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# Evaluation of Mitigation Measures for Coastal Flooding in Newport, RI

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# Agenda

- Project Overview
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- Public Involvement
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Project Overview

# Historic Issues

- Historical tidal or “sunshine” flooding
- Precipitation events coinciding with high tide create a compound problem
- Previous measures not 100% effective – example, tide gates at 2nd & 3rd Streets installed in November 2011
- Sea level rise and more intense and frequent storms are already being experienced….there is more projected to come

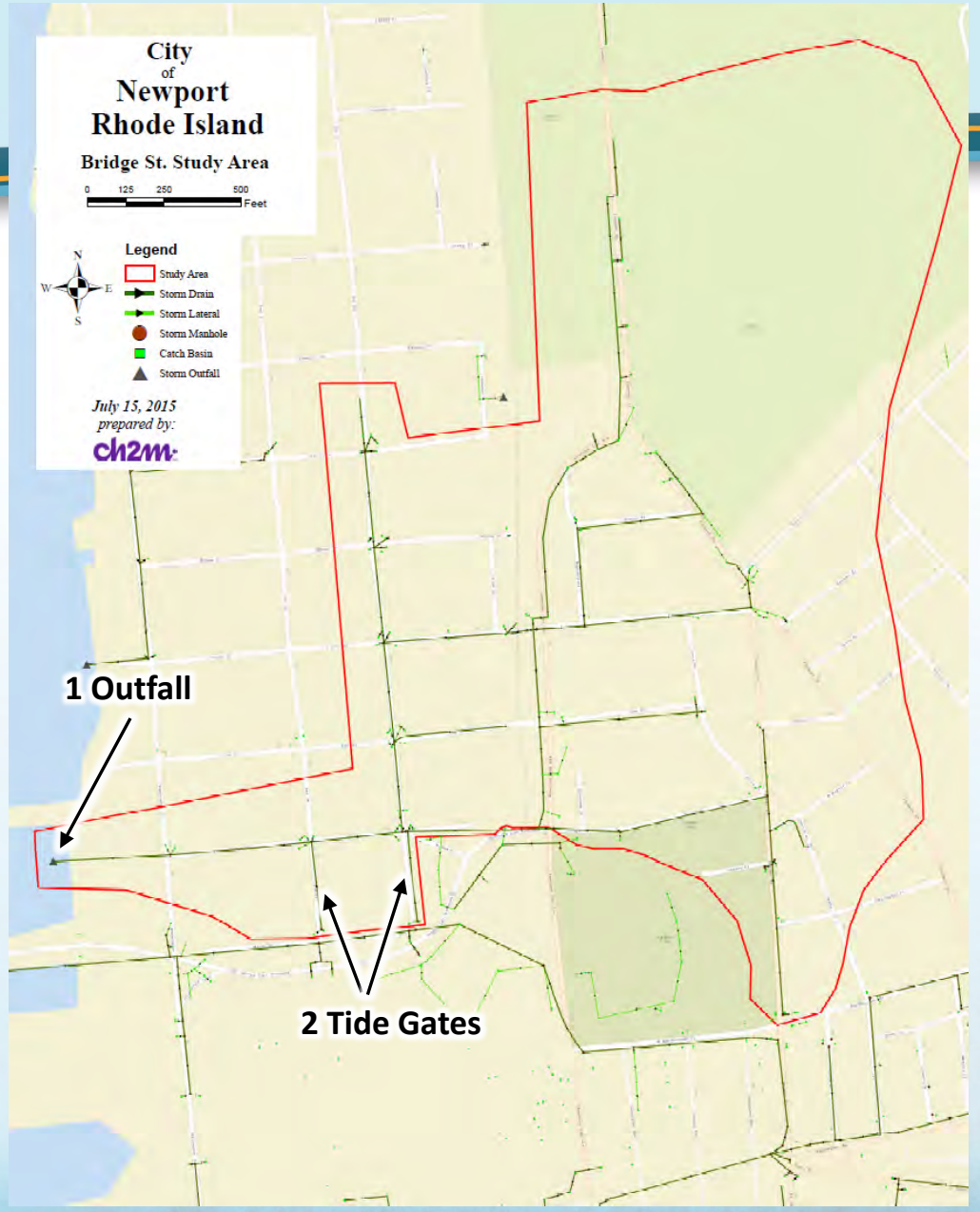
Tidal flooding at Wellington Avenue in 2011

