Flood Mitigation Study
Hampton, New Hampshire

Presented by

Jennifer Hale, PE and Chris Jacobs, PE, Town of Hampton

Roy Schiff, PE, PhD and Jessica Louisos, PE, MS, Milone & MacBroom, Inc.

Heidi Marshall, PE, Hoyle, Tanner & Associates, Inc.

MILONE & MACBROOM

Hoyle, Tanner & Associates, Inc.

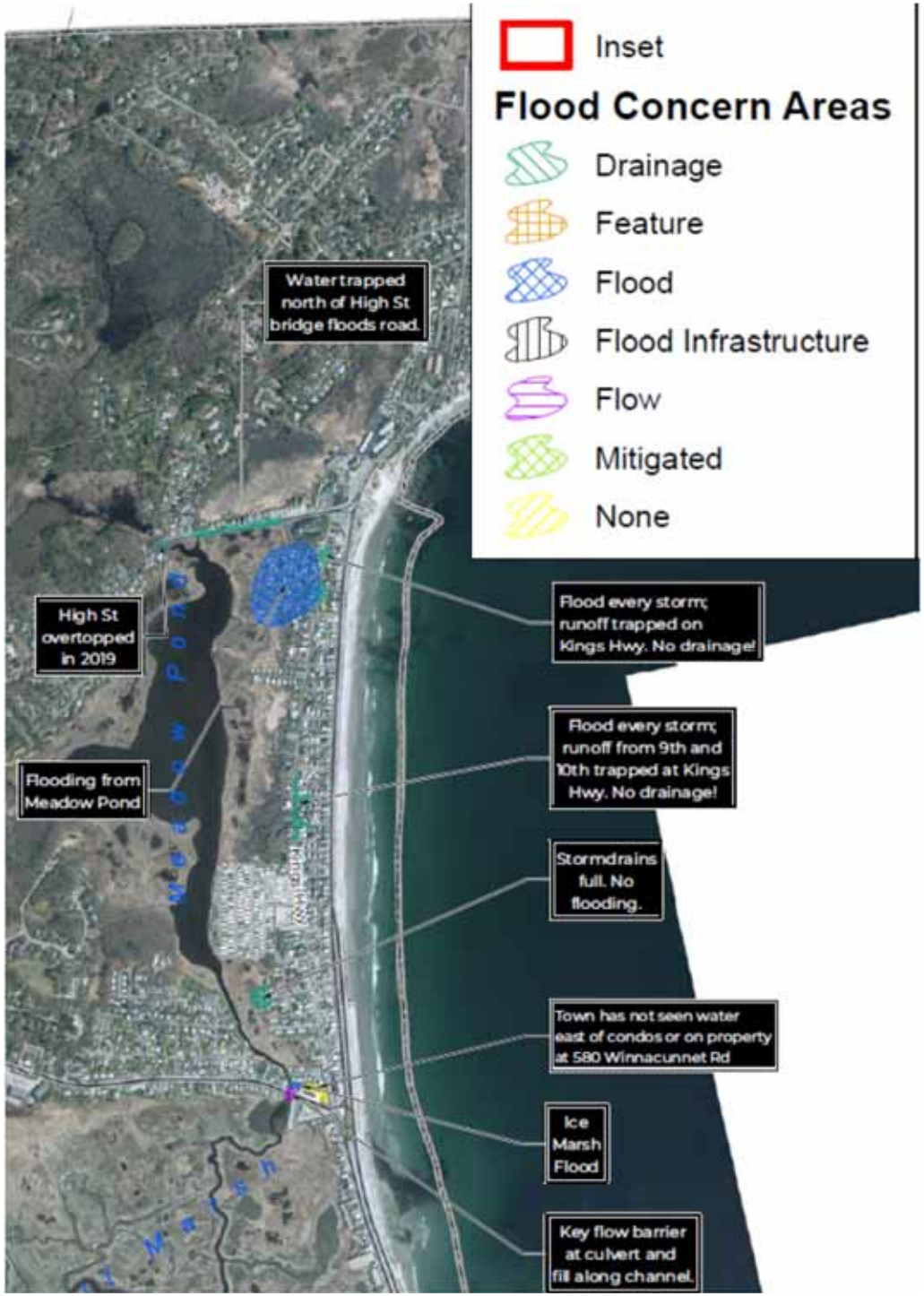
Public Meeting | September 16, 2020

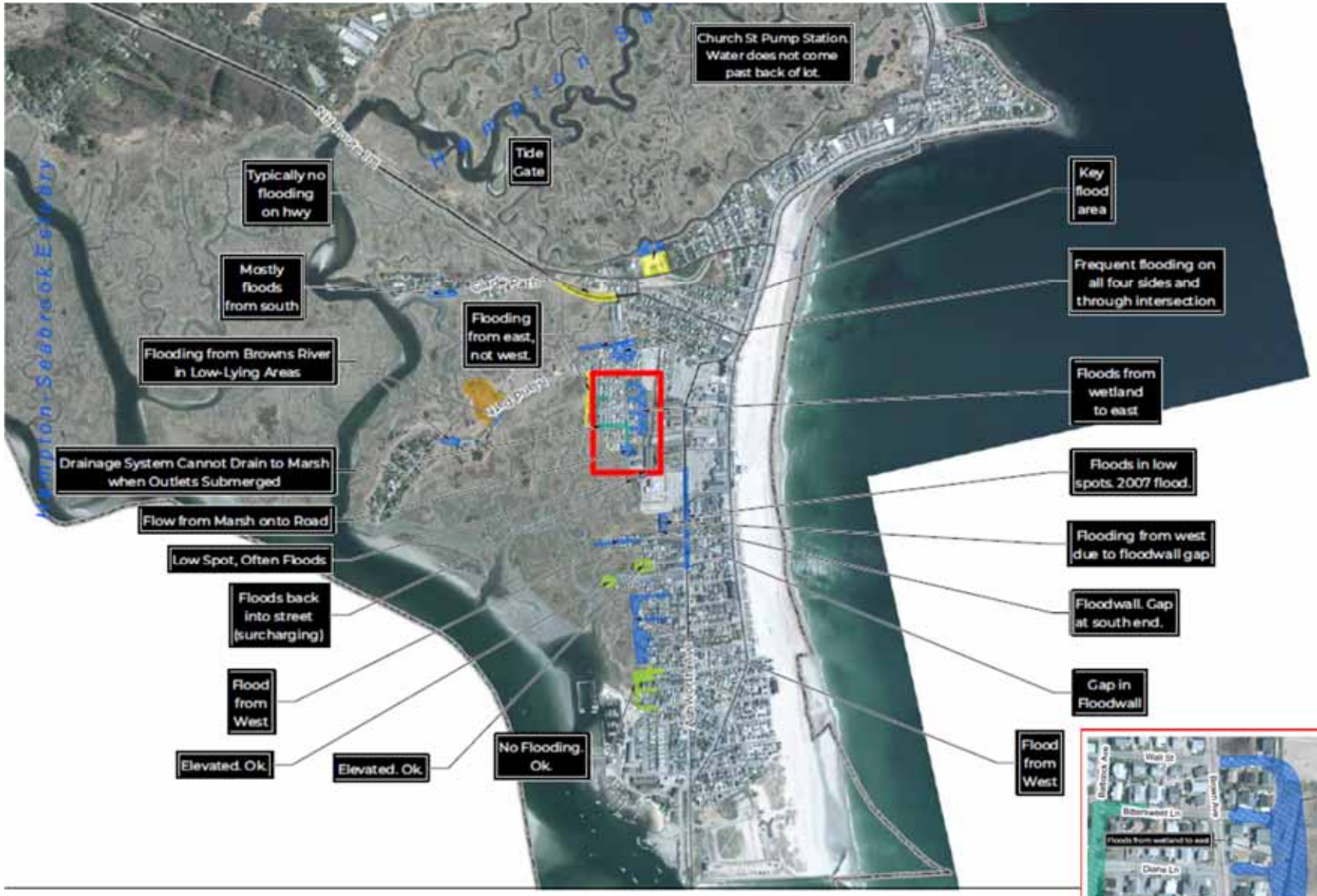
Agenda

- Introductions
- Summary of data collection
- Review of the existing conditions hydraulic model
- Alternatives analysis
- Next steps

Data Collection / Flood Concern Areas

- From town, public input, Coastal Master Planning





Flood Concern Areas

Hampton-Seabrook Estuary Flood Study

Flood Concern Areas Identified Through Public Input and Municipal Participation

0 0.05 0.1 0.2 0.3 0.4

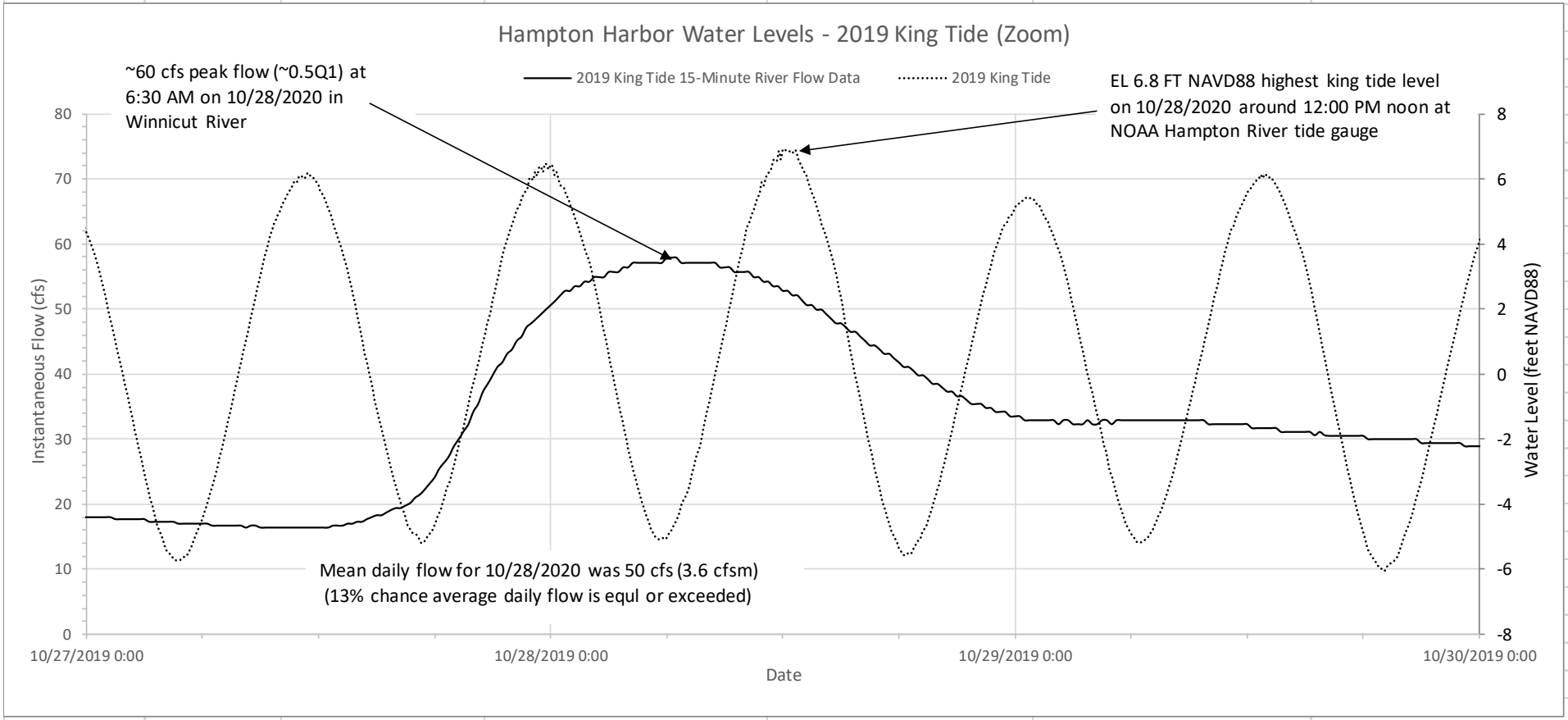
MILES

1 in = 0 miles

Data Collection / Model Setup Overview

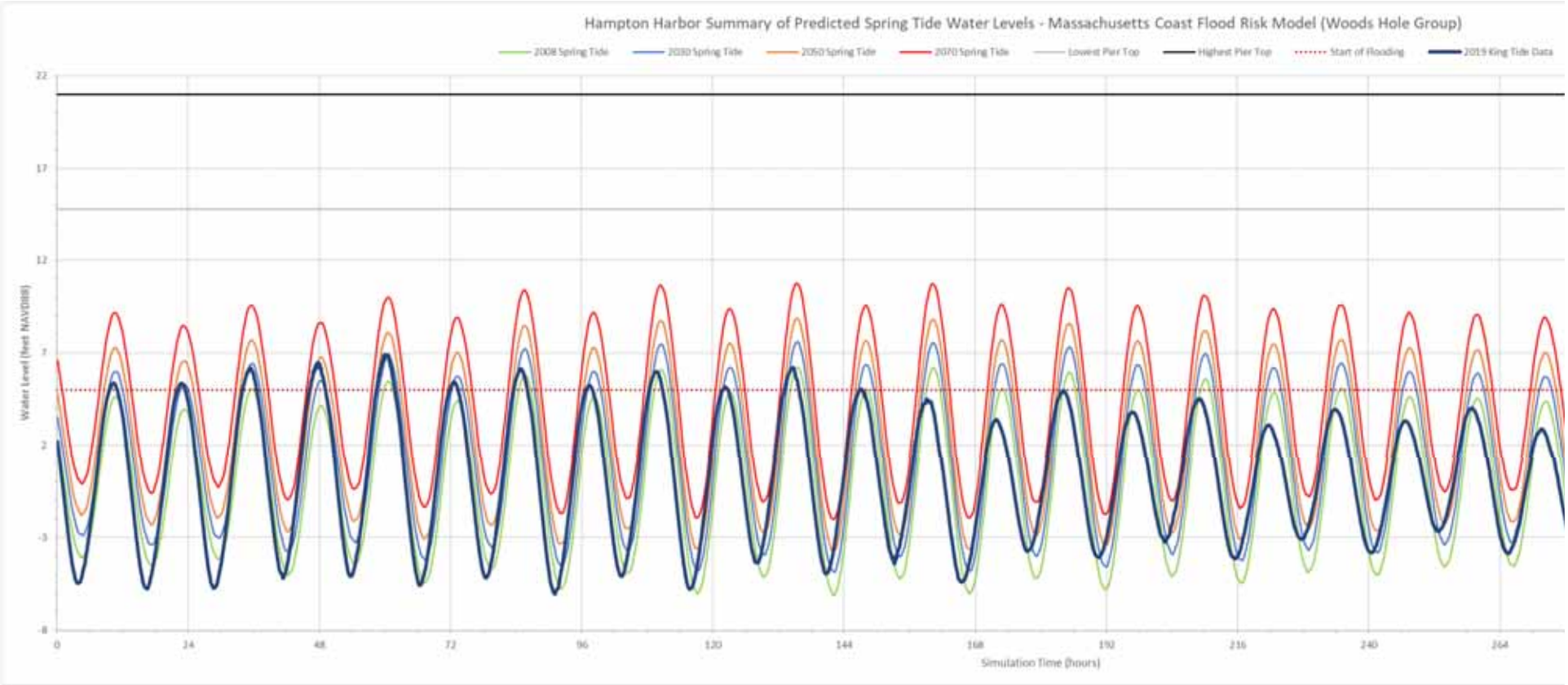
- Fifteen (15) upstream watersheds feeding into system
- Downstream tidal input from Hampton Harbor
- Cross section survey and LIDAR elevations
- Hydraulic roughness from land cover
- UNH water level data for tidal lag and model validation

