



Low-lying Roads: Wellfleet

Project funded by the Municipal
Vulnerability Preparedness
Program and the Economic
Development Administration

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
- Town staff comments
- Presentation of conceptual design alternatives
 - East Commercial Street
 - Commercial Street
 - Kendrick Ave (East)
 - Kendrick Ave (West)
- Questions, comments, and discussion
- Next Steps

Low Lying Roads

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10

TOWNS

Barnstable	Orleans
Bourne	Sandwich
Brewster	Truro
Dennis	Wellfleet
Eastham	Yarmouth



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



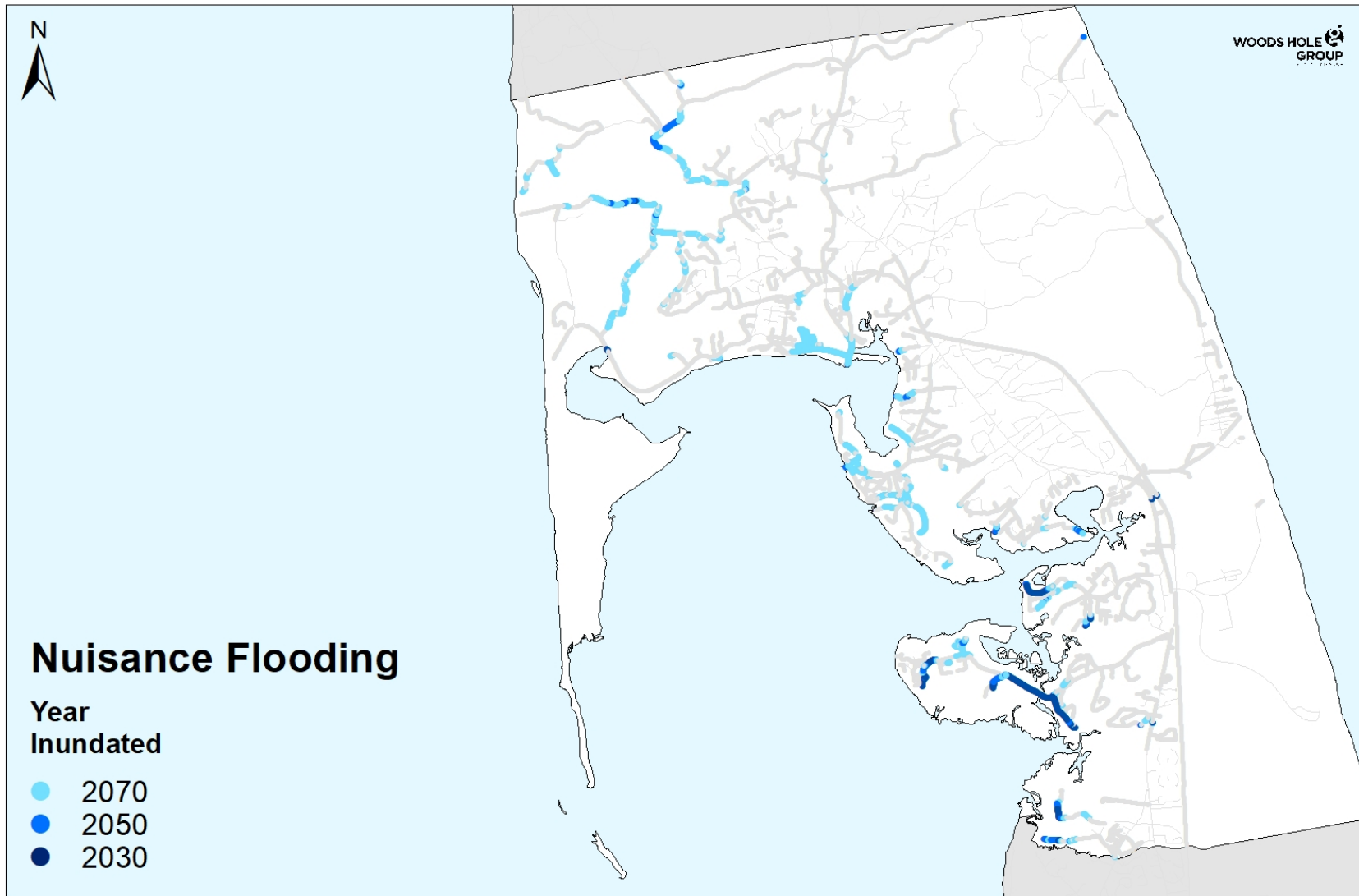
Additional Context & Information

- **Detailed information on webpages:**

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

- **Other Wellfleet road projects – town comments?**
- **Clarifying questions**
- **Format for meeting + timing**

Low Lying Roads Nuisance (MHW) Flooding (Wellfleet)



Road Miles 2030

1.4/136.5

Road Miles 2050

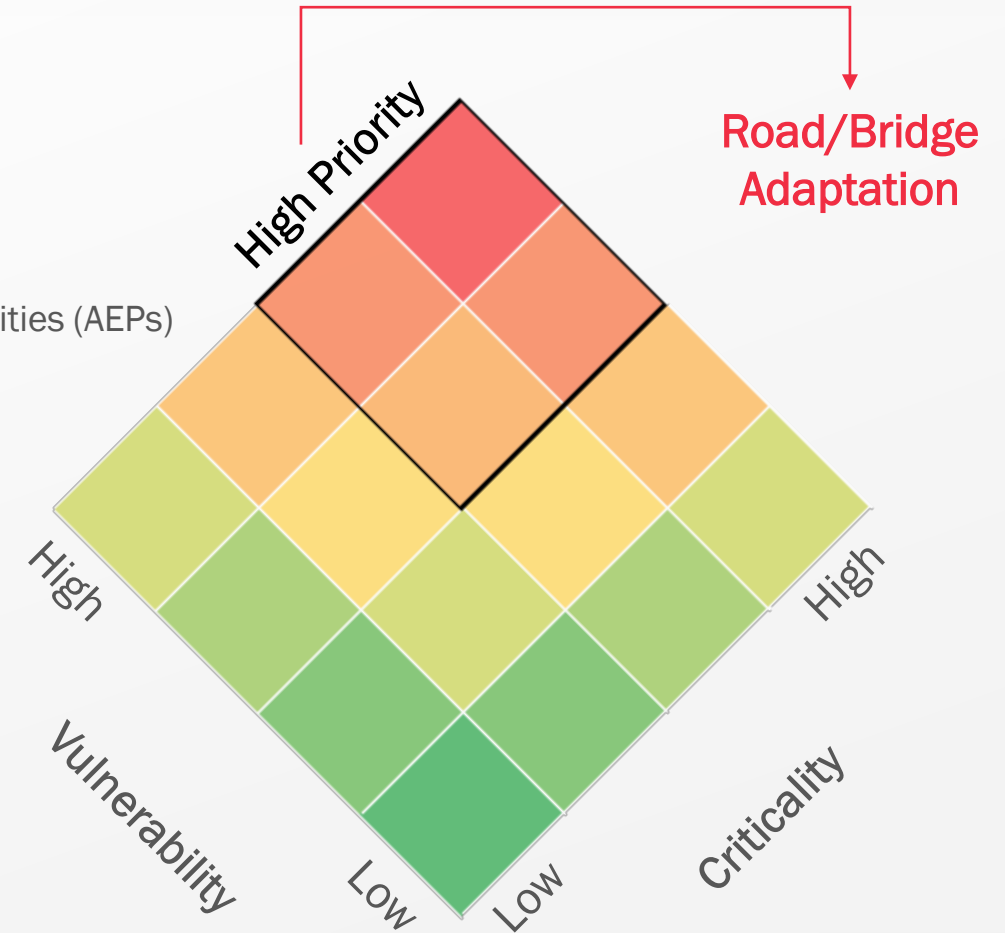
2.3/136.5

Road Miles 2070

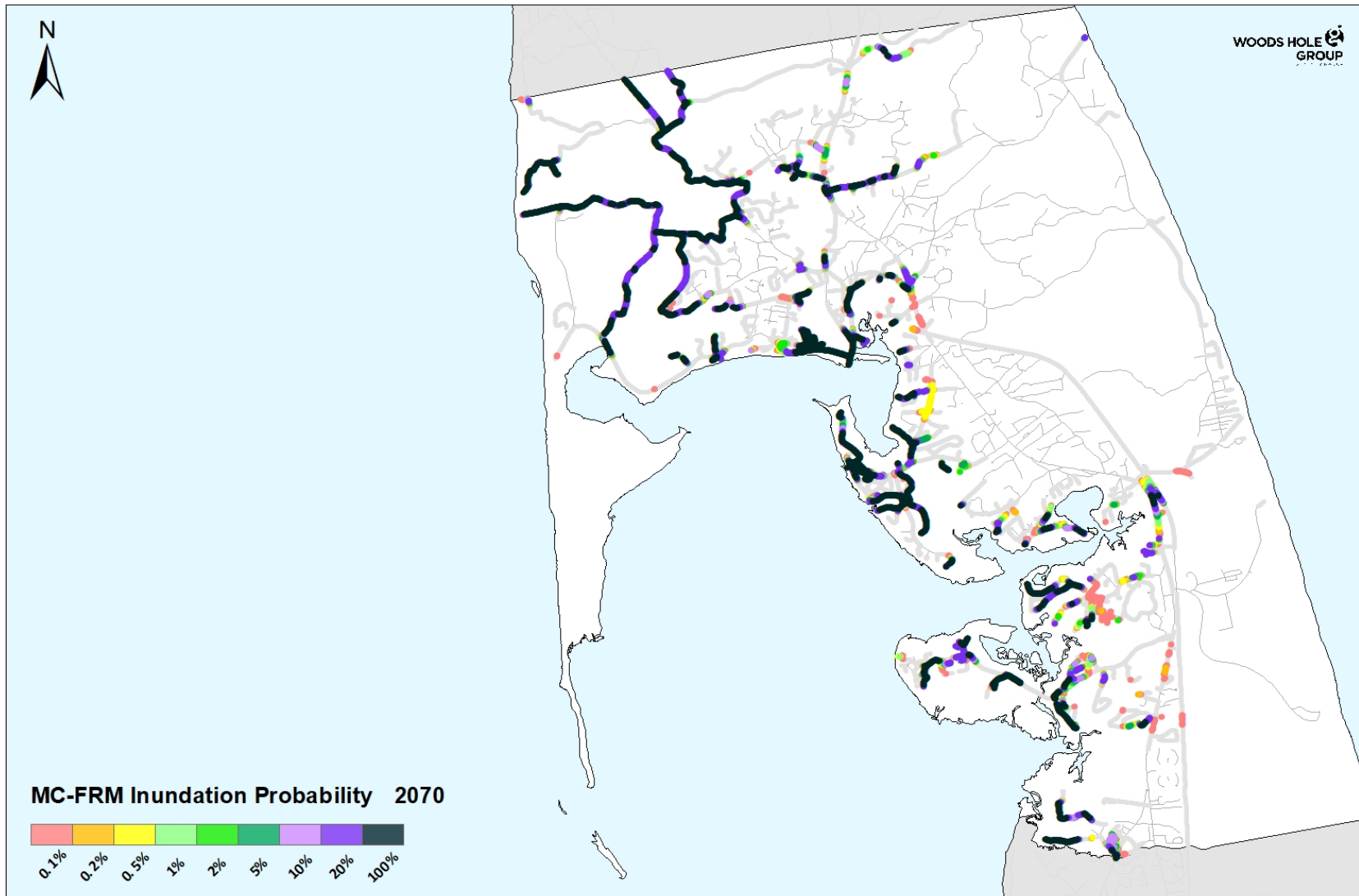
9.4/136.5

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 CE 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

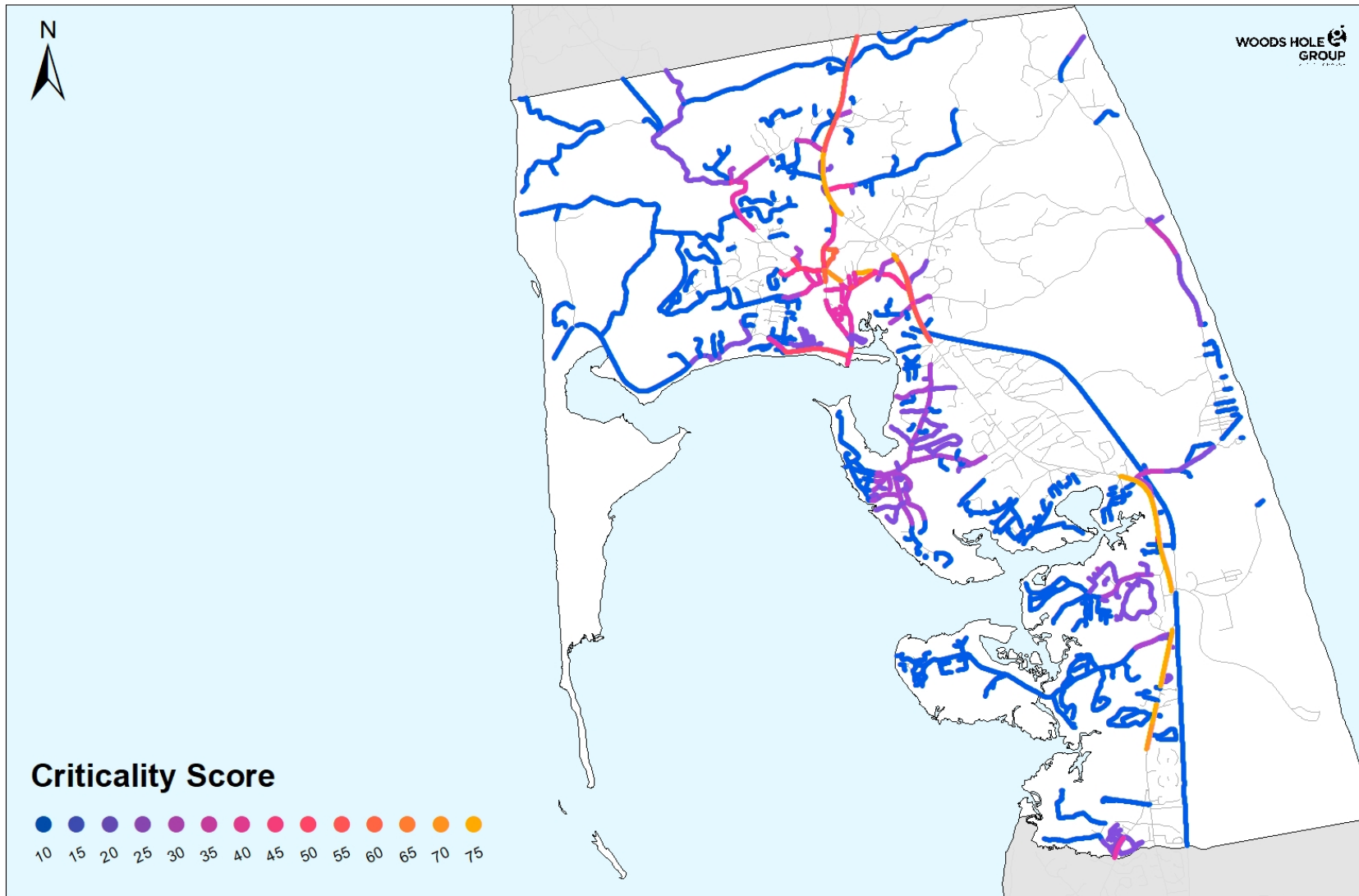


Low Lying Roads 2070 Inundation Probability (Wellfleet)