Tidal flooding compounded by precipitation along 2nd Street in 2011

Project Overview

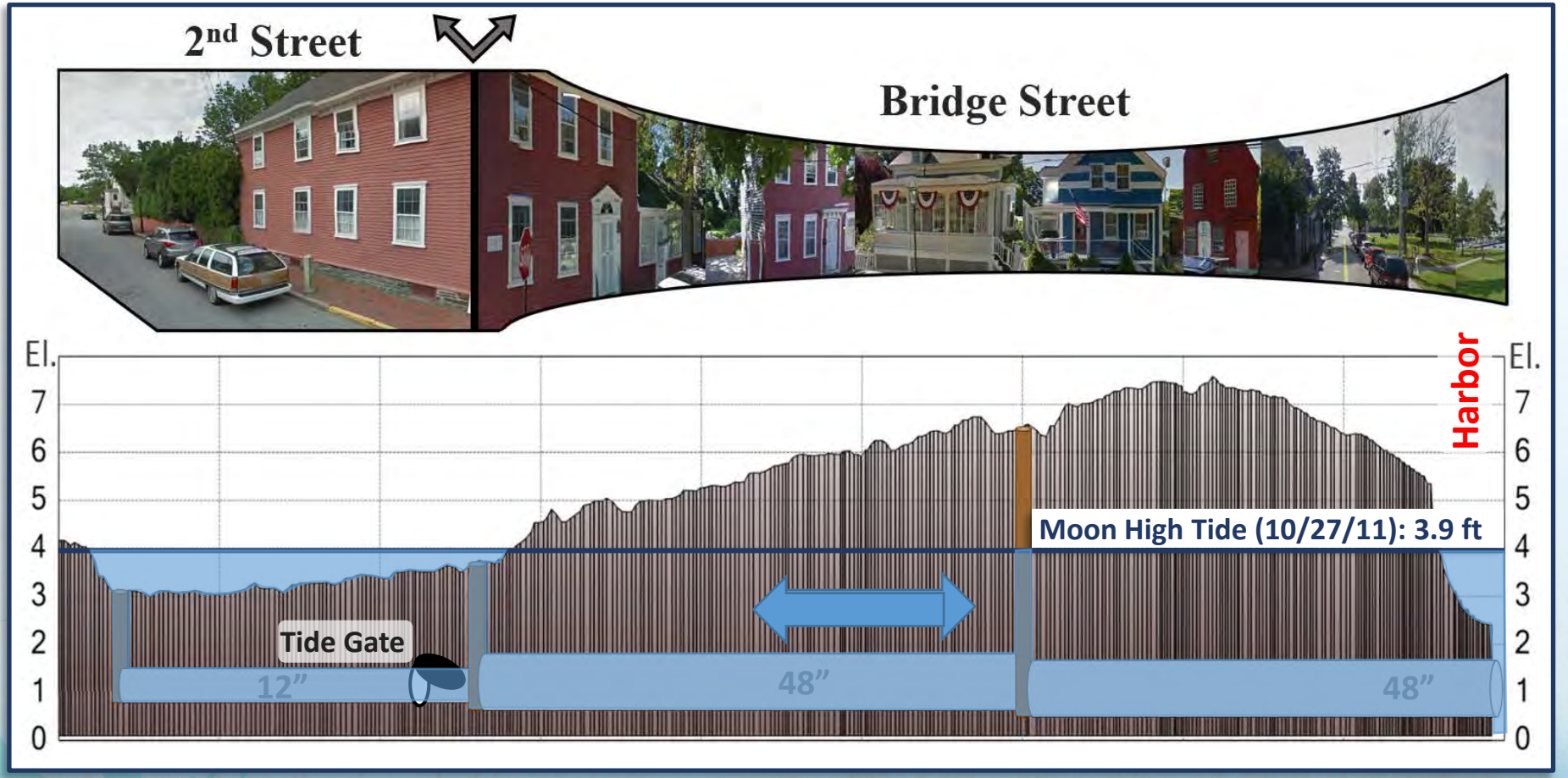
# Bridge Street Study Area

- Root Causes of Flooding
  - » Precipitation events
  - » Extreme high tides
  - » Storm surge
  - » Sea level rise
  - » Combinations of above
- Infrastructure
  - » Storm drain outfall to harbor
  - » Tide gates
- Impacts
  - » Residential zone flooding
  - » Street flooding and access issues
  - » Basement flooding



