Town of Hingham
Climate Change Vulnerability, Risk Assessment and Adaptation Study

Steering Committee Update Meeting
June 10, 2015

KLEINFELDER
Bright People. Right Solutions.

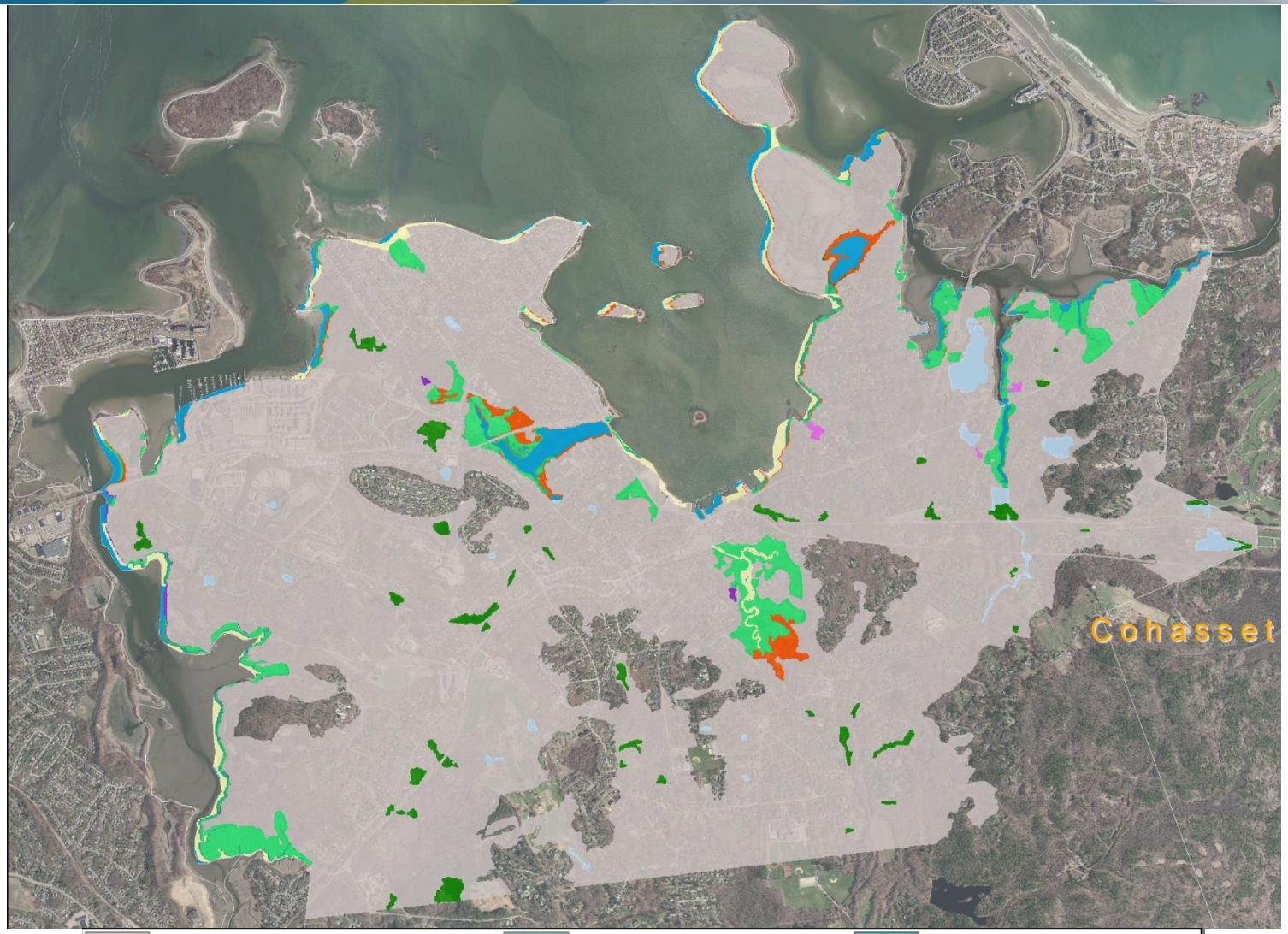
Today's Agenda

- Natural resources evolution summary:
  - Maps (2011, 2030 and 2070)
  - Summary of impacts
- Adaptation strategies
- Schedule
- Public Outreach
  - Con Com/Planning Board Update Meeting
  - BOS Public Meeting

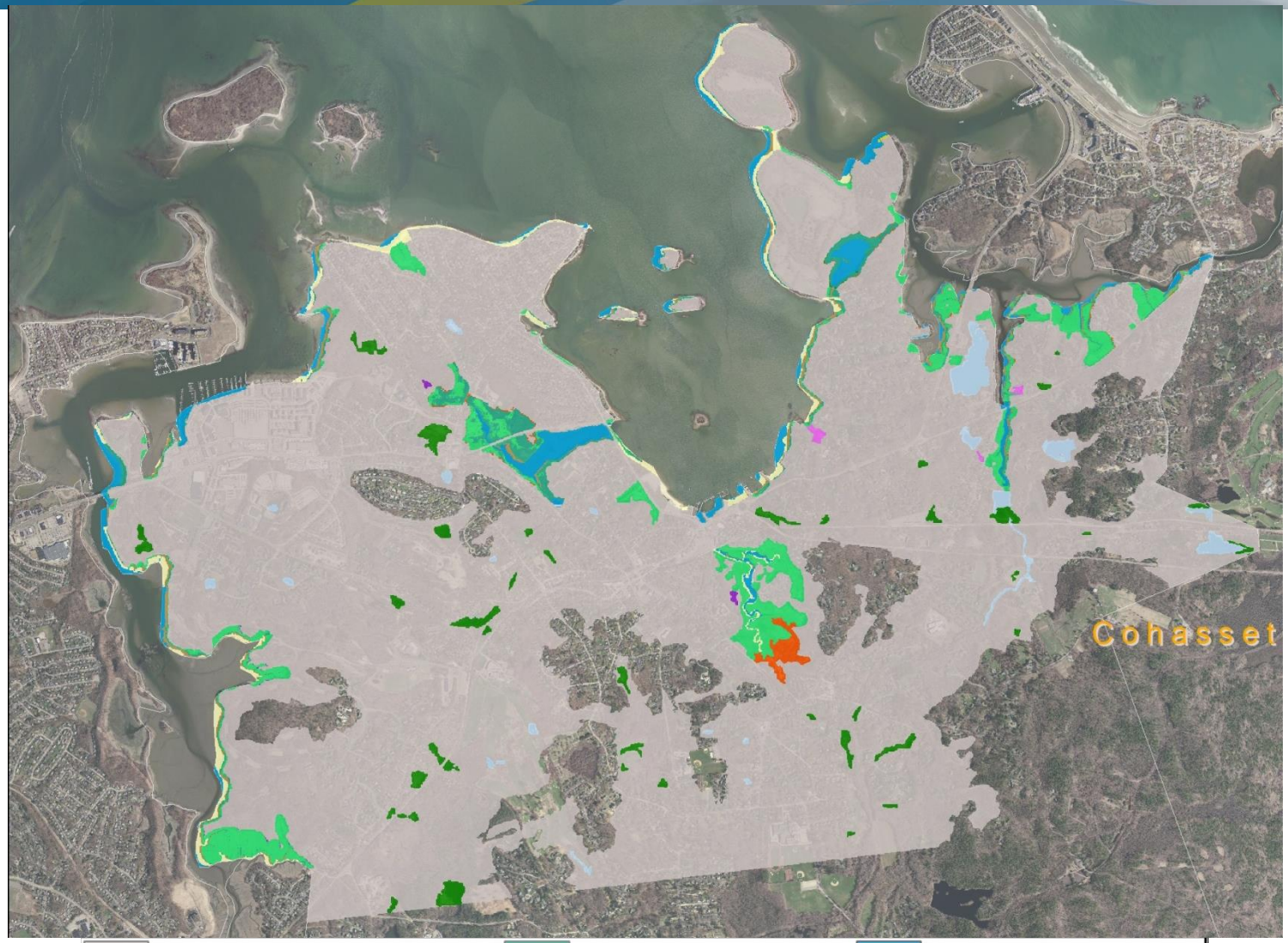
Natural Resources Evolution

- Evolution of natural resources modeled using Sea Level Affecting Marsh Migration (SLAMM) software
- Topography based on 2011 USGS LiDAR from Mass GIS
- 2011 wetland layer classified by National Wetland Inventory (NWI) used as base line
- Model inputs include:
  - Accretion rates (marsh, beach, etc.)
  - Tidal range and attenuation
  - Freshwater parameters
  - Impervious surfaces
  - Storm surge not included

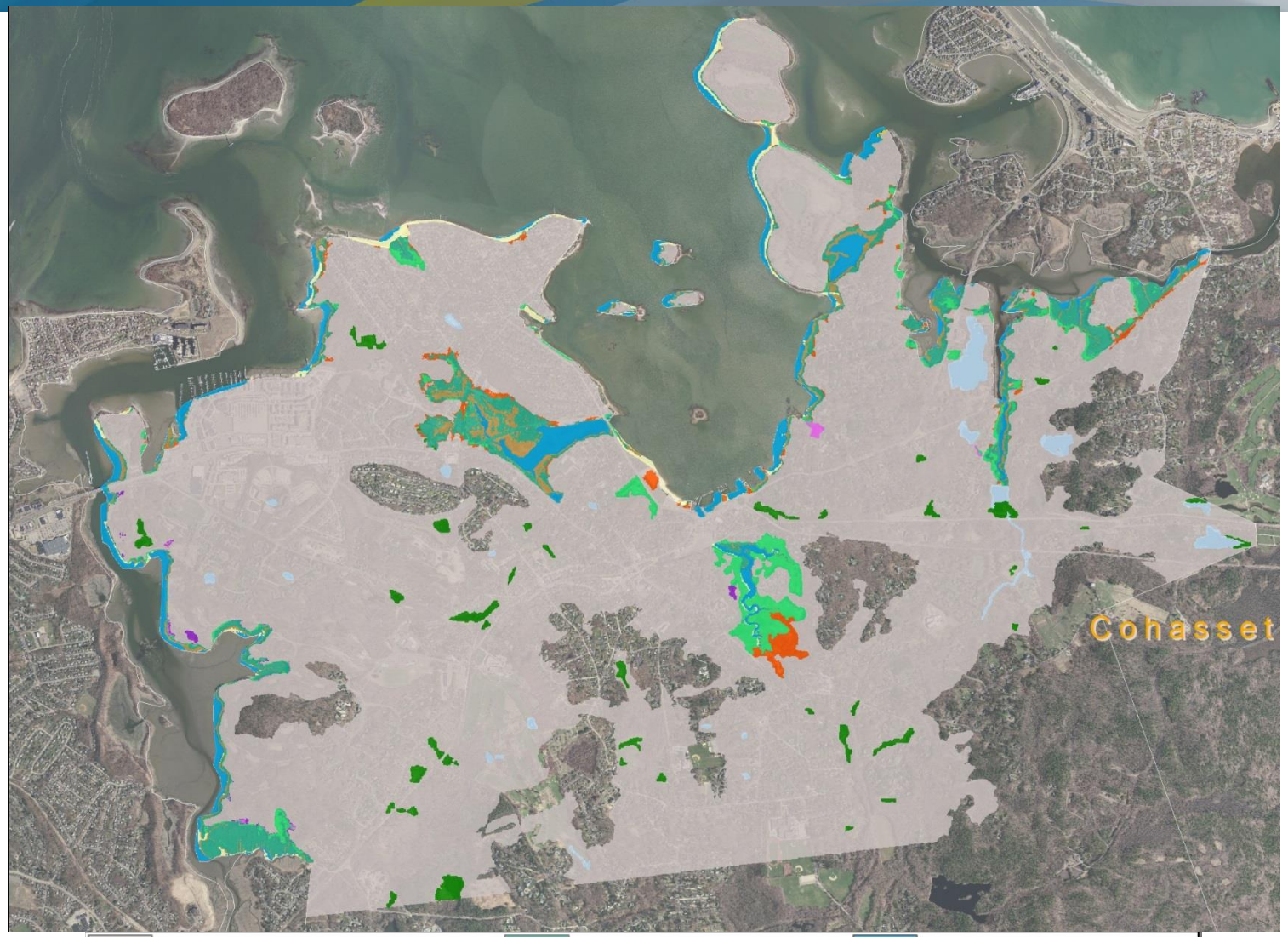
Natural Resources Evolution - 2011



Natural Resources Evolution - 2030



Natural Resources Evolution - 2070



Natural Resources Evolution - Summary

Town-wide Changes

2011 - 2030

- Loss of approximately 13 acres of high marsh (to low marsh – not necessarily a problem)
- Loss of approximately 10 – 30 acres of upland area
- Loss of approximately 28 acres of transitional marsh to high marsh
- Gain of approximately 28 acres of low marsh
- Gain of approximately 25 acres of tidal flats

