

# Climate Resilience Design Standards Tool Project Report

## Falmouth Great Pond TWMP

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Created By: GHDHyannis

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Tool Version: Version 1.2

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## Project Summary

[Link to Project](#)

Estimated Capital Cost: \$114700000.00

End of Useful Life Year: 2075

Project within mapped Environmental Justice neighborhood: No

Ecosystem Service	Scores
<b>Benefits</b>	
Project Score	High
<b>Exposure</b>	
Sea Level Rise/Storm Surge	High
Surge	Exposure
Extreme Precipitation - Urban Flooding	High
Extreme Precipitation - Riverine Flooding	High
Extreme Heat	Moderate



## Asset Preliminary Climate Risk Rating

Number of Assets: 1

### Summary

Asset Risk	Sea Level Rise/Storm Surge	Extreme Precipitation - Urban Flooding	Extreme Precipitation - Riverine Flooding	Extreme Heat
TASA Lift Stations	High Risk	High Risk	High Risk	High Risk

## Climate Resilience Design Standards Summary

	Target Planning Horizon	Intermediate Planning Horizon	Percentile	Return Period	Tier
<b>Sea Level Rise/Storm Surge</b>					
TASA Lift Stations	2070	2050		200-yr (0.5%)	
<b>Extreme Precipitation</b>					
TASA Lift Stations	2070			50-yr (2%)	Tier 3
<b>Extreme Heat</b>					
TASA Lift Stations	2070		90th		Tier 3

## Scoring Rationale - Project Exposure Score

The purpose of the Exposure Score output is to provide a preliminary assessment of whether the overall project site and subsequent assets are exposed to impacts of natural hazard events and/or future impacts of climate change. For each climate parameter, the Tool will calculate one of the following exposure ratings: Not Exposed, Low Exposure, Moderate Exposure, or High Exposure. The rationale behind the exposure rating is provided below.

## Sea Level Rise/Storm Surge

This project received a "High Exposure" because of the following:

- Located within the predicted mean high water shoreline by 2030
- Exposed to the 1% annual coastal flood event as early as 2030
- Located within the 0.1% annual coastal flood event within the project's useful life

## Extreme Precipitation - Urban Flooding

This project received a "High Exposure" because of the following:

- Maximum annual daily rainfall exceeds 10 inches within the overall project's useful life
- No historic flooding at project site
- No increase to impervious area
- Existing impervious area of the project site is between 10% and 50%

## Extreme Precipitation - Riverine Flooding

This project received a "High Exposure" because of the following:

- Part of the project is within a mapped FEMA floodplain, outside of the Massachusetts Coast Flood Risk Model (MC-FRM)
- Part of the project is within 500ft of a waterbody and less than 20ft above the waterbody
- No historic riverine flooding at project site
- Project is not likely susceptible to riverine erosion

## Extreme Heat

This project received a "Moderate Exposure" because of the following:

- Existing impervious area of the project site is between 10% and 50%
- 10 to 30 day increase in days over 90 deg. F within project's useful life
- Located within 100 ft of existing water body
- No increase to the impervious area of the project site
- No tree removal

## Scoring Rationale - Asset Preliminary Climate Risk Rating

A Preliminary Climate Risk Rating is determined for each infrastructure and building asset by considering the overall project Exposure Score and responses to Step 4 questions provided by the user in the Tool. Natural Resource assets do not receive a risk rating. The following factors are what influenced the risk ratings for each asset.

### Asset - TASA Lift Stations

Primary asset criticality factors influencing risk ratings for this asset:

- Asset must be operable at all times, even during natural hazard event
- Less than 10,000 people would be directly affected by the loss/inoperability of the asset
- Few alternative programs and/or services are available to support the community
- Inoperability is likely to significantly impact other facilities, assets, or buildings and will likely affect their ability to operate
- Spills and/or releases of hazardous materials are expected with difficult remediation and pose a severe threat to public health or safety

# Project Climate Resilience Design Standards Output

Climate Resilience Design Standards and Guidance are recommended for each asset and climate parameter. The Design Standards for each climate parameter include the following: recommended planning horizon (target and/or intermediate), recommended return period (Sea Level Rise/Storm Surge and Precipitation) or percentile (Heat), and a list of applicable design criteria that are likely to be affected by climate change. Some design criteria have numerical values associated with the recommended return period and planning horizon, while others have tiered methodologies with step-by-step instructions on how to estimate design values given the other recommended design standards.