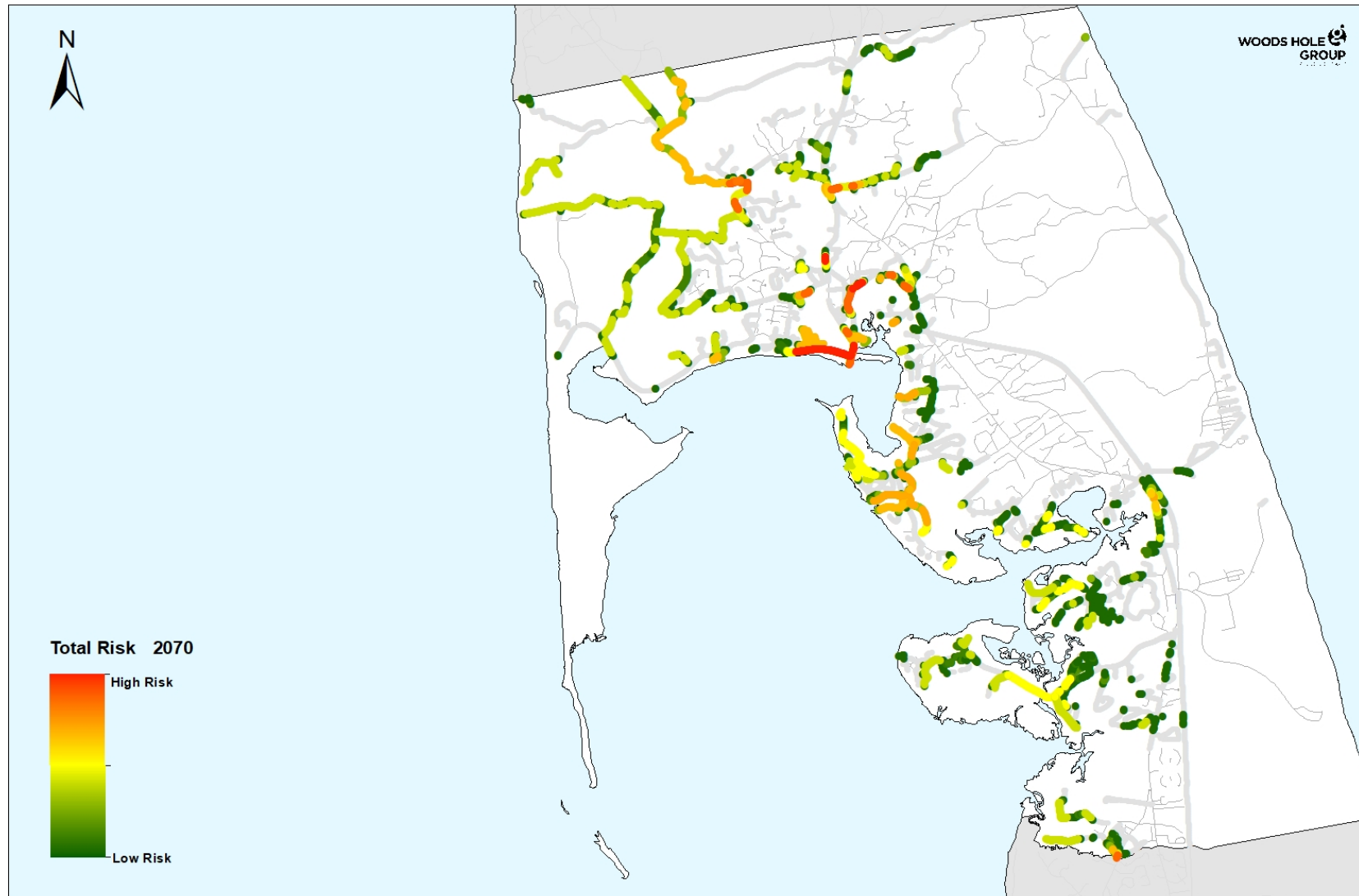


	%	Road miles
	0.1	28.6
	0.2	26.0
	0.5	25.1
	1	24.2
	2	22.9
	5	21.7
	10	20.7
	20	19.3
	100	12.8

Low Lying Roads Criticality Scoring (Wellfleet)



Low Lying Roads 2070 Risk Results (Wellfleet)



High Risk Road Segments

- Commercial St (Town Pier)
 - Herring River Restoration Roads+
 - King Phillip Rd (Paine Hollow)
 - Old Pier Rd (Wellfleet Harbor)
 - East Commercial St (Downtown)
 - Lieutenant Island Rd
-
- Route 6 at Black Fish Creek*
 - Main St (Downtown)
 - Chequessett Neck Rd (Davey's Path)
 - Holbrook Ave (Downtown)
 - Cove Rd (Chipman's Cove)
-
- Briar Ln (Squires Pond)
 - Gull Pond Rd and Route 6*
 - West Rd
 - Old Wharf Rd
 - Dike Bridge (Herring River)+

Summary/Selection of High Priority Road Segments (Wellfleet)

	Name	Length (ft)	Description	Segment Storm Probability (%)			Nuisance Length (ft)		
				2030	2050	2070	2030	2050	2070
<input checked="" type="checkbox"/>	A Commercial St (Town Pier)	3840	Leading south to Wellfleet Harbor	0.1-100	2-100	10-100	20	20	3420
	B Herring River Restoration Roads+	8020	Bound Brook Is, Old County, Coles Neck, Pole Dike Rd	0.1-100	0.5-100	20-100		1240	4800
	C King Phillip Rd (Paine Hollow)	380	Access to neighborhoods	0-100	1-100	5-100			260
	D Old Pier Rd (Wellfleet Harbor)	740	Off of Cove Rd on east side of Wellfleet Harbor	5-100	20-100	20-100		180	740
<input checked="" type="checkbox"/>	E East Commercial St (Downtown)	1540	Access to downtown and Town landing	0.1-20	2-100	20-100			820
	F Lieutenant Island Rd	2340	Including bridge to Lieutenant Island	0.2-100	5-100	20-100	1900	2100	2240
	G Route 6 at Black Fish Creek*	520	Route 6 segment over Blackfish Creek	0.2-2	10-100	100			
	H Main St (Downtown)	340	Access to downtown from Route 6	0.1-1	2-100	100			
	I Chequessett Neck Rd (Davey's Path)	460	Access to neighborhoods	0.5-20	10-100	100			280
	J Holbrook Ave (Downtown)	600	Access to downtown	5-20	20-100	20-100			400
	K Cove Rd (Chipman's Cove)	560	Access to homes and Indian Neck Rd	0.5-10	10-100	20-100			
	L Briar Ln (Squires Pond)	180	Connecting Route 6 and West Main St	0.2-5	5-20	100			
	M Gull Pond Rd and Route 6*	1740	Access to Atlantic beaches, plus Route 6 intersection	0.1-5	1-20	20-100			
	N West Rd	200	Access to homes and Town boundary	0.2-10	5-100	20-100			
	O Old Wharf Rd	580	Access to homes on Old Wharf Pt	0.5-20	5-100	20-100			280
	P Dike Bridge (Herring River)+	600	Dike Bridge over Herring River	0-0.5	1-10	10-100			
<input checked="" type="checkbox"/>	Kendrick Avenue (East)								
<input checked="" type="checkbox"/>	Kendrick Avenue (West)								

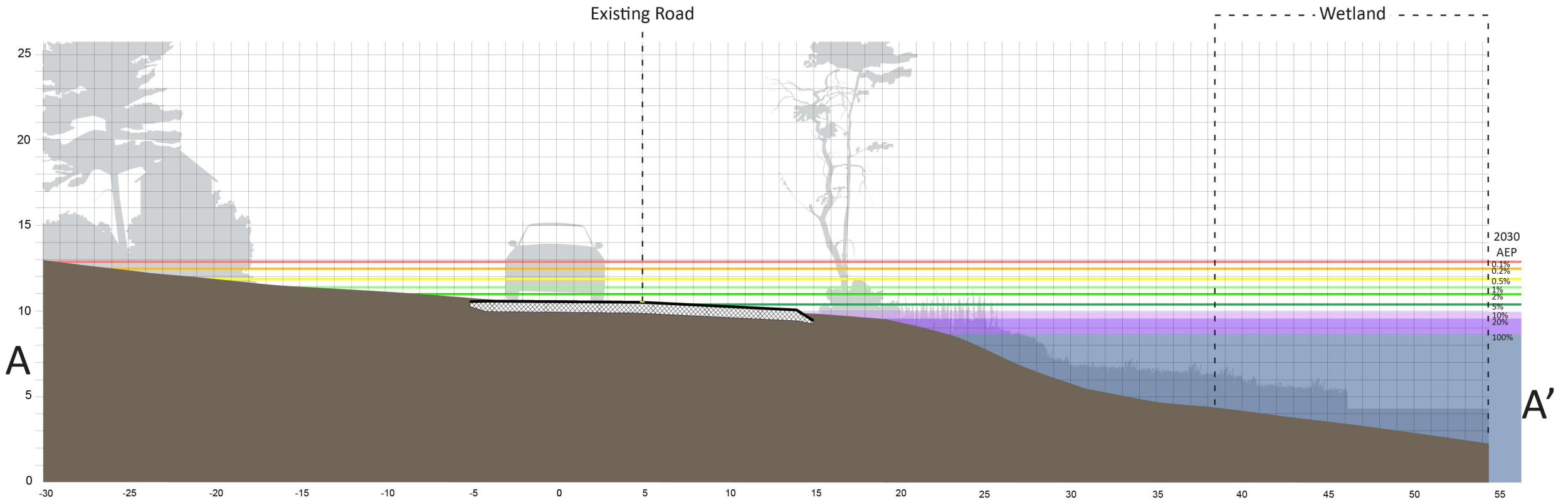
+ = Herring River Restoration Project

* = MassDOT roadway

East Commercial Street

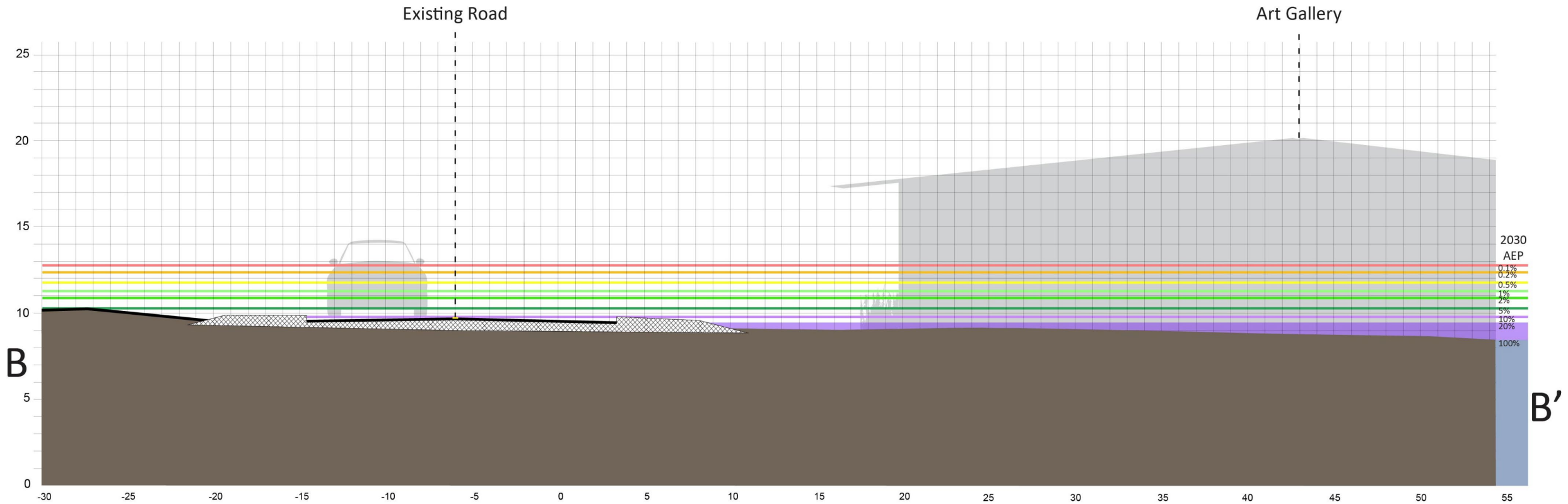


East Commercial Street

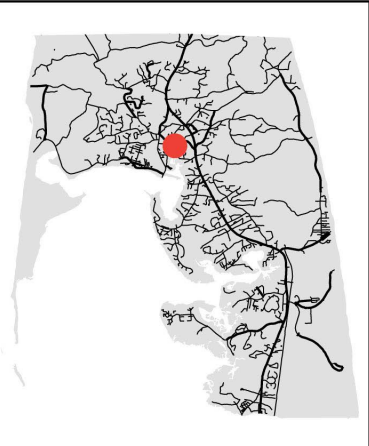
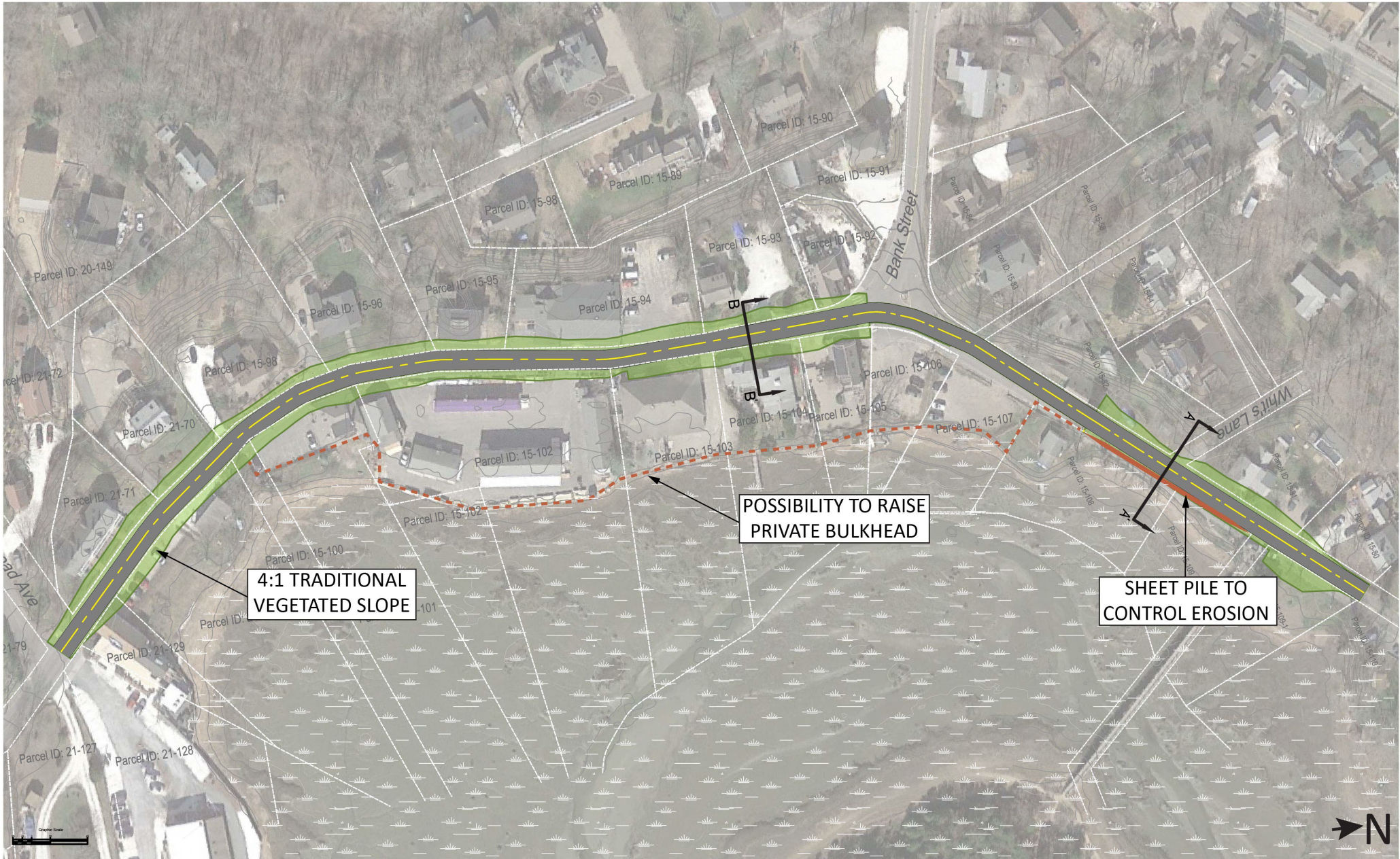