Natural Resources Evolution - Summary

Town-wide Changes

2030 - 2070

- Loss of approximately 98 acres of high marsh (to low marsh)
- Loss of approximately 70 – 100 additional acres of upland area along edges of water bodies
- Loss of approximately 26 acres of estuarine beach along edges of estuaries – increase in tidal creeks
- Gain of approximately 100 acres of low marsh
- Gain of approximately 32 additional acres of tidal flats, especially in Broad Cove area
- Gain of approximately 38 acres of tidal creeks

Natural Resources Evolution - Summary

Broad Cove Area

By 2030

- Reduction in transitional marsh – converts to mix of low and high marsh
- Fringing high marsh begins to transition to low marsh and estuarine open water expands
- Significant loss of upland

By 2070

- Major loss of upland
- High marsh essentially disappears – converts to low marsh or un-vegetated tidal flats
- Becomes a degraded system by 2070

Natural Resources Evolution - Summary

Hingham Harbor Shoreline

- Shows retreat through 2030 with conversion of beach and upland to open water
- By 2070, significant loss of shoreline transitioning to open water
- Start of transitional marsh in previous upland areas

ADAPTATION STRATEGIES

Highest Risk Assets

- **Seawalls and Revetments**
  - Walton Cove
    - Structure is in total disrepair, but low consequence
  - Iron Horse Park
    - 8 of 12 have low-point elevations at or below Present 1% flood elevation (8.5 ft NAVD)
  - Lincoln St/Bridge St (Rt 3A) at Mill River crossing
    - Actual roadway is above 2070 0.2% flood elevation (14 ft NAVD)
- **Foster Elementary School**
- **Major roads**
  - Rt 3A (Broad Cove Rd, Otis St, Summer St/Rotary)
  - Rockland St
- **West Corner Pump Station**

Highest Risk Assets

Composite Risk Ranking	Type	Address/Location	Name/Number	Critical Elevation	Consequence Score	Present Probability (%)	2030 Probability (%)	2070 Probability (%)	Composite Risk Score
1	Bulkhead/ Seawall	Walton Cove	034-027-000-059-100	0.4	37	100	100	100	3667
2	Bulkhead/ Seawall	Iron Horse Park Area	034-051-000-003-100	7.0	60	25	50	100	2850
3	Bulkhead/ Seawall	Iron Horse Park Area	034-051-000-005B-200	6.6	57	30	50	100	2833
4	Revetment	Bridge Street	034-045-000-002-100	6.6	50	30	50	100	2500
5	Bulkhead/ Seawall	Iron Horse Park Area	034-051-000-059-100	4.8	33	50	50	100	2000
6	Bulkhead/ Seawall	Iron Horse Park Area	034-051-000-001-200	7.8	60	5	30	100	1890
7	Bulkhead/ Seawall	Bridge Street	034-045-000-002-200	7.6	50	10	30	100	1700
8	Revetment	Bridge Street	034-045-000-002-300	7.7	50	10	30	100	1700
9	Facility	55 Downer Ave	William L Foster Elementary School	6.1	63	0	10	100	1457
10	Bulkhead/ Seawall	Iron Horse Park Area	034-051-000-004-100	8.4	60	2	10	100	1440
11	Bulkhead/ Seawall	Iron Horse Park Area	034-050-000-050-200	7.3	40	10	30	100	1360
12	Roadway	0	Rockland St and Kilby St	7.6	30	10	50	100	1200
13	Roadway		Otis St (Rt 3A) at Hingham Bathing Beach	8.7	50	1	10	100	1175
14	Revetment	Martin's Well	034-030-000-011-100	5.3	23	30	50	100	1167
15	Groin/ Jetty	Bridge Street	034-045-000-002-400	6.8	23	30	50	100	1167
16	Bulkhead/ Seawall	Iron Horse Park Area	034-051-000-005-100	8.5	50	1	10	100	1163
17	Revetment	Broad Cove Entrance	034-039-000-009-100	8.5	47	2	10	100	1120
18	Facility	338 Rockland St	West Corner Pump Station	8.2	50	1	5	100	1088
19	Roadway		Broad Cove Rd (Rt 3A)	6.3	47	0	10	100	1073
20	Roadway		Beach Rd and Beach Ln	7.8	33	5	25	100	1000

Regional Areas of Concern

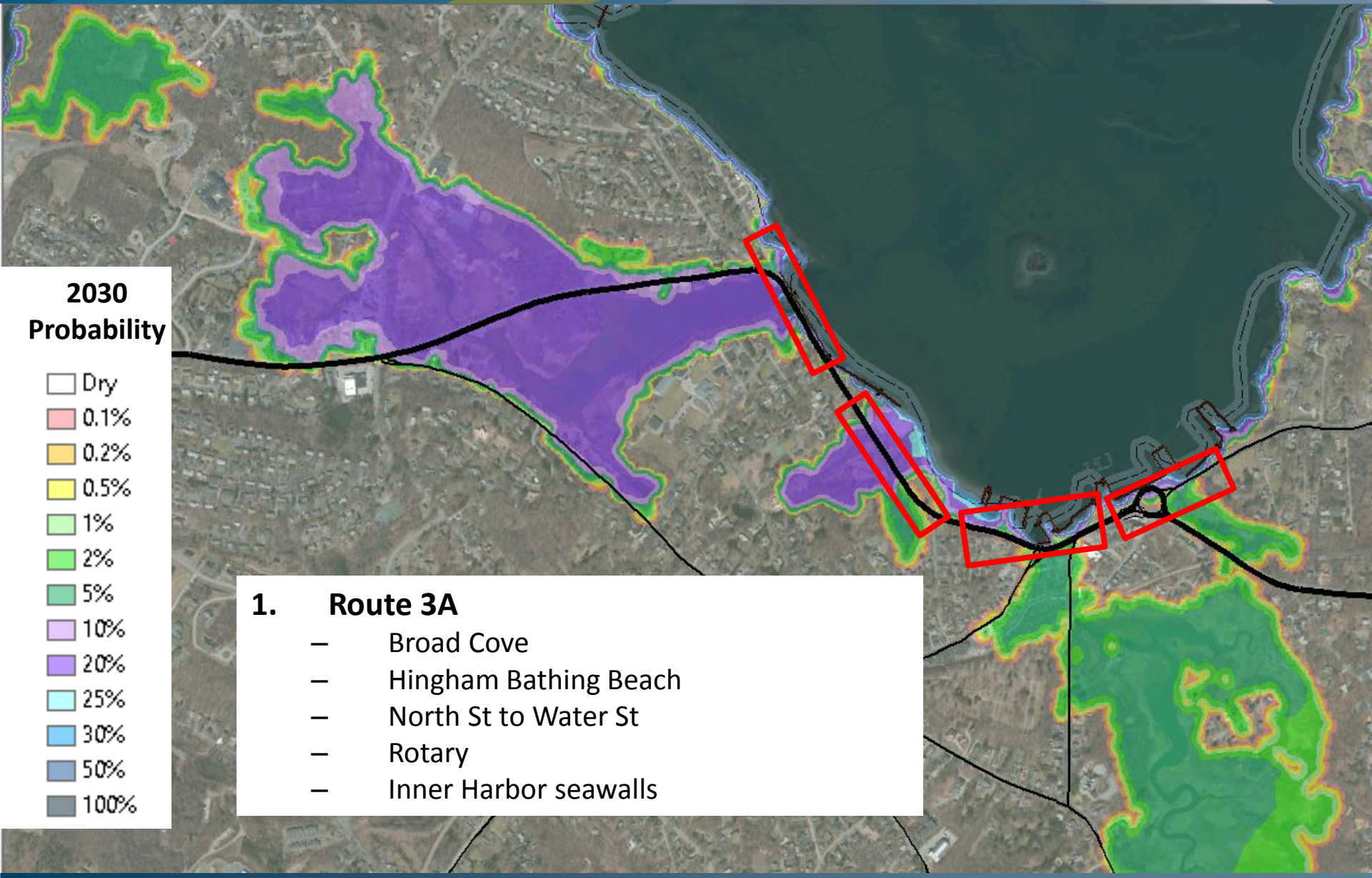
1. **Route 3A**
   - Broad Cove
   - Hingham Bathing Beach
   - North St to Water St
   - Rotary
   - Inner Harbor seawalls

2. **George Washington Blvd**
   - South of Hingham District Court to the bridge

3. **Rockland St**
   - Weir River crossing (Kilby St intersection)
   - Wier Street Extension to Hull St

4. **Hull St**
   - Straits Pond Dam

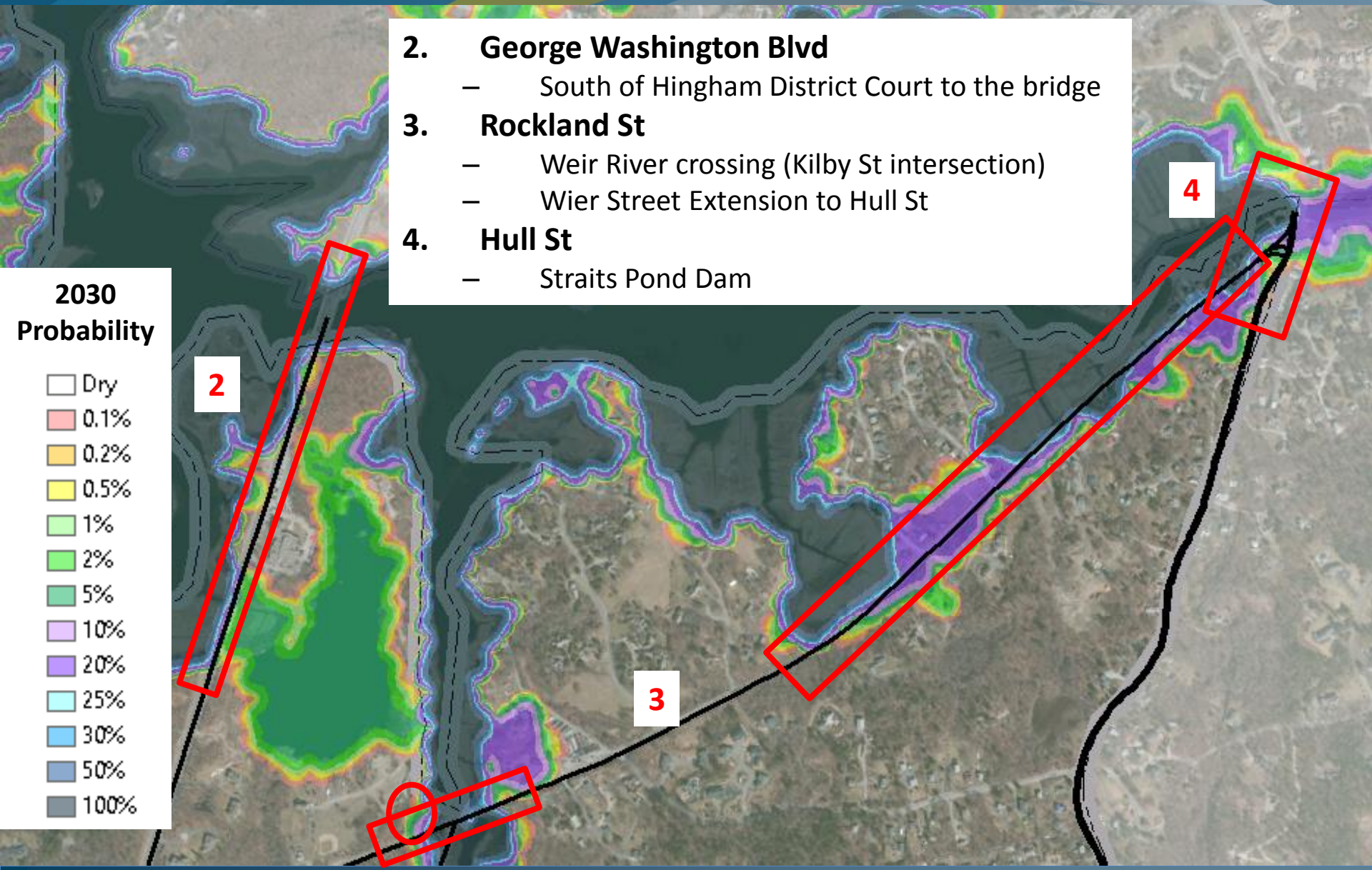
Route 3A (Broad Cove-Inner Harbor)



