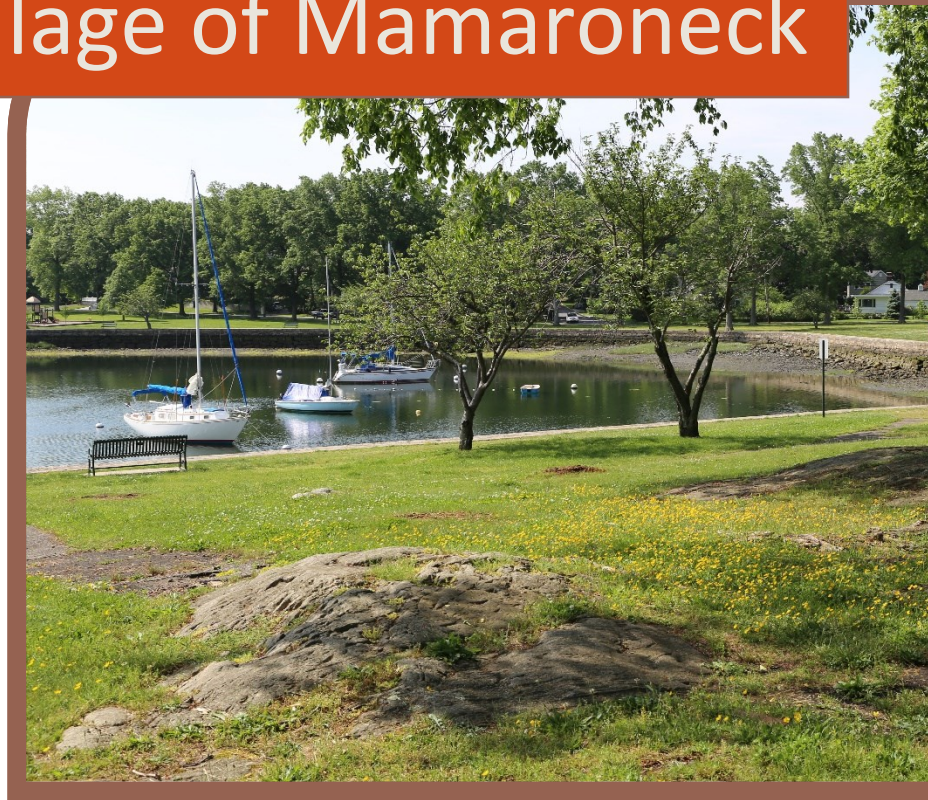


Sea Level Rise and Flooding Village of Mamaroneck



Village of Mamaroneck Planning Department

Assistance provided by Westchester
County GIS

February 2017

Planning.VillageofMamaroneck.org

Introduction

The Village of Mamaroneck is a coastal village with approximately 9 miles of coastline along the Long Island Sound, the majority of which is developed. As global warming occurs and arctic ice sheets continue to melt, our oceans will continue to rise. This will be disruptive to coastlines throughout the globe, including the coastline in Mamaroneck.

The Village has a diverse mix of uses along its coastline, including water-dependent uses such as boatyards and water-enhanced uses such as recreational facilities to residential and private club facilities. As sea level rises the Village will face ever-increasing economic risks to these vital assets. As a community with a Local Waterfront Revitalization Plan (LWRP), the Village has made its coastal character a priority by implementing long-term policies that preserve and enhance the quality of Mamaroneck as a waterfront community.

This report will act to supplement the Village in its long-range planning framework with respect to sea level rise by outlining several probable scenarios. Scenarios that will be assessed include expected impacts related to strictly sea level rise as well as expected impacts from sea level rise coupled with 100 year and 500 year flood events. These scenarios will look at properties that will be impacted at 1, 3, and 6 feet of sea level rise. In each scenario the economic risks will be outlined in 2017 dollars based on the most recent assessment numbers by the Town of Mamaroneck and Town of Rye. This report will also consider the most recent scientific modeling with respect to projected time frames. Lastly, this report will outline several recommendations to increase coastal resiliency and mitigate the expected impacts of sea level rise.