Asset: TASA Lift Stations

Building/Facility

## Sea Level Rise/Storm Surge

High Risk

Target Planning Horizon: 2070

Intermediate Planning Horizon: 2050

Return Period: 200-yr (0.5%)

**LIMITATIONS:** The recommended Climate Resilience Design Standards for the Sea Level Rise / Storm Surge Design Criteria are based on the user drawn polygon and relationships as defined in the Supporting Documents. The projected values provided through the Tool are based on the Massachusetts Coast Flood Risk Model (MC-FRM) outputs as of 9/13/2021, which included GIS-based data for three planning horizons (2030, 2050, 2070) and six return periods (0.1%, 0.2%, 0.5%, 1%, 2%, 5%). These values are projections based on assumptions as defined in the model and the LiDAR used at the time. For additional information on the MC-FRM, review the additional resources provided on the Start Here page.

The projected values, Standards, and Guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence.

### Applicable Design Criteria

#### Projected Tidal Datums: APPLICABLE

Planning Horizon	MHHW	MHW	MTL	MLW	MLLW
	(ft - NAVD88)				
2050	3.7	3.4	2.6	1.9	1.7
2070	5.6	5.3	4.5	3.6	3.5

#### Projected Water Surface Elevation: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period	Max	Min	Area Weighted Average
			(ft - NAVD88)		
TASA Lift Stations	2050	0.5% (200-Year)	14.8	13.1	13.9
	2070		16.9	15.0	15.8

#### Projected Wave Action Water Elevation: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period	Max	Min	Area Weighted Average
			(ft - NAVD88)		
TASA Lift Stations	2050	0.5% (200-Year)	24.5	13.4	15.7
	2070		26.7	15.5	18.0

#### Projected Wave Heights: APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period	Max	Min	Area Weighted Average
			(Feet)		
TASA Lift Stations	2050	0.5% (200-Year)	15.5	0.0	5.1
	2070		16.5	0.0	5.4

**ATTENTION:** This project intersects areas influenced by wave overtopping based flooding. These areas are where flooding is caused by intermittent pulses that come from wave run-up and overtopping at a coastal structure. Additional site analyses are recommended to establish design values associated with design criteria.

#### Projected Duration of Flooding: APPLICABLE

[Methodology to Estimate Projected Values](#)

#### Projected Design Flood Velocity: APPLICABLE

[Methodology to Estimate Projected Values](#)

**Extreme Precipitation**

High Risk

Target Planning Horizon: 2070  
 Return Period: 50-yr (2%)

**LIMITATIONS:** The recommended Standards for Total Precipitation Depth & Peak Intensity are determined by the user drawn polygon and relationships as defined in the Supporting Documents. The projected Total Precipitation Depth values provided through the Tool are based on the climate projections developed by Cornell University as part of EEA's Massachusetts Climate and Hydrologic Risk Project, GIS-based data as of 10/15/21. For additional information on the methodology of these precipitation outputs, see Supporting Documents.

While Total Precipitation Depth & Peak Intensity for 24-hour Design Storms are useful to inform planning and design, it is recommended to also consider additional longer- and shorter-duration precipitation events and intensities in accordance with best practices. Longer-duration, lower-intensity storms allow time for infiltration and reduce the load on infrastructure over the duration of the storm. Shorter-duration, higher-intensity storms often have higher runoff volumes because the water does not have enough time to infiltrate infrastructure systems (e.g., catch basins) and may overflow or back up during such storms, resulting in flooding. In the Northeast, short-duration high intensity rain events are becoming more frequent, and there is often little early warning for these events, making it difficult to plan operationally. While the Tool does not provide recommended design standards for these scenarios, users should still consider both short- and long-duration precipitation events and how they may impact the asset.

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**Applicable Design Criteria**

**Tiered Methodology:** Tier 3

**Projected Total Precipitation Depth & Peak Intensity for 24-hr Design Storms:** APPLICABLE

Asset Name	Recommended Planning Horizon	Recommended Return Period (Design Storm)	Projected 24-hr Total Precipitation Depth (inches)	Step-by-Step Methodology for Peak Intensity
TASA Lift Stations	2070	50-Year (2%)	8.8	<a href="#">Downloadable Methodology PDF</a>