1. Route 3A

- Broad Cove
- Hingham Bathing Beach
- North St to Water St
- Rotary
- Inner Harbor seawalls

Regional Connectors

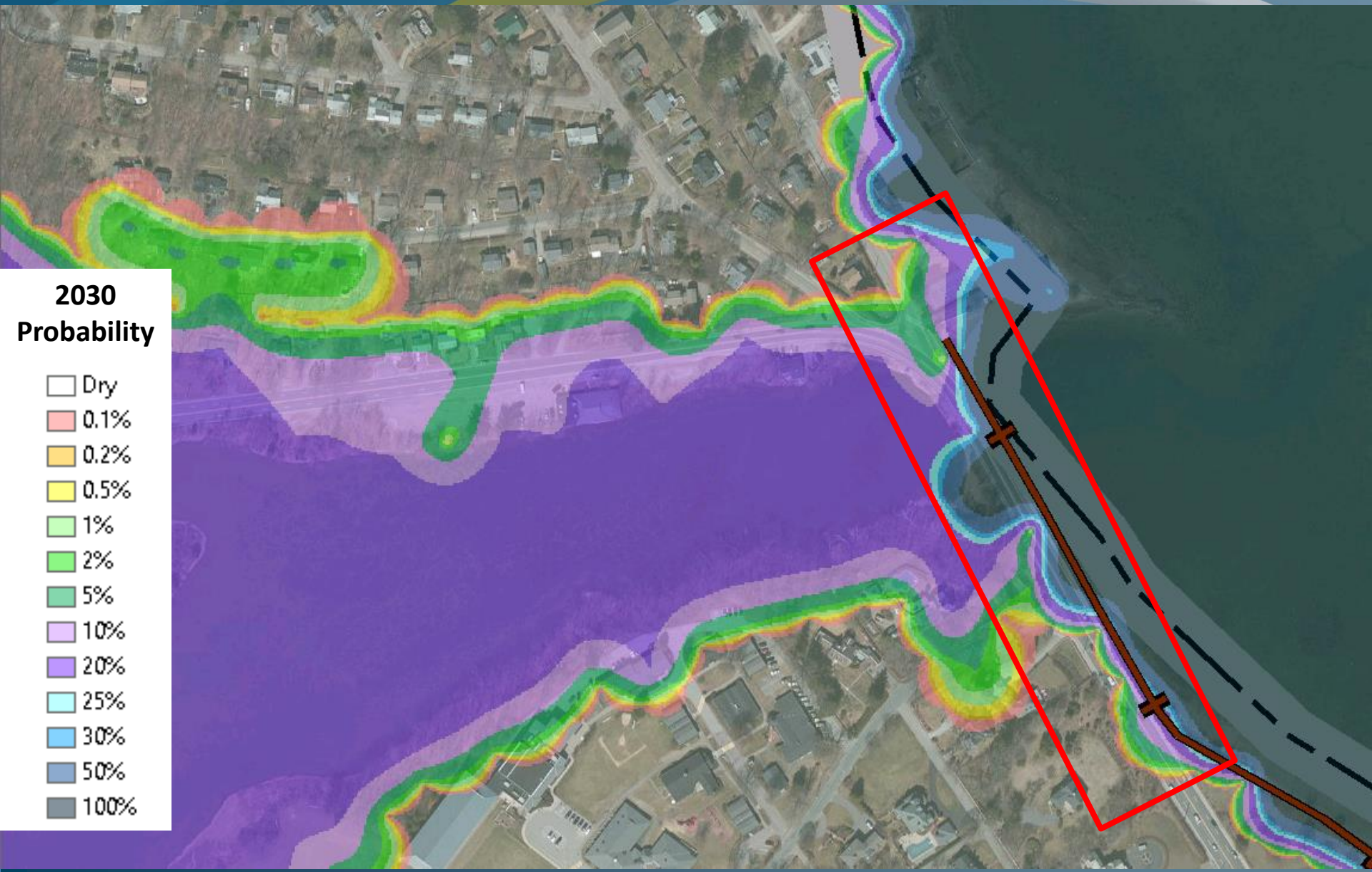


2. **George Washington Blvd**
   - South of Hingham District Court to the bridge
3. **Rockland St**
   - Weir River crossing (Kilby St intersection)
   - Wier Street Extension to Hull St
4. **Hull St**
   - Straits Pond Dam

Base Flood Elevations

	Present	2030	2070
Exceedance Probability	Water Surface Elevation (ft-NAVD88)	Water Surface Elevation (ft-NAVD88)	Water Surface Elevation (ft-NAVD88)
0.1	9.1	11.8	14.1
0.2	9	10.2	14
0.5	9	10.1	13.5
1	8.5	10	12.8
2	8.4	9.9	12.5
5	8	9	12.1
10	7.7	8.8	11.6
20	7.2	8.3	11
25	7.1	8.2	10.8
30	6.9	8.1	10.7
50	5	7.2	10.2
100	3.4	4.5	9.1

Route 3A at Broad Cove



Route 3A at Broad Cove

Impacted Facilities:

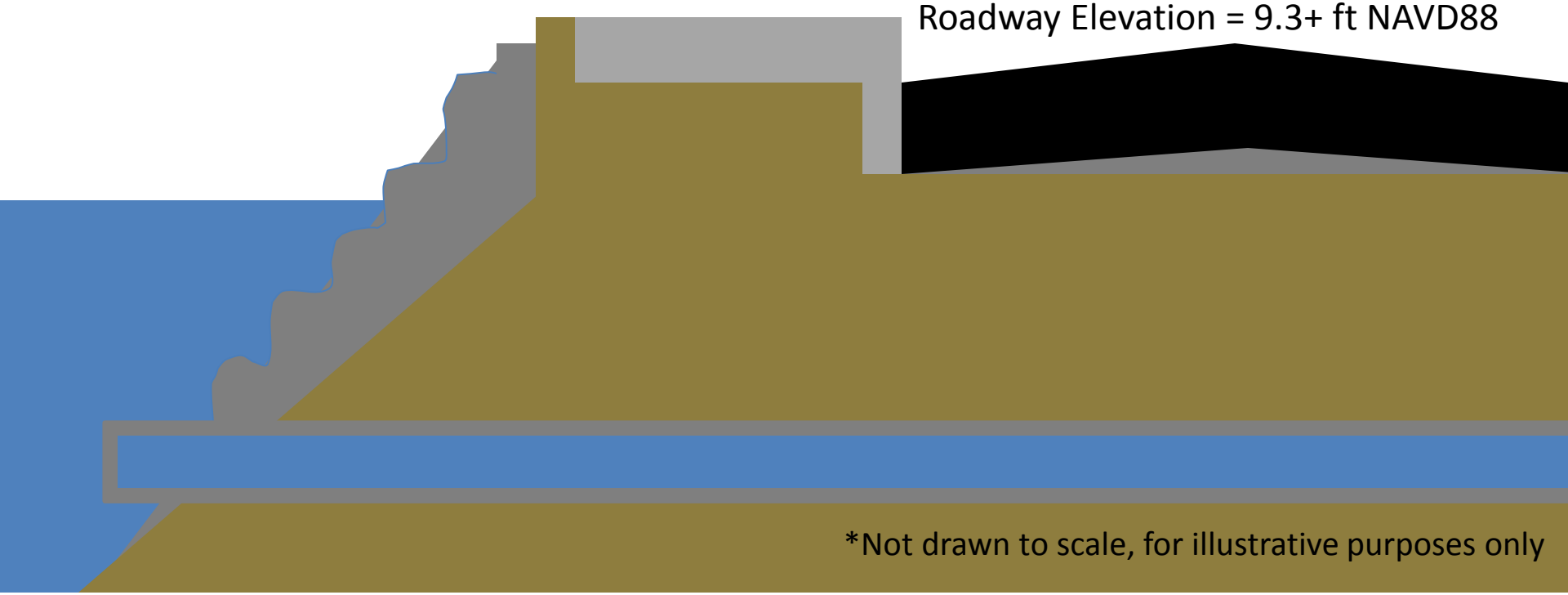
- Broad Cove Rd (Rt 3A), Downer Ave, Lincoln St
- Foster Elementary School, Derby Academy
- Broad Cove Sewer Pump Station
- Harbor House Nursing Center
- Pharmacy, gas station, businesses
- Residences

Existing Conditions

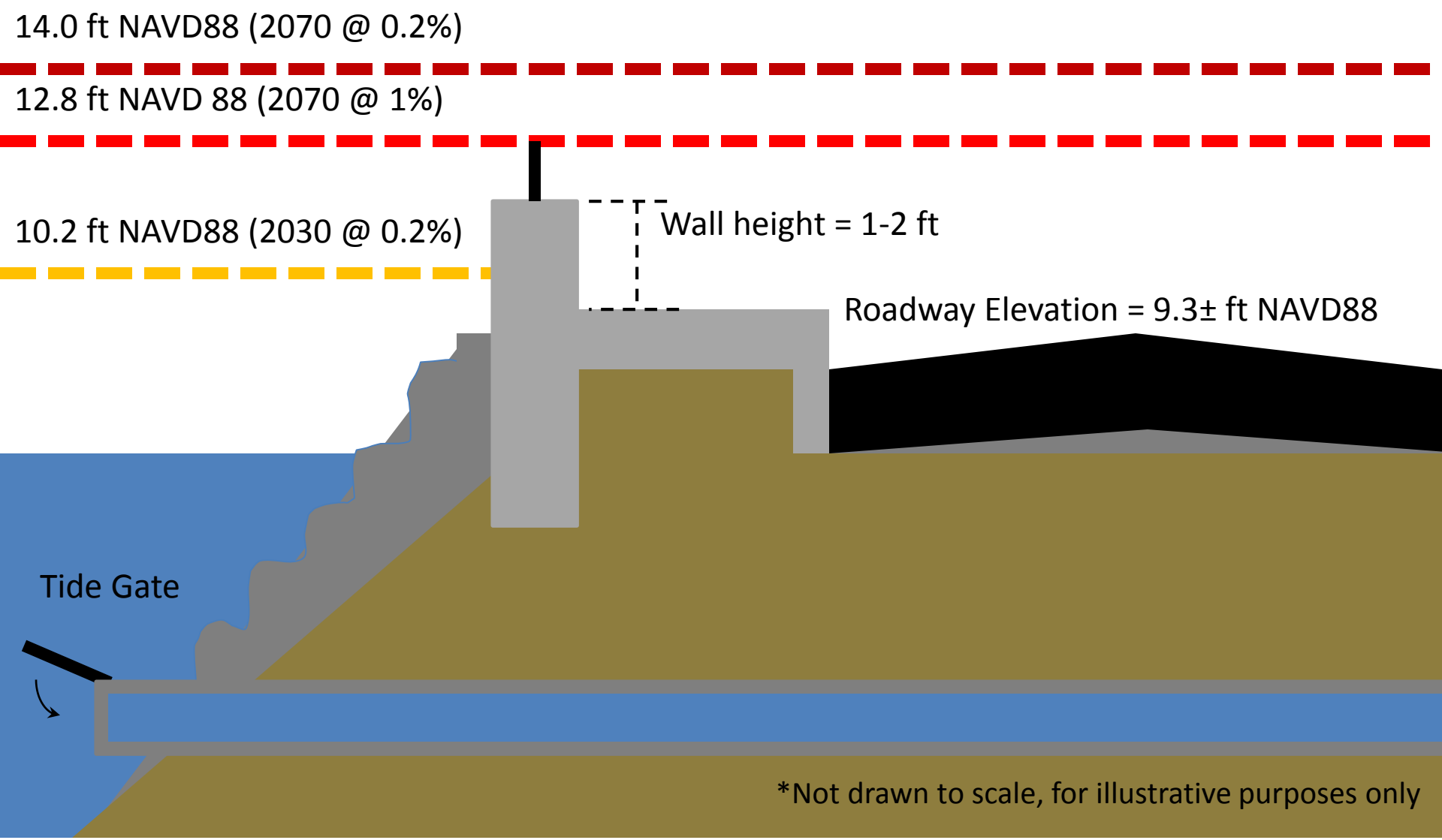
14.0 ft NAVD88 (2070 @ 0.2%)