Project Overview

# Causes of Flooding

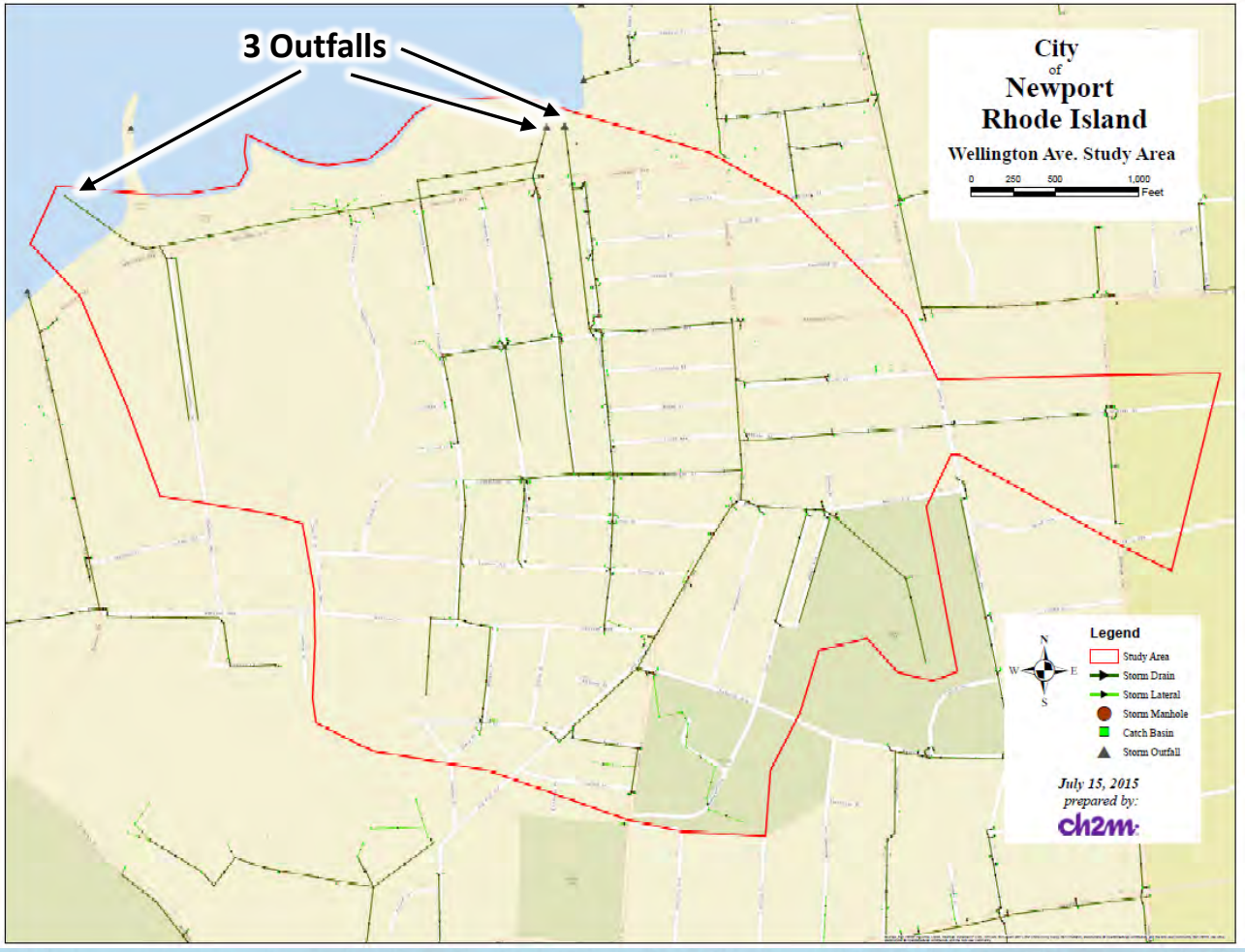




All elevations in NAVD 88

Project Overview

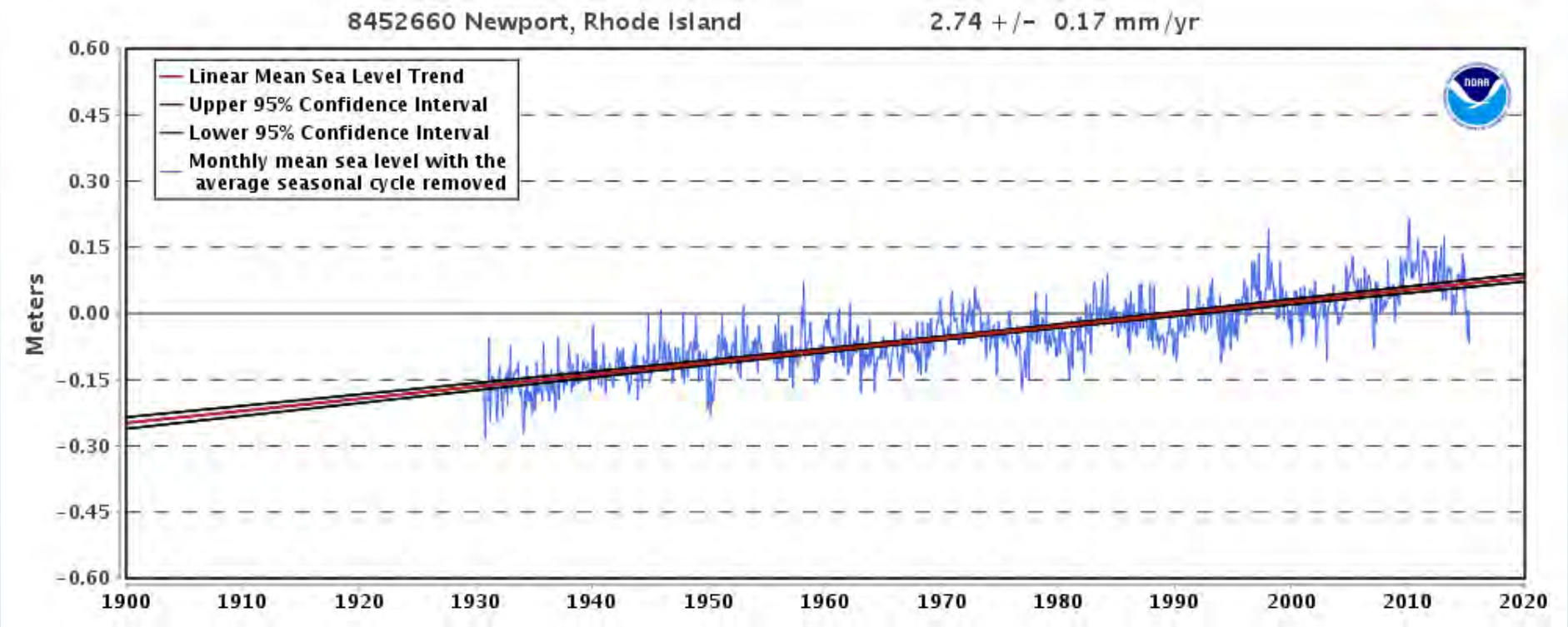
# Wellington Avenue Study Area

- Root Causes of Flooding
  - » Extreme high tides
  - » Storm surge
  - » Sea level rise
  - » Precipitation events
  - » Combinations of above
- Infrastructure
  - » Existing storm drain outfalls to harbor
  - » No tide gates
- Impacts
  - » Frequent traffic rerouting
  - » Access restrictions to public facilities
  - » Basement flooding