**Projected Riverine Peak Discharge & Peak Flood Elevation:** APPLICABLE

[Methodology to Estimate Projected Values](#) : Tier 3

**Extreme Heat**

High Risk

Target Planning Horizon: 2070  
 Percentile: 90th Percentile

**Applicable Design Criteria**

**Tiered Methodology:** Tier 3

**Projected Annual/Summer/Winter Average Temperatures:** APPLICABLE

[Methodology to Estimate Projected Values](#) : Tier 3

**Projected Heat Index:** APPLICABLE

[Methodology to Estimate Projected Values](#) : Tier 3

**Projected Growing Degree Days:** NOT APPLICABLE

**Projected Days Per Year With Max Temp > 95°F, >90°F, <32°F:** APPLICABLE

[Methodology to Estimate Projected Values](#) : Tier 3

**Projected Number of Heat Waves Per Year & Average Heat Wave Duration:** APPLICABLE

[Methodology to Estimate Projected Values](#) : Tier 3

**Projected Cooling Degree Days & Heating Degree Days (base = 65°F):** APPLICABLE

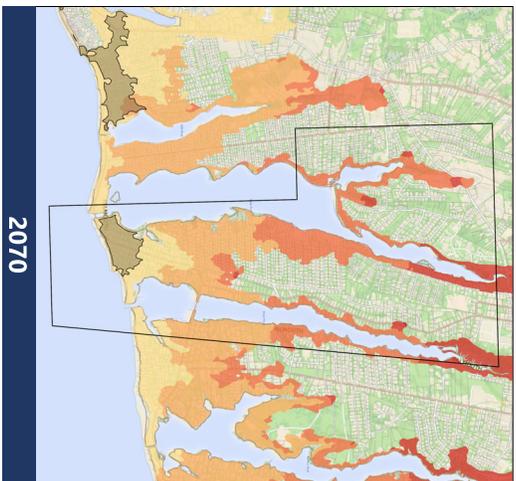
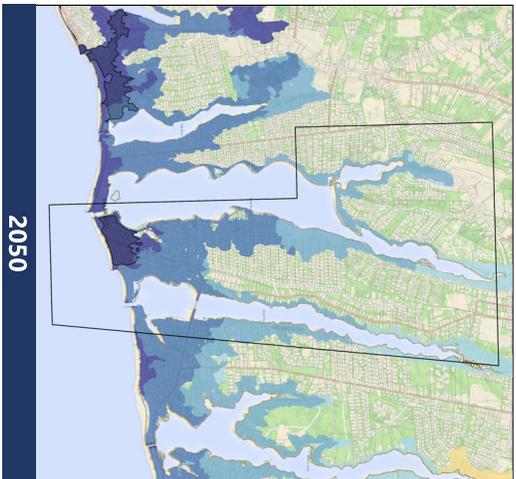
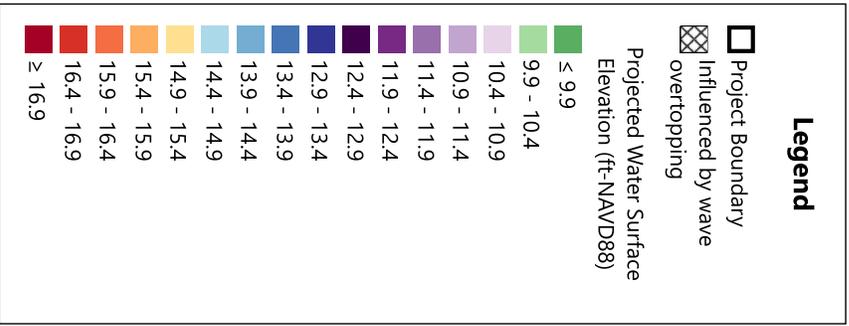
[Methodology to Estimate Projected Values](#) : Tier 3

## Sea Level Rise/Storm Surge Project Maps

The following three maps illustrate the Projected Water Surface Elevation for the 2030, 2050, and 2070 planning horizons corresponding to the lowest return period (largest design storm) recommended across the assets identified for this project in the Tool. For projects that only have Natural Resource assets, the maps will show the Projected Water Surface Elevations corresponding to the 5% (20-year) return period. Refer to the Climate Resilience Design Standards Output - Sea Level Rise/Storm Surge Section for additional values associated with other assets. The maps include the project area as drawn by the user with a 0.1 mile minimum buffer, but do not reflect the location of specific assets on the site.

**LIMITATIONS:** The recommended Climate Resilience Design Standards for the Sea Level Rise / Storm Surge Design Criteria are based on the user drawn polygon and relationships as defined in the Supporting Documents. The projected values and maps provided through the Tool are based on the Massachusetts Coast Flood Risk Model (MC-FRM) outputs as of 9/13/2021, which included GIS-based data for three planning horizons (2030, 2050, 2070) and six return periods (0.1%, 0.2%, 0.5%, 1%, 2%, 5%). These values are projections based on assumptions as defined in the model and the LiDAR used at the time. For additional information on the MC-FRM, review the additional resources provided on the Start Here page.