12.8 ft NAVD 88 (2070 @ 1%)

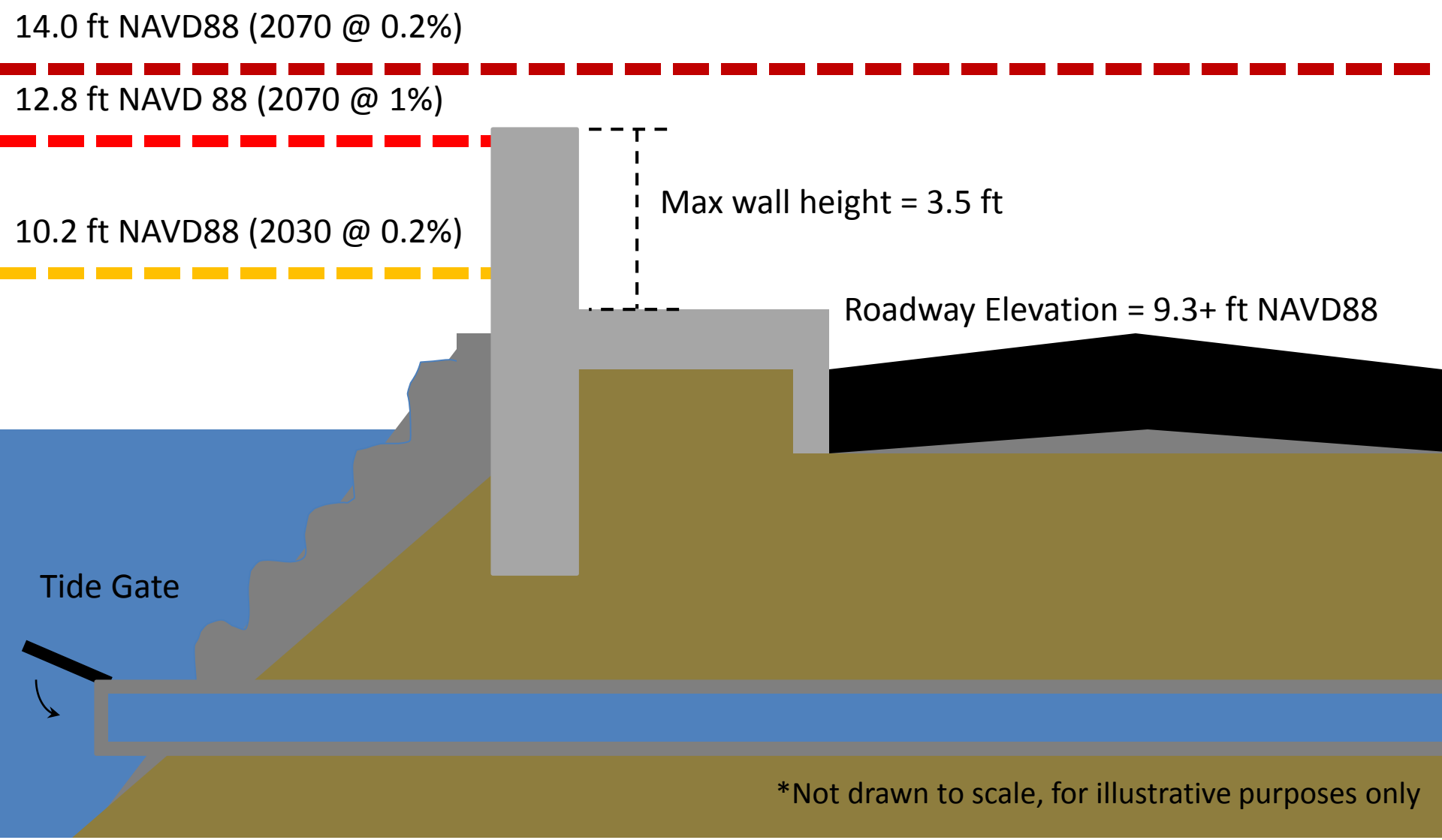
10.2 ft NAVD88 (2030 @ 0.2%)



