical activities involving repair, rehabilitation, or construction of publicly funded projects. This includes all water infrastructure projects that are eligible to receive funding from the Water Bank.

**Table 2: Water Bank Program Eligible Projects**

| Type | Description | Example |
|---|---|---|
| Water Supply | Infrastructure for the purpose of augmenting the natural water resources of the State, including for drinking water, collecting, impounding, storing, improving, treating, filtering, or transmitting of water, the preservation and protection of these resources and facilities, the conservation and development of future water supply resources, and facilitating incidental recreational uses | Water intake, distribution and storage, booster stations, drinking water treatment plants, pump stations, valves, fire hydrants, water meters, service connections, curb stops, surge chambers, interconnections, and storage tanks |
| Wastewater | Infrastructure for the storage, collection, reduction, recycling, reclamation, disposal, separation or other treatment of wastewater, wastewater sludges, septage or industrial wastes | Lift stations, headworks, wastewater treatment plants, pumping and ventilating stations, connections, extensions, outfall sewers, combined sewer overflows, intercepting sewers, trunklines, sewage collection systems |
| Stormwater | Infrastructure to prevent, reduce, store, or treat stormwater runoff, correct interconnections, or cross-connections, or otherwise address adverse impacts of stormwater runoff that enters a municipal separate storm sewer system. | Stormwater basins, maintenance equipment, inlets, pipes, treatment facilities, green infrastructure, outlets, channels, and culverts |
| Nonpoint Source Pollution | Infrastructure to prevent, reduce, store, or treat stormwater runoff and other water pollution that is not collected, conveyed and/or discharged through a municipal separate storm sewer system | Landfill closure facilities, new landfill facilities, remedial action activities, land purchase and conservation, well sealing, implementation/ construction of other systems that will result in water quality benefits |
| Components | Infrastructure that falls under any of the above | Buildings, chemical and other storage, electrical controls, power supply |

## Resilience Requirements This Guidance Will Achieve

Previous flooding regulations have proven inadequate in New Jersey, with recent storms Sandy and Ida revealing significant vulnerabilities. Furthermore, much of the state's existing water infrastructure lies within the FEMA 500-year flood plain, meaning that more comprehensive strategies for mitigation are required. The State of New Jersey, following the previous outlined mandates and standards determined by the best available science, will implement stronger requirements for modification or new construction of infrastructure to receive state funding under the SRF program. As explained in other Department resilience guidance, the Department strongly suggests that decision-makers critically evaluate the expected life of an asset, its supporting systems, and the services it provides when determining the planning horizon for initial infrastructure siting and improvements. With such attention to the impact of today's decisions on future generations, the Department recommends decision-makers generally utilize 2100 as a planning horizon.

With these considerations in mind, Water Bank applicants will be expected to evaluate the maximum feasible resilience measures considering future condition scenarios over the anticipated life of the asset. As an absolute minimum baseline, the Water Bank will evaluate applications in accordance with graduated standards and requirements discussed below, which will be updated as needed to ensure state funded water infrastructure accounts for the best available science concerning existing and anticipated climate change impacts.

To qualify for SRF funding, applicants must demonstrate resilience to climate change impacts, including state-specific projects concerning:

- Flood hazards
- Sea-level rise
- Precipitation
- Storm surge

In addition to current and future rules applicable to infrastructure, such as Coastal Zone Management rules, Flood Hazard Area Control Act and Stormwater Management rules, Uniform Construction Code (UCC), or other applicable regulations, applicants must plan and design projects that are resilient to at least the 17% SLR scenario, flood hazard areas, Category 1 storm surge projections, and an increase in precipitation for 2-,10-, and 100-year ARI in the geographically relevant area.

Furthermore, potential climate change effects on the overall community and user base will be considered in the development of the loan conditions. Such evaluations could, for example, result in a shorter loan term for communities projected to experience a reduced user base due to climate impacts. Applicants should be aware of the minimum climate impact projections with which they must comply, and thoroughly evaluate project alternatives that account for future condition scenarios over the anticipated life of the asset.

The relevant projections, with a focus on the absolute minimum standards, are described in more detail below.

## Flood Hazard Areas

There are two types of flood hazard areas, as defined by the Flood Hazard Area Control Act rules, N.J.A.C. 7:13:

1) Tidal flood hazard area, in which the flood hazard area design flood elevation is governed by tidal flooding from the Atlantic Ocean. Flooding in a tidal flood hazard area may be contributed to or influenced by stormwater runoff from inland areas, but the depth of flooding generated by the tidal rise and fall of the Atlantic Ocean is greater than flooding from any fluvial sources; and
2) Fluvial flood hazard area, in which the flood hazard area design flood elevation is governed by stormwater runoff. Flooding in a fluvial flood hazard area may be contributed to or influenced by elevated water levels generated by the tidal rise and fall of the Atlantic Ocean, but the depth of flooding generated by stormwater runoff is greater than flooding from the Atlantic Ocean.

The Flood Hazard Area Control Act (FHACA) rules define flood hazard area design flood elevations and sets forth requirements governing human disturbances to these areas. It is expected that under EO 100 the Department will propose updates to the design flood elevations, and other requirements to further resilience. FHACA rules regulate areas identified as being inundated by the 100-year design flood, while SRF funding has utilized the tiered approach using the FEMA 500-year+1 foot flood design elevation. The addition of 1-foot is a safety factor to protect against inundation in the event of a 500-year flood. Planning and design of projects must meet FHACA rules and other applicable rules. Infrastructure planning and design projects should use the design flood elevation as defined by N.J.A.C. 7:13 or FEMA 500+1, whichever is higher. Applicants should keep in mind that the regulatory flood elevation as defined in the FHACA, N.J.A.C. 7:13, may be higher than flood elevations published by FEMA, depending on site location.

Flood design elevation will be used for permitting, planning, and design, while the Resilience Assessment will demonstrate the rationale for the selected project alternative given an analysis of resilience to flooding which considers the type and level of service, vulnerability of the infrastructure to climate change impacts, and its impact to community resilience. New construction and repair, remediation, or alteration of lawfully existing infrastructure may be permitted within flood hazard areas. New construction and substantial alteration projects, where the cost of work is higher than or equal to 50% of the current market rate of the lawfully existing infrastructure, will be subject to a higher level of scrutiny by the SRF program and should carefully construct decision matrices and provide a well-reasoned justification for the selected design plan.

