Presentation for:

Town of Fenwick Island

FLOOD RESILIENCE PLANNING STUDY UPDATE

December 9, 2025
10:00 AM – 11:00 AM

STRAUGHAN ENVIRONMENTAL

Phase 2 Resiliency Planning Updates – Scope of Work

Task 1 - Define a Comprehensive Engineering Master Plan

- ✓ Develop list and description of subprojects (eight (8) street ends)
- ✓ Define forecast scenarios plan will consider
- ✓ Document assumptions about actions taken by private property owners

Task 2 - Define Methods to be Used in Mitigation

- ✓ Define flood protection toolkit for use on public and private property
- ✓ Assess road heights and possible lot elevations
- ✓ Analyze stormwater management (SWM) alternatives

Task 3 - Define Demonstration Projects

- ✓ Develop multi-criteria decision analysis (MCDA) matrix for town owned streets and recommend four (4) specific streets
  - *Perform topographic survey*
- ✓ Conduct field work at demonstration sites to acquire additional data
- ✓ Continue property owner engagement, field assessments and development of homeowner packages

Task 4 - Develop Concept Designs for Demonstration Projects

- ✓ Concept design for town owned sites using potential mitigation methods
  - *Analyze, compare, and contrast feasibility and comparative effectiveness of mitigation*
  - *Define site specific flood mitigation and SWM designs*
  - *Perform design analysis*

Task 5 - Prepare Pre-Final Design (60% Completion Level)

- *Prepare pre-final design level plans for two (2) street ends and/or marsh ends*
- *Prepare design report*
- *Prepare hydrologic/hydraulic analysis*
- *Prepare permitting applications*

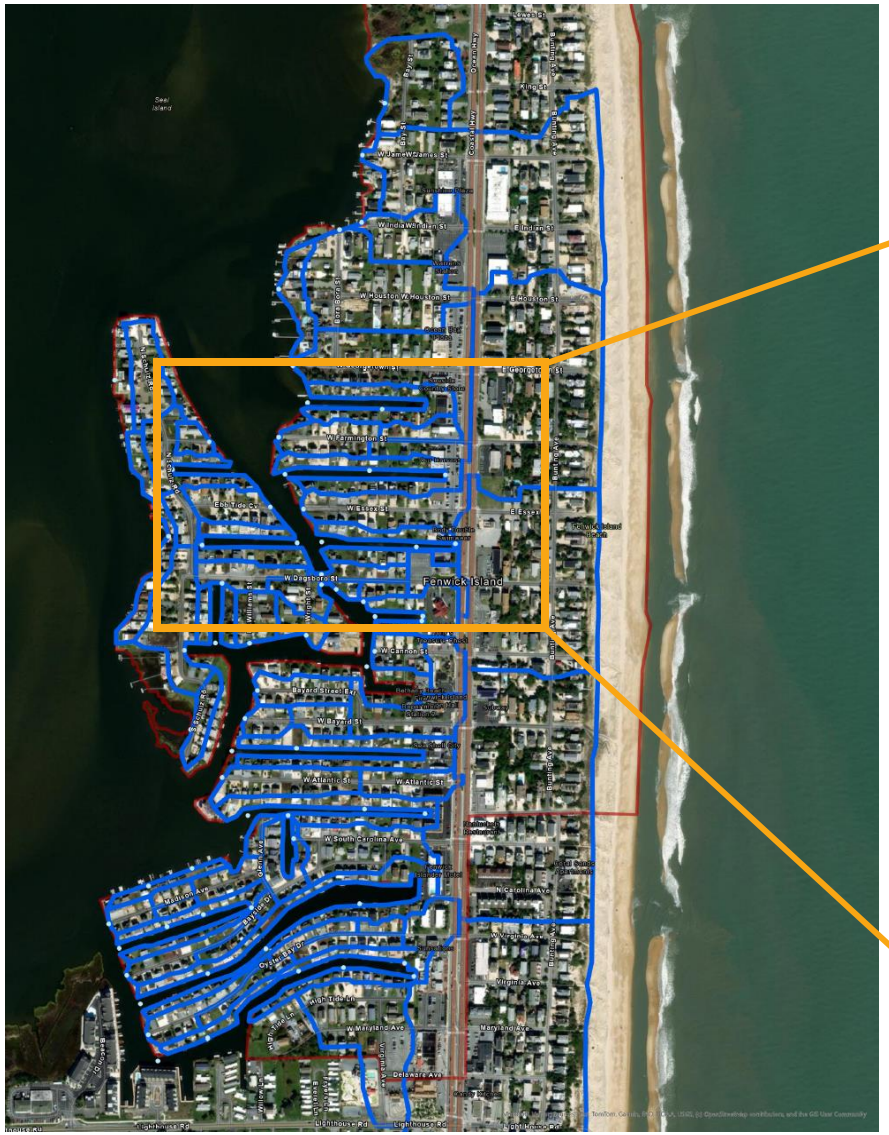
Task 6 - Prepare Bid Documents (100% Completion Level)

Task 7 - Develop Storymap and 3D Renderings

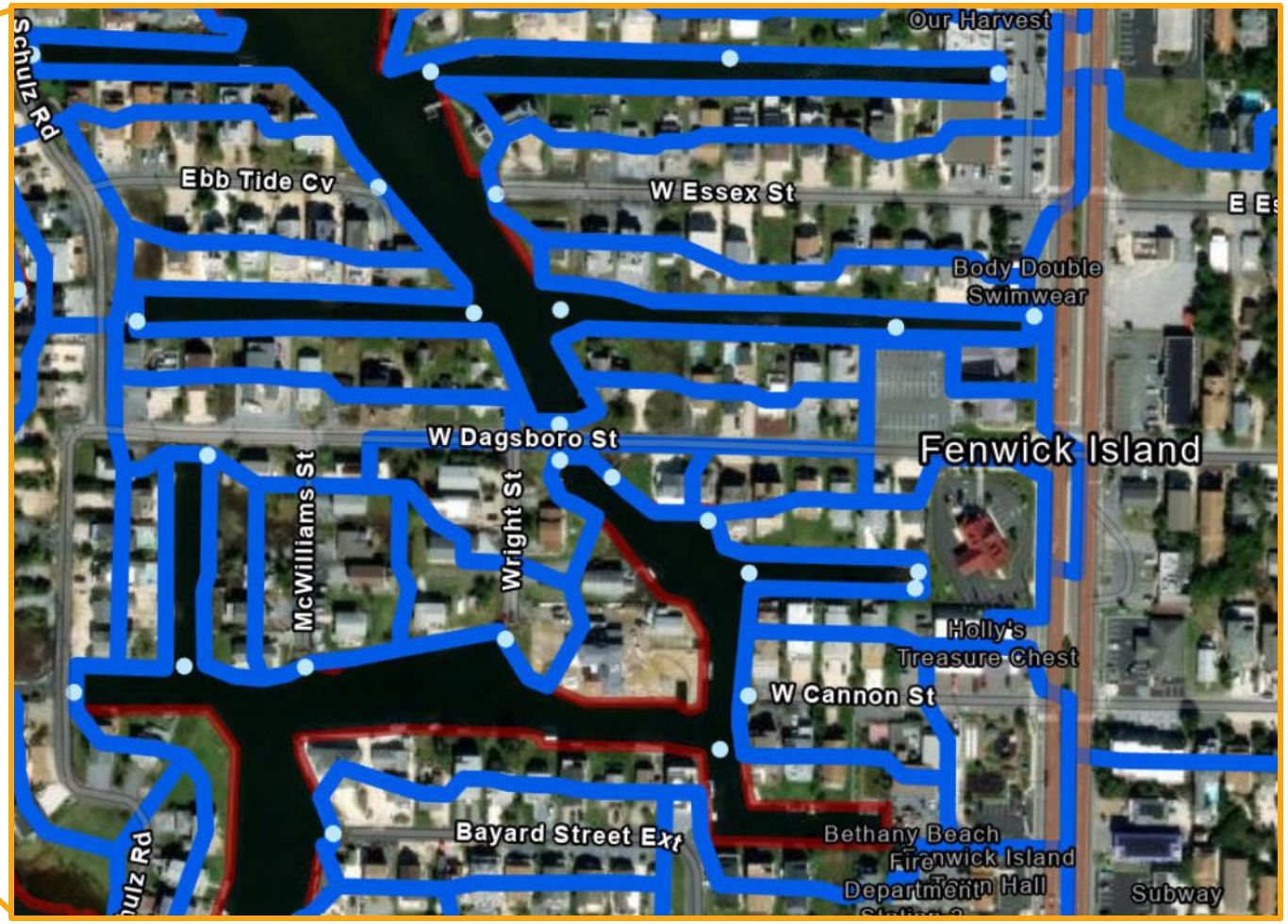
What's New?

- Defined "Focus Areas" for concept prioritization
- Created banding for wave action flood depths
- Performed regression analysis to confirm appropriate planning scenario for Sea Level Rise assessment
- Working Multi-Criteria Decision Matrix!