Sea Level Rise Scenarios

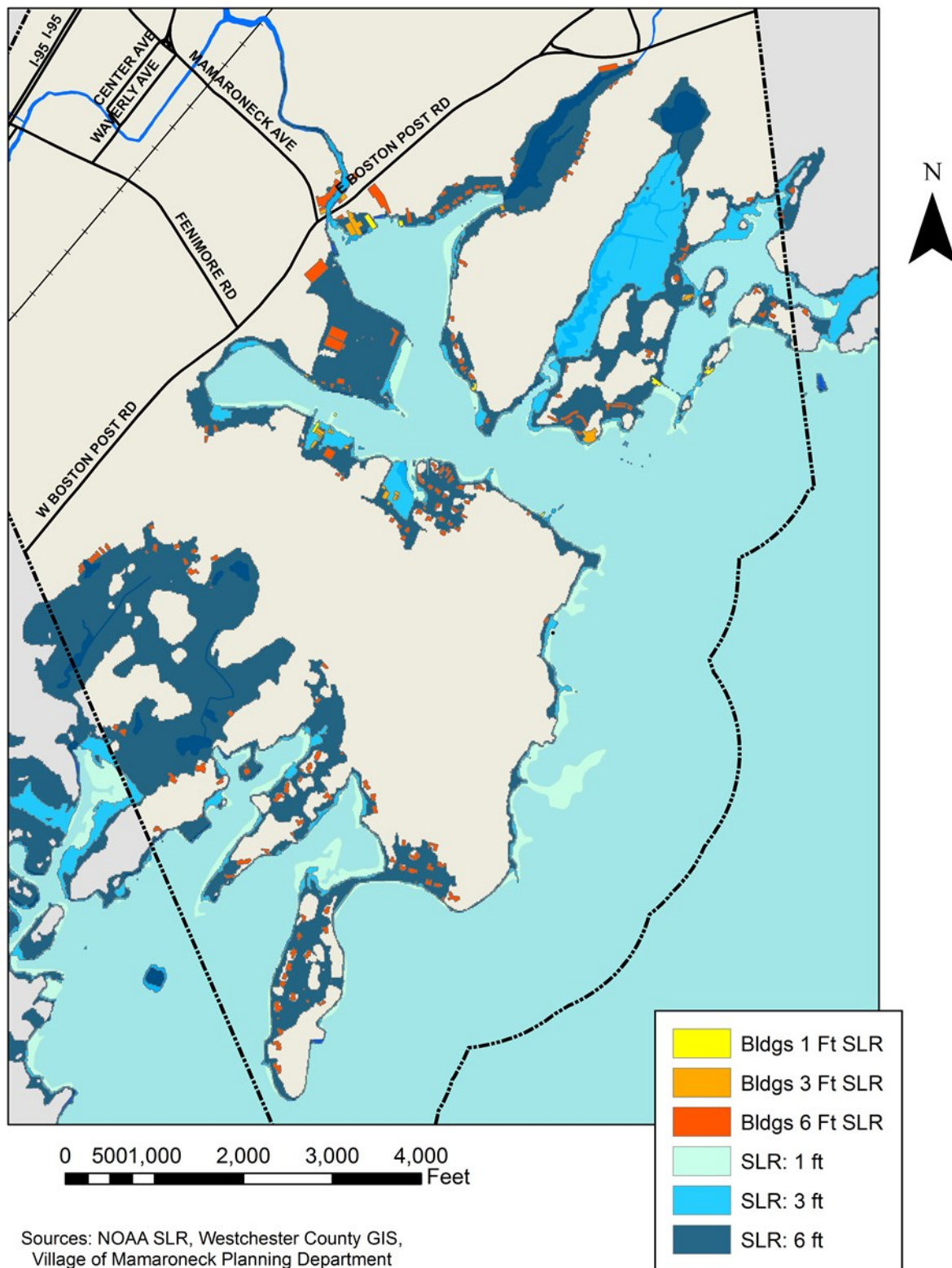
Utilizing NOAA sea level rise data the Planning Department assessed impacts on buildings and sewer infrastructure at 1, 3, and 6 feet of sea level rise. The map below details the locations of buildings that will be directly impacted by sea level rise. Utilizing the most recent assessment data provided by the Town of Mamaroneck and Town of Rye the total economic impact sea level rise is outlined in the table below.

Sea Level Rise	Total Buildings Value	# of Structures	Acres	% of Total Landmass Lost	Timeline
1 Foot	\$5,613,900	8	42	2%	NYSERDA Model: 2050s Rapid Ice Melt: 2030s
3 Feet	\$26,791,100	34	96	5%	NYSERDA Model: 2080s Rapid Ice Melt: 2060s
6 Feet	\$181,059,050	248	330	17%	NYSERDA Model: Past 2100 Rapid Ice Melt: 2090s

*Buildings were joined to assessment data for entire property, value represents amalgamated value of buildings on a lot. Value of tax exempt structures not represented.