EXISTING CONDITIONS
East Commercial Street, Wellfleet

East Commercial Street



EXISTING CONDITIONS
East Commercial Street, Wellfleet



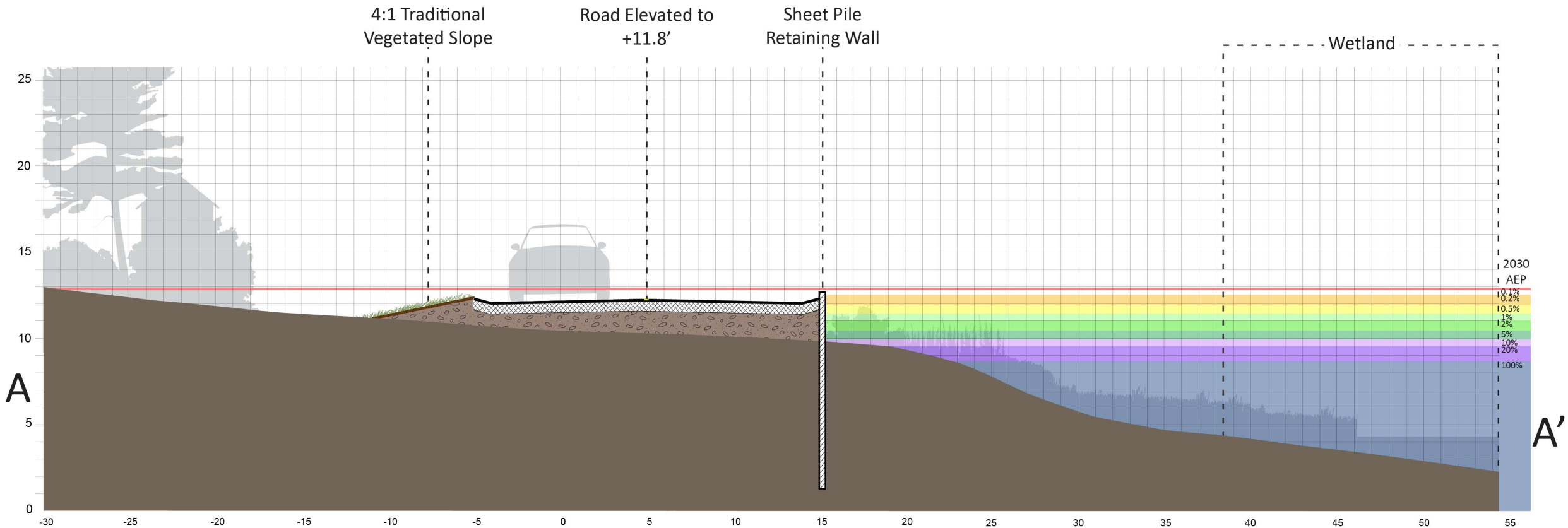
**East Commercial Street
WELLFLEET**

ALTERNATIVE 1: GRAY

1438 linear feet of Town-owned road are elevated from a lowest point of 8.6 feet to a lowest point of 10.5 feet. Sheet pile is used to control erosion on the coastal bank near Whit's Lane, and there is a possibility to raise the bulkhead edge and protect waterfront businesses, tying in to the sheet pile and eastern road segment at 11.8ft.

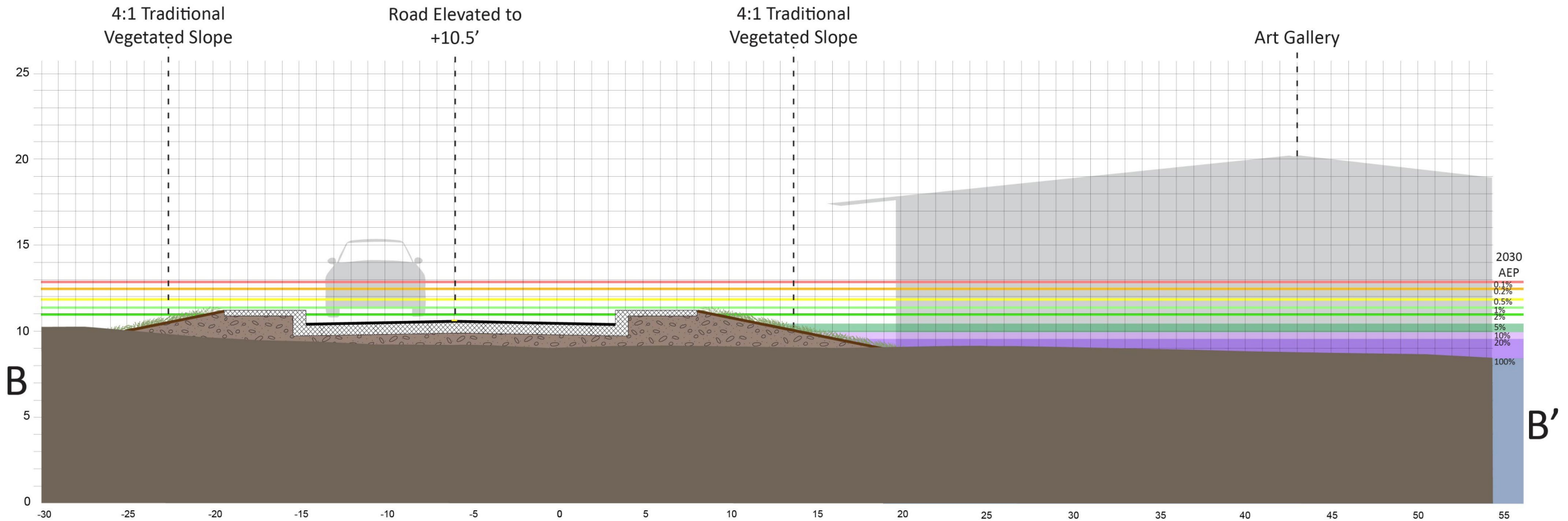
Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey

East Commercial Street

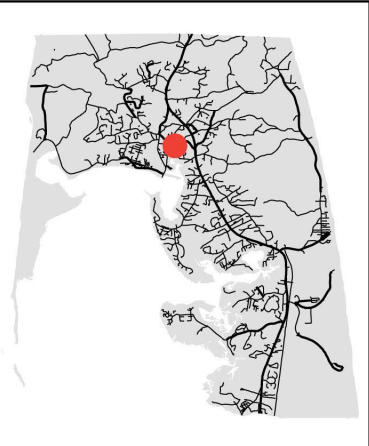


ALTERNATIVE 1: GRAY
East Commercial Street, Wellfleet

East Commercial Street



ALTERNATIVE 1: GRAY
East Commercial Street, Wellfleet



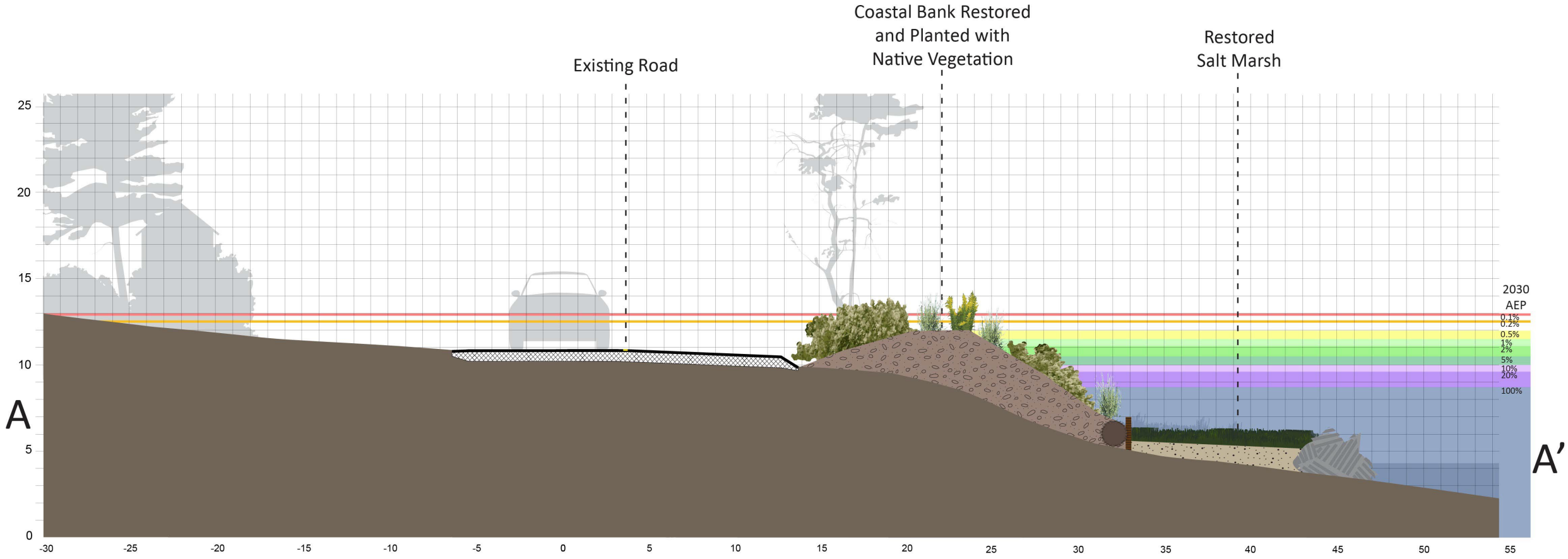
**East Commercial Street
WELLFLEET**

ALTERNATIVE 2: HYBRID

The coastal bank near Whit's Lane is stabilized and restored using coastal bank and salt marsh vegetation, erosion control materials, fill, and sand. Waterfront properties on East Commercial Street are acquired and converted to a waterfront park, which integrates a berm, flood wall, or other flood protection feature.

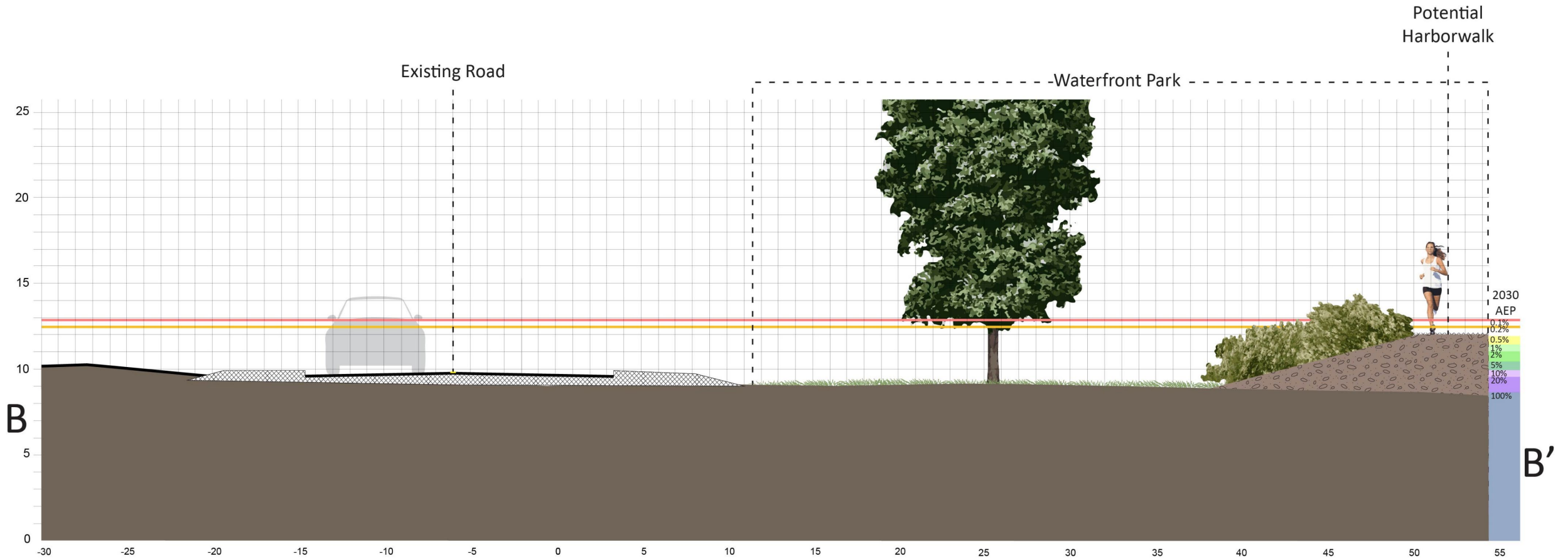
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East Commercial Street



ALTERNATIVE 2: HYBRID
East Commercial Street, Wellfleet

East Commercial Street



ALTERNATIVE 2: HYBRID
East Commercial Street, Wellfleet

EAST COMMERCIAL STREET, WELLFLEET

Summary of alternatives

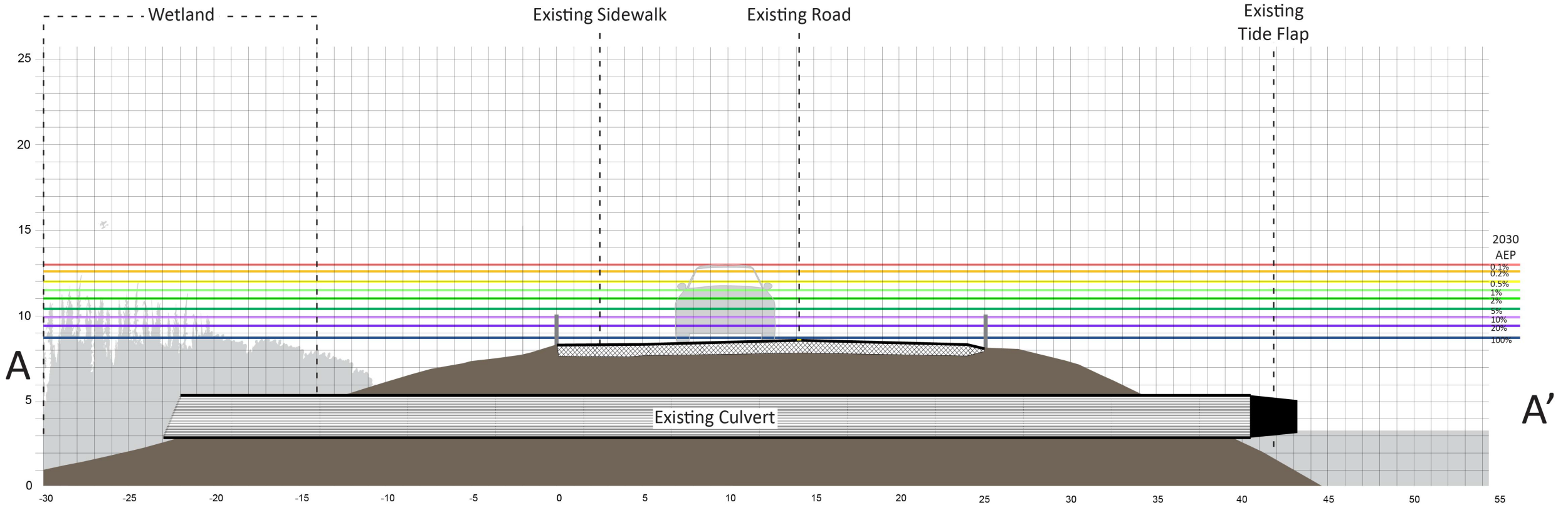
	Description	Critical Elevation	Annual Exceedance Probability			Vulnerable to Tidal Flooding	Impacts to Wetlands	Impacts to Private Property	Estimated Cost*	
			2030	2050	2070					
EXISTING	A segment of 21ft wide road with commercial and residential uses.	8.6 feet	20%	100%	100%	2070	N/A	N/A	N/A	
ALTERNATIVE 1: GRAY	1438 linear feet of Town-owned road are elevated from a lowest point of 8.6 feet to a lowest point of 10.5 feet. Sheet pile is used to control erosion on the coastal bank near Whit's Lane, and there is a possibility to raise the bulkhead edge and protect waterfront businesses, tying in to the sheet pile and eastern road segment at 11.8ft.	A	11.8 feet	0.5%	10%	100%	N/A	Negative	Yes	\$968,000
		B	10.5 feet	5%	20%	100%				
ALTERNATIVE 2: HYBRID	The coastal bank near Whit's Lane is stabilized and restored using coastal bank and salt marsh vegetation, erosion control materials, fill, and sand. Waterfront properties on East Commercial Street are acquired and converted to a waterfront park, which integrates a 12 foot berm and shared use path. The berm and path connect to Uncle Tim's Bridge.		12.0 feet	0.2%	5%	20%	N/A	Possible Positive	Yes	\$945,000+ (excludes buyouts)

*Installed material cost +20% contingency. Excludes design, permitting, mobilization, stormwater and wastewater infrastructure, and site controls. Costs based on RSMeans 2021 cost book and adjusted for inflation and region.

