



Low-lying Roads: Mashpee

Project funded by the
Municipal Vulnerability
Preparedness Program

Purpose and Objectives of Public Meeting

- **Overview of Low-lying Roads Project**
- **Review adaptation alternatives for priority low-lying roads**
- **Discuss advantages and disadvantages of green, gray, and hybrid alternatives**

Agenda

- Project Overview – Heather McElroy, CCC and Joe Famely, WHG
- Presentation of conceptual design alternatives – Linnea Laux, WHG
 - Great Oak Road
 - Monomoscoy Road
- Questions, comments, and discussion
- Next Steps – Heather McElroy
 - Conclude by 7:30 pm

Low-Lying Roads 2

5

TOWNS

Chatham
Falmouth
Harwich

Mashpee
Provincetown



Flooding vulnerability assessment of low-lying roads and transportation infrastructure



Support municipal road segment prioritization



Identify range of potential design solutions, costs

Work performed by Cape Cod Commission and Woods Hole Group

PROJECT TIMELINE & ELEMENTS

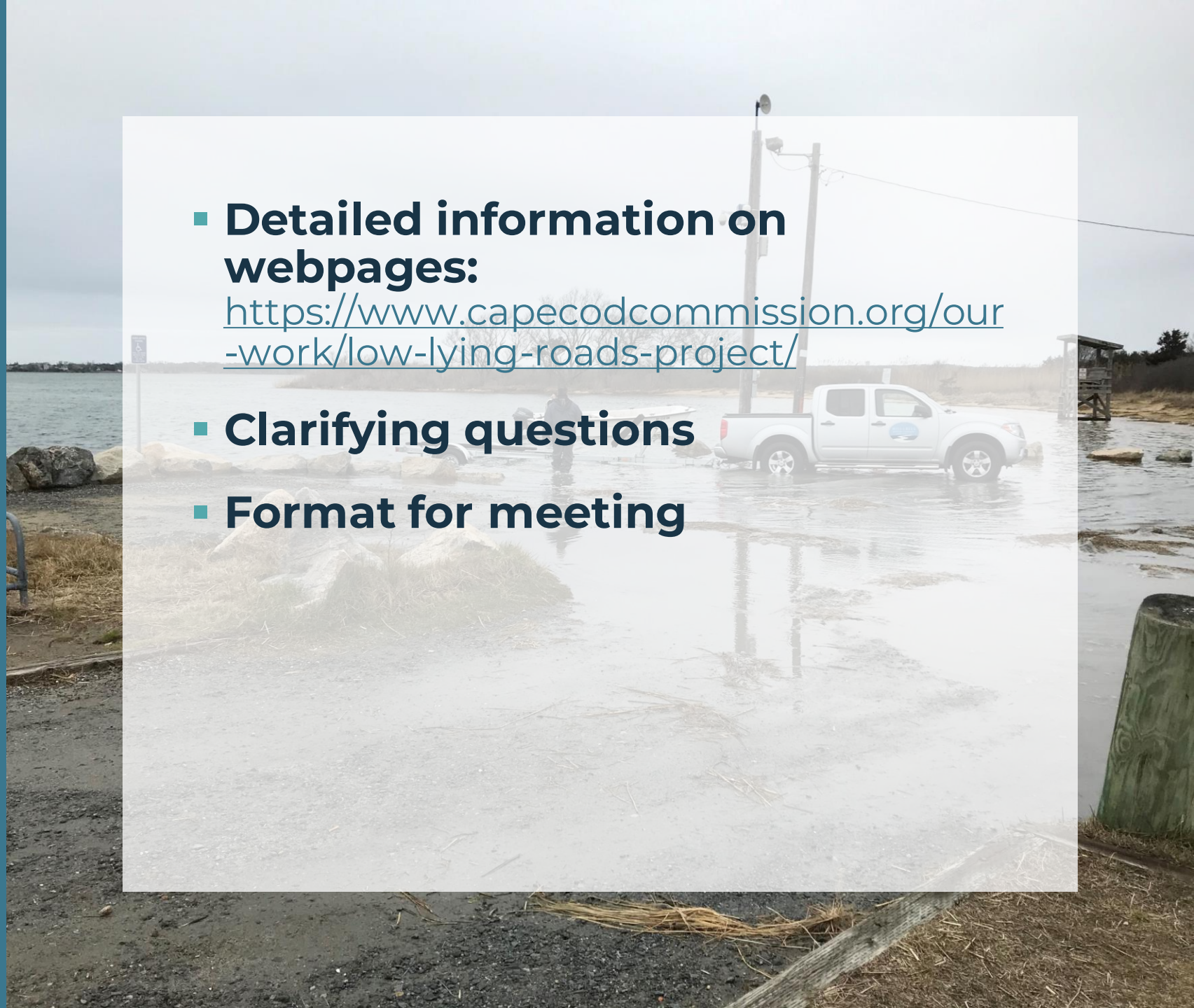


Additional Context & Information

- **Detailed information on webpages:**

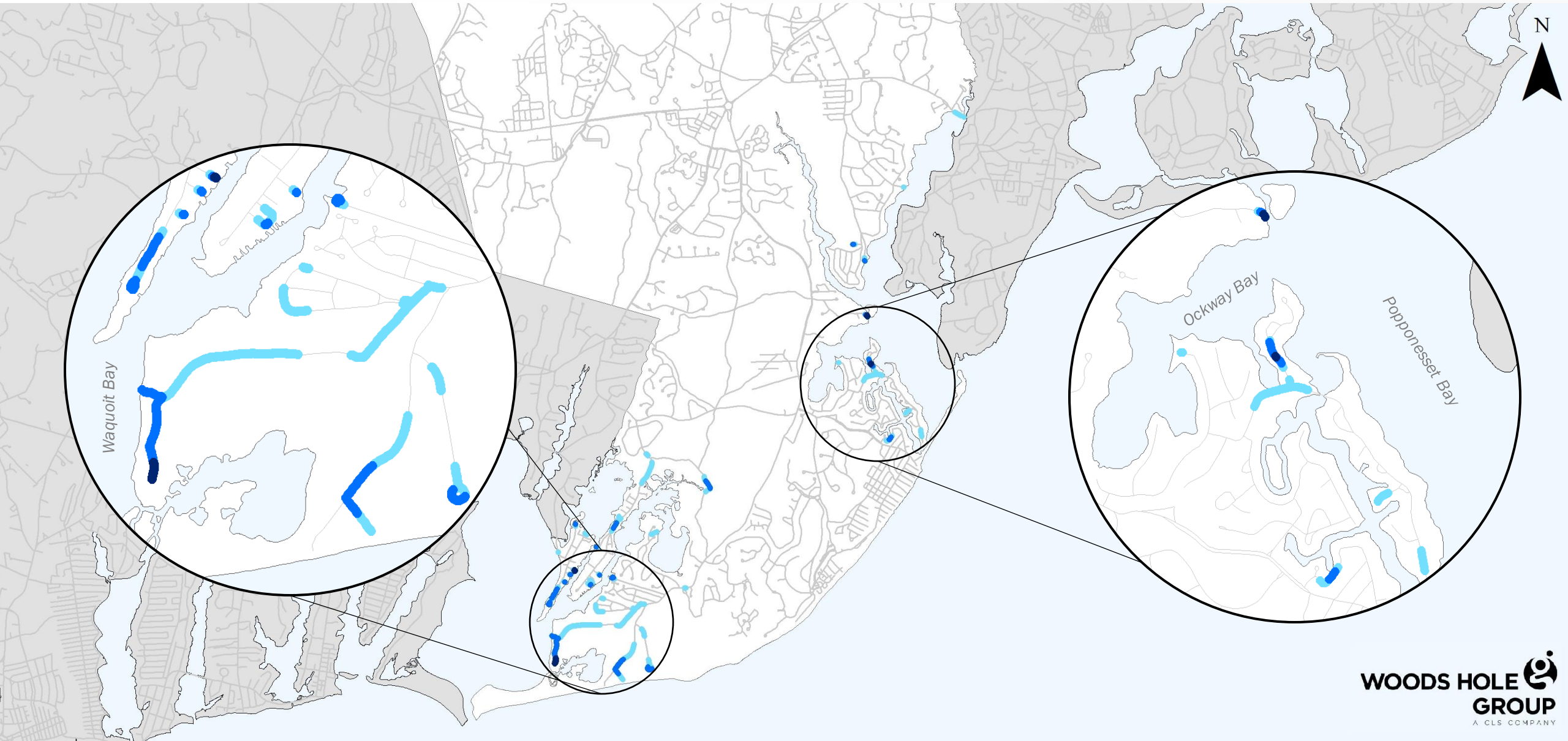
<https://www.capecodcommission.org/our-work/low-lying-roads-project/>

- **Clarifying questions**
- **Format for meeting**



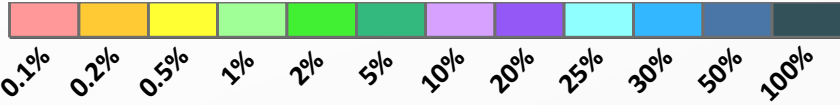
Low Lying Roads Nuisance Flooding

- Road Surface Elevations Below MHW
- 2070 (3.5 mi) ●
- 2050 (1.0 mi) ●
- 2030 (0.1 mi) ●