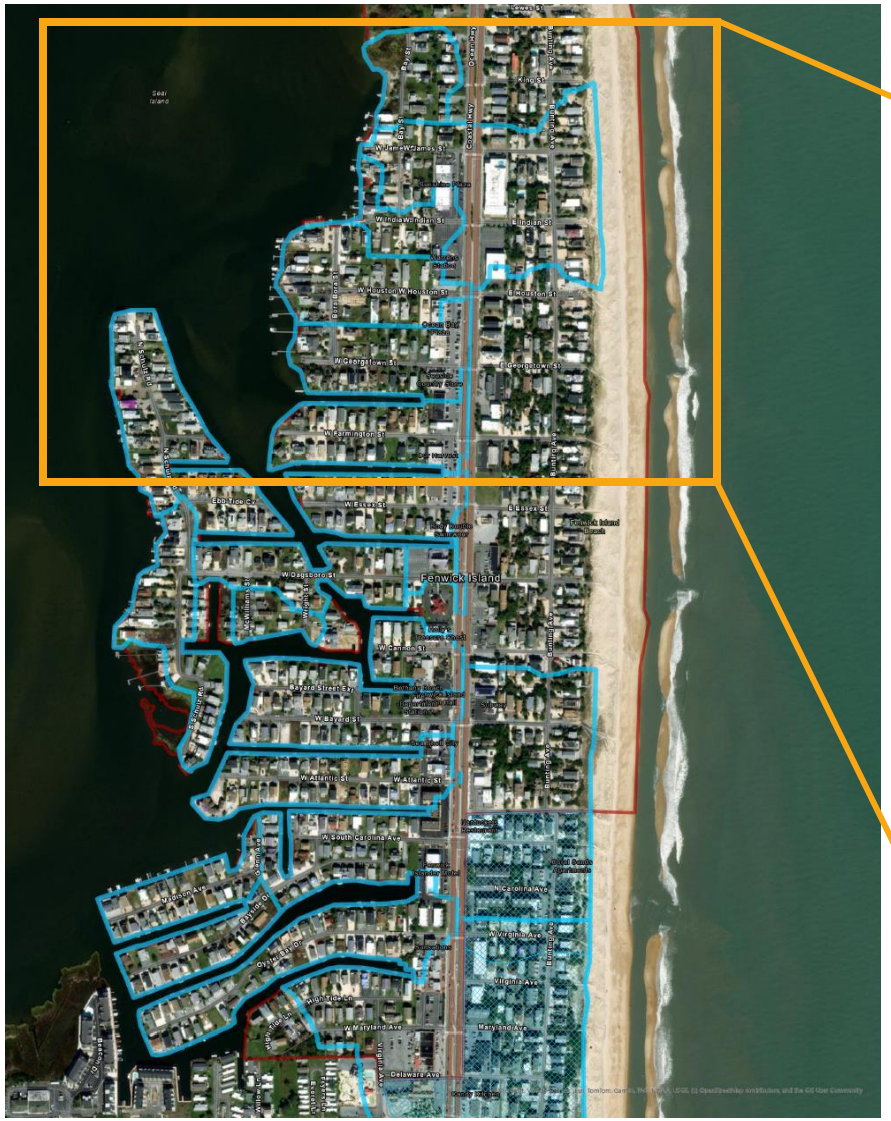
Drainage Area Delineations



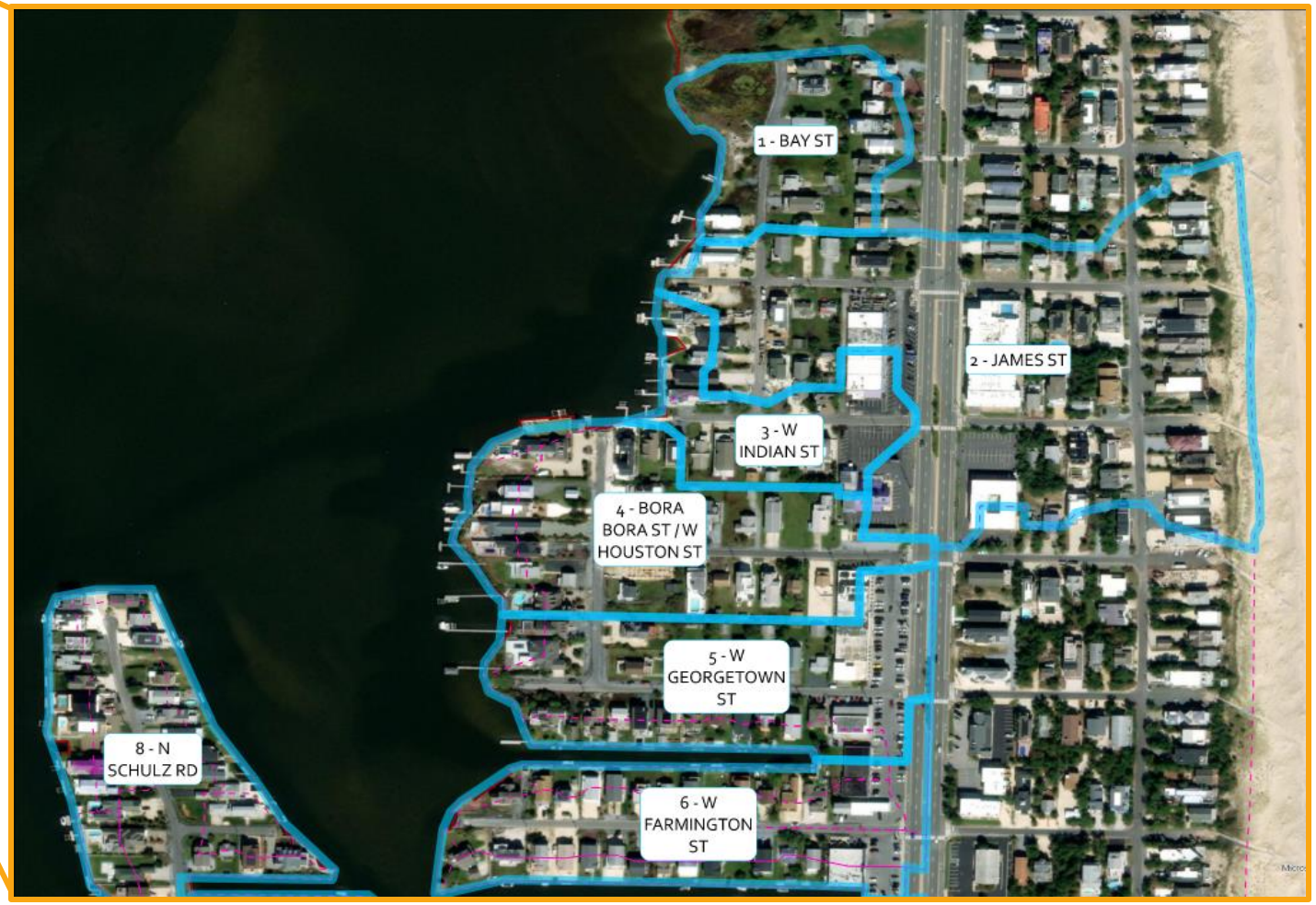
67 Individual Drainage Areas and Points of Interest (POIs)