Applicants can use the FEMA Flood Map Service Center Flood Insurance Study (FIS) Reports to determine the horizontal and vertical 500-year floodplain, using the most recent studies preliminary or effective studies. Other mapping sources may become available as the Department continues to incorporate consideration of climate impacts into policies. Where watercourses regulated under the FHACA do not have FEMA studies or where FEMA studies do not specify the 500-year flood elevation, applicants may have to calculate the elevation themselves or reach out to the Department for assistance. (N.J.A.C. 7:13-3.2- Selecting a method for determining the flood hazard area and floodway along a regulated water).

## Projected Sea-level Rise (SLR)

The tiered approach will likewise be used for planning and design of projects vulnerable to inundation and flooding related to sea-level rise based on regulatory flood elevations (N.J.A.C. 7:13, N.J.A.C. 7:7, etc.) or the FEMA 500-year flood elevation plus sea-level rise, whichever elevation is higher.

As part of their alternatives analysis, applicants are expected to consider future condition scenarios that may impact the project or greater water asset using 2100 projections, providing justification for the chosen scenario given risk tolerance and feasibility. **Table 3** shows the SLR standard applicable to 30-year Fund loans approved by the Department. The minimum SLR planning horizon is based on the fiscal year in which *the Project Report/Facilities Plan* is submitted.

**Table 3: Existing Infrastructure SLR Projections and Fund Loan Fiscal Years***

| Year of Project Report Submission | Minimum SLR Planning Horizon assuming 30-year Loan Terms |
|---|---|
| 2023 - 2029 | 2060 |
| 2030 - 2039 | 2070 |
| 2040 - 2049 | 2080 |
| 2050 - 2059 | 2090 |
| 2060 - 2069 | 2100 |

*This is based on the 30-year loan. Projects that are seeking a longer-term loan, such as CSO projects, should consult with the program to determine the SLR planning horizon.

For example, applicants seeking support for existing infrastructure must, at a minimum, account for 2.5 feet of SLR for loans where 30-year loan terms ending in 2060 are anticipated, and 3.1 feet of SLR where 45-year terms ending in 2070 are anticipated. Following the tiered approach, this means that planning and design will first avoid or elevate infrastructure outside FEMA 500 +2.5 feet and FEMA 500 +3.1 feet elevations, respectively. The minimum SLR height will change depending on the estimated year of loan repayment for the project and as future climate change projections are updated by the Department. And, in all cases, applicants must present a robust alternative analysis that demonstrates the basis for applying the minimum standard rather than adopt at least a 2100 planning horizon.

For new construction or substantial alterations of water infrastructure providing essential services for the health and safety of its customers, applicants may not rely upon these minimum standards and will be subject to a higher level of scrutiny. For such new construction and substantial alterations, applicants proposing a project alternative that does not comport with a 2100 planning horizon must demonstrate infeasibility. In all cases, applicants must carefully construct decision matrices and amply justify the selected alternative.

**Table 4** indicates the probability that sea-level rise will meet or exceed a certain elevation every 10 years under a moderate emissions scenario. The SRF program will use the projected sea-level rise that has a less than a 17% chance of being met or exceeded. The red highlights on the table outline SLR projections for the 2100 planning horizon and 2060 as a minimum SLR projection for projects that submit their project report between 2023 and 2029 state fiscal years.

Table 4: Sea-level rise Projections

| Year | Low End | At least a 66% chance between | | | High End |
|---|---|---|---|---|---|
| | Greater than a 95% chance SLR exceeds | Greater than an 83% chance SLR exceeds | ~50% chance SLR exceeds | Less than a 17% chance SLR exceeds | Less than a 5% chance SLR exceeds |
| **2020** | 0.1 ft | 0.3 ft | 0.5 ft | 0.7 ft | 0.9 ft |
| **2030** | 0.3 ft | 0.5 ft | 0.8 ft | 1.1 ft | 1.3 ft |
| **2040** | 0.5ft | 0.7 ft | 1.1 ft | 1.5 ft | 1.9 ft |
| **2050** | 0.7 ft | 0.9 ft | 1.4 ft | 2.1 ft | 2.6 ft |
| **2060** | 0.8 ft | 1.2 ft | 1.8 ft | 2.5 ft | 3.1 ft |
| **2070** | 1.0 ft | 1.4 ft | 2.2 ft | 3.1 ft | 3.8 ft |
| **2080** | 1.1 ft | 1.6 ft | 2.6 ft | 3.8 ft | 4.8 ft |
| **2090** | 1.2 ft | 1.8 ft | 3.0 ft | 4.4 ft | 5.8 ft |
| **2100** | 1.3 ft | 2.0 ft | 3.3 ft | 5.1 ft | 6.9 ft |
| **2110** | 1.6 ft | 2.3 ft | 3.7 ft | 5.7 ft | 8.1 ft |
| **2120** | 1.6 ft | 2.4 ft | 4.1 ft | 6.4 ft | 9.4 ft |
| **2130** | 1.7 ft | 2.6 ft | 4.5 ft | 7.1 ft | 10.9 ft |
| **2140** | 1.9 ft | 2.9 ft | 4.9 ft | 7.7 ft | 12.4 ft |
| **2150** | 2.1 ft | 3.1 ft | 5.2 ft | 8.3 ft | 13.8 ft |