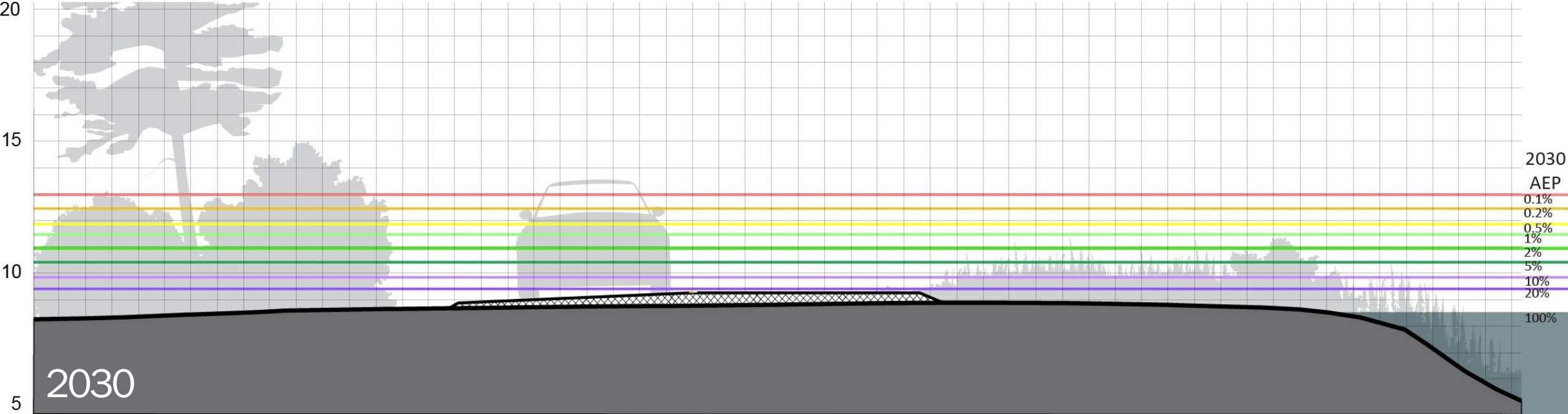
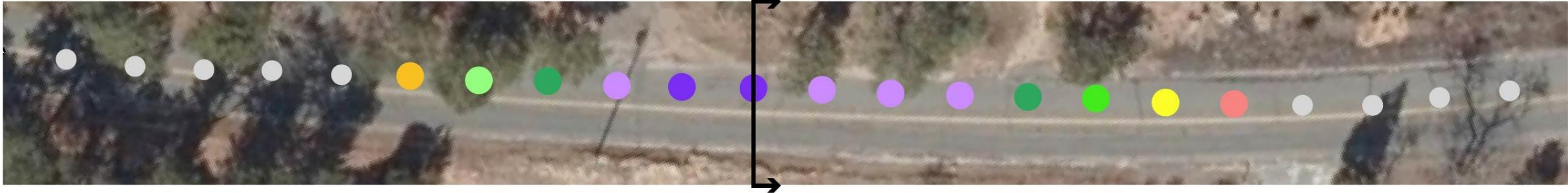
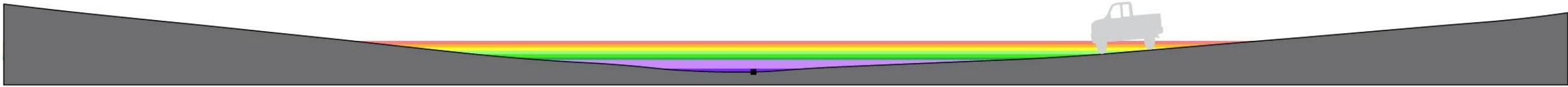
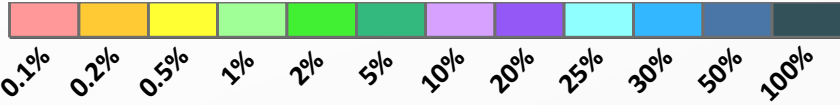
Cape Cod Low Lying Roads Vulnerability Assessment Methods

COASTAL FLOOD EXCEEDANCE PROBABILITY



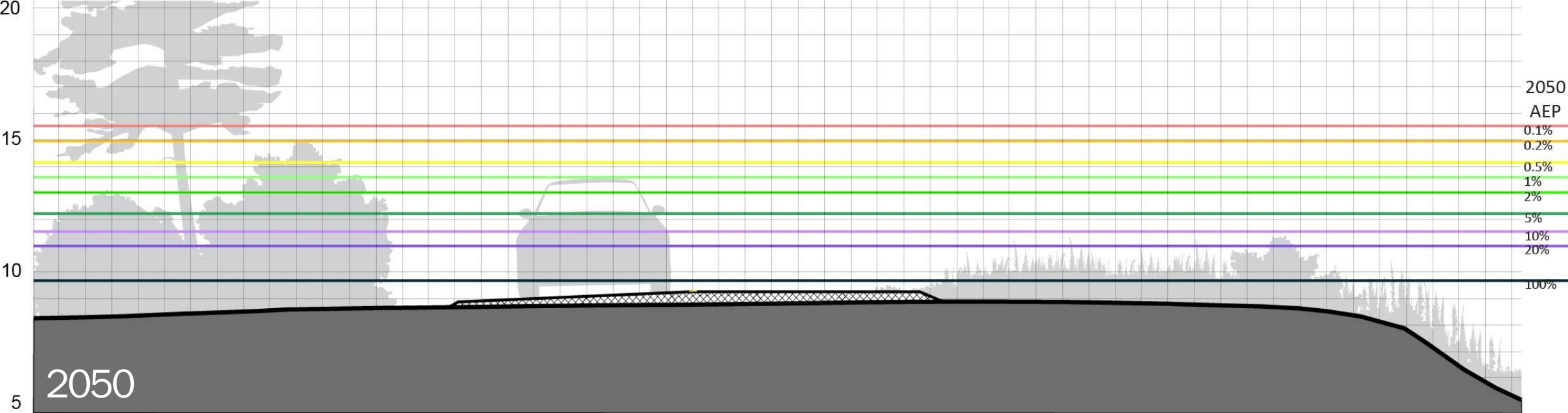
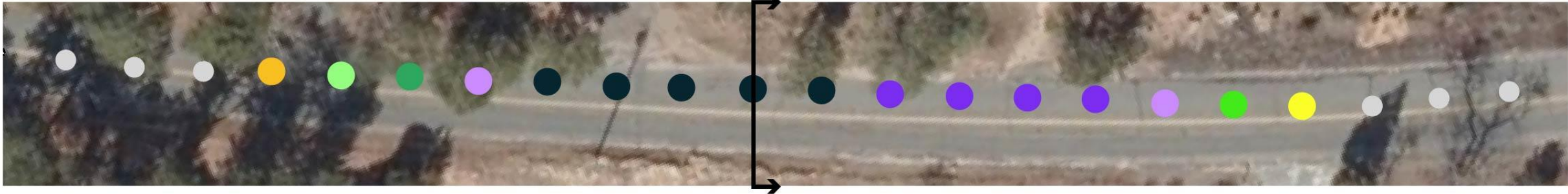
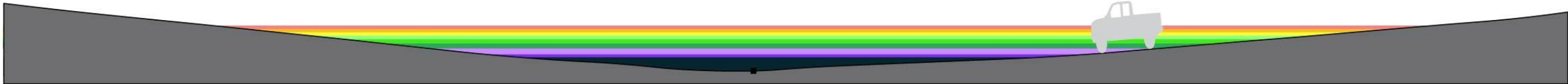
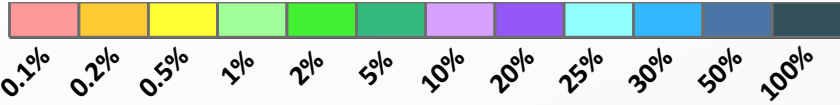