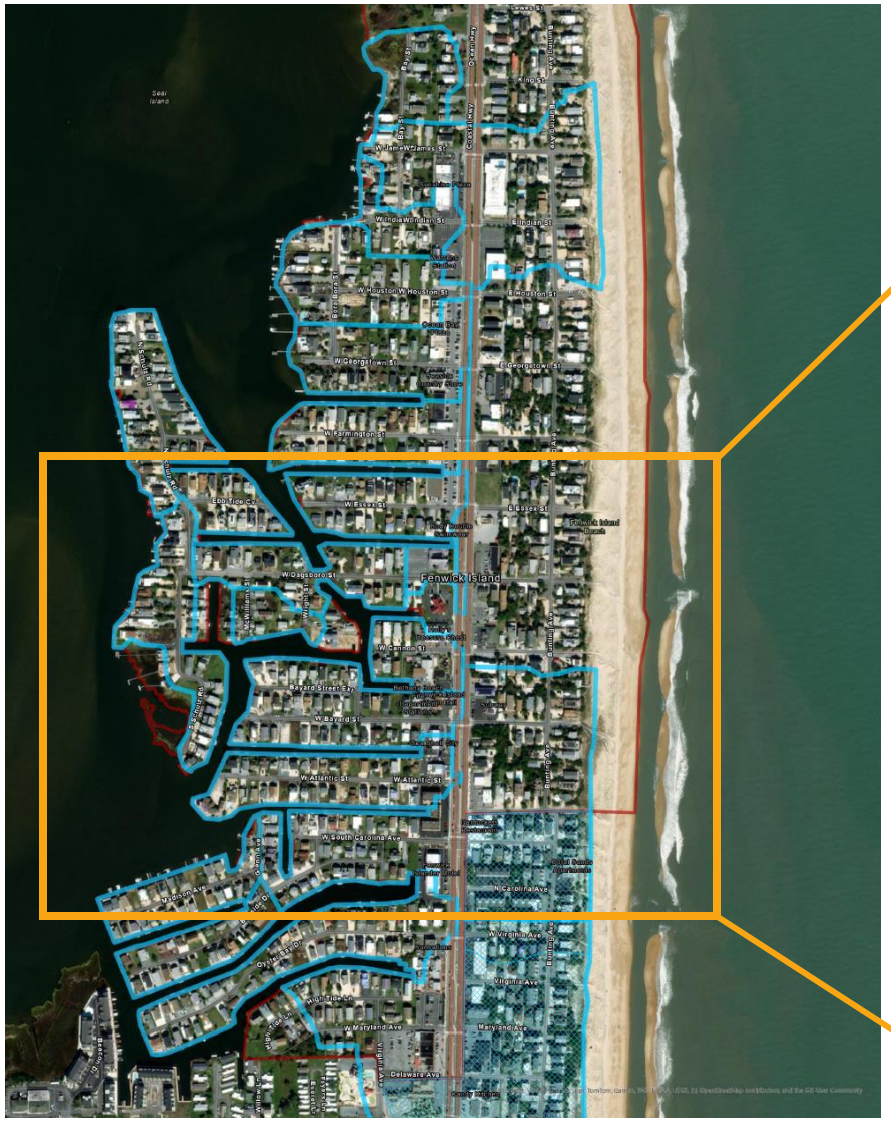
Focus Area Definitions - North



21 Focus Areas (FAs) for Concept Prioritization



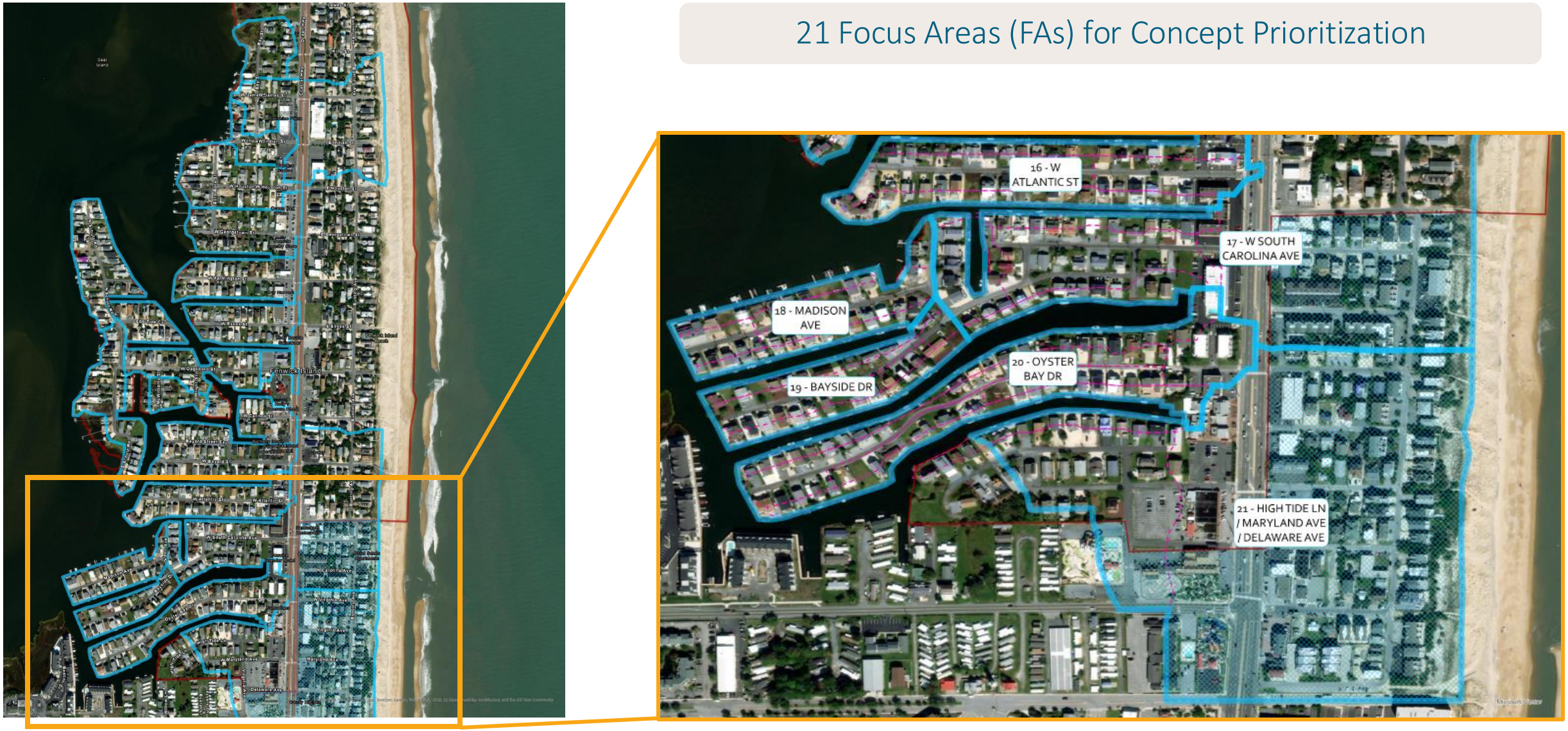
Focus Area Definitions - Mid



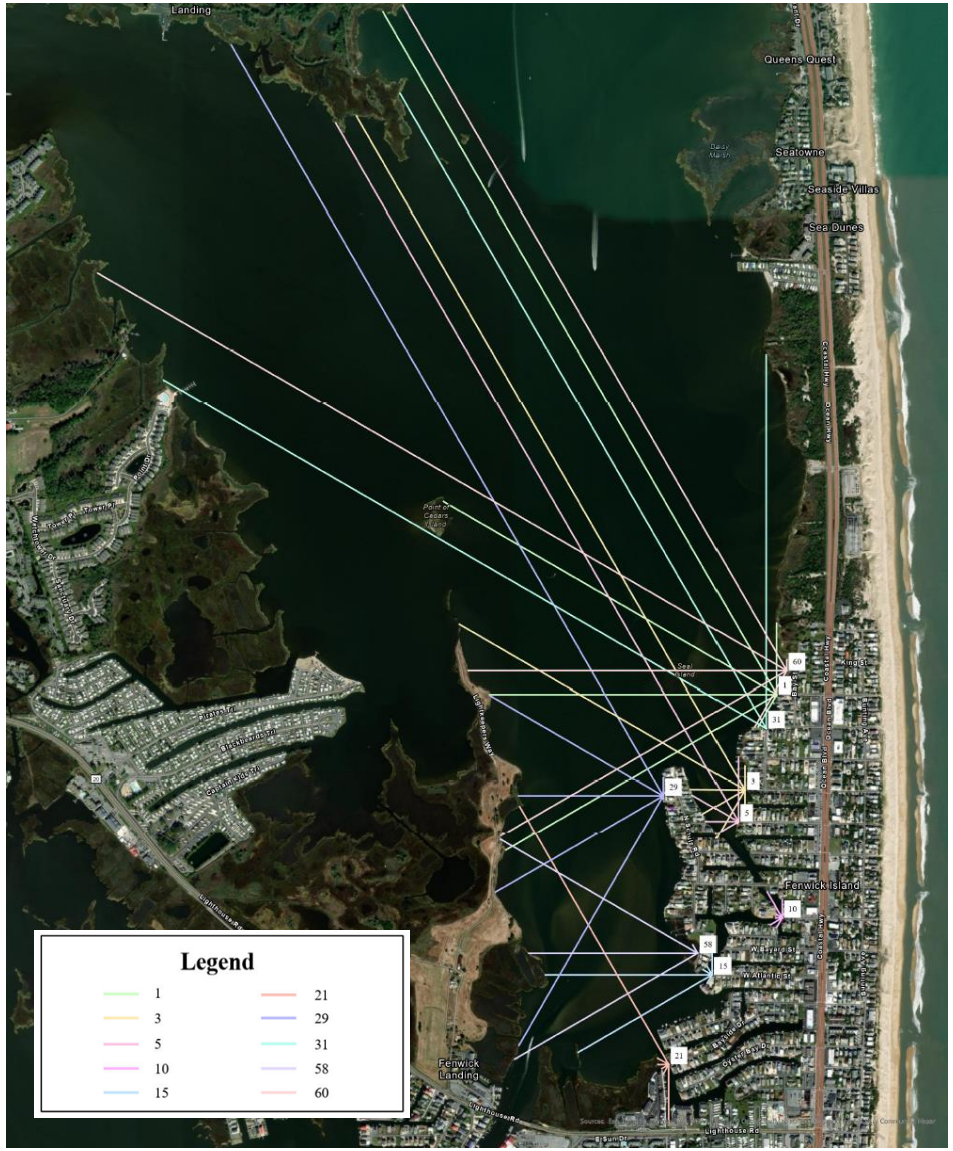
21 Focus Areas (FAs) for Concept Prioritization