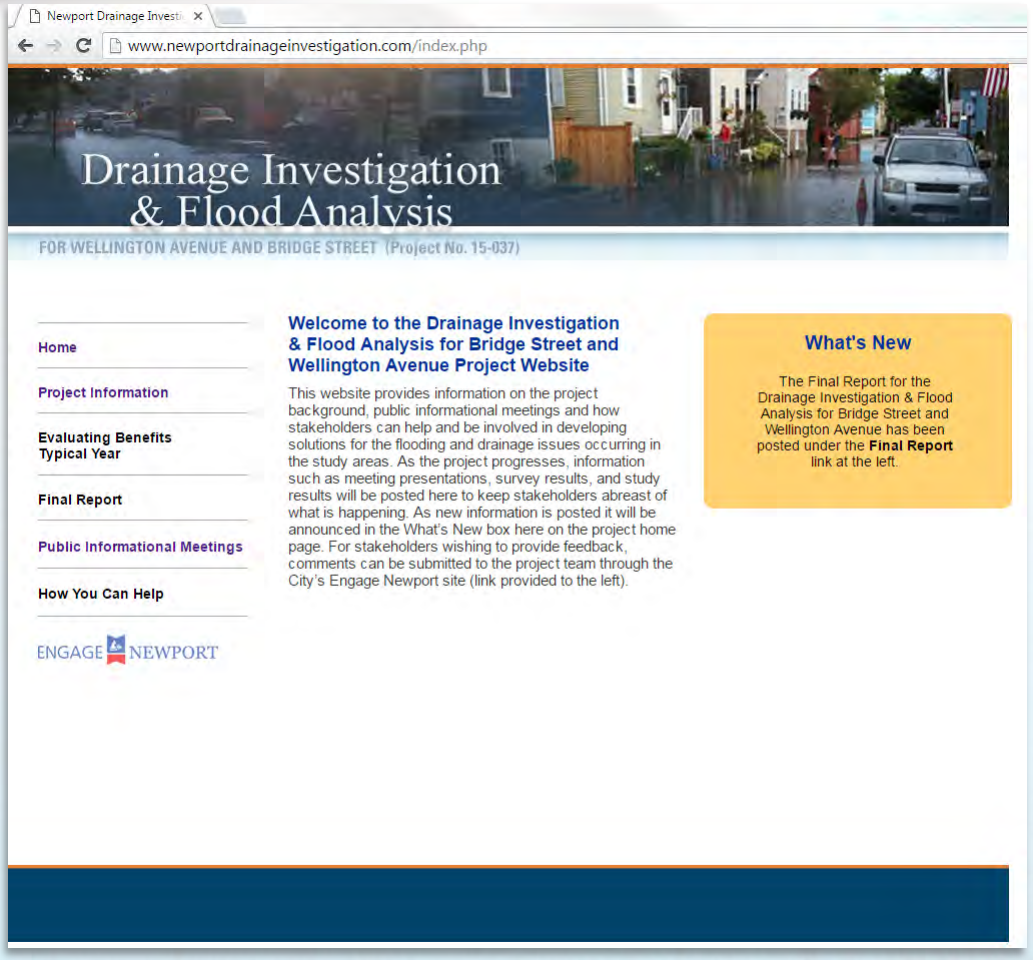
# Sea Level Trends

Historic sea level rise is 0.1 inch/year



# Public Involvement

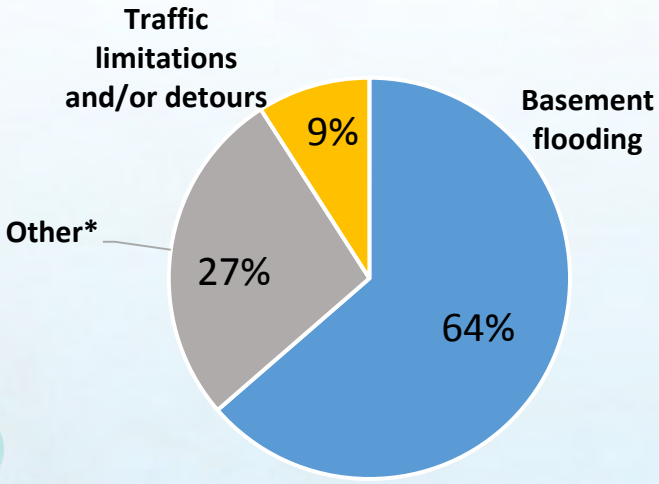
- Website keeps the public informed
- Surveys used to identify the public's concerns
- Workshops used to present findings and discuss benefits



# Survey Results

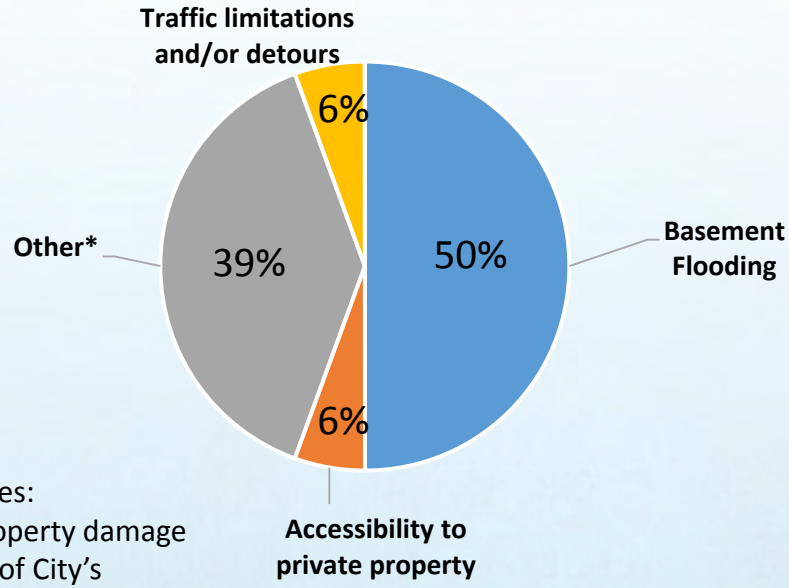
Which best describes your greatest concern with regards to drainage and flooding issues in your area?

## Wellington Avenue




*Other Includes:
- Overall property flooding
- Water damage caused by cars driving through street flooding