Commercial Street



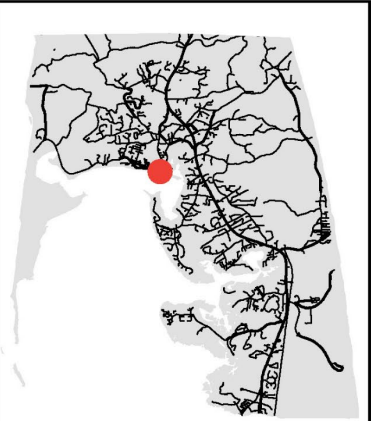
Commercial Street



EXISTING CONDITIONS
Commercial Street, Wellfleet



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

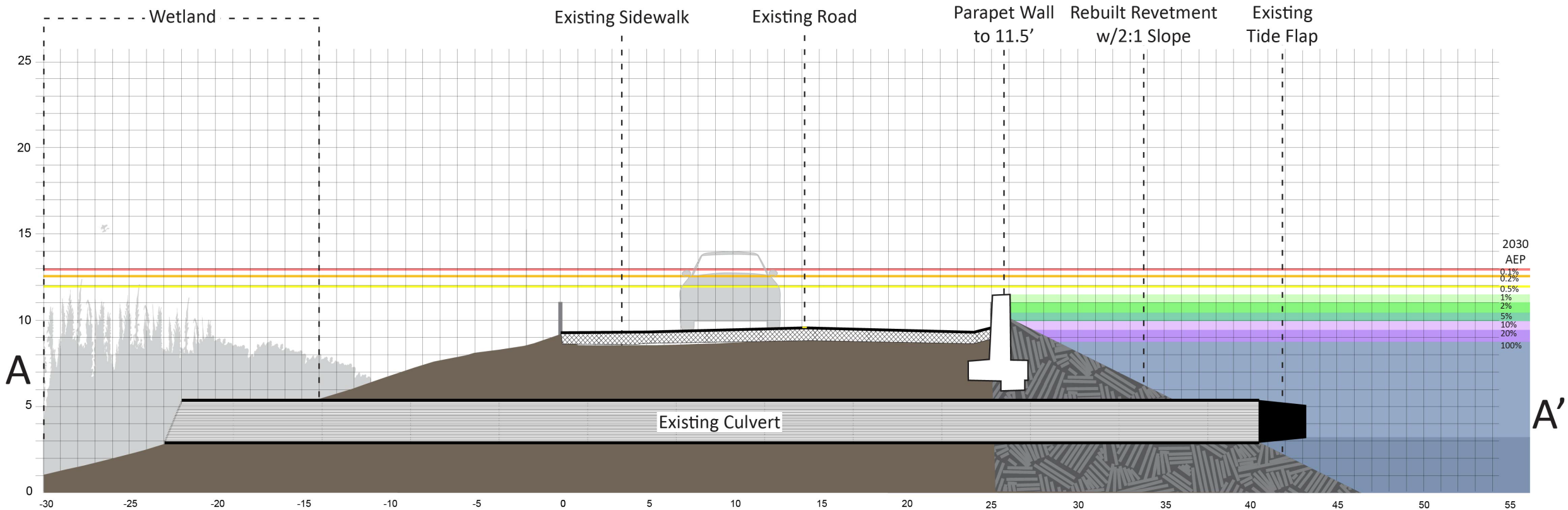


**Commercial Street
WELLFLEET**

ALTERNATIVE 1: GRAY

A parapet wall to 11.5 feet and a rebuilt revetment along the Mayo Creek crossing tie in to a high point near Mac's on the Pier. Sliding gates or deployable barriers are necessary at the parking lot and dock to allow for entry and exit. Connections to the alternative selected for Kendrick Avenue must be considered.

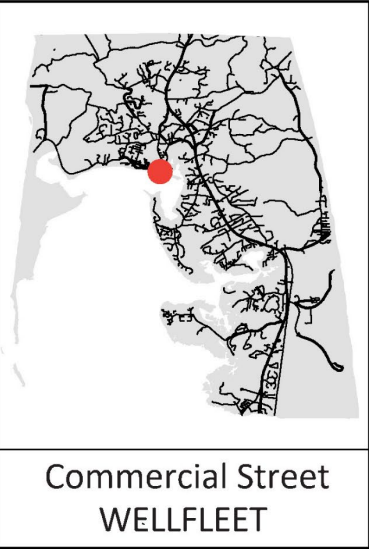
Commercial Street



ALTERNATIVE 1: GRAY
Commercial Street, Wellfleet



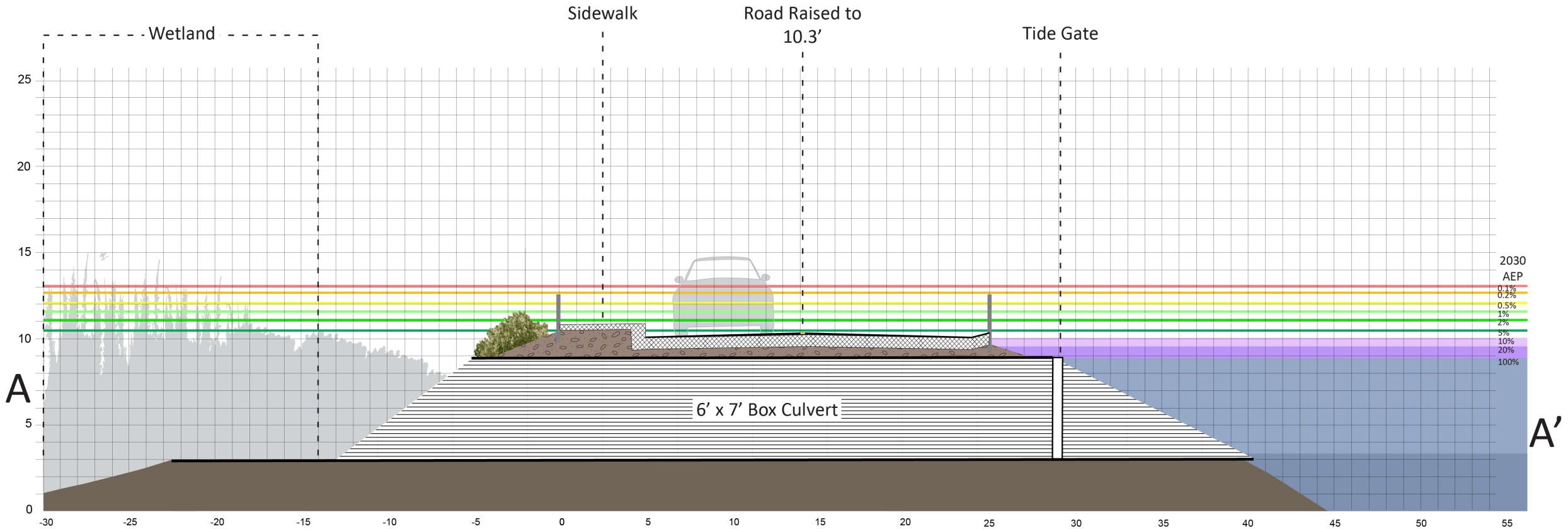
Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey



**Commercial Street
WELLFLEET**

ALTERNATIVE 2: HYBRID
 1079 linear feet of road are elevated to 10.3 feet with 3:1 side slopes. A 6' x 7' box culvert and operable tide gate are installed at the crossing of Mayo Creek, consistent with recommendations from an existing project. Connections to the alternative selected for Kendrick Avenue must be considered.

Commercial Street



ALTERNATIVE 2: HYBRID

Commercial Street, Wellfleet

COMMERCIAL STREET, WELLFLEET

Summary of alternatives

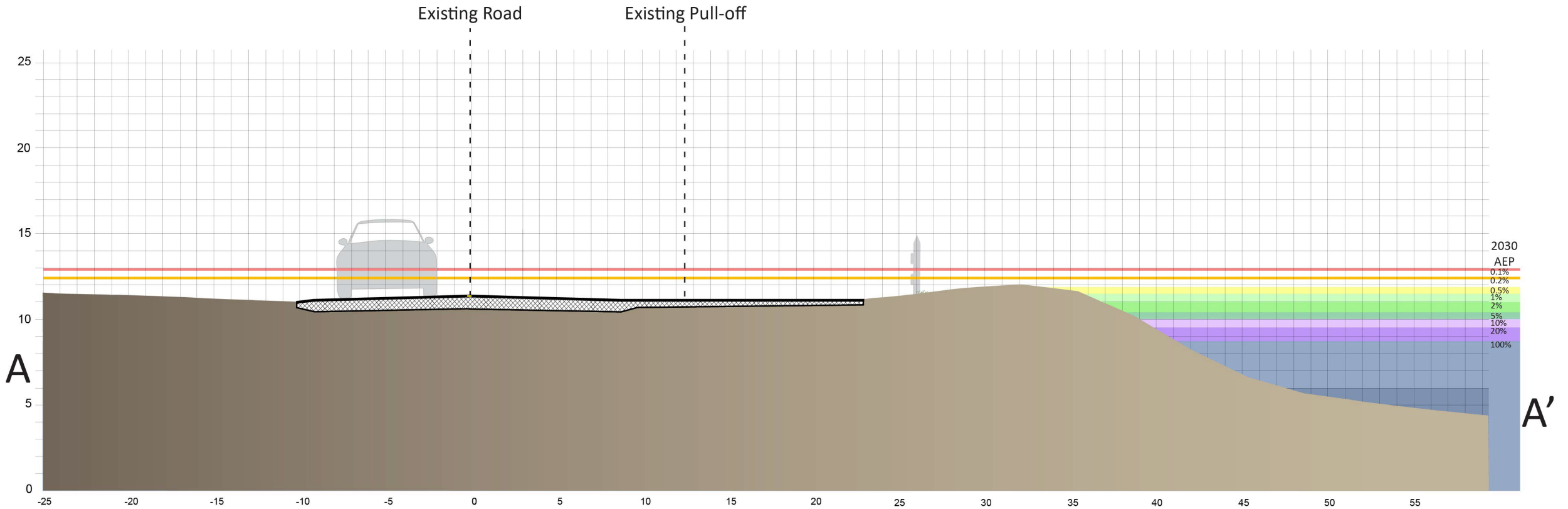
	Description	Critical Elevation	Annual Exceedance Probability			Vulnerable to Tidal Flooding	Impacts to Wetlands	Impacts to Private Property	Estimated Cost*
			2030	2050	2070				
EXISTING	A segment of 20 foot wide road with a creek crossing and culvert.	8.2 feet	100%	100%	100%	2070	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	A parapet wall to 11.5 feet and a rebuilt revetment along the Mayo Creek crossing tie in to a high point near Mac's on the Pier. Sliding gates or deployable barriers are necessary at the parking lot and dock to allow for entry and exit. Connections to the alternative selected for Kendrick Avenue must be considered.	11.5 feet	1%	10%	100%	N/A	Negative	Yes	\$454,000
ALTERNATIVE 2: HYBRID	1079 linear feet of road are elevated to 10.3 feet with 3:1 side slopes. A 6' x 7' box culvert and operable tide gate are installed at the Mayo Creek crossing, consistent with recommendations from an existing project. Connections to the alternative selected for Kendrick Avenue must be considered.	10.3 feet	5%	100%	100%	N/A	Possible Positive	Yes	\$519,000

*Installed material cost +20% contingency. Excludes design, permitting, mobilization, stormwater and wastewater infrastructure, and site controls. Costs based on RSMeans 2021 cost book and adjusted for inflation and region.

Kendrick Avenue (West/East)



Kendrick Avenue (West)