Focus Area Definitions - South

21 Focus Areas (FAs) for Concept Prioritization



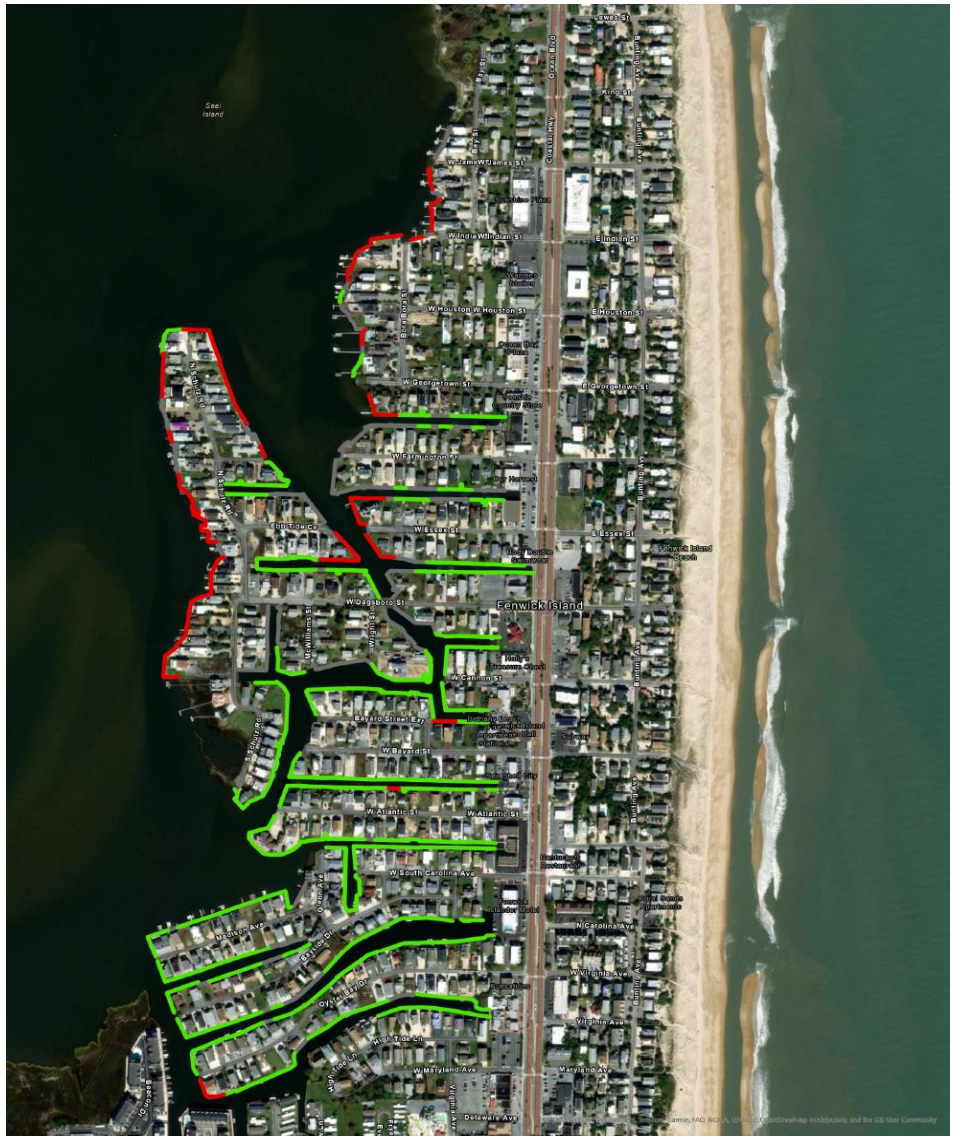
Storm Wave Height Assessment

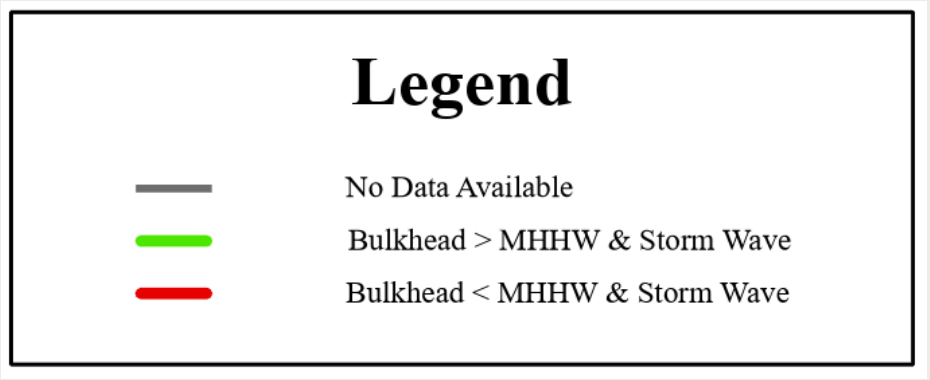


Maximum Wave Heights (Representative POIs)

Point of Interest		Wave Height (ft)	Direction
21	Bayside Dr	1.03	NNW
15	W Atlantic Ave	0.73	WSW
29	N Schulz Rd	1.75	NNW
10	W Cannon St	0.33	NNW
3	Georgetown St	1.66	NNW
1	W James St	1.67	NNW
31	Bora Bora St	1.61	NNW
5	Farmington St	1.69	NNW
58	S Schulz Rd (LOI)	0.24	WNW
60	West Bay St (LOI)	1.65	NNW

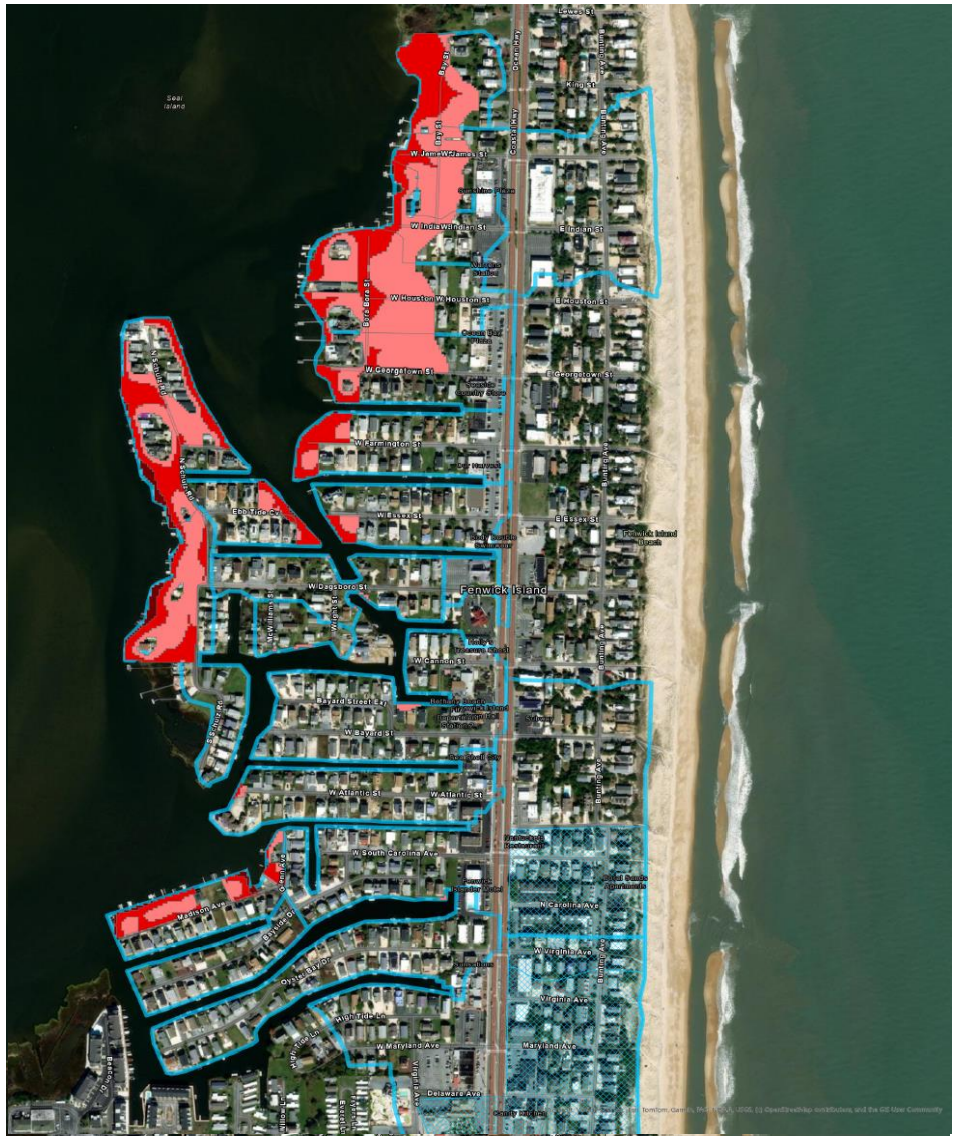
Wave Height Bulkhead Vulnerability Evaluation