Data Collection /
NOAA Tide Data and USGS Flow Data



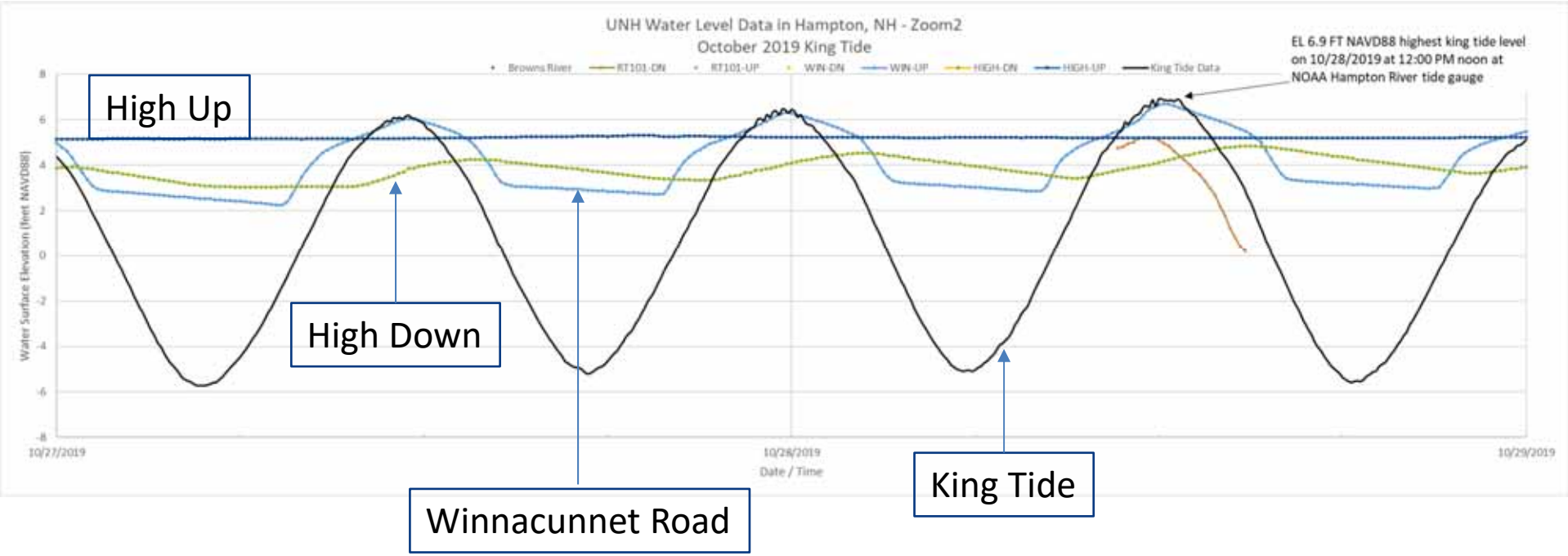
Data Collection / WHG Coastal Flood Risk Model Harbor Water Levels

1. Normal spring tide (present day)
2. Normal spring tide (2030)
3. Normal spring tide (2050)
4. Normal spring tide (2070)
5. Astronomical (annual high) tide (present day)
6. Astronomical (annual high) tide (2050)
7. 10-year extra tropical storm (present day)
8. 10-year extra tropical storm (2050)
9. 100-year extra tropical storm (present day)
10. 100-year extra tropical storm (2050)
11. 50-year tropical storm (present day)
12. 50-year tropical storm (2050)



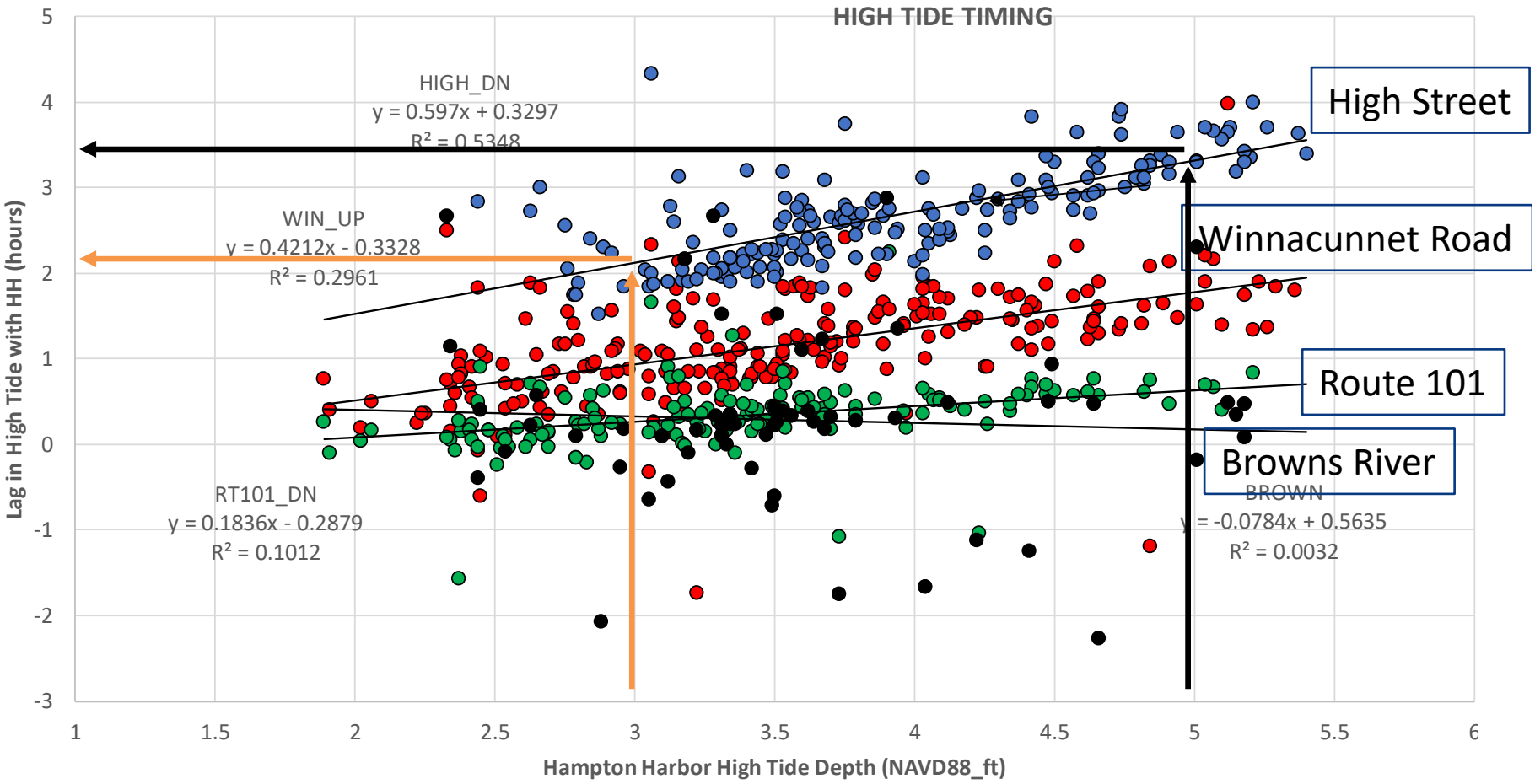
Data Collection / UNH Water Levels

- Validate model (~1.0-1.5 feet)
- Observe dampening of tide
- Observe tidal lag
- More data coming



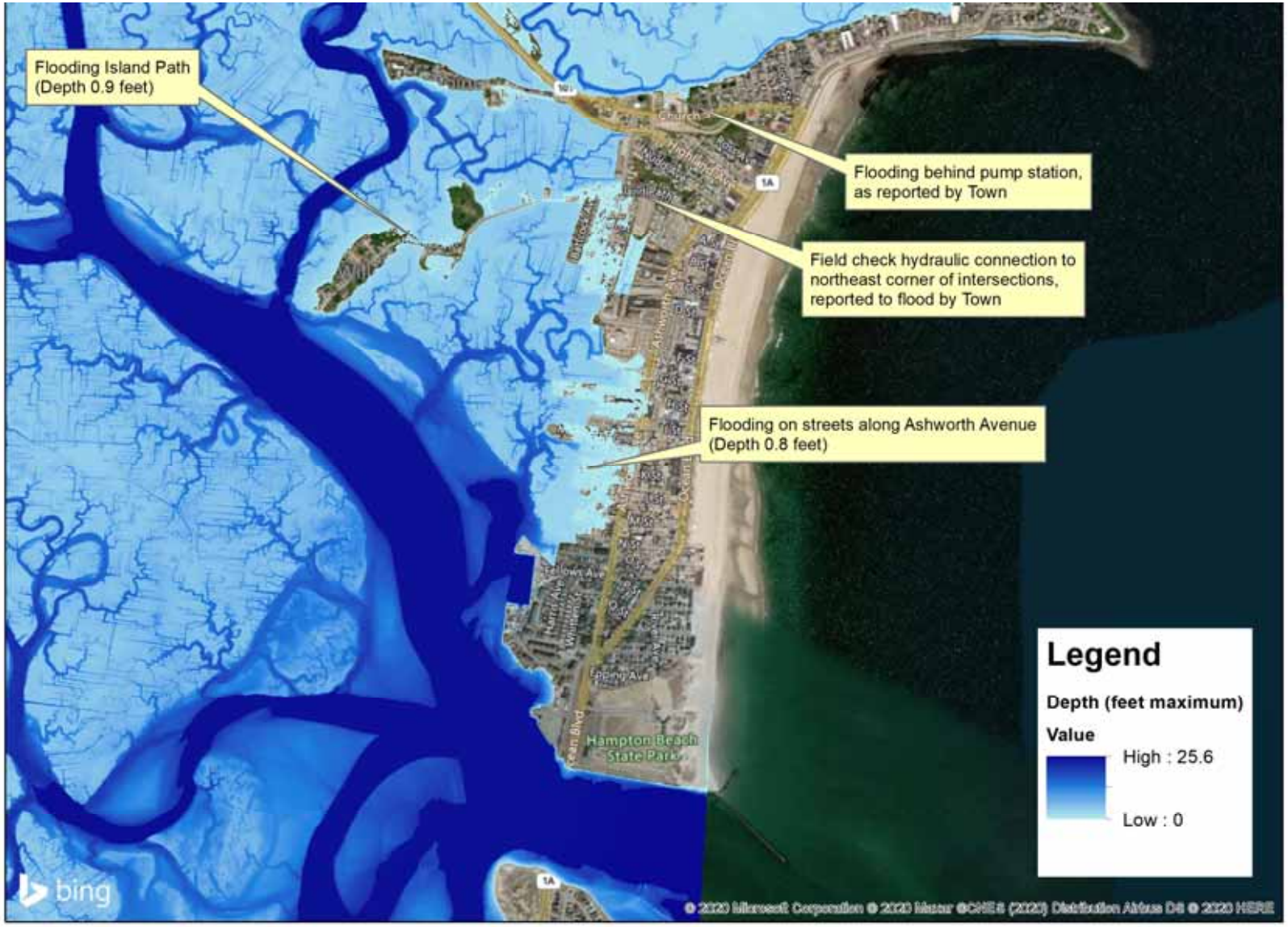
Data Collection / UNH Tidal Lag

- High Street: 2-3.5 hours
- Winnacunnet Road: 0.5-2 hours
- Route 101: 0-0.5 hours