## Bridge Street

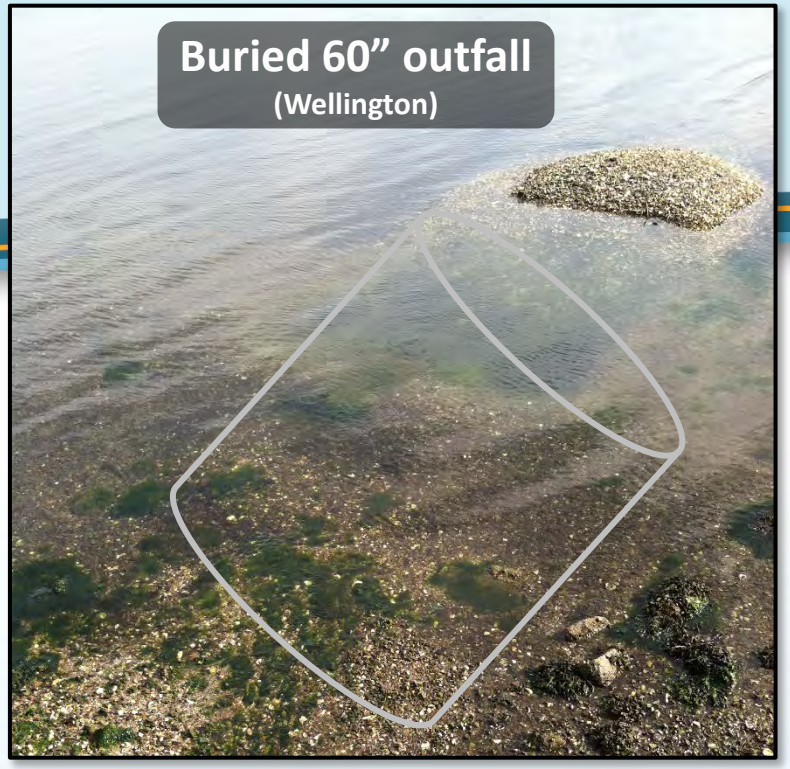



*Other includes:
- Private property damage
- Condition of City's infrastructure
- Management of City's infrastructure relating to sea level rise

Modeling

# Confirmation Surveys

- 80+ drainage manholes inspected
- Major connectivity in GIS is correct
- Both study areas heavily influenced by the tide
- 2nd St. and 3rd St. tide gates functioning but occasionally impacted by debris
- Some catch basins in need of cleaning
- 4 outfall pipes (3 Wellington, 1 Bridge) each has some sedimentation





# Confirmation Surveys

Cross-connection found between neighboring storm drain system

Modeling

# Calibration: Bridge St.

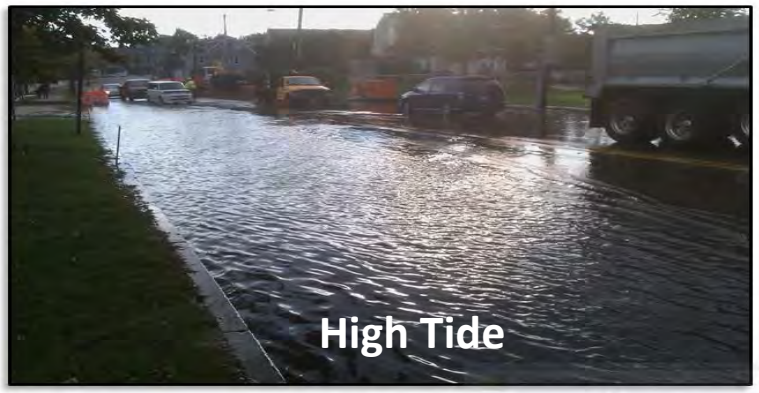
## 7/1/2015: 1.2 in of rain at high tide

Coupled SWMM with terrain model to support flood analysis

# Calibration: Wellington Ave.

## 10/7/2010: Lunar High Tide – No rain



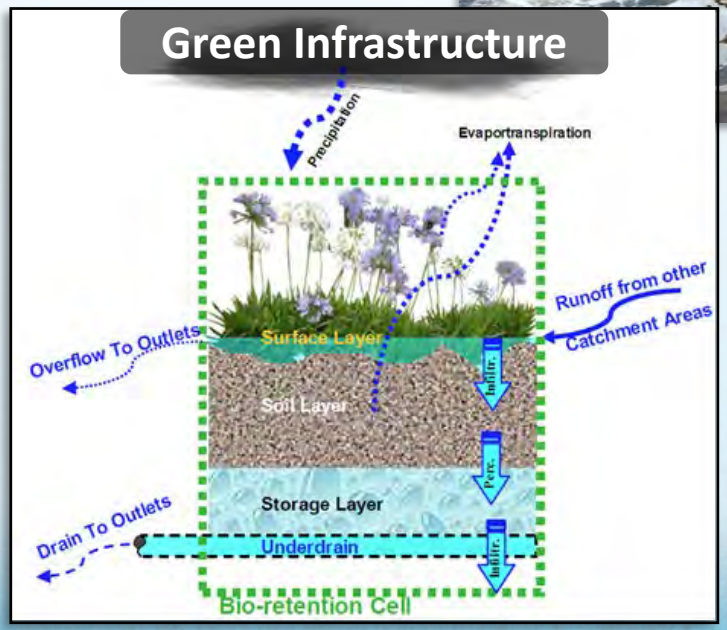


Alternatives Evaluation

# Overview

- Tide Gates
  - » Prevent sunshine flooding
  - » May prolong rain event flooding
  - » Many types
- Larger Pipes
  - » Increased conveyance
  - » Space constraints with other utilities (gas, water, etc.)
- Catch Basin Sumps
  - » Collect debris in manhole to avoid clogging pipes
- Green Infrastructure
  - » Provides storage
  - » Can increase basement flooding
- Pump Station
  - » Complete solution
  - » Expensive, large facility





# Screening

## Wellington Ave. – Sediment Removal, Rain Event at Low Tide



Datum: MLLW

# Overview

## Short-term Controls

- Key Objectives
  - » Address today's climate conditions
  - » Reduce observed/historic flooding issues
- Effectiveness
  - » Technologies with largest benefit
- Implementation Considerations
  - » Shorter Implementation Schedule
    - – Minimal technical or legal barriers
    - – 5 years to implement
    - – Capital costs ranging from $1.5M - $6M
  - » Complimentary to long-term plans