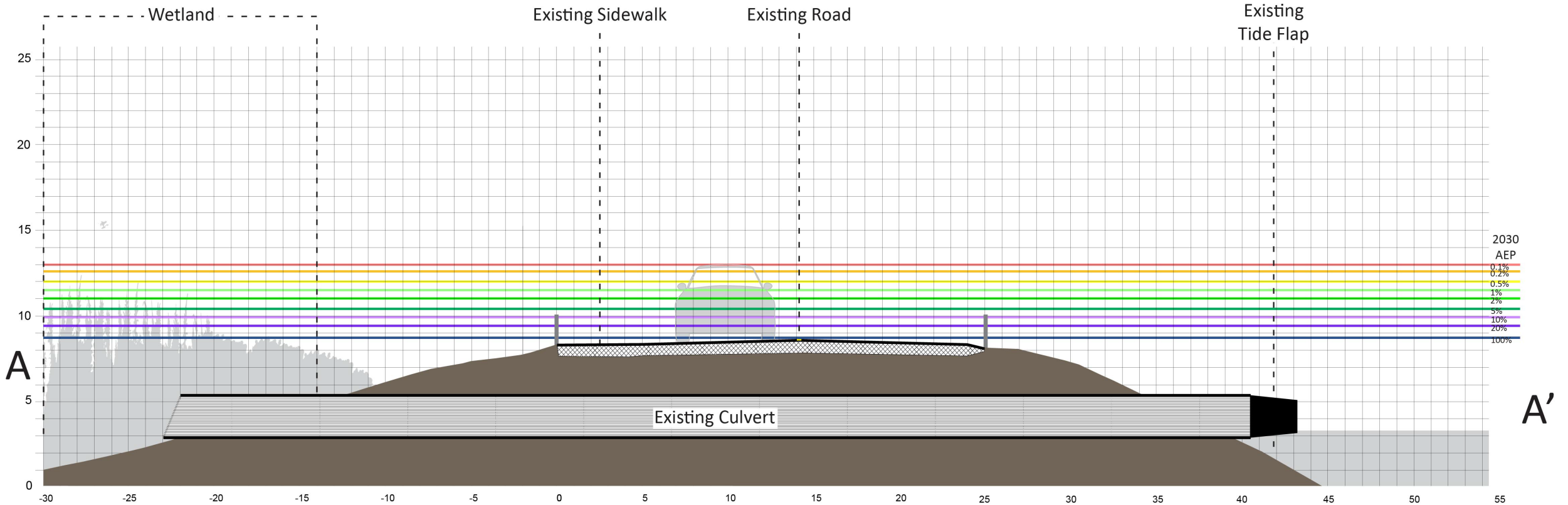


EXISTING CONDITIONS
Kendrick Avenue, Wellfleet

Commercial Street



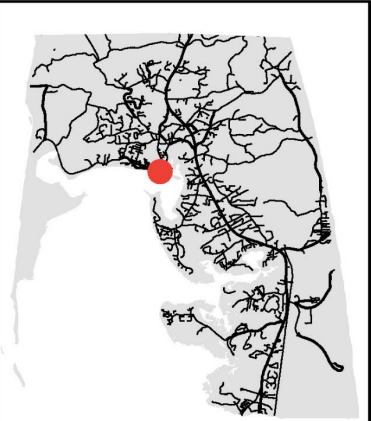
Commercial Street



EXISTING CONDITIONS
Commercial Street, Wellfleet



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

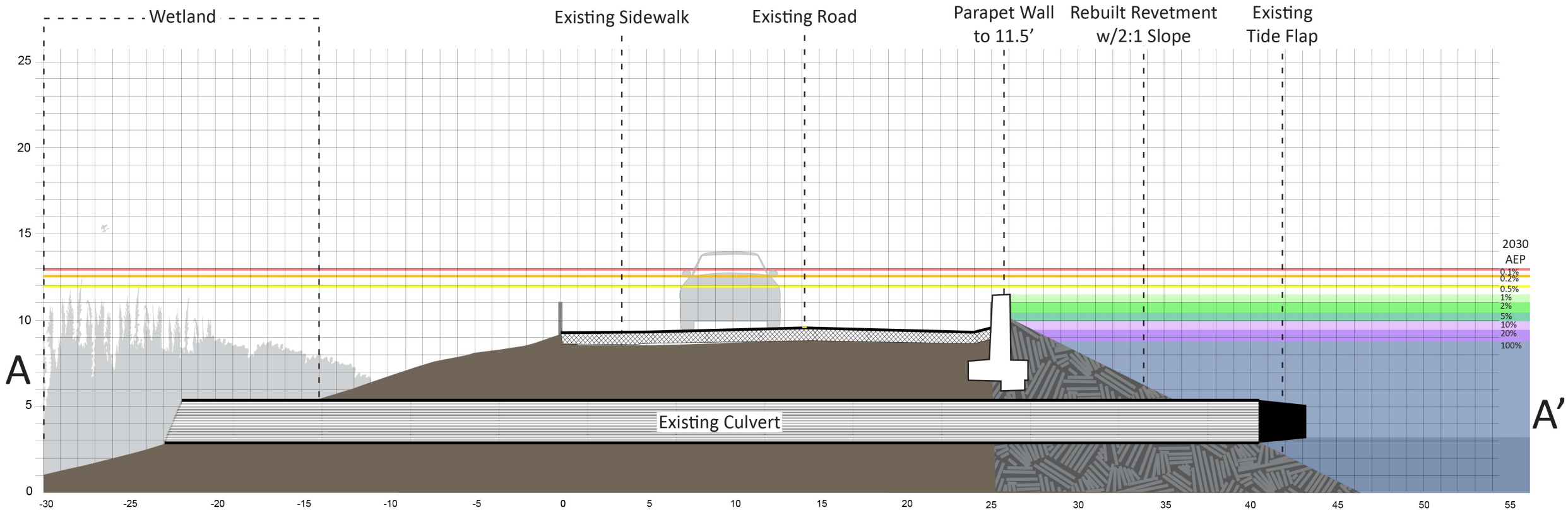


Commercial Street
WELLFLEET

ALTERNATIVE 1: GRAY

A parapet wall to 11.5 feet and a rebuilt revetment along the Mayo Creek crossing tie in to a high point near Mac’s on the Pier. Sliding gates or deployable barriers are necessary at the parking lot and dock to allow for entry and exit. Connections to the alternative selected for Kendrick Avenue must be considered.

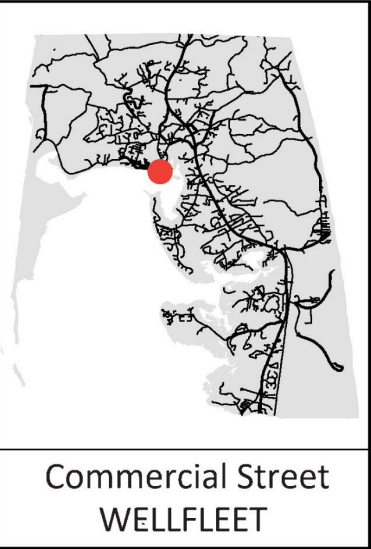
Commercial Street



ALTERNATIVE 1: GRAY
Commercial Street, Wellfleet



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

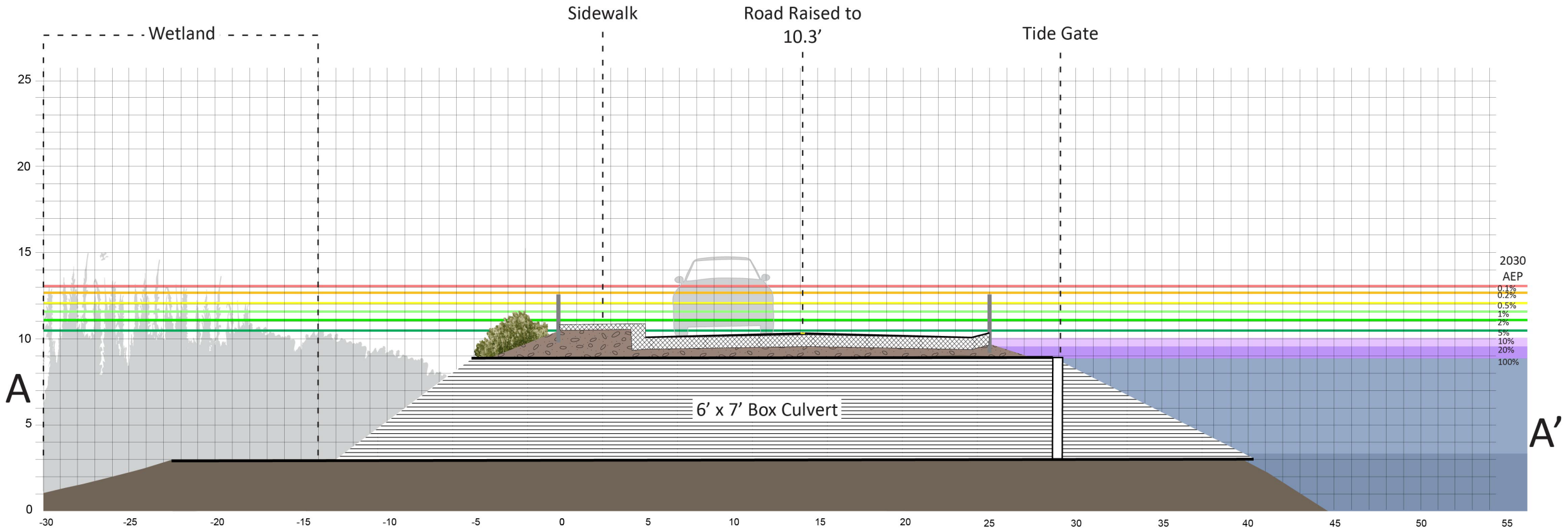


**Commercial Street
WELLFLEET**

ALTERNATIVE 2: HYBRID

1079 linear feet of road are elevated to 10.3 feet with 3:1 side slopes. A 6' x 7' box culvert and operable tide gate are installed at the crossing of Mayo Creek, consistent with recommendations from an existing project. Connections to the alternative selected for Kendrick Avenue must be considered.

Commercial Street



ALTERNATIVE 2: HYBRID
Commercial Street, Wellfleet

COMMERCIAL STREET, WELLFLEET

Summary of alternatives

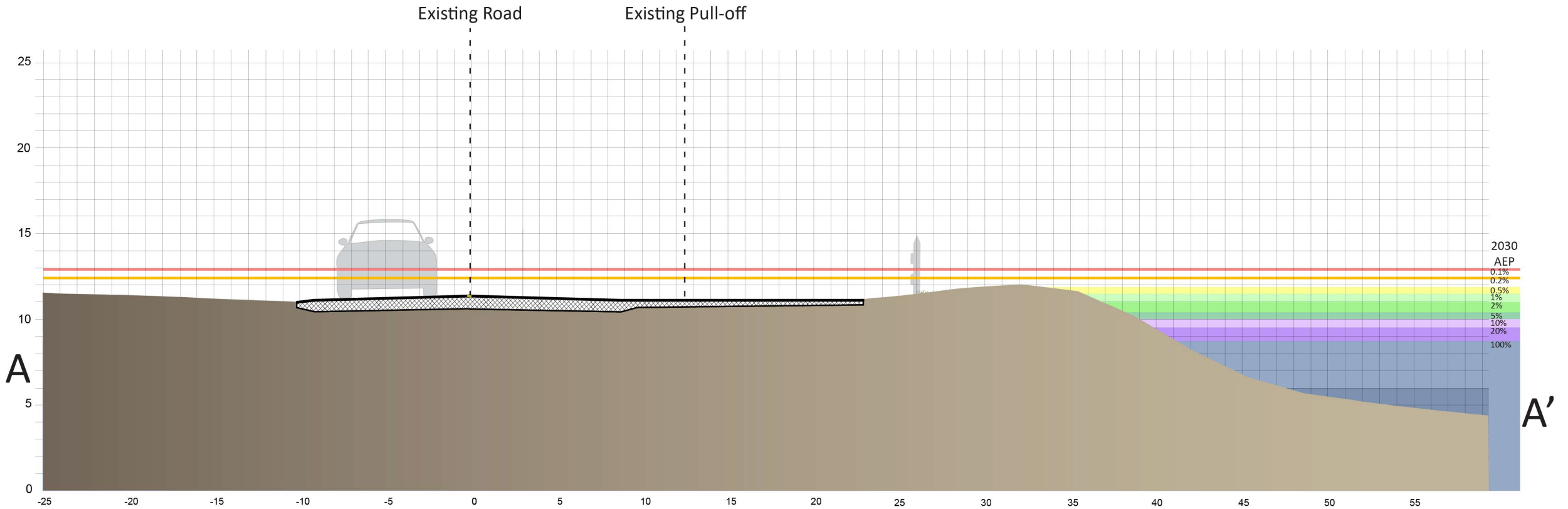
	Description	Critical Elevation	Annual Exceedance Probability			Vulnerable to Tidal Flooding	Impacts to Wetlands	Impacts to Private Property	Estimated Cost*
			2030	2050	2070				
EXISTING	A segment of 20 foot wide road with a creek crossing and culvert.	8.2 feet	100%	100%	100%	2070	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	A parapet wall to 11.5 feet and a rebuilt revetment along the Mayo Creek crossing tie in to a high point near Mac's on the Pier. Sliding gates or deployable barriers are necessary at the parking lot and dock to allow for entry and exit. Connections to the alternative selected for Kendrick Avenue must be considered.	11.5 feet	1%	10%	100%	N/A	Negative	Yes	\$454,000
ALTERNATIVE 2: HYBRID	1079 linear feet of road are elevated to 10.3 feet with 3:1 side slopes. A 6' x 7' box culvert and operable tide gate are installed at the Mayo Creek crossing, consistent with recommendations from an existing project. Connections to the alternative selected for Kendrick Avenue must be considered.	10.3 feet	5%	100%	100%	N/A	Possible Positive	Yes	\$519,000

*Installed material cost +20% contingency. Excludes design, permitting, mobilization, stormwater and wastewater infrastructure, and site controls. Costs based on RSMeans 2021 cost book and adjusted for inflation and region.

Kendrick Avenue (West/East)

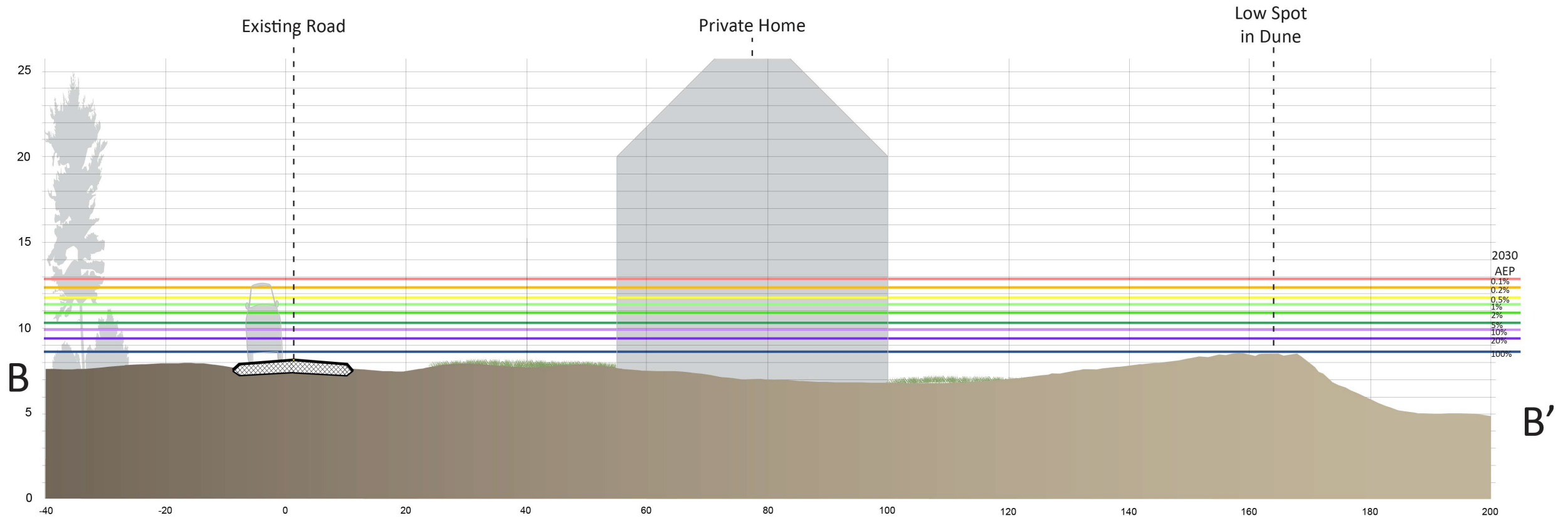


Kendrick Avenue (West)



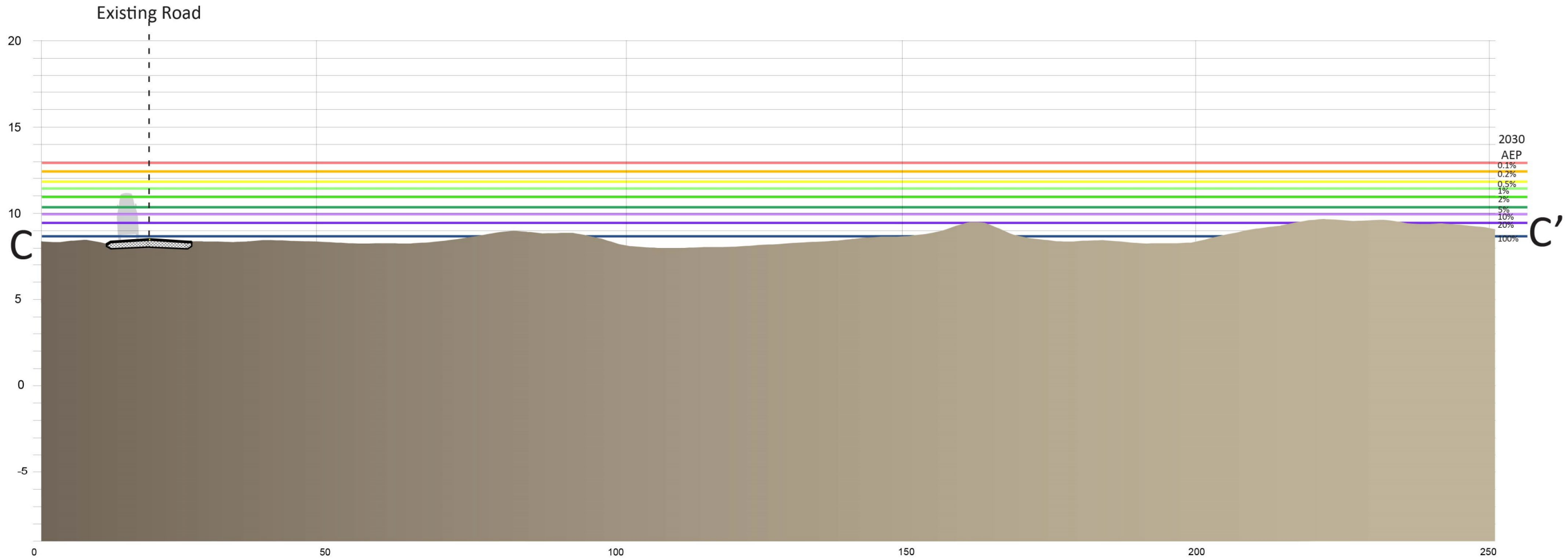
EXISTING CONDITIONS
Kendrick Avenue, Wellfleet