Source: Sea-level rise Guidance for New Jersey, June 2021

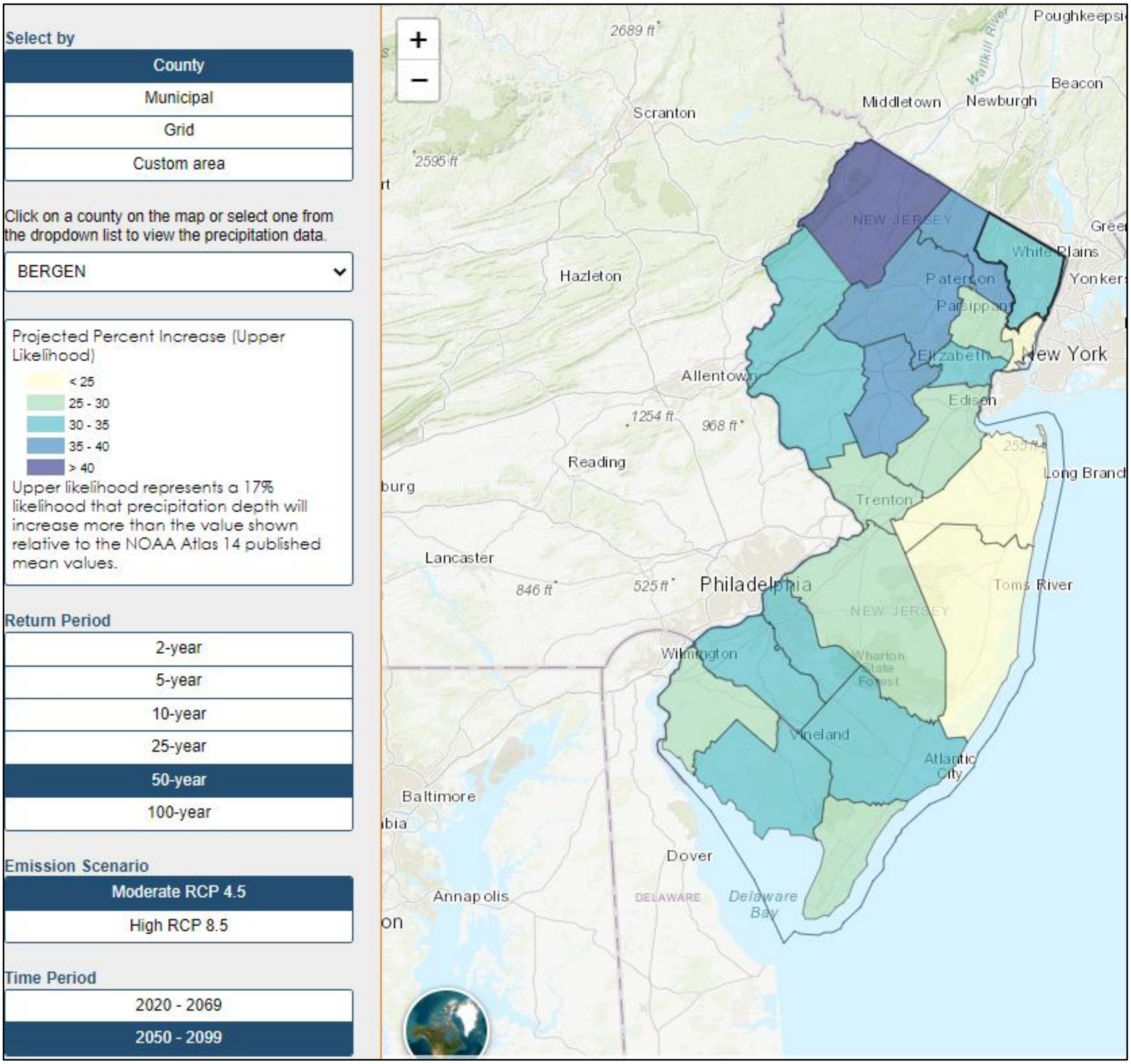
## Extreme Rainfall Average Recurrence Interval (ARI)

The Extreme Rainfall Average Recurrence Interval (ARI) is an average that indicates the frequency statistic of rainfall amounts within a given time period. This corresponds to annual exceedance probability, the probability that rainfall amounts will exceed a certain level. For example, a 5-year ARI, or 5-year storm, indicates the precipitation depth (inches) of a 24-hour storm which has a 20% chance of occurring or being exceeded in any given year. These precipitation frequency estimates are crucial in wastewater and stormwater management and planning for climate change impacts to water infrastructure, including ponding and erosion. Recent studies have shown an increase in Extreme Rainfall ARI within New Jersey relative to older NOAA Atlas 14 precipitation data that is employed for current design standards and regulations. Applicants must account for updated rainfalls where necessary, including but not limited to analyzing sites and designing stormwater infrastructure.

In addition, new data indicates that extreme precipitation will increase across the state at rates that vary across the state. The Department has developed the New Jersey Extreme Precipitation Projection Tool to allow users to view a range of rainfall depths, with options for frequencies, emission scenarios, and time periods to identify regional and local estimates of projected changes. The tool will assist applicants in determining the projected percent increase (e.g. 17% chance upper likelihood) of extreme precipitation over a 24-hour period for different storm return periods.

The type of infrastructure will dictate the precipitation projections to be considered when evaluating alternatives and providing the justification for resilience measures to account for extreme precipitation given relevant uses and risks. Infrastructure meant for dry weather and wet weather (green infrastructure, other stormwater) will likely require different planning horizons, for example. Applicants will need to provide justification for the precipitation projection that is selected to evaluate alternatives. This should include an analysis of the impact of precipitation on the project and, given its use and life cycle, the appropriate precipitation projections to be utilized. Applicants need to include a statement within the Resilience Assessment of the Planning Report/Project Report that summarizes this analysis and the justification for chosen precipitation projections.

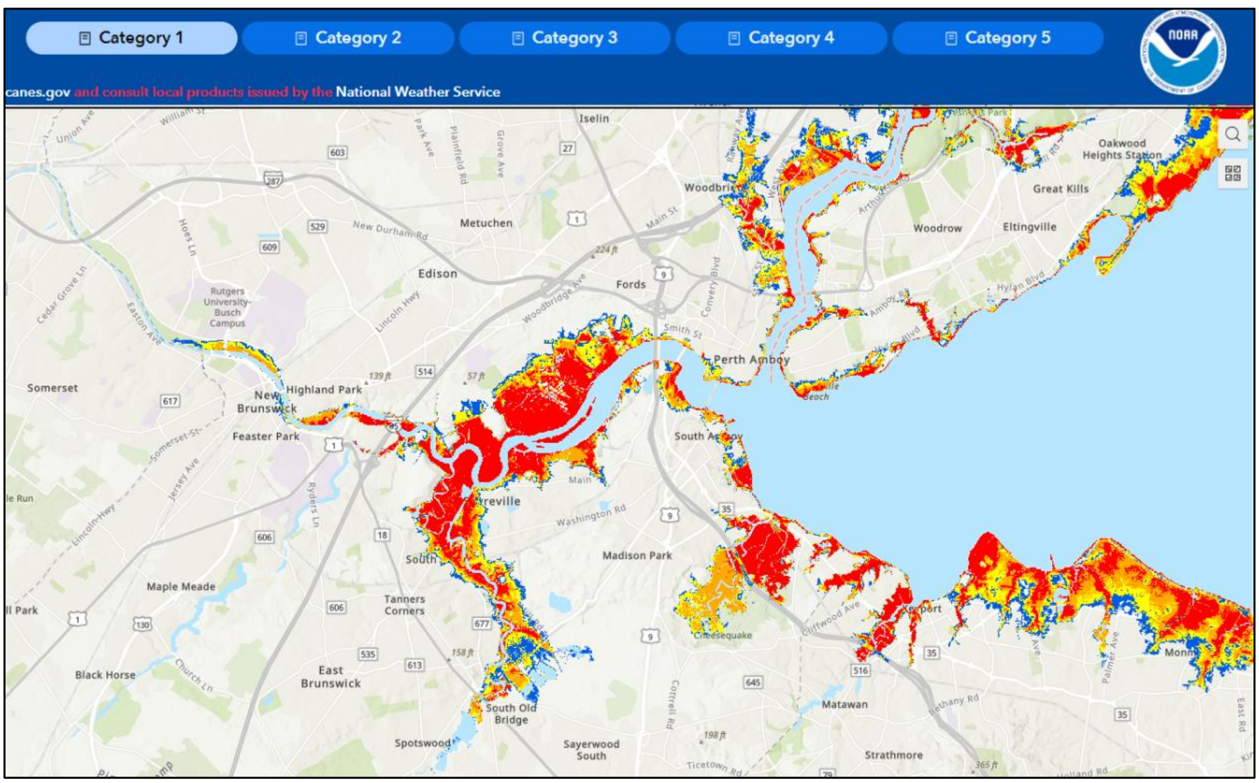
**New Jersey Extreme Precipitation Projection Tool**