- Evaluated at MHHW and the maximum fetch wave height to display if a bulkhead will breach
- Many crucial properties do not have bulkhead elevations in our internal survey

Wave Height Danger Level Evaluation



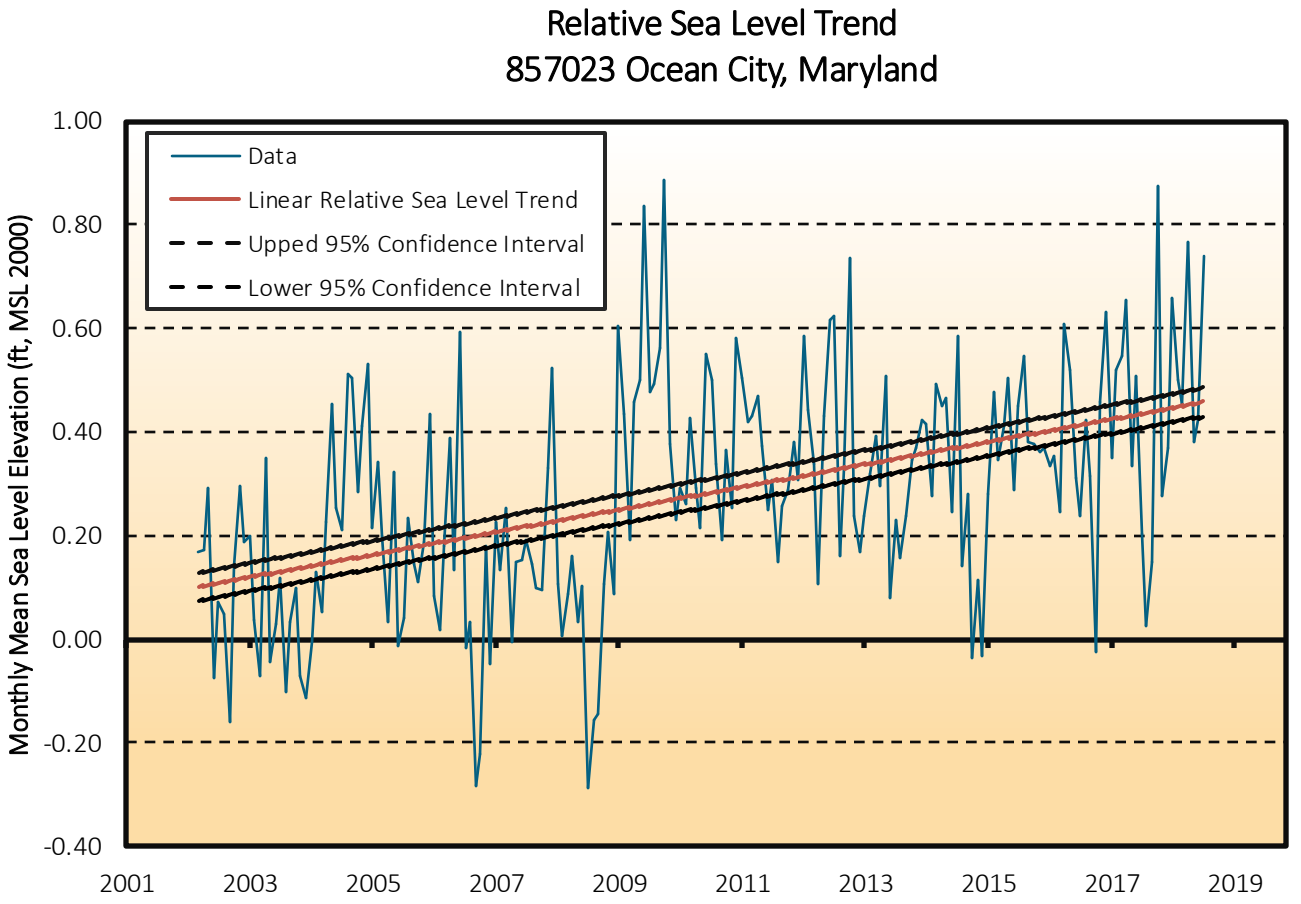
- Evaluated the difference between the DEM and the maximum wave height impacting each FA at MHHW
- The thresholds identify areas where tangible hazards can occur under storm wave conditions, adjusted to consider hazard protection for known bulkhead elevations

Sea Level Rise Escalation Comparison

- Compared SLR escalations (presented in 2017 Delaware Sea Level Rise Technical Report) against current data trends to identify appropriate SLR planning scenario

Year	Planning Scenario		
	Low	Intermediate	High
2030	0.11 m / 0.36 ft	0.22 m / 0.72 ft	0.33 m / 1.08 ft
2050	0.22m / 0.72 ft	0.40 m / 1.31 ft	0.58 m / 1.90 ft
2080	0.42 m / 1.38 ft	0.74 m / 2.43 ft	1.11 m / 3.64 ft
2100	0.52 m / 1.71 ft	0.99 m / 3.25 ft	1.53 m / 5.02 ft

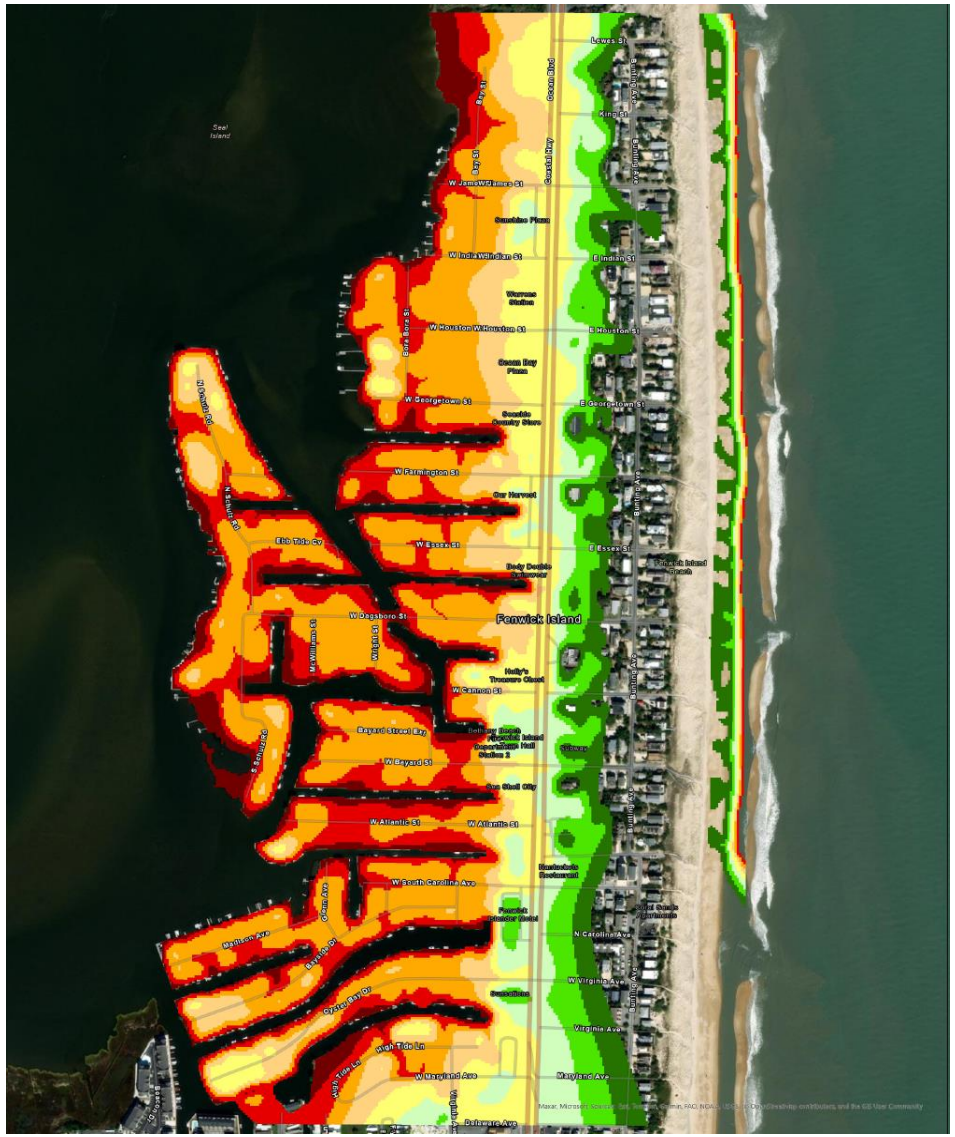
- Real-life data trends agree with “intermediate” planning scenario, assumed approximately linear up to year 2030 for near-term planning