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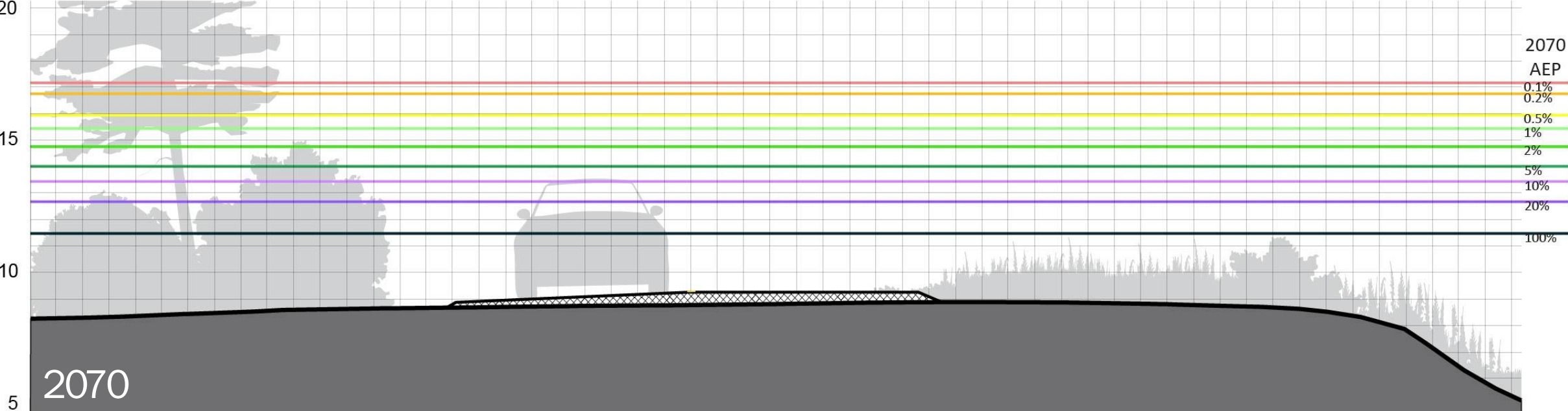
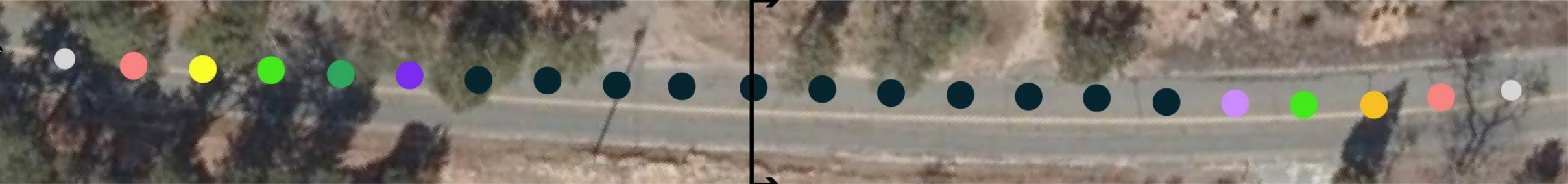
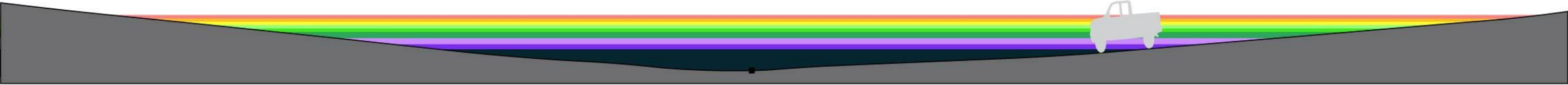
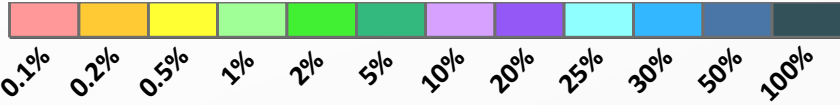
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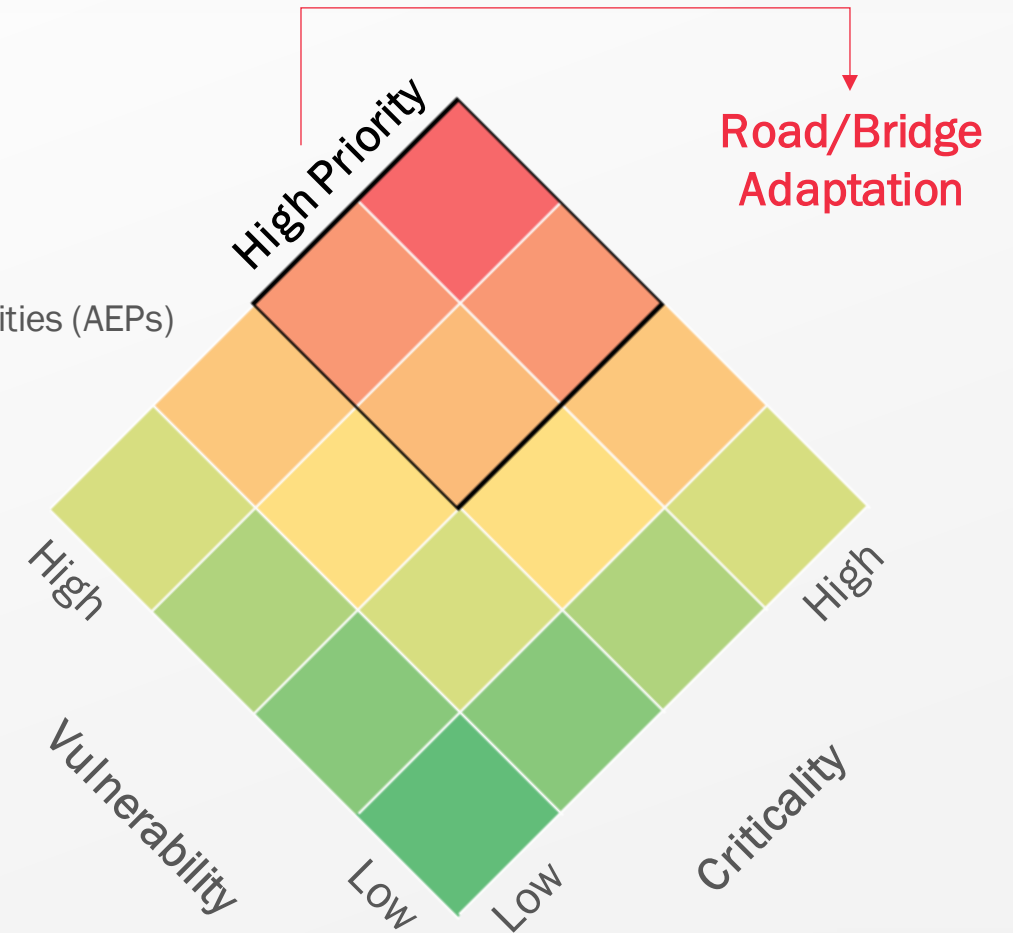
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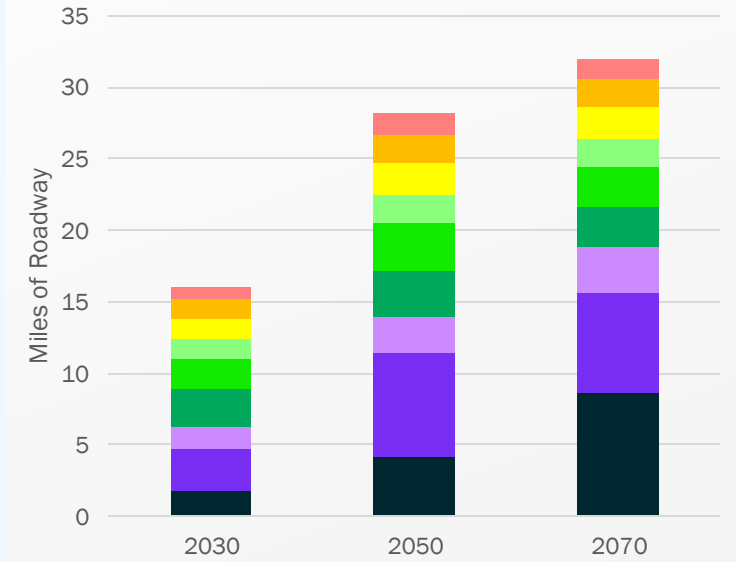
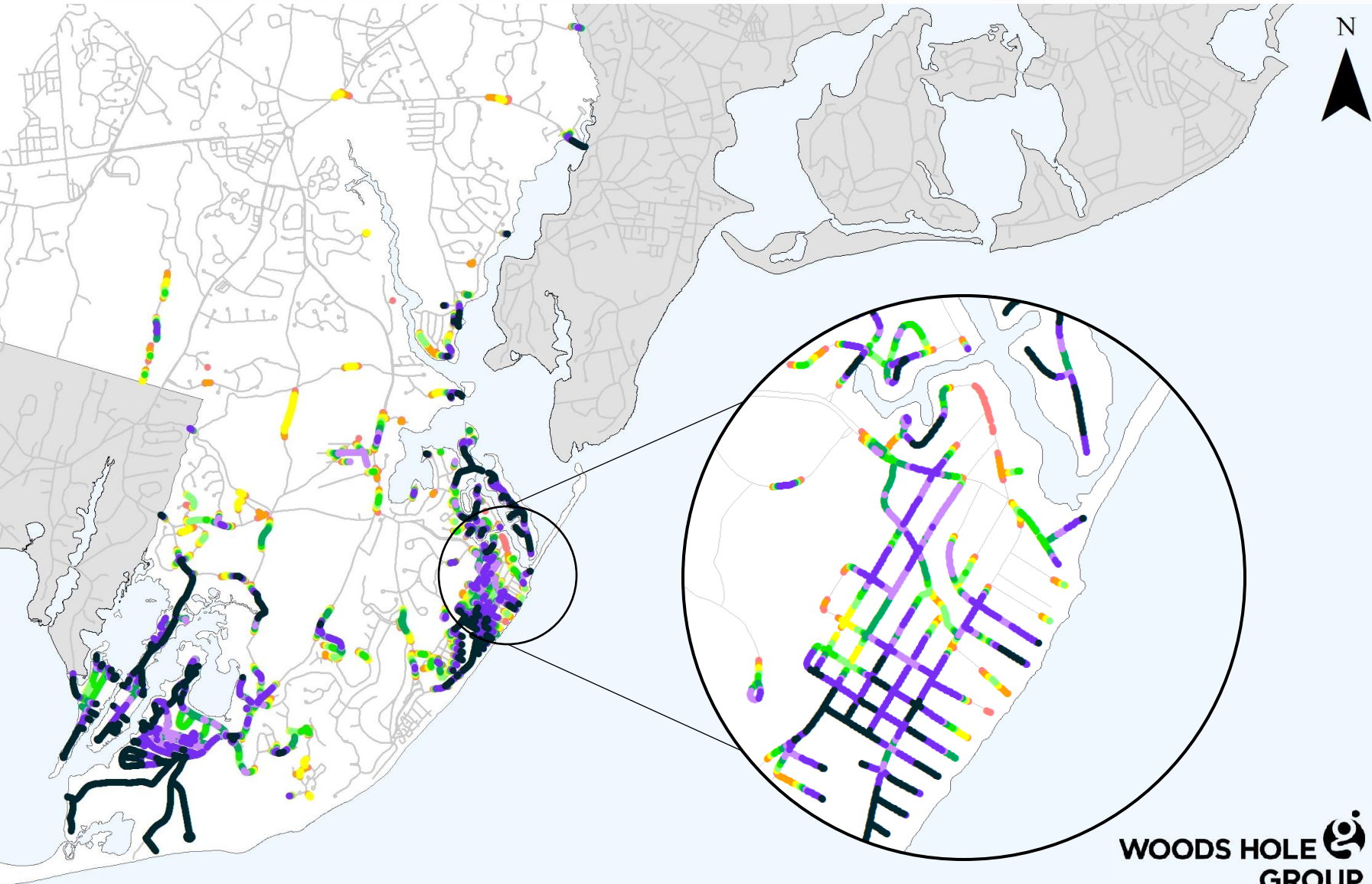