Even at just one foot of sea level rise the Village faces a substantial risk to \$5.6 million in residential and commercial assets. At three feet of sea level rise the Village faces a potential loss of up to \$26.8 million and 5% of total landmass as early as the 2060s. At six feet of sea level rise the Village faces a total risk of up to \$181 million in residential and commercial assets, as early as the 2090s according the rapid ice melt scenario. This represents a loss of 17% of the Village's landmass and over 30% of the landmass below Boston Post Road. Loss of property of this magnitude will certainly impact the Village's overall budgeting over the long term. While sea level rise is a slow moving phenomenon the Village should consider implementing policies and capital improvements that will begin to address sea level rise now in an effort to protect property and quality of life. The investment in protective measures is justified in light of the potential costs. Further analysis is warranted to assess the costs and benefits of raising or replacing seawalls along Village owned properties. As noted in the LWRP the Village should also explore options for implementing native plantings and restored wetlands adjacent to or in place of new seawalls. This could be beneficial to both water quality and as a mitigating factor against wave action during storm events. The Village has worked with Westchester County Planning to restore a natural habitat and remove a portion of the seawall along the West Basin of Harbor Island Park and could continue this work up the coastline.

Sea Level Rise



*Data portrayed above are not suitable for site-specific analysis. Data is provided by NOAA and is subject to their use disclaimer located at the end of this report.

Commerce & Infrastructure

Commerce

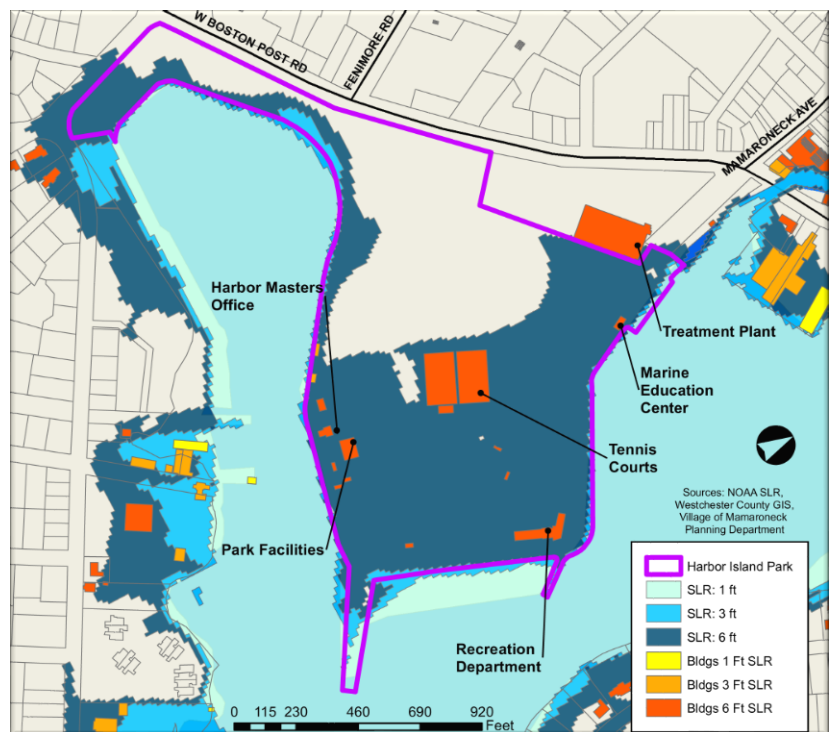
The Village has a number of vital marine businesses located in areas that will be inundated due to sea level rise. During the first iteration of the LWRP in the mid-1980s the Village made the preservation of these water-dependent uses a major priority by adopting new marine commercial zones and marine recreational zones. Many of the business in these zones face economic risk related to sea level rise. Appropriate action to improve resiliency along the shorelines within marine commercial and recreational zones is necessary for the long-term economic success of these businesses.



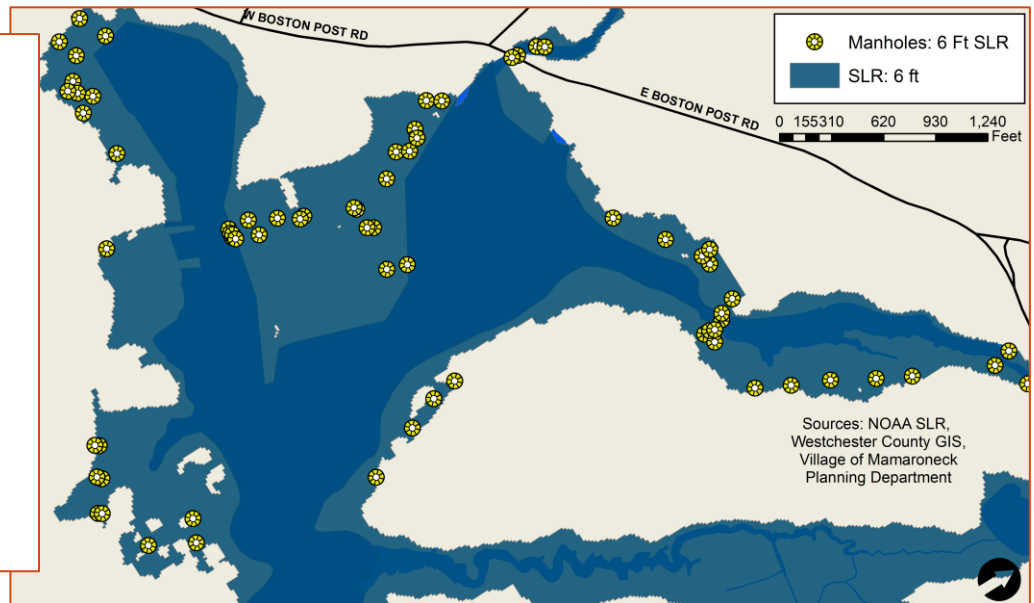
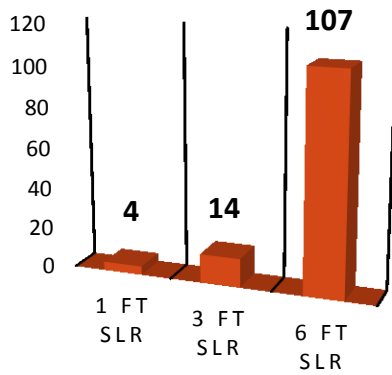
Mamaroneck Water Treatment Plant (Westchester County) and commercial boatyards