## Storm Surge Hazards

Storm surge is defined as the abnormal rise of water generated by a storm, over and above the predicted astronomical tides. The National Storm Surge Hazard Maps use the SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model to compute storm surges. This data may not include local features such as construction walls, levees, berms, pumping systems, or other mitigation systems. Applicants should include these local mitigating systems in their analysis of storm surge hazard and understand the risks of these systems failing as well as the resulting consequences for the proposed infrastructure. Planning and design should be resilient to at least a Category 1 hurricane to avoid direct and indirect disruptions, which includes but is not limited to flooding hazards, sustained winds of 74 - 95 mph, or failure of permanent flood mitigating infrastructure including levees, berms, flood walls, sluice/slide gates, tidal floodgates, retention structures, and other such measures.

National Storm Surge Hazard Maps



## Water Bank Application Requirements

Application procedures are located at N.J.A.C. 7:22-3.11, which indicate what must be submitted for a Fund loan for facilities, including environmental infrastructure, wastewater, water supply, stormwater, and various nonpoint source pollution projects. The conditions of the Fund loan also state that "the Department may impose such other conditions as may be necessary and appropriate to implement the laws of the State and effectuate the purpose and intent of the Bond Acts" (N.J.A.C 7:22-3.17). Finally, in addition to the Department's regulatory authority governing clean water and drinking water systems, infrastructure projects may also be regulated under current and future rules as applicable.

The loan process for the SRF program requires applicants to submit a Project Report/ Facilities Plan as well as information for engineering and environmental reviews (N.J.A.C. 7:22-3.11 d5). The Project Report/ Facilities Plan must demonstrate resilience consistent with flood hazard areas, sea-level rise, storm surge hazards, and extreme rainfall ARI projections using the resilience assessment in this guidance to be eligible for SRF funding per federal and state public financial assistance laws and climate change policy. The Resilience Assessment should refer to other planning tools and resources the community and water system have used to place chosen projections into the context of long-term resilience planning. Examples of these resources and tools include:

- Municipal and Regional Comprehensive/Master Plans
- Municipal and Regional Vulnerability Assessments
- Long-Term Control Plans
- Asset Management Plans

The environmental review ensures compliance with applicable state and federal environmental and cultural resource laws. The engineering review ensures all projects meet the requirements of the SRF Program and various state-only programs. The following sections details the specific requirements which will determine eligibility:

### Mapping

To ensure that project sponsors are meeting standards set by the projections above, project planning and design must include the maps indicated in the list below. The maps must include all current or projected SLR adaptation or other mitigation measures already in place within the area served, whether they were funded through SRF or another funding mechanism.

- ❑ Community Served
- ❑ Existing & Proposed Infrastructure Location(s)
- ❑ FEMA 500+1 floodplain or map with calculated flood elevations
- ❑ Current mean water line
- ❑ Projected storm surge hazard for Category 1 hurricane
- ❑ FEMA 500+ future projected SLR (selected projections and long-term projections)
- ❑ SLR flooding adaptation measures (bulkheads, seawalls, breakwaters, floodwalls, etc.)
- ❑ Other NJ Flood Mapper information as appropriate

## Assessing Resilience of Project Alternatives

*Resilience is: "the ability of social and ecological systems to absorb and adapt to shocks and stresses resulting from a changing climate, while becoming better positioned to respond in the future."*

The Water Bank will require applicants to assess the resilience of project alternatives, the purpose of which is to guide applicants towards economic, effective, and practical projects that enable the greatest measures of resilience for New Jersey communities. The process for the resilience assessment is indicated in the following steps and will assist the applicant in the development and selection of project alternatives.

- First, conduct a *vulnerability assessment*, if applicable, to measure the vulnerability of the infrastructure to climate change impacts.
- Second, examine the *risk tolerance* of impacts to the community served based on public health and safety, environmental, and financial considerations.
- Third, analyze the project's contribution to *resilience* through direct and indirect effects. Include a summary in the *justification* of the selected project alternative.

The steps below will assist project sponsors in fulfilling this assessment to meet planning and design requirements:

1. Develop project alternatives that are economical, practical, effective, and contribute to community resilience. Projects must be permittable under all applicable regulations and project applicants should be familiar with municipal finance regulations (N.J.A.C. 7:22). Applicants are also encouraged to consult the USEPA Flood Resilience: A Basic Guide for Water and Wastewater Utilities, USEPA's Community-Based Water Resilience Guide, and other such guides indicating adaptation measures for climate change impacts that may assist applicants in planning and design for repair, rehabilitation, or construction of proposed projects.
2. Identify the potential climate impacts to the project in short-term and long-term scenarios.
    a. Use the most recent FEMA studies to determine the 500-year flood elevation for the area, including preliminary studies which are not yet effective but surpass effective FEMA 500-year flood elevations.
    b. Demonstrate consideration of long-term resilience goals consistent with a 2100 planning horizon, including a description of the project's exposure to FEMA 500 + SLR for year 2100 even if a shorter planning horizon is advocated. In proposing a selected alternative, applicants must use at least minimum standards for SLR projections at the end of the loan term as described in the Resilience Requirements section above. Where such minimum standards are applied, a well-reasoned justification for the selected projection is required.

c. Utilize the most recent data for storm surge risk, including local data, when available. Applicants should detail current and anticipated local storm surge protections and account for potential failure of surge protections using available data, including, but not limited to, historical events, levee inventories, and other related and relevant information.

d. Utilize precipitation projections appropriate to infrastructure type, level of investment, and potential effects of precipitation on the project, greater water system, and the community in which the project is located. Applicants must present a well-reasoned justification for their selection of mid-century or end of century projections in a a Resilience Assessment that evaluates the potential effects of both projections on the infrastructure and demonstrates why the selected projection is believed to be the most appropriate and effective measure.