Cape Cod Low Lying Roads Risk Assessment Approach

1. Extract roadway/bridge critical elevations (CEs)
 - › From LiDAR at 20m interval along surface
2. Compile 2030/2050/2070 MC-FRM water surface elevations (WSEs)
 - › 0.1%, 0.2%, 0.5%, 1%, 2%, 5%, 10%, 20%, 100% Annual Exceedance Probabilities (AEPs)
3. Compare CEs to WSEs to determine vulnerability
 - › Highest probability WSE exceeding CE
4. Score road segment criticality
 - › Usage/Network Function
 - › Economy
 - › Vulnerable Populations
 - › Community and Emergency Services
5. $\text{Probability} * \text{Criticality} = \text{Risk}$
6. Prioritize high-risk road segments for community consideration

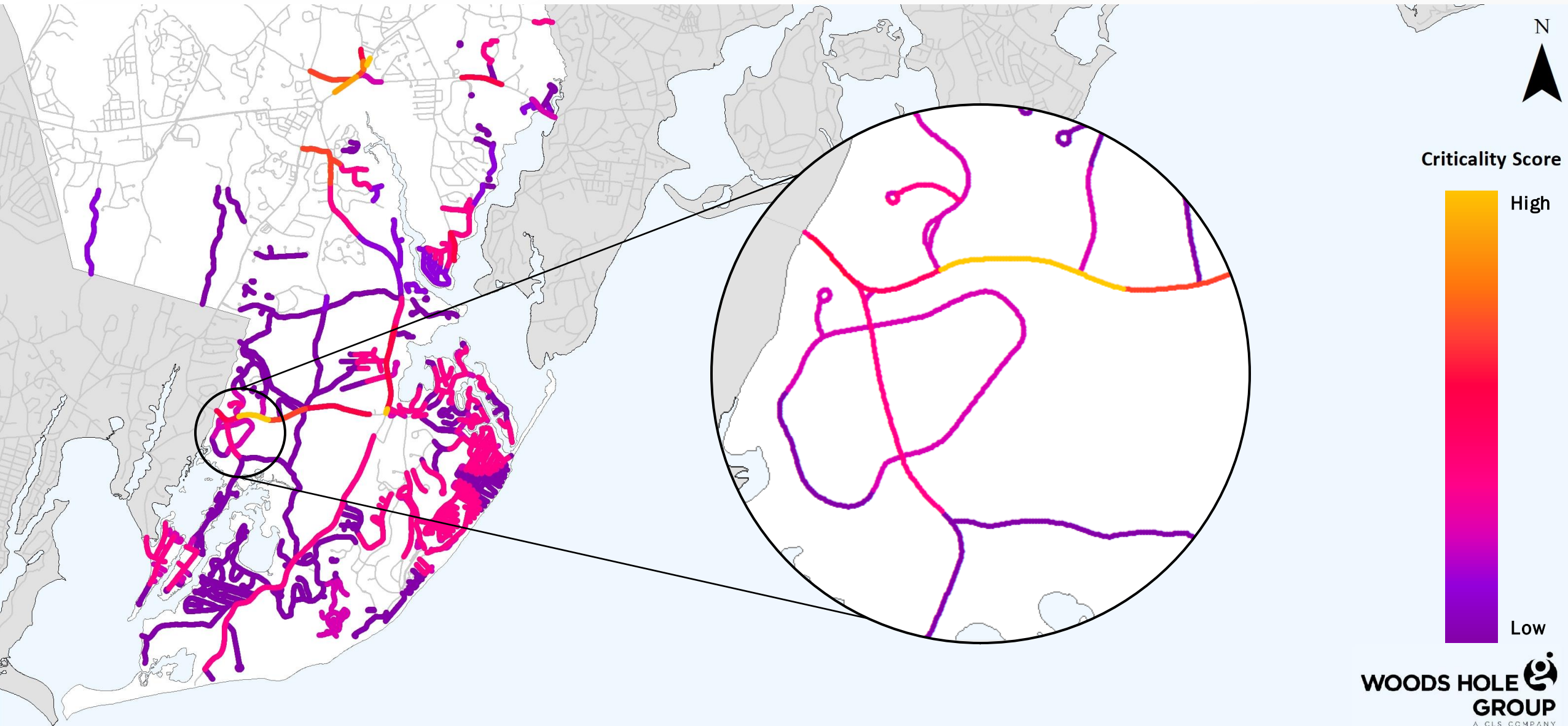


Low Lying Roads 2070 Flood Probability (Annual Exceedance Probability)



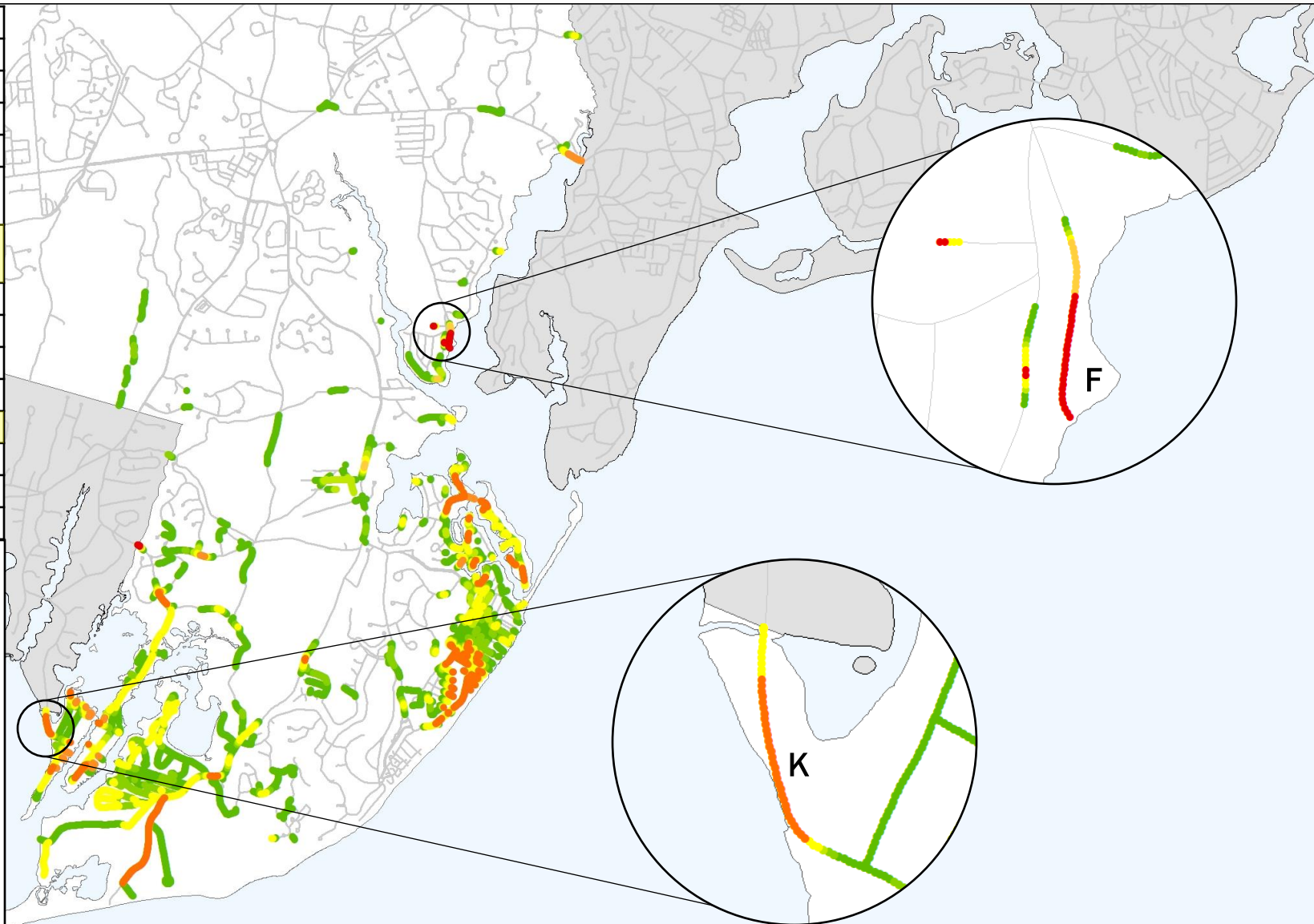
Flood Probability	Total Road Miles
0.1%	32.0
0.2%	30.7
0.5%	28.7
1%	26.5
2%	24.6
5%	21.7
10%	18.9
20%	15.6
100%	8.7

Low Lying Roads Criticality Scoring



Low Lying Roads 2070 Risk Results

High Risk Road Segments	
A	Monomoscoy Rd North
B	Popponneset Island Road
C	Daniels Island Road
D	Spoondrift Way
E	Great Oak Road at Mashpee Town Beach
F	Mashpee Neck Road at Baker Boat Ramp
G	Red Brook Road at Falmouth Town Line
H	Monomoscoy Road - South
I	Monomoscoy Road - Middle
J	Sipps Road at Waqouit Public Landing
K	Seconsett Island Road at Hamblin Pond
L	Great Oak Road at Jehu Pond
M	Quinaquisset Avenue at Santuit River
N	Shore Drive at Deans Pond