Existing Model Results – October 2019 King Tide

Existing Model Results – October 2019 King Tide



HYDRAULIC MODEL PRELIMINARY RESULTS - 2019 KING TIDE

HAMPTON FLOOD STUDY

TOWN OF HAMPTON, NH

0 250 500 1,000 1,500 2,000

Feet

1 in = 1,250 feet

N

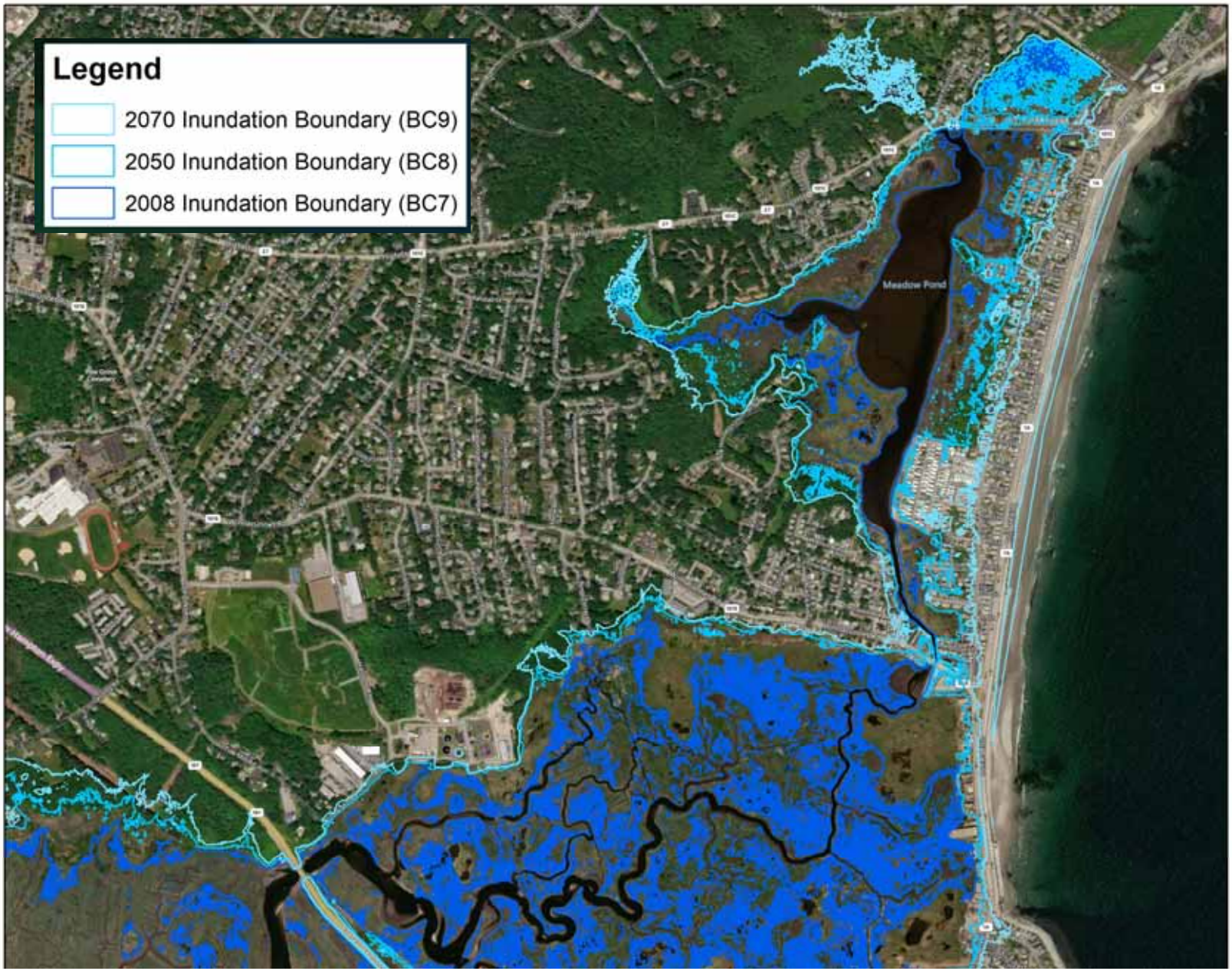
MILONE & MACBROOM

1 South Main St

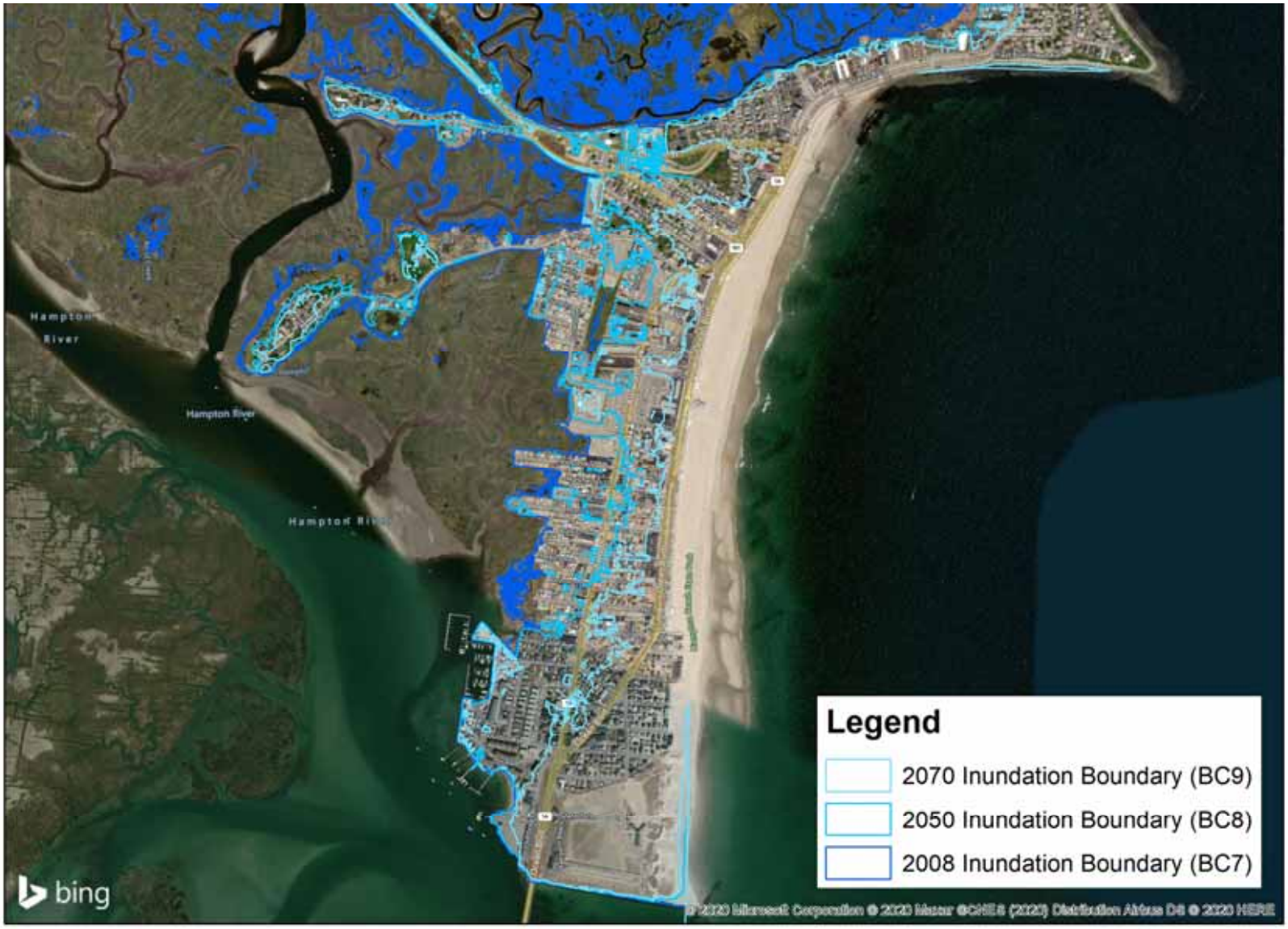
Waterbury, VT 05676

802-882-8335

Existing Model Results – Spring Tides



Existing Model Results – Spring Tides



HYDRAULIC MODEL PRELIMINARY RESULTS
HAMPTON FLOOD STUDY
TOWN OF HAMPTON, NH

0 225 450 900 1,350 1,800
Feet
1 in = 1,125 feet

N

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1 South Main St
Waterbury, VT 05676
802-882-8335

Alternatives Analysis Concepts

No Action
do nothing

Avoid
keep out of risk zones

Accommodate
elevate, raise roads, etc.

Resist
build walls, fill, etc.

Relocate
move to higher ground

Alternatives Analysis Overview – Meadow Pond Area

FLOOD MITIGATION ALTERNATIVES - MEADOW POND AREA
HAMPTON FLOOD STUDY
TOWN OF HAMPTON, NEW HAMPSHIRE

1 in = 1,000 feet

N

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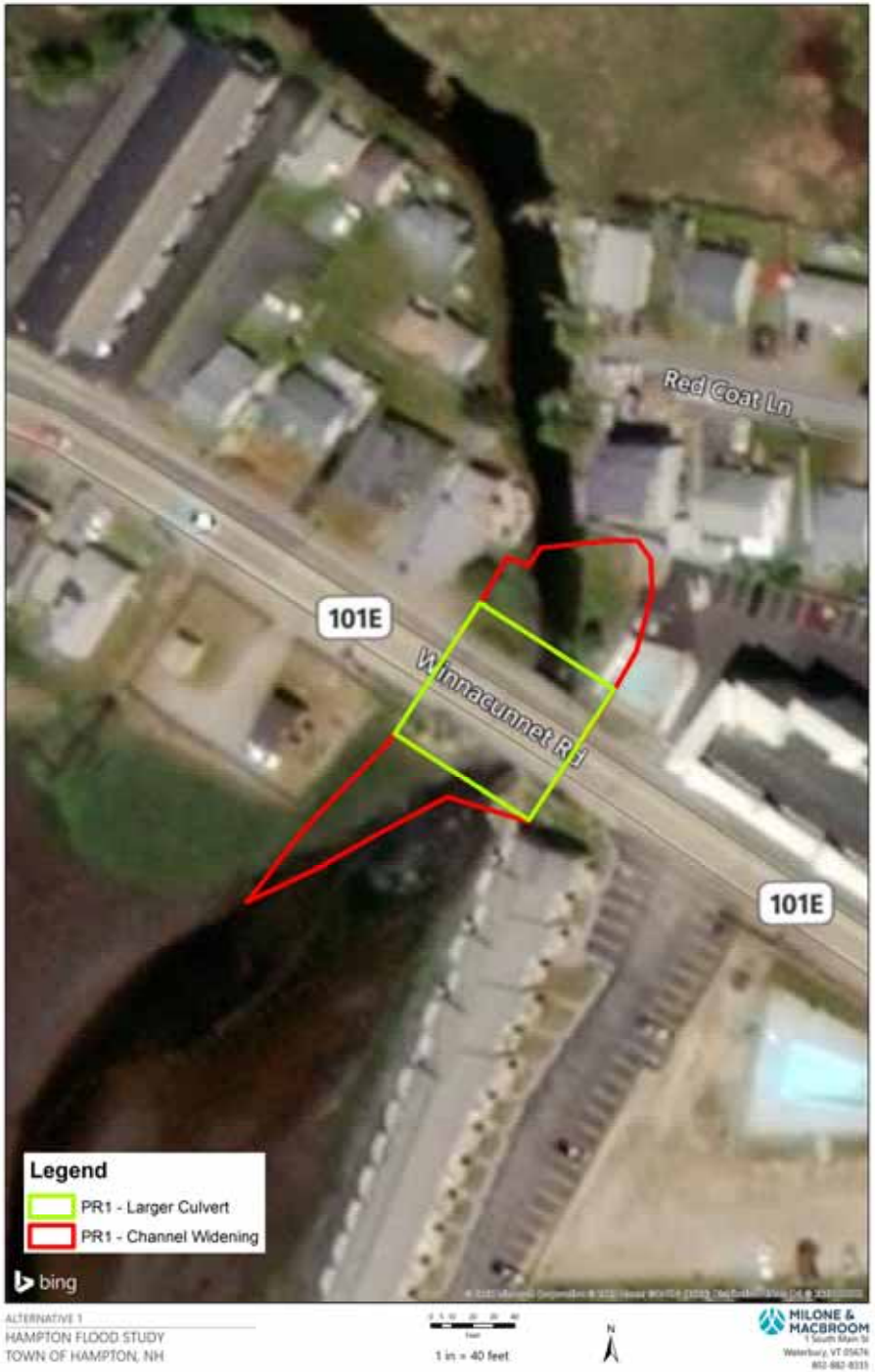
1 South Main St
Waterbury, VT 05676
802-882-8335

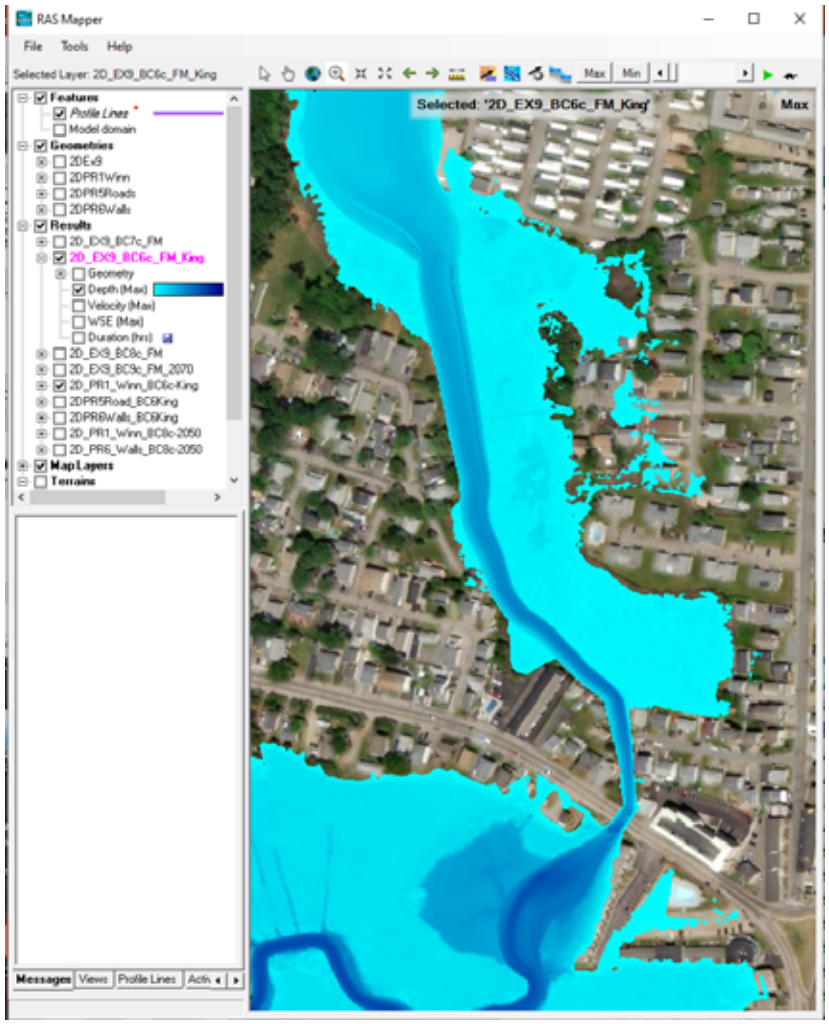
Alternative 1 – Replace Winnacunnet Road Culvert

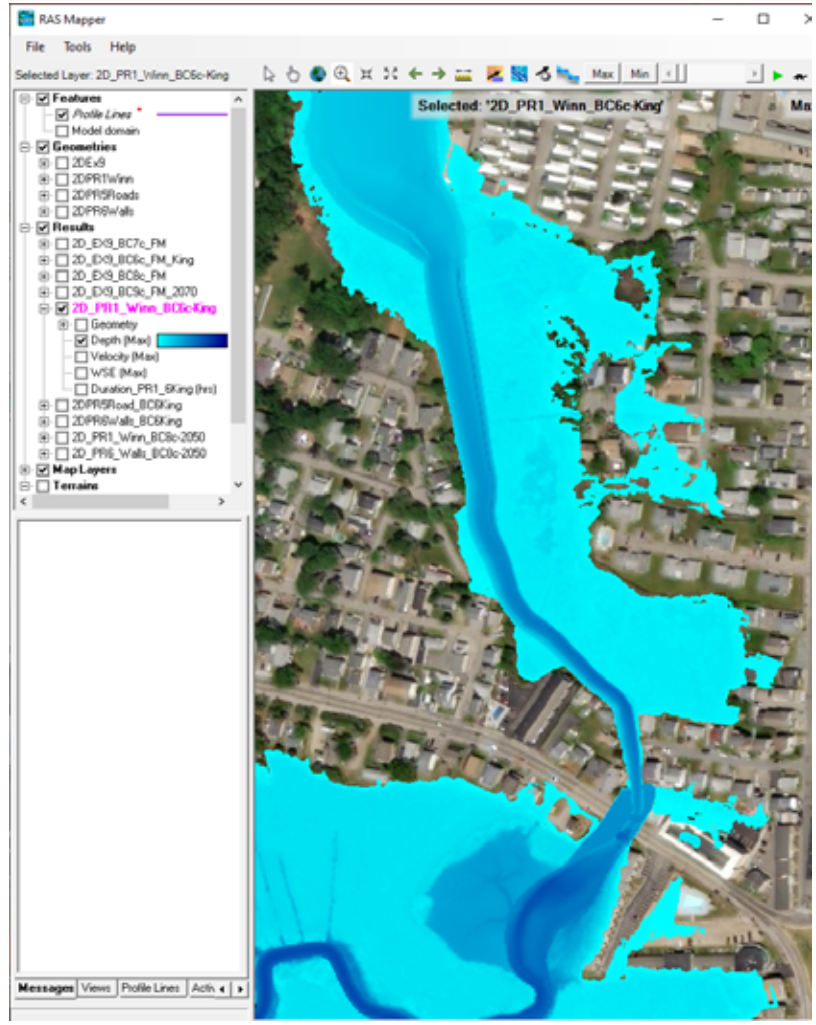
- New 75-foot wide structure, was 24 foot
- Maximized width without removing homes or structures



Alternative 1 – Replace Winnacunnet Road Culvert

- 0.1-foot <u>decrease</u> in <u>downstream</u> water surface
- 0.5-foot <u>increase</u> in <u>upstream</u> water surface
- 0.2-foot increase in water surface at Greene Street