2030 Projection = 0.70 ft

0.022 +/- 2.26x10^{-3} ft/yr

Sea Level Rise Evaluation

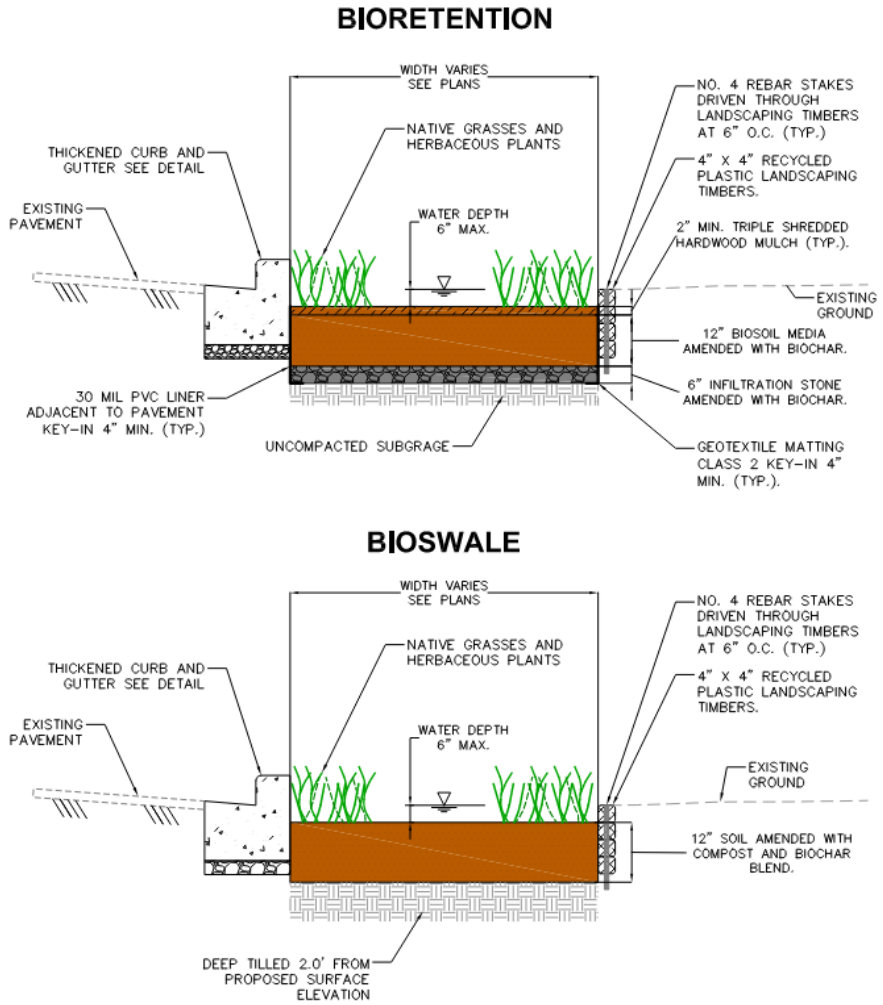


Legend

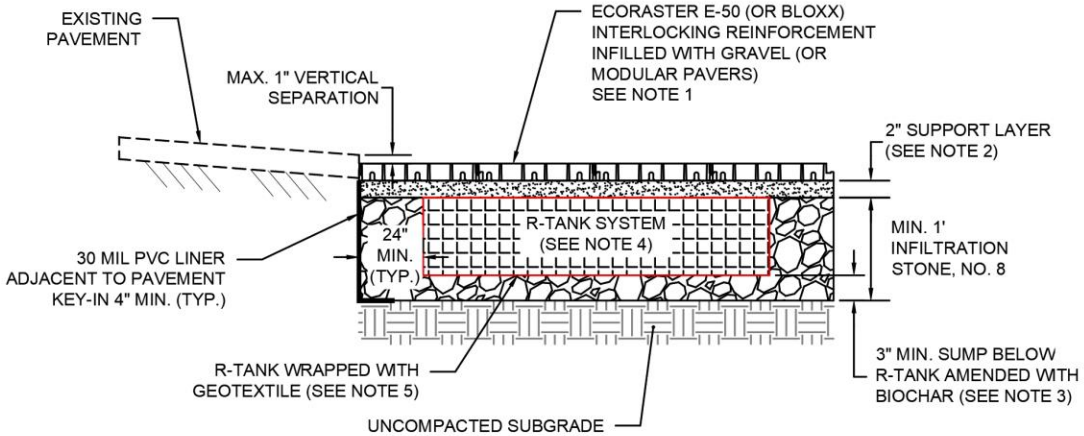
MHHW (1.11 ft)	MHHW + 3'
MHHW + 2030 SLR (0.72 ft)	MHHW + 4'
MHHW + 2050 SLR (1.31 ft)	MHHW + 5'
MHHW + 2'	MHHW + 6'

- Identified areas prone to current tidal flooding (at MHHW)
- Estimated areas susceptible to future tidal flooding based on intermediate SLR predictions (Delaware SLR Planning Scenarios)
- Additional prioritization for streets where 2030 SLR escalation is expected to impact roadways at mid-block locations