High Risk

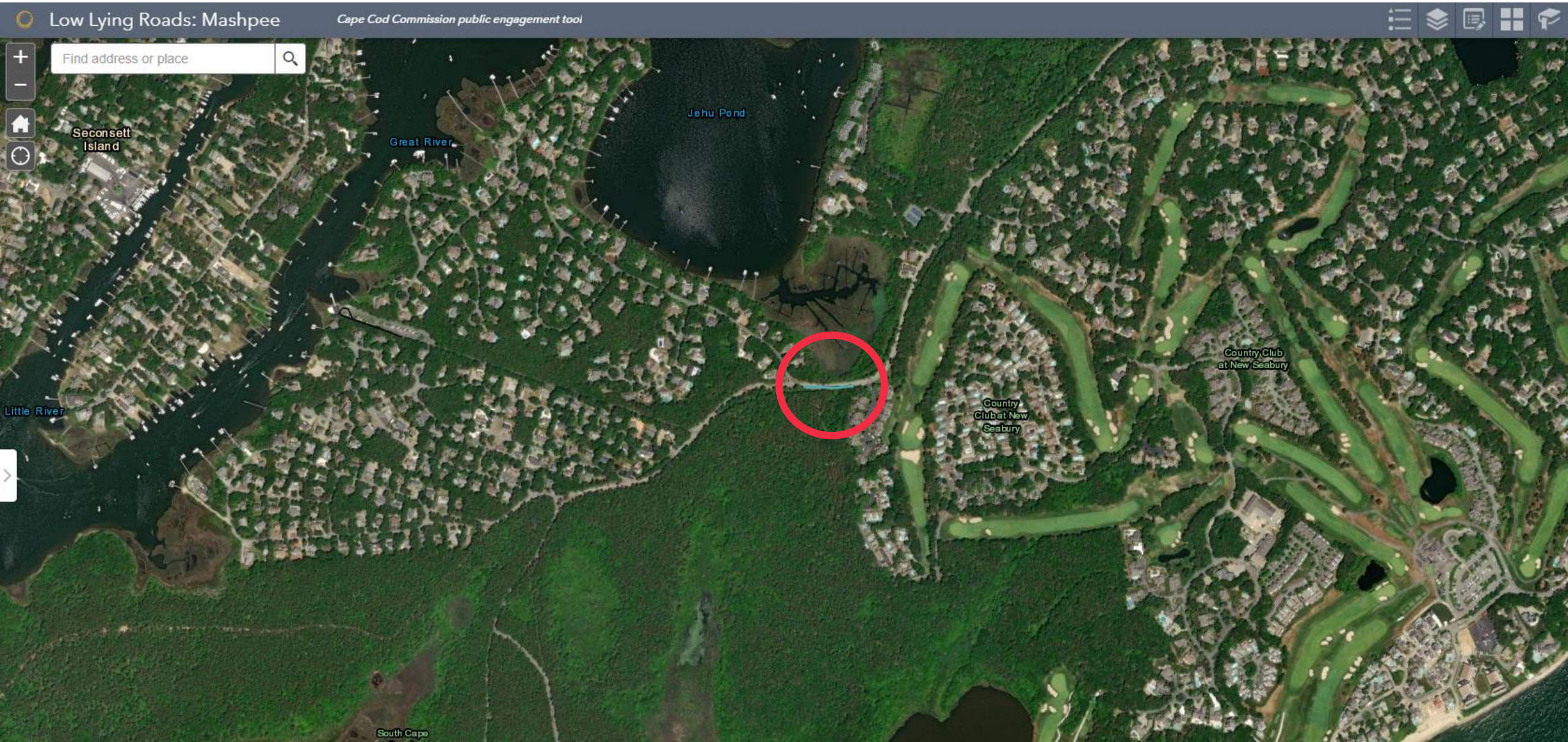
Low Risk

Summary of High Priority Road Segments

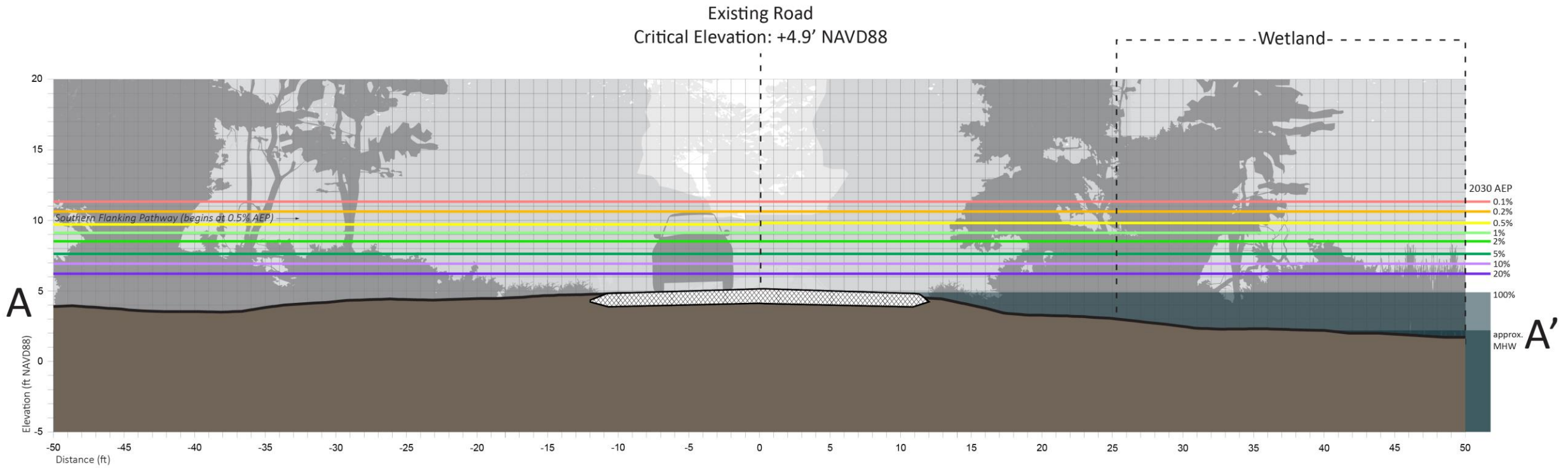
	Road Name	Length (ft)	Description	AEP 2030	Criticality Score	2030 Risk Score	Tidal Flooding Length (ft)		
							2030	2050	2070
A	Monomoscoy Rd North	640	Connector Rd between Meadowbrook Rd & Amy Brown Rd	100%	16	1600			140
B	Daniels Island Road/Popponesset Island Rd*	1340	Daniels Island Road/Popponesset Island Road	100%	16	1600			920
C	Daniels Island Road*	960	N-S road spine in coastal neighborhood	100%	16	1600	40	400	640
D	Spoondrift Way*	540	Spoondrift Way behind Poppo. Beach Community House	100%	16	1600		160	340
E	Great Oak Road at Mashpee Town Beach	1140	Great Oak Road leading to Mashpee Town Beach	100%	16	1600		580	1140
F	Mashpee Neck Road at Baker boat ramp	680	Road segment leading to Edward Baker Boat Ramp	20%	26	520		40	160
G	Red Brook Road at Falmouth Town Line	140	Connector Rd at Falmouth line between Ostrom Rd & Monos. Rd	20%	20	400			
H	Monomoscoy Road - South	1140	Roadway between Child's Rd and Hamblin Rd	100%	4	400		280	700
I	Monomoscoy Road - Middle	1460	Roadway between Amy Brown Rd and Point Rd	100%	4	400			1020
J	Town Landing Road*	600	Road Leading to Waquait Public Landing	100%	4	400		140	300
K	Seconsett Island Road at Hamblin Pond	740	Coastal road fronting Hamblin Pond	20%	16	320			40
L	Great Oak Road at Jehu Pond	340	Connector to between Tide Run and Quinns Way	20%	16	320			100
M	Quinaquisset Ave at Santuit River (Bridge)	660	Road & bridge at Barnstable line and over Santuit River	10%	13	130			340
N	Shore Drive at Deans Pond*	2160	Shore Drive fronting Deans Pond	5%	16	80			

*Private Road

Great Oak Road

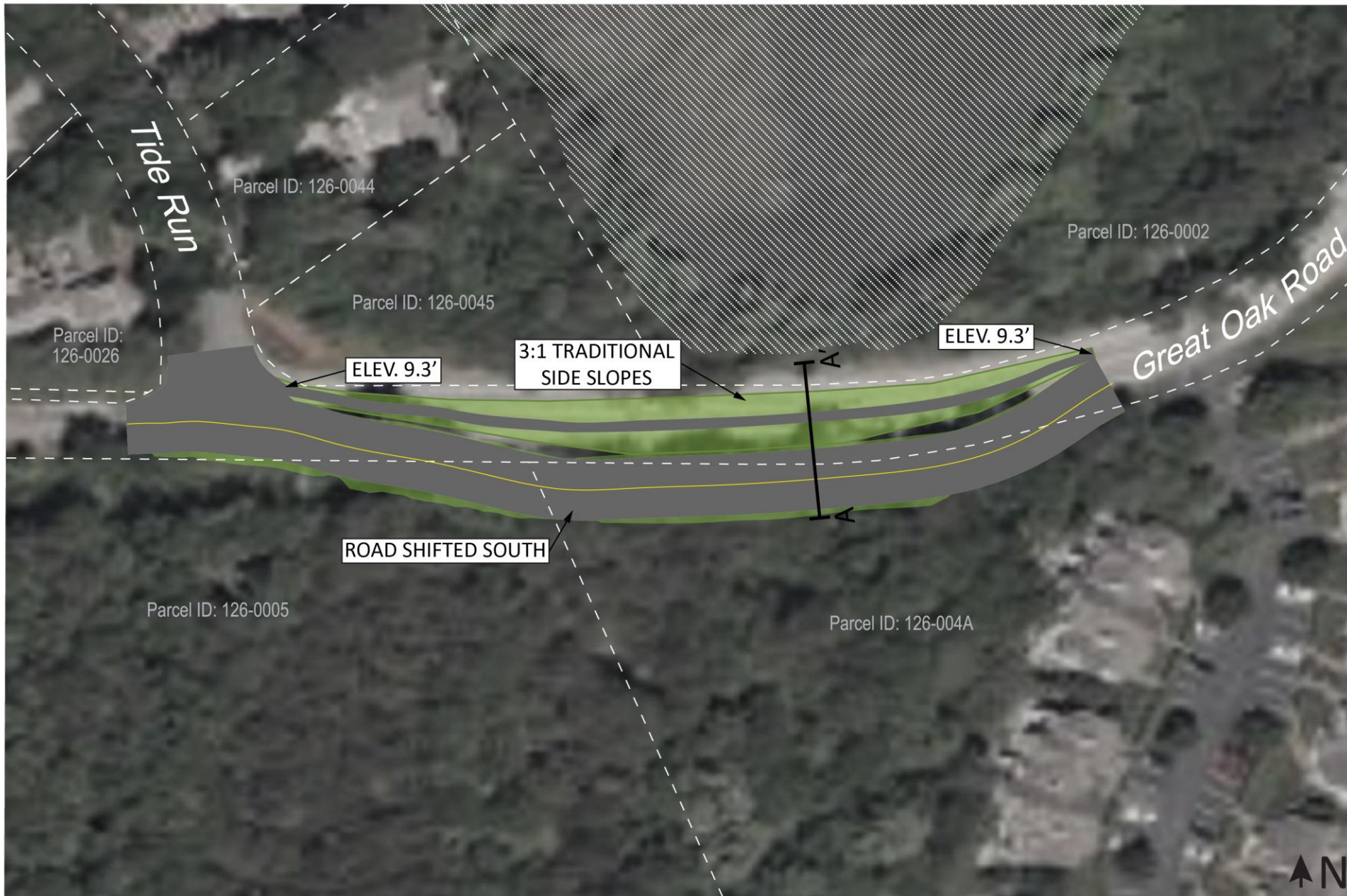


Great Oak Road



EXISTING CONDITIONS

Great Oak Road, Mashpee



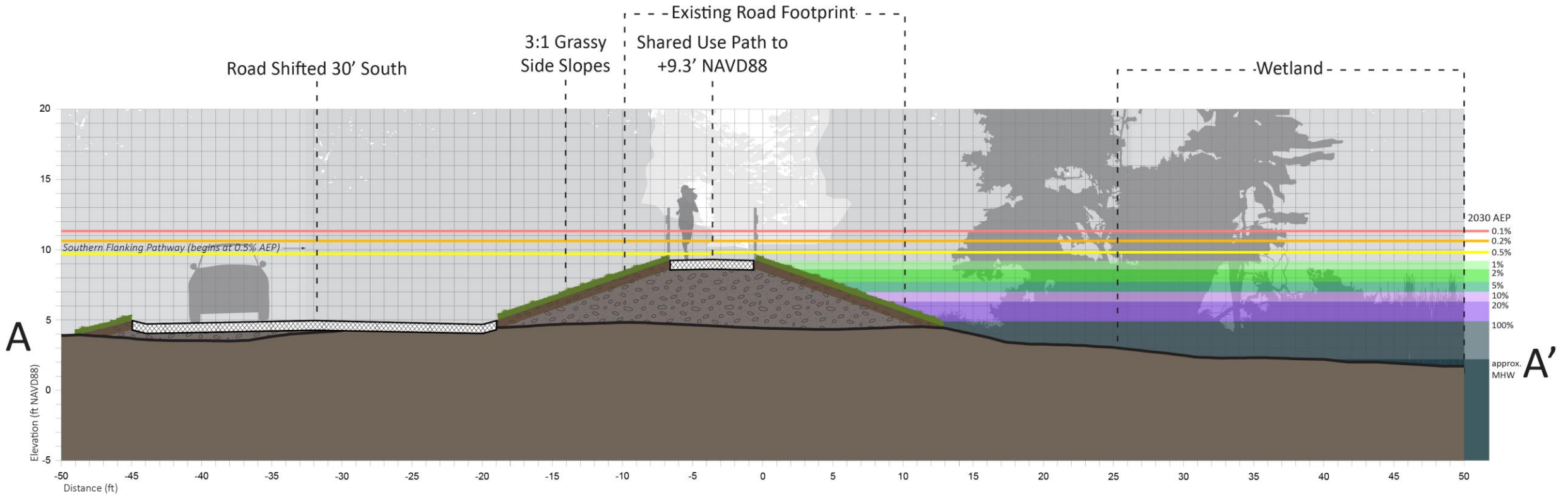
Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey



ALTERNATIVE 1: GRAY

532 linear feet of town-owned road are shifted approximately 30 feet to the south to allow an elevated shared use path to be built. The path maintains an elevation of 9.3 feet NAVD88 with 3:1 traditionally vegetated side slopes. The path is at most 4.5' higher than the road.