Infrastructure & Facilities

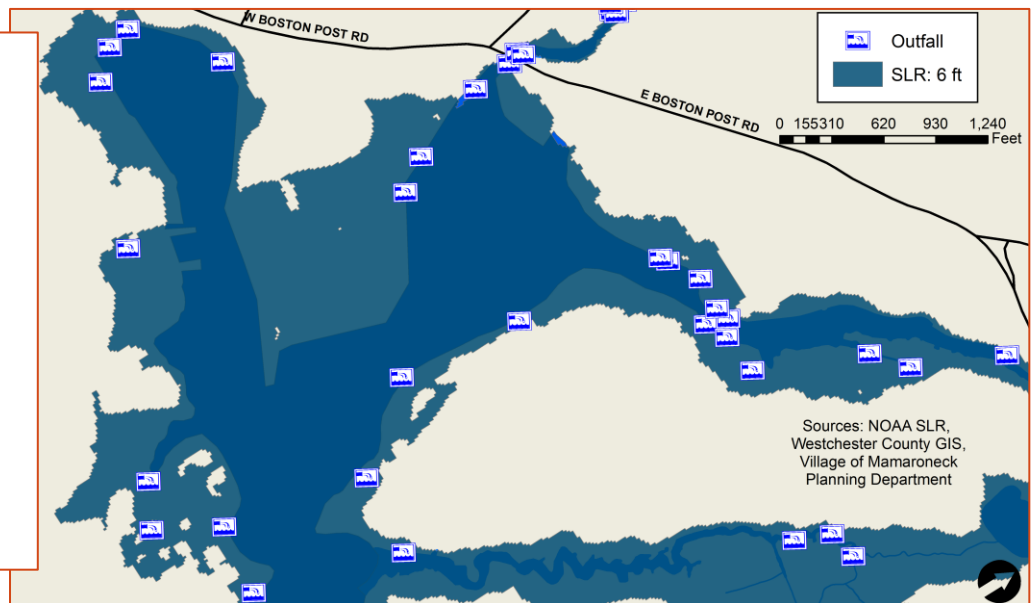
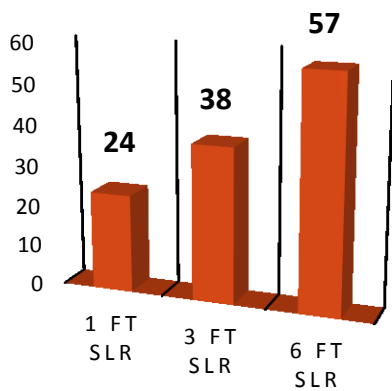
As a coastal community, the Village faces unique risks to its infrastructure as a result of sea level rise. The Village recognizes that the sanitary sewer system is aging and as a result may be prone to issues of inflow and infiltration, where ground water enters the system through cracks in the pipes. This issue may be further irritated by sea level rise as inundation and a heightened water table will lead to increased levels of inflow. Other critical infrastructure at risk include sanitary sewer pump stations and force mains, sewer and drainage manholes and outfalls, and Village-owned roadways and buildings. Harbor Island Park is the most at risk Village property as it is low lying and hosts the recreation department offices, the pavilion recreational space, the Harbor Master's office, the Marine Education Center, and the entire parks department facilities. All of these locations are at risk of inundation due to sea level rise.