Low Cost / Near Term Option: 1-2 ft Wall at Edge of Sidewalk

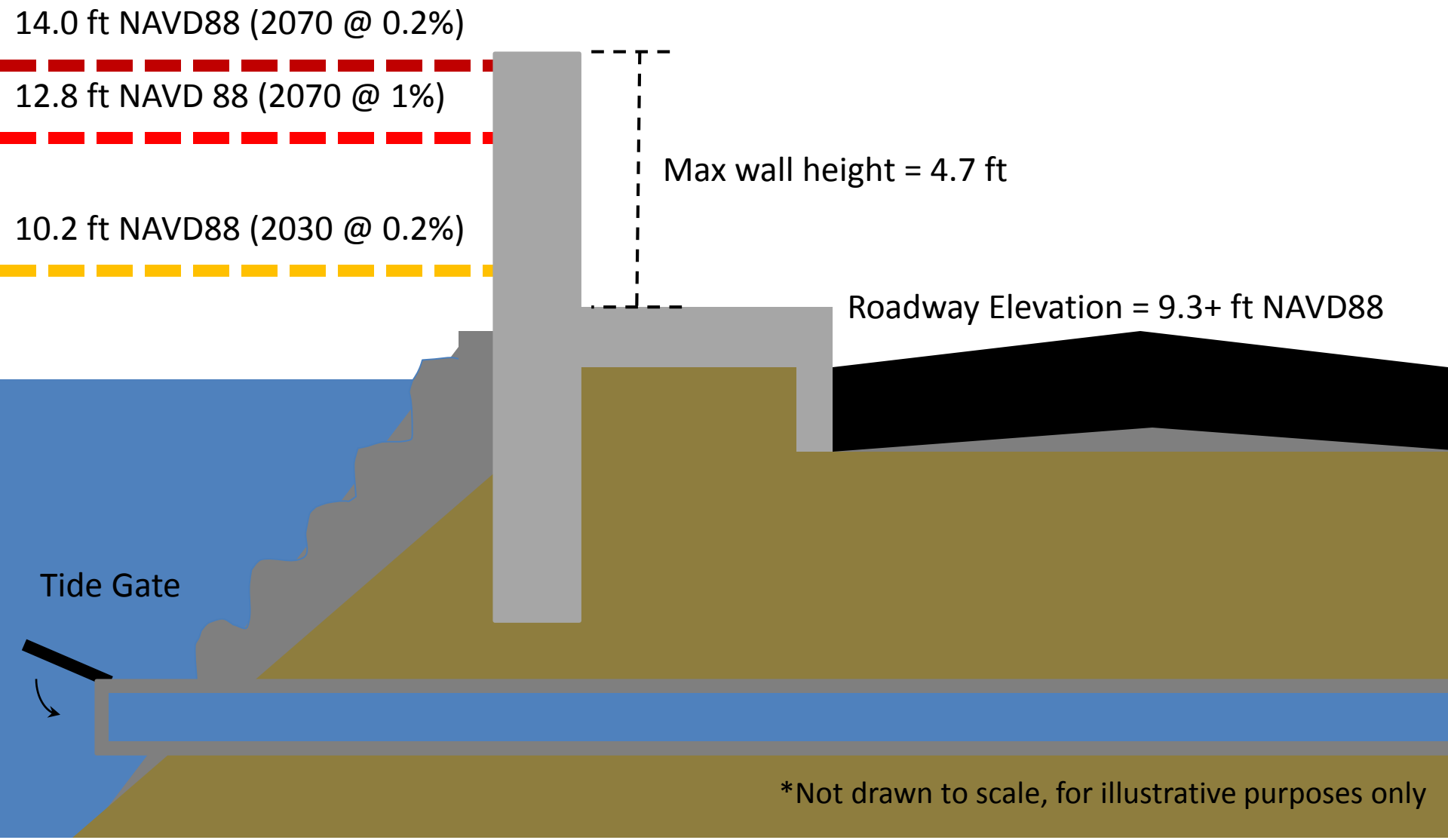


Low Cost / Medium Term Option: 3.5 ft Wall at Edge of Sidewalk



*Not drawn to scale, for illustrative purposes only

Long Term Option: Over Long Term, Increasing Wall Height Unsustainable

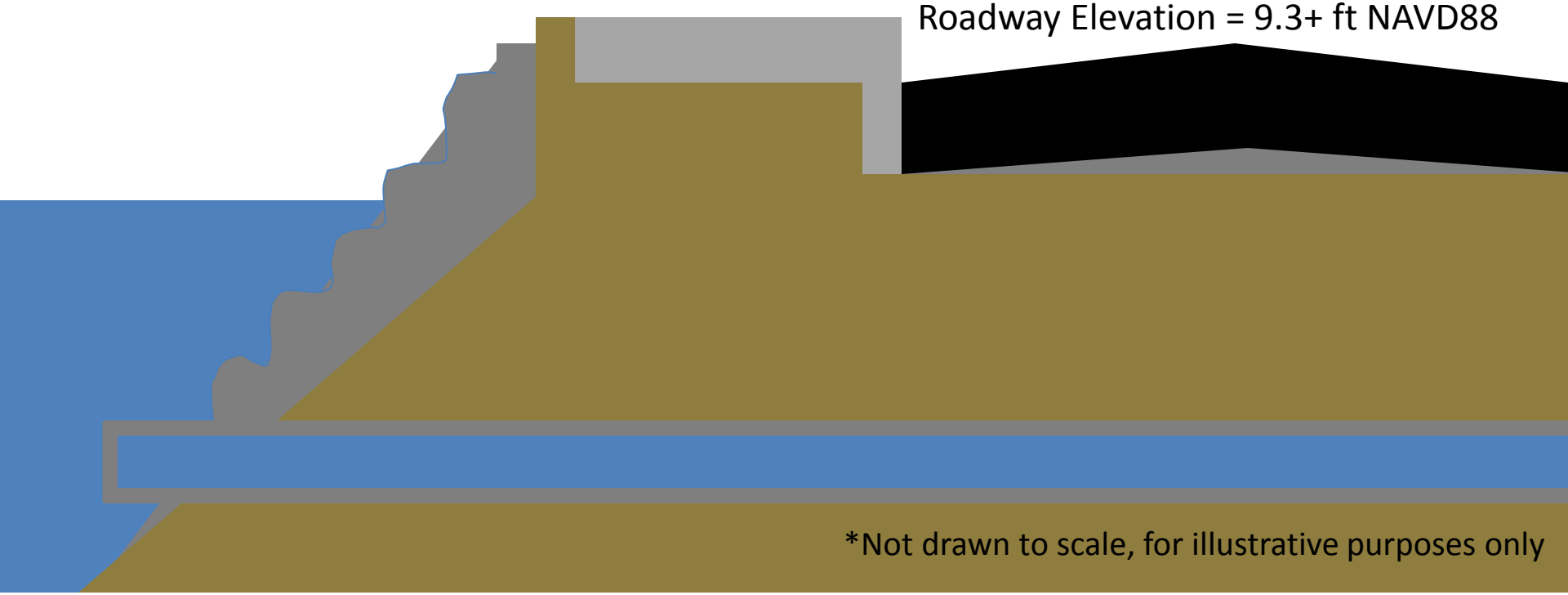


Existing Conditions

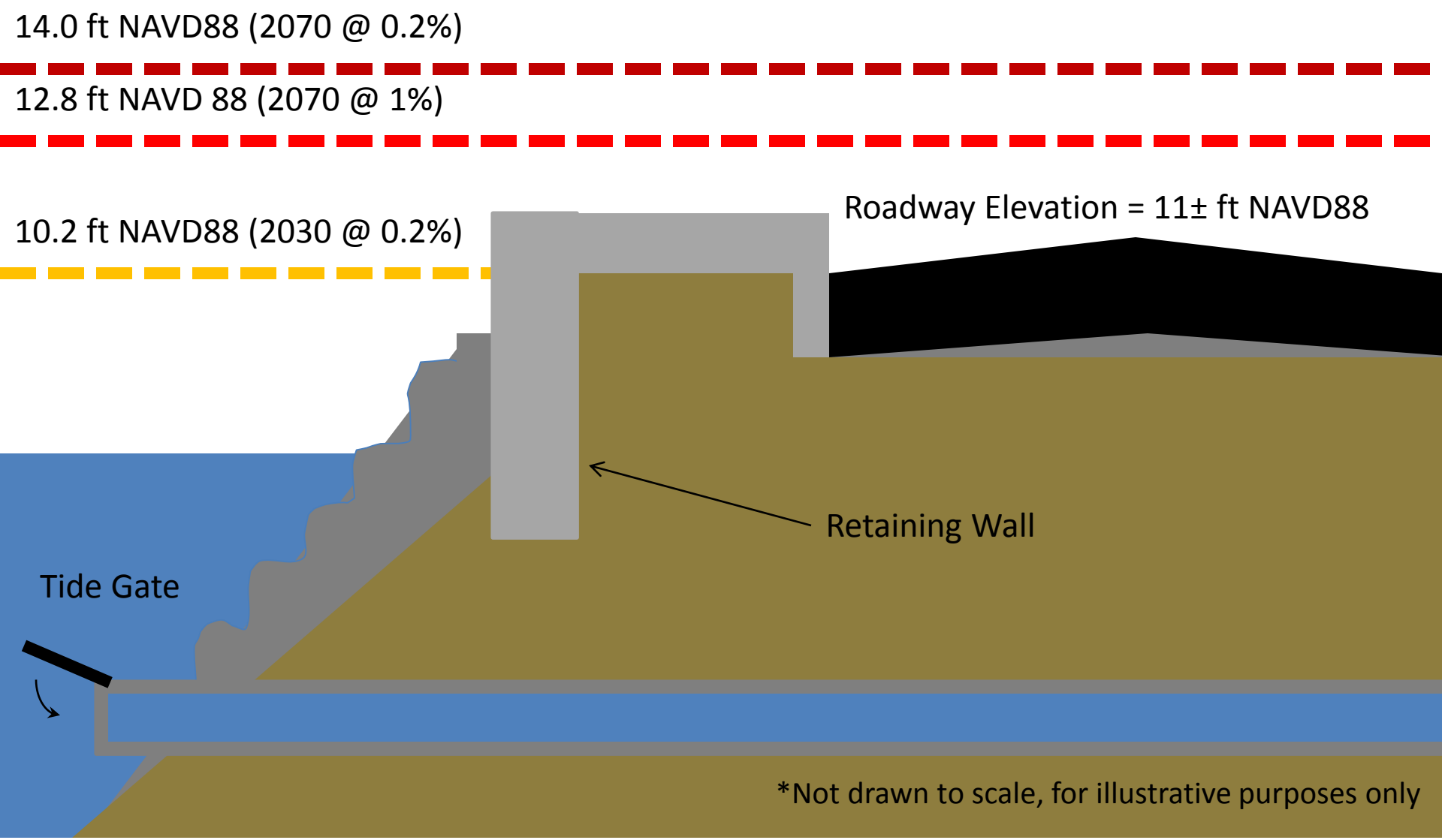
14.0 ft NAVD88 (2070 @ 0.2%)

12.8 ft NAVD 88 (2070 @ 1%)

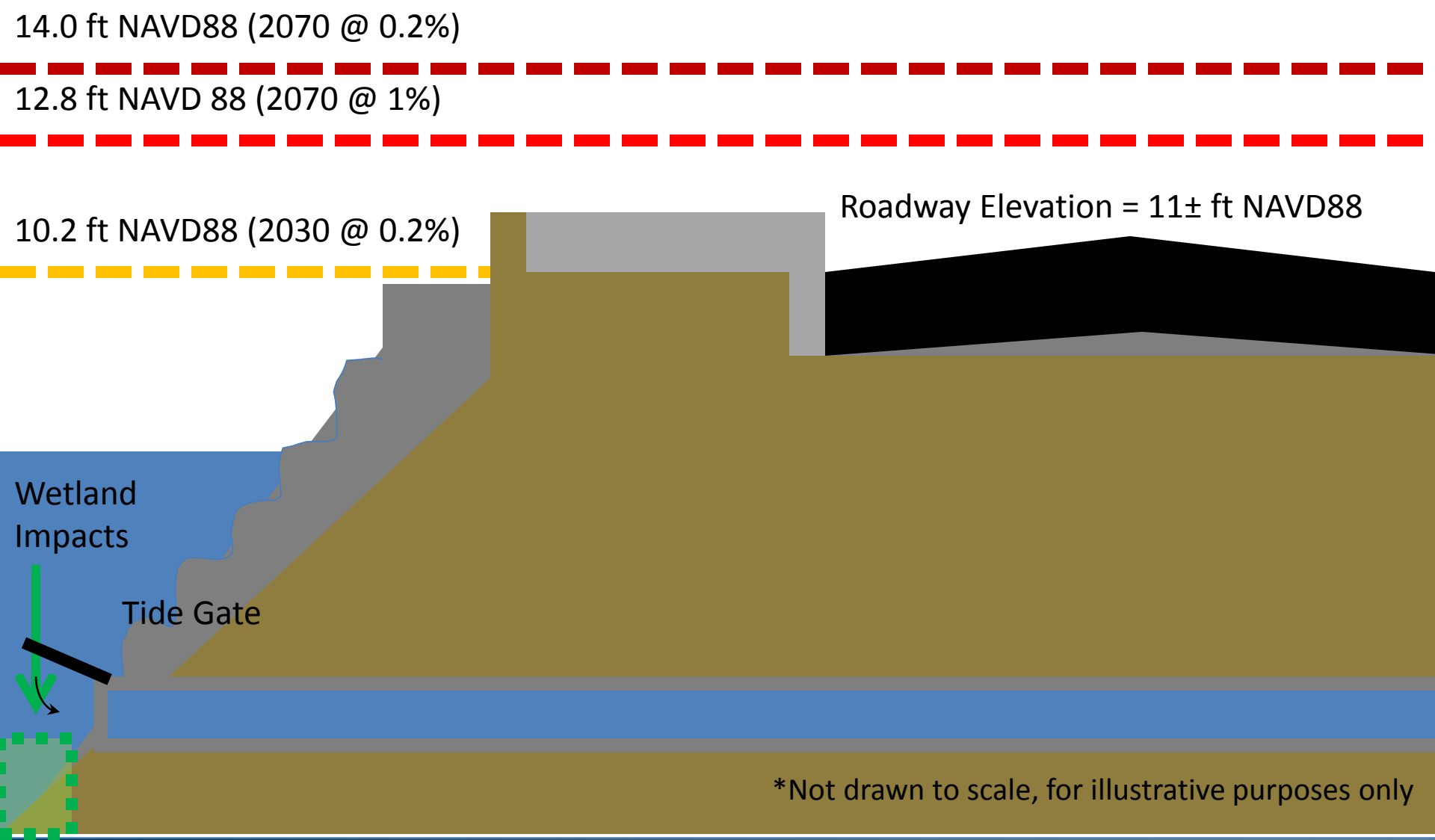
10.2 ft NAVD88 (2030 @ 0.2%)



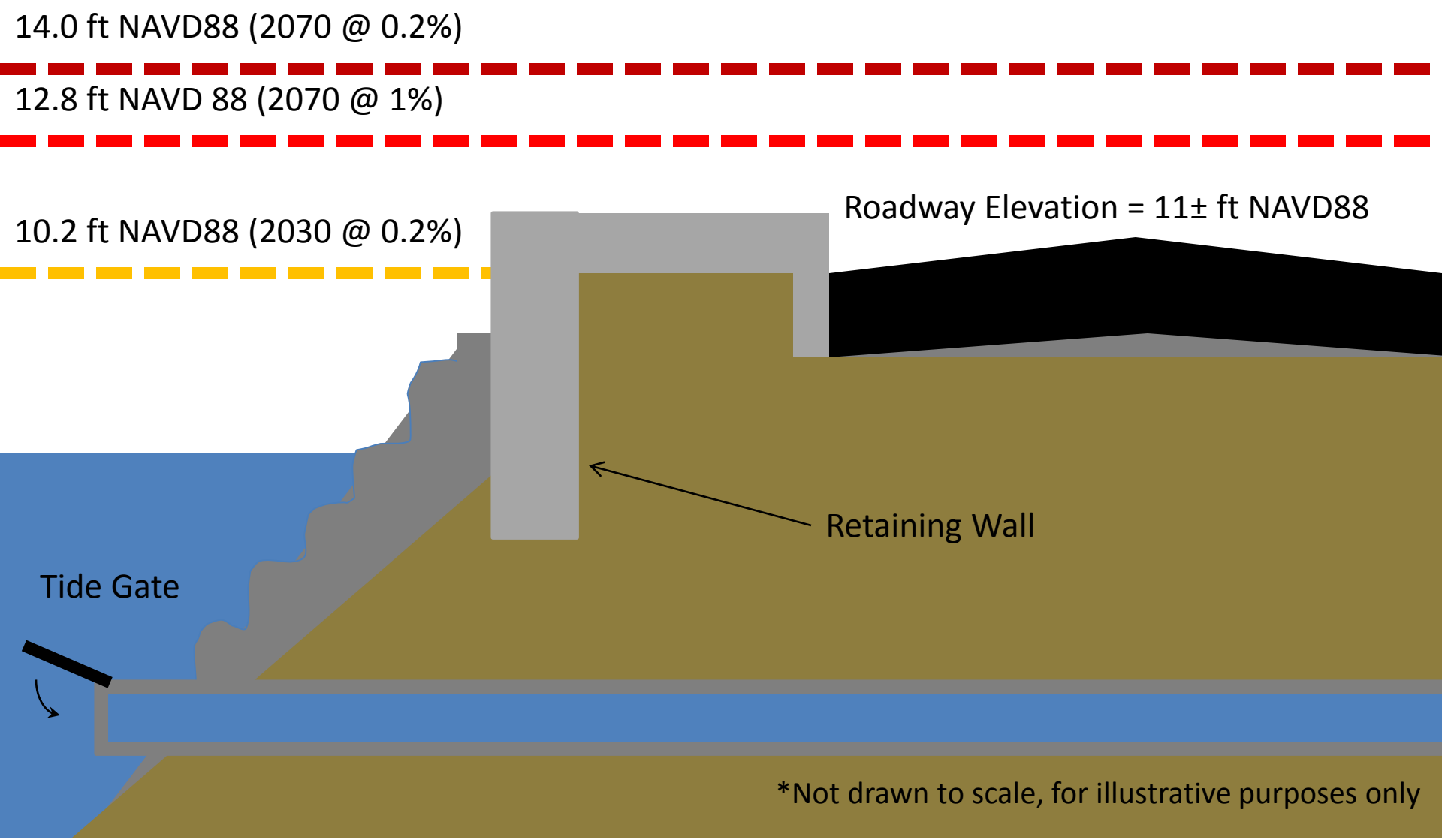
Recommended Option / Medium Term: Raise Road and Sidewalk to 11 ft ± NAVD