Great Oak Road



ALTERNATIVE 1: GRAY

Great Oak Road, Mashpee



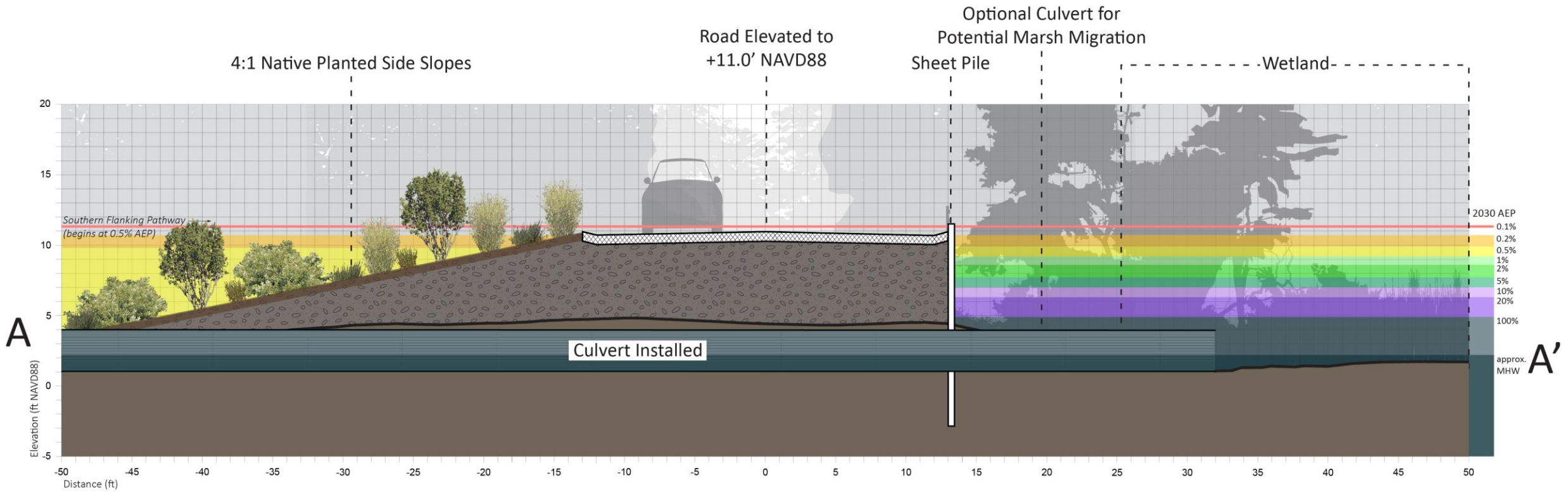
Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey



ALTERNATIVE 2: HYBRID

435 linear feet of town-owned road are elevated to 11.0 feet NAVD88 using sheet pile and 4:1 native planted side slopes. A culvert can be added at the low point of the road to mitigate stormwater buildup on the south side of the road and allow for future marsh migration.

Great Oak Road



ALTERNATIVE 2: HYBRID

Great Oak Road, Mashpee

GREAT OAK ROAD, MASHPEE

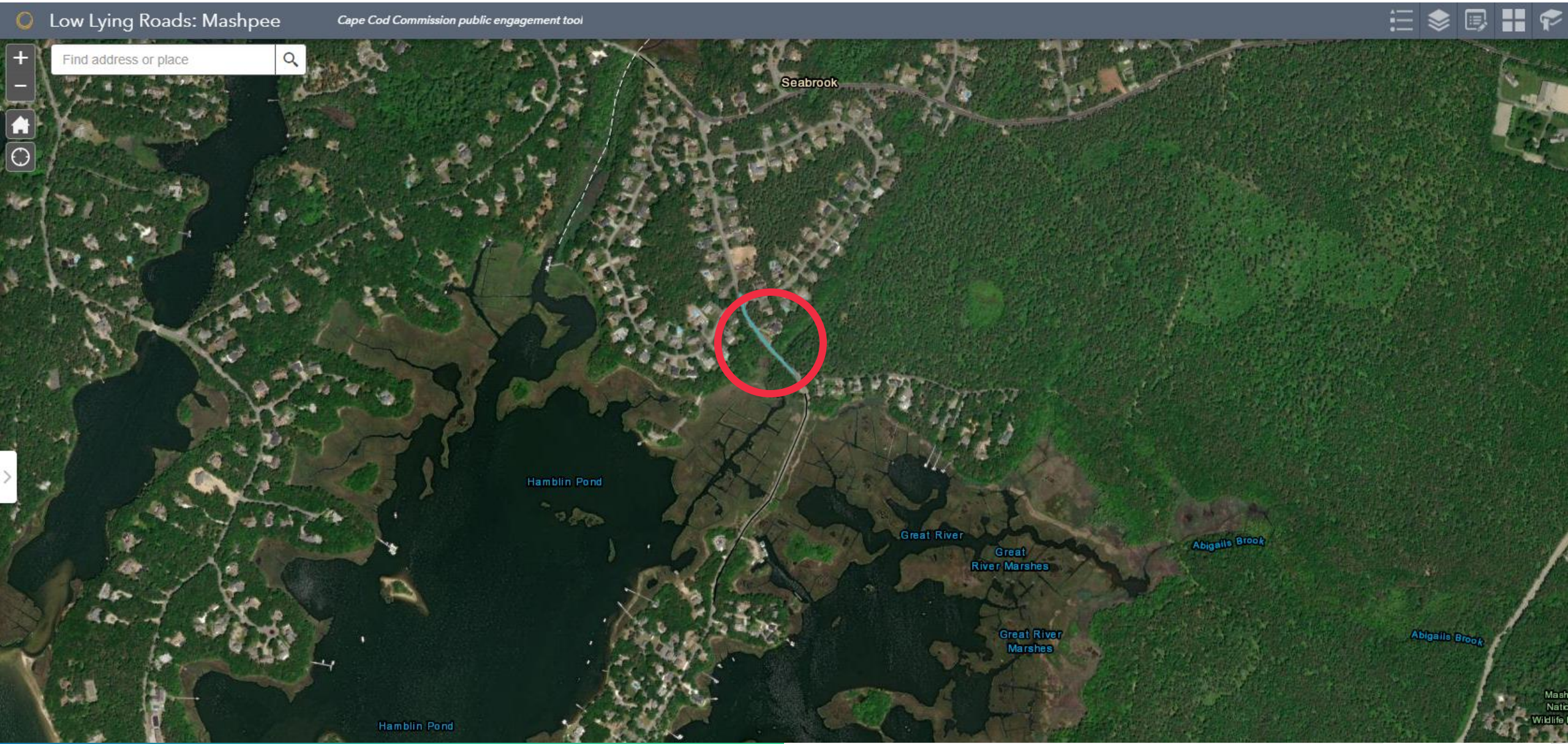
Summary of alternatives

	Description	Critical Elevation (NAVD88)	Annual Exceedance Probability			Vulnerable to Tidal Flooding†	Permitability Concerns	Impacts to Private Property	Estimated Cost*
			2030	2050	2070				
EXISTING	A segment of 26 foot wide road bordering a wetland.	4.9 feet	20%	100%	100%	No	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	532 linear feet of town-owned road are shifted approximately 30 feet to the south to allow an elevated shared use path to be built. The path maintains an elevation of 9.3 feet NAVD88 with 3:1 traditionally vegetated side slopes. The path is at most 4.5' higher than the road.	9.3 feet	0.5%	10%	20%	No	Located in an ACEC, possible wetland impacts	Extensive	\$208,000
ALTERNATIVE 2: HYBRID	435 linear feet of town-owned road are elevated to 11.0 feet NAVD88 using sheet pile and 4:1 native planted side slopes. A culvert can be added at the low point of the road to mitigate stormwater buildup on the south side of the road and allow for future marsh migration.	11.0 feet	0.1%	2%	10%	No	Located in an ACEC, possible wetland impacts	Minimal	\$608,000 (+\$146,000 for culvert)

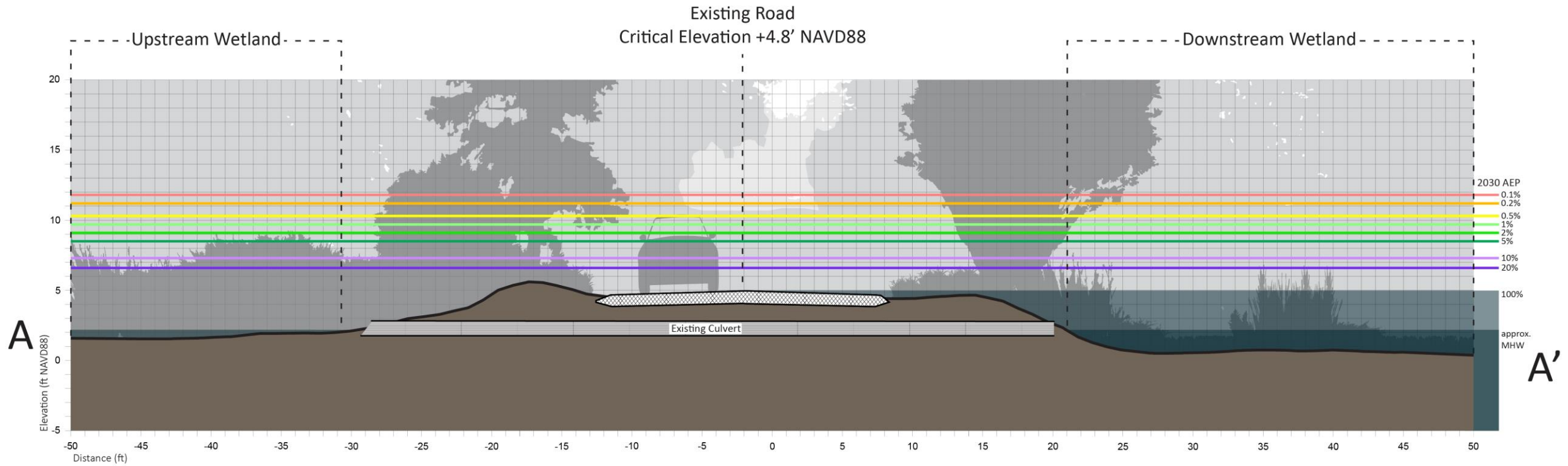
*2023 installed material cost +40% escalation (through 2029) and 15% contingency. Excludes design, permitting, mobilization, stormwater and wastewater infrastructure, and site controls. Costs based on experienced contractor opinion and MassDOT costing data.

†Future tidal datums are approximate.