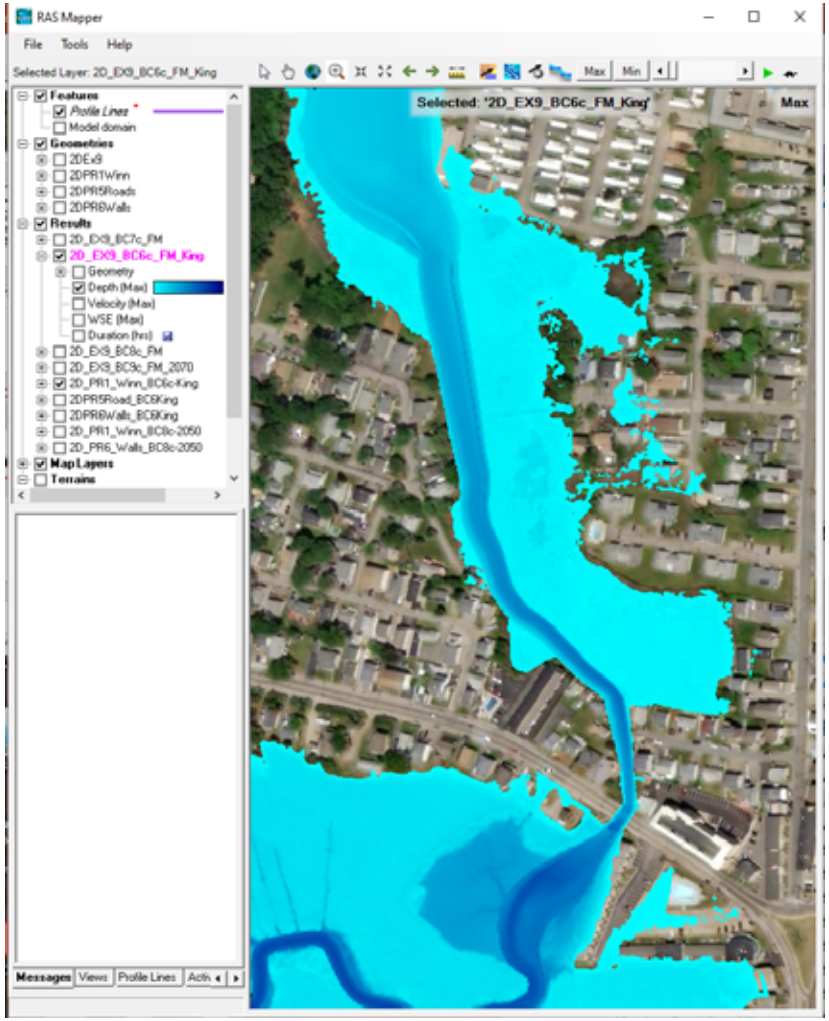


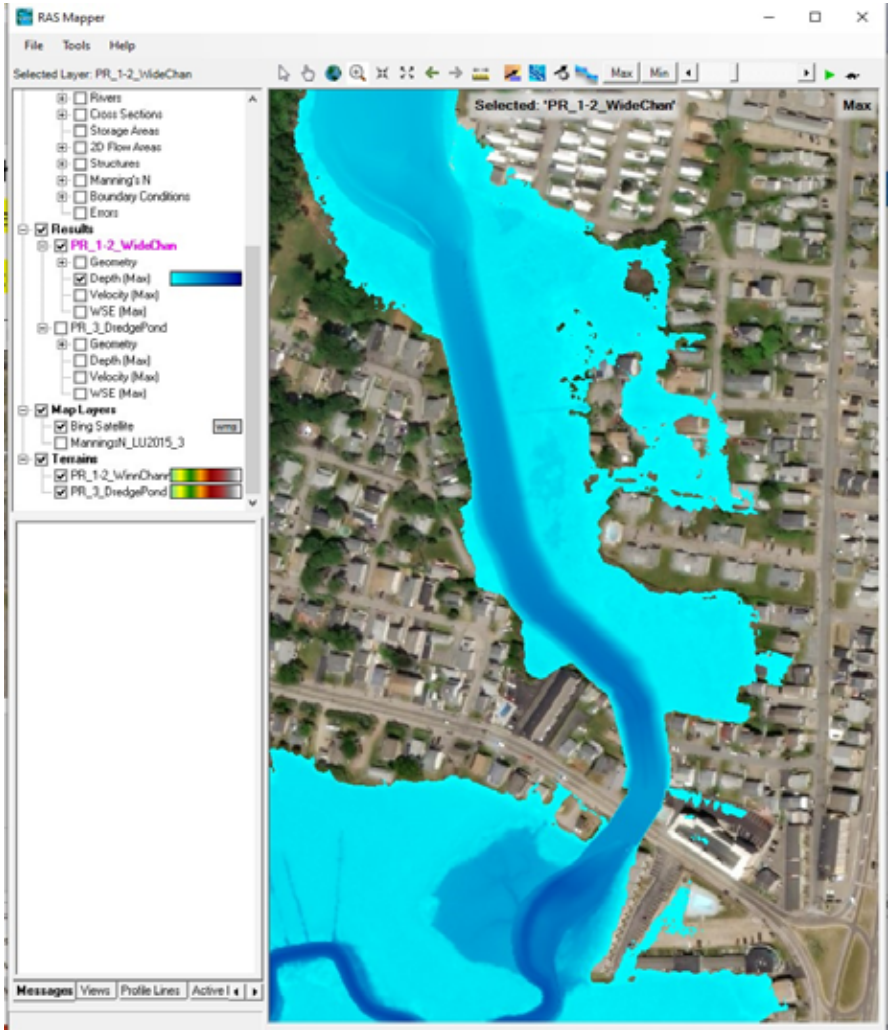
Alternative 2 – Winnacunnet Culvert & Fill Removal

- New 75-foot wide structure, was 24 foot
- Widened channel between Meadow Pond and Winnacunnet Road
- Includes removing homes & structures off of Winnacunnet Road and Red Coat Lane

Alternative 2 –Winnacunnet Culvert & Fill Removal

- 0.2-foot <u>decrease</u> in <u>downstream</u> water surface
- 0.3-foot <u>increase</u> in <u>upstream</u> water surface
- 0.4-foot increase in water surface at Greene Street





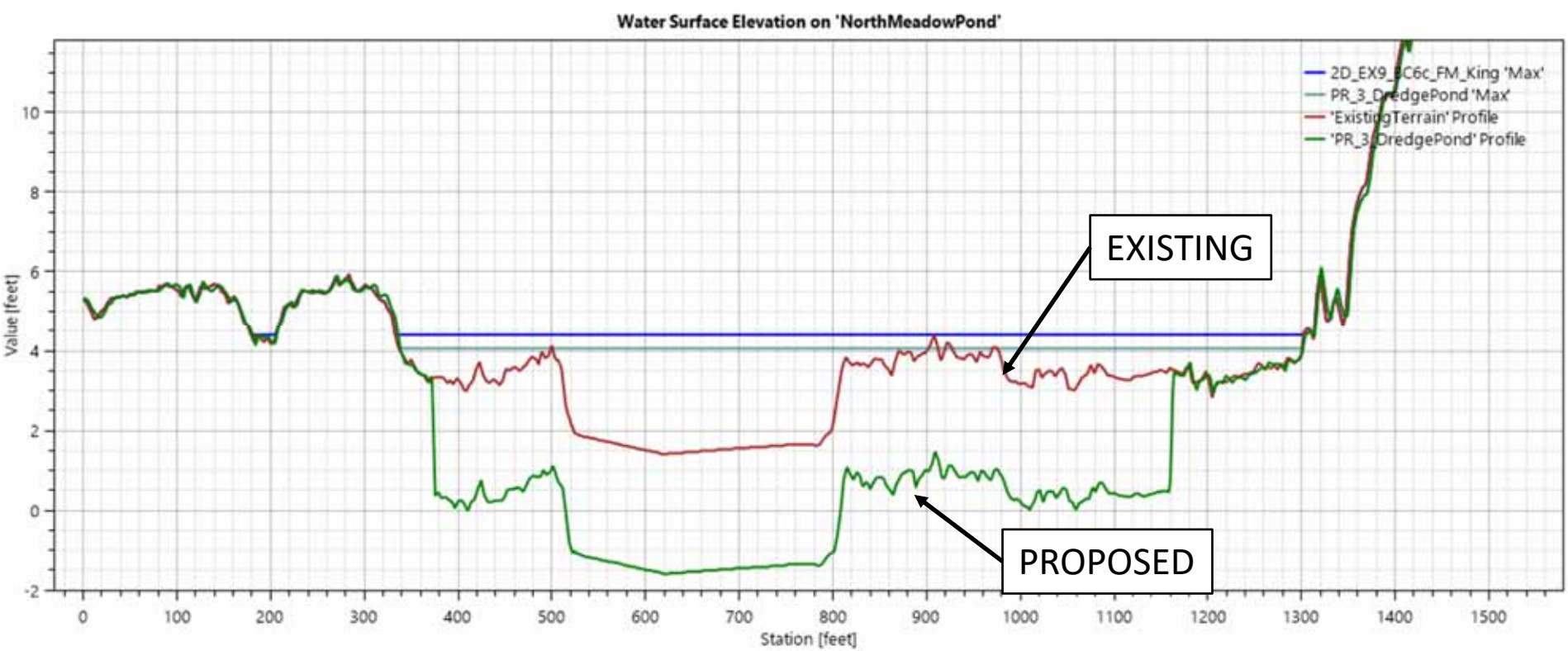
Alternative 3 – Dredging / Phragmites Removal

- Lowered ground elevation by 3 feet in and around Meadow Pond to create storage

- May not be allowed by regulations?

Alternative 3 – Dredging / Phragmites Removal

Alternative 3 – Dredging / Phragmites Removal



- Water levels decrease 1.0 - 0.2 feet during 2019 king tide.
- Reduces drainage structure submergence by 4 hours.

- Water levels decrease 0 - 0.02 feet during 2050 spring tide.

Alternative 4 – Ditch / Marsh Remediation

- Roughen marsh to slow tidal inflow and storm surge and reduce erosion potential.
- Improves habitat by naturalizing flow and vegetation patterns.
- UNH 2010 Meadow Pond study recommended phragmites removal and native plantings.

Increased roughness:
N 0.6 to 0.1

Alternative 4 – Ditch / Marsh Remediation

Alternative 4 – Ditch / Marsh Remediation

- 0.1-foot decrease in water surface at Greene Street and in Meadow Pond
- No change in water surface through the constricted channel upstream of Winnacunnet Road
- 0.2-foot decrease in water surface downstream of Winnacunnet Road
- 0.2-foot increase in water surface upstream of Route 101
- 0.1-foot increase in water surface near Glade Path and Island Path
- Temporary solution as marsh may get smoother due to more submergence with sea-level rise.

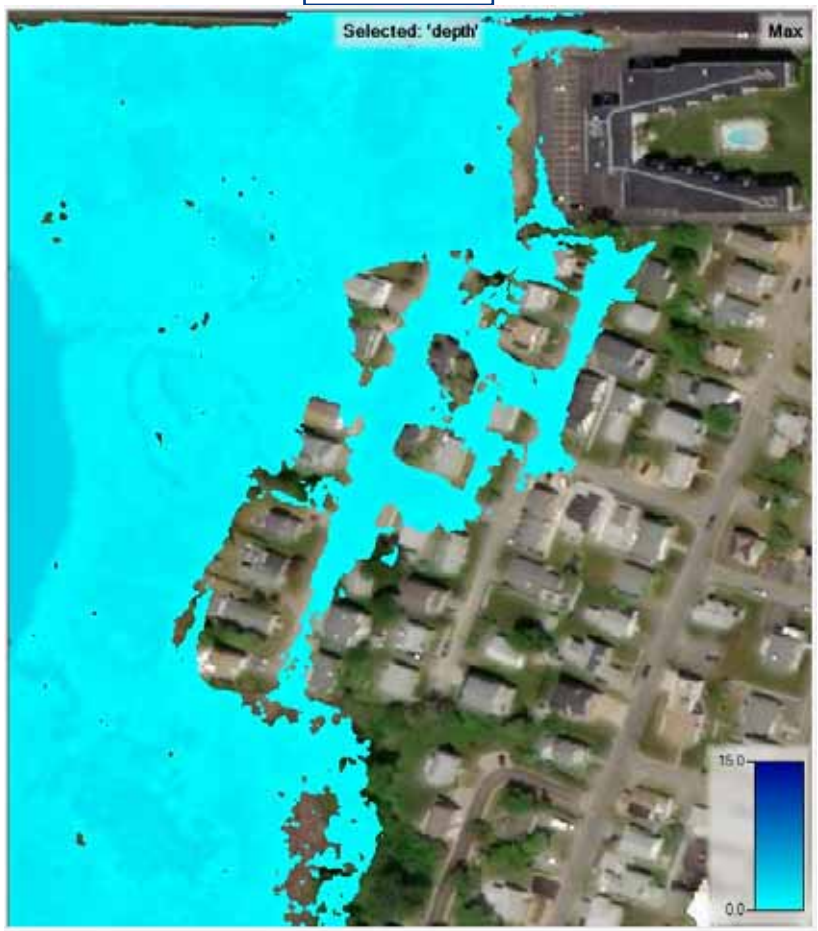
Alternative 5 – Elevate Road

- Raise road surface 1-2 feet along Greene Street, Gentian Road, and Meadow Pond Road
- Provide access above predicted 2050 flood elevation
- Complicated grades to make this work. Likely requires house elevations.

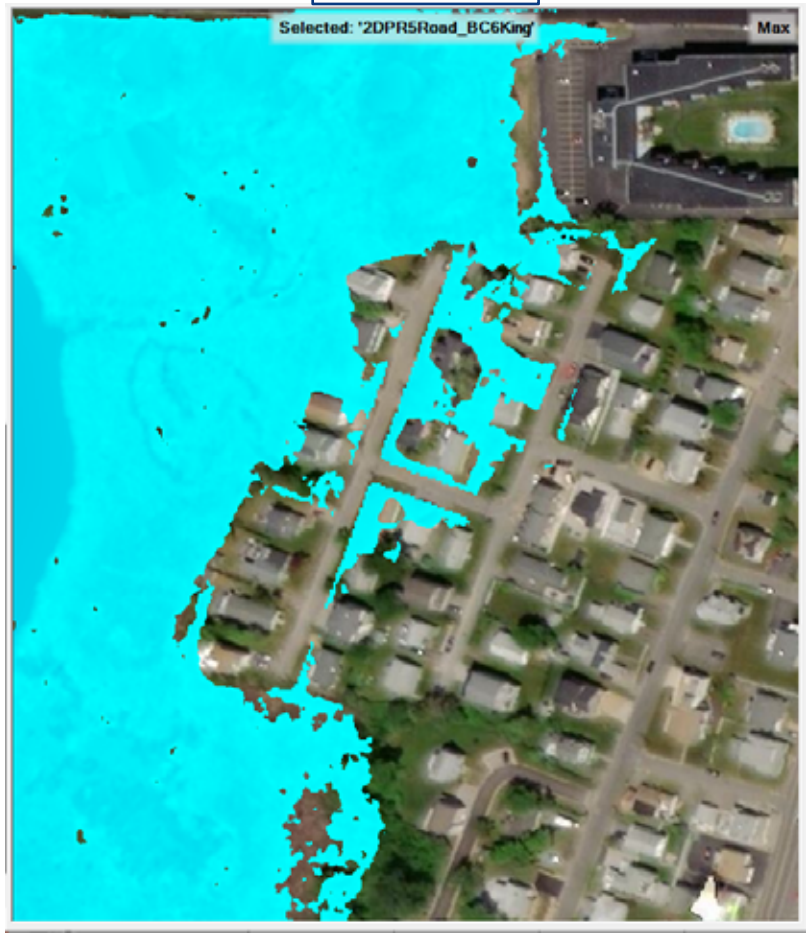
Alternative 5 – Elevate Road

- Greene Street, Gentian Road, & Meadow Pond Road passable
- No change in surrounding flood depths or extent for 2019 King Tide and predicted 2050 normal spring tide

Existing



Proposed



Alternative 6 – Improve Drainage on Greene Street, Gentian Road, and Kings Highway