Kendrick Avenue (Middle)

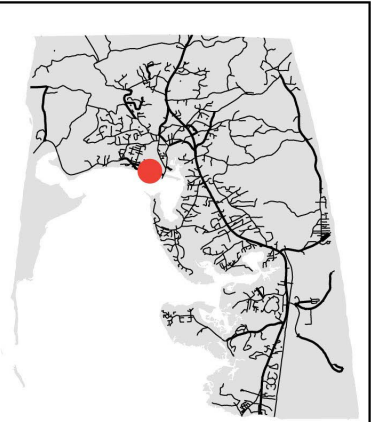
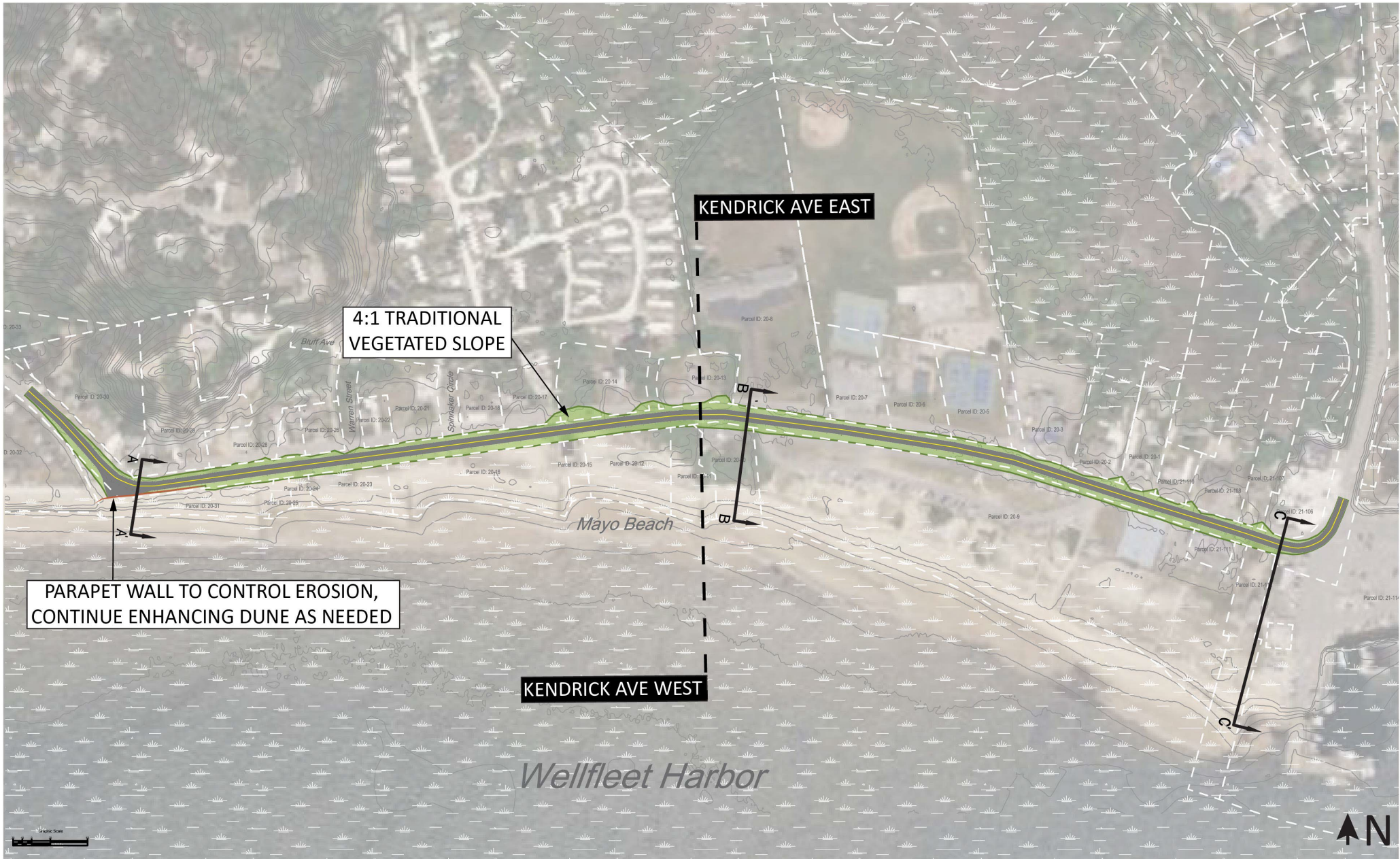


EXISTING CONDITIONS
Kendrick Avenue, Wellfleet

Kendrick Avenue (East)



EXISTING CONDITIONS
Kendrick Avenue, Wellfleet



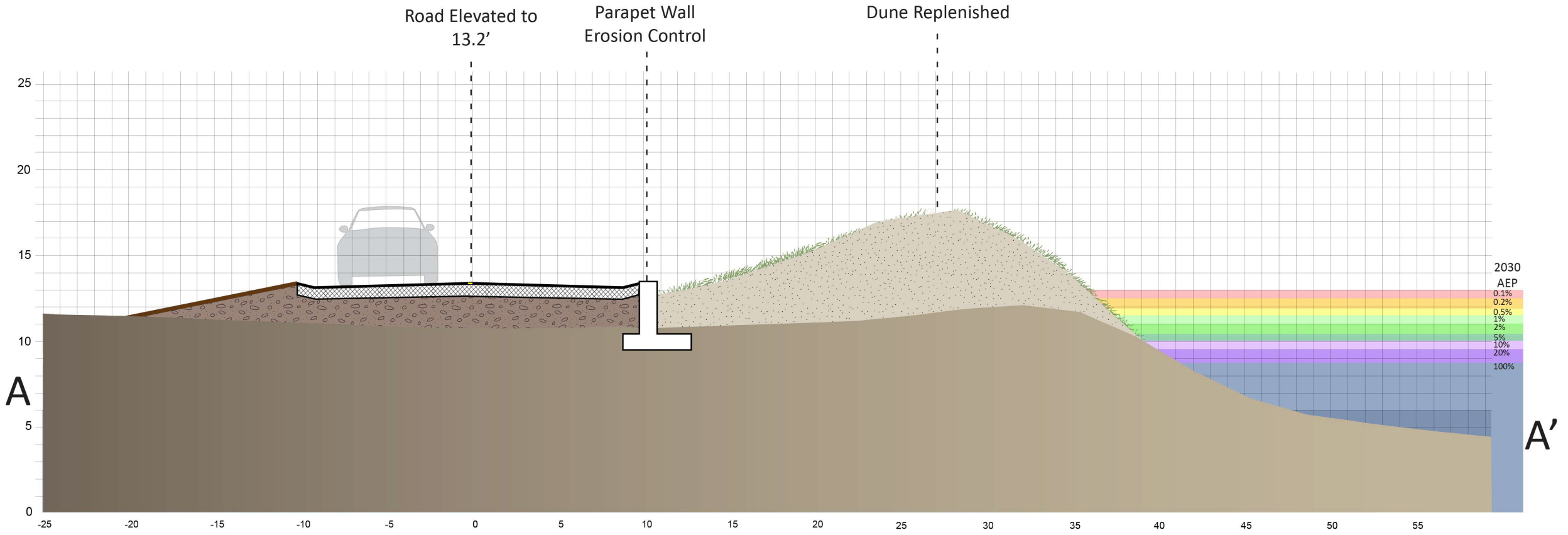
**Kendrick Ave
WELLFLEET**

ALTERNATIVE 1: GRAY

2830 linear feet of Town-owned road are elevated from a lowest point of 7.6 feet to a lowest point of 10.3 feet. Parapet wall and dune replenishment are used to control erosion at the western end of the road segment.

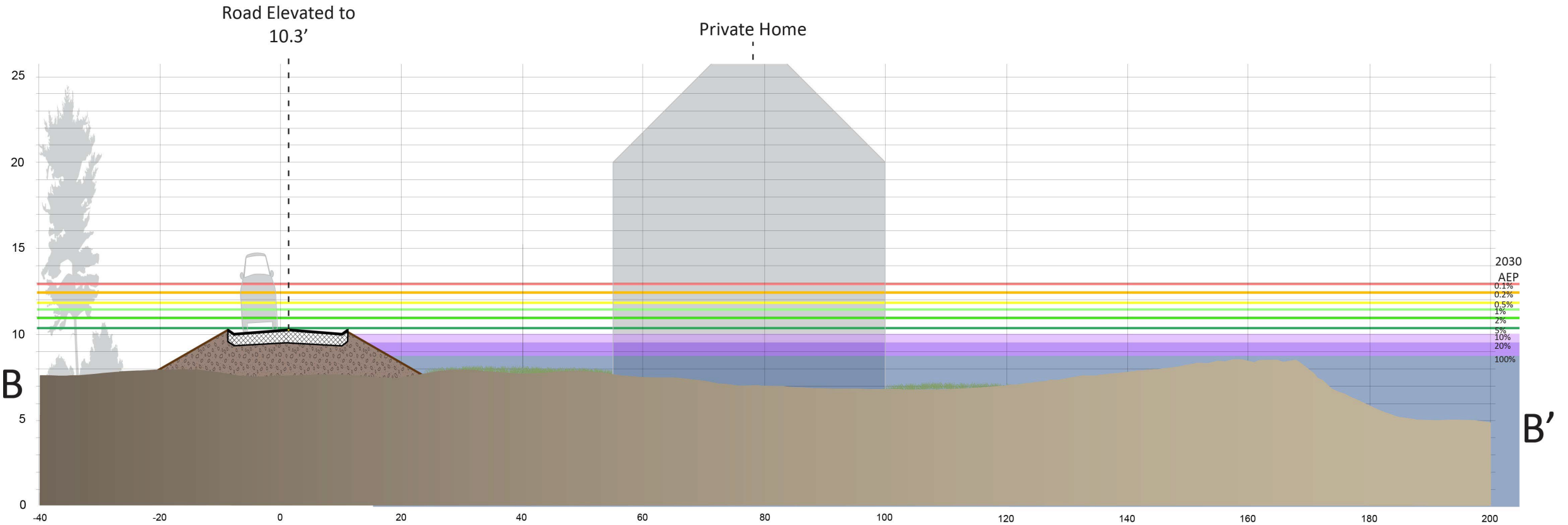
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Kendrick Avenue (West)



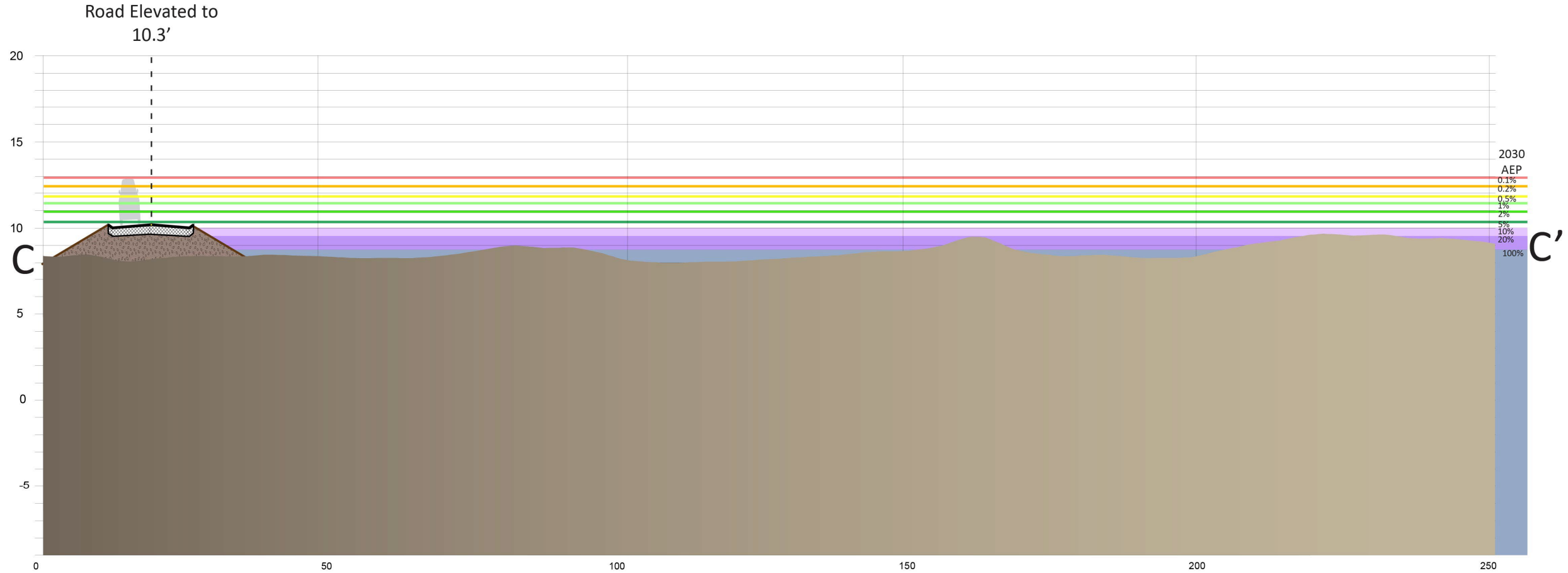
ALTERNATIVE 1: GRAY
Kendrick Avenue, Wellfleet

Kendrick Avenue (Middle)