3. Conduct a *vulnerability assessment* for each project alternative consistent with relevant projections as indicated in this guidance or using the most recent best available science recognized by the Department.

   The following projects will require a vulnerability assessment:

- New construction of water infrastructure that is permittable and allowed within the flood hazard elevation.
- New construction that is vulnerable to climate impacts outside of flooding risk such as drought, saltwater intrusion, and other potential impacts that may affect water infrastructure.
- Repair, rehabilitation, and any alteration to existing infrastructure within the flood hazard areas or those subject to other climate change impacts.
- Projects that were outside the FEMA 500+1 flood elevation but within flood hazard elevations identified by pending or later adopted Department Flood Hazard Area or Coastal Zone Management rules, such as the Inland Flood Protection Rule pending adoption as of the date of publication of this guidance.
- Green or natural infrastructure that has risk associated with a disruption in level of service or maladaptation.

For guidance, the following vulnerability assessment has been adapted from the Cambridge Sea-level rise and Coastal Storm Surge Vulnerability Assessment to determine the vulnerability of the proposed project to climate impacts. A project may be subject to multiple points of vulnerability assessment where climate impacts may overlap (e.g., flooding and storm surge), or may not require assessment of immaterial facts (e.g., SLR in upland fluvial areas). Applicants should utilize publicly available mapping and vulnerability assessment tools, as well as integrate local expertise and documented community experience into their assessments. The assessment includes all assets except for equipment purchase, such as street sweepers or vacuum trucks.

a. Determine *exposure*, the extent to which an asset is directly influenced by a climate change impact. For example, measure the elevation of flood threat as indicated by relevant projections and the elevation of the asset and critical components. Table 1. indicates the elevation of assets and elevation of the flood threat to determine exposure. Other climate change impacts such as extreme precipitation, wind speeds, sea water intrusion, and drought should all be considered. Some assets will be vulnerable to multiple climate change impacts. Infrastructure in coastal areas may need to examine FEMA 500, SLR, saltwater intrusion, and storm surge hazards.

b. Determine *sensitivity*, the extent to which the level of service is disrupted in each scenario where assets are exposed to climate change impacts by both direct disruptions (e.g., critical equipment damage, power loss, contamination) and indirect disruptions (e.g., loss of transportation access, evacuations causing loss of personnel and customers, disruption of other services). Assign sensitivity scores from S0 (least sensitive) to S4 (most sensitive) to each asset based on their exposure to relevant climate change impacts and the *criticality* of the asset to level of service. Use your best judgement, local expertise, or climate modeling to determine severity, and justify the decision-making process. Use matrices, decision trees, or other decision-making tools and maintain consistency with climate science. Matrix 1. is an example for determining flooding sensitivity for the flooding vulnerability assessment in Table 1.

Matrix 1. Flood Sensitivity for Flooding Vulnerability Assessment

| Criticality | Within Flood Zone (Exposure) | |
|---|---|---|
| | Yes | No |
| High | S4 | S2 |
| Medium | S3 | S1 |
| Low | S2 | S0 |

c. Determine *adaptive capacity*, the extent to which an asset can accommodate or adjust to an impact with existing and/or proposed adaptation measures such as technological operational protections, physical facility improvements, system-level redundancies, changes in utility policy and procedures, etc. Use your best judgement, local expertise, of climate modeling to assign an adaptive capacity score from AC0 (least adaptive) to AC2 (most adaptive).

d. Determine *vulnerability* by assessing sensitivity and adaptive capacity. **Matrix 2.** shows a vulnerability scoring matrix.

| **Matrix 2.** | | **Sensitivity:** Low → High | | | | |
|---|---|---|---|---|---|---|
| | | **S0** | **S1** | **S2** | **S3** | **S4** |
| **Adaptive Capacity** Low ↓ High | **AC0** | V2 | V3 | V4 | V5 | V5 |
| | **AC1** | V1 | V1 | V2 | V3 | V4 |
| | **AC2** | V0 | V0 | V0 | V1 | V2 |

Table 5. Flood Vulnerability Assessment of Key Components within Project Alternative

| | Exposure | | Sensitivity | | Adaptive Capacity | | Vulner-ability |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Asset/ Operation | Elevation of Asset (ft) | Elevation of Flood Threat (ft) | Criticality | S Score (0-4) | Mitigation Measures | AC Score (0-2) | V Score (0-5) |
| Raw Water Pump | 238.5 | 240 | High | S4 | Install watertight doors and sandbags for waterproofing | AC2 | V2 |
| Air Compressor | 238.75 | 240 | High | S4 | Install external connection to facility's compressed air system to allow for temporary, portable air compressor | AC2 | V2 |
| Automatic Transfer Switch | 241.5 | 240 | Medium | S1 | Install manual transfer switch for emergencies | AC1 | V1 |
| Electrical Outlets | 241.5 | 240 | Low | S0 | None, outlets for general use are not critical | AC0 | V2 |

4. Determine the *risk tolerance* of disruption of level of service to the community served financially, environmentally, and based on public health & safety in the event of a disaster, including FEMA 100- and 500-year floods, Category 1 storm surge hazards, projected SLR (based on 17% probability), and relevant extreme rainfall events, wherever they apply. Risk tolerance refers to the level of risk that is tolerable to achieve objectives, that being construction or alteration of the proposed project. To do this, determine the level of service, indicate consequences of climate impacts in the event of each disaster, and measure the level at which these consequences can tolerate risk. Low risk tolerance indicates that little or no risk for these consequences is tolerable. High risk tolerance means that the risk for these consequences is more tolerable. Applicants may measure risk tolerance for each climate change disaster from 1 to 5 (highest tolerance to lowest tolerance) by considering the associated consequences of disruption to level of service. Indicate the following, using a comprehensive summary or a table like the one below:

    a. *How would this project affect the community financially in the event of a disaster?* Consider the loss to rate payer base as a result of SLR and or other impacts of climate change to determine whether the loan is a resilient investment. Also consider future costs for repairs, remediation for environmental contamination, future adaptation measures to ensure resilience of the project. How tolerable is the risk of these costs?