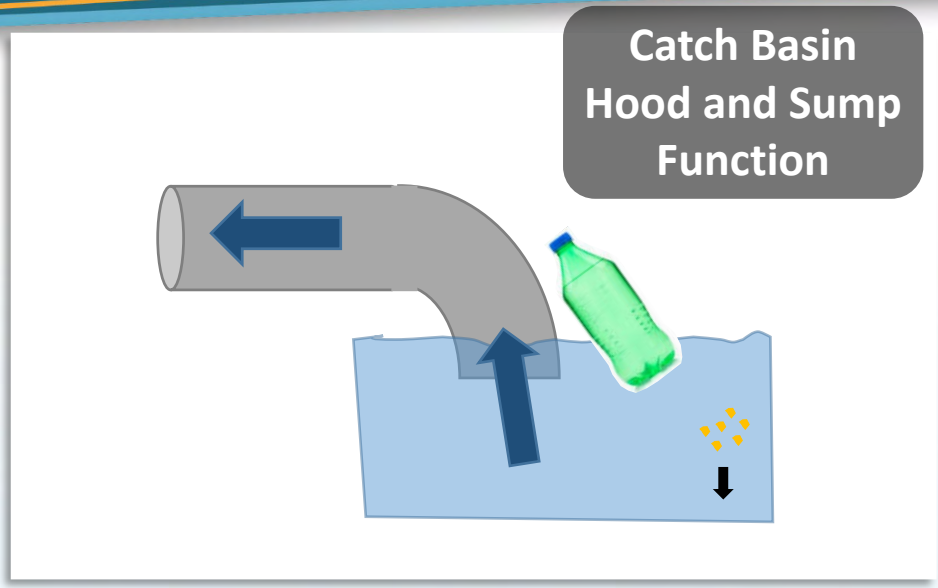
## Long-term Controls

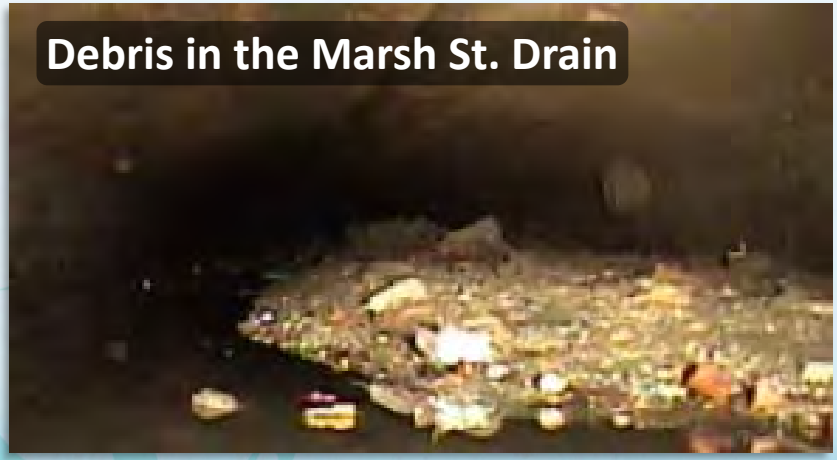
- Key Objectives
  - » Address current flooding issues not mitigated by short-term controls
    - – Large rain events at high tide
  - » Address future conditions related to climate change
    - – Sea level rise and precipitation changes
- Effectiveness
  - » Sized to handle a 5-year storm
- Implementation Considerations
  - » Controls that take longer to implement
    - – Technical and legal barriers
    - – 25 years to implement
    - – Capital costs ranging from $13M - $46M

Recommended Plan

# Short-term Controls for Bridge Street

- New tide gate
- Remove old tide gates
- Sediment removal
- Catch basin sumps and rehabilitation