The projected values, maps, Standards, and Guidance provided within this Tool may be used to inform plans and designs, but they do not provide guarantees for future conditions or resilience. The projected values are not to be considered final or appropriate for construction documents without supporting engineering analyses. The guidance provided within this Tool is intended to be general and users are encouraged to do their own due diligence.



**Climate Resilience Design Standards Tool:  
Sea Level Rise/Storm Surge Design Criteria  
Projected Water Surface Elevation Map: 0.5% (200-yr)**

Project Name: Falmouth Great Pond TWMP  
Location (Town): Falmouth

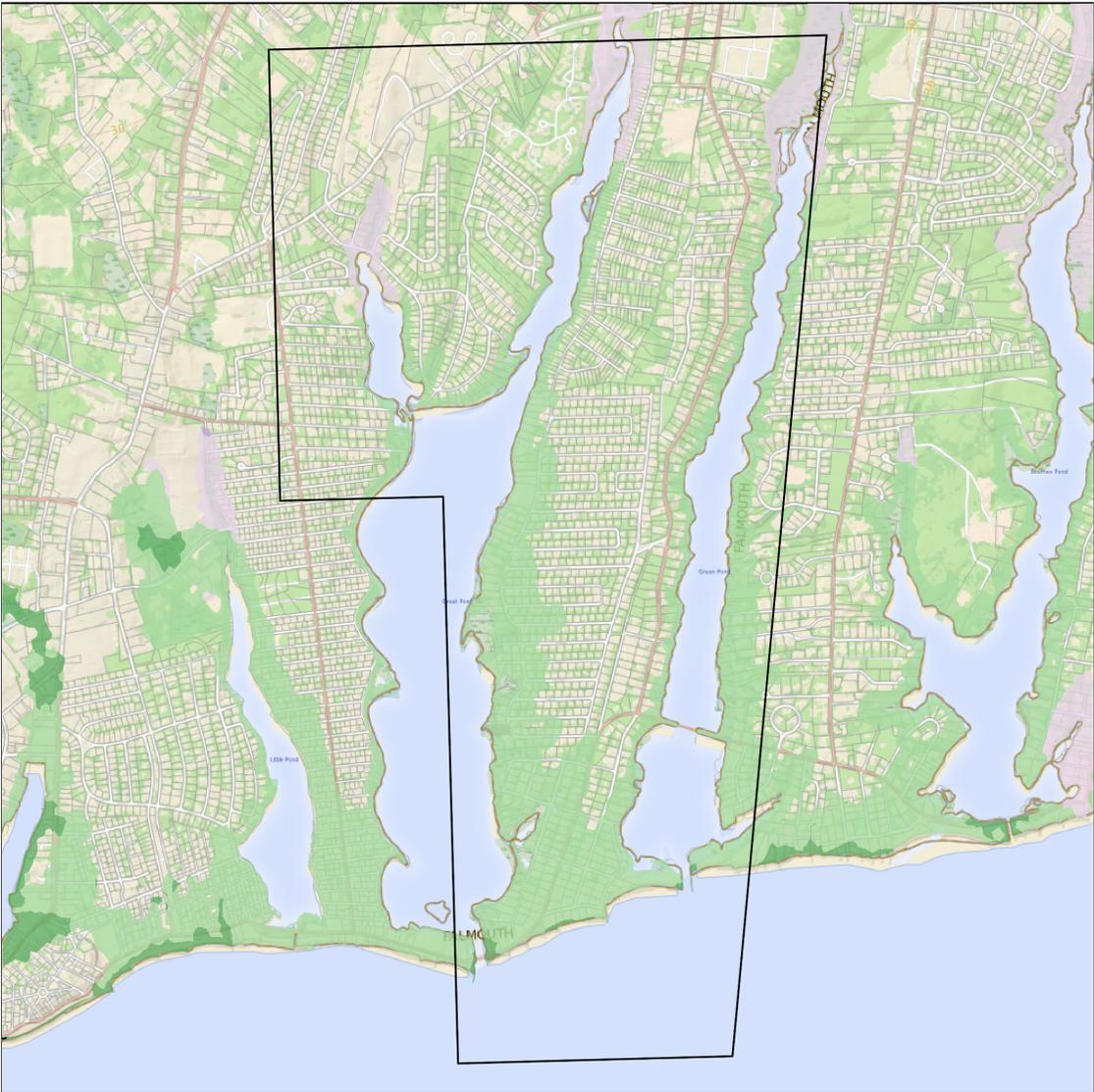
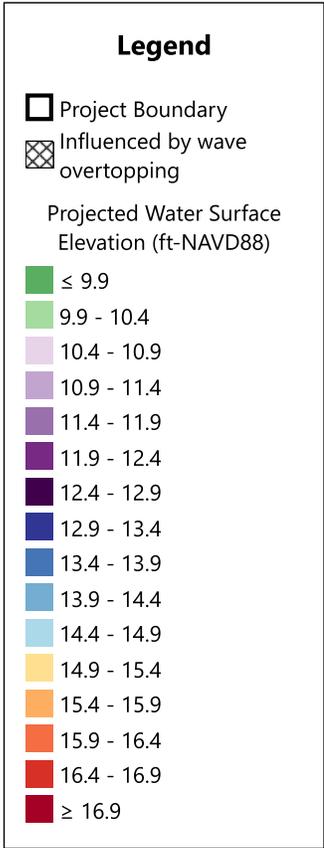