    b. *How would this project affect public health & safety in the event of a disaster?* These consequences will vary greatly depending on the type of project proposed. For example, If the consequences of infrastructure failure include severe flooding, risk to human life will have the least tolerance. Boil water advisories will be more tolerable, depending on the length and risk to vulnerable communities.

    c. *How would this project affect the environment in the event of a disaster?* Some projects, such as sewage treatment, may increase likelihood of environmental contamination during a disaster, while improved stormwater infrastructure is intended to mitigate risks. Consider effects to water quality, water supply, and ecology. How tolerable are these risks?

**Table 6. Examples of Project's Impact on the Community in the Event of a Disaster**

| | Financial Risks | Public Health & Safety Risks | Environmental Risks |
|---|---|---|---|
| **SLR** Example: Stormwater Infrastructure | Community is expected to be partly inundated by 2050 given current SLR projections. This may result in a lower rate payer base and difficulty paying off the project loan. | Mean water levels will rise with SLR, leading to more frequent "sunny day" flooding. Proposed water infrastructure project will be obsolete during these events. | Inundated stormwater infrastructure during "sunny day" flooding will lead to pollution and debris entering water sources, including the ocean. |
| **FEMA 500** Example: Wastewater Plant | In the event of a FEMA 500 flood, the project will be inundated. Proposed adaptation measures will ensure minimal remediation is necessary to make infrastructure fully functional. | In the event of a FEMA 500 flood, some assets may be inundated which will spill sewage into the floodwaters and into the community. | Inundation of the wastewater treatment plant will dump sewage into the river, resulting in adverse effects to the ecology. |
| **SLOSH Cat 1** Example: Septic System | Septic systems inundated during a storm surge may fail and need to be replaced. There may also be some remediation cost. | Excessive rains during storm surge will raise water table, exposing the aquifer underneath to unfiltered septic. Wells in the area are exposed to contamination. | Coastal septic system will be vulnerable to storm surge and are expected to contaminate the land and ocean. |
| **Extreme Rain** Example: Stormwater Infrastructure | Failure of stormwater infrastructure may damage private property. The project is intended to reduce this risk. | Extreme rain event may cause some stormwater drains to backflow, causing minor localized flooding. | Extreme rain events are expected to overwhelm the proposed stormwater overflows, leading to surcharge into the river. However, this project reduces existing risk. |
| **Other** Example: Water pump/well | Overextraction of water during drought increases land subsidence which will lead to costs to repair affected infrastructure. | The pump's energy source is vulnerable to fire during fire season. This could cause a disruption in water pressure necessary for fire suppression. | Groundwater pump will compound with drought, worsening water quality and supply. |

5. Project sponsors may utilize various methods to analyze the effect of the project on *resilience* as it is defined in this guidance. These steps demonstrate how the project achieves this objective by evaluating vulnerability of local systems to climate change impacts and measuring the project's direct and indirect effects. The result should justify the selected alternative on the basis that it contributes to resilience. The following step by step is considered the minimum for SRF funding. More technical and analytical methods are encouraged to effectively demonstrate resilience.

    a. Analyze the *climate change impact vulnerability for the community served*. As of February 4, 2021, the State's Municipal Land Use Law requires municipalities to incorporate a climate change related vulnerability assessment into any Master Plan Land Use Element adopted after the signing (P.L. 2021, c. 6). For projects within communities that have conducted a climate vulnerability assessment, may use these assessments. NJ Adapt municipal snapshots can be used to summarize vulnerability data by category- built infrastructure report, critical asset report, natural and working lands report, public health report, and vulnerable populations report. Ensure that all data is accurate. In this section, include current climate impact adaptation measures within the community served.

    b. Use project vulnerability and risk tolerance to disruption of level of service to determine how the project alternative directly affects resilience. Examine the vulnerability scores of the assets comprised within the project alternative and assume a comprehensive level of vulnerability for the whole project. The vulnerability of a project demonstrates the risk of disruptions to level of service while risk tolerance examines the consequences of those disruption and determines the tolerance to risk of those consequences. Weigh the vulnerability of the project and risk tolerance to climate change impacts to measure *direct effect* on resilience from 1 to 5 (most resilient to most vulnerable). If the direct effect of the project is too vulnerable, consider additional adaptation or mitigation measures to address vulnerability and/or risks to the community.

**Matrix 3. Direct Impact**

| | 0 | Vulnerability | | | | 5 |
|---|---|---|---|---|---|---|
| 1 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| | 1 | 1.5 | 2 | 2.5 | 3 | 3.5 |
| Risk Tolerance | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 |
| | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 |
| 5 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 |

**Table 7. Example of Project Direct Effect**

| | V Score | Risk Tolerance | Direct Effect |
|---|---|---|---|
| Flood Hazard | 3 | 2 | 2.5 |
| SLOSH Cat 1 | 4 | 4 | 4 |
| Extreme Precipitation | 1 | 1 | 1 |

c. Determine how the project alternative indirectly affects resilience. *Indirect effects* are those not immediately explained by the level of service and the consequences of disruption. For example, a project increasing water supply capacity might encourage additional development in areas that are vulnerable to climate change impacts. On the other hand, green infrastructure projects may add green space and contribute to quality of life. Effects may be primary, such as water and energy efficiency, or secondary, such as a decrease in groundwater pollution through natural filtration. It is important to be accurate and realistic about the level of resilience and/or vulnerability that will be added to the community. Use best judgement, local expertise, and climate modeling to account for these indirect effects.

**Table 8. Examples of Indirect Effects**

| Increased Resilience | Decreased Resilience |
|---|---|
| • Addresses current vulnerabilities to climate change impacts in the system<br>• Lower risk for vulnerable communities<br>• Green and natural infrastructure leading to higher quality of life, reduced pollution, and ecological diversity<br>• Energy and water efficiency<br>• Cumulative effects with other adaptation measures | • Increased development in areas more exposed to climate change impacts<br>• Disproportionate risk to vulnerable communities<br>• Temporary adverse effects to environment or neighborhood<br>• Financial burden to vulnerable communities |

6. Use analytical methods or best judgement to weigh the project's total contribution to resilience as it is defined in this guidance by analyzing direct and indirect effects. Summarize this contribution and explain how it reduces vulnerability. Use this discussion to *justify the selected project alternative*.