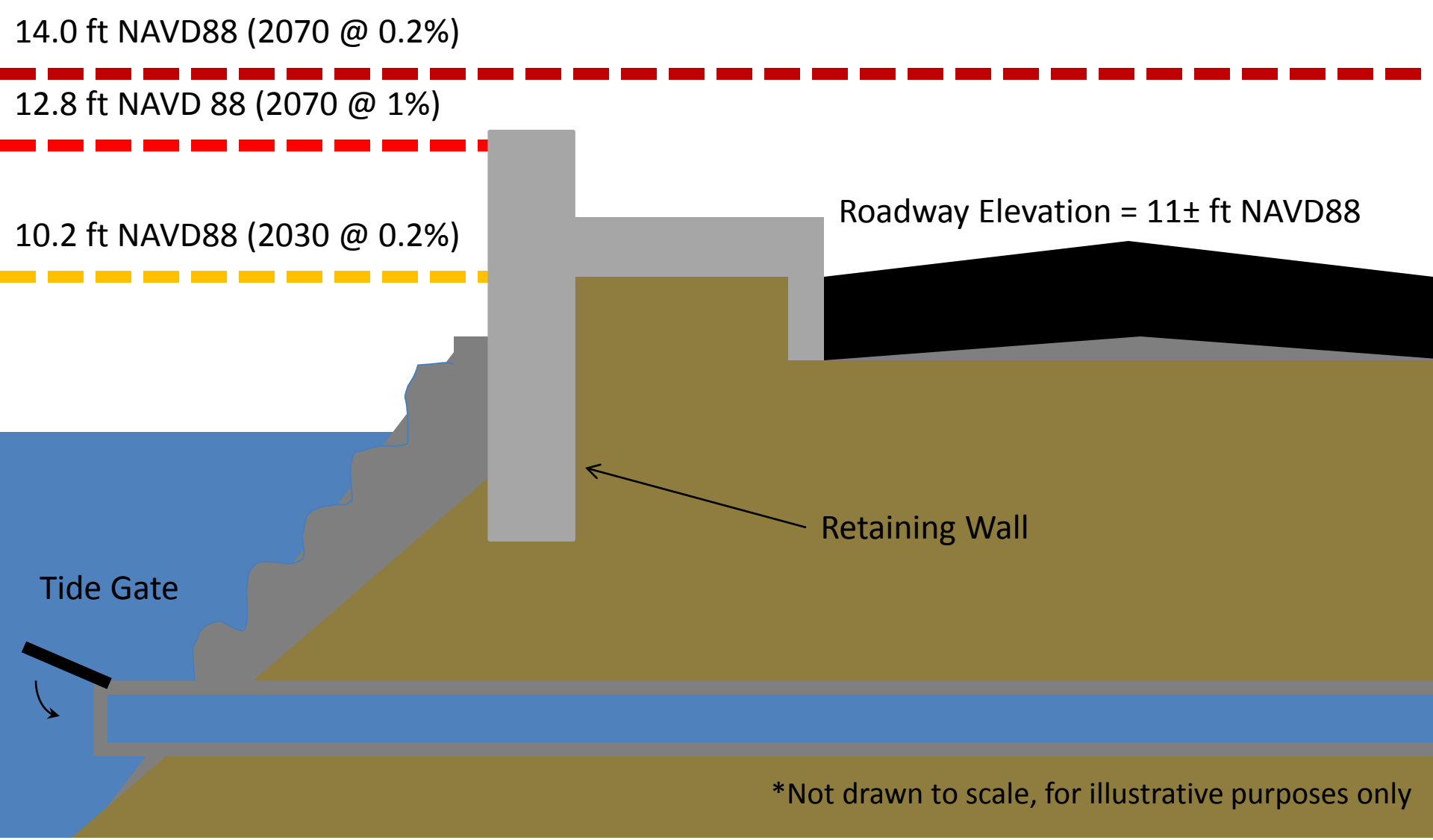
Alternative Medium Term Option: Raise Road and Sidewalk to 11 ft ± NAVD



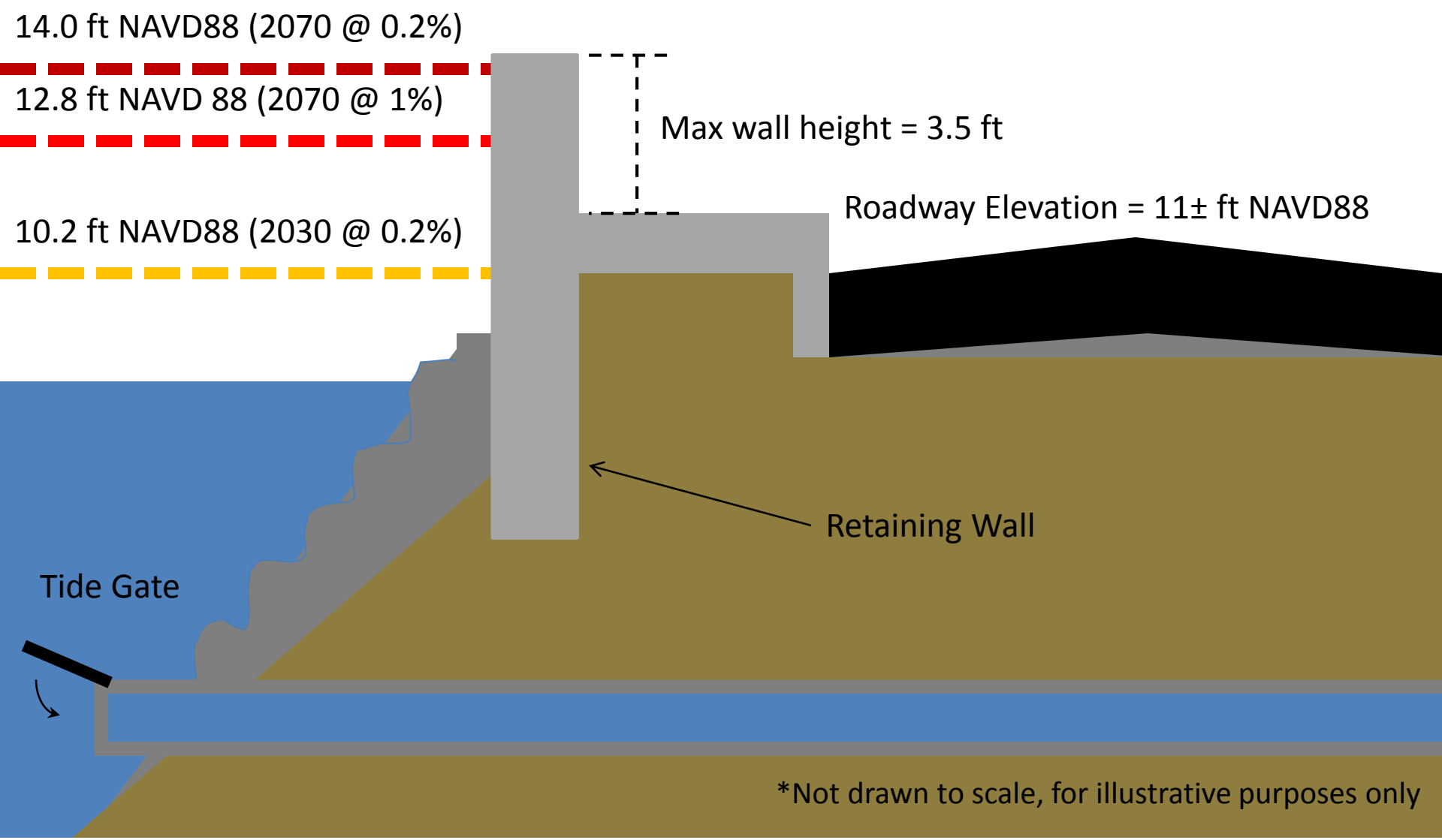
Recommended Option / Medium Term: Provides Flexibility to Increase Level of Protection Later



Recommended Option / Long Term: Provides Flexibility to Increase Level of Protection Later



Recommended Option / Long Term: Provides Flexibility to Increase Level of Protection Later

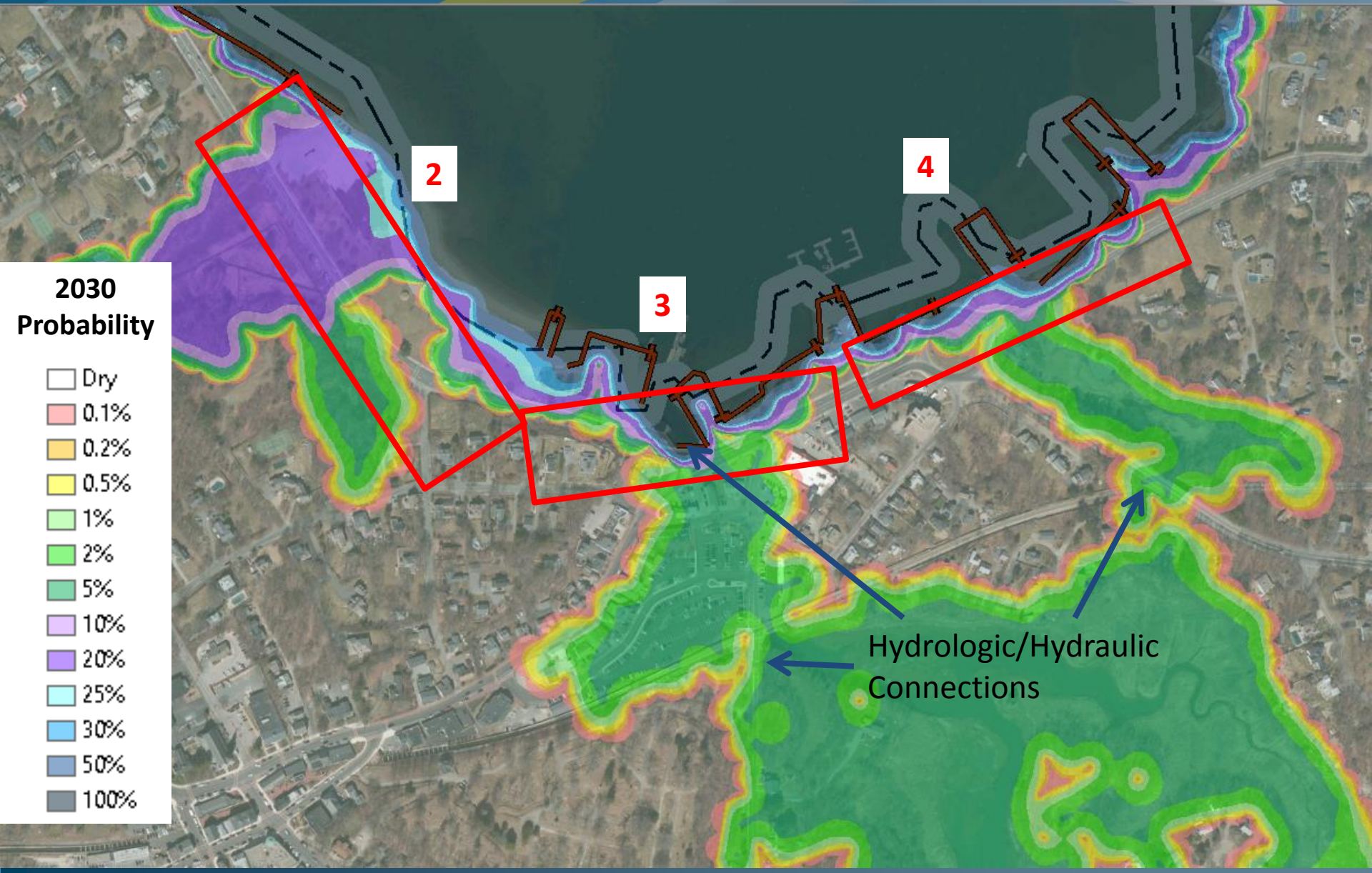


Route 3A at Broad Cove

Recommended Adaptation Options:

	Adaptation Strategies	Adaptation Cost
Present	• Evacuation planning for floodplain residents, businesses, institutions • Electronic warning signs for road closures / evacuation • Emergency student relocation plan • Identify alternate heliport locations for flooding emergencies • Capital planning, engineering design, environmental assessment for Rt 3A at Broad Cove entrance	$ $ $ $$
2030	• Raise Rt 3A at Broad Cove entrance to 11 ft ± NAVD • Add tide gate structure (type TBD) at Broad Cove entrance	$$$$ $$$
2070	• If needed, add up to 3.5 ft barrier wall to water side of Rt 3A sidewalk	$$