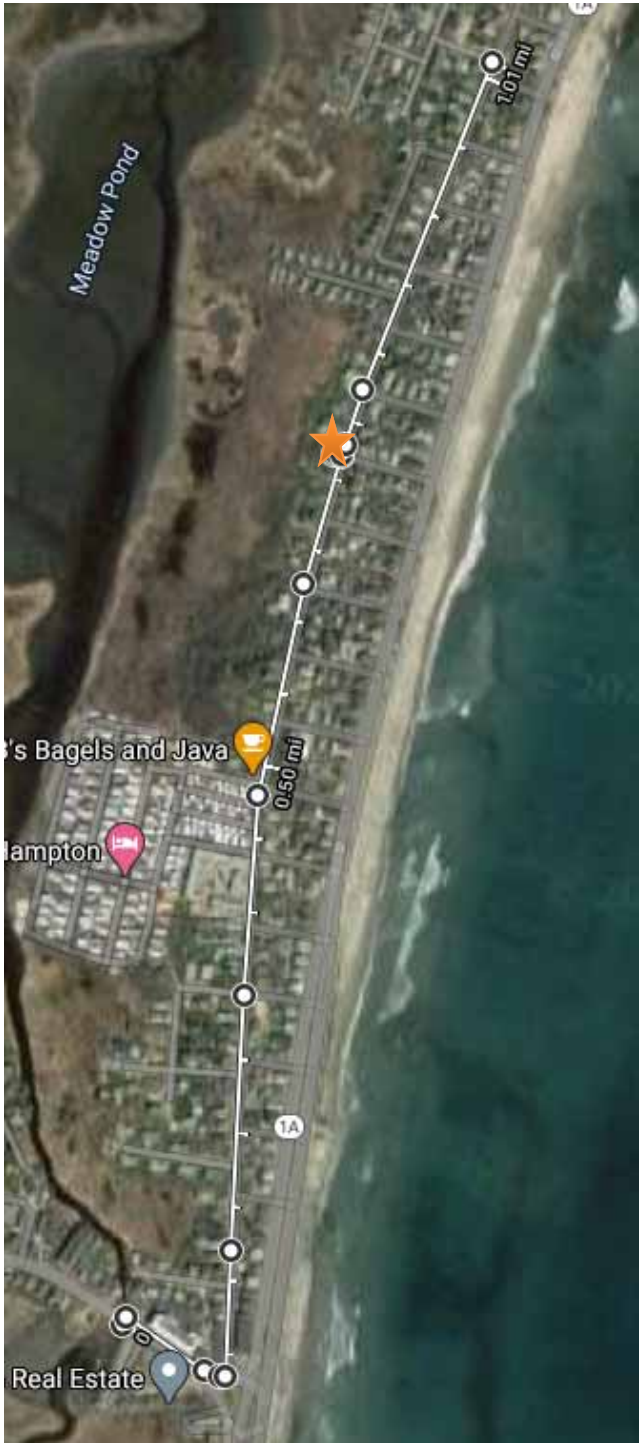
- Approximate drainage pipe elevations at Gentian Road
  - Top of pipe ~ 2.5 feet NAVD88
  - Invert of pipe ~ 1.0 feet NAVD88

- Pipes submerged most of the time
  - 27 of 36 hours during the King Tide simulation
  - 23 of 36 hours during the King Tide with the dredging
  - 36 of 36 hours during 2050 tide simulation

Drainage outlet at Gentian Road
Meadow Pond Area
Town of Hampton, 2017

Alternative 6 – Improve Drainage on Greene Street, Gentian Road, and Kings Highway

- ~1 mile of force main to improve drainage in area
- Outlet downstream of Winnacunnet Road
- Bottom elevation above 2050 maximum tide level of 6.2 feet NAVD88 (top of road is ~7.5 feet NAVD88 in this area).
- $1.4M estimate in 2014 for ~0.5 miles of force main



Alternative 7 – Elevate Floodprone Houses

- Recommended throughout study area due to low-lying buildings and increasing risk associated with sea-level rise, increasing storms, and inefficient drainage setting.
- Target elevation for lowest living floor would be between the maximum flood level of the predicted 2070 spring tide (6.8 feet NAVD88) and the FEMA BFE (8.5 feet NAVD88).
- May require a change in zoning regulations.

Elevated house
Meadow Pond Area
MMI, 2020

Elevated house
Brown Avenue Area
MMI, 2020

2070 Normal Spring Tide Inundation Area

Alternative 8 – Managed Retreat

- Modeling confirms that low-lying areas are regularly inundated annually or semi-annually.
- Modeling shows that flooding will get worse with increasing risk associated with sea-level rise, increasing storms, and inefficient drainage setting.
- Managed retreat through FEMA-buyouts and other mechanisms should be considered to reduce risk of property loss and increase flood storage.

Existing Model Results: Extent of Flooding

N

All Aerial Images Obtained from Bing

Hoyle, Tanner & Associates, Inc.

Alternatives Analysis Concepts

No Action
do nothing

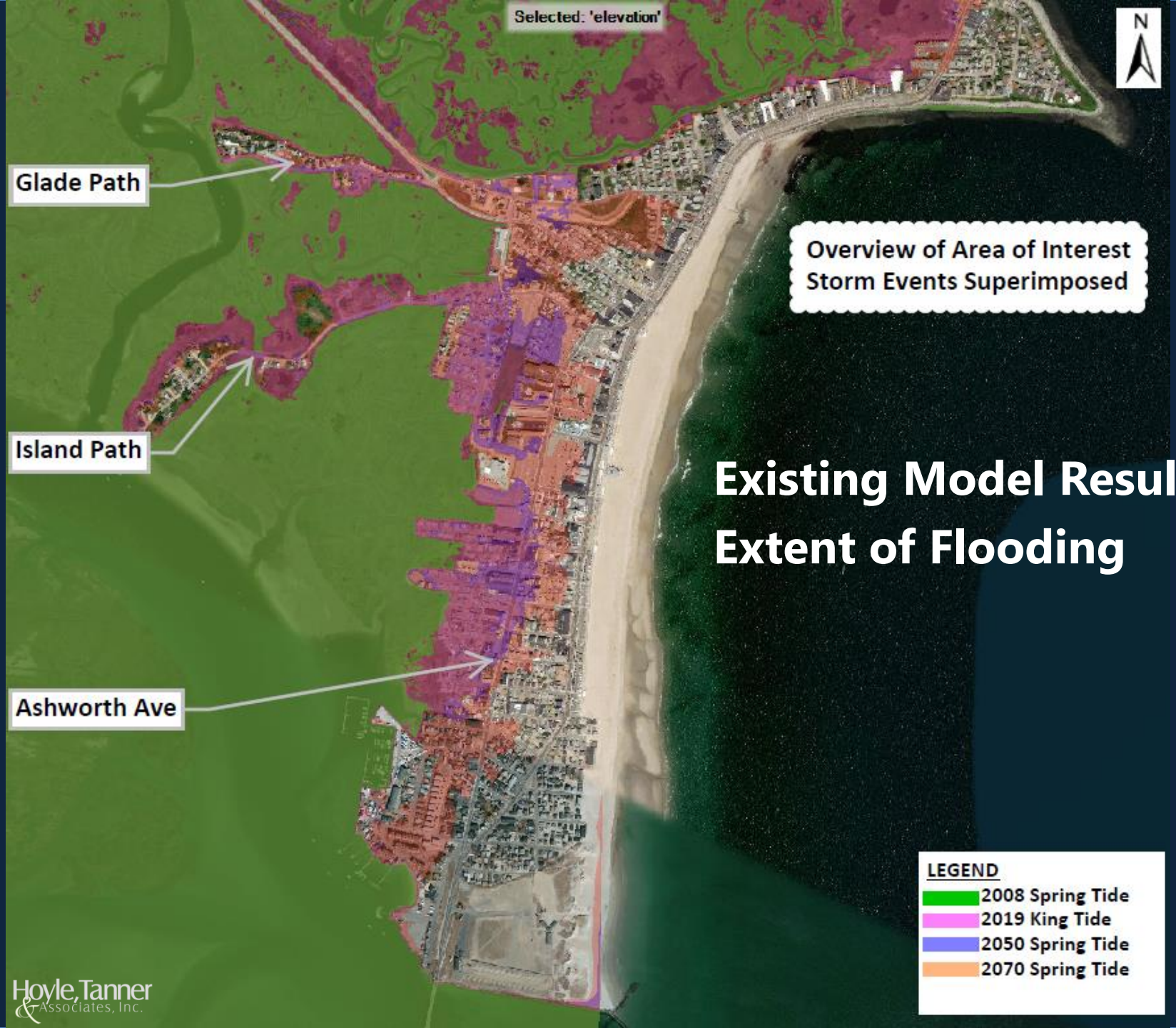
Avoid
keep out of risk zones

Accommodate
elevate, raise roads, etc.

Resist
build walls, fill, etc.

Relocate
move to higher ground

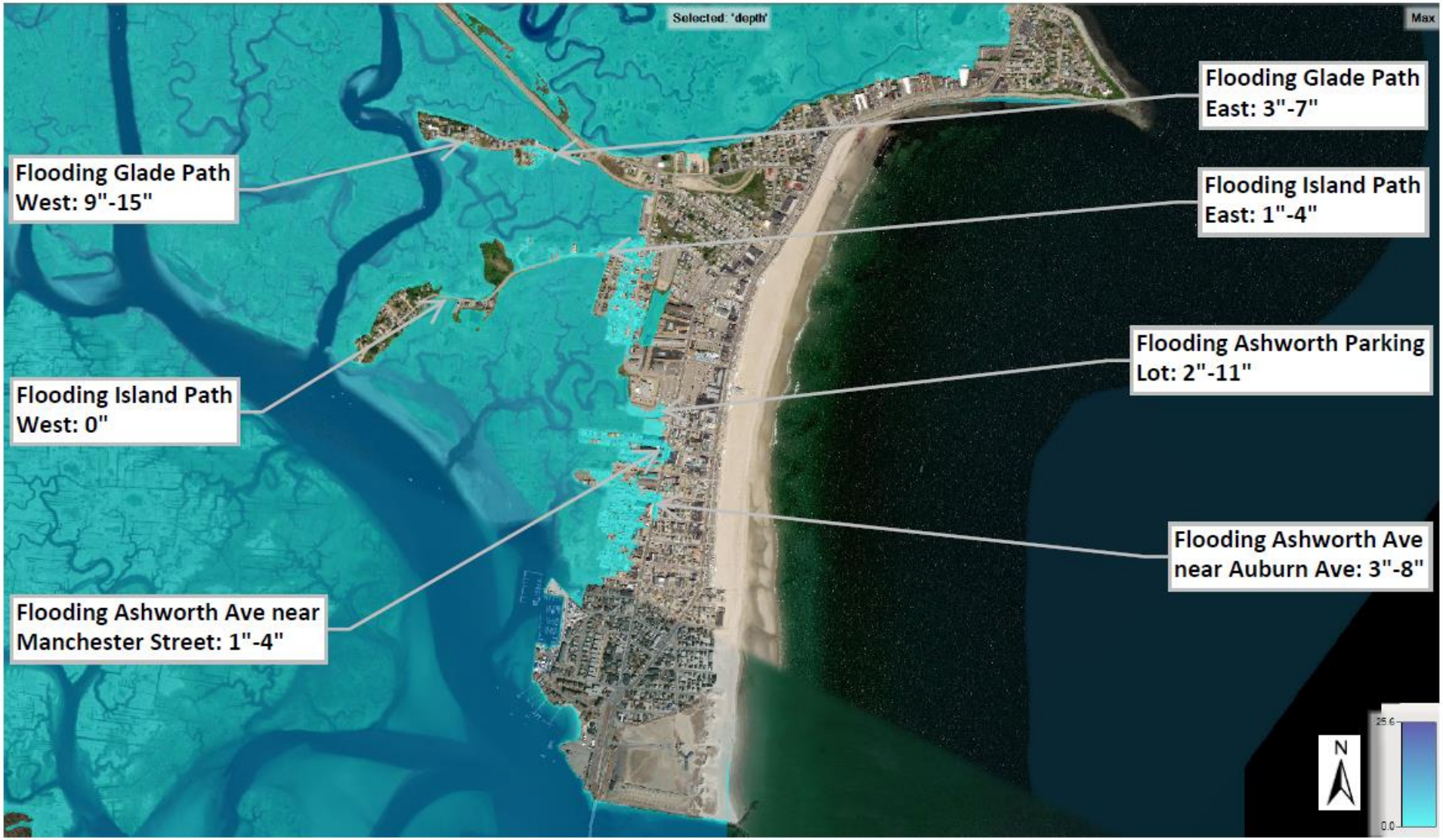
From NH coastal adaptation report and Hampton Coastal Resiliency Master Planning



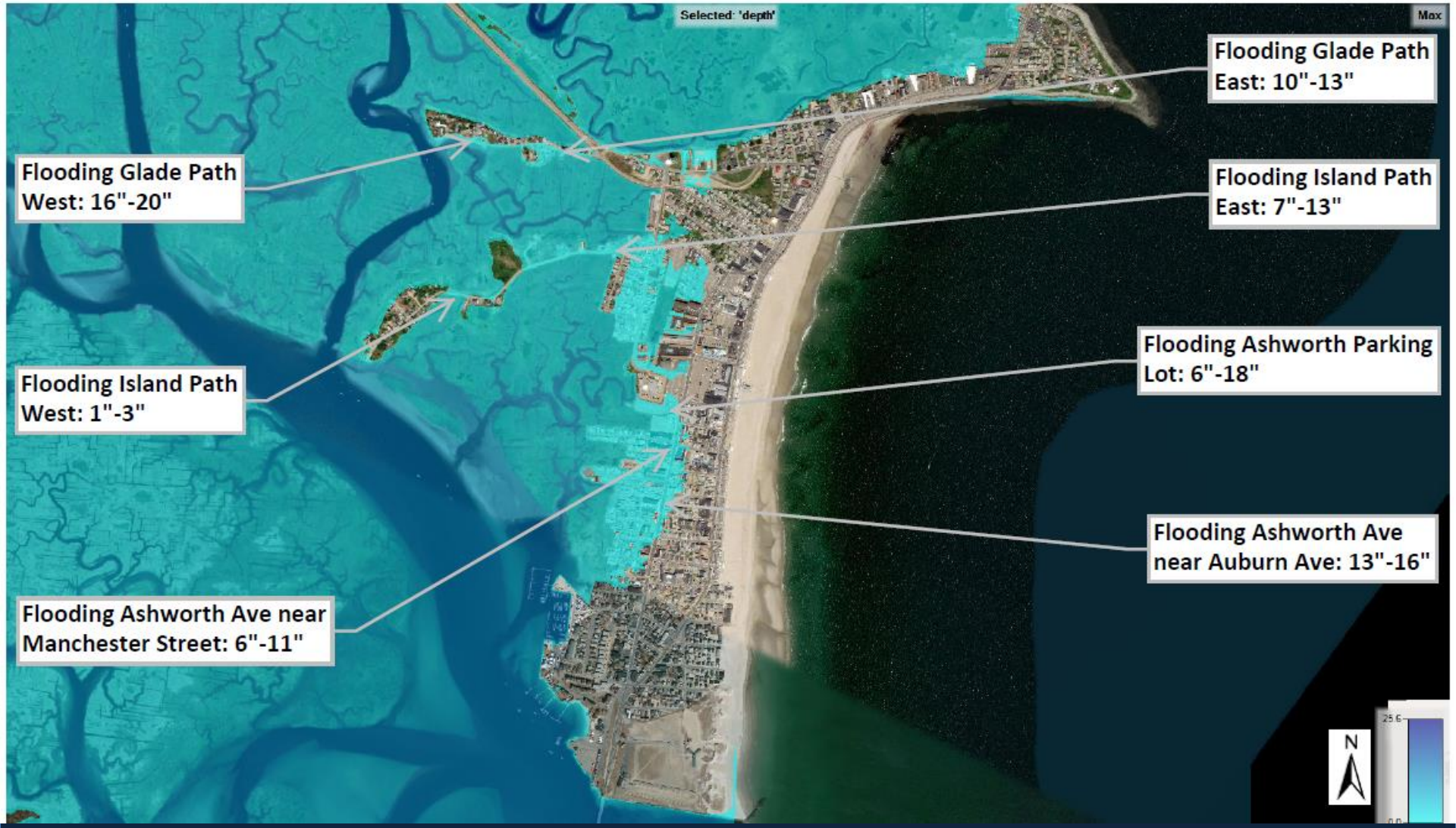
Existing Model Results: Extent of Flooding

Hoyle, Tanner & Associates, Inc.