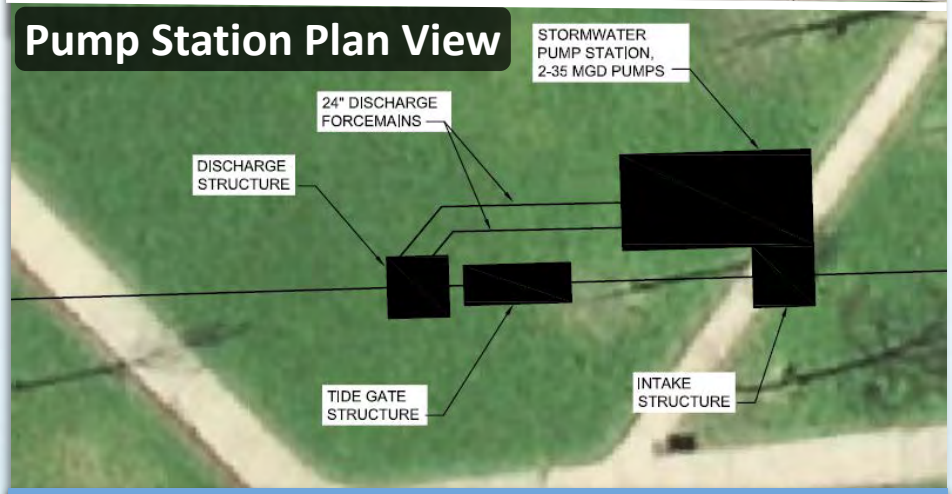



Recommended Plan

# Long-term Controls for Bridge Street

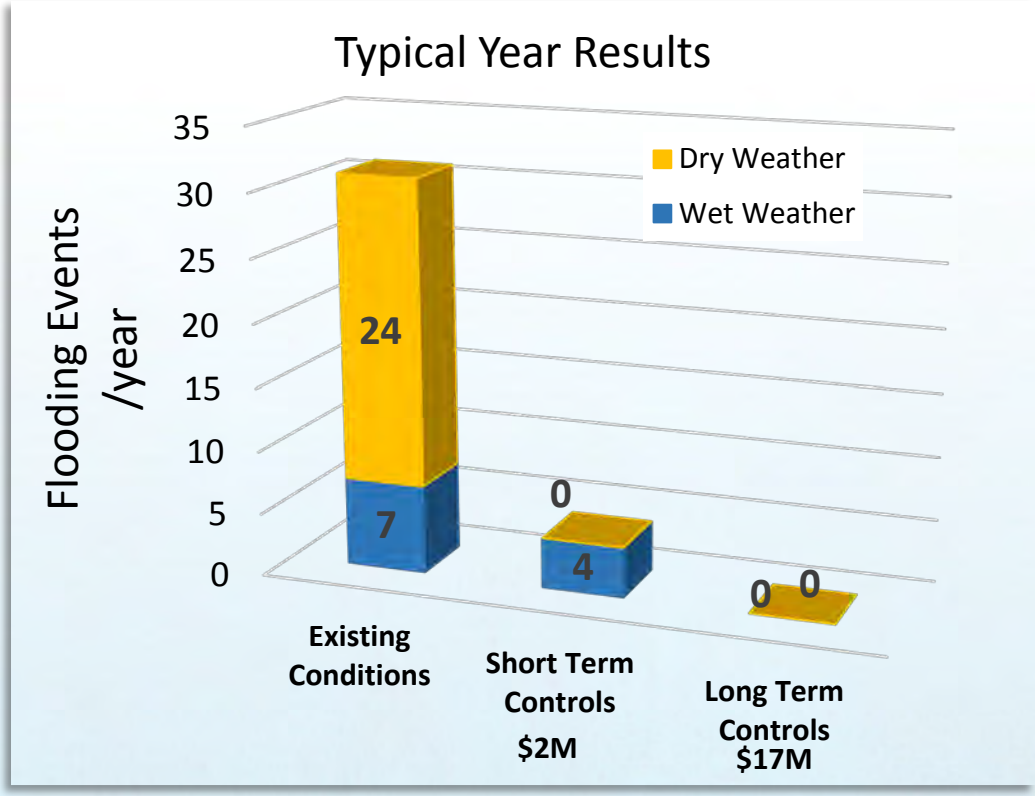
- Green infrastructure
- 35 MGD Stormwater pump station


Pumps for pump station will be located below ground.

# Flood Mitigation for Bridge Street

- Existing Conditions
  - » 1.0 million gallons/yr
  - » 32 hours flooded/yr
- Short-Term Controls
  - » 0.1 million gallons/yr
  - » 2.1 hours flooded/yr
- Long Term Controls
  - » 0 million gallons/yr
  - » 0 hours flooded/yr



# Short-term Controls for Wellington Avenue

- Tide gates
- Outfall dredging
- Sediment removal
- Catch basin sumps and rehabilitation
- Pipe system improvements



# Long-term Controls for Wellington Avenue

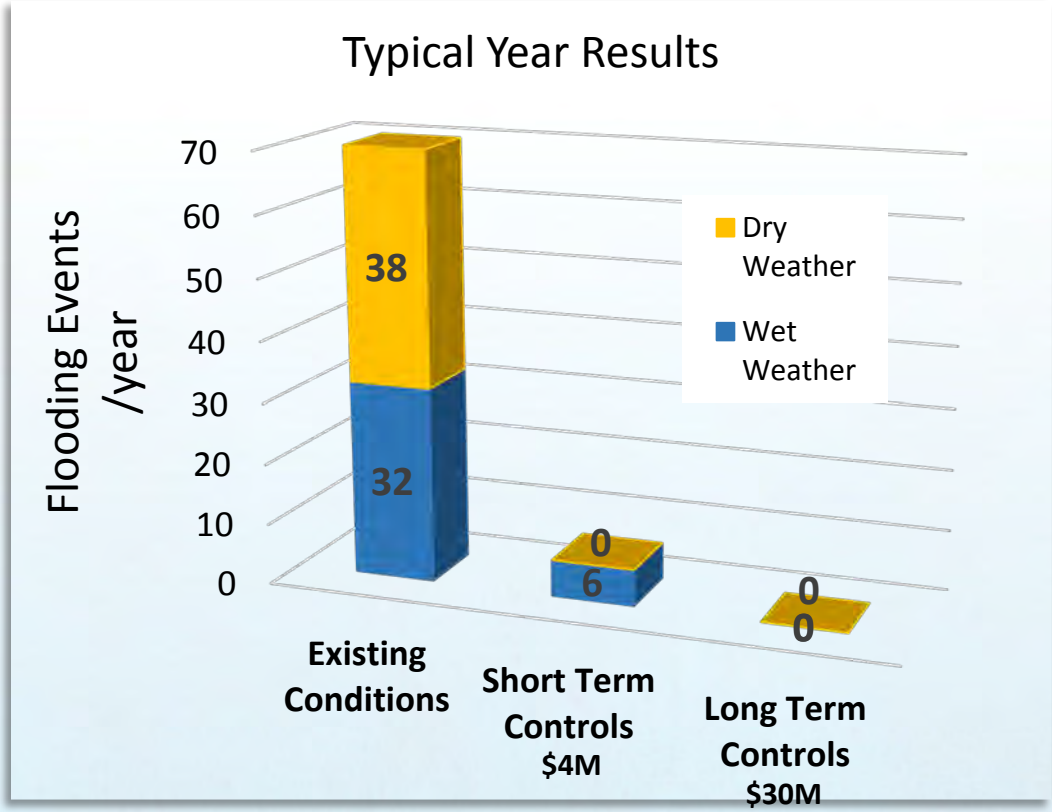
- All short-term controls
- Additional tide gate
- Green infrastructure
- 55 MGD Stormwater pump station



Pumps for pump station will be located below ground.