Monomoscoy Road (North)

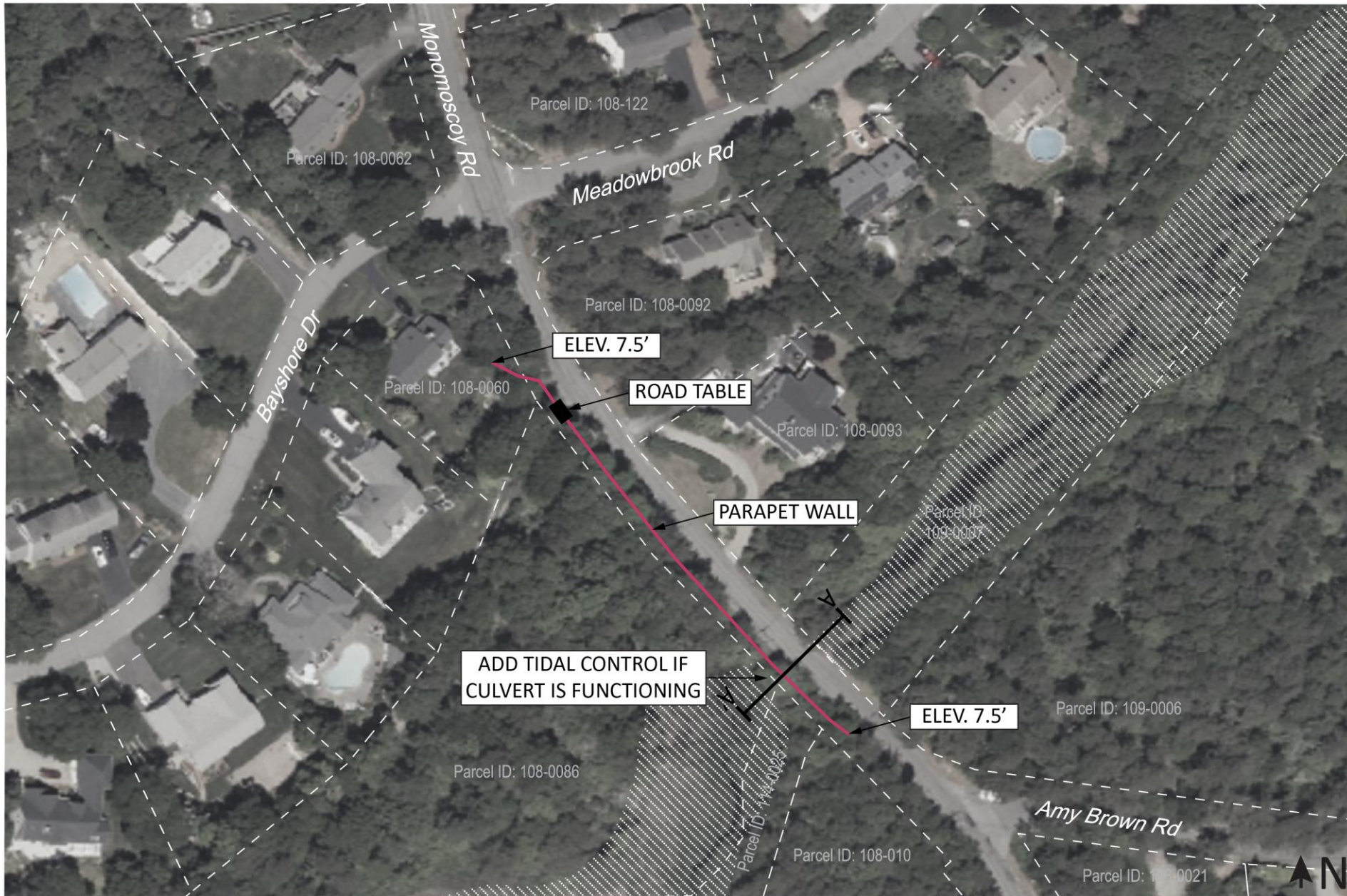


Monomoscoy Road (North)

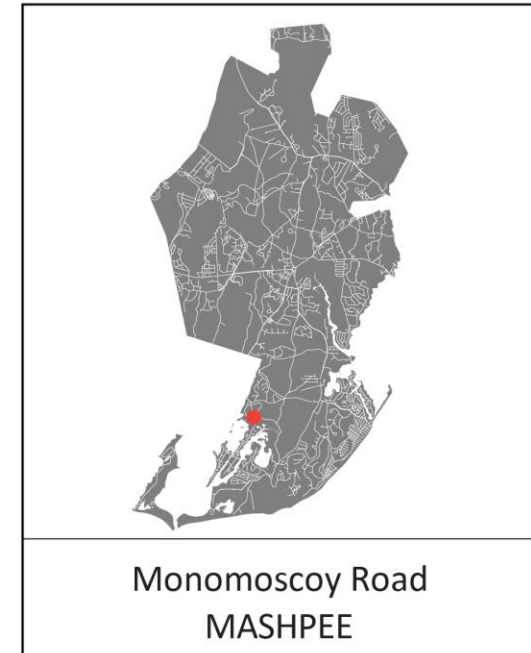


EXISTING CONDITIONS

Monomoscoy Road, Mashpee



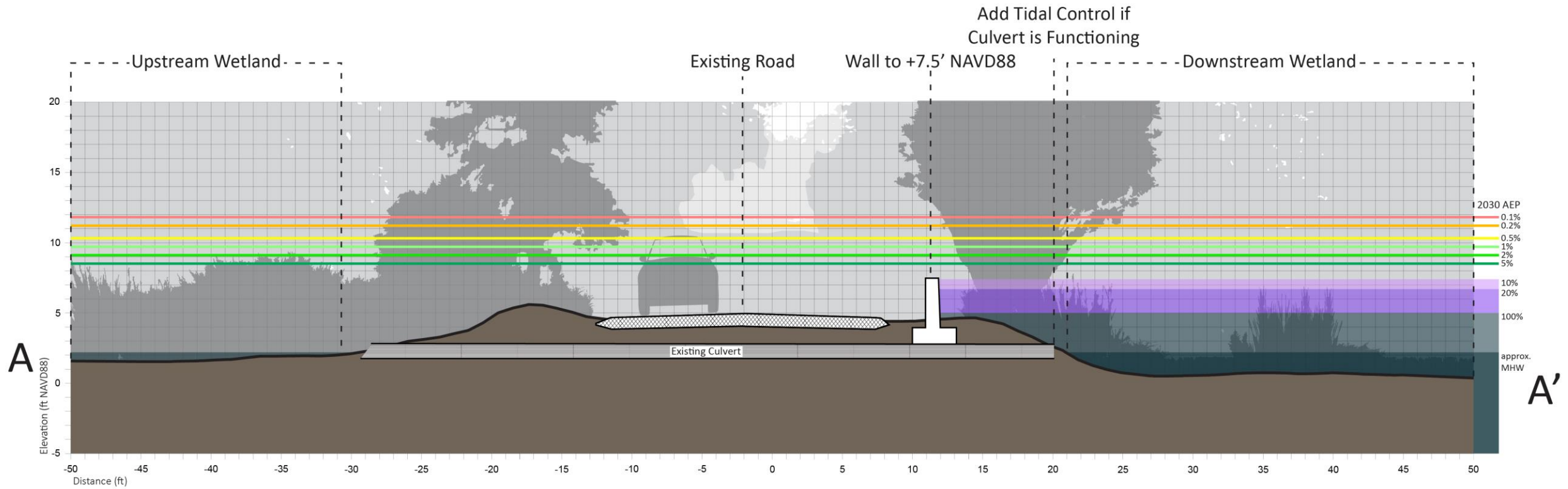
Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey



ALTERNATIVE 1: GRAY

A concrete wall to 7.5 feet NAVD88 is built on the seaward side of the road, reaching a maximum height of approximately 2.7 feet above grade. The road is re-graded or converted to permeable pavement to prevent stormwater buildup behind the wall. If the culvert is still functioning, tidal control is added to prevent flanking.

Monomoscoy Road (North)



ALTERNATIVE 1: GRAY
Monomoscoy Road, Mashpee



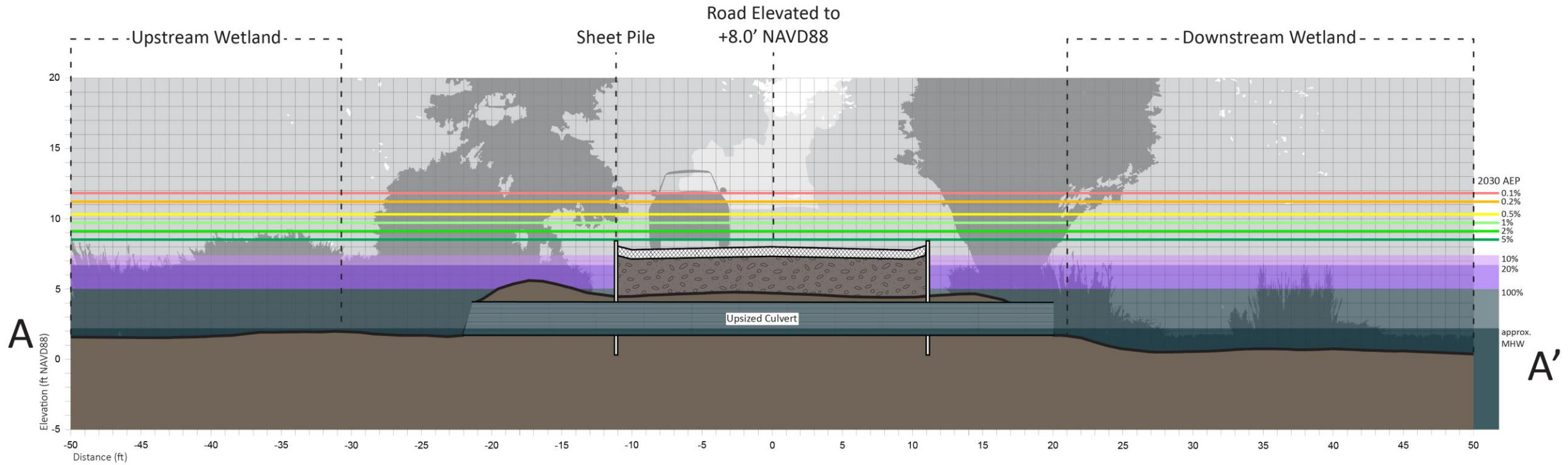
Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey



ALTERNATIVE 2: HYBRID

590 linear feet of town-owned road are raised from a lowest point of 4.8 feet to a lowest point of 8.0 feet NAVD88. Native planted side slopes tie into the surrounding grade, and sheet pile is used to avoid wetland impacts at the stream crossing. The culvert is replaced and increased in size to allow for future marsh migration.