Created by: GHDHyannis  
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Asset Name	Planning Horizon	Return Period	Max/Min Area Weighted Average (ft-NAVD88)	
			Max	Min
TASA Lift Stations	2030	0.5% (200-yr)	10.6	9.9
	2050	0.5% (200-yr)	14.8	13.1
	2070	0.5% (200-yr)	16.9	15.0

**ATTENTION: This project intersects areas influenced by wave overtopping based flooding. These areas are where flooding is caused by intermittent pulses that come from wave run-up and overtopping at a coastal structure. Additional site analyses are recommended to establish design values associated with design criteria.**



**Climate Resilience Design Standards Tool:  
Sea Level Rise/Storm Surge Design Criteria  
Projected Water Surface Elevation Map: 2030, 0.5% (200-yr)**

Project Name: Falmouth Great Pond TWMP  
Location (Town): Falmouth

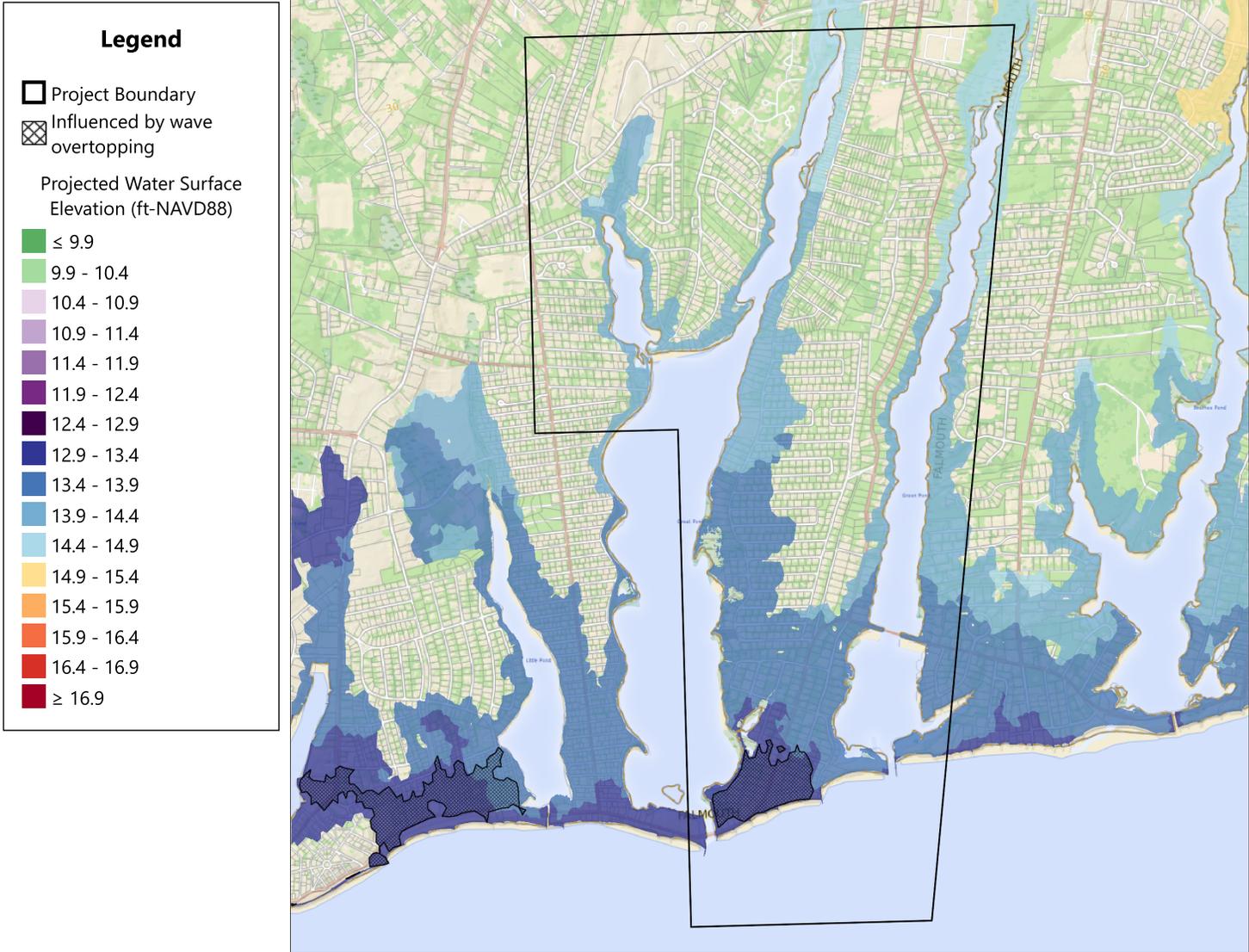