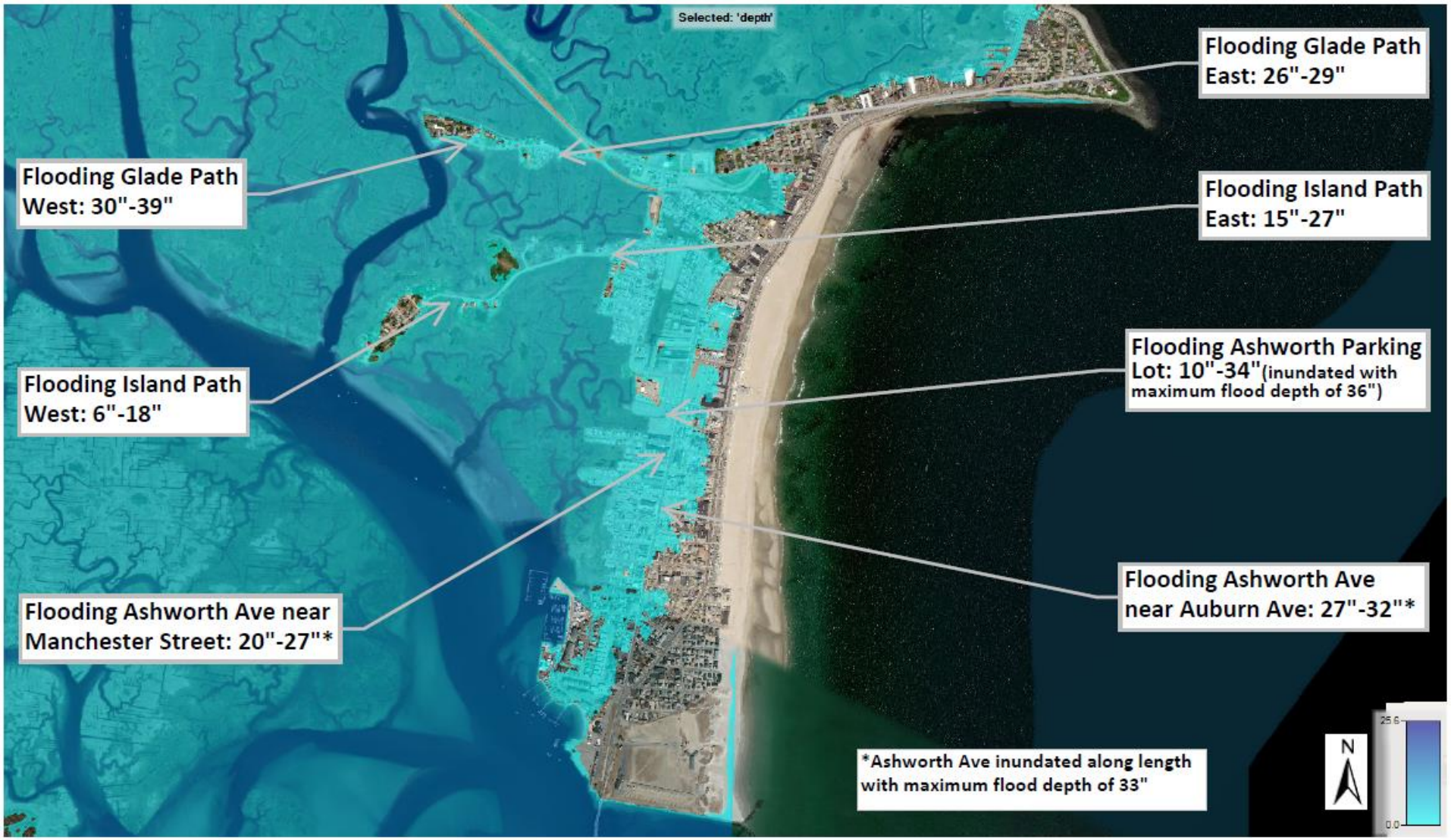
Existing Model Results: Water Depth for 2019 King Tide



Existing Model Results: Water Depth for 2050 Spring Tide



Existing Model Results: Water Depth for 2070 Spring Tide



Harbor Alternatives Analysis

Alternatives Evaluated

- Improve Drainage Infrastructure
- Improve/Add Tide Gates and Backflow Valves

Harbor Alternatives Analysis

Alternatives Evaluated

- Elevate Roads
- Elevate Structures (Homes & Businesses)
  - Likely requires regulatory updates

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Proposed Model Results: Raised Roads for 2019 King Tide

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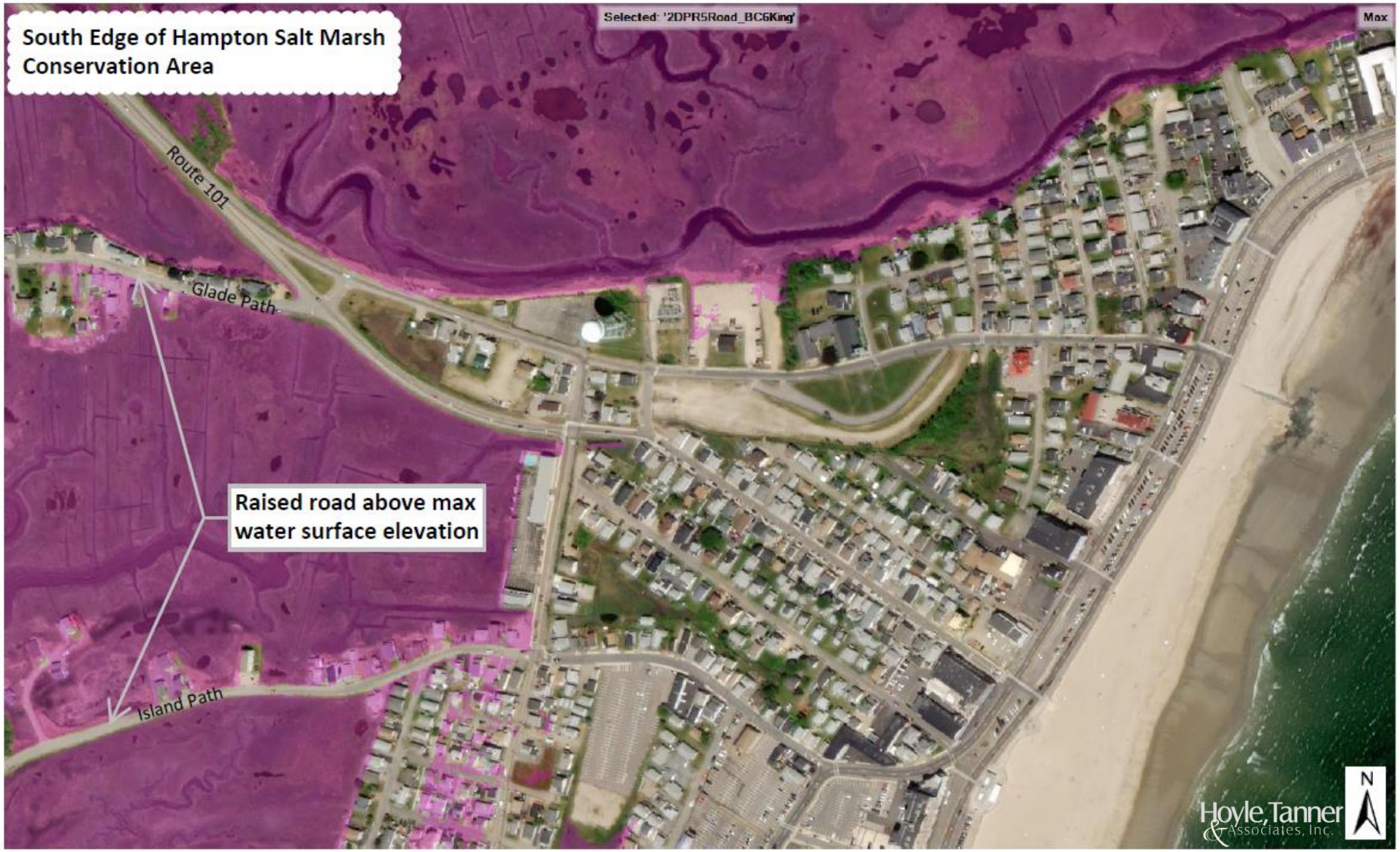
Proposed Model Results: Raised Roads for 2019 King Tide

Proposed Model Results: Raised Roads for 2019 King Tide



Proposed Model Results: Raised Roads for 2019 King Tide

Proposed Model Results: Raised Roads for 2019 King Tide

Proposed Model Results: Raised Roads for 2019 King Tide

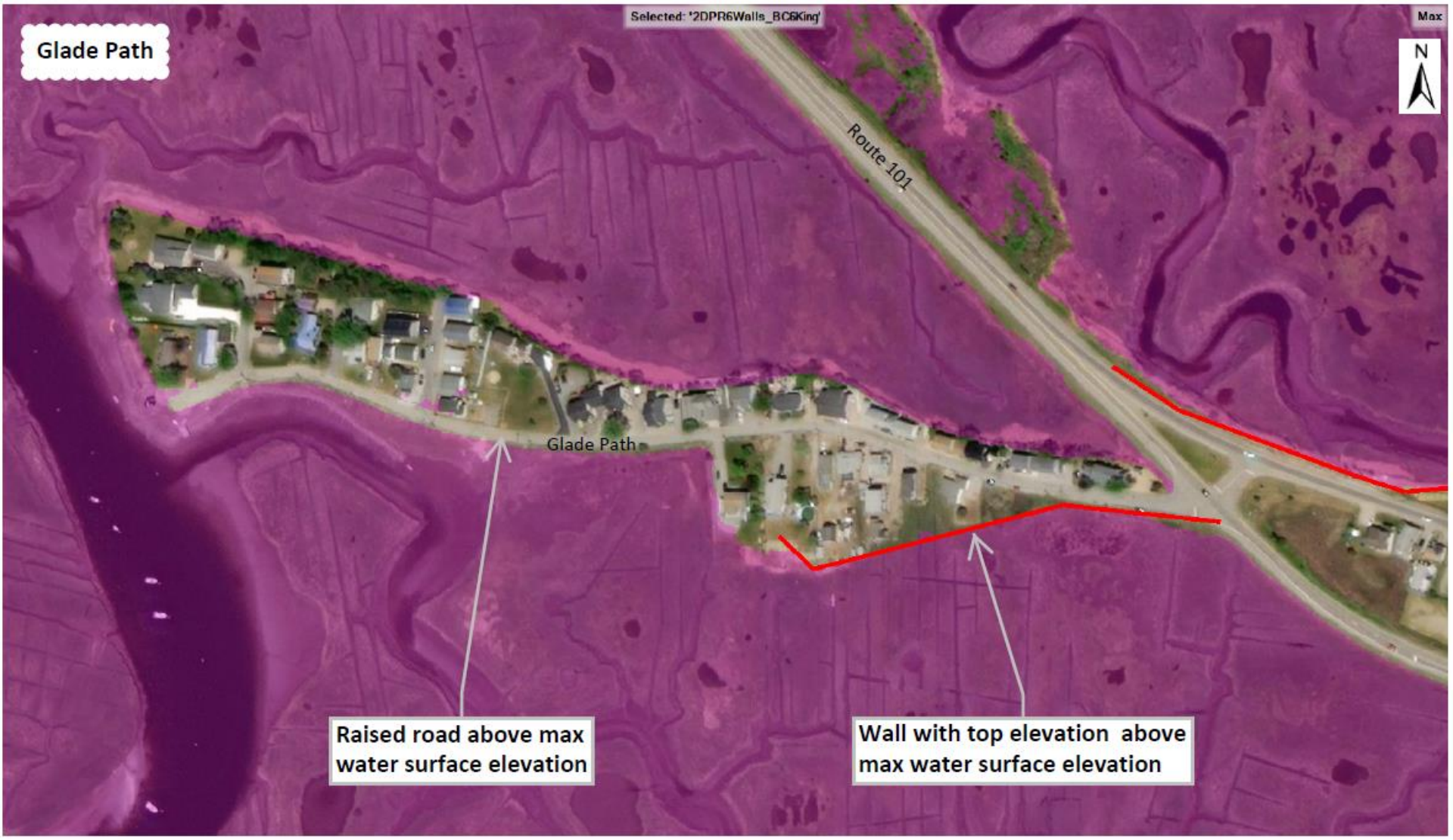
Harbor Alternatives Analysis

Alternatives Evaluated

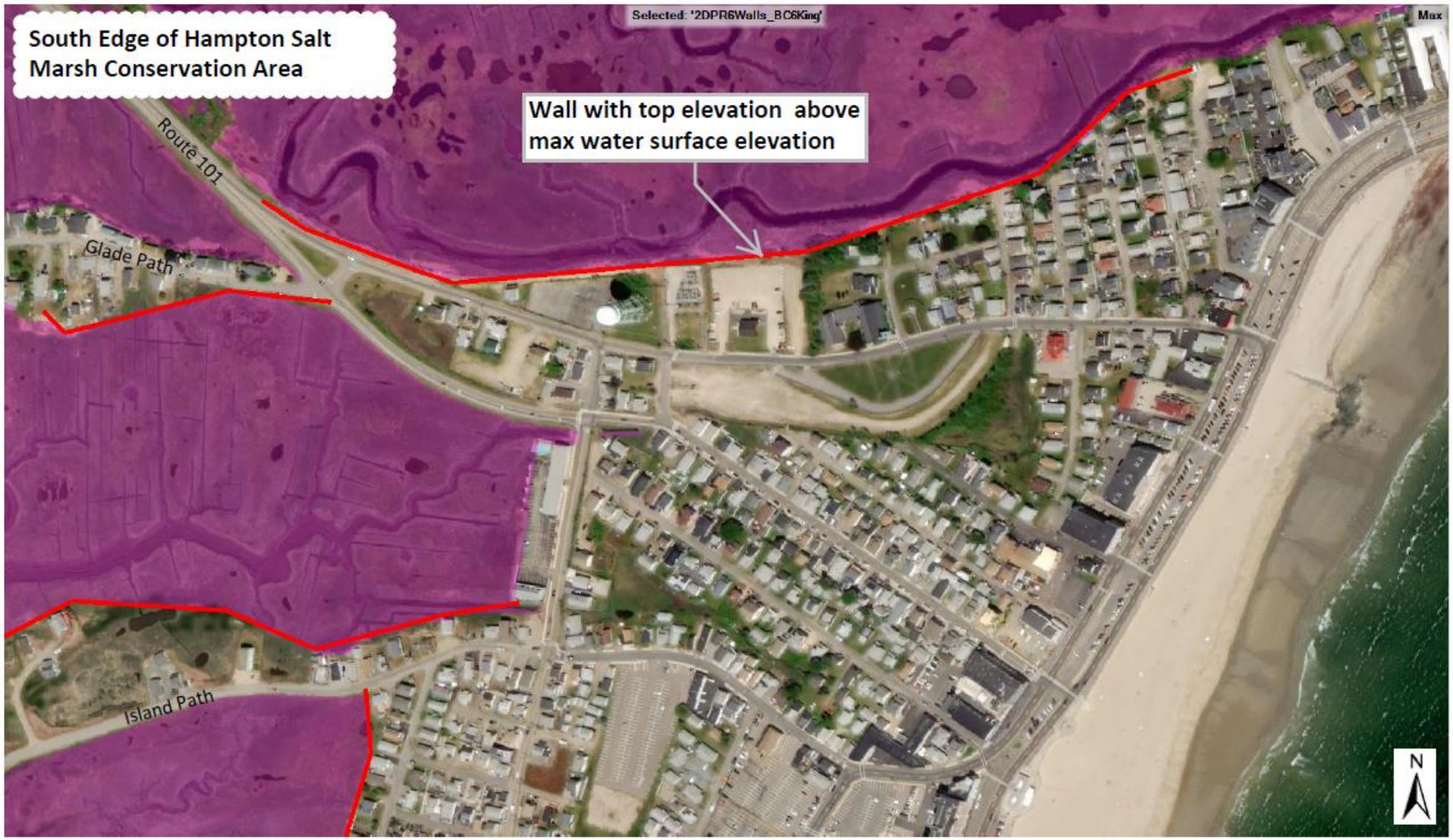
- Construct Barrier (Wall, Levee, Berm)