Toolkit: Green Infrastructure Concepts

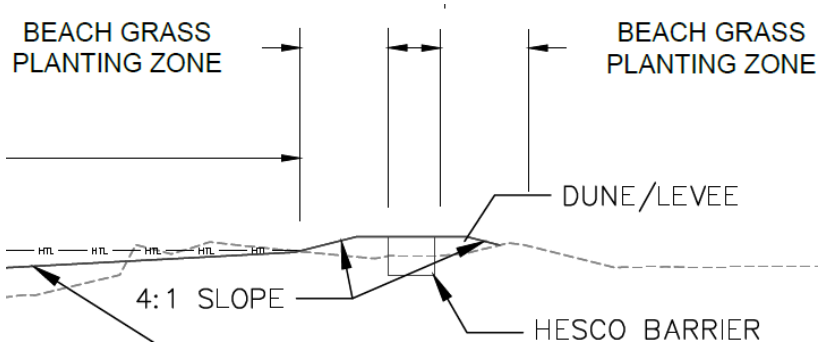


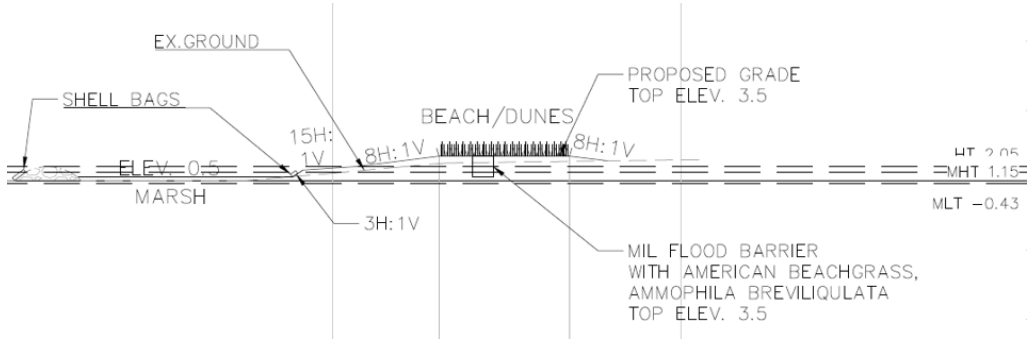
Streetscape Bioretention



Stabilized Infiltration Trench

Toolkit: Shoreline and Street End Concepts

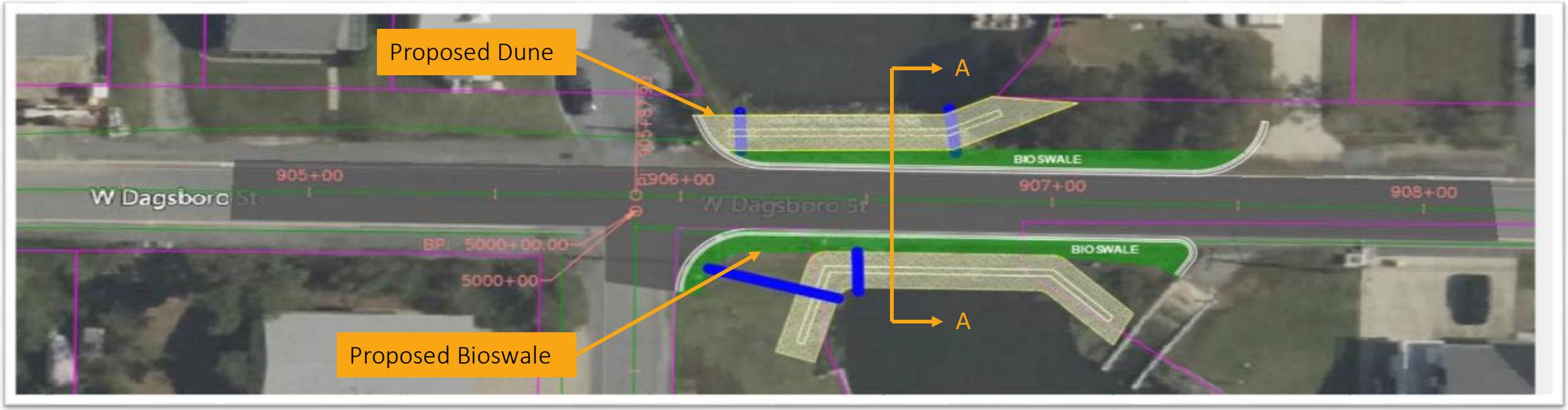


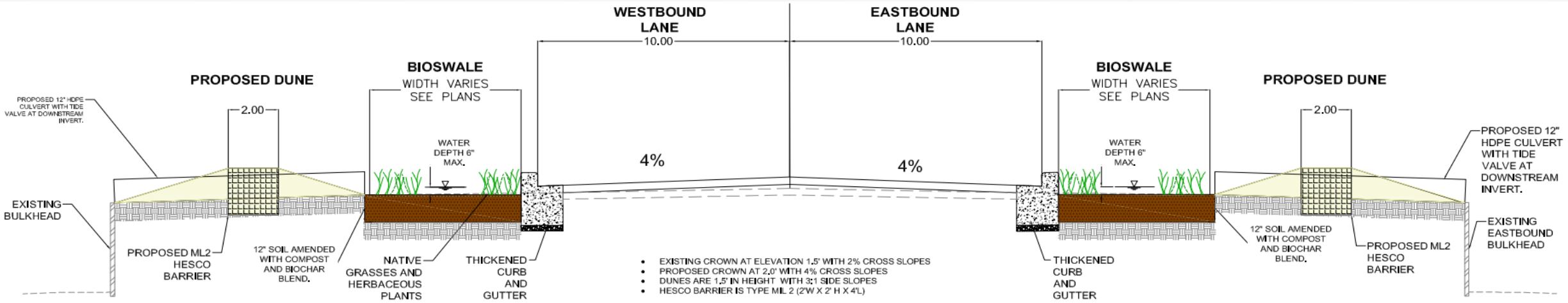


Dune/Levee

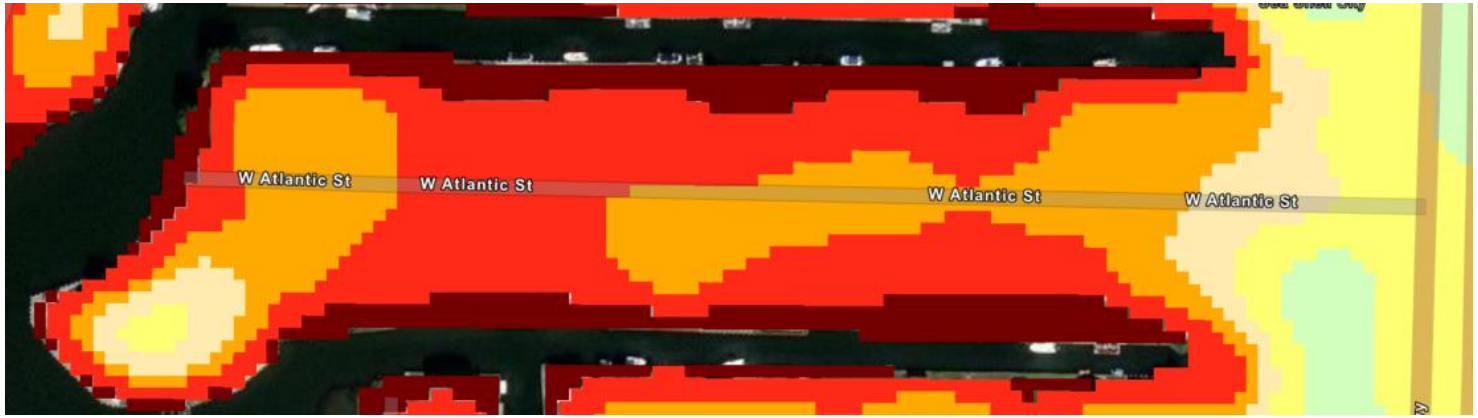
Living Shoreline

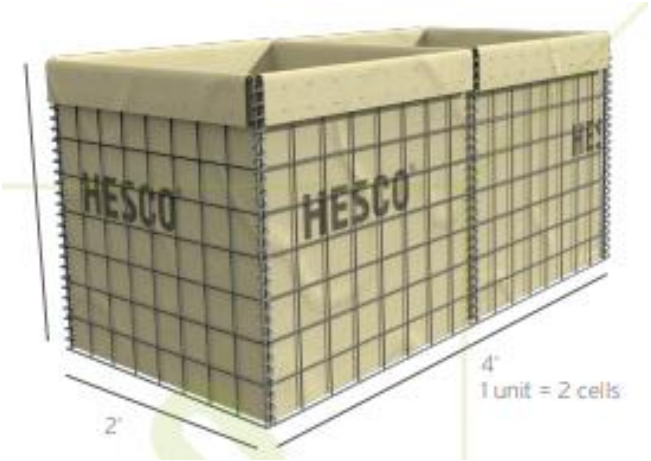
Toolkit: Road Raising and Dune/Levee Bulkhead Concepts

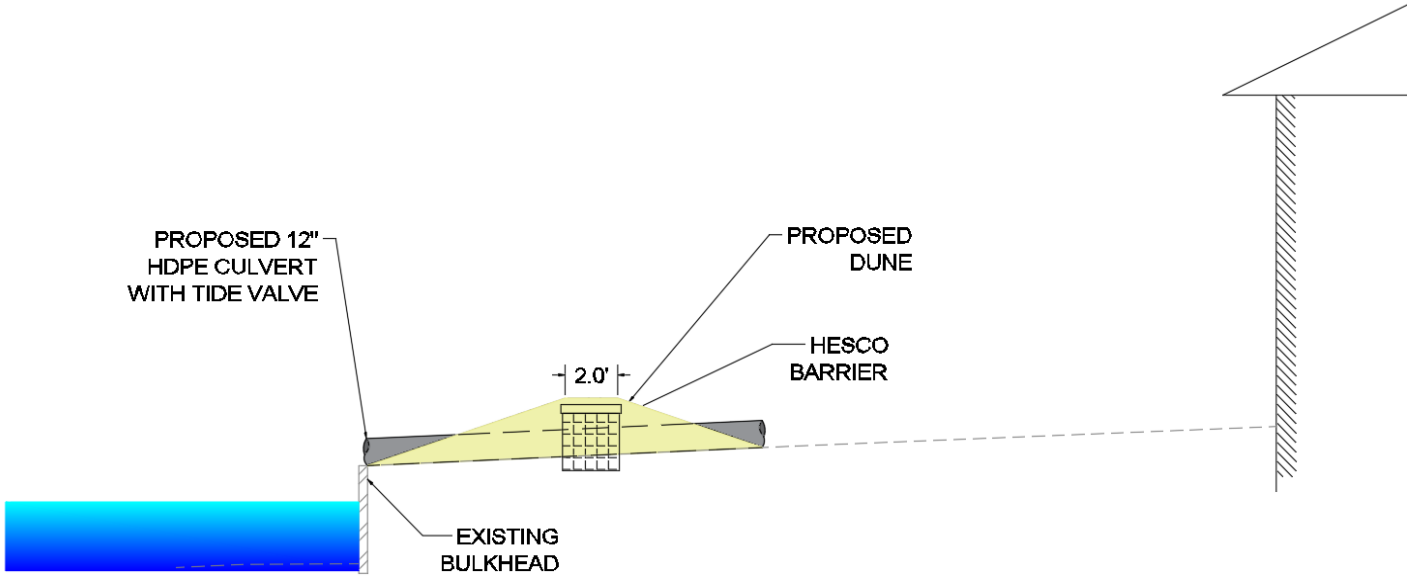




Private Dune/Levee Bulkhead Concepts







Sand-Filled HESCO Barriers to Reinforce Existing Bulkheads

Multi-Criteria Decision Matrix: Prioritization Framework

- ✓ Prioritization of flood resilience implementations is dependent upon various criteria
- ✓ Multi-criteria decision tool intended to standardize criteria, assign weights based on community needs and precedence, and rank priority locations accordingly
  - Four draft categories identified for the Town of Fenwick Island
    - **Social Vulnerability** – threat to people & property
    - **Asset Vulnerability** – threat to infrastructure
    - **Actionability** – conditions suitable for construction
    - **Implementation Feasibility** – potential for BMP or resiliency infrastructure
  - Several criteria assigned per category
  - POLL TIME