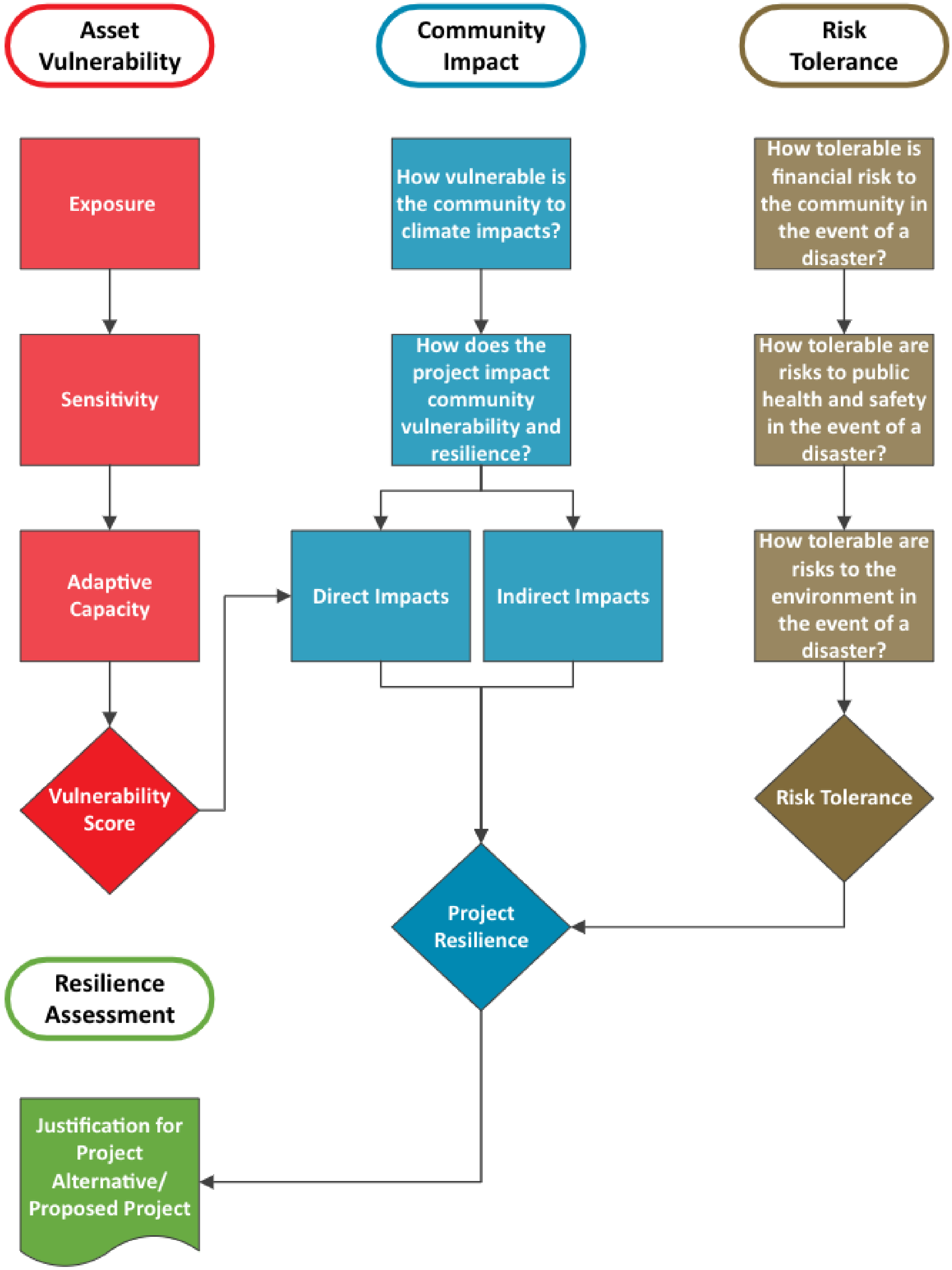
**Below is a summary of the requirements detailed in this guidance:**

## Mapping

- ❑ Community Served
- ❑ Existing & Proposed Infrastructure Location(s)
- ❑ FEMA 100 & 500 flood-zone maps or map with calculated flood elevations
- ❑ Current mean water line
- ❑ Current and projected storm surge hazard for Category 1 hurricane
- ❑ FEMA 500+ future projected SLR (based on 17% probability)
- ❑ Current and/or projected SLR and flooding adaptation measures (bulkheads, seawalls, breakwaters, floodwalls, etc.)
- ❑ Other mapping information as appropriate

## Resilience Assessment

| Climate Impact | Projections | Specific Requirements |
|---|---|---|
| Flooding | FEMA 500+1 Base Flood Elevation **or** Flood Hazard Elevations indicated in FHACA, whichever is highest | Justification of new and costly construction will be held to higher scrutiny.<br>Use the most stringent and protective measures when they differ across permitting standards and regulatory guidance. |
| Sea-level rise | FEMA 500+ SLR at 17% chance of meeting or exceeding **or** Flood Hazard Elevations indicated in FHACA, whichever is highest | The minimum SLR height reflects the estimated year of loan repayment for the project, shown in **Table 4**. In all cases, applicants must present a robust alternative analysis that demonstrates the basis for applying the minimum standard rather than adopt at least a 2100 planning horizon. For new construction or substantial alterations of water infrastructure providing essential, applicants may not rely upon these minimum standards and will be subject to a higher level of scrutiny. |
| Extreme Precipitation | Geographically relevant increases in ARI | Mid-century or end of century projections may be used and justified depending on type of infrastructure and risks. Applicants need to include a statement within the resilience section of the Planning Report that summarizes this analysis and the justification for chosen precipitation projections. |
| Storm Surge | Areas exposed to SLOSH (Sea, Lake, and Overland Surges from Hurricanes) Cat 1 hurricanes | Direct effects (rise in tide) and indirect effects (wind and coastal erosion) must be considered as well as risks to infrastructure in the case of failing mitigating infrastructure. |


Asset Vulnerability
Community Impact
Risk Tolerance
Exposure
How vulnerable is the community to climate impacts?
How tolerable is financial risk to the community in the event of a disaster?
Sensitivity
How does the project impact community vulnerability and resilience?
How tolerable are risks to public health and safety in the event of a disaster?
Adaptive Capacity
Direct Impacts
Indirect Impacts
How tolerable are risks to the environment in the event of a disaster?
Vulnerability Score
Risk Tolerance
Project Resilience
Resilience Assessment
Justification for Project Alternative/ Proposed Project

## Glossary

**Adaptation Measures –** adjust planning and design to actual and future climate change projections to reduce risk

**Average Recurrence Interval (ARI) –** means the frequency at which an event will meet or exceed a threshold. A 2- year flood elevation is one in which the flood elevation at a given location is met or exceeded about every two years. It is based on the annual exceedance probability.