Created by: GHDHyannis  
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Asset Name	Planning Horizon	Return Period	Max	Min	Area Weighted Average (ft-NAVD88)
TASA Lift Stations	2030	0.5% (200-yr)	10.6	9.9	10.2

**ATTENTION: This project intersects areas influenced by wave overtopping based flooding. These areas are where flooding is caused by intermittent pulses that come from wave run-up and overtopping at a coastal structure. Additional site analyses are recommended to establish design values associated with design criteria.**



**Climate Resilience Design Standards Tool:  
Sea Level Rise/Storm Surge Design Criteria  
Projected Water Surface Elevation Map: 2050, 0.5% (200-yr)**

Project Name: Falmouth Great Pond TWMP  
Location (Town): Falmouth

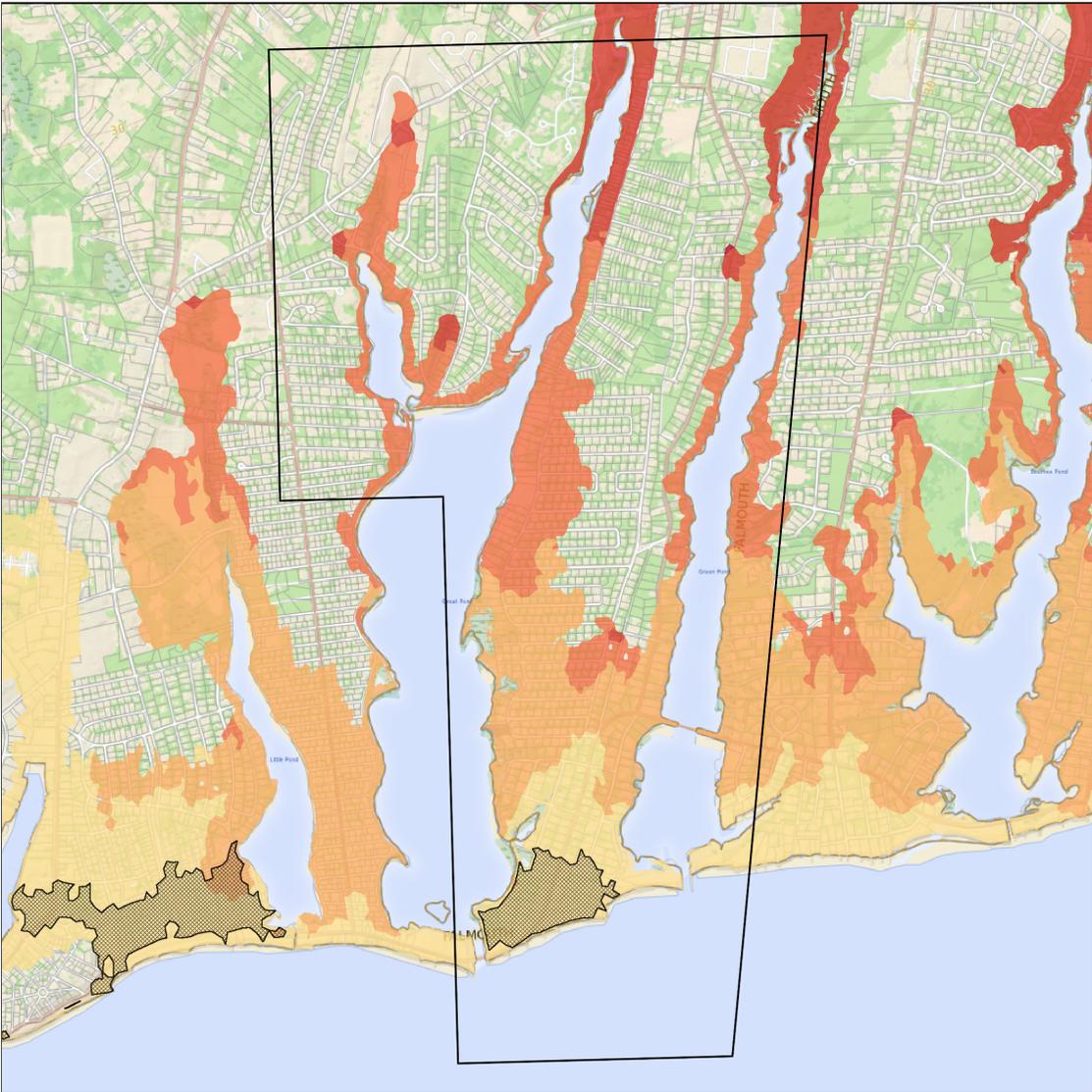
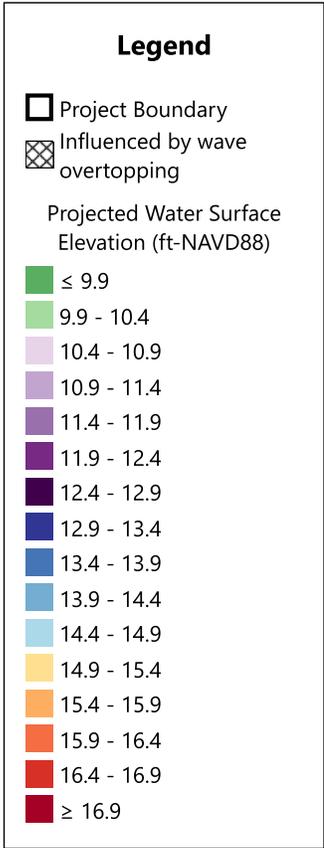