# Flood Mitigation for Wellington Avenue

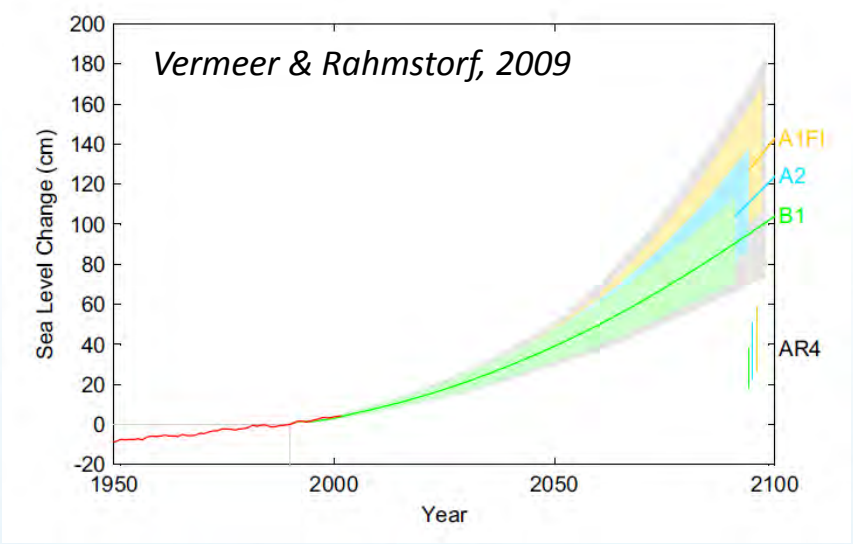
- Existing Conditions
  - » 5.8 million gallons/yr
  - » 62 hours flooded/yr
- Long-Term Controls
  - » 0 million gallons/yr
  - » 0 hours flooded/yr



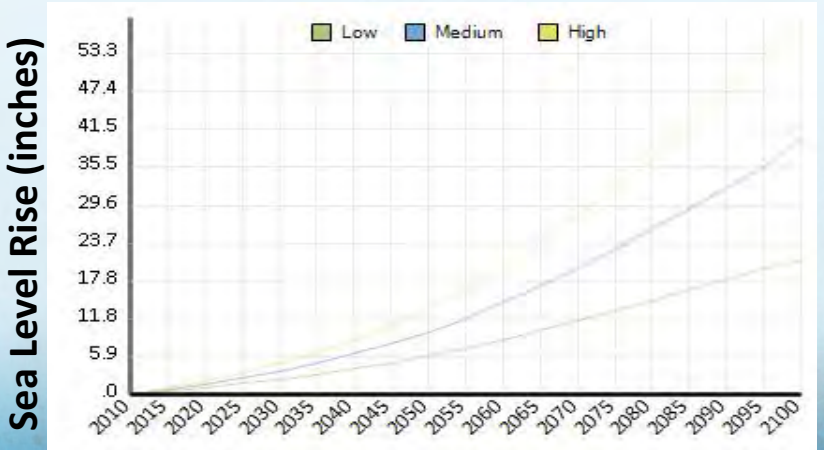
# Sea Level Projections

- 2014 US National Climate Assessment
  - » Global: 1 to 4 feet by 2100
  - » Local projections affected by subsidence and other regional factors
- RI Sea Grant for Newport:
  - » 3 to 5 feet by 2100
- US EPA CREAT 2.0
  - » Climate Resilience Evaluation & Awareness Tool for water and wastewater utilities
  - » 2 to 6 feet by 2100 at Newport

Global Sea Level Rise

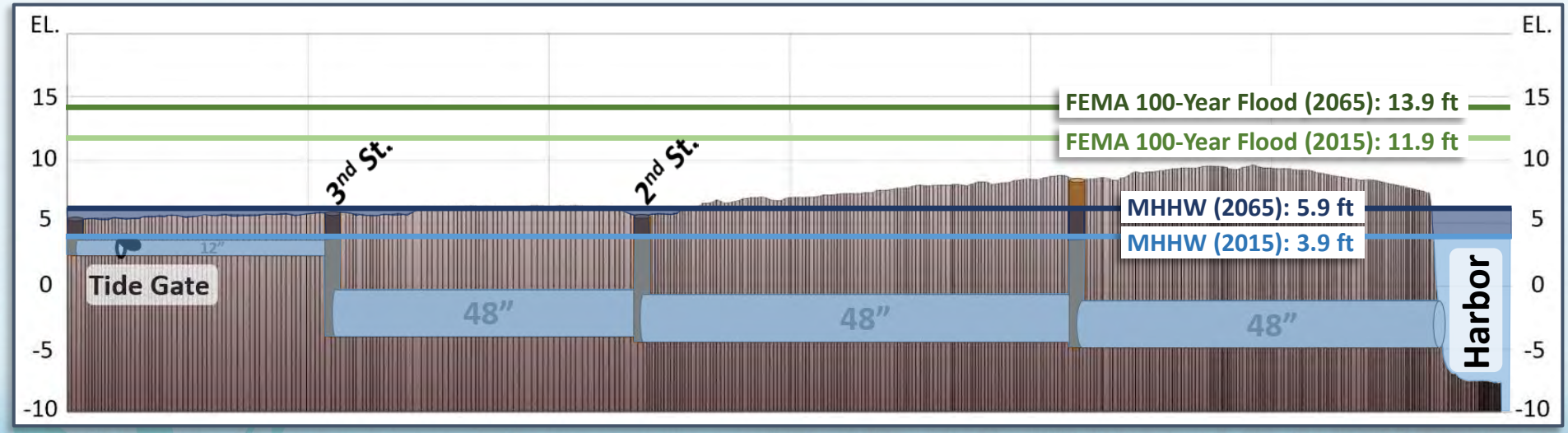



US EPA CREAT 2.0



# 100-year Flood Elevations at Bridge Street


- In 2065, higher high tides will be above some ground surfaces
- The current 100-year storm surge inundates streets over bulkheads. In 2065, the surge will be 2 feet higher



# Strategies for Addressing Effects of Climate Change

- Identify regional efforts and guidelines related to climate change.
- Define the process and considerations for planning.
- Define climate change scenarios for rainfall, sea level, storm surge and rivers.
- Evaluate sewer and storm drain system performance with climate change.
- Evaluate flooding vulnerabilities to sea level rise, storm surge and rivers.
- Develop strategies and design standards.
- Monitor changes over time and be prepared to adjust.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# Thank You