INUNDATED MANHOLES

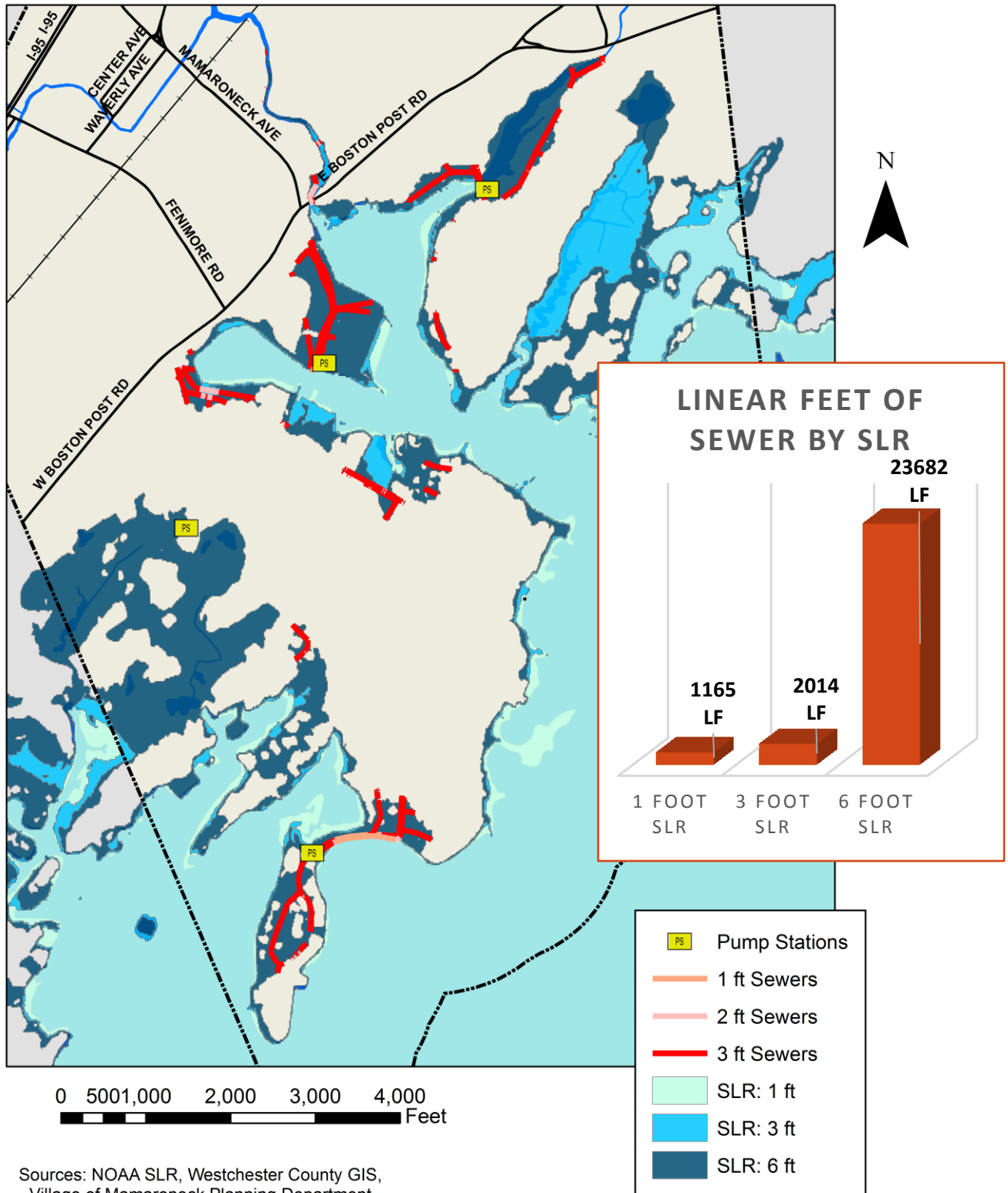


INUNDATED OUTFALLS



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Pump Stations & Sewers Impacted by SLR