Route 3A at Bathing Beach & Inner Harbor



Route 3A at Bathing Beach & Inner Harbor

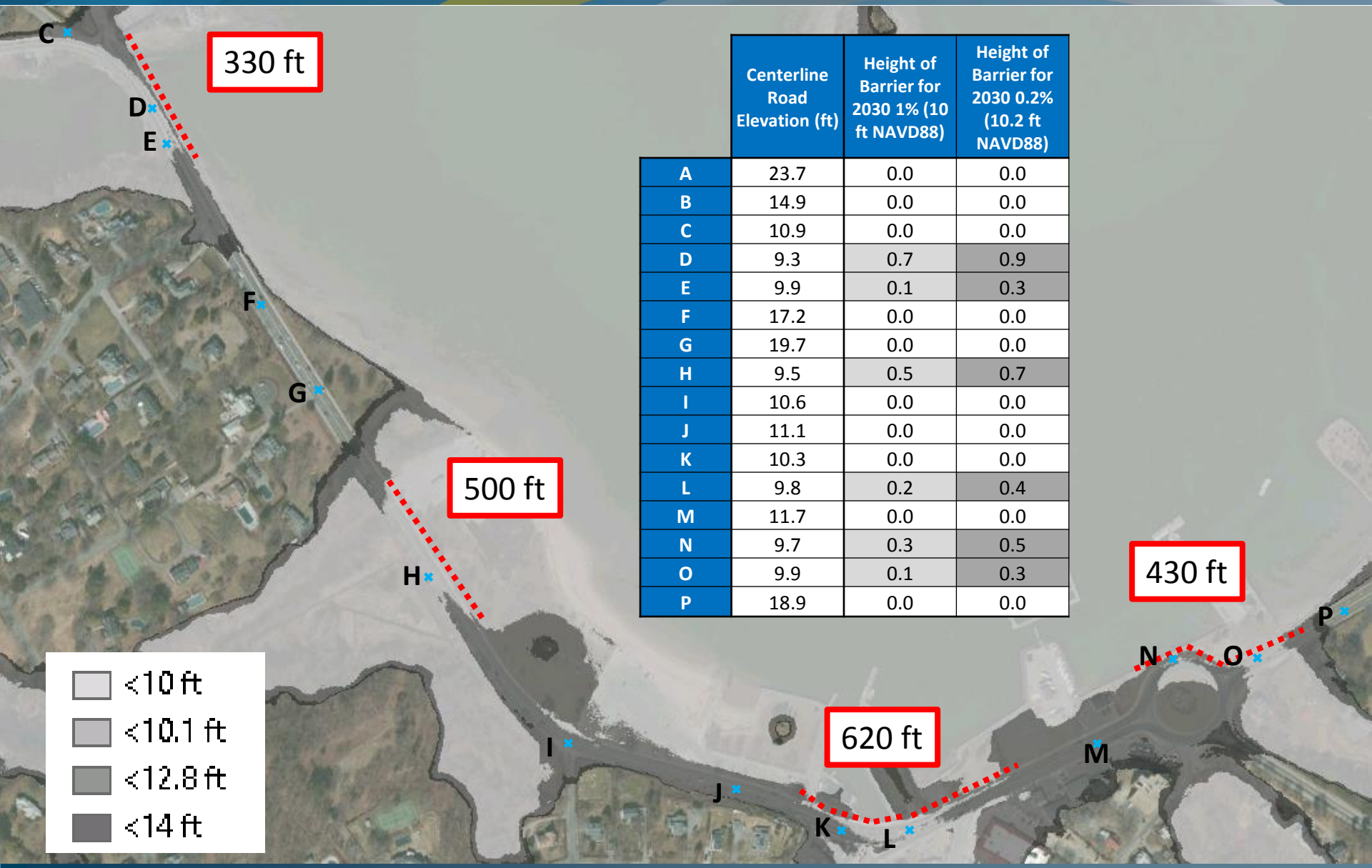
Impacted Facilities:

- Rt. 3A, North St, Water St, Mill St, Green St, Eldridge Ct, Station St, etc.
- Downtown overlay district
- Mill St Pumping Station
- Telephone and natural gas infrastructure
- MBTA rail line

Recommended Adaptation Options:

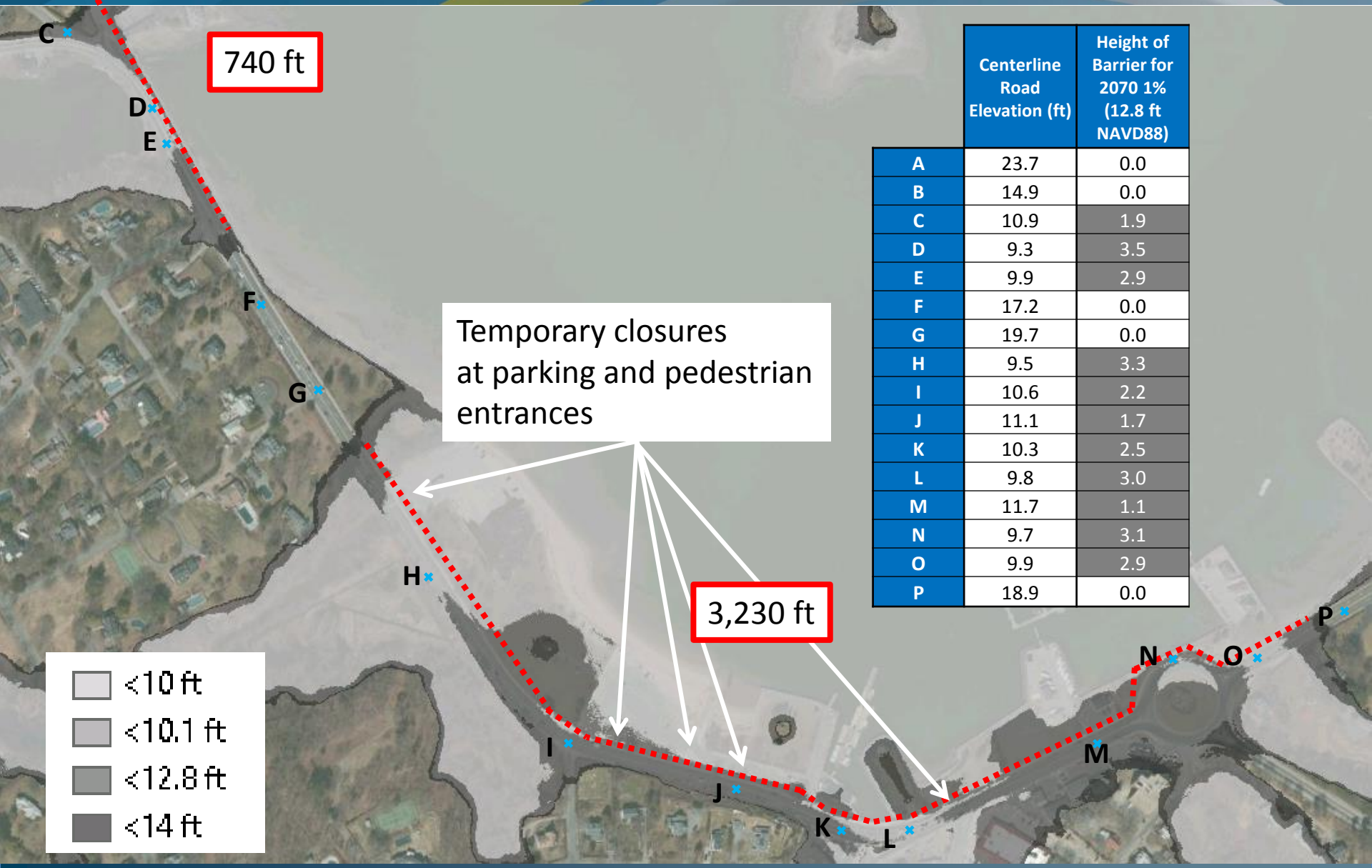
	Adaptation Strategies	Adaptation Cost
Present	• Evacuation planning for floodplain residents, businesses, institutions	$
	• Electronic warning signs for road closures / evacuation	$
	• Educate residents and businesses on modern building flood protection technologies	$
	• Identify alternate heliport locations for flooding emergencies	$
	• Capital planning, engineering design, environmental assessment for Rt 3A and seawall improvements	$$
2030	• Raise Rt 3A to 11 ft ± NAVD	$$$$$
	• Add tide gate structures (type TBD) at Rt 3A & North St Outfalls	$$$$
2070	• If needed, add up to 3.5 ft barrier wall to water side of Rt 3A sidewalk	$$

Vulnerable Segments – Near/Medium Term



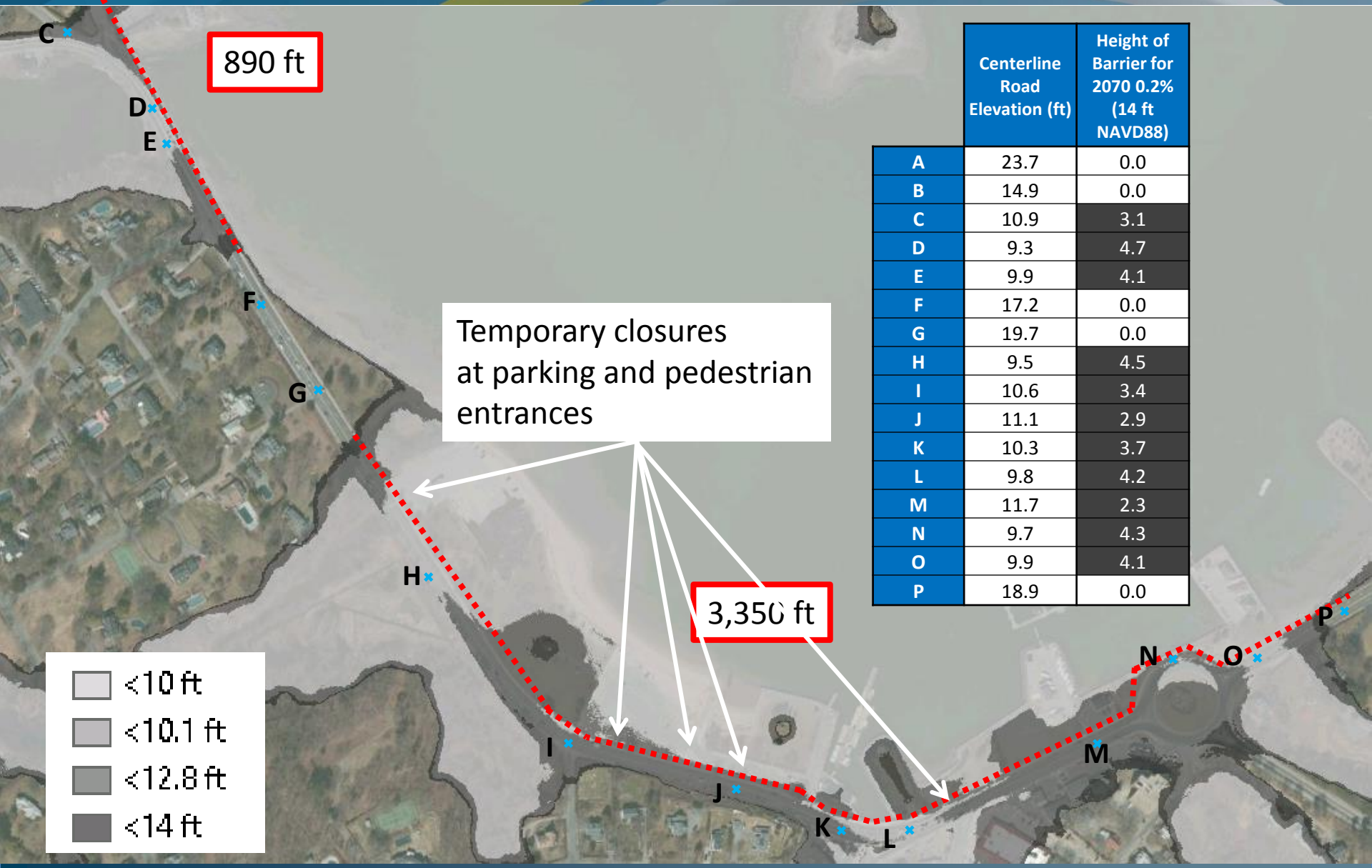
	Centerline Road Elevation (ft)	Height of Barrier for 2030 1% (10 ft NAVD88)	Height of Barrier for 2030 0.2% (10.2 ft NAVD88)
A	23.7	0.0	0.0
B	14.9	0.0	0.0
C	10.9	0.0	0.0
D	9.3	0.7	0.9
E	9.9	0.1	0.3
F	17.2	0.0	0.0
G	19.7	0.0	0.0
H	9.5	0.5	0.7
I	10.6	0.0	0.0
J	11.1	0.0	0.0
K	10.3	0.0	0.0
L	9.8	0.2	0.4
M	11.7	0.0	0.0
N	9.7	0.3	0.5
O	9.9	0.1	0.3
P	18.9	0.0	0.0