Multi-Criteria Decision Matrix: Decision Criteria

Social Vulnerability	Asset Vulnerability	Actionability	Implementation Feasibility
Property Density	Unmanaged Impervious Coverage	Actionable ROW Area for BMPs	Shallow Bioretention Facility
Wave Height Threat Level for Children (> 6”)	Evacuation Routes and Accessibility	Depth to Water Table (> 2 ft)	Streetscape Bioretention Facility
Wave Height Threat Level for Properties (> 1 ft)	Roadway Impacts Attributable to Near-, Mid-, and Long-Term Flooding	Depth to Water Table (> 3 ft)	Bioswale
Wave Height Threat Level for Adults (> 2 ft)	Roadway Impacts Attributable to Bulkhead Vulnerability		Permeable Asphalt
	Non-existing Outfall Protection		Infiltration Trench
	Non-existing Tidal Valve		Impervious Reduction
			Road Raising
			Living Shoreline
			Bulkhead/Levee/Dune

Higher scores deno Higher scores denote more possibility
vulnerability (highe for implementations (higher priority)

Multi-Criteria Decision Matrix: Social Vulnerability

Criteria	Definition	Metric
Wave Height Threat Level for Children (≥ 6”)	Area of flood depths ≥ 6” under the MHHW + wave height condition	Acres/FA Acres
Wave Height Threat Level for Properties (≥ 1’)	Area of flood depths ≥ 1’ under the MHHW + wave height condition	Acres/FA Acres
Wave Height Threat Level for Adults (≥ 2’)	Area of flood depths ≥ 2’ under the MHHW + wave height condition	Acres/FA Acres
Property Density	Parcels within FA boundary	Count/FA Acres

Multi-Criteria Decision Matrix: Asset Vulnerability

Criteria	Definition	Metric
Unmanaged Impervious Coverage	Area of contributory impervious land cover	Acres/FA Acres
Evacuation Routes and Accessibility	Number of streets dependent for primary ingress/egress	Count/FA Acres
Roadway Impacts Attributable to Near-Term Flooding (MHHW)	Length of roadway inundated under current MHHW elevation	Linear Feet/Total FA Road Length
Roadway Impacts Attributable to Mid-Term Flooding (MHHW + 2030)	Length of roadway inundated under MHHW + 2030 SLR elevation	Linear Feet/Total FA Road Length
Roadway Impacts Attributable to Long-Term Flooding (MHHW + 2050)	Length of roadway inundated under MHHW + 2050 SLR elevation	Linear Feet/Total FA Road Length
Roadway Impacts Attributable to Bulkhead Vulnerability	Anticipated bulkhead overtopping under MHHW + 2030 SLR elevation (scaled factor)	Linear Feet x Factor/Total FA Bulkhead Length
Existing Outfall Protection	Number of drainage outfalls without outfall protection	Acres/FA Acres
Existing Tidal Valve	Number of drainage outfalls without tidal valves	Count/FA Acres

Prioritization Framework in Action

Prioritization Framework Table

Criteria	Metric Notes	Category	Criteria Weight (max Score)*	Focus Areas 1 Bay St	2 James St	3 W Indian St	4 Bora Bora St / W Houston St	5 W Georgetown St	6 W Farmington St	7 W Essex St	8 N Schulz Rd	9 Ebb Tide Cv	10 S Schulz Rd	11 South McWilliams St / Wright St	12 South W Dagsboro St	13 North W Dagsboro St	14 W Cannon St	15 W Bayard St	16 W Atlantic St	17 W S Carolina Ave	18 Madison Ave	19 Bayside Dr	20 Oyster Bay Dr	21 High Tide Ln / MD Ave / DE Ave
Wave Height Threat Level for Children (≥ 6")	Acres/FA Acres		6	5.6	5.3	3.5	6.0	3.0	1.3	0.5	5.7	1.8	4.6	0.2	0.0	0.0	0.1	0.1	0.3	0.0	4.8	0.0	0.0	0.0
Wave Height Threat Level for Properties (≥ 1 ft)	Acres/FA Acres		6	6.0	1.3	1.6	2.9	1.2	1.6	0.5	5.3	2.0	3.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	3.6	0.0	0.0	0.0
Wave Height Threat Level for Adults (≥ 2 ft)	Acres/FA Acres	Social Vulnerability	6	0.0	0.0	0.5	0.0	0.1	0.2	0.0	5.2	0.8	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0
Property Density	Acres x Factor Total/FA Acres		2	1.6	0.9	1.4	1.0	0.8	1.1	1.2	1.3	1.2	1.4	2.0	1.2	0.7	1.0	1.3	1.4	0.8	1.7	1.6	1.3	0.2
Unmanaged Impervious Coverage								2.9	1.6	1.5	3.2	2.0	3.8	5.3	1.7	3.1	2.6	4.0	2.1	1.4	0.6	0.8	1.2	0.0
Evac ibility								1.5	0.0	0.0	2.9	0.0	0.0	0.0	8.8	8.8	0.0	1.5	0.0	7.3	0.0	2.9	0.0	2.9
Roa to Nea al FA																								
Flooding (MHHW)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	3.5	5.3	0.0	0.0	0.0
Roadway Impacts Attributable to Mid-Term Flooding (MHHW + 2030)	Linear Feet/Total FA Road Length			0.9	0.7	0.2	1.3	1.3	3.5	3.0	2.0	0.0	0.2	0.3	2.6	0.7	2.3	1.1	0.0	0.0
Roadway Impacts Attributable to Long-Term Flooding (MHHW + 2050)	Linear Feet/Total FA Road Length	Asset Vulnerability	4	1.8	1.4	0.8	1.2	1.3	1.2	1.0	1.4	1.8	1.8	1.8	1.8	0.6	0.3	1.5	1.4	1.5	1.8	1.8	1.0	0.6
Roadway Impacts Attributable to Bulkhead Vulnerability	0		5	1.2	1.8	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Existing Outfall Protection	Count/Total Outfalls		2	0.0	0.9	0.0	0.6	0.0	0.8	0.9	0.2	0.0	1.2	0.0	1.2	1.8	0.6	0.3	0.3	0.7	1.1	0.9	1.5	1.5
Existing Tidal Valve	Count/Total Outfalls		2	0.0	1.8	1.8	1.2	1.8	0.8	0.9	1.8	0.9	1.8	1.8	1.4	1.8	0.6	0.9	1.0	1.2	0.9	1.2	1.6	1.5
Actionable ROW Area for BMPs	Acres/FA Acres		8	7.5	5.9	4.1	5.5	3.2	2.8	2.7	6.4	3.5	6.8	7.5	1.7	3.5	2.9	4.7	3.9	5.1	1.5	1.4	1.8	3.3
SHWT >= 2 fbgs	Acres/FA Acres	Actionability	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SHWT > 3 fbgs	Acres/FA Acres		5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shallow Bioretention BMP Feasibility	Acres/FA Acres		6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Streetscape Bioretetntion BMP Feasibility	Acres/FA Ac																							
Bioswale BMP Feasibility	Linear Feet/																							
Permeable Asphalt	Acres/FA Ac																							
Infiltration Trench Feasibility	Linear Feet/																							
Living Shoreline Feasibility	Linear Feet/																							
Impervious Reduction Feasibility	Acres/FA Acres																							
Road Raising	Linear Feet/FA Acres		2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Structural (Bulkhead/Levee/Dune) Feasibility	Linear Feet/FA Acres		3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SUBTOTAL	Social Vulnerability	20	13.2	7.5	7.0	9.9	5.1	4.2	2.2	17.4	5.9	13.6	2.2	1.2	0.7	1.1	1.4	1.7	0.8	16.1	1.6	1.3	0.2
	SUBTOTAL	Asset Vulnerability	35	9.0	13.5	7.3	8.2	8.4	5.0	4.5	10.8	6.0	12.0	11.7	16.8	16.0	4.3	8.4	9.1	16.4	11.9	8.7	5.2	6.5
	SUBTOTAL	Actionability	15	7.5	5.9	4.1	5.5	3.2	2.8	2.7	6.4	3.5	6.8	7.5	1.7	3.5	2.9	4.7	3.9	5.1	1.5	1.4	1.8	3.3
	SUBTOTAL		30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			100	29.6	26.9	18.4	23.6	16.7	12.0	9.4	34.7	15.4	32.3	21.4	19.7	20.2	8.2	14.5	14.7	22.2	29.4	11.7	8.4	10.1
				3	5	11	6	12	16	19	1	13	2	8	10	9	21	15	14	7	4	17	20	18

Criteria

Category

Criteria Weight

Weighted Criteria Score

Category Weight

Weighted Category Score

Priority Score

Next Steps

- Analyze feedback from today's poll
- Build out functional actionability and implementation sections of Prioritization Matrix
- Remaining scoped tasks:
  - Task 4 - Develop Concept Designs for Demonstration Projects
  - Task 5 - Prepare Pre-Final Design (60% Completion Level)
  - Task 6 - Prepare Bid Documents (100% Completion Level)
  - Task 7 - Develop Storymap and 3D Renderings

QUESTIONS?

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