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Flood Event Scenarios

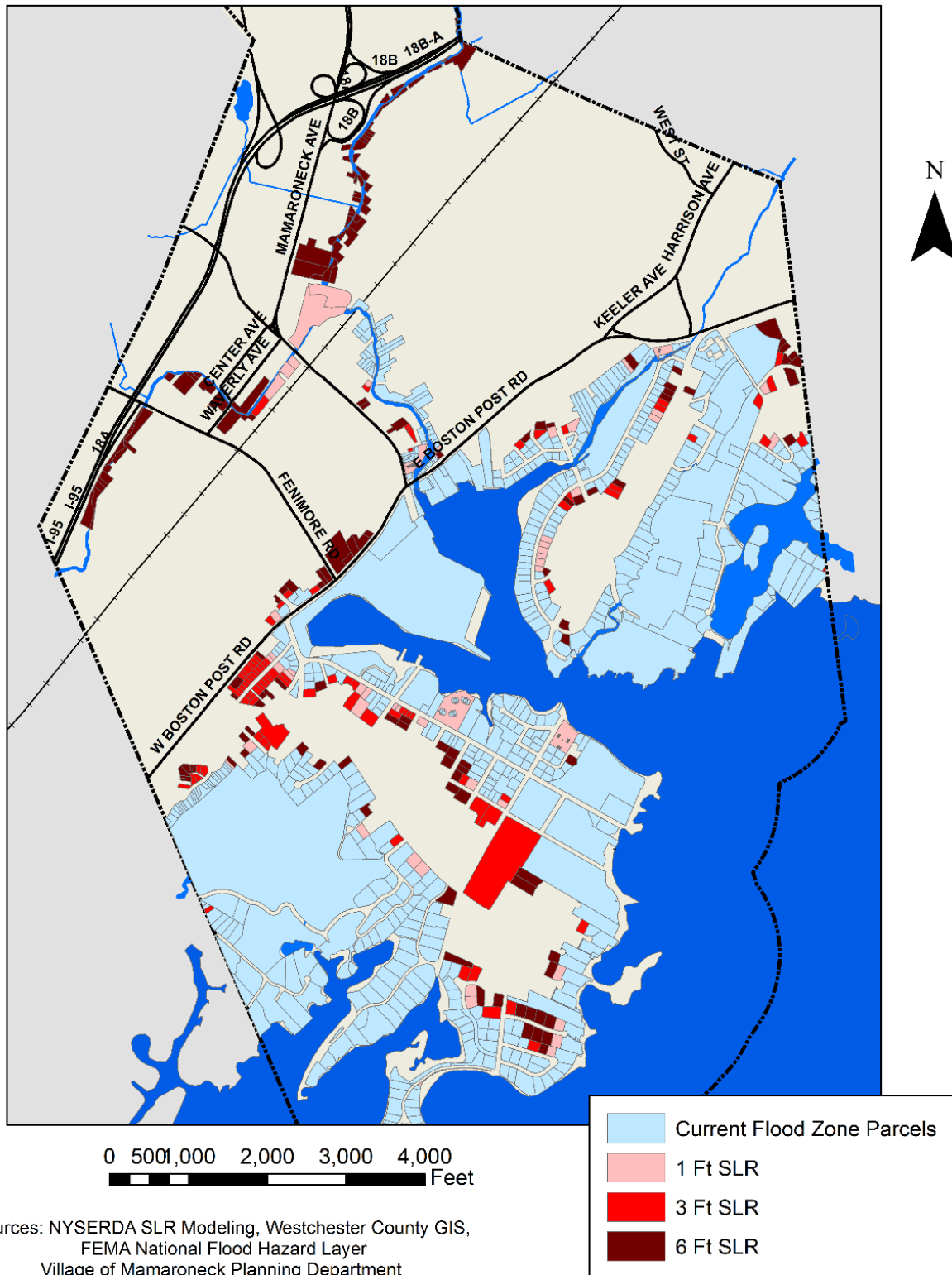
In an effort to understand the expected economic impacts of sea level rise a closer look at the compounding effects on coastal flooding was performed. The Village Planning Department utilized information provided by NYSERDA and Westchester County GIS to inform the scenarios outlined below. The first scenario reviews a 100 year interval storm as applied to 1, 3, and 6 feet of sea level rise. The second scenario reviews a 500 year interval storm as applied to 1, 3, and 6 feet of sea level rise.

100 Year Flood Scenario

Sea Level Rise	Total Value Building Only (in 2017 dollars)	25%-75% Damage (in 2017 dollars)	# of Additional Properties	Timeline
1 Foot	\$30,456,200	\$7,614,050-\$22,842,150	56	NYSERDA Model: 2050s Rapid Ice Melt: 2030s
3 Feet	\$79,656,146	\$19,914,037-\$59,742,110	164	NYSERDA Model: 2080s Rapid Ice Melt: 2060s
6 Feet	\$166,610,419	\$41,652,605-\$124,957,814	327	NYSERDA Model: Past 2100 Rapid Ice Melt: 2090s

With just a one foot rise in seal level an additional 56 properties are added to the 100 year flood zone, representing a value of over \$30 million. Since the timeline for a one foot scenario is anywhere from 13 to 33 years it is important for the Village to integrate adaptation and resiliency measures into its planning framework as expeditiously as possible. As sea levels rise the Village may expect even greater coastal flooding and higher levels of damage with up to 327 additional properties being added to the 100 year flood zone at 6 feet of sea level rise, which could occur as soon as the 2090s. If feasible and economically sound measures are taken now the Village will be better equipped to handle the increasing sea level rise later on. It is important to note that these scenarios describe only the difference between the existing conditions and expected conditions, not the overall expected damages.