Proposed Model Results: Added Walls & Raised Roads 2019 King Tide

Proposed Model Results: Added Walls & Raised Roads 2019 King Tide



Proposed Model Results: Added Walls & Raised Roads 2019 King Tide



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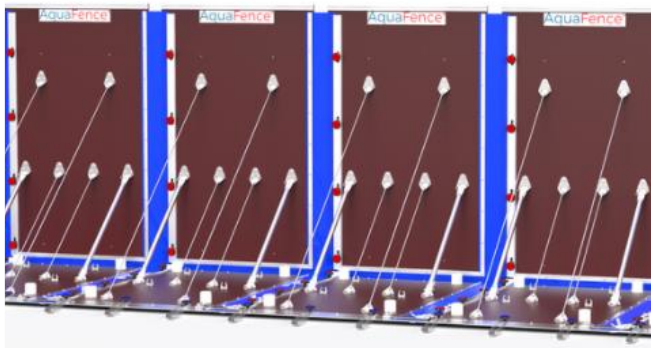
https://floodcontrolinternational.com/products/noaq-boxwall/



Damitdams.com

https://floodcontrolinternational.com/products/inero-flood-barriers/

Types of Temporary Flood Walls/Barriers

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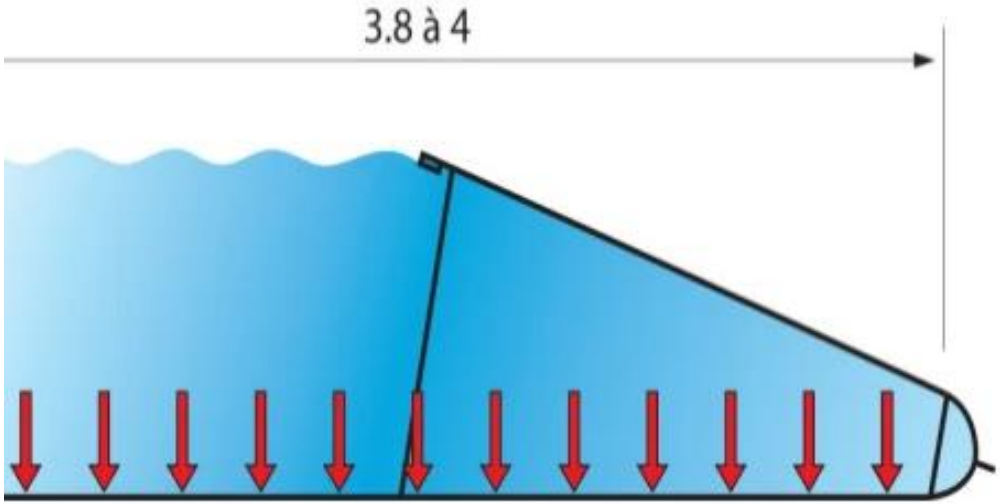

Water Gate Flood Barrier

https://youtu.be/ze3pYcATYEg

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Harbor Alternatives Analysis

Alternatives Evaluated

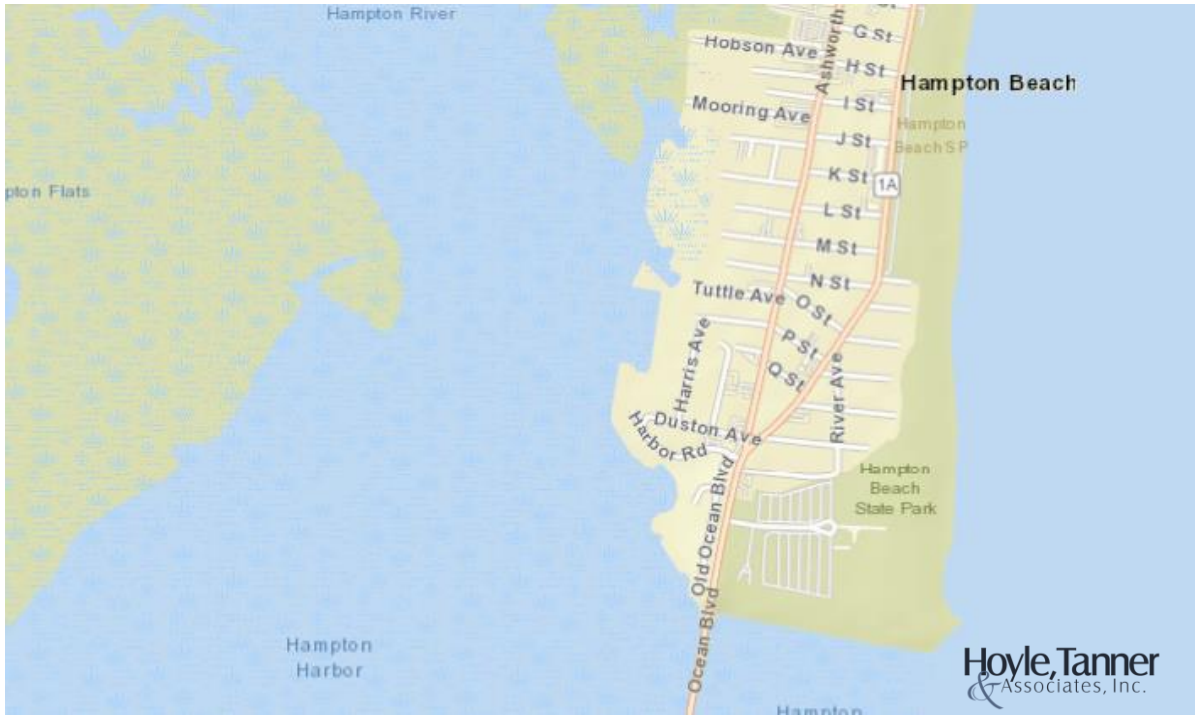
- Managed Retreat

  (Purchase Property Prone to Flooding)

Harbor Alternatives Analysis

Alternatives not Pursued

- Dredging to Create Capacity
- Marsh Remediation



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Thank You

- Presentation slides and a recording of the meeting will be posted on the Town website.
- Please submit questions to the Town of Hampton via Jennifer Hale at jhale@town.hampton.nh.us

Meadow Pond
Photo by Kinneya

Extra Slides

Data Collection / Outlets and Walls

- From field observations, Town mapping, and Town

Data Collection / Outlets and Walls

- From field observations, Town mapping, and Town

Data Collection / Survey

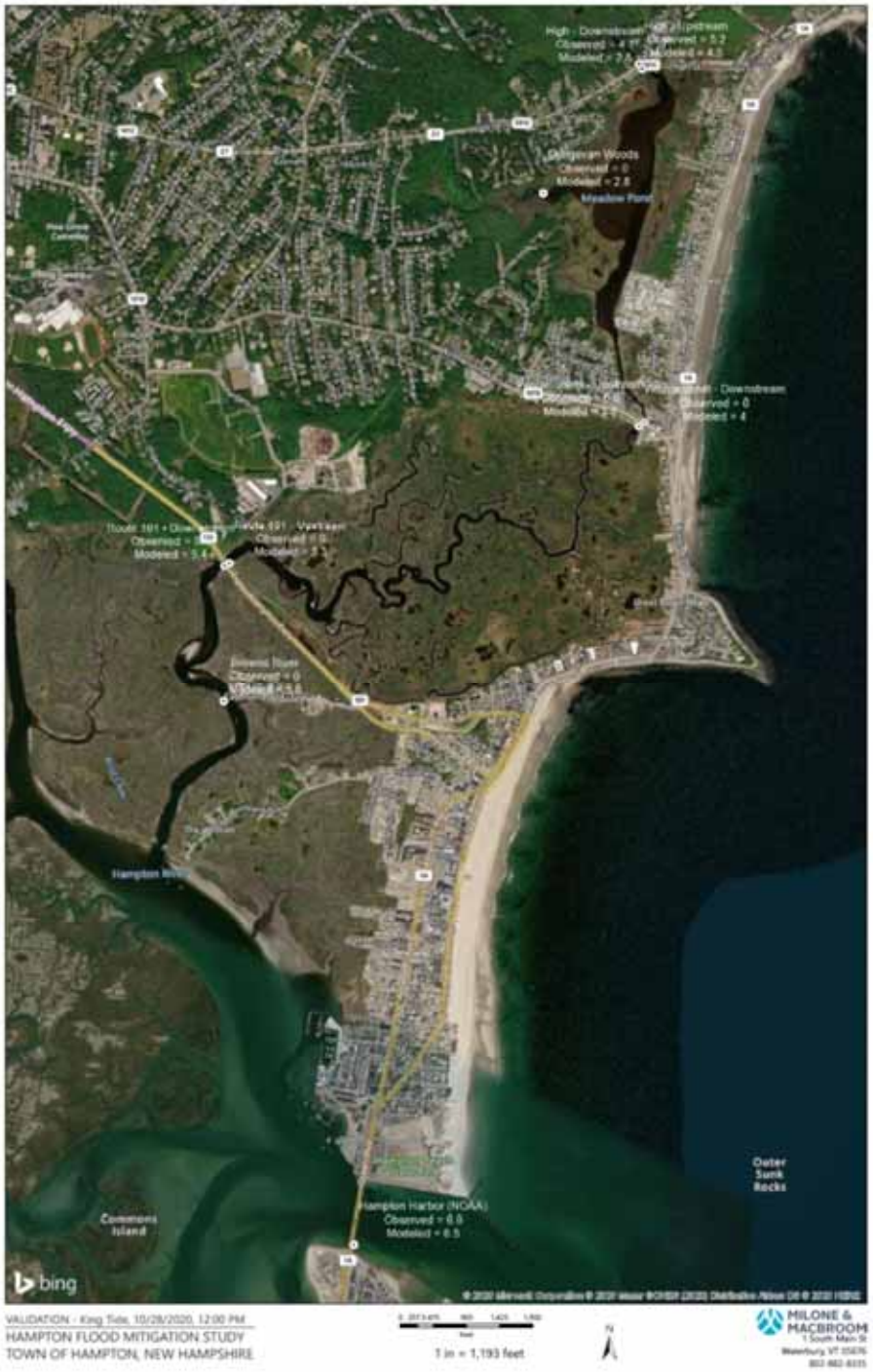
- Completed by Doucet

Data Collection / LIDAR

- 2-foot contours
- Coastal New Hampshire 2014 bare-earth DEM
- 1-meter resolution
- Data from NH GRANIT

Data Collection / UNH Water Levels

- Used for validating model
- Awaiting 2020 data



Data Collection / UNH Water Levels

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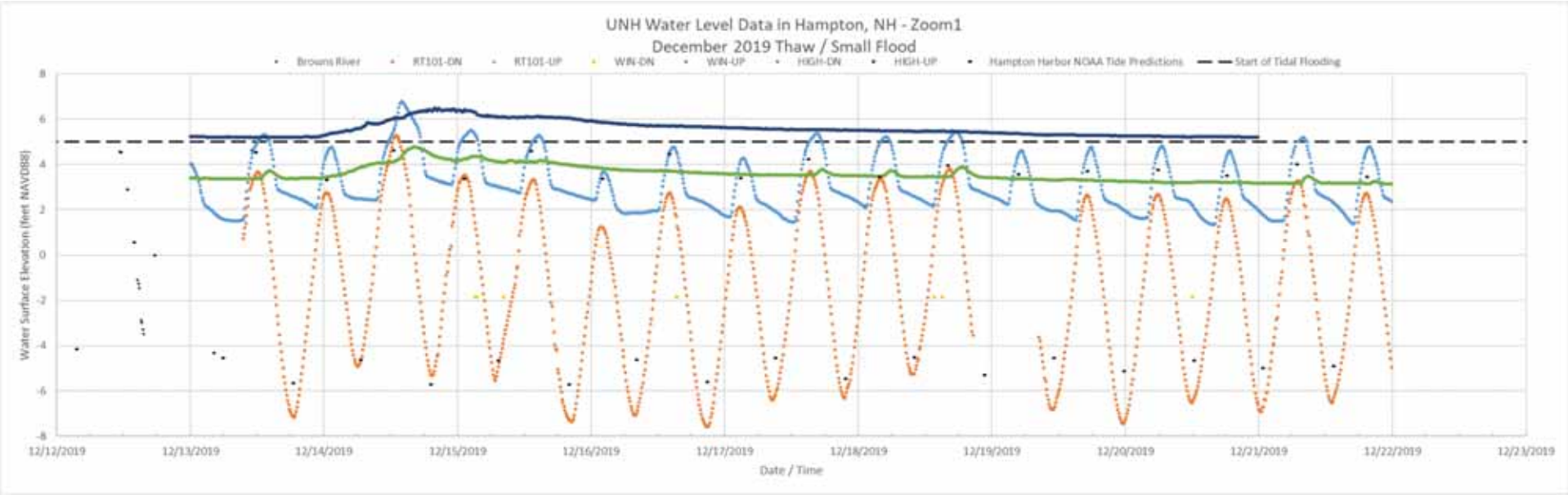
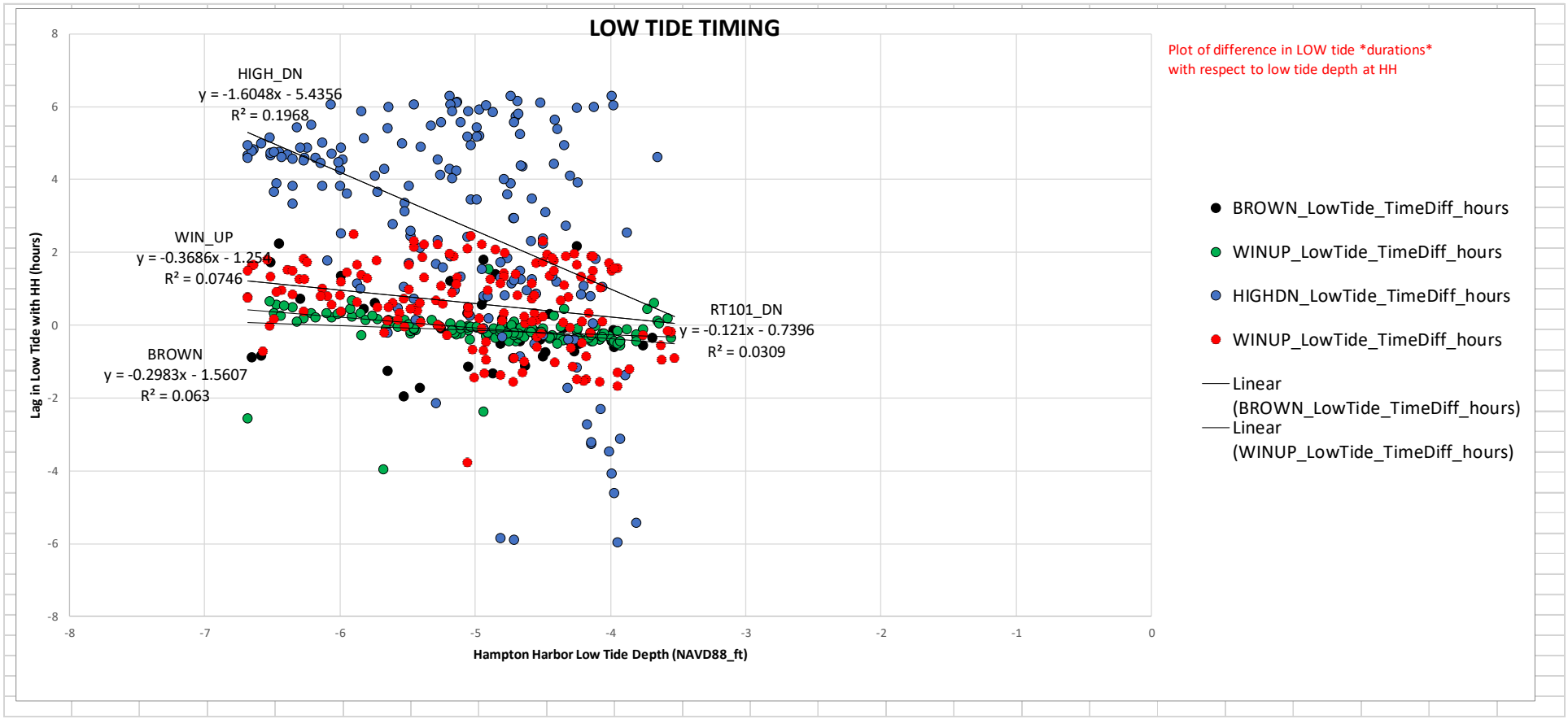
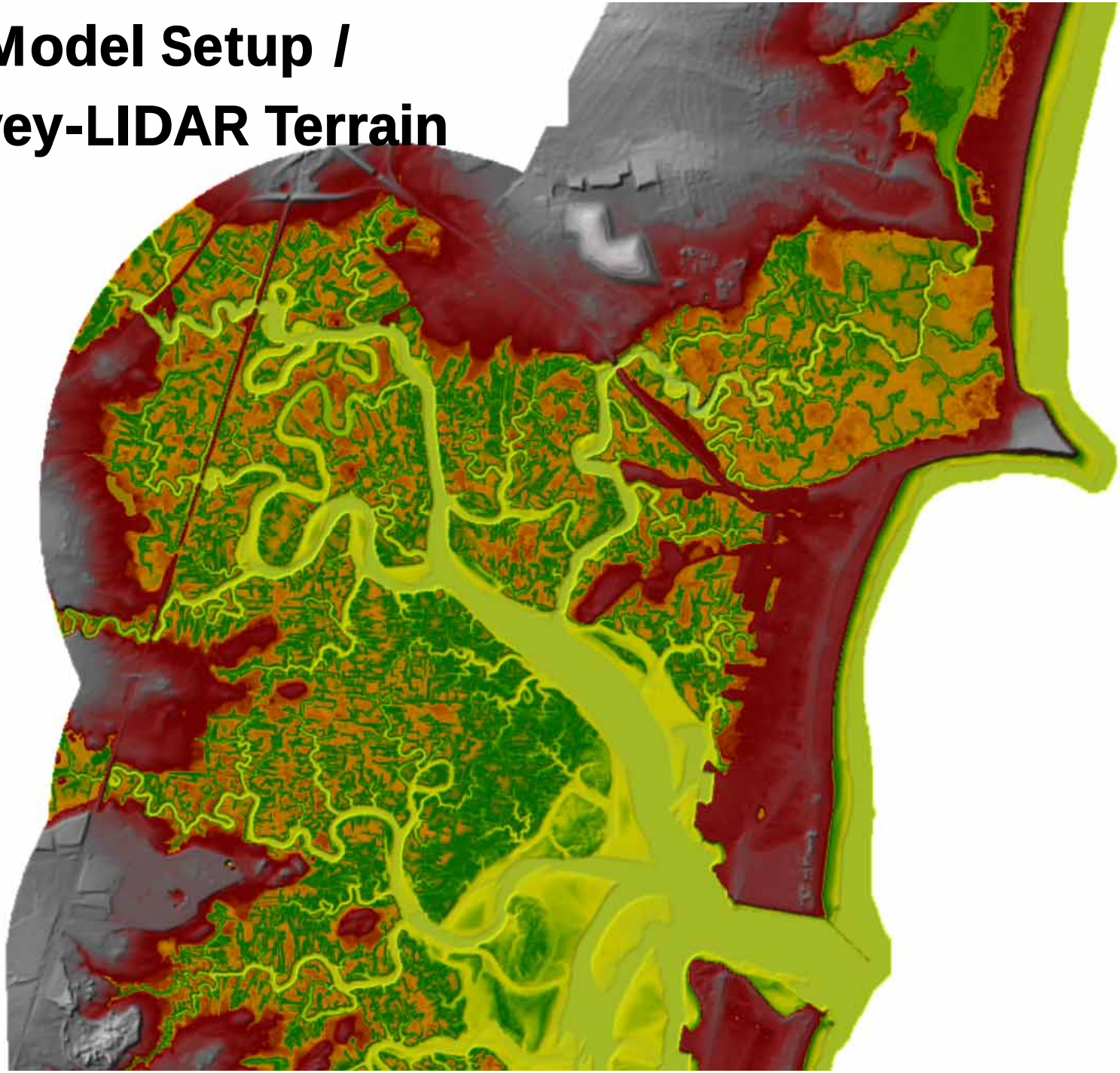