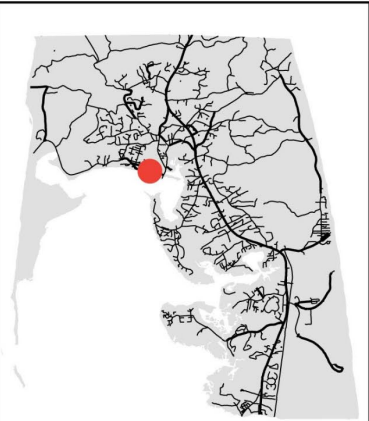
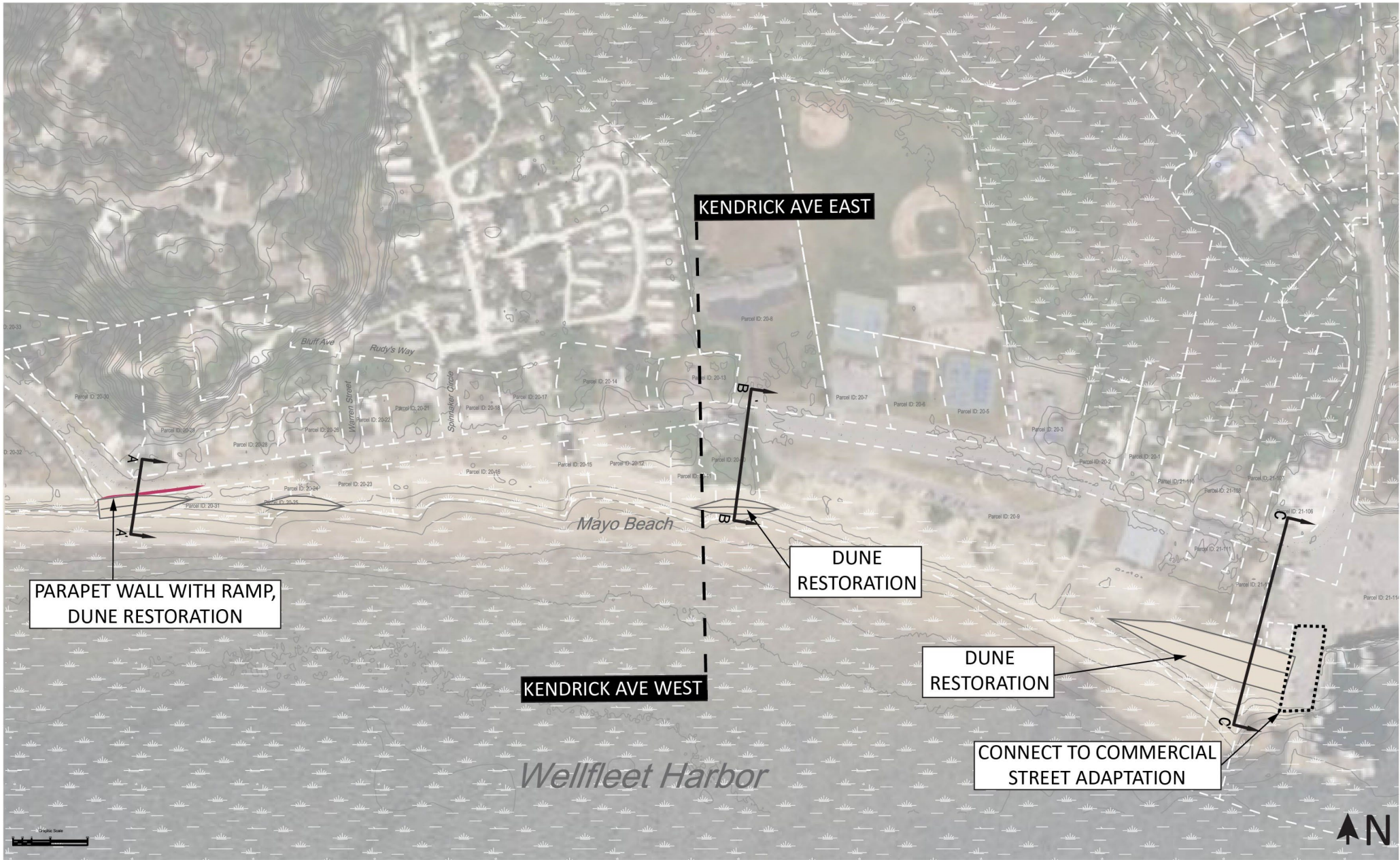


ALTERNATIVE 1: GRAY
Kendrick Avenue, Wellfleet

Kendrick Avenue (East)



ALTERNATIVE 1: GRAY
Kendrick Avenue, Wellfleet



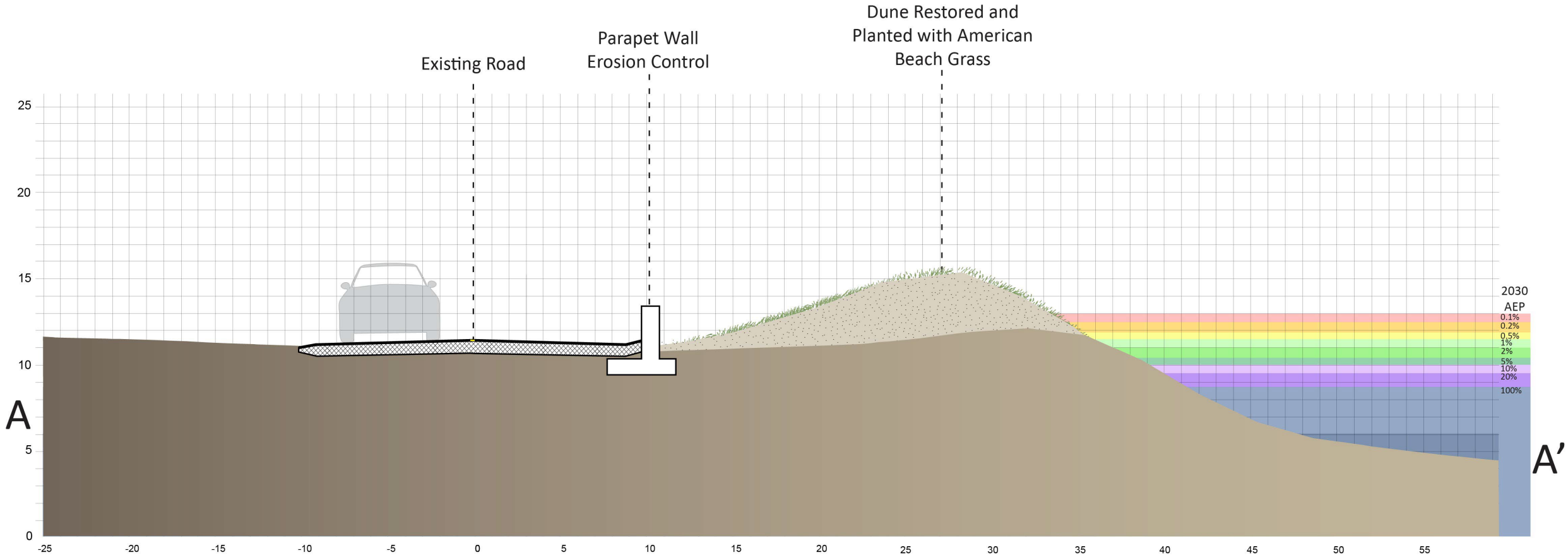
**Kendrick Ave
WELLFLEET**

ALTERNATIVE 2: HYBRID

Targeted dune restorations and parapet walls bring the dune's elevation to 10.1ft. At the western curve of the road, a parapet wall prevents erosion. Connection to the alternative chosen for Commercial Street must be considered.

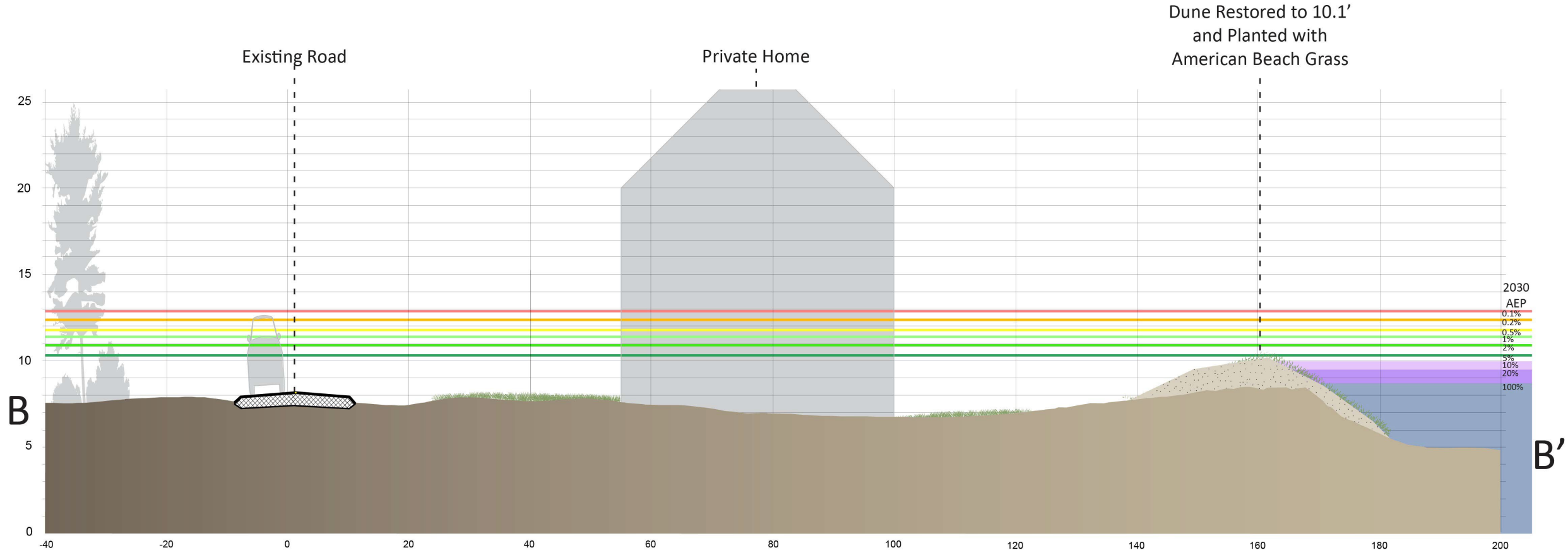
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Kendrick Avenue (West)



ALTERNATIVE 2: HYBRID
Kendrick Avenue, Wellfleet

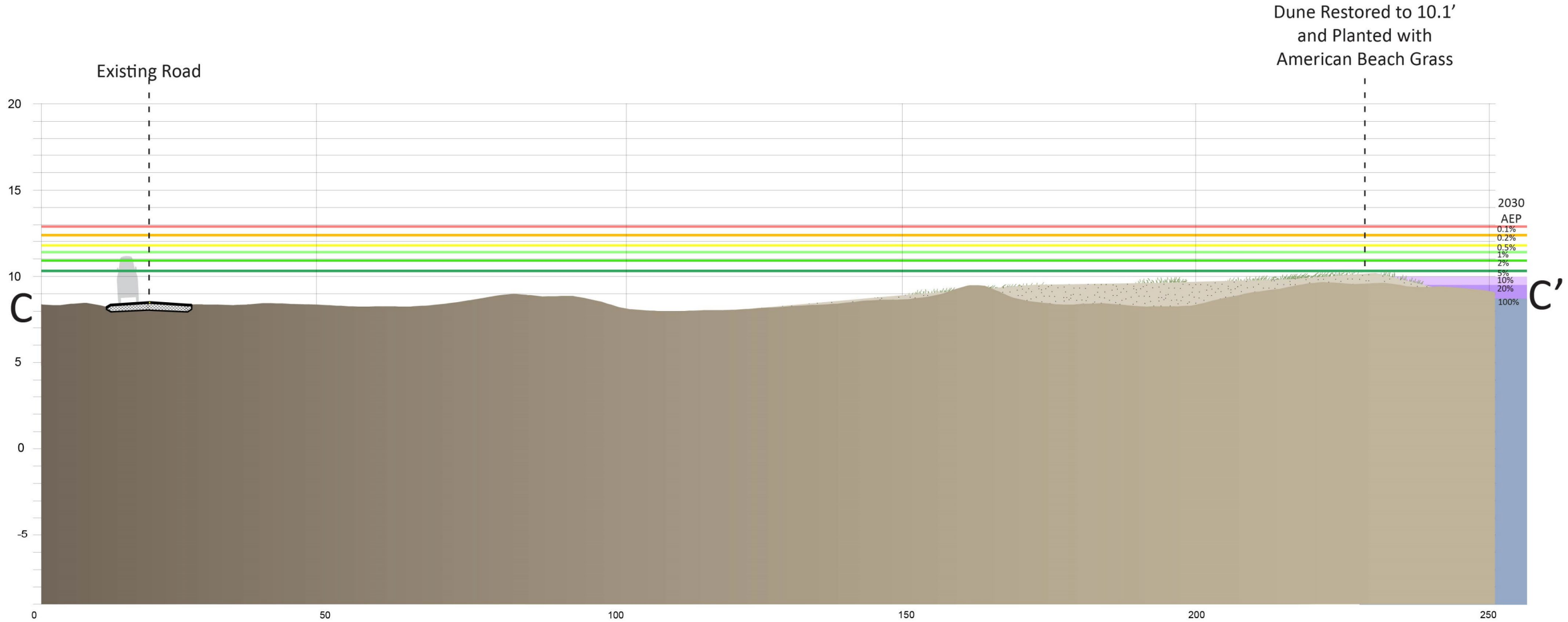
Kendrick Avenue (Middle)



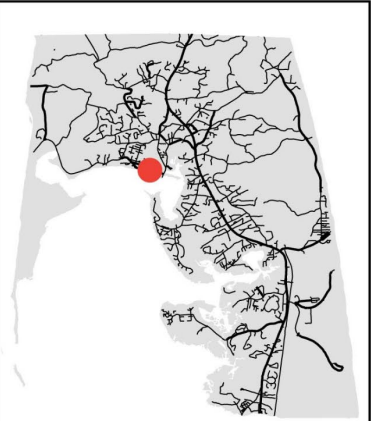
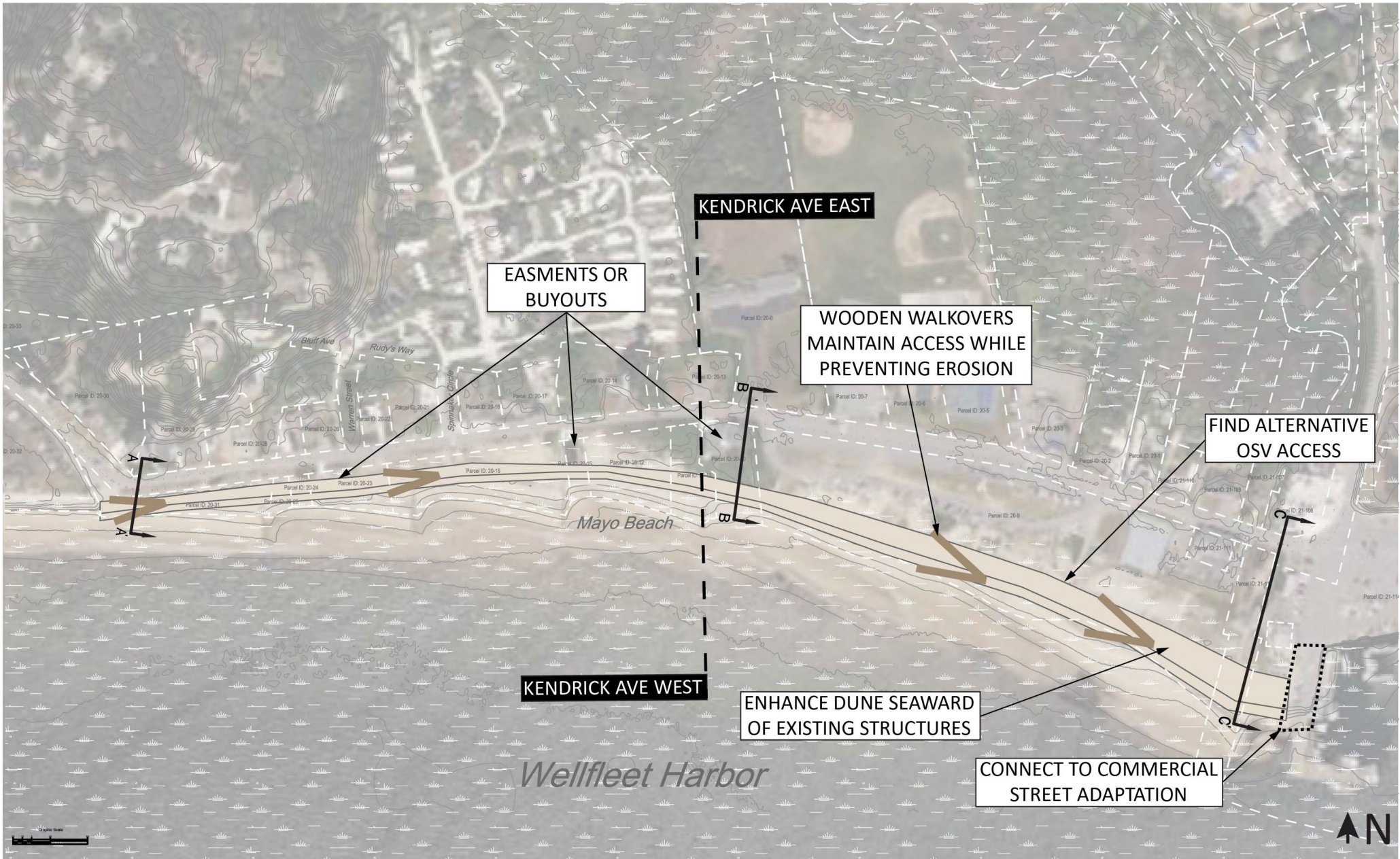
ALTERNATIVE 2: HYBRID