Sea Level Rise + 100 Year Storm



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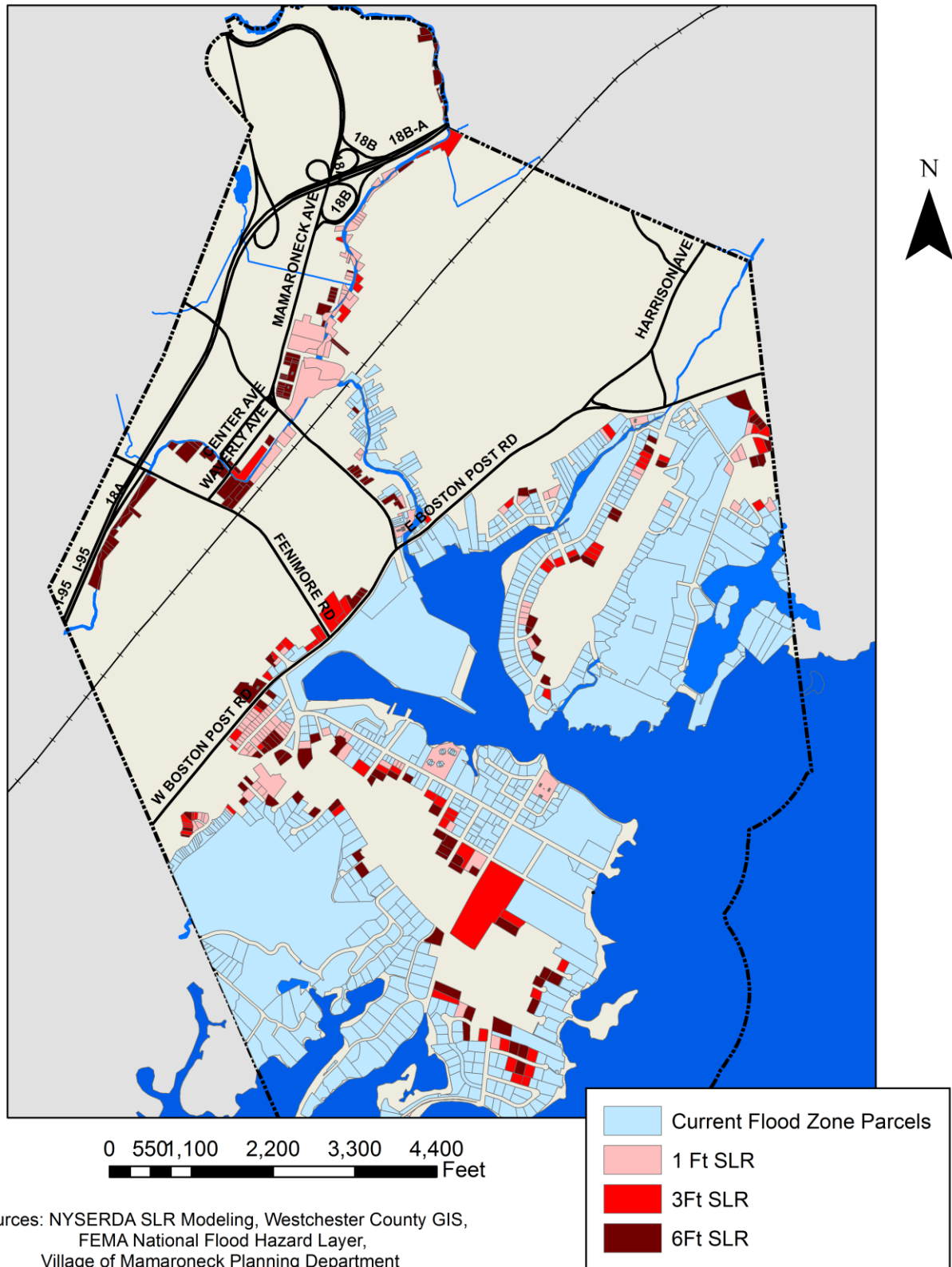
500 Year Flood Scenario

Sea Level Rise	Total Value Building Only (in 2017 dollars)	25%-75% Damage (in 2017 dollars)	# of Additional Properties	Timeline
1 Foot	\$50,131,096	\$12,532,774-\$37,598,322	144	NYSERDA Model: 2050s Rapid Ice Melt: 2030s
3 Feet	\$99,636,119	\$24,909,030-\$74,727,089	227	NYSERDA Model: 2080s Rapid Ice Melt: 2060s
6 Feet	\$189,636,918	\$47,409,230-\$142,227,689	404	NYSERDA Model: Past 2100 Rapid Ice Melt: 2090s

In the event of a 500 year flood the Village could face the most significant loss of property. With just a one foot rise in seal level an additional 144 properties are added to the 500 year flood zone, representing a value of over \$50 million. The risk to property grows as sea level rises with a total value near \$100 million at three feet, and near \$190 million at 6 feet. A 500 year flood occuance has a 0.2% chance of occurring in any given year. However as climate change progresses there is a consensus among multiple climate models for this region that the interval between storms will continue to decrease while the intensity of storms increases.¹ The compounding effect of sea level rise, flooding, and growing intensity and frequency of storms, may increase the total risk to life and property in the Village of Mamaroneck and warrants investments in resiliency measures to lessen these risks.