Monomoscoy Road (North)



ALTERNATIVE 2: HYBRID
Monomoscoy Road, Mashpee



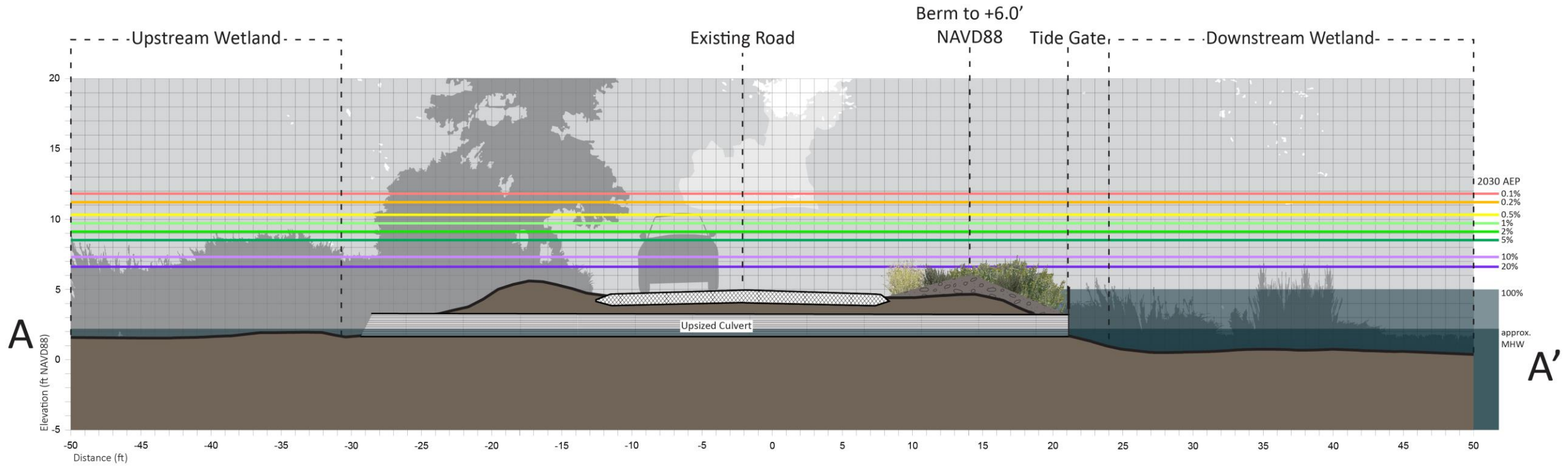
Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey



ALTERNATIVE 3: GREEN

A small berm with 3:1 native planted side slopes to 6.0 feet NAVD88 is added on the seaward side of the road. The road is regraded or converted to permeable pavement to manage stormwater. The culvert is replaced with a larger culvert and a tide gate is added to prevent flanking.

Monomoscoy Road (North)



ALTERNATIVE 3: GREEN

Monomoscoy Road, Mashpee

MONOMOSCOY ROAD, MASHPEE

Summary of alternatives

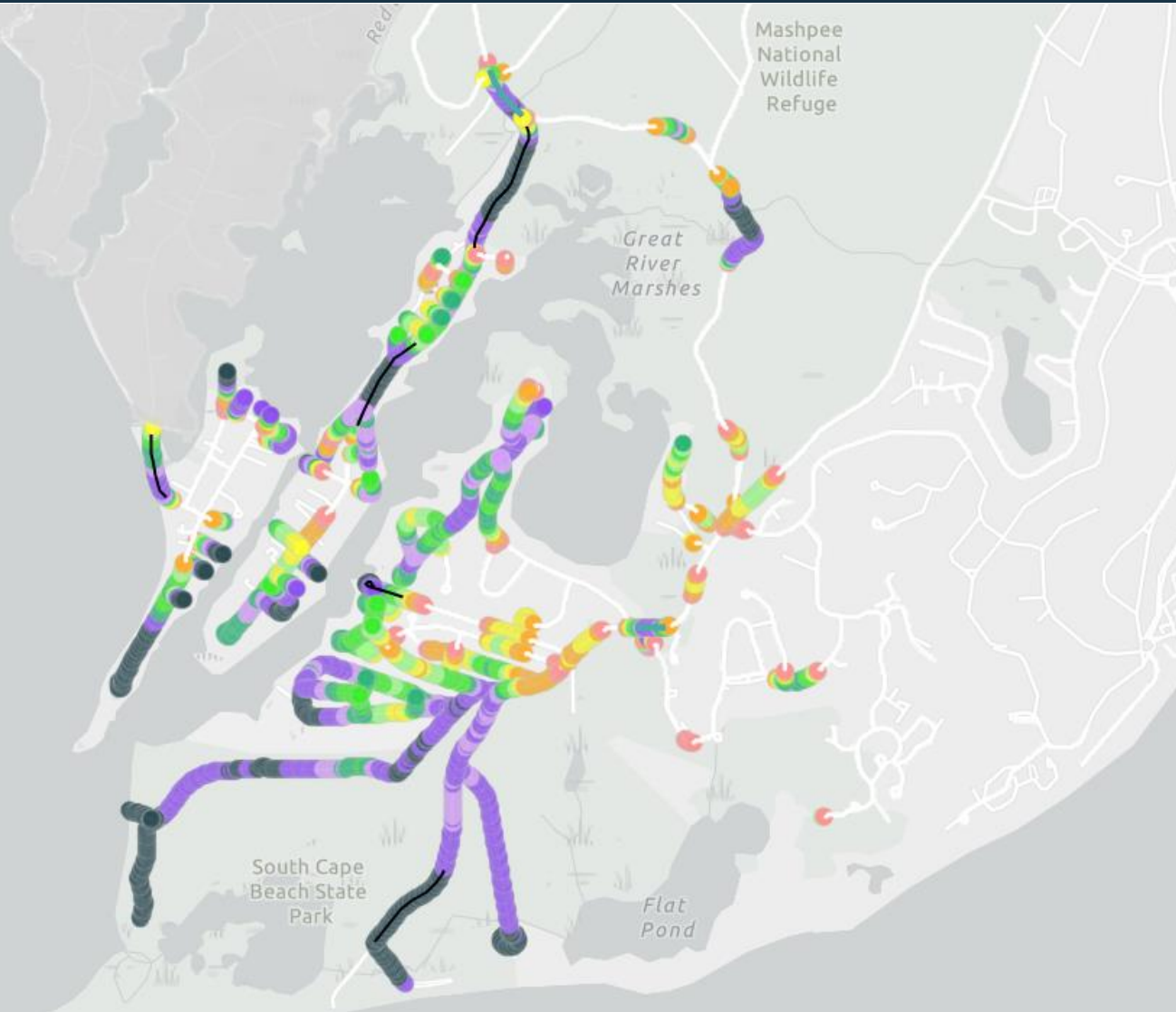
	Description	Critical Elevation (NAVD88)	Annual Exceedance Probability			Vulnerable to Tidal Flooding†	Permitability Concerns	Impacts to Private Property	Estimated Cost*
			2030	2050	2070				
EXISTING	A segment of 22 foot wide road with a culvert crossing Dutchman’s Creek.	4.8 feet	100%	100%	100%	2070	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	A concrete wall to 7.5 feet NAVD88 is built on the seaward side of the road, reaching a maximum height of approximately 2.7 feet above grade. The road is re-graded or converted to permeable pavement to prevent stormwater buildup behind the wall. If the culvert is still functioning, tidal control is added to prevent flanking.	7.5 feet	5%	20%	100%	No	Located in an ACEC, no direct wetland impacts	Minimal	\$207,000
ALTERNATIVE 2: HYBRID	590 linear feet of town-owned road are raised from a lowest point of 4.8 feet to a lowest point of 8.0 feet NAVD88. Native planted side slopes tie into the surrounding grade, and sheet pile is used to avoid wetland impacts at the stream crossing. The culvert is replaced and increased in size.	8.0 feet	5%	20%	100%	No	Located in an ACEC, minimal wetland impacts	Minimal	\$663,000
ALTERNATIVE 3: GREEN	A small berm with 3:1 native planted side slopes to 6.0 feet NAVD88 is added on the seaward side of the road. The road is regraded or converted to permeable pavement to manage stormwater. The culvert is upsized and a tide gate is added to prevent flanking.	6.0 feet	20%	100%	100%	2070	Located in an ACEC, minimal wetland impacts	None	\$129,000

*2023 installed material cost +40% escalation (through 2029) and 15% contingency. Excludes design, permitting, mobilization, stormwater and wastewater infrastructure, and site controls. Costs based on experienced contractor opinion and MassDOT costing data.

†Future tidal datums are approximate.

LOW LYING ROADS

Discussion



- **Great Oak Road**
- **Monomoscoy Road**

NEXT STEPS

- Comments! Use form on project webpages
<https://www.capecodcommission.org/our-work/low-lying-roads-project/>
- Town staff to determine which projects, designs
 - Review of community input
 - Engineering, permitting
- Identify funding

FUNDING OPPORTUNITIES

Federal Bipartisan Infrastructure Law (BIL)

Federal Highway Administration

- PROTECT – Competitive Resilience Improvement and Planning grants
- Culvert Aquatic Organism Passage Program - competitive grants for the replacement, removal, and repair of culverts or weirs that meaningfully improve or restore fish passage for anadromous fish

[NEW] PROTECT Grants (discretionary)

Purpose	Planning, resilience improvements, community resilience and evacuation routes, and at-risk coastal infrastructure
Funding	\$1.4 B (FY 22-26) in Contract Authority from the HTF
Eligible entities	<ul style="list-style-type: none">• State (or political subdivision of a State)• MPO• Local government• Special purpose district or public authority with a transportation function• Indian Tribe• Federal land management agency (applying jointly with State(s))• <i>Different eligibilities apply for at-risk coastal infrastructure grants</i>
Eligible projects	<ul style="list-style-type: none">• Highway, transit, intercity passenger rail, and port facilities• Resilience planning activities, including resilience improvement plans, evacuation planning and preparation, and capacity-building• Construction activities (oriented toward resilience)• Construction of (or improvement to) evacuation routes
Other key provisions	<ul style="list-style-type: none">• Higher Federal share if the eligible entity develops a resilience improvement plan (or is in a State or area served by MPO that does) and the State or MPO incorporates it into its long-range transportation plan• May only use up to 40% of the grant for construction of new capacity



FUNDING OPPORTUNITIES

Nature Based Solutions, Ecological Restoration, Culverts

- FEMA Building Resilient Infrastructure and Communities (BRIC)
- National Coastal Resiliency Fund (NCRF) through National Fish and Wildlife Fund
- Natural Resources Conservation Service (NRCS) through the Cape Cod Conservation District
- Municipal Vulnerability Preparedness Program (MVP)
- Division of Ecological Restoration (DER) Culvert Replacement Municipal Assistance Grant Program