Vulnerable Segments – Long Term



	Centerline Road Elevation (ft)	Height of Barrier for 2070 1% (12.8 ft NAVD88)
A	23.7	0.0
B	14.9	0.0
C	10.9	1.9
D	9.3	3.5
E	9.9	2.9
F	17.2	0.0
G	19.7	0.0
H	9.5	3.3
I	10.6	2.2
J	11.1	1.7
K	10.3	2.5
L	9.8	3.0
M	11.7	1.1
N	9.7	3.1
O	9.9	2.9
P	18.9	0.0

Vulnerable Segments – Long Term



	Centerline Road Elevation (ft)	Height of Barrier for 2070 0.2% (14 ft NAVD88)
A	23.7	0.0
B	14.9	0.0
C	10.9	3.1
D	9.3	4.7
E	9.9	4.1
F	17.2	0.0
G	19.7	0.0
H	9.5	4.5
I	10.6	3.4
J	11.1	2.9
K	10.3	3.7
L	9.8	4.2
M	11.7	2.3
N	9.7	4.3
O	9.9	4.1
P	18.9	0.0

Raise Inner Harbor Seawalls/Wharves

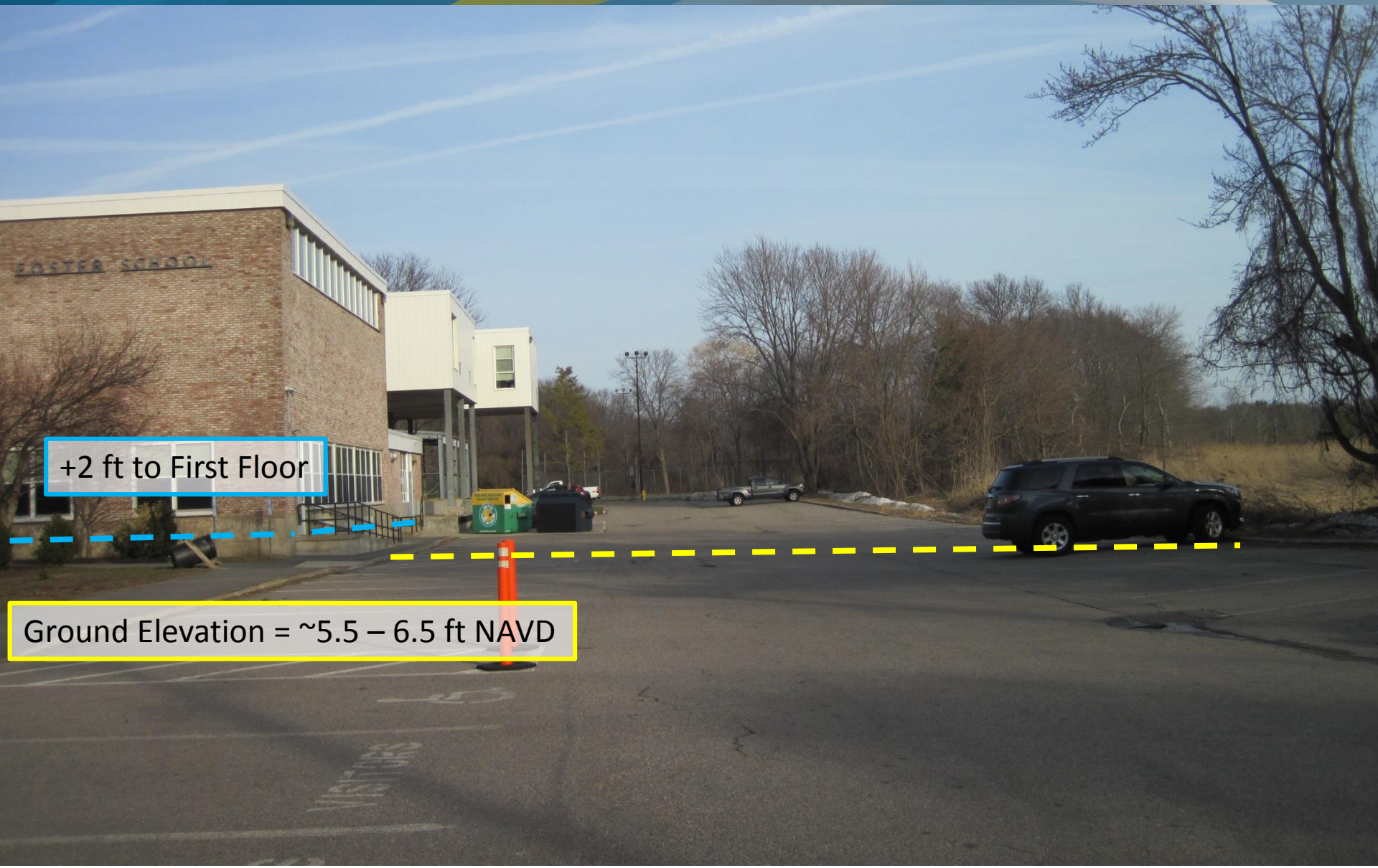
- Protection from waves and run-up (VE Zone)
- Preserve public spaces / maritime character

Type	Name/Number	Critical Elevation	Conseq. Score	Present Prob. (%)	2030 Prob. (%)	2070 Prob. (%)	Comp. Risk Score
Bulkhead/ Seawall	034-051-000-003-100	**7.0**	60	25	50	100	2850
Bulkhead/ Seawall	034-051-000-005B-200	**6.6**	57	30	50	100	2833
Bulkhead/ Seawall	034-051-000-059-100	**4.8**	33	50	50	100	2000
Bulkhead/ Seawall	034-051-000-001-200	**7.8**	60	5	30	100	1890
Bulkhead/ Seawall	034-051-000-004-100	**8.4**	60	2	10	100	1440
Bulkhead/ Seawall	034-050-000-050-200	**7.3**	40	10	30	100	1360
Bulkhead/ Seawall	034-051-000-005-100	**8.5**	50	1	10	100	1163
Revetment	034-050-000-050-100	**8.3**	23	2	10	100	560
Bulkhead/ Seawall	034-051-000-001-300	**10.6**	60	0	0	30	362
Bulkhead/ Seawall	034-051-000-001-100	**10.4**	60	0	0	30	362
Bulkhead/ Seawall	034-051-000-005B-100	**9.7**	33	0	2	50	353
Bulkhead/ Seawall	034-051-000-001-400	**10.9**	60	0	0	20	242

Cons of Raising Seawalls vs. Raising Roadway

- Different Structure Types
- Non-Continuous Barrier
- Different Ownership
- Permitting Complexity
- Higher Likelihood of Failure
- Potentially Higher Cost

Foster Elementary School



Foster Elementary School – Near Term

Foster Elementary School – Near Term

Figure 7-4. Low wall construction

Build small enclosures around louvers and crawl space entrance on vulnerable sides of School building

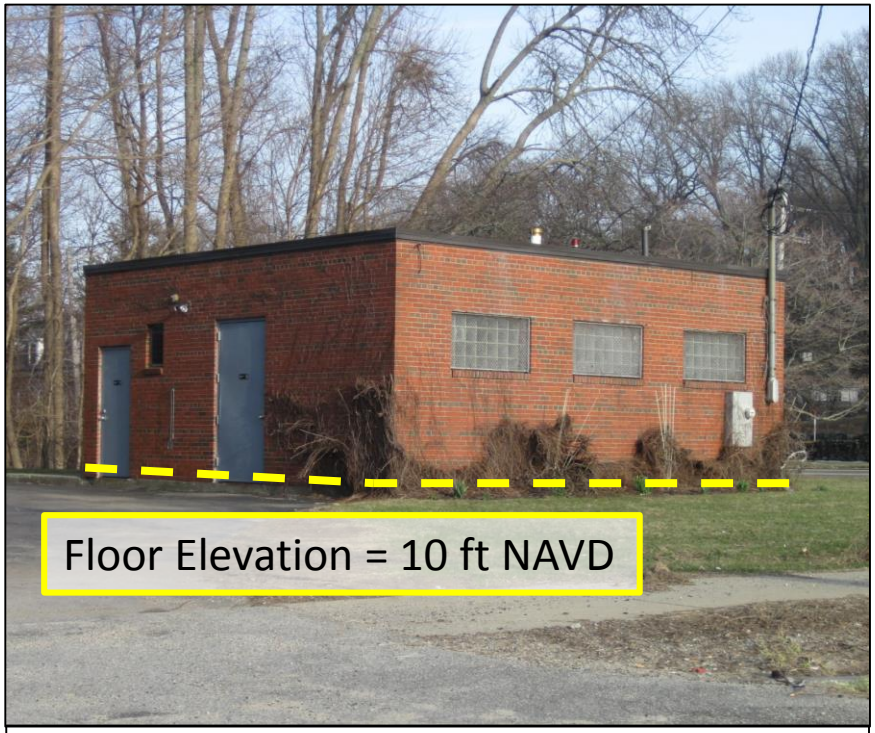
Foster Elementary School – Medium Term

Mill St Pump Station – Medium/Long Term

Well Elevation = 8.7 ft NAVD

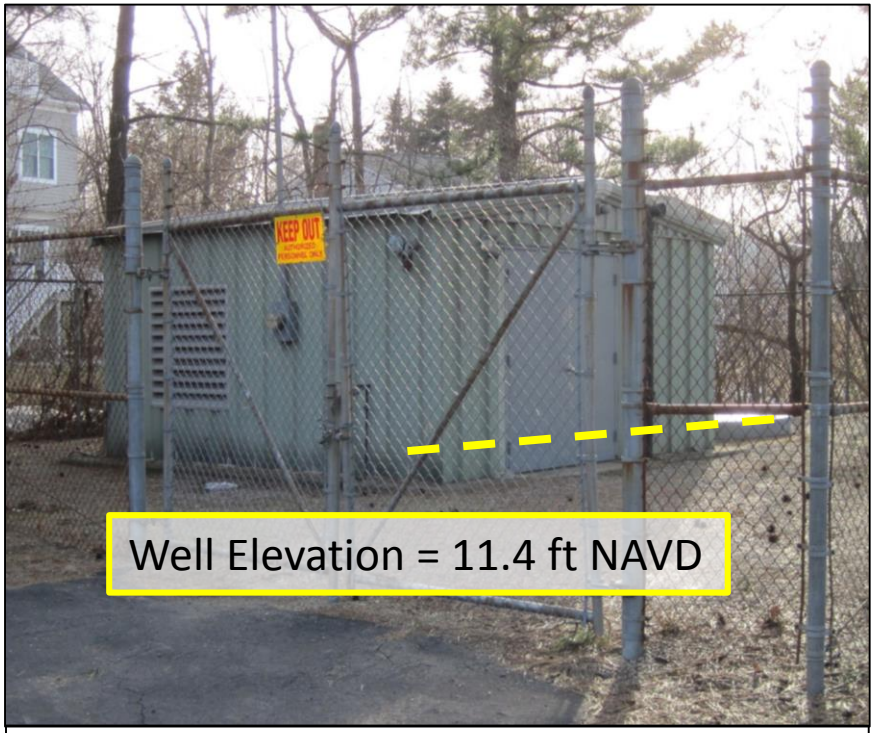
Install 4 ft high 160 ft long temporary flood barrier around perimeter of pump station and generator

Sewer Pump Stations – Long Term



Broad Cove Pump Station

- Install flood panels on doors
- Raise or protect utility boxes
- Seal electrical conduits
- Emergency generator connected to pump



Broad Cove Pump Station

- Install temporary flood barrier around perimeter of building and wells
- Seal electrical conduits