Kendrick Avenue, Wellfleet

Kendrick Avenue (East)



ALTERNATIVE 2: HYBRID
Kendrick Avenue, Wellfleet



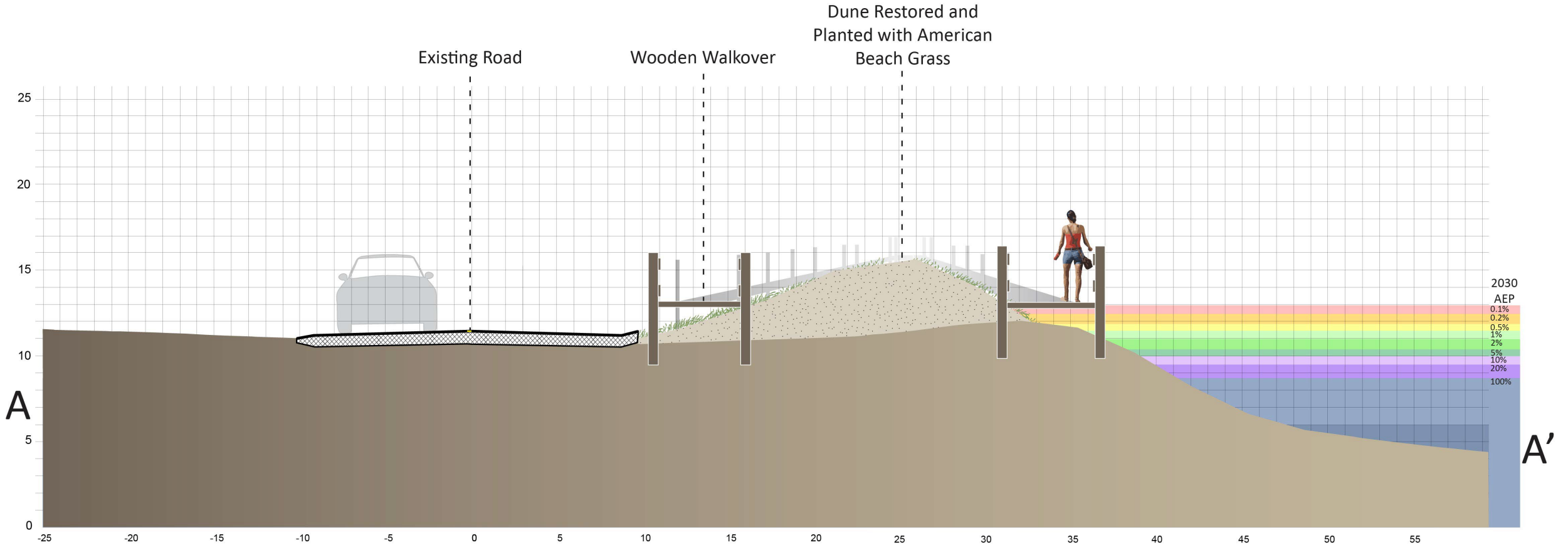
**Kendrick Ave
WELLFLEET**

ALTERNATIVE 3: GREEN

Private easements or buyouts allow the entire dune along Mayo Beach to be restored to 11.5ft. Some sections are already higher and would not require much work. Connection to the alternative chosen for Commercial Street must be considered.

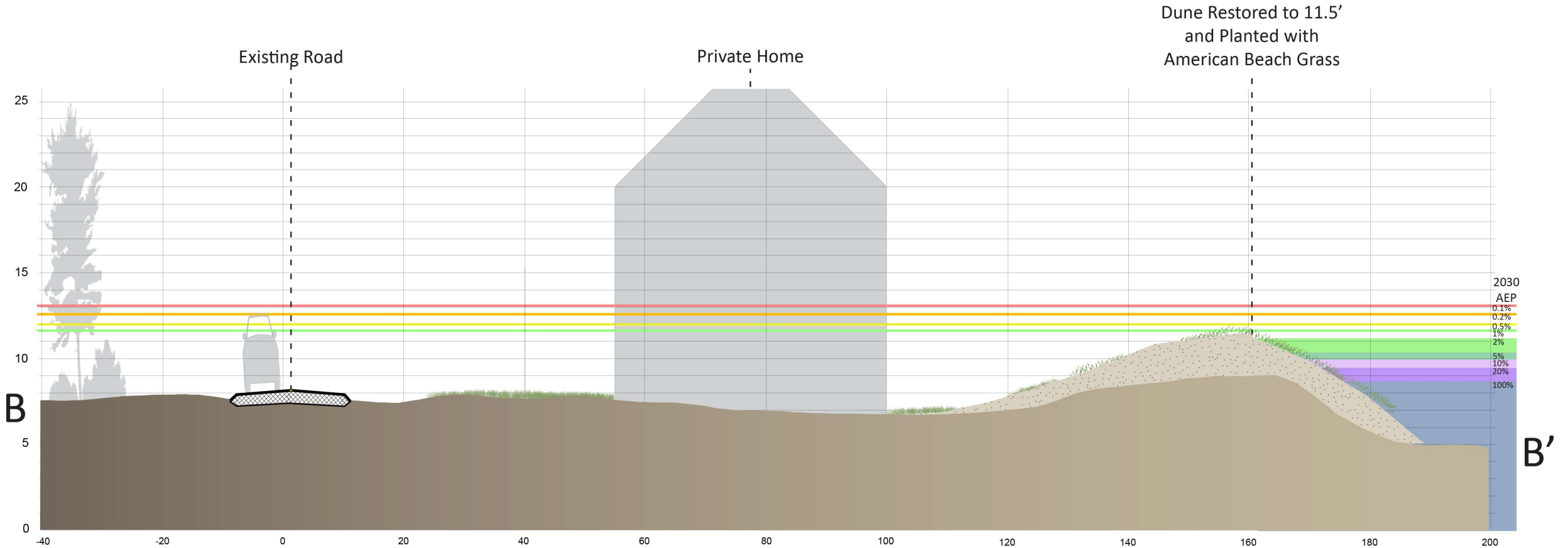
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Kendrick Avenue (West)



ALTERNATIVE 3: GREEN
Kendrick Avenue, Wellfleet

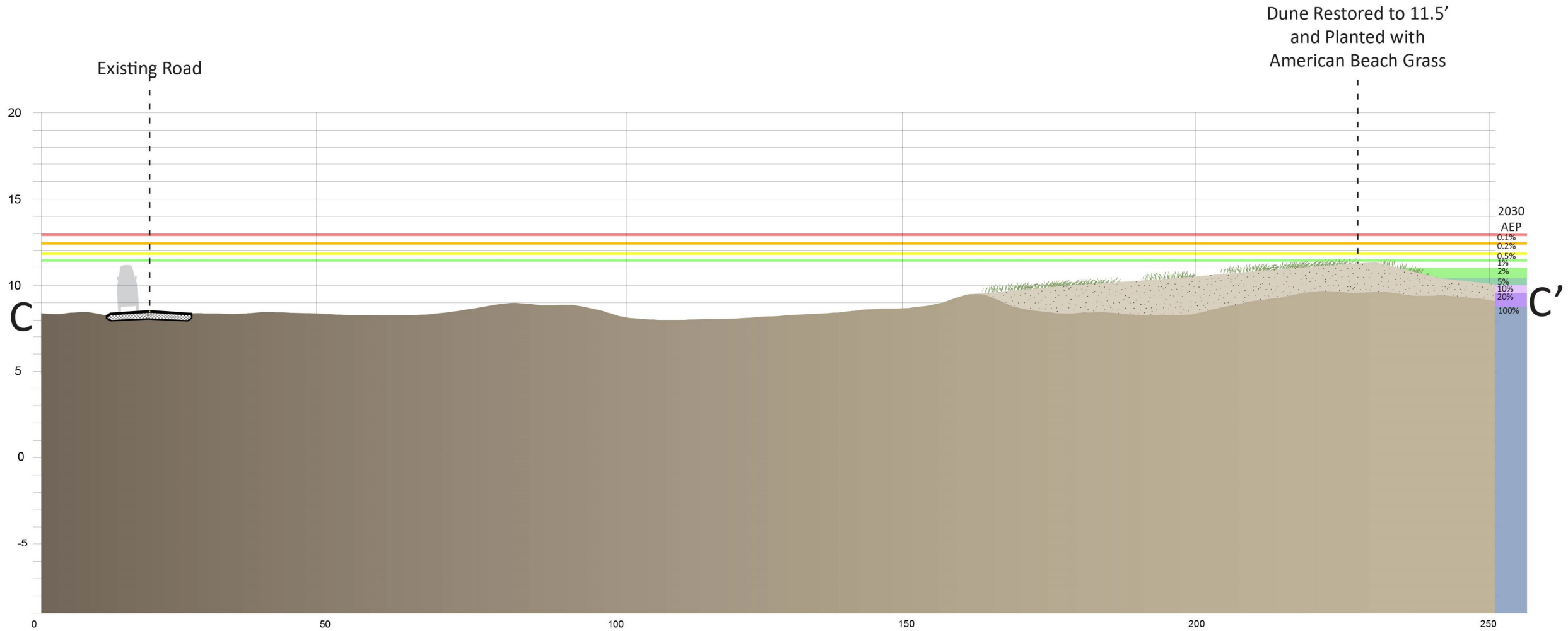
Kendrick Avenue (Middle)



ALTERNATIVE 3: GREEN

Kendrick Avenue, Wellfleet

Kendrick Avenue (East)



ALTERNATIVE 3: GREEN

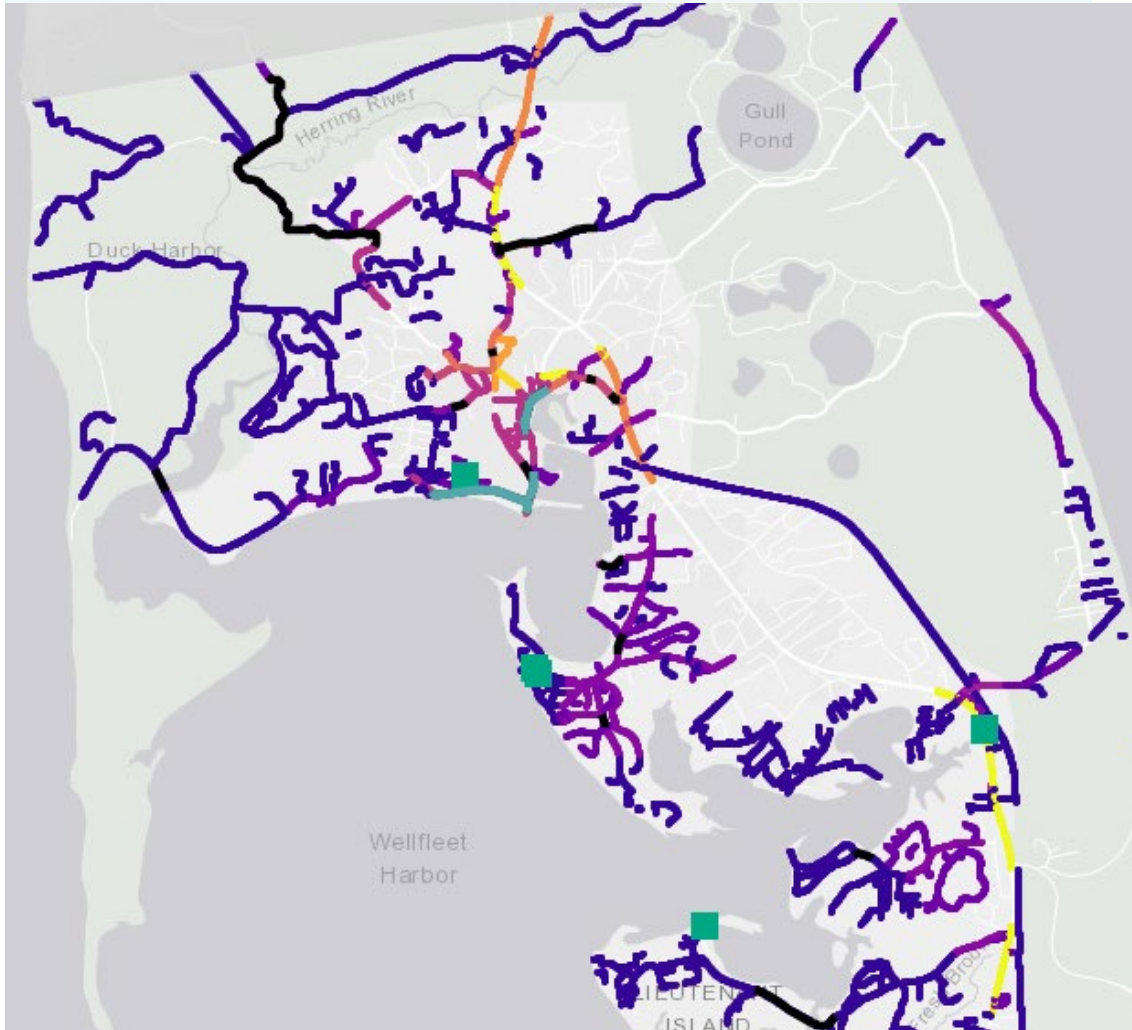
Kendrick Avenue, Wellfleet

KENDRICK AVENUE, WELLFLEET

Summary of alternatives

	Segment	Description	Critical Elevation	Annual Exceedance Probability			Vulnerable to Tidal Flooding	Impacts to Wetlands	Impacts to Private Property	Estimated Cost*
				2030	2050	2070				
EXISTING	EAST	A segment of 23ft wide road.	7.6 feet	100%	100%	100%	2070	N/A	N/A	N/A
	WEST	A segment of 23ft wide road.	8.0 feet	100%	100%	100%	2070			
ALTERNATIVE 1: GRAY	EAST	2830 linear feet of road are elevated from a lowest point of 7.6 feet to 10.3 feet. Parapet wall and dune restoration are used to control erosion at the western corner. Connection to work on Commercial Street must be considered.	10.3 feet	5%	100%	100%	N/A	N/A	Yes	\$991,000
	WEST		10.3 feet	5%	100%	100%	N/A	Possible Negative	Yes	\$1,029,000
ALTERNATIVE 2: HYBRID	EAST	Targeted dune restorations bring the dune's lowest elevation to 10.1ft. At the western curve of the road, a parapet wall prevents road erosion. Connection to work on Commercial Street must be considered.	10.1 feet	5%	100%	100%	N/A	Possible Positive	Yes	\$101,000
	WEST		10.1 feet	5%	100%	100%	N/A	Possible Positive	Yes	\$137,000
ALTERNATIVE 3: GREEN	EAST	Easements allow the dune along Mayo Beach to be restored to 11.5ft. Walkovers prevent further erosion.	11.5 feet	1%	10%	100%	N/A	Possible Positive	Yes	\$388,000 + cost of buyouts or easements
	WEST	Buyouts or easements allow the dune along Mayo Beach to be restored to 11.5ft. Walkovers prevent erosion.	11.5 feet	1%	10%	100%	N/A	Possible Positive	Yes	\$388,000 + cost of buyouts or easements

*Installed material cost +20% contingency. Excludes design, permitting, mobilization, stormwater and wastewater infrastructure, and site controls. Costs based on RSMMeans 2021 cost book and adjusted for inflation and region.



- **East Commercial Street**
- **Commercial Street**
- **Kendrick Avenue (East)**
- **Kendrick Avenue (West)**

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