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Asset Name	Planning Horizon	Return Period	Max	Min	Area Weighted Average
			(ft-NAVD88)		
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**Climate Resilience Design Standards Tool:  
Sea Level Rise/Storm Surge Design Criteria  
Projected Water Surface Elevation Map: 2070, 0.5% (200-yr)**

Project Name: Falmouth Great Pond TWMP  
Location (Town): Falmouth



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Asset Name	Planning Horizon	Return Period	Max	Min	Area Weighted Average
			(ft-NAVD88)		
TASA Lift Stations	2070	0.5% (200-yr)	16.9	15.0	15.8

**ATTENTION: This project intersects areas influenced by wave overtopping based flooding. These areas are where flooding is caused by intermittent pulses that come from wave run-up and overtopping at a coastal structure. Additional site analyses are recommended to establish design values associated with design criteria.**

## Project Inputs

### Core Project Information

Name:	Falmouth Great Pond TWMP
Given the expected useful life of the project, through what year do you estimate the project to last (i.e. before a major reconstruction/renovation)?	2075
Location of Project:	Falmouth
Estimated Capital Cost:	\$114,700,000
Who is the Submitting Entity?	City/Town Falmouth Anastasia Rudenko (anastasia.rudenko@ghd.com)
Is this project identified as a priority project in the Municipal Vulnerability Preparedness (MVP) plan or the local or regional Hazard Mitigation Plan (HMP)?	No
Is this project being submitted as part of a state grant application?	No
Which grant program?	
What stage are you in your project lifecycle?	Planning
Is climate resiliency a core objective of this project?	Yes
Is this project being submitted as part of the state capital planning process?	No
Is this project being submitted as part of a regulatory review process or permitting?	Yes
Brief Project Description:	Project is included in the Great Pond TWMP, which is undergoing MEPA review.
Project Submission Comments:	

### Project Ecosystem Service Benefits

#### Factors Influencing Output

- ✓ This is an ecological restoration project
- ✓ Project protects public water supply
- ✓ Project recharges groundwater
- ✓ Project improves water quality
- ✓ Project protects land containing shellfish
- ✓ Project remediates existing sources of pollution
- ✓ Project prevents pollution