**Climate resilience –** is defined by New Jersey as the ability of social and ecological systems to absorb and adapt to shocks and stresses resulting from a changing climate, while becoming better positioned to respond in the future.

**Community** – refers to the population served by the water infrastructure, regardless of municipality boundaries.

**Engineering Review –** has overall engineering (planning and design) responsibility for ensuring all projects meet the requirements of the Environmental Infrastructure Financing Program (EIFP) and various State-only programs. The Project Report/ Facilities Plan, where the Resilience Assessment will be required, is reviewed as part of the engineering section.

**Environmental Review –** performs environmental and cultural resource impact assessments for the planning and design of projects pursuing financing under any of the programs administered by the Municipal Finance and Construction Element. This ensures projects receiving financing follow applicable state and federal environmental and cultural resource laws. The environmental review and engineering review are distinct and both necessary for the application process. The Project Report/Facilities Plan is also reviewed as part of the environmental section.

**FEMA Flood Elevation –** refers to the FEMA 100- and 500-year flood elevation refers to the elevation of a flood projected to occur every 100 or 500 years. This is known as a reoccurrence interval and can also be understood as the annual exceedance probability that a flood will reach a certain elevation each year, being .2% and .1% respectively. The occurrence of a flood one year does not impact the probability that it will happen the next year; they are independent events with their own probability.

**Flood Hazard Area –** land, and the space above that land, which lies below the regulatory flood elevation (and as defined in N.J.A.C. 7:13-1.2). Structures, fill and vegetation that are situated on land that lies below the flood hazard area design flood elevation are described as being "in" or "within" the flood hazard area. The inner portion of the flood hazard area is called the floodway and the outer portion of the flood hazard area is called the flood fringe.

**Flood Hazard Area Control Act Rules –** the Flood Hazard Area (FHACA) Control Act Rules, N.J.A.C. 7:13, implement the New Jersey Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq. They incorporate stringent standards for development in flood hazard areas and adjacent to surface waters to mitigate the adverse impacts to flooding and the environment that can be caused by such development.

**Fund Loan –** means a loan from one or more of the applicable Funds for the allowable costs of an environmental infrastructure project.

**Level of Service (LOS) –** refers to the role and function of infrastructure assets and how they are expected to perform. LOS considerations involve the components, services, and goals that are deemed appropriate.

**Mitigation Measures –** eliminate, reduce, control, or offset the adverse effects of a project or designated project, and include restitution for any damage caused by those effects through replacement, restoration, compensation, or any other means.

**Project –** refers to the defined services for the construction of specified operable facilities as approved by the Department in the Fund loan agreement.

**Project Report/ Facilities Plan –** describes the project and provides relevant information for environmental infrastructure projects.

**Project Sponsor –** means any local government unit or private entity that seeks a Fund loan pursuant to this subchapter.

**Protecting Against Climate Threats (NJPACT) –** under Governor Phil Murphy's Executive Order No. 100 (2020), former Commissioner Catherine McCabe issued Administrative Order No. 1 (2020) requiring the New Jersey Department of Environmental Protection to begin a regulatory reform effort to help reduce greenhouse gas (GHG) and other climate pollutant emissions while making our natural and built environments more resilient to the impacts of climate change that we cannot avoid.

**Resilience Assessment –** is the systematic evaluation of a project alternative's vulnerabilities to climate change impacts and its direct and indirect effects on community and water system resilience. The Resilience Assessment shall be included in the Project Report/Facilities Plan.

**Risk –** means the possibility that physical, social, or economic damages will result from climate change impacts.

## Abbreviations

| Abbreviation | Definition |
|---|---|
| **ARI** | Average reoccurrence interval |
| **BIL** | Bipartisan Infrastructure Law |
| **CAFRA** | Coastal Area Facility Review Act |
| **CC** | Climate change |
| **DEP** | Department of Environmental Protection (Department) |
| **EO** | Executive Order |
| **FEMA** | Federal Emergency Management Agency |
| **FHACA** | Flood Hazard Area Control Act |
| **I-Bank** | Infrastructure Bank |
| **NJPACT** | New Jersey Protecting Against Climate Threats |
| **NOAA** | National Oceanic and Atmospheric Administration |
| **SLOSH** | Sea, Lake, and Overland Surges from Hurricanes |
| **SLR** | Sea-level rise |
| **SRF** | State Revolving Fund |
| **USEPA** | United States Environmental Protection Agency |

## Regulation Key

The following regulations are mentioned throughout this guidance:

**Fund Procedures and Requirements**

- N.J.A.C. 7:22-3.11 (Application Procedures)
- N.J.A.C. 7:22-3.14 (Supplemental Information)
- N.J.A.C. 7:22-3.17 (Loan Conditions)

**Environmental Infrastructure Trust Procedures and Requirements**

- N.J.A.C. 7:22-4.11 (Application Procedures)
- N.J.A.C. 7:22-4.14 (Supplemental Information)

**Flood Hazard Area Control Act Rules (FHACA)**

- N.J.A.C. 7:13

**New Jersey Protecting Against Climate Threats (NJPACT)**

- Inland Flood Protection Rule (IFPR)
  - proposed rule available at https://dep.nj.gov/inland-flood-protection-rule/
- Resilient Environment and Landscapes (REAL) reform package, which is expected to amend:
  - FHACA rules- N.J.A.C. 7:13
  - Freshwater Wetlands Protection Act (FWPA) Rules- N.J.A.C. 7:7A
  - Coastal Zone Management (CZM) Rules- N.J.A.C. 7:7
  - Stormwater Management Rules- N.J.A.C. 7:8