¹ Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

Sea Level Rise + 500 Year Storm



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January 2017

Recommendations

1. Repair and replace failing seawalls with new higher walls. The useful life of the seawall should incorporate accepted NYS sea level rise projections and build to them. For instance if the useful life of a new seawall is 60 years it should be built to accommodate three feet of sea level rise. Given the historic nature of the Village's seawalls, particularly those along the shore in Harbor Island



Coastal Flooding in Harbor Island Park

Park, efforts should be made to reinforce and raise seawalls rather than replace entirely. This approach may have the added benefit of reduced costs. Repair and reinforcement of sea walls will not only benefit Village parkland but also serve to protect the Westchester County Treatment Plant located adjacent to Harbor Island Park. The treatment plant will be subject to inundation at 6 feet of sea level rise. To that end the Village may consider a partnership with Westchester County to improve resiliency near the treatment plant.

Precedent: Seawalls are used in the Netherlands to protect inland areas from flooding and sea level rise.

2. Plant native plantings and restore wetlands where possible. Wetlands serve not only as vital habitats for the diverse ecology of the Long Island Sound, but also serve to lessen wave action during coastal storm events. Native plantings work to stabilize the shoreline by preventing and slowing erosion while also filtering pollutants out of the water.
3. Begin tracking sea level rise at Harbor Island Park to inform future projections using high-accuracy locally derived data.
4. Reduce local contributions to carbon emissions through energy reduction programs.



Harbor Island Wetland Restoration

5. Explore ways to address sea level rise along privately owned areas of the shoreline, through either code requirements or incentives.
6. Permit the raising of homes to heights that incorporate expected sea level rise. Current freeboard requirements of two feet above base flood elevation work towards that goal, but may need to be revisited as the sea rises. Concurrently, the Village should consider revising height limits to measure height from the base flood elevation.

7. Consider installation of vegetated berms to protect from both storm surge and sea level rise. Berms may also serve a secondary purpose of increasing public access to the waterfront.
8. Explore the use of other structural interventions including automated flood walls that retract to maintain view sheds.

Precedent: Both berms and automated flood walls are proposed under New York City's Big U project to mitigate flooding and sea level rise impacts on Lower Manhattan.



9. Raise or relocate critical infrastructure such as pump stations and force mains in areas that are expected to be inundated.
10. Raise or relocate facilities (managed retreat).

Precedent: The City of Beacon recently moved a proposed project on city-owned properties further uphill in recognition of SLR.

NYSDA SLR Model Use Disclaimer: This electronic tool provides estimated projections of the potential impact of future sea-level rise and storm surge on inundation and coastal flooding that could occur in portions of New York State. The estimated projections of future sea level are based on the best available scientific information but have large uncertainties and are subject to change as the state of the science evolves. The values do not reflect the likelihood of changes in climate or sea level.

This tool is intended to be used only as a screening-level tool to consider potential policy responses to sea-level rise and coastal flooding. It is not intended for, nor suitable for, navigation, site-specific analysis for permitting or other legal purposes. The data and maps in this tool are provided “as is,” without warranty to their performance, merchantable state, or fitness for any particular purpose. There is no warranty that access to content will be uninterrupted or error-free; that content will be virus-free; or that content will be complete, accurate, or timely. The entire risk associated with the results and use of these data is assumed by the user. Under no circumstances, including but not limited to negligence, shall the creators of this mapping tool be liable for any direct, indirect, incidental, special, or consequential damages.

NOAA SLR Mapper Use Purpose & Disclaimer: The purpose of this data viewer is to provide coastal managers and scientists with a preliminary look at sea level rise and coastal flooding impacts. The viewer is a screening-level tool that uses nationally consistent data sets and analyses. Data and maps provided can be used at several scales to help gauge trends and prioritize actions for different scenarios.

The data and maps in this tool illustrate the scale of potential flooding, not the exact location, and do not account for erosion, subsidence, or future construction. Water levels are shown as they would appear during the highest high tides (excludes wind driven tides). The data, maps, and information provided should be used only as a screening-level tool for management decisions. As with all remotely sensed data, all features should be verified with a site visit. The data and maps in this tool are provided “as is,” without warranty to their performance, merchantable state, or fitness for any particular purpose. The entire risk associated with the results and performance of these data is assumed by the user. This tool should be used strictly as a planning reference tool and not for navigation, permitting, or other legal purposes.