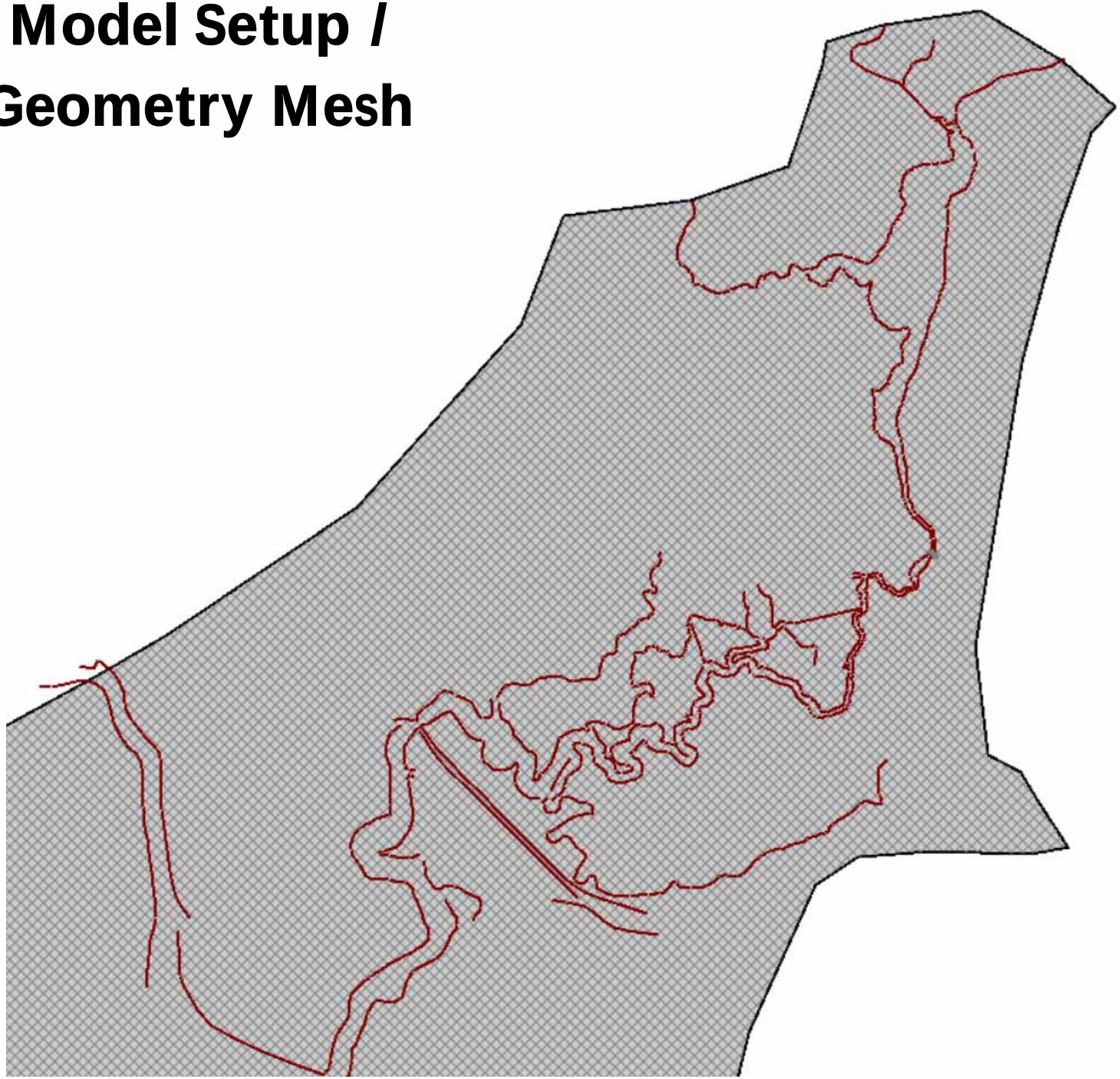
Data Collection / UNH Water Levels



Model Setup / Survey-LIDAR Terrain

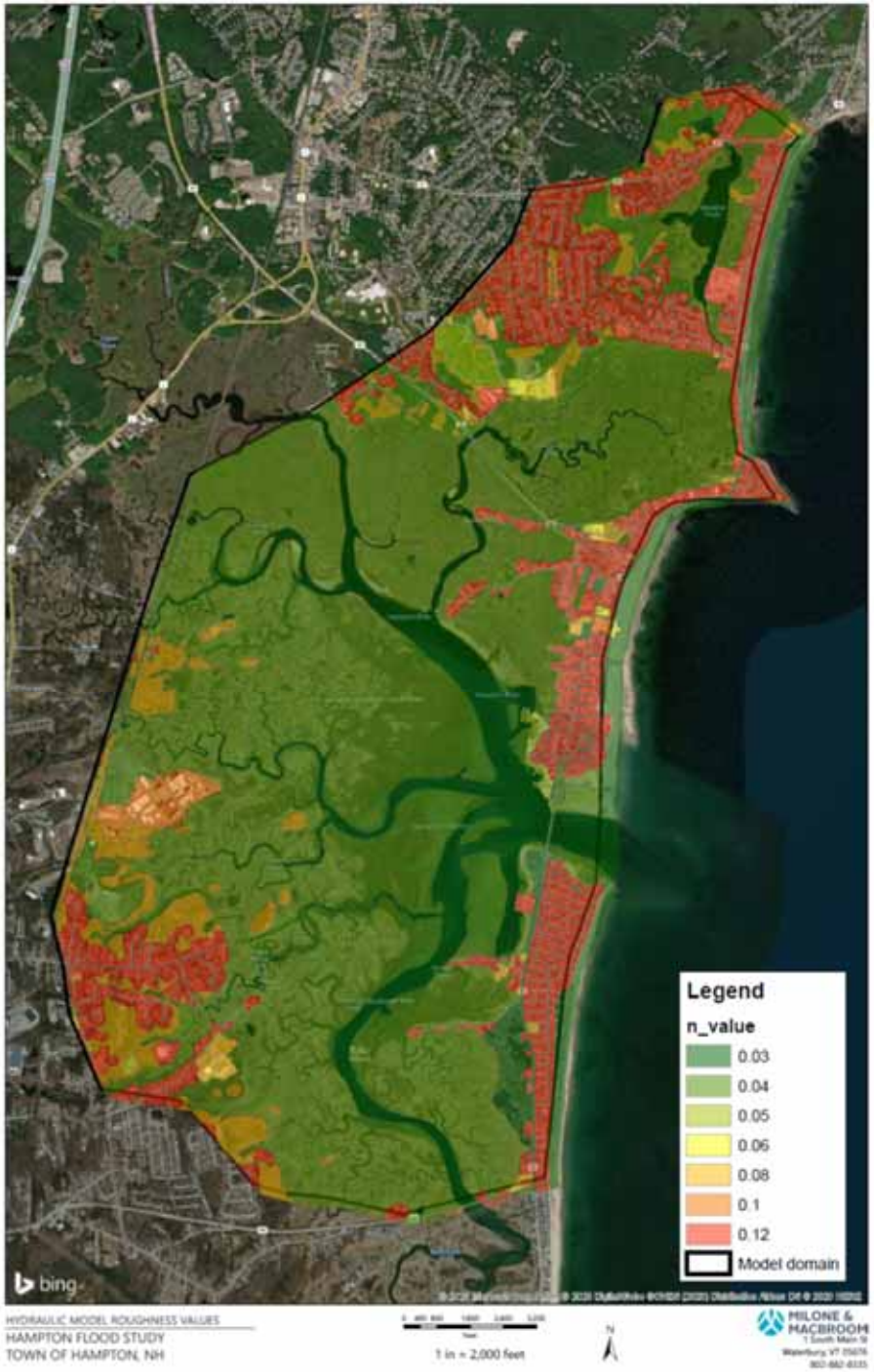


Model Setup / Geometry Mesh



Model Setup / Hydraulic Roughness

- Based on land cover
- Manning's N



Alternatives Analysis Summary – Meadow Pond

#	Alternative	Results / Recommendations
1	Increase culvert size at Winnacunnet Road	Flood levels decrease ~0.1 feet downstream of culvert and increase ~0.5 feet upstream of culvert (0.2 feet at Greene Street). Throttle remains in fill around buildings. Limited change in submergence of storm drain outlets.
2	Increase culvert size at Winnacunnet Road and remove fill in narrow channel	Same pattern as enlarging culvert but more water is let into Meadow Pond area due to fill removal. This alternative corrects the tidal lag, but impacts homes and infrastructure already in place.
3	Dredging / phragmites removal	Flood storage is increased and flood levels drop 0.3 to 1.0 feet in Green and Gentian areas. Still some minor flooding during King Tide.
4	Ditch / marsh remediation	
5	Elevate floodprone roads such as Greene Street, Gentian Road, and Meadow Pond Road	Roads passable. No change in flooding to surrounding areas. More water may get trapped around houses from precipitation as drianage infrastructure submerged.
6	Improve drainage on Green Street, Gentian Streets, and Kings Highway.	Top of pipes at EL 2.5 FT and inverts around EL 1.0 FT NAVD88. Innundated for ?? hours during existing conditions and ?? hours during other alternatives. Force main required. Outlet to downstream side of Winnicunnet and target elevation would be above 2050 high tide at EL ????.
7	Elevate floodprone houses	This alternative is recommended throughout study area. Target elevation for lowest living floor would be ????. This may require a change in zoning regulations.
8	Managed retreat - house and fill removal along Winnacunnet Road, Green Street, Gentian Street, High Street	Modeling shows several of the lowest lying areas to be regularly inundated, and condtions to get worse with predicted sea-level rise and increasing storm sizes. Managed retreat through FEMA-buyouts and other mechanisms should be considered ????
9	Tide gate improvements or installation	

Alternatives Analysis Summary – Meadow Pond

ID	Description	Reduce Flooding	Reduce Erosion	Increase Public Safety	Naturalize the Marsh	Comparative Implementation Cost	Comparative Maintenance Cost
1	Increase culvert size at Winnacunnet Road	Poor	Poor	Poor	Fair	Fair	Fair
2	Increase culvert size at Winnacunnet Road and remove fill in narrow channel	Poor	Poor	Poor	Good	Fair	Fair
3	Dredging / phragmites removal	Good	Fair	Good	Poor	Fair	Poor
4	Ditch / marsh remediation	Fair	Fair	Fair	Good	Fair	Fair
5	Elevate floodprone roads such as Greene Street, Gentian Road, and Meadow Pond Road	Fair	Poor	Fair	Poor	Fair	Fair
6	Improve drainage on Green Street, Gentian Streets, and Kings Highway.	Good	Fair	Good	Poor	Poor	Fair
7	Elevate floodprone houses	Good	Fair	Good	Fair	Poor	Good
8	Managed retreat - house and fill removal along Winnacunnet Road, Green Street, Gentian Street, High Street	Good	Good	Good	Good	Poor	Good
9	Tide gate improvements or installation	Fair	Fair	Fair	Poor	Fair	Poor

Alternative 9 – Tide Gate Improvements or Installation

- Fixing leaky flapper gates will create short-term improvements to local drainage, but will not change drainage setting enough to eliminate flooding now or in the future.

- Short-term fix as modeling shows that gravity drainage is not effective now and will be impossible in the future.