St. Joseph Shoreline Softening Study

Community Presentation

December 2024

Introduction

- The goal of this study is explore potential new and innovative strategies for protecting the St. Joseph shoreline, reduce shoreline armoring, expand habitat, and reduce ongoing maintenance costs.

Project Funding Through

- Michigan Economic Development Corporation
- Special Thanks to the City of St. Joseph, Berrien County, Great Lakes Coalition, and State Representative Joe Andrews

Edgewater resources

Project Partners

- Michigan Economic Development Corporation
- City of St. Joseph
- Berrien County
- SeaWorks Group
- Michigan Technological University
- Abonmarche
- Edgewater Resources

MICHIGAN ECONOMIC DEVELOPMENT CORPORATION
PURE MICHIGAN

1885 Michigan Technological University

CITY OF St. Joseph MICHIGAN

seaworks
HYDROGRAPHIC • GEOPHYSICAL • ENVIRONMENTAL

ABONMARCHE

BERRIEN COUNTY MICHIGAN

Edgewater resources

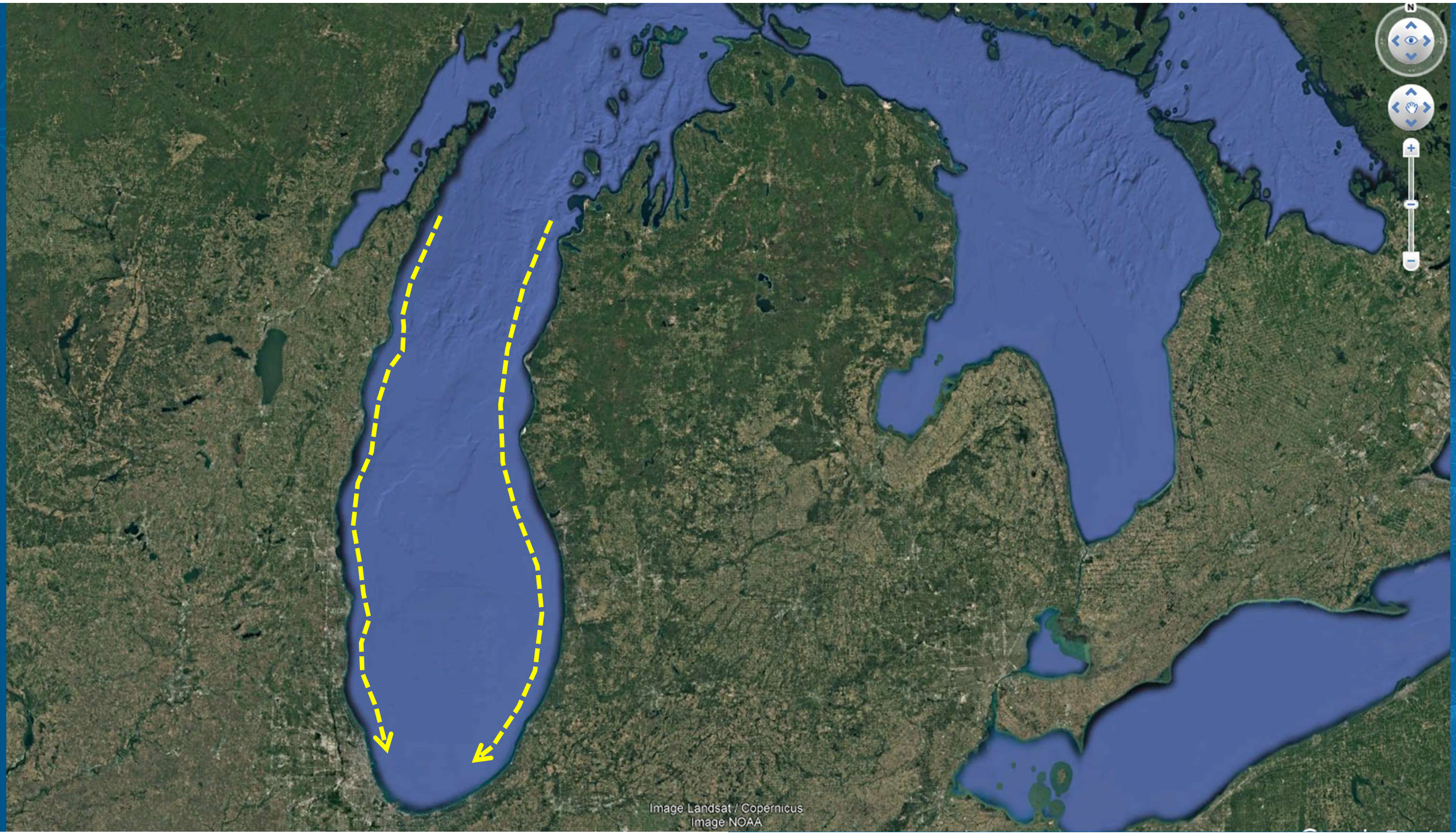
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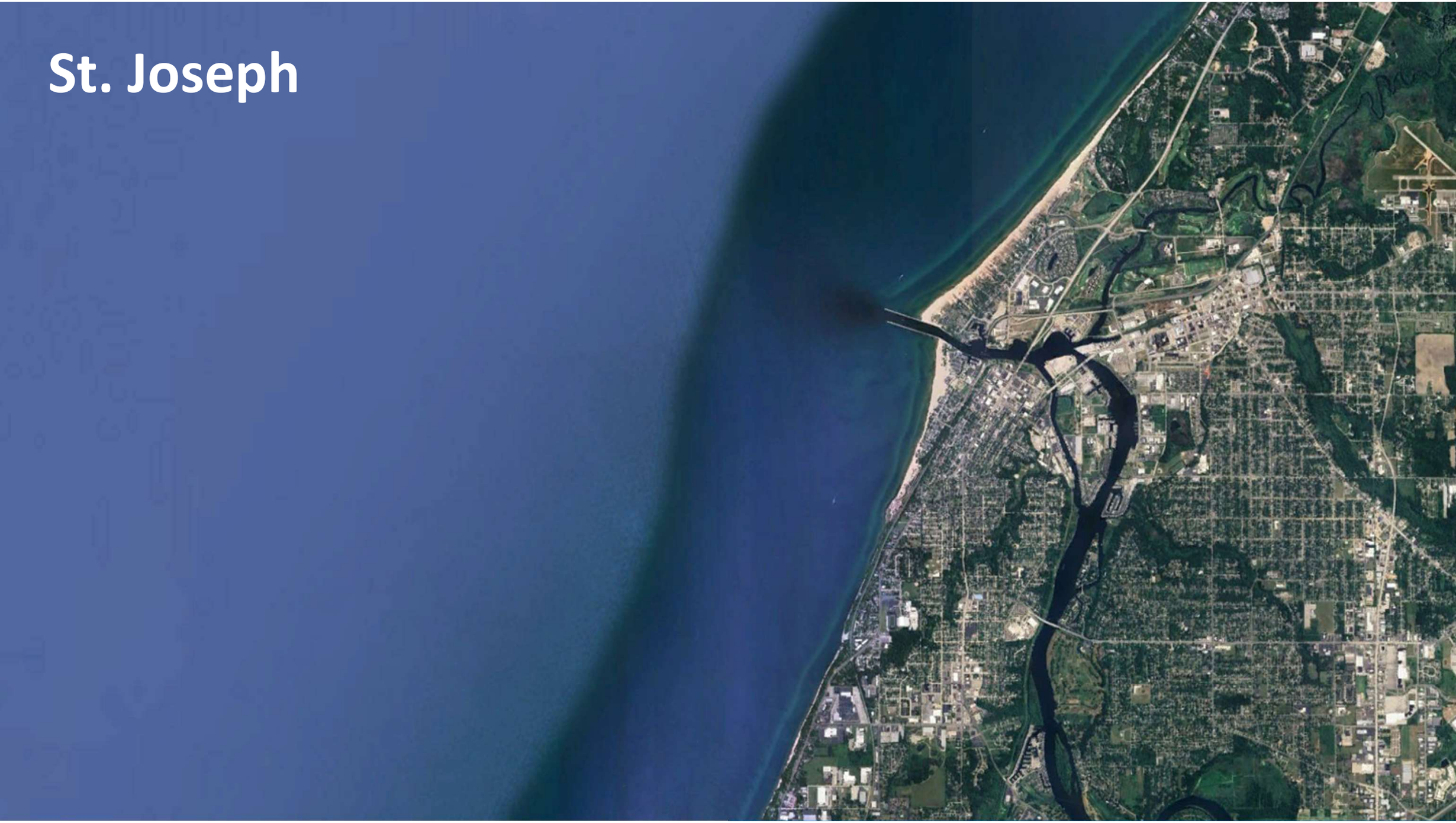
Image Landsat / Copernicus
Image NOAA

St. Joseph



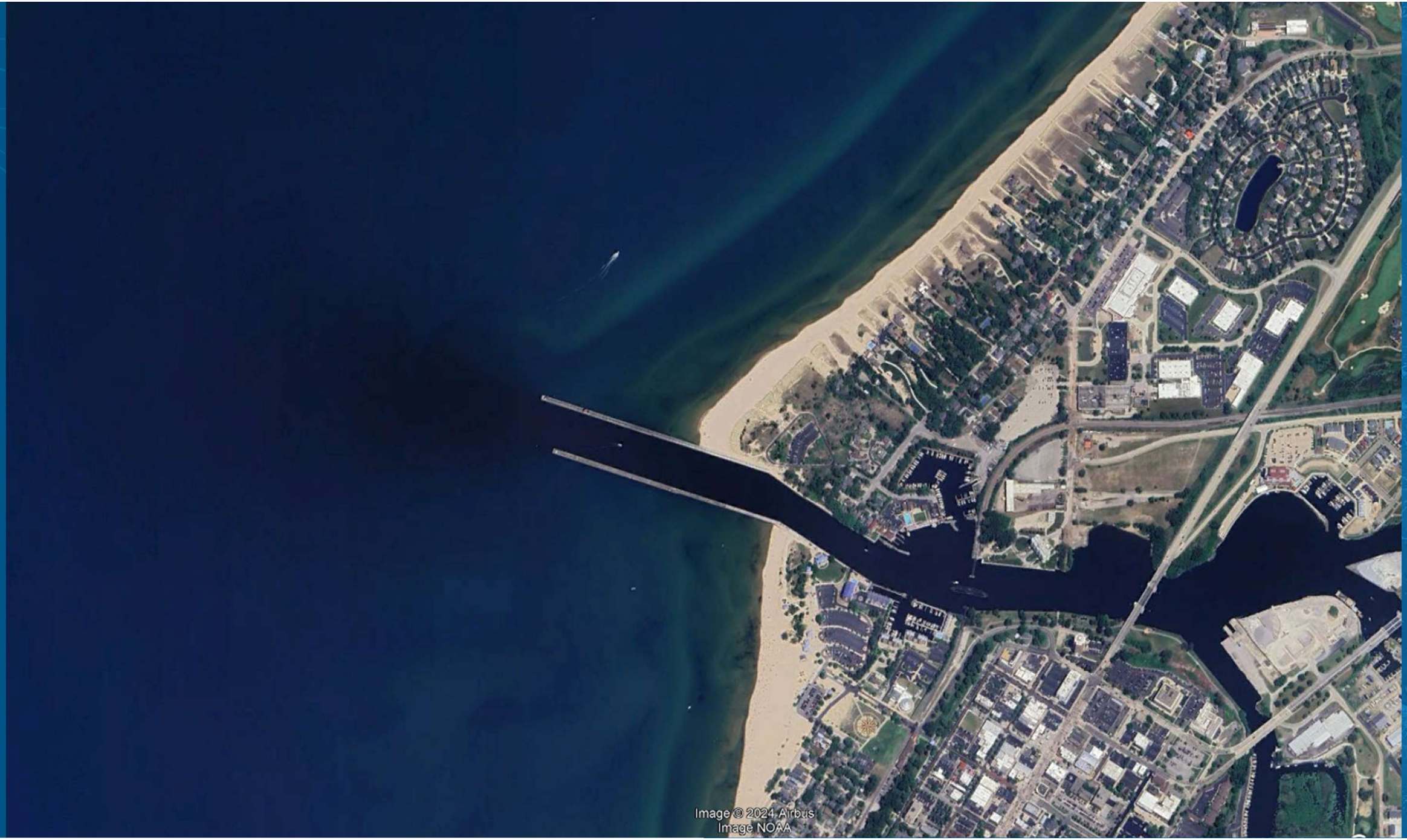
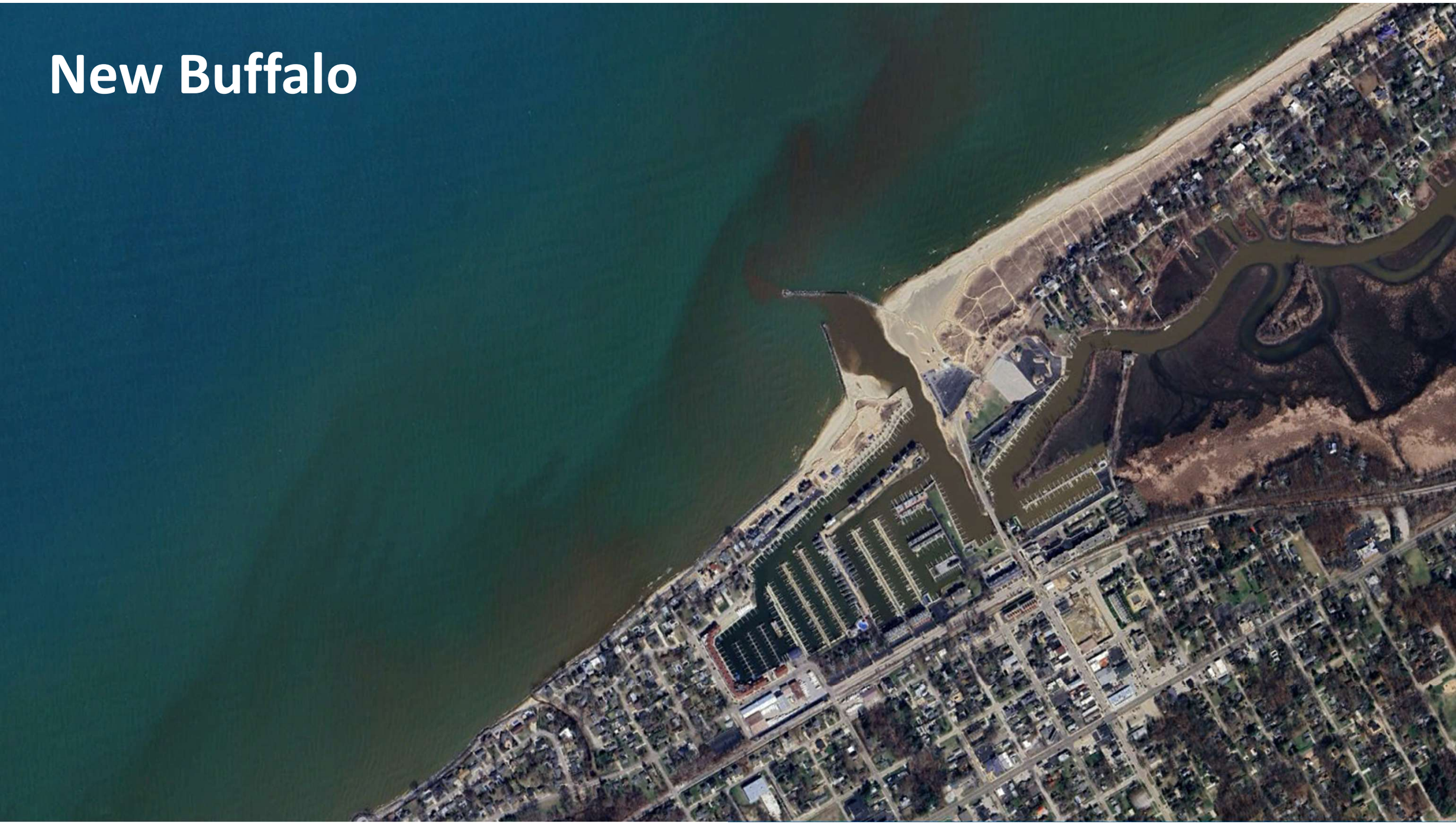


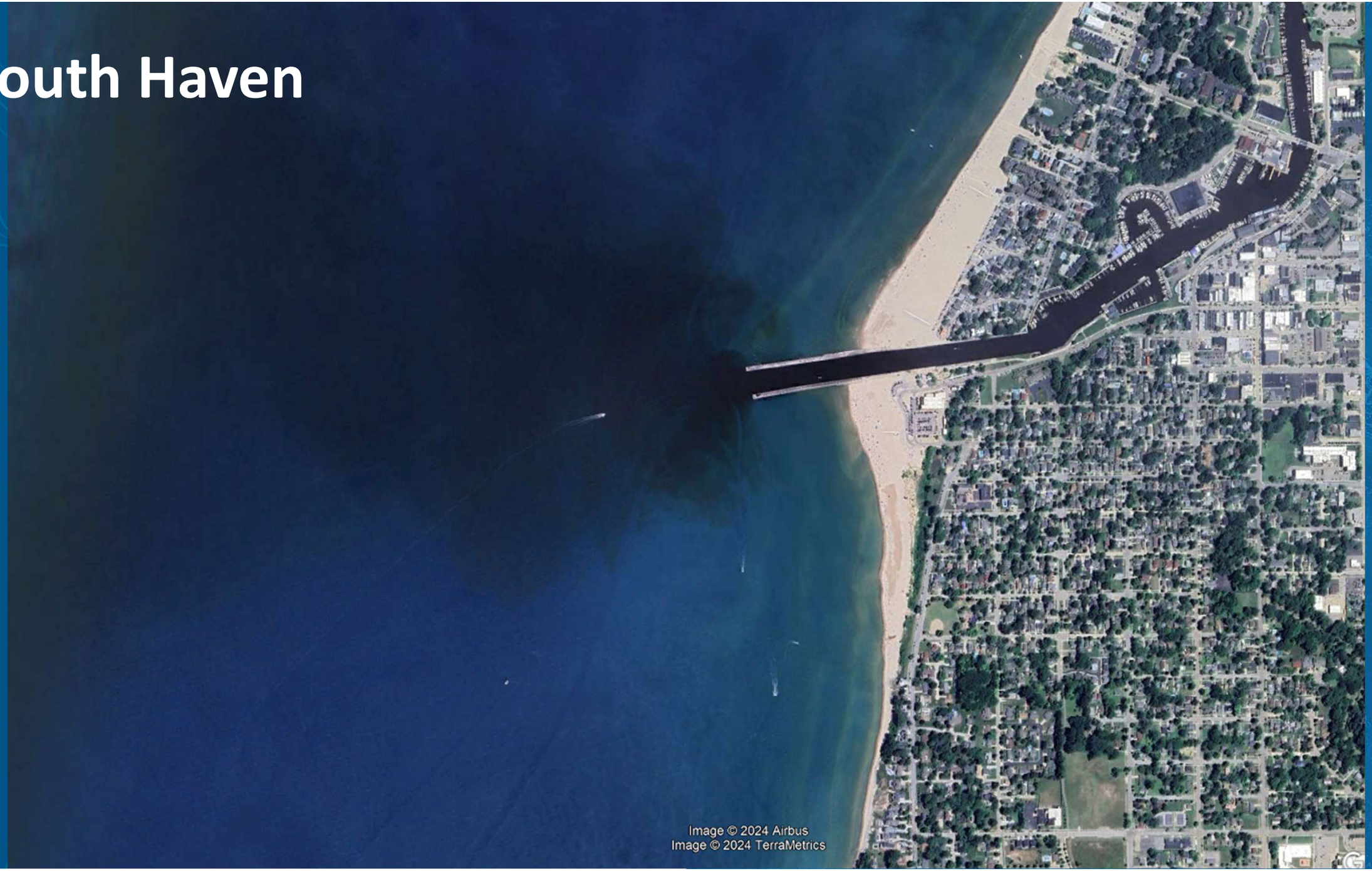
Image © 2024 Airbus
Image NOAA


Image © 2024 Airbus
Image NOAA

New Buffalo

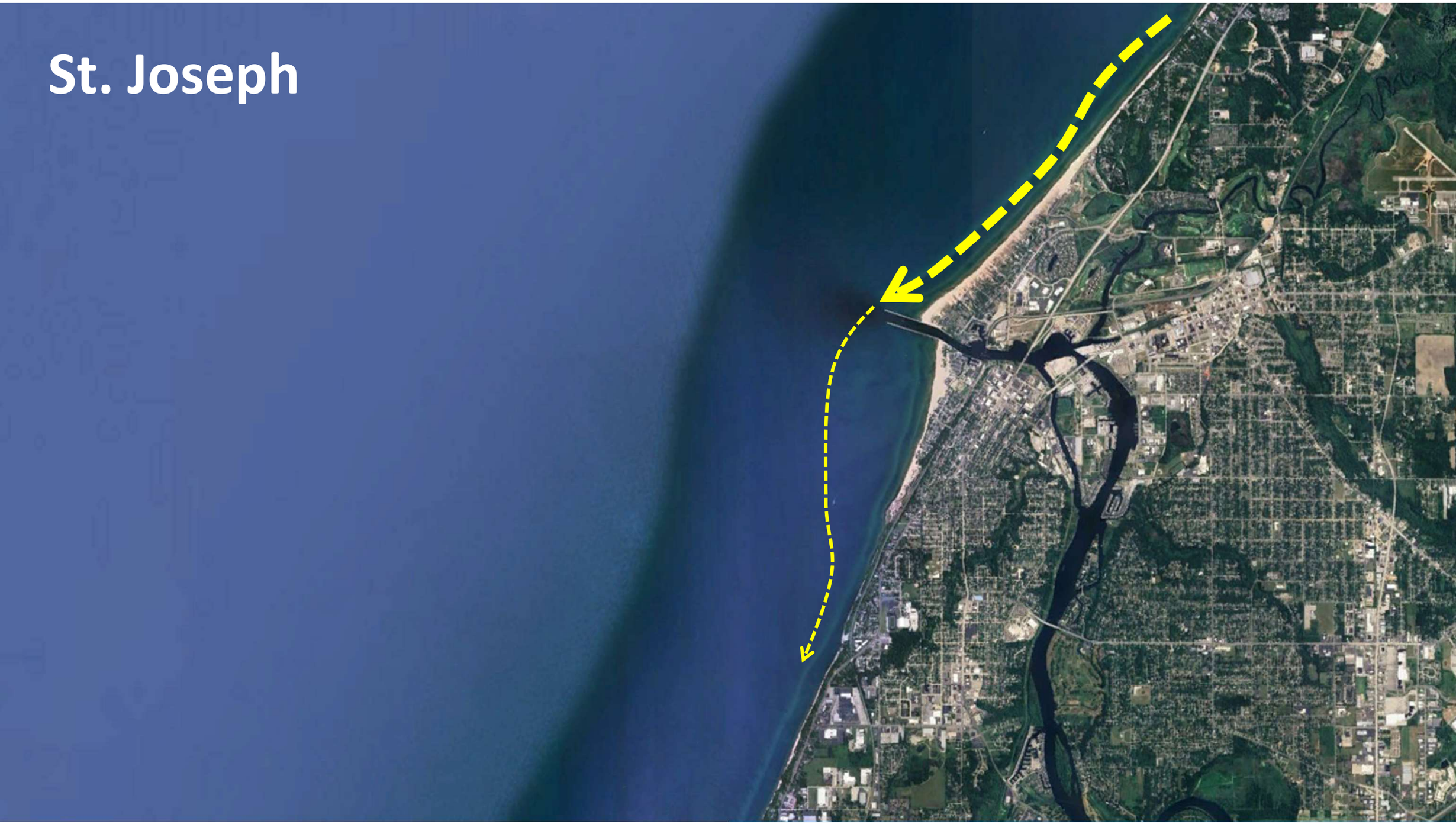


South Haven



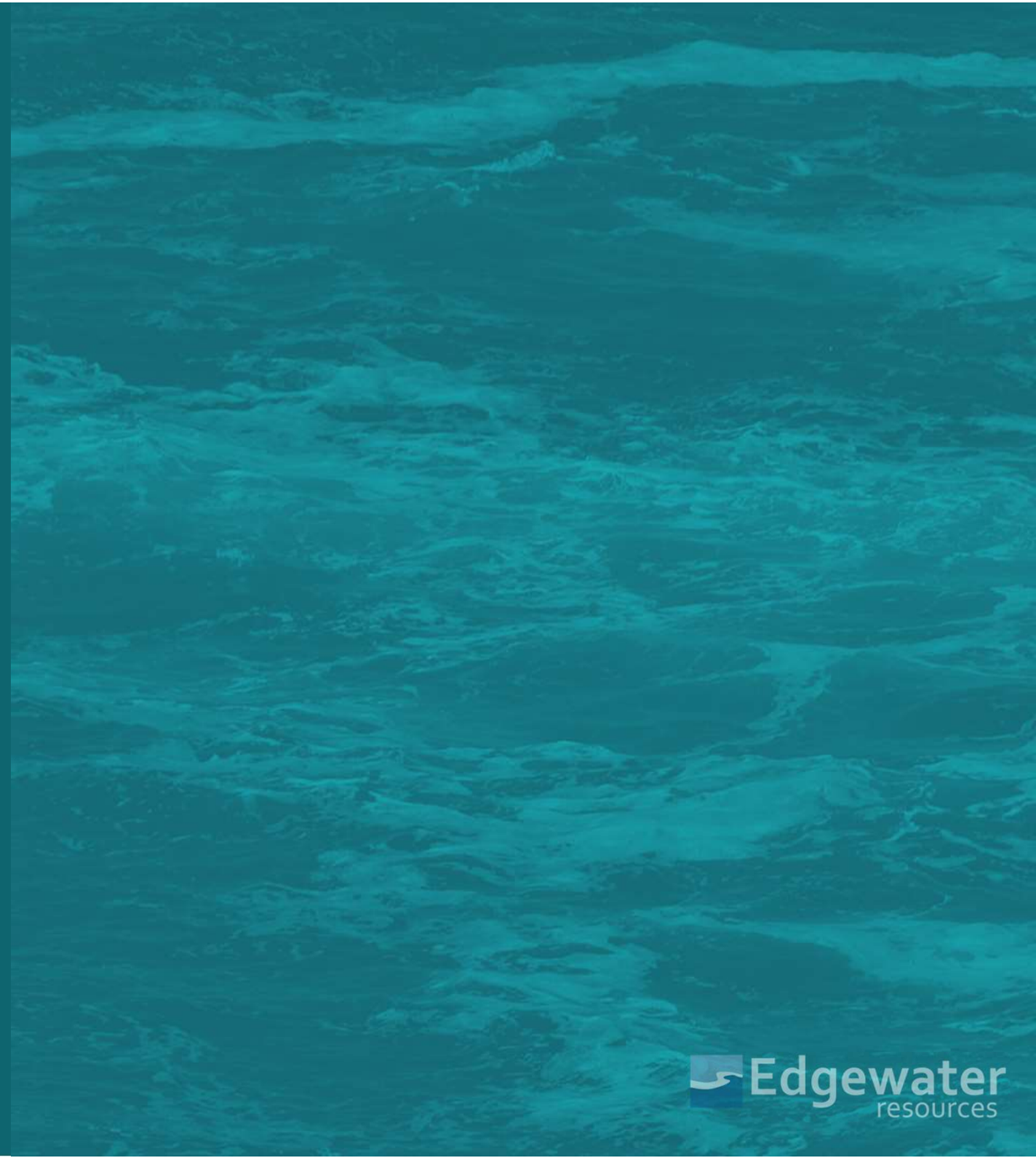
Holland

St. Joseph



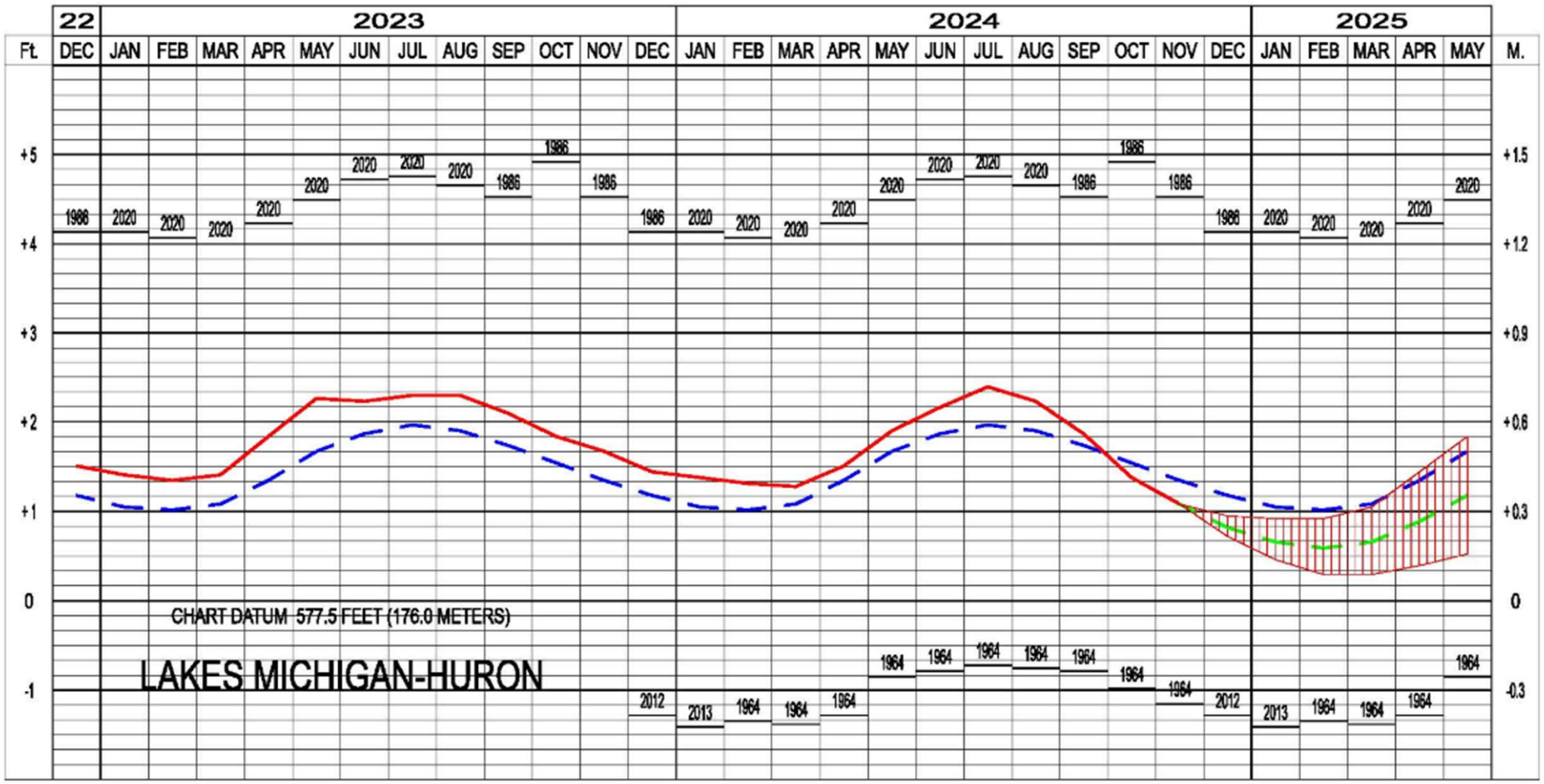
Existing Shoreline Protection Strategies

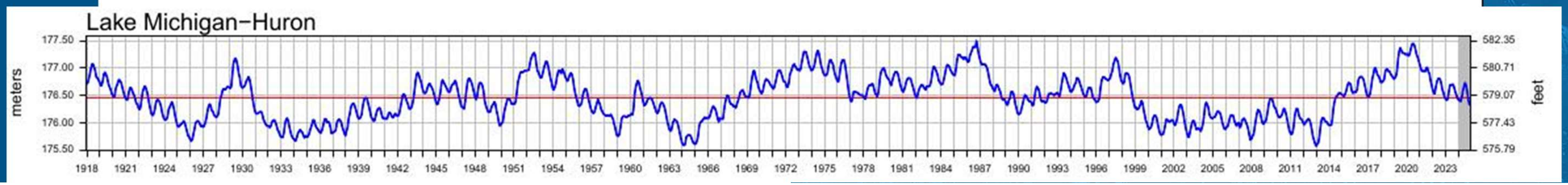
- Do Nothing
- Beach Nourishment
- “Soft Armoring” Sandbags / Geotubes / Temp
- Armor Stone
- Walls



Edgewater resources

LAKES MICHIGAN-HURON WATER LEVELS - DECEMBER 2024

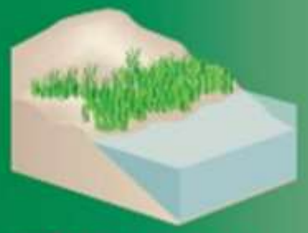




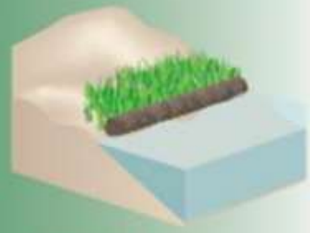
GREEN - SOFTER TECHNIQUES

GRAY - HARDER TECHNIQUES

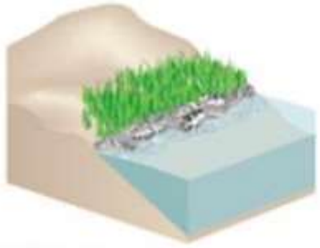
Living Shorelines



VEGETATION ONLY - Provides a buffer to upland areas and breaks small waves. Suitable for low wave energy environments.



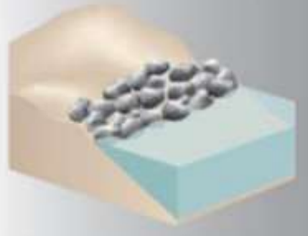
EDGING - Added structure holds the toe of existing or vegetated slope in place. Suitable for most areas except high wave energy environments.



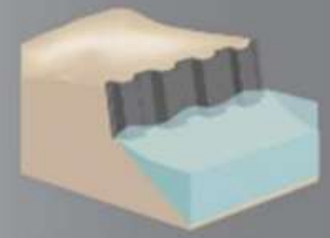
SILLS - Parallel to vegetated shoreline, reduces wave energy, and prevents erosion. Suitable for most areas except high wave energy environments.

Coastal Structures

BREAKWATER - (vegetation optional) - Offshore structures intended to break waves, reducing the force of wave action, and encourage sediment accretion. Suitable for most areas.



REVETMENT - Lays over the slope of the shoreline and protects it from erosion and waves. Suitable for sites with existing hardened shoreline structures.



BULKHEAD - Vertical wall parallel to the shoreline intended to hold soil in place. Suitable for high energy settings and sites with existing hard shoreline structures.


Edgewater
resources


Douglas


Douglas


South Haven - 2017

South Haven – 2020

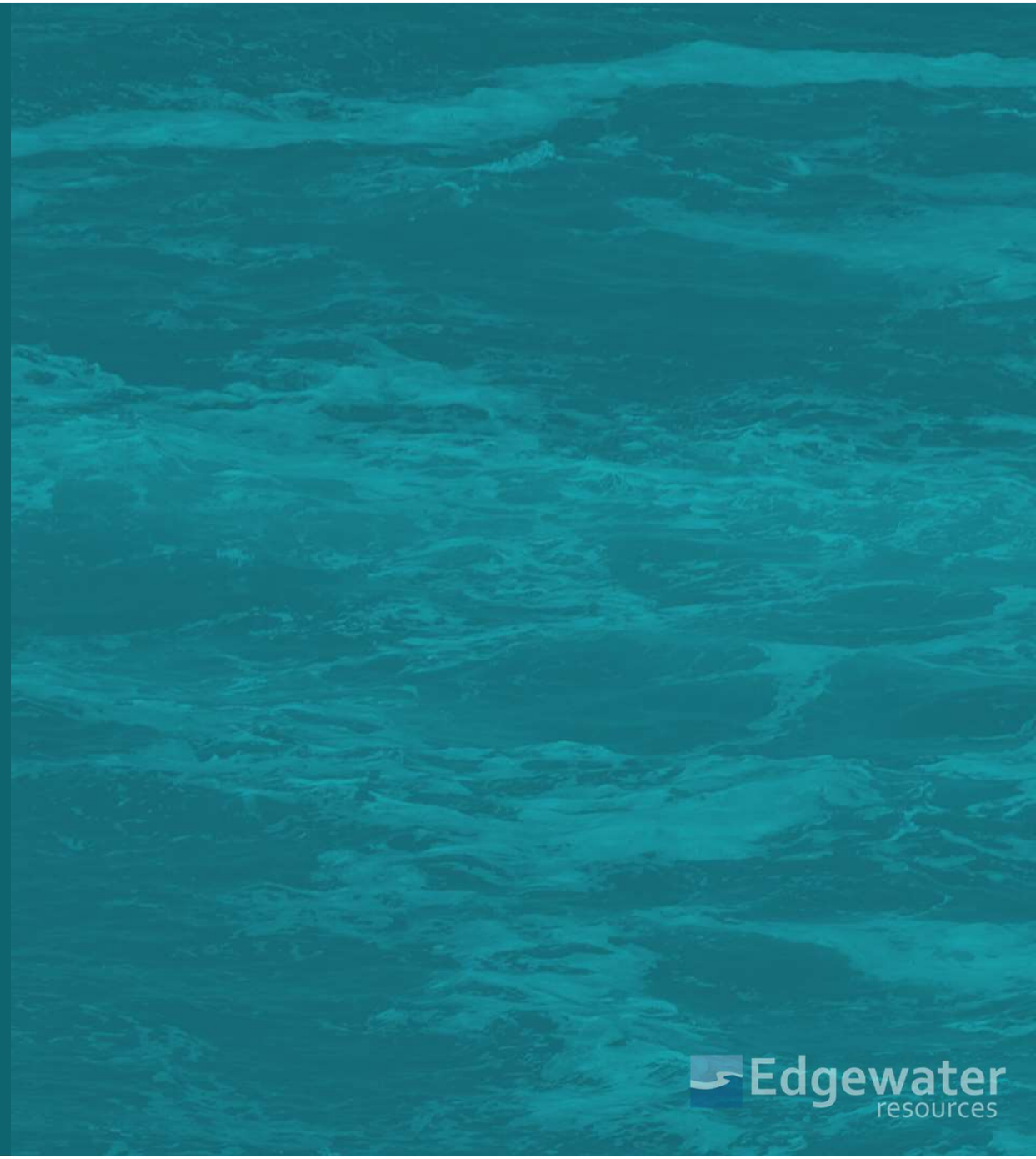
South Haven

South Haven


SLOW NO WAKE

What's the Challenge with Beach Nourishment?

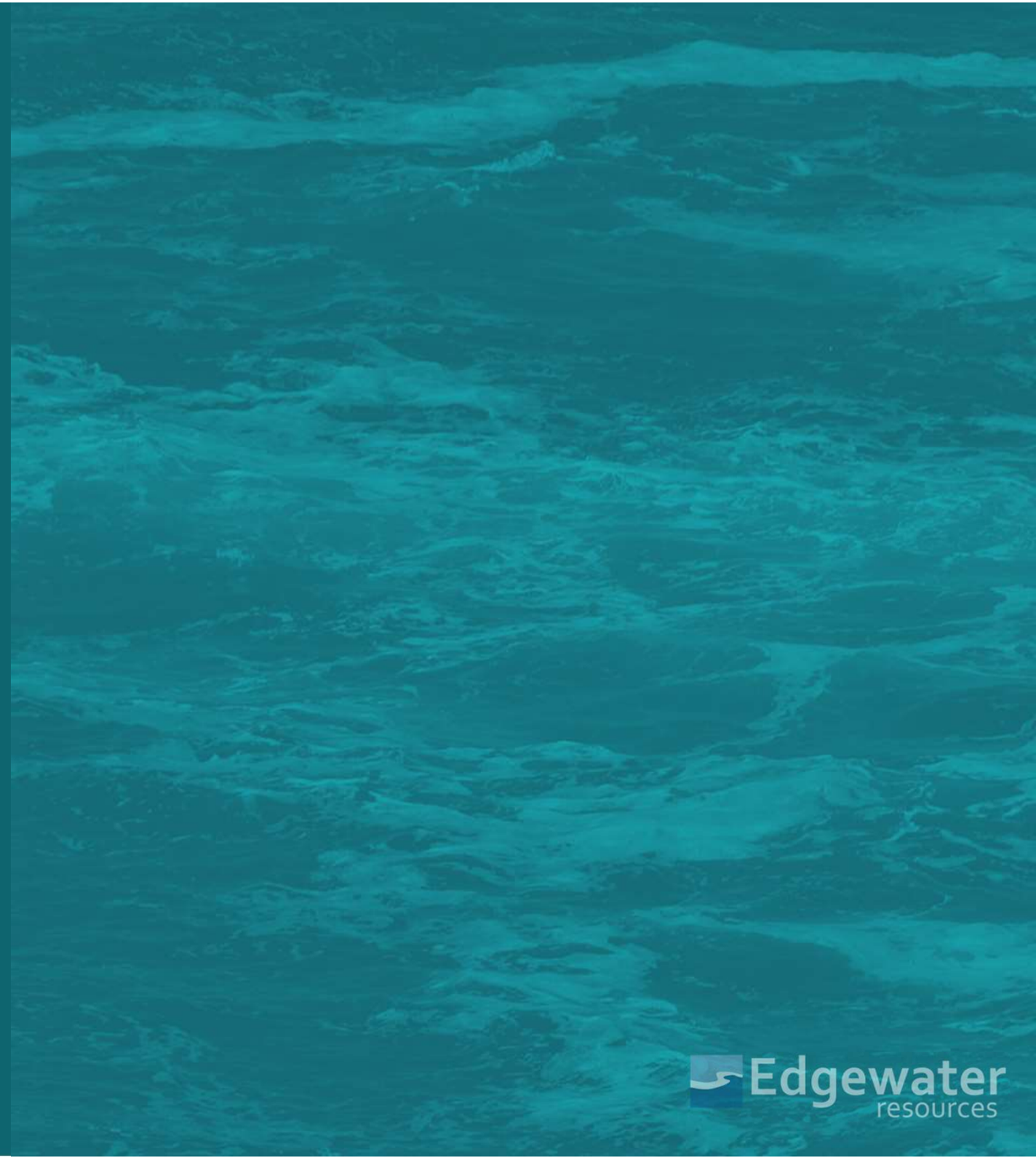
- Can be Very Expensive, Especially if Importing Sand
- Inconsistent Federal Dredging and Funding Schedule
- Relatively Short Lived Solution



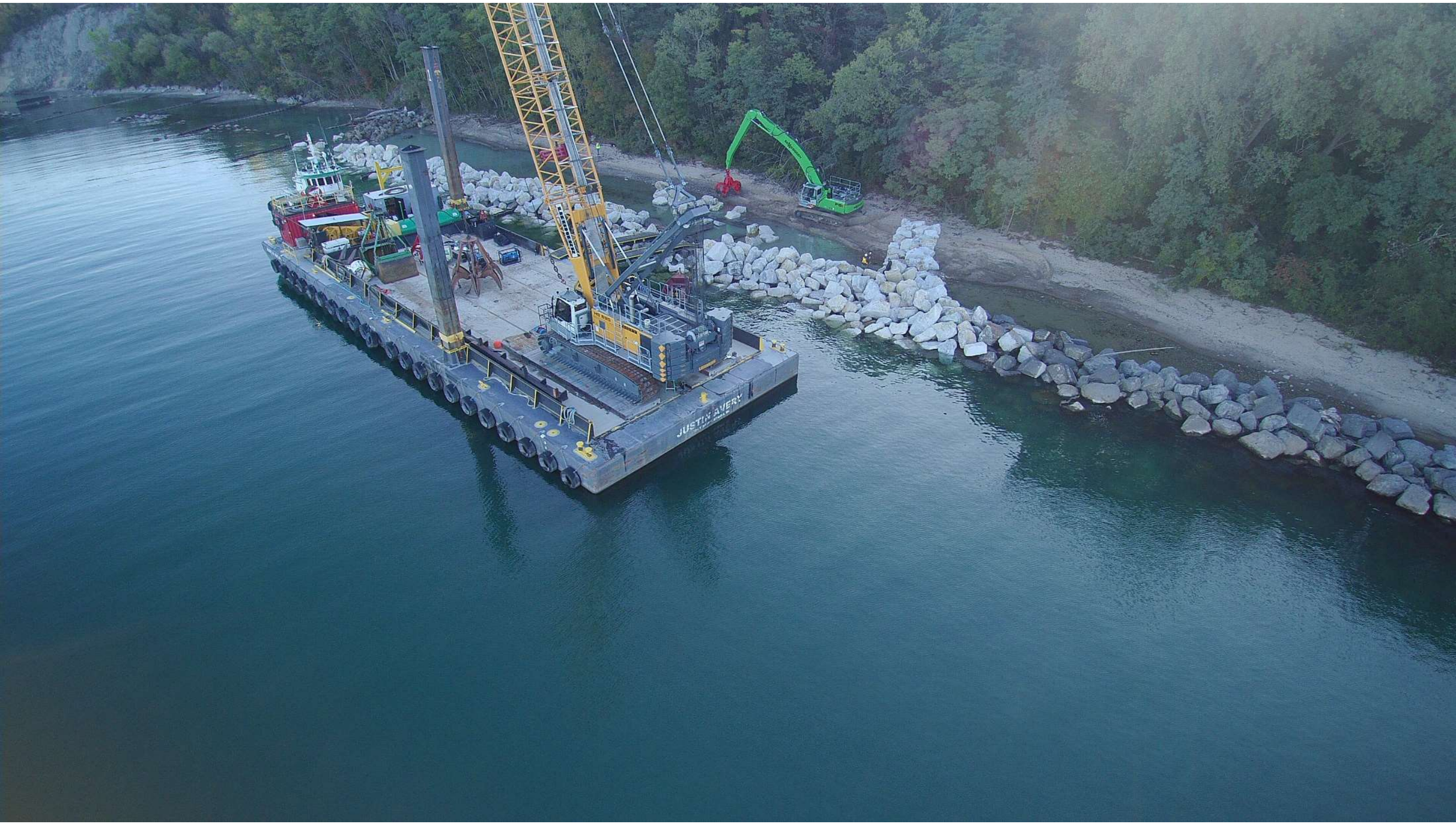
Edgewater resources

What's the Challenge with Temporary "Soft Armoring"?

- While Less Expensive, Still Costly
- Relatively Short Lived Solution
- EGLE Required Removal at End of Permit Window



Edgewater resources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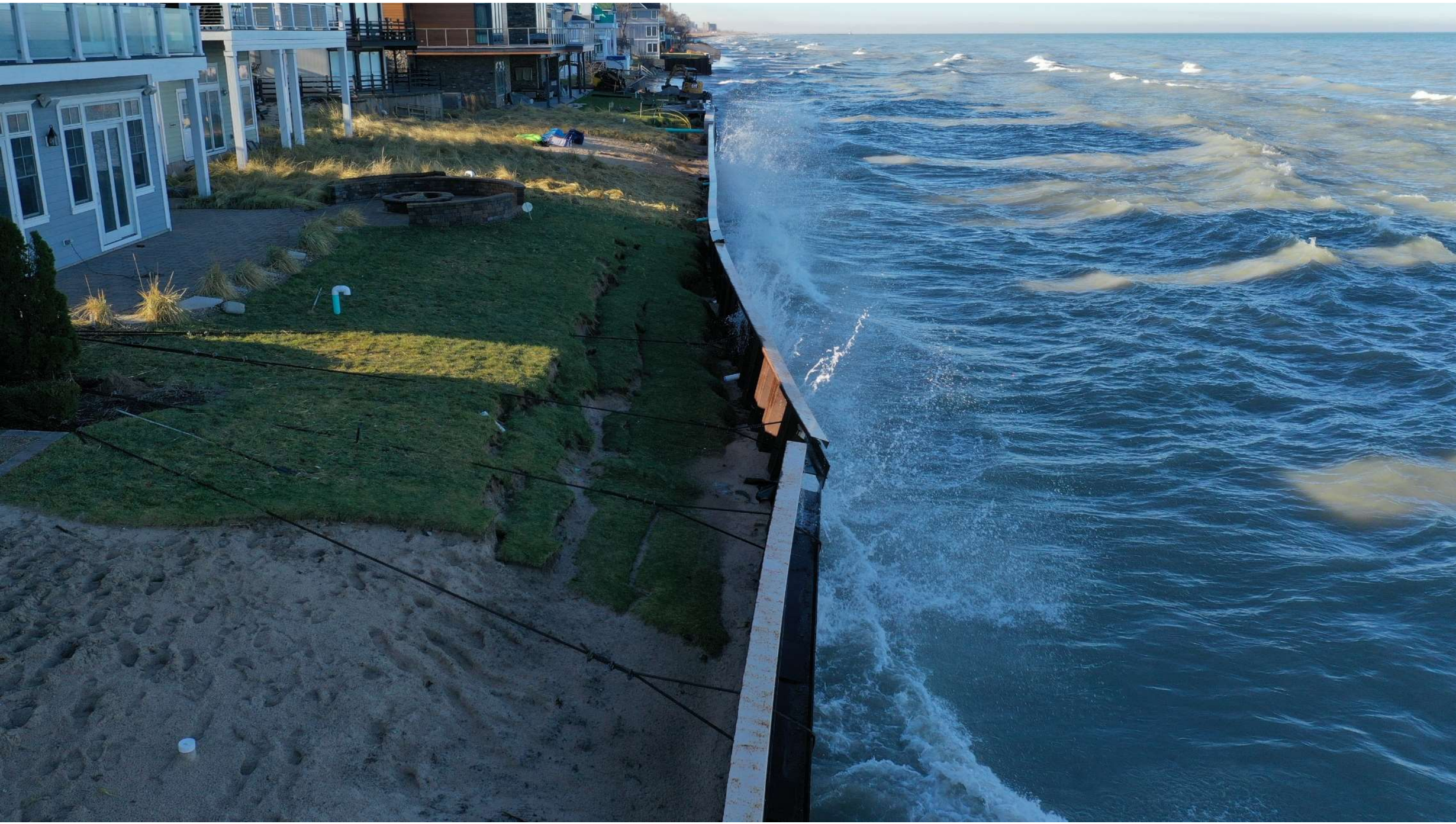
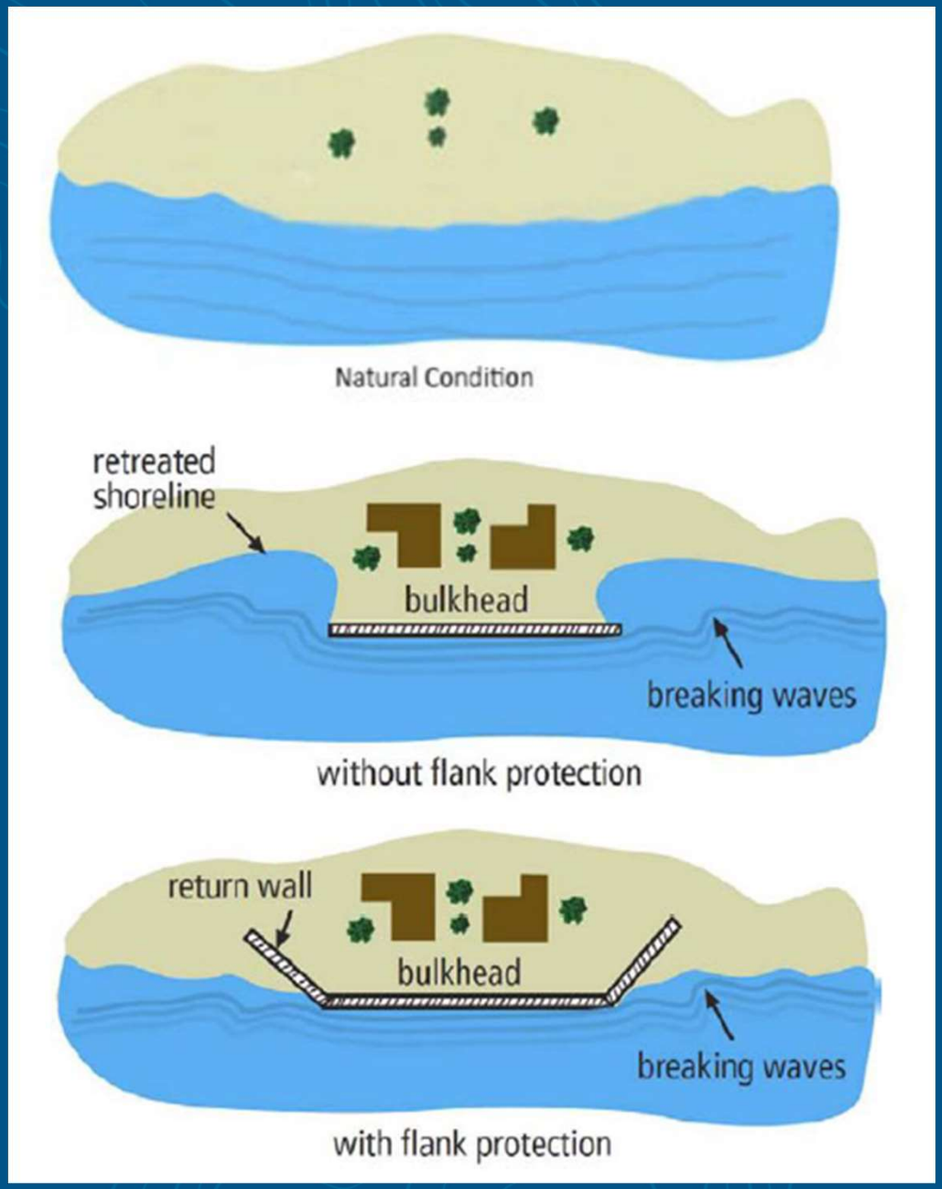
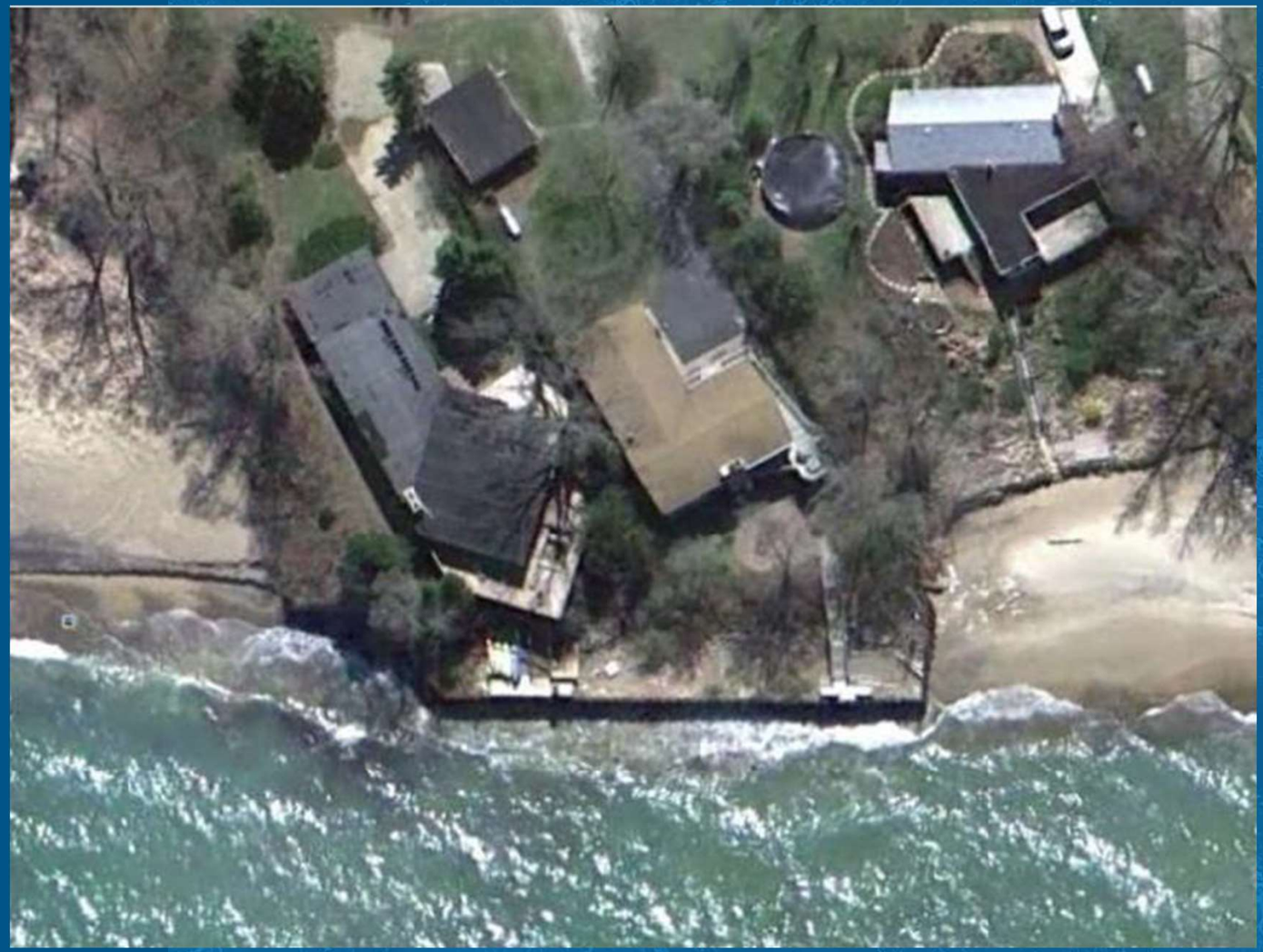



Natural Condition
retreated
shoreline
bulkhead
breaking waves
without flank protection
return wall
bulkhead
breaking waves
with flank protection



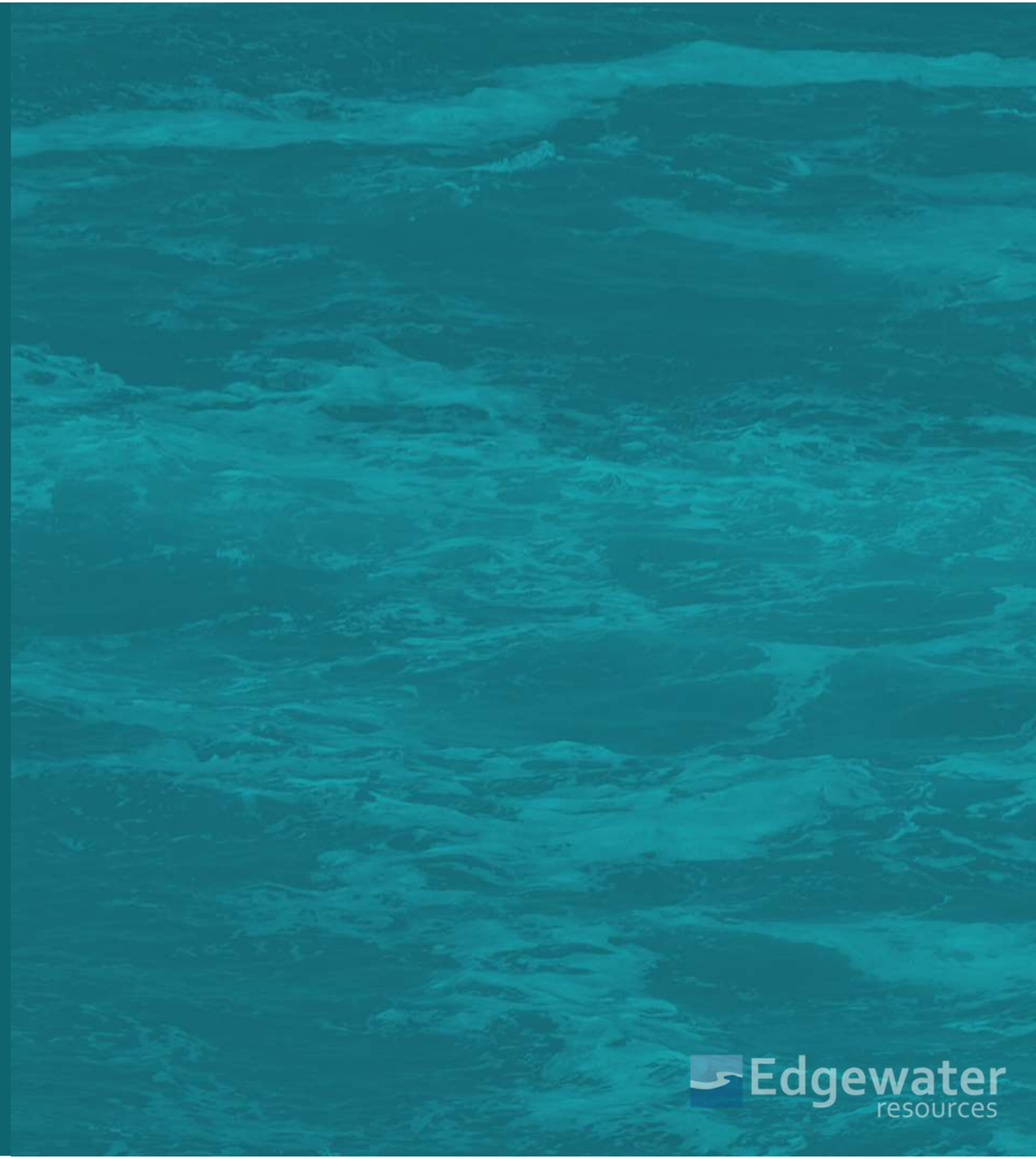
What's Wrong with Hard Armoring?

- Very Expensive
- Impacts Neighboring Properties
- Impacts to Environment of Mobilizing Construction Equipment
- Reduces the Source of Materials in the Littoral Drift System that Naturally Nourishes our Shoreline

Edgewater resources

What Does Climate Change Have to do With it?

- More Rapidly Changing Water Levels
- Increased Storm Intensity and Frequency
- Less Ice Cover Leaves Shorelines Exposed to the Worst Storms
- Less Predicatability

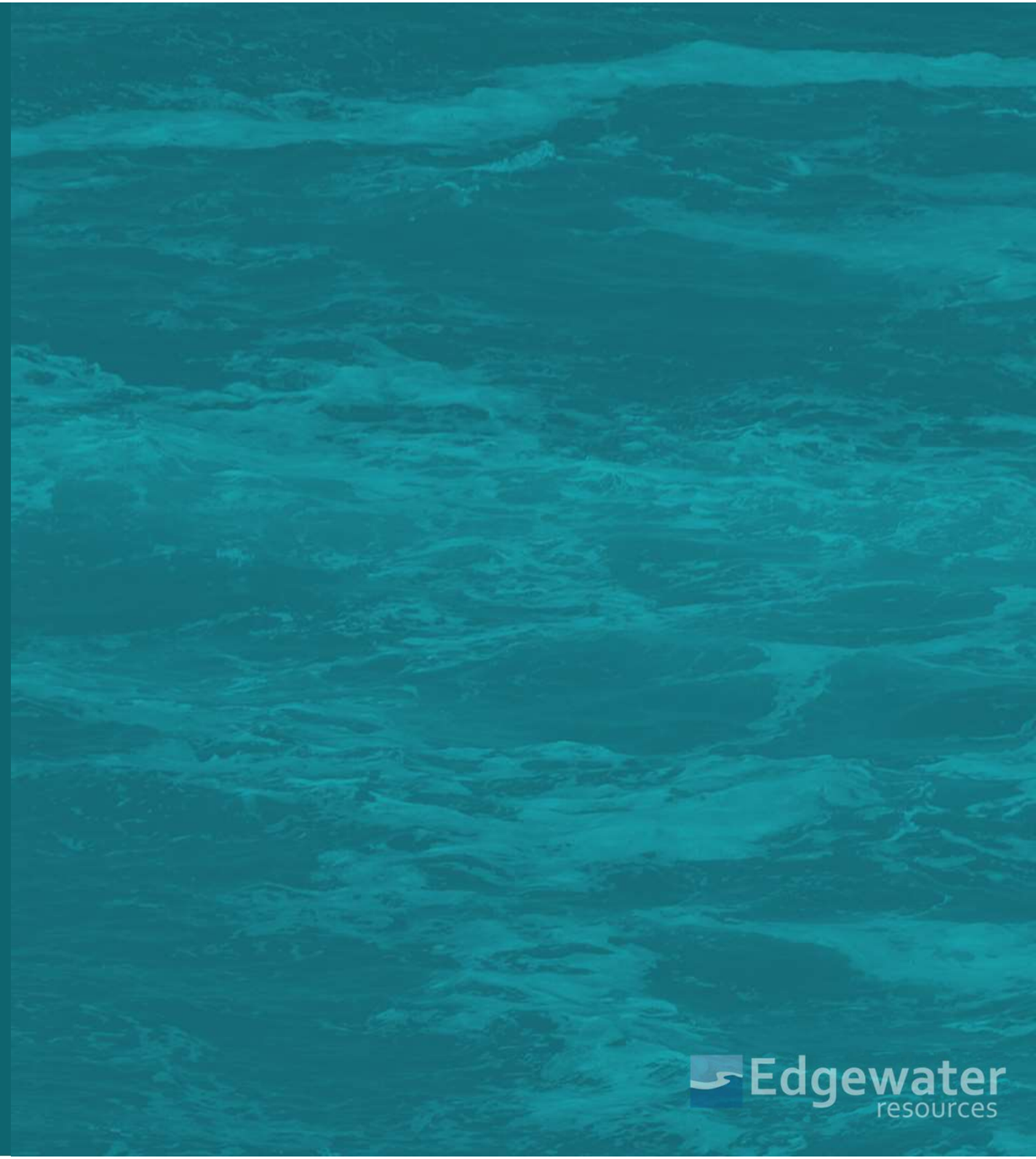


Edgewater resources

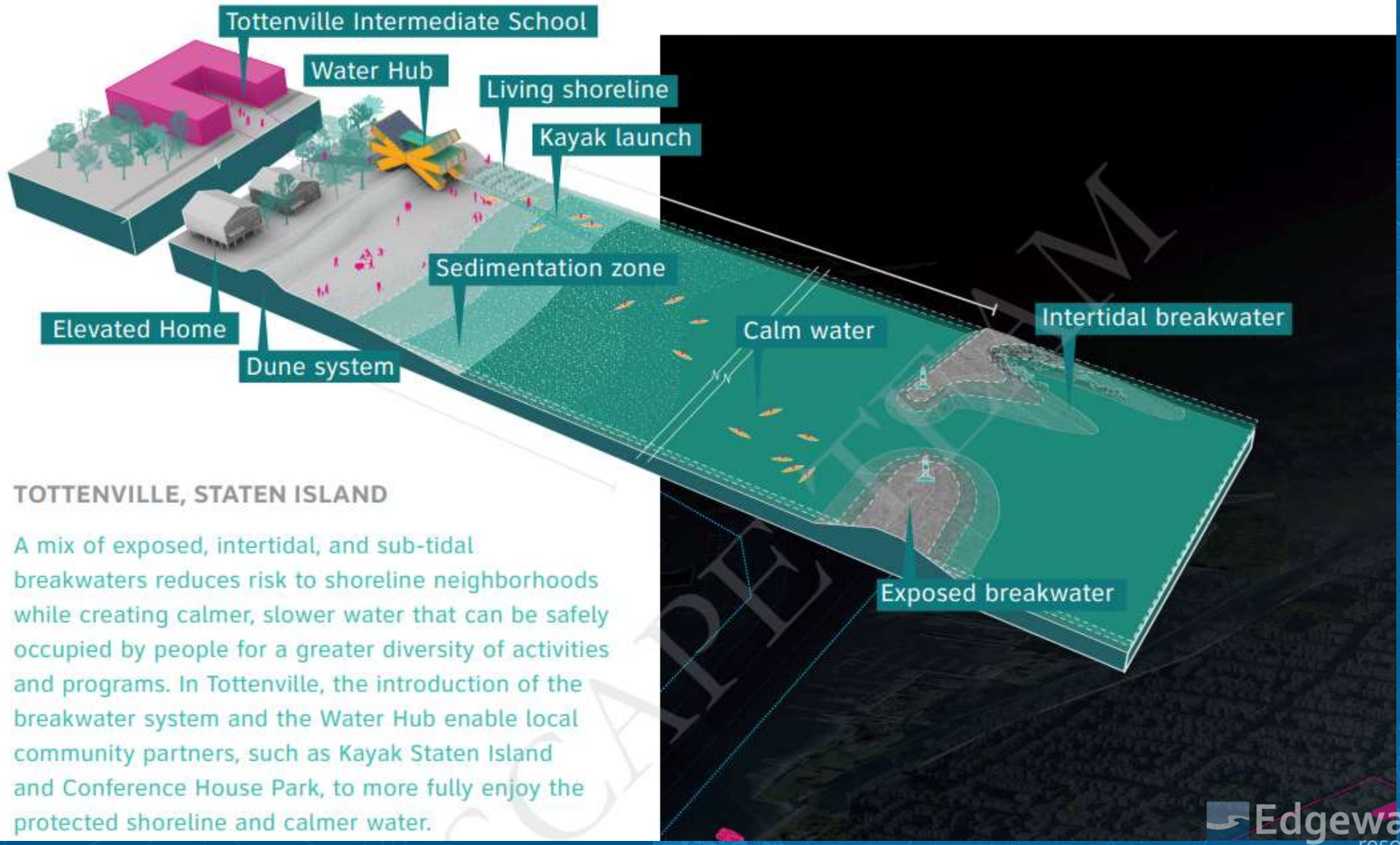

KOBELCO
KOBELCO

Future Shoreline Protection Strategies

- Do Nothing
- Beach Nourishment
  - Offshore Source
- Engineer With Nature to Maintain Beach and Direct Sediment
  - Prenourishment
  - Offshore Segmented Breakwaters
  - Habitat Reefs
  - Habitat Islands

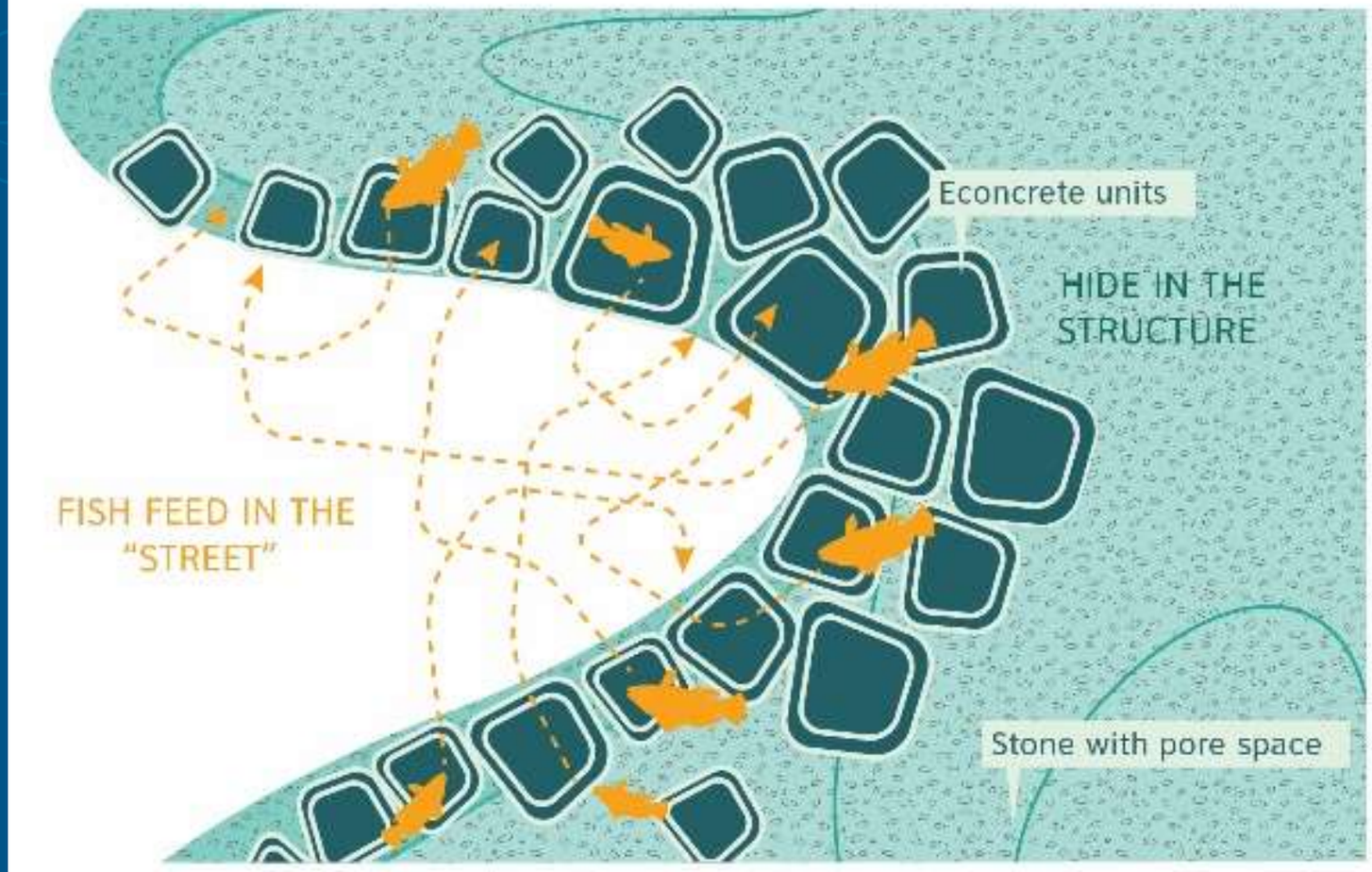


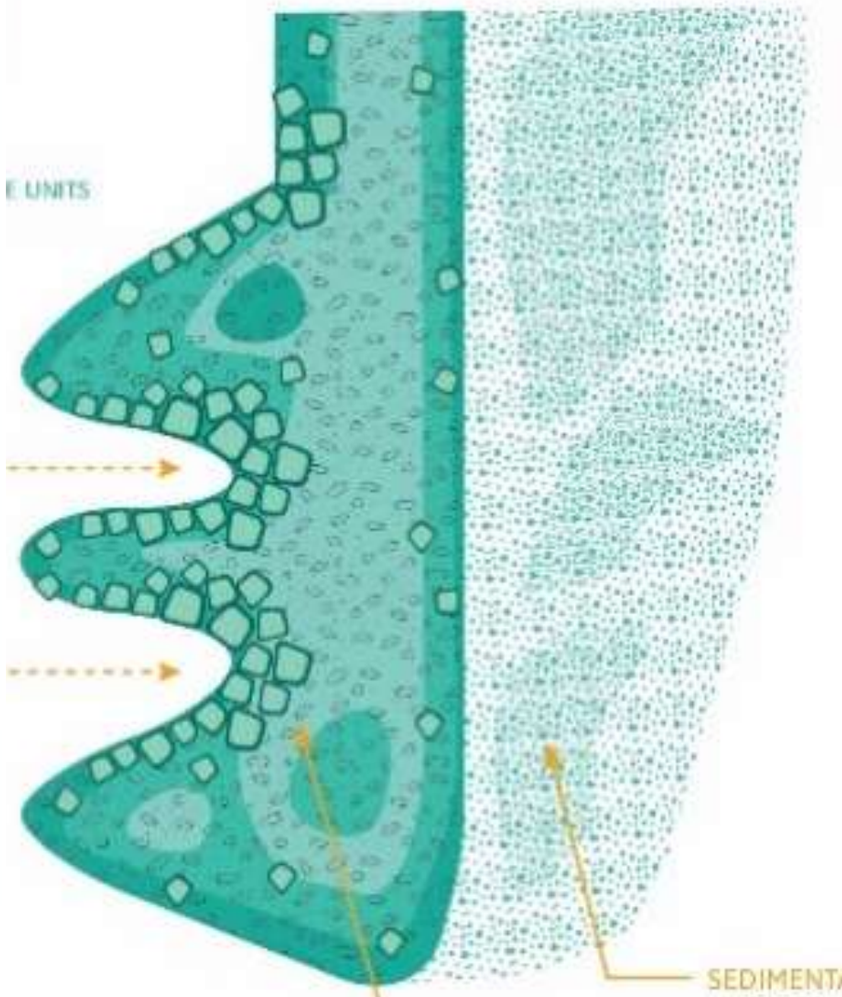
Edgewater resources



TOTTENVILLE, STATEN ISLAND

A mix of exposed, intertidal, and sub-tidal breakwaters reduces risk to shoreline neighborhoods while creating calmer, slower water that can be safely occupied by people for a greater diversity of activities and programs. In Tottenville, the introduction of the breakwater system and the Water Hub enable local community partners, such as Kayak Staten Island and Conference House Park, to more fully enjoy the protected shoreline and calmer water.


Econcrete units
HIDE IN THE STRUCTURE
FISH FEED IN THE "STREET"
Stone with pore space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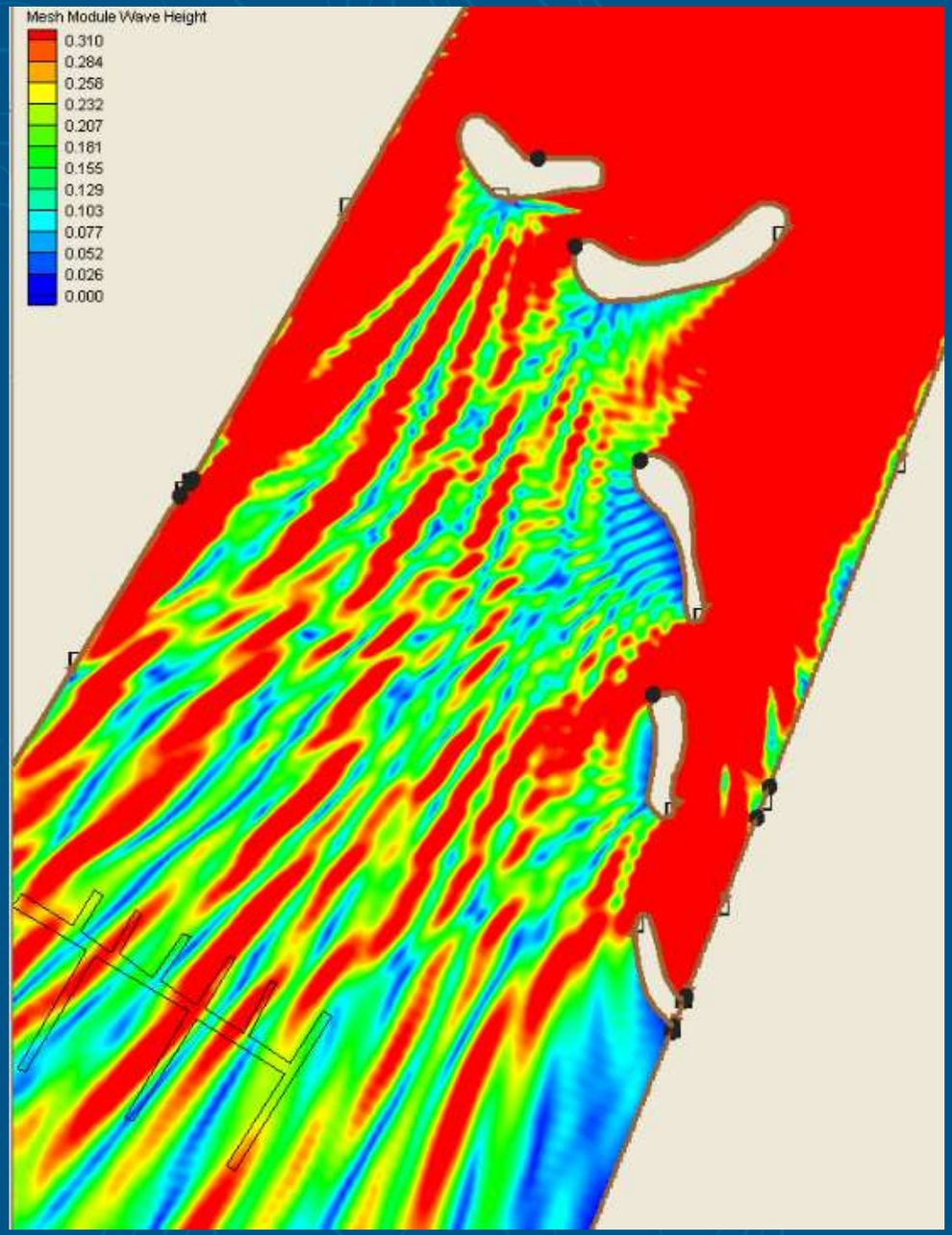
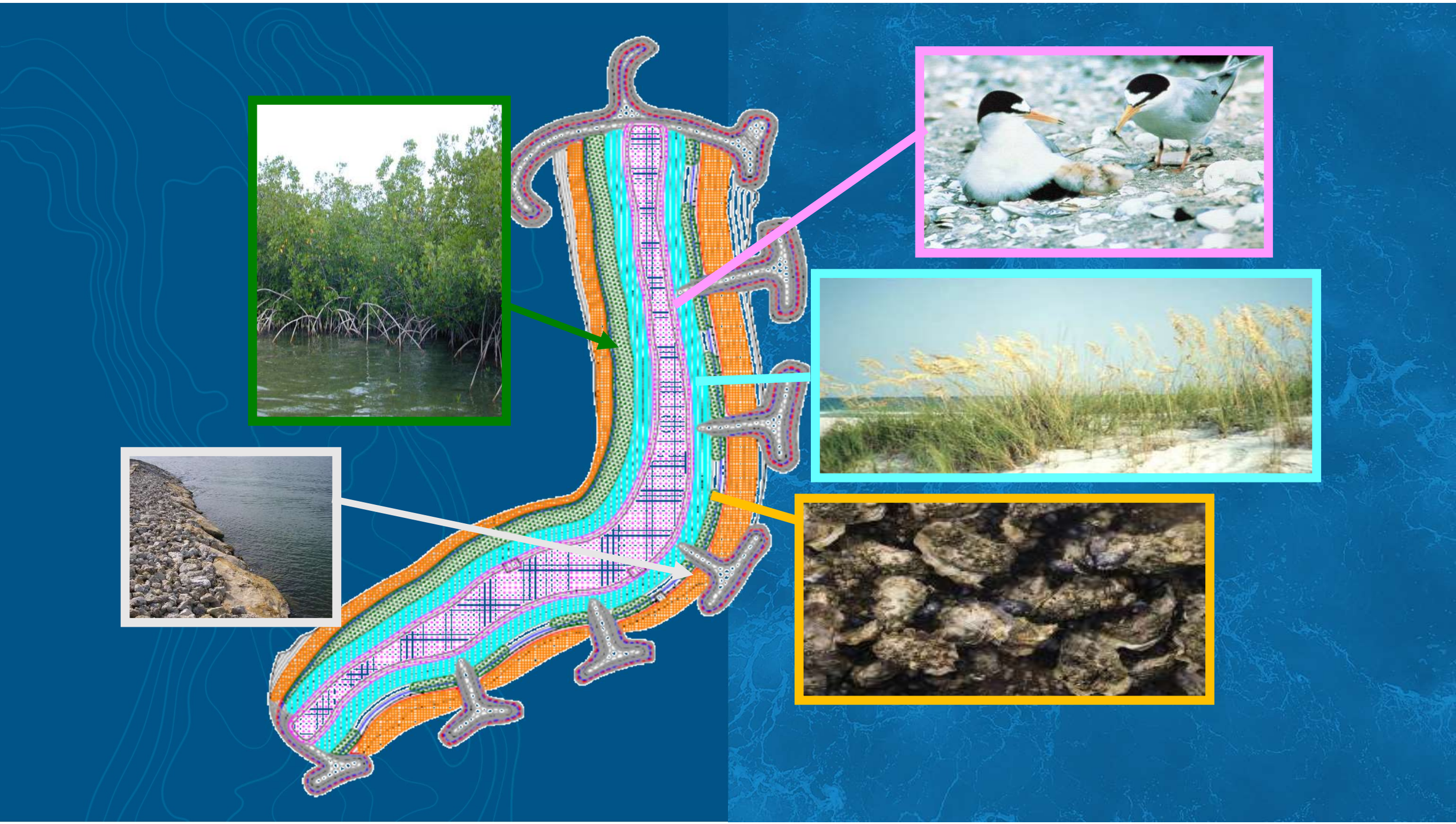
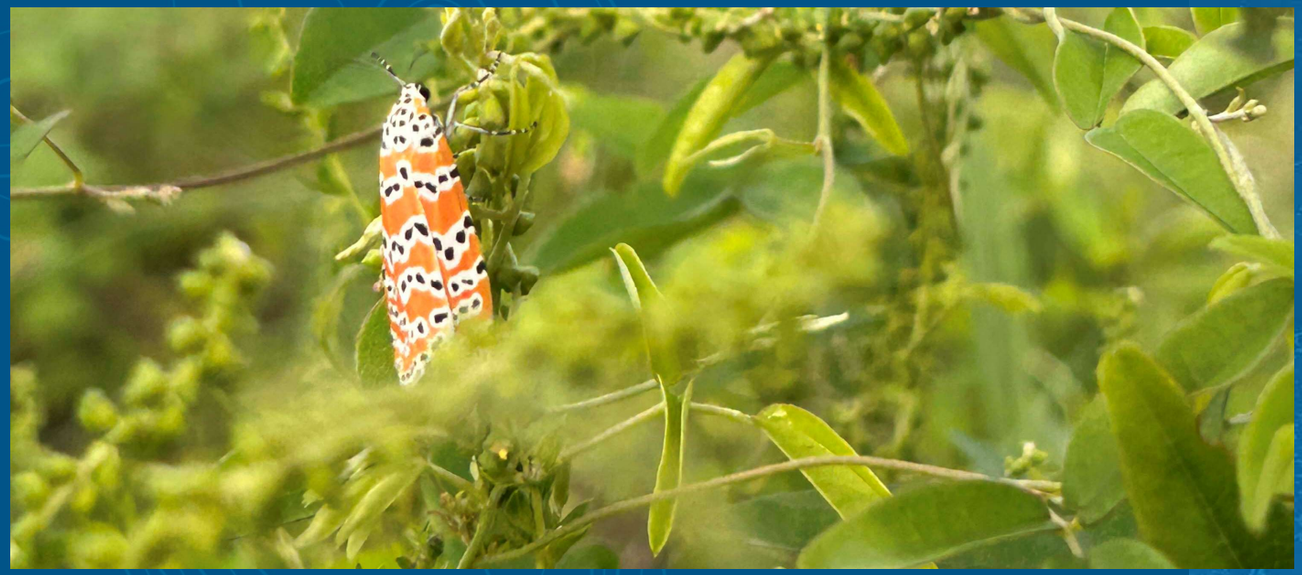
SEDIMENTATION Z
HARD CLAMS, EEL
DEPENDANT ON R
ECONCRETE UNITS
CONCENTRATE AT
INTERTIDAL AND S

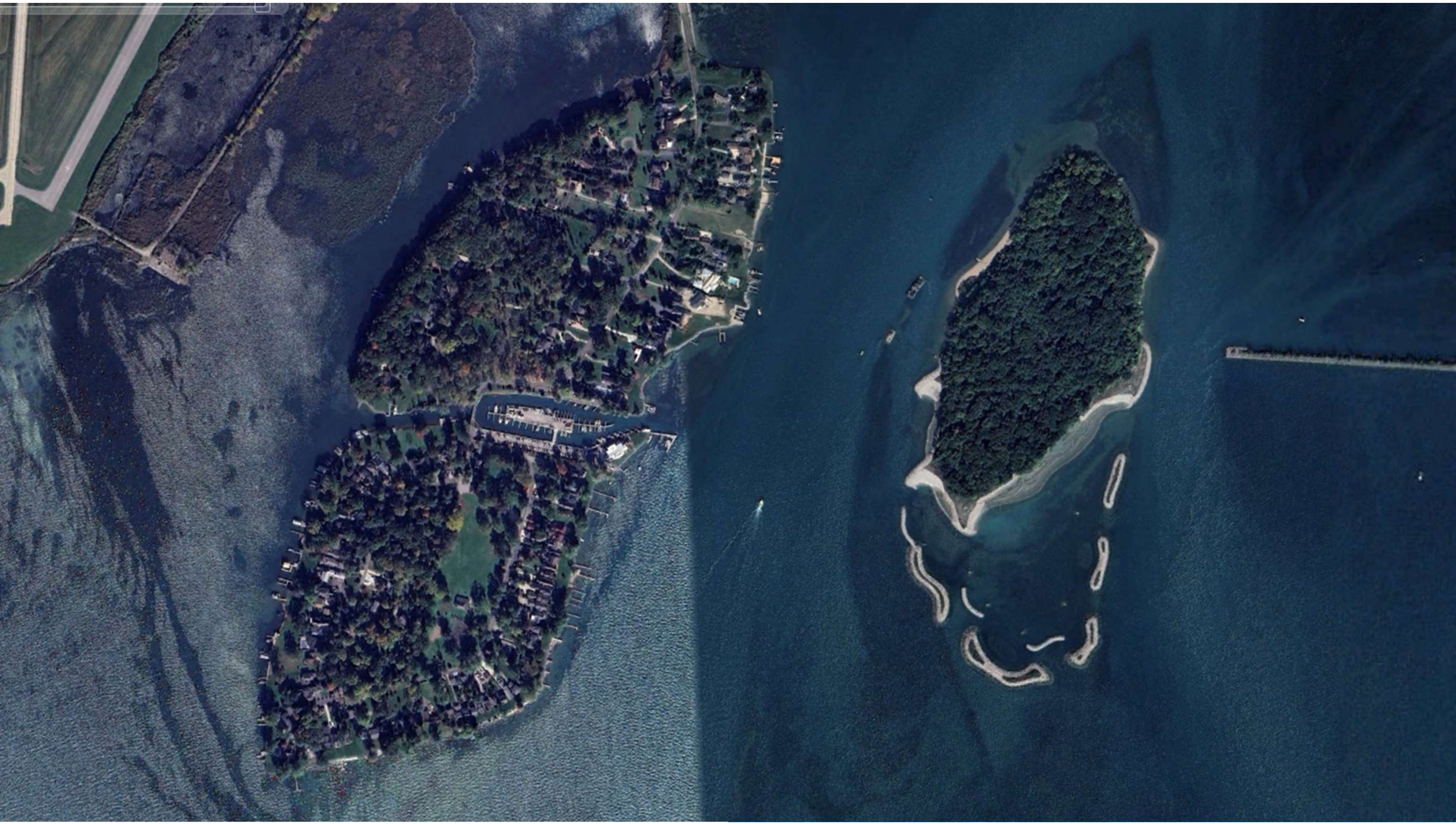


Edgewater resources


Edgewater
resources



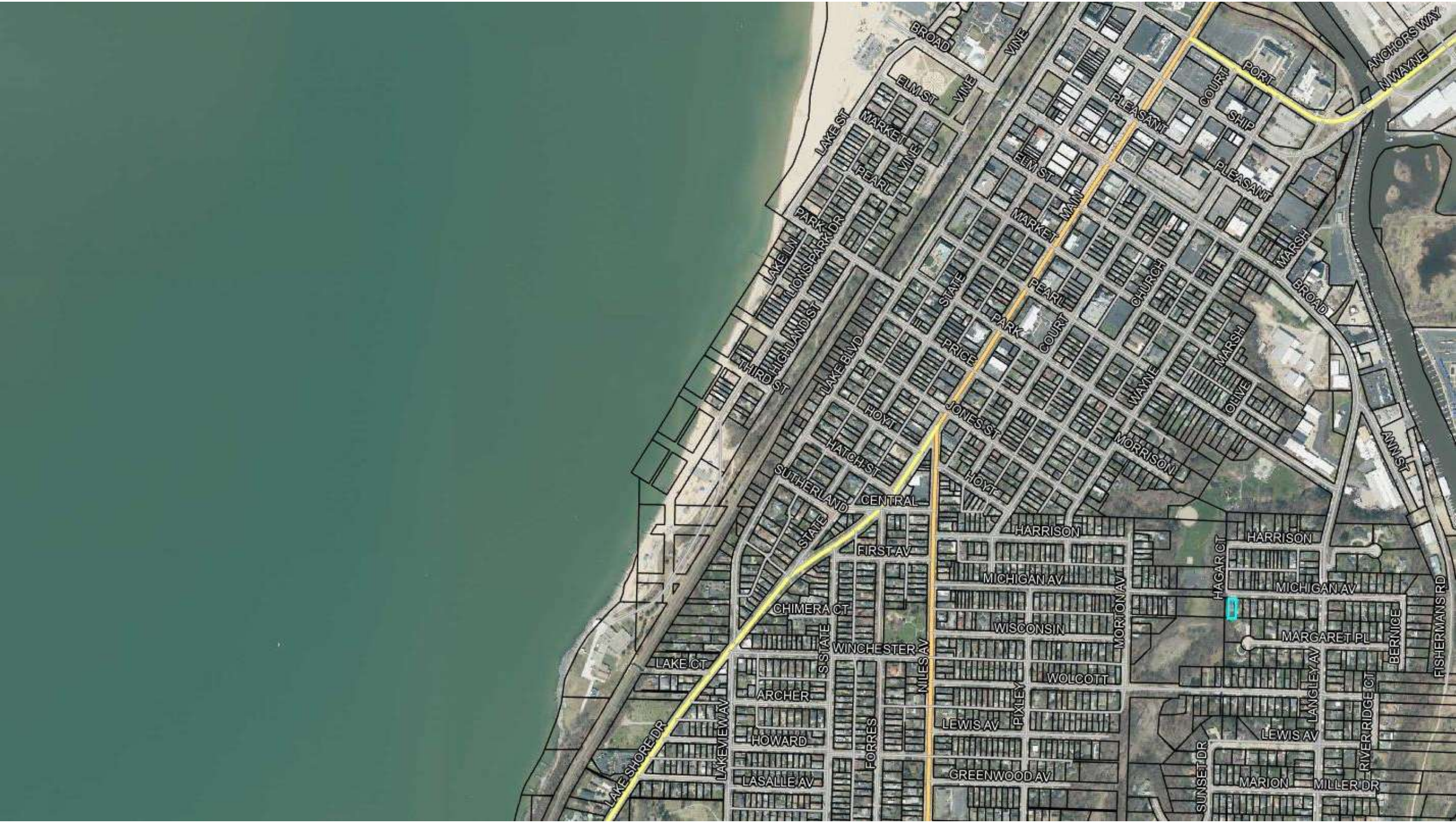




Permitting Considerations

- Joint Permit Application Submitted to EGLE and USACE
- Requires Permission From All Riparian Interest Holders
- All Projects Require Consideration of the Public Trust
- All Projects Require Consideration of Potential Impacts to Habitat and Threatened and Endangered Species
- All Permits for Innovative Ideas Become Precedents
- May Require a Bottomlands Lease
- Will Require a Long Term Maintenance Strategy

Edgewater resources


BROAD
VINE
ELM ST
LAKE ST
MARKET
PEARL
PARK DR
LAKE LN
LION'S PARK DR
THIRD ST
HIGHLAND ST
JAKE BLVD
STATE
PRICE
PARK
COURT
MAIN
PLEASANT
SHIP
PORT
ANCHORS WAY
N WAYNE
CHURCH
MARSH
WAYNE
OLIVE
MORRISON
HOYT
JONES ST
HATCH ST
SUTHERLAND
CENTRAL
FIRST AV
HARRISON
MICHIGAN AV
MORTON AV
HAGAR CT
CHIMERA CT
WISCONSIN
WINCHESTER
MARGARET PL
BERNICE
FISHERMANS RD
LAKE CT
ARCHER
HOWARD
LASALLE AV
LAKESHORE DR
LAKEVIEW AV
FORRES
NILES AV
PIXLEY
WOLCOTT
LEWIS AV
GREENWOOD AV
LANGLEY AV
RIVERRIDGE CT
SUNSET DR
MARION
MILLER DR
ANN ST

Permitting Process

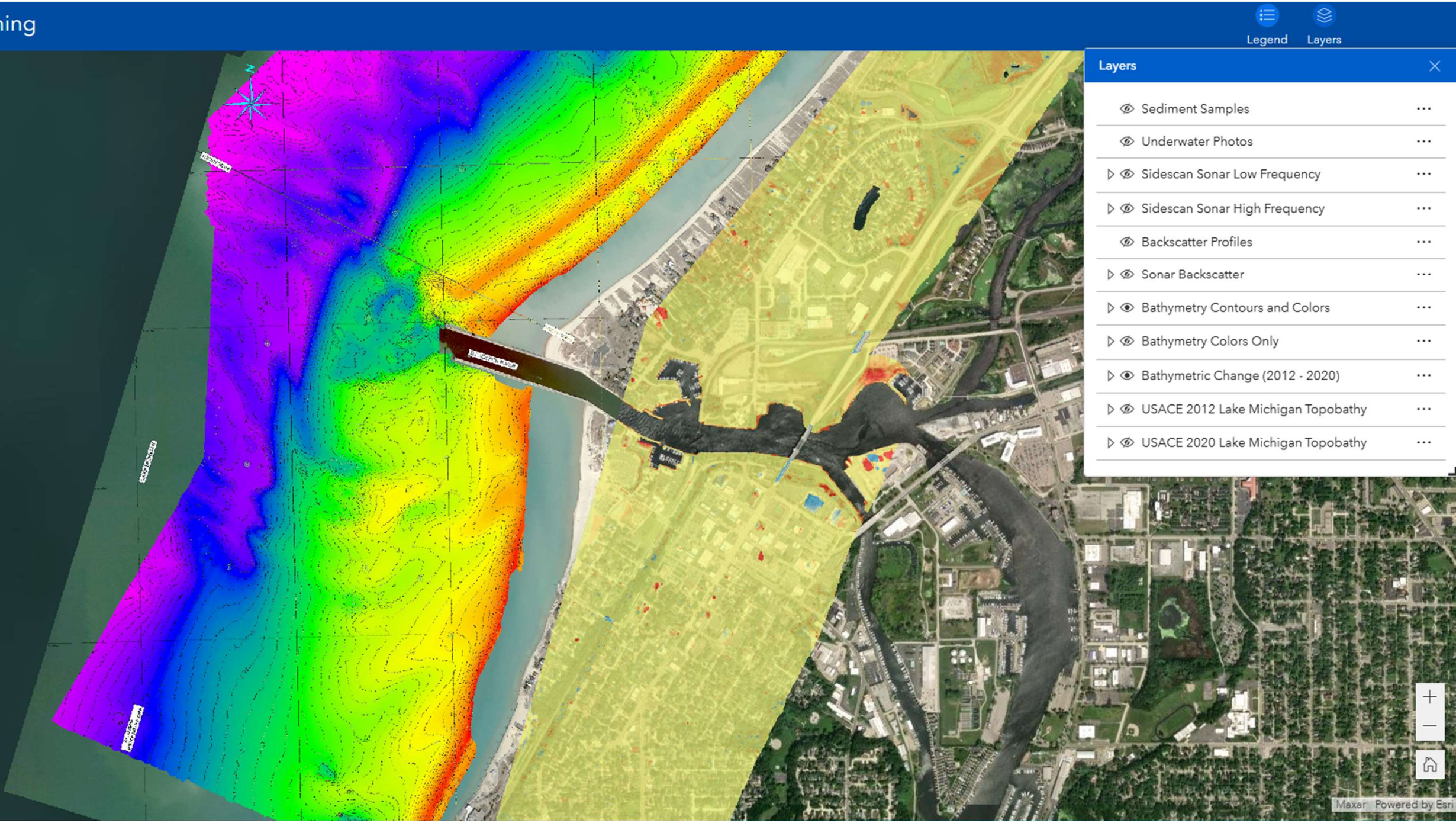
- *This STUDY Will NOT Result in the Submission of a Permit Application*
- Development of Concept Alternatives
- Preliminary Application Meeting
- Completion of Preliminary Engineering
- Submission of Joint Permit Application
    - Distributed to all State and Federal Agencies
    - Separate Public Comment Periods
    - Special Studies – Wave and Circulation Studies, Habitat Studies, etc
    - Resolution of Issues
    - Permit Issued

Edgewater resources

Study Process

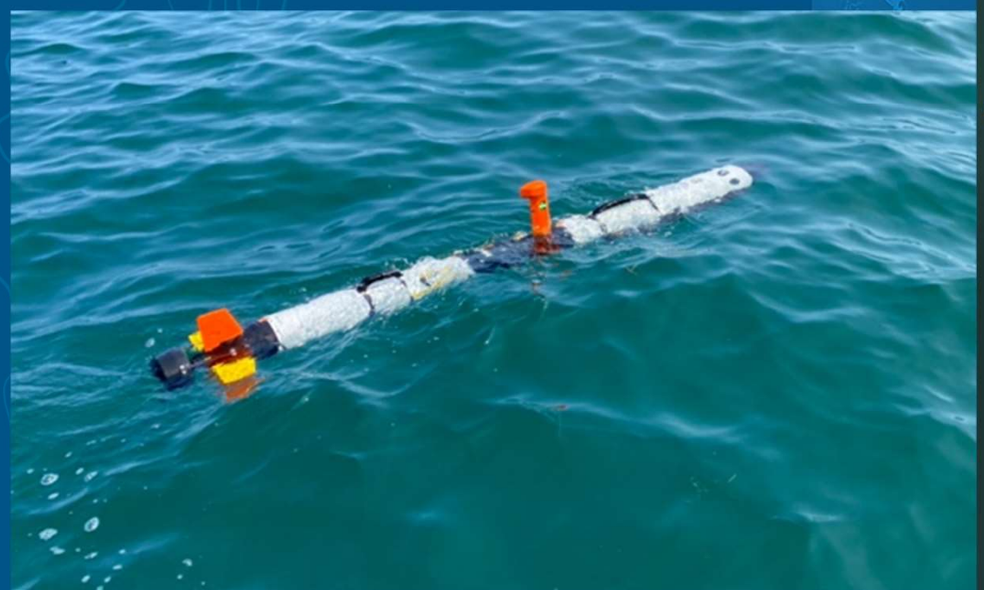
- Collect Current Bathymetry
- Collect Underwater Photography
- Collect Sediment Samples for Sieve Analysis
- Analyze Potential Sites for Beach Nourishment Materials Source
- Analyze Potential Strategies for Directing Sediment to the Shore, and Slowing the Movement of Nourishment Materials
- Analyze Imagery for Habitat at Source and Placement Locations
- Review with EGLE and USACE

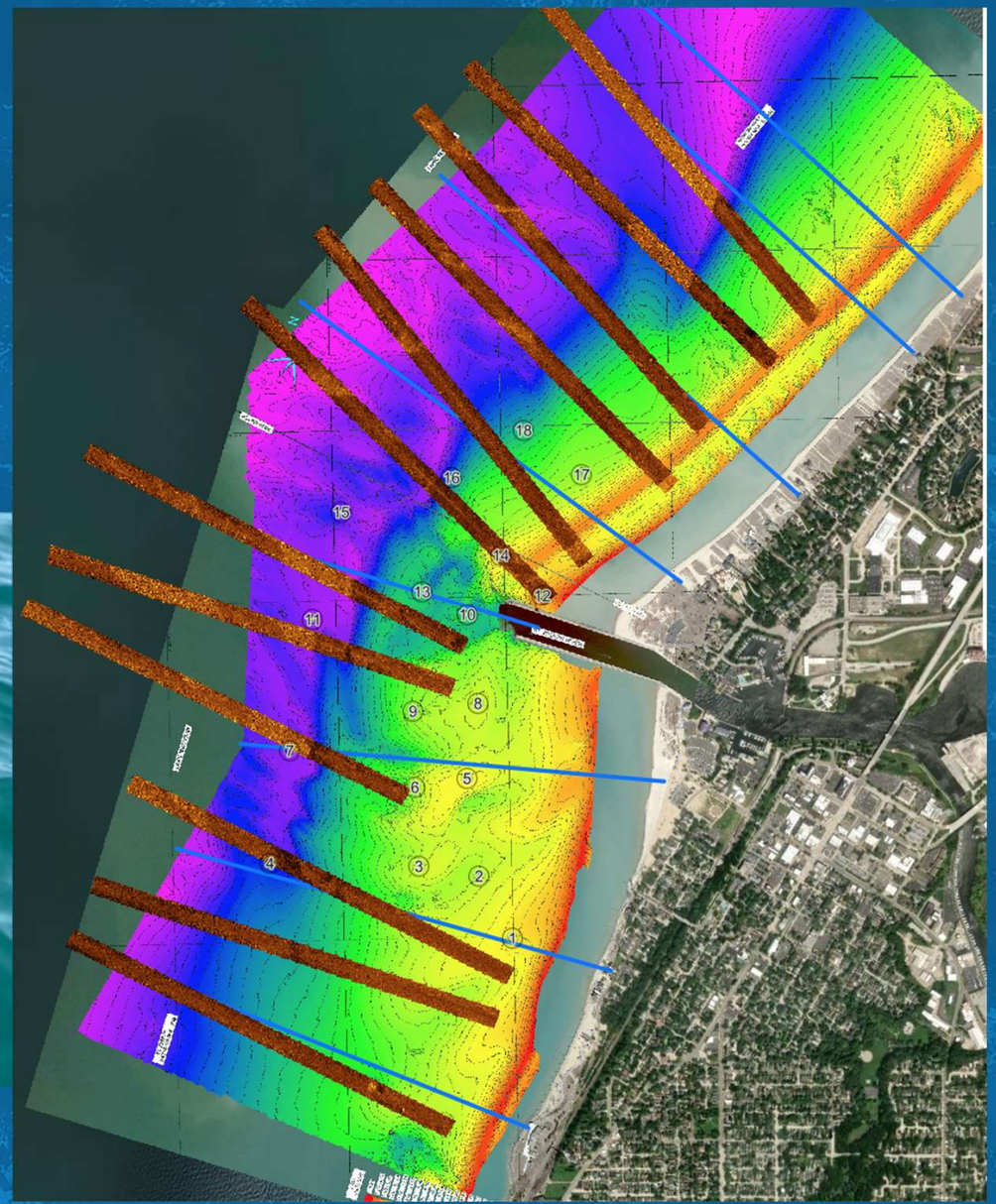
Edgewater resources


ning
Legend
Layers
Layers
Sediment Samples
Underwater Photos
Sidescan Sonar Low Frequency
Sidescan Sonar High Frequency
Backscatter Profiles
Sonar Backscatter
Bathymetry Contours and Colors
Bathymetry Colors Only
Bathymetric Change (2012 - 2020)
USACE 2012 Lake Michigan Topobathy
USACE 2020 Lake Michigan Topobathy
Maxar
Powered by Esri

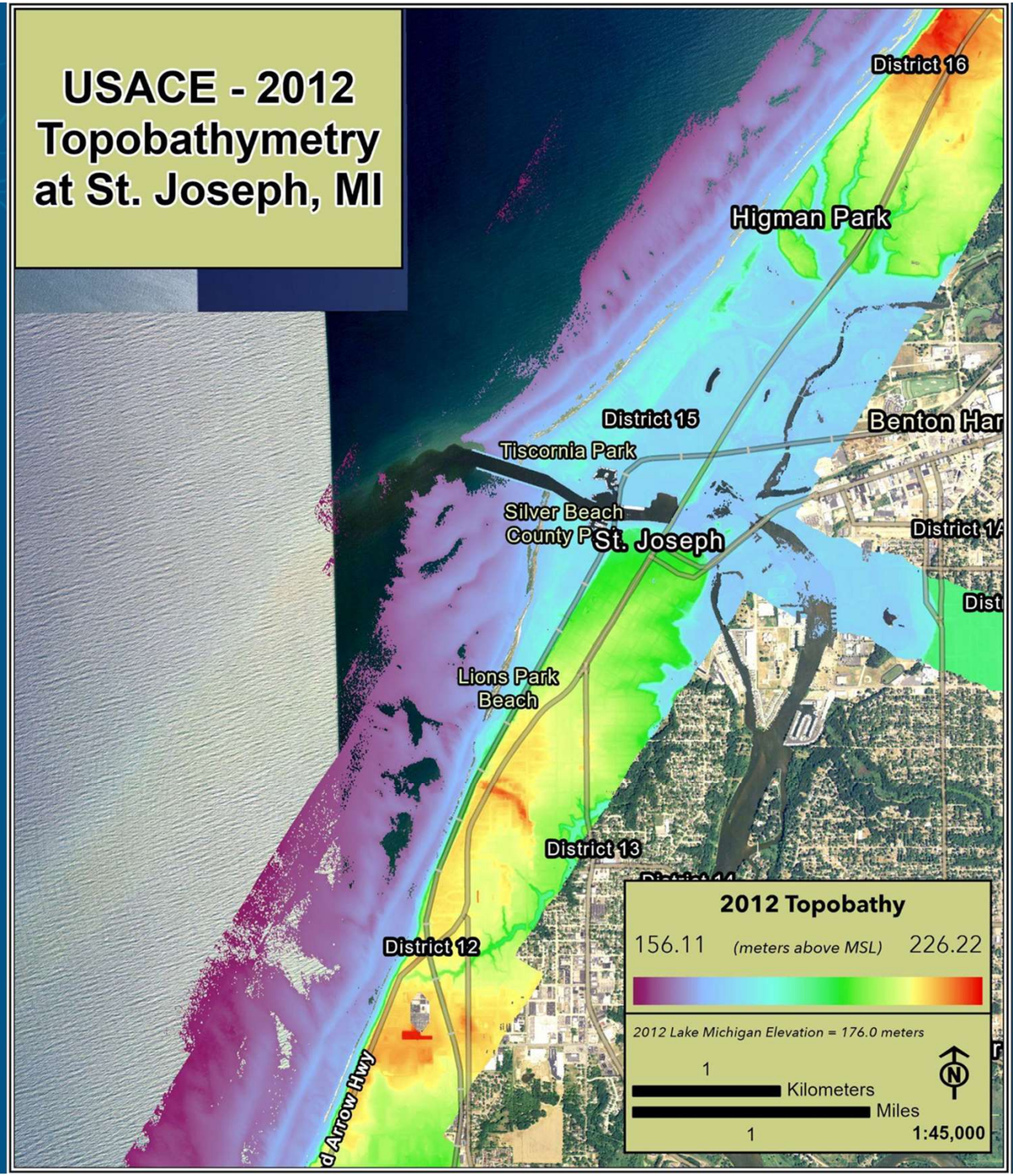
Autonomous Underwater Vehicle (AUV) Surveys

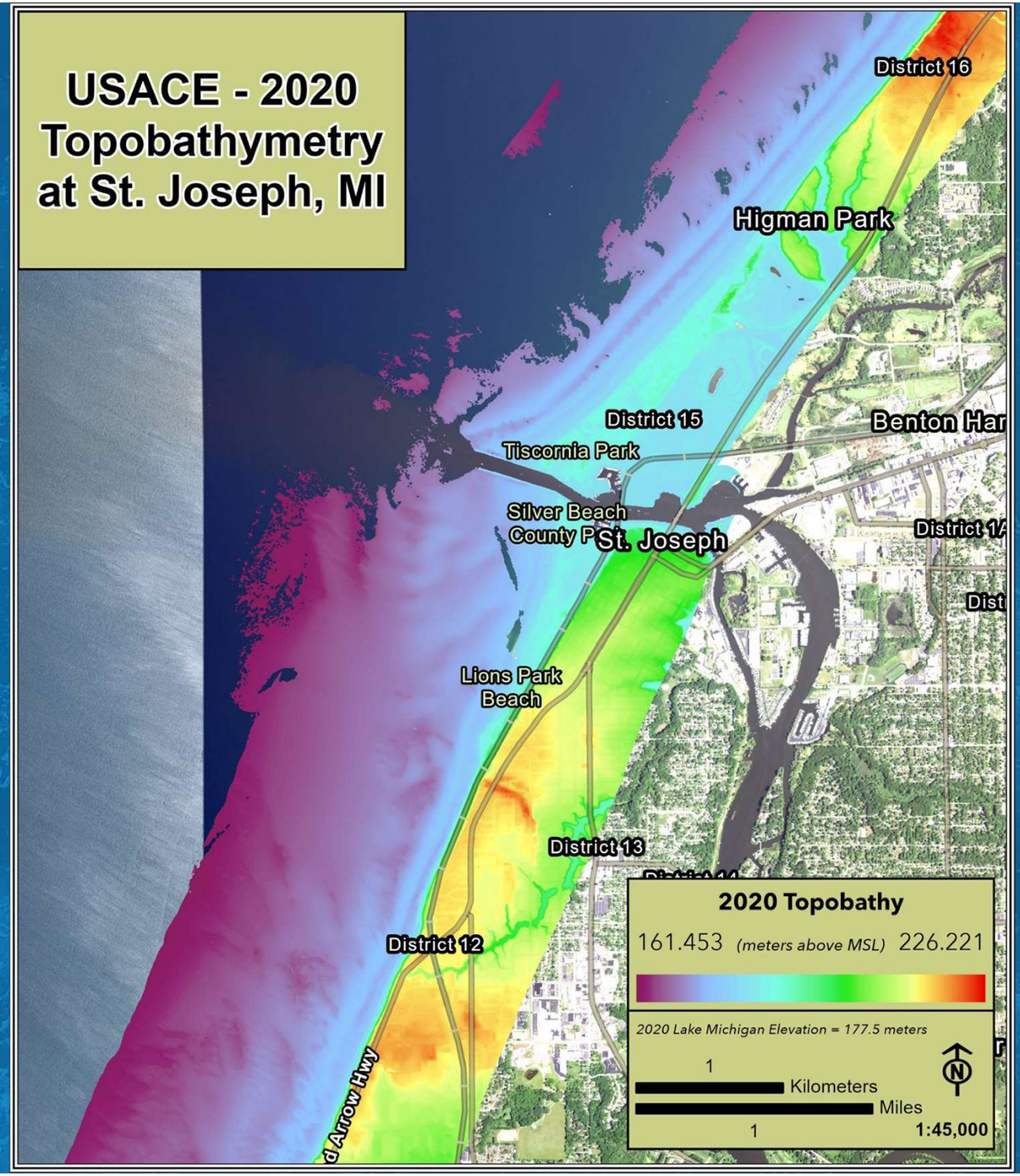
- MTU Provided IVER3 AUV and Operators
- Continuous sidescan sonar images (amber colored bands) captured with IVER along 12 transects





- Coincident Bottom Photography was captured during Side Scan Sonar missions
- Images georeferenced and viewable via an interactive map


USACE - 2012
Topobathymetry
at St. Joseph, MI
District 16
Higman Park
District 15
Benton Har
Tiscornia Park
Silver Beach
County P
St. Joseph
District 1A
Dist
Lions Park
Beach
District 13
District 12
d Arrow Hwy
2012 Topobathy
156.11
(meters above MSL)
226.22
2012 Lake Michigan Elevation = 176.0 meters
1
Kilometers
Miles
1
1:45,000
N


USACE - 2020
Topobathymetry
at St. Joseph, MI
District 16
Higman Park
District 15
Benton Har
Tiscornia Park
Silver Beach
County P
St. Joseph
District 1A
Dist
Lions Park
Beach
District 13
District 12
d Arrow Hwy
2020 Topobathy
161.453
(meters above MSL)
226.221
2020 Lake Michigan Elevation = 177.5 meters
1
Kilometers
Miles
1
1:45,000
N

Topobathy Analysis Results

Minimum δ value = -20.38 m

- Elevation loss due to sediment transport and/or **erosion**

Maximum δ value = 8.55 m

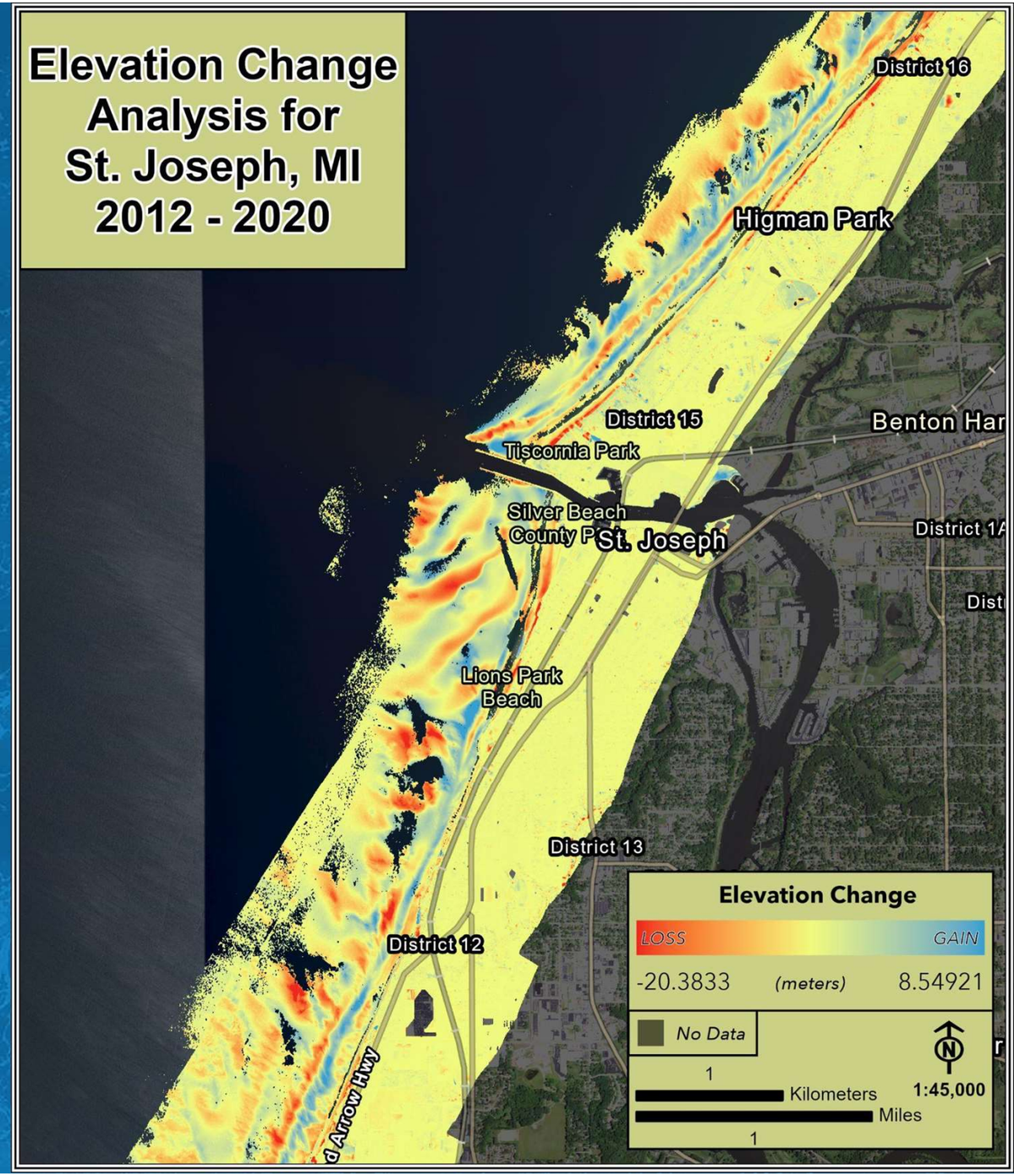
- Elevation gain due to sediment transport and/or **accretion**

Mean δ value = -0.01 m

- Little to no change most places

Std. Deviation = 0.66 m

δ = change in elevation

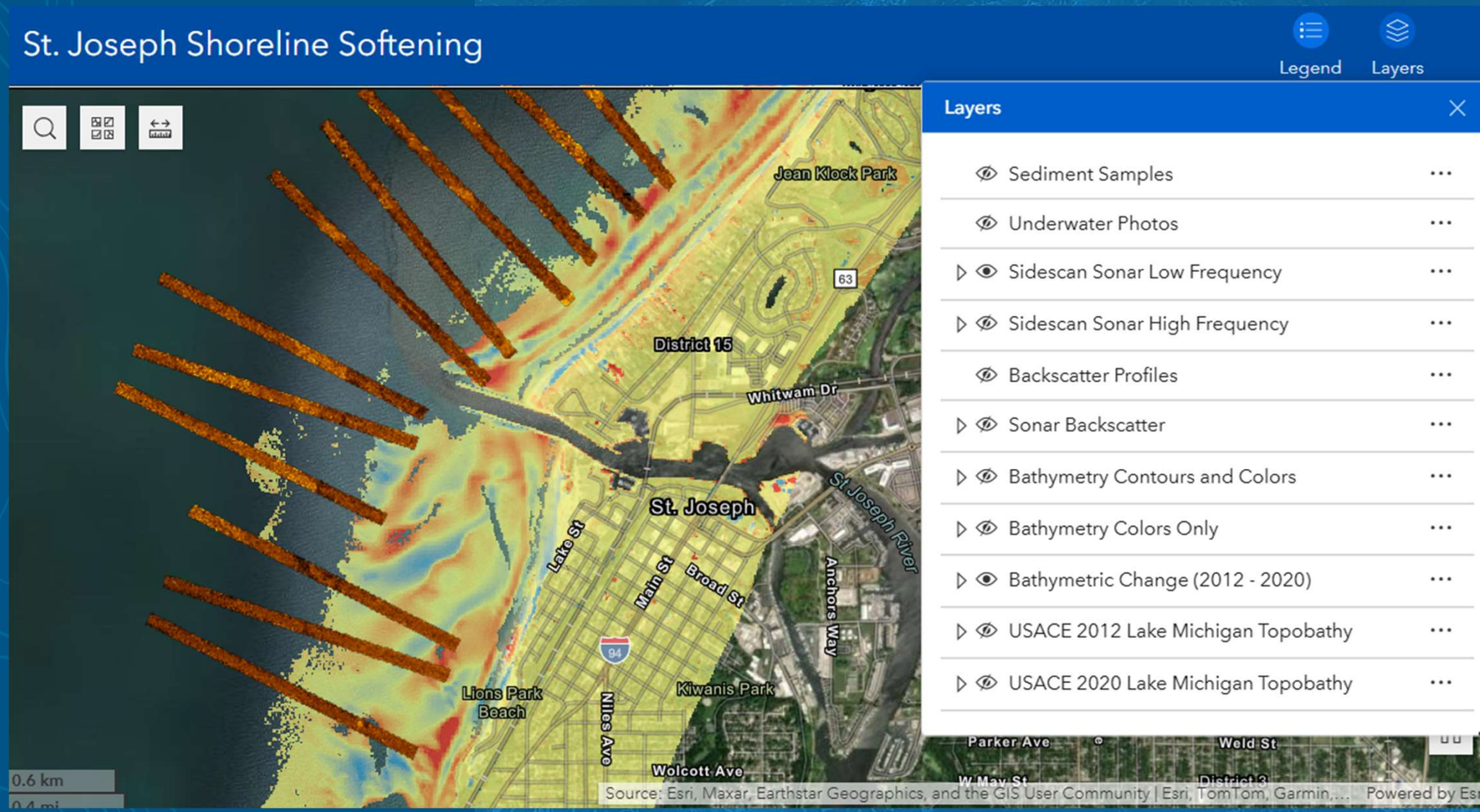


St. Joseph Shoreline Web-viewer

Access Link

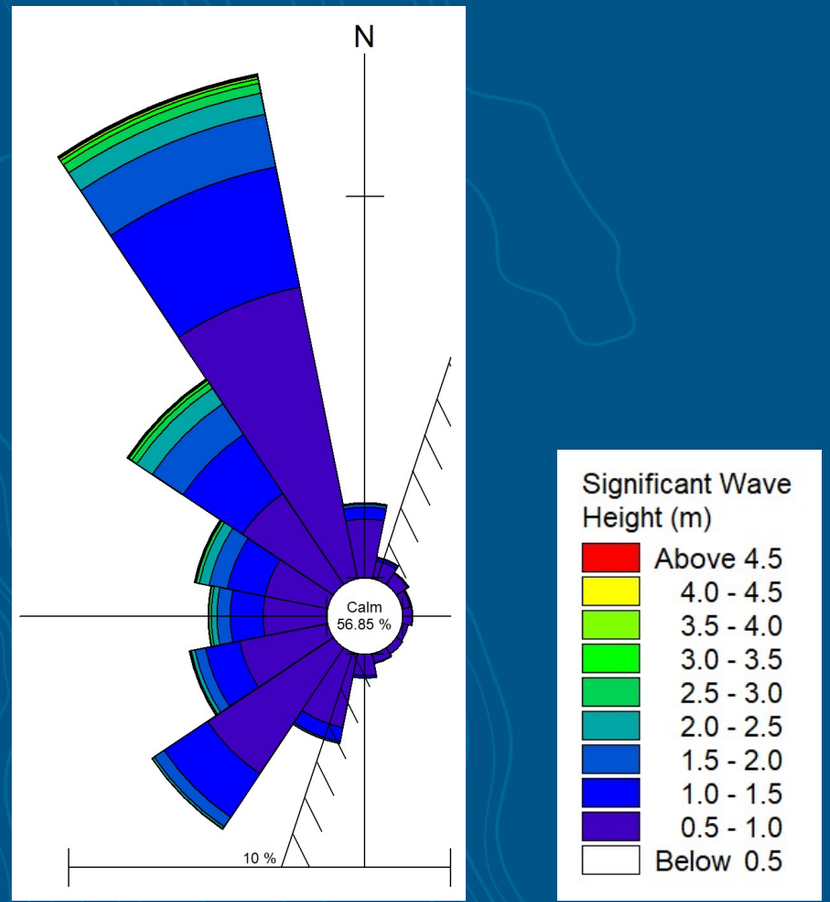
Data Layers:

- Sediment Samples
- Underwater Photos
- Side-scan Sonar
- Backscatter
- Bathymetry
- Bathy Change Analysis
- USACE Topobathy

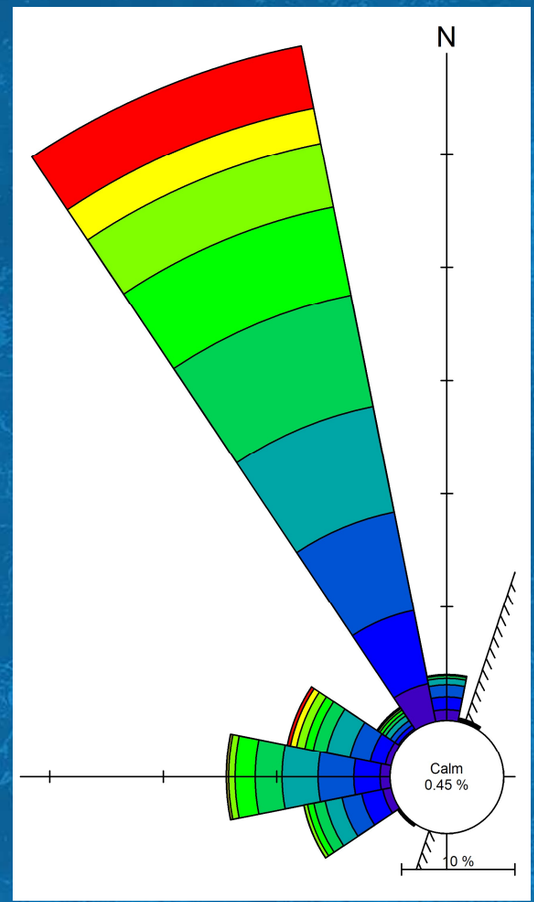


https://portal1-geo.sabu.mtu.edu/mtuarcgis/apps/experiencebuilder/experience/?id=0[illegible]

Representative Climate and Sediment Budget Rose



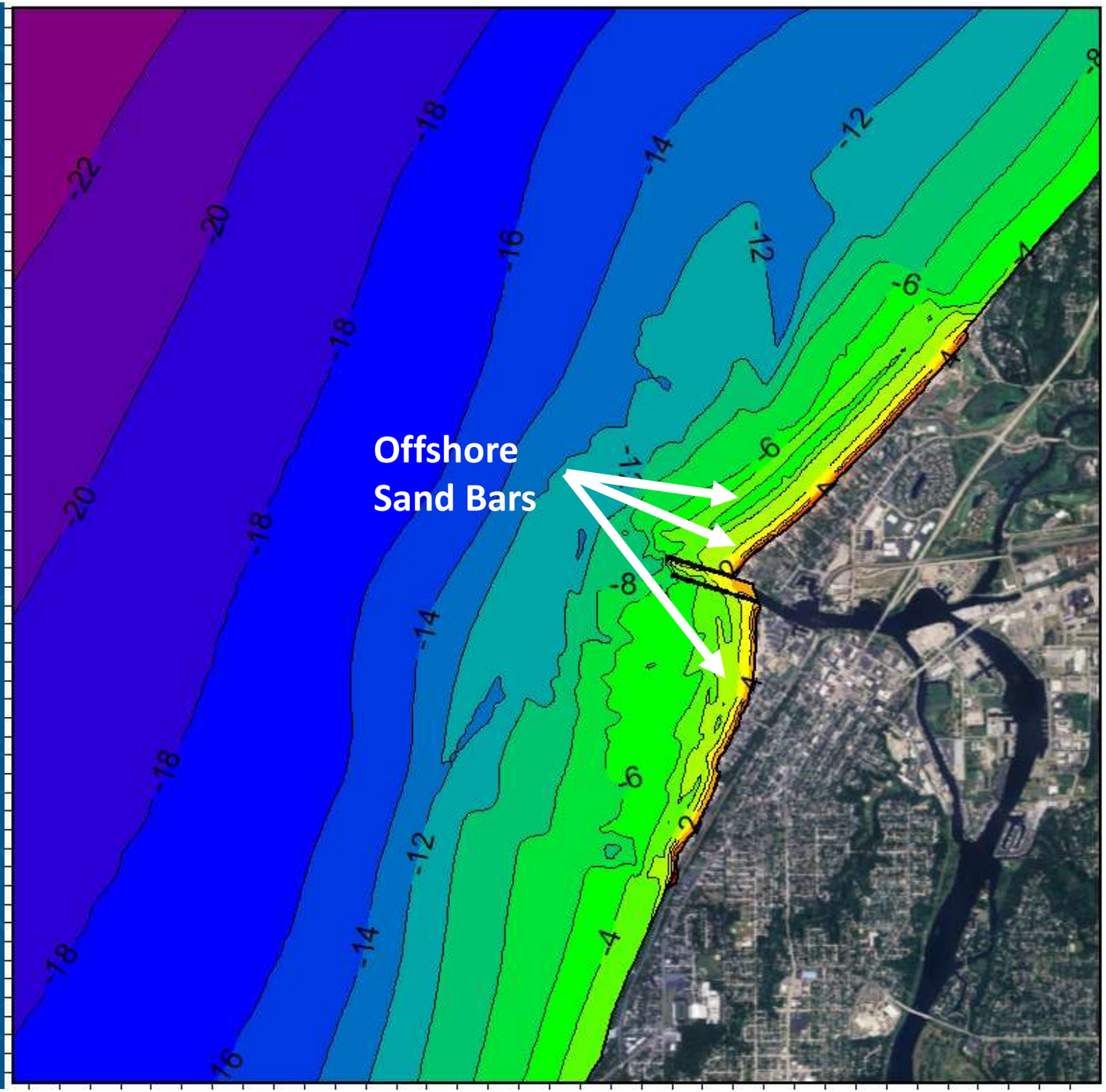
Edgewater Resources analyzed 54 years of wave data to develop a representative annual wave climate, which indicates that the predominant wave direction is from the NNW and NW sectors.



This annual wave data was used to identify the waves most responsible for sediment transport, as illustrated in the sediment budget rose.

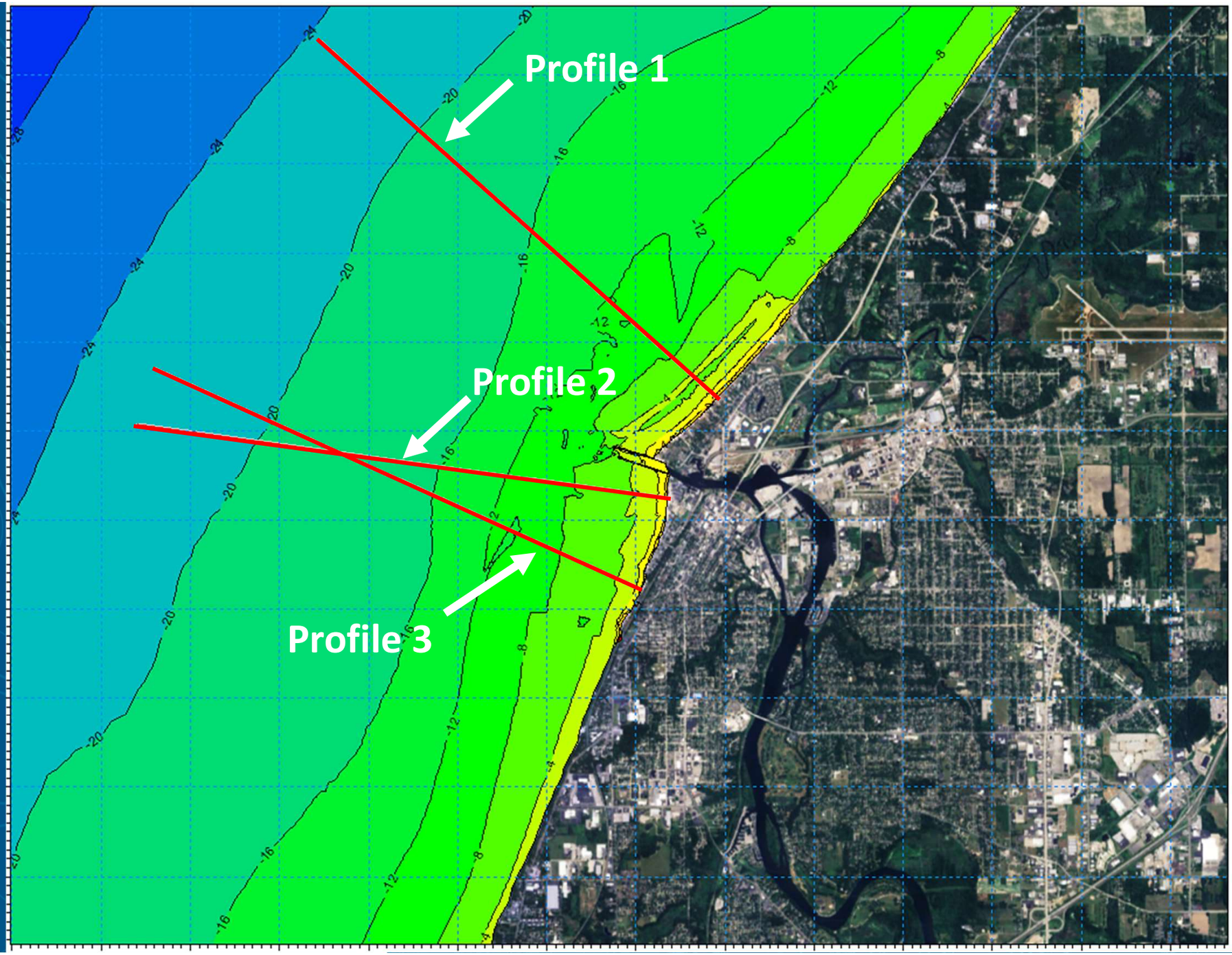
Bathymetry

The local bathymetric data reveals the presence of offshore sandbars located lakeward of the city.



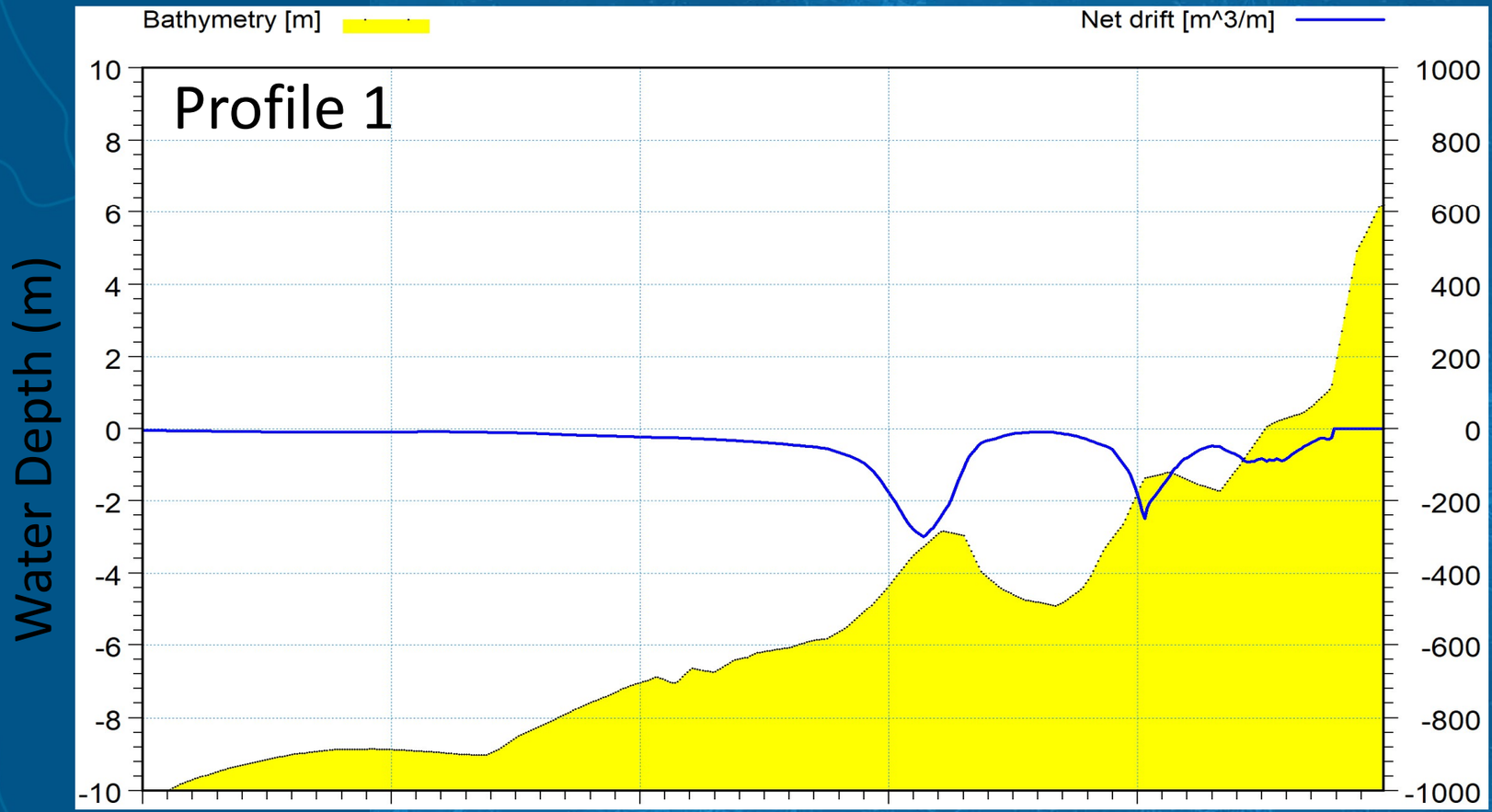
Shoreline Characterization

Three profiles representing the range of shoreline orientations along the city limits were selected to analyze sediment movement across varying depths: one located north of the federal breakwaters and two to the south.



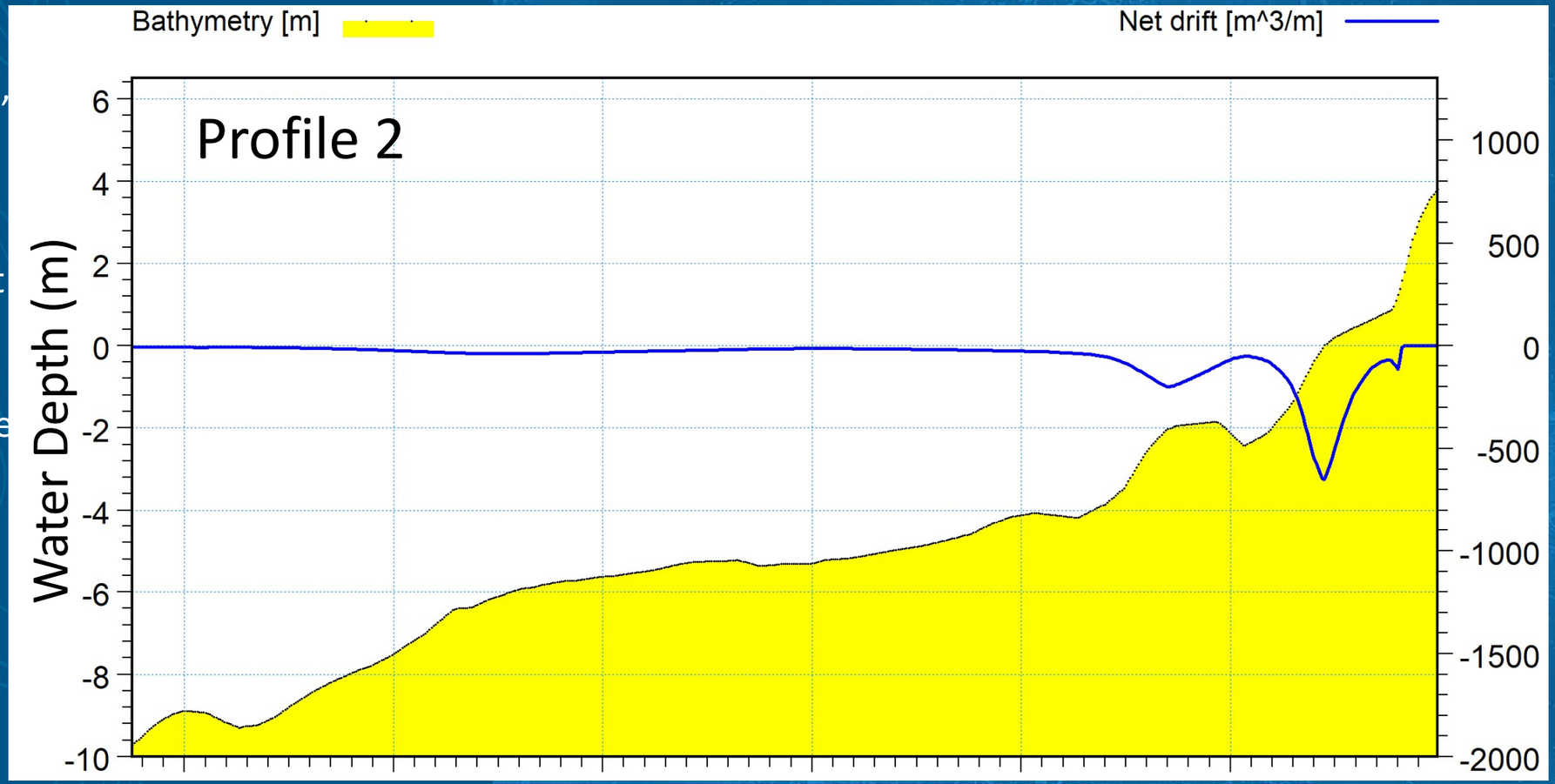
Longshore sediment transport along each profile

Profile 1, located north of the federal breakwaters, reveals that the first sandbar is situated at an approximate depth of -6m. The blue line on the graph represents the volume of net littoral drift per meter across the profile, where negative values indicate sediment transport to the south. This aligns with the predominant wave direction from the NNW. The second sandbar also contributes significantly to the transport volume, while sediment movement at the shoreline is minimal



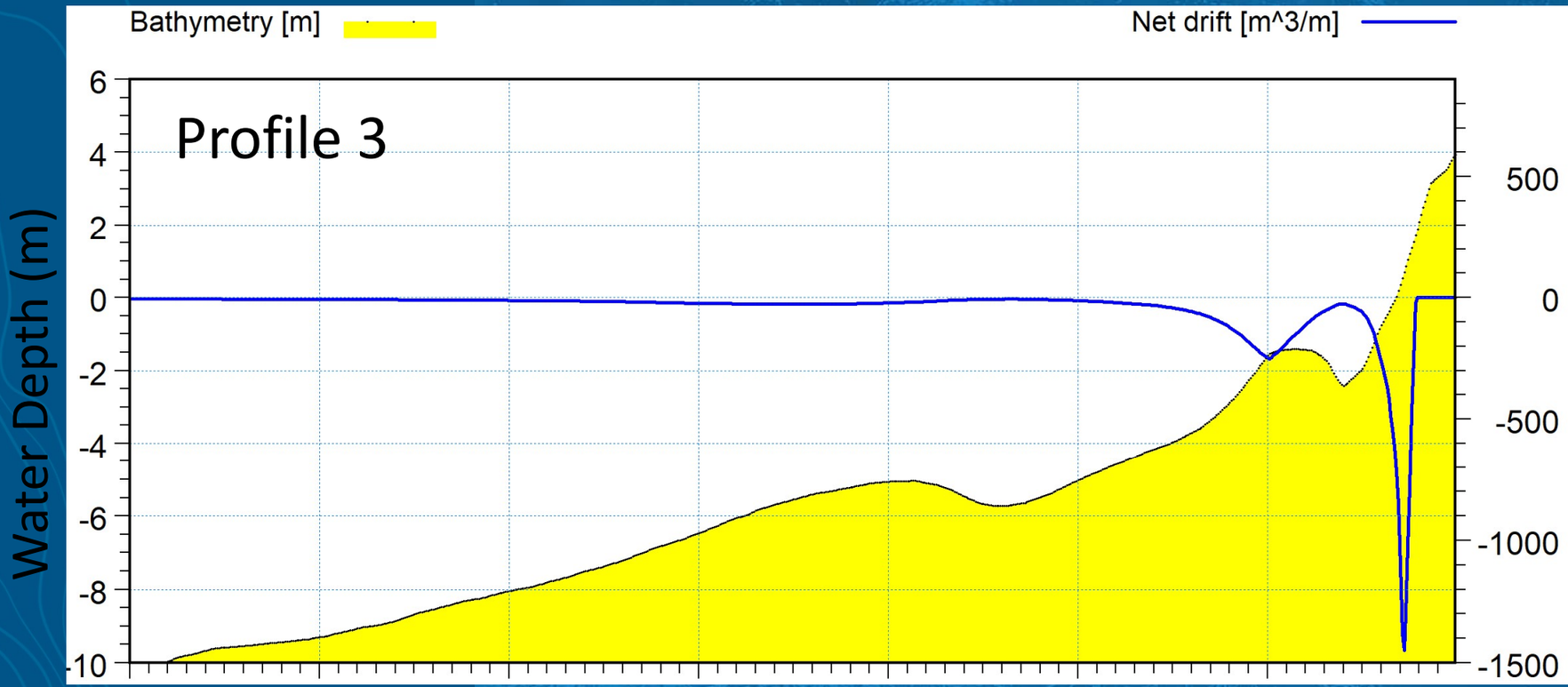
Longshore sediment transport along each profile

Profile 2, located immediately south of the federal breakwaters, indicates a small component of sediment transport at the first sandbar. However, the majority of sediment movement occurs at the shoreline. This highlights the critical importance of ongoing beach nourishment efforts by the USACE, as discontinuing these activities would likely result in significant shoreline erosion in this area.