#### Factors to Improve Output

- ✓ Incorporate nature-based solutions that may provide flood protection
- ✓ Incorporate nature-based solutions that may reduce storm damage
- ✓ Incorporate strategies that reduce carbon emissions
- ✓ Incorporate green infrastructure to filter stormwater
- ✓ Incorporate nature-based solutions that sequester carbon carbon
- ✓ Increase biodiversity, protect critical habitat for species, manage invasive populations, and/or provide connectivity to other habitats
- ✓ Incorporate vegetation that provides pollinator habitat
- ✓ Provide opportunities for passive and/or active recreation through open space
- ✓ Increase plants, trees, and/or other vegetation to provide oxygen production
- ✓ Mitigate atmospheric greenhouse gas concentrations and other toxic air pollutants through nature-based solutions
- ✓ Incorporate education and/or protect cultural resources as part of your project

#### Is the primary purpose of this project ecological restoration?

Yes

#### Project Benefits

Provides flood protection through nature-based solutions	Maybe
Reduces storm damage	Maybe
Recharges groundwater	Yes
Protects public water supply	Yes
Filters stormwater using green infrastructure	Maybe
Improves water quality	Yes
Promotes decarbonization	Maybe
Enables carbon sequestration	Maybe
Provides oxygen production	Maybe
Improves air quality	Maybe
Prevents pollution	Yes
Remediates existing sources of pollution	Yes
Protects fisheries, wildlife, and plant habitat	Maybe
Protects land containing shellfish	Yes
Provides pollinator habitat	Maybe
Provides recreation	Maybe
Provides cultural resources/education	Maybe

### Project Climate Exposure

Is the primary purpose of this project ecological restoration?	Yes
Does the project site have a history of coastal flooding?	Unsure
Does the project site have a history of flooding during extreme precipitation events (unrelated to water/sewer damages)?	Unsure
Does the project site have a history of riverine flooding?	Unsure
Does the project result in a net increase in impervious area of the site?	Unsure
Are existing trees being removed as part of the proposed project?	Unsure

### Project Assets

Asset: TASA Lift Stations  
 Asset Type: Typically Unoccupied  
 Asset Sub-Type: Pump Station - Sanitary  
 Construction Type: New Construction  
 Construction Year: 2025  
 Useful Life: 50

**Identify the length of time the asset can be inaccessible/inoperable without significant consequences.**

Building must be accessible/operable at all times, even during natural hazard event

**Identify the geographic area directly affected by permanent loss or significant inoperability of the building/facility.**

Impacts would be limited to local area and/or municipality

**Identify the population directly served that would be affected by the permanent loss of use or inoperability of the building/facility.**

Less than 10,000 people

**Identify if the building/facility provides services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.**

The building/facility does not provide services to populations that reside within Environmental Justice neighborhoods or climate vulnerable populations.

**If the building/facility became inoperable for longer than acceptable in Question 1, how, if at all, would it be expected to impact people's health and safety?**

Inoperability of the building/facility would be expected to result in minor impacts to people's health, including minor injuries or minor impacts to chronic illnesses

**If there are hazardous materials in your building/facility, what are the extent of impacts related to spills/releases of these materials?**

Spills and/or releases of hazardous materials are expected with difficult remediation and pose a severe threat to public health or safety (E.g. wastewater treatment plant; biohazard laboratory)

**If the building/facility became inoperable for longer than acceptable in Question 1, what are the impacts on other facilities, assets, and/or infrastructure?**

Significant – Inoperability is likely to impact other facilities, assets, or buildings and will likely affect their ability to operate

**If this building/facility was damaged beyond repair, how much would it approximately cost to replace?**

Less than \$10 million

**Is this a recreational facility which can be vacated during a natural hazard event?**

No

**If the building/facility became inoperable for longer than acceptable in Question 1, what are the public and/or social services impacts?**

Few alternative programs and/or services are available to support the community

**If the building/facility became inoperable for longer than acceptable in Question 1, what are the environmental impacts related to natural resources?**

Impact on natural resources will require remediation/rehabilitation

**If the building/facility became inoperable for longer than acceptable in Question 1, what are the impacts to government services (i.e. the building is not able to serve or operate its intended users or function)?**

Loss of building is not expected to reduce the ability to maintain government services.

**If the building/facility became inoperable for longer than acceptable in Question 1, what are the impacts to loss of confidence in government (i.e. the building is not able to serve or operate its intended users or function)?**

Reduced morale and public support

### Report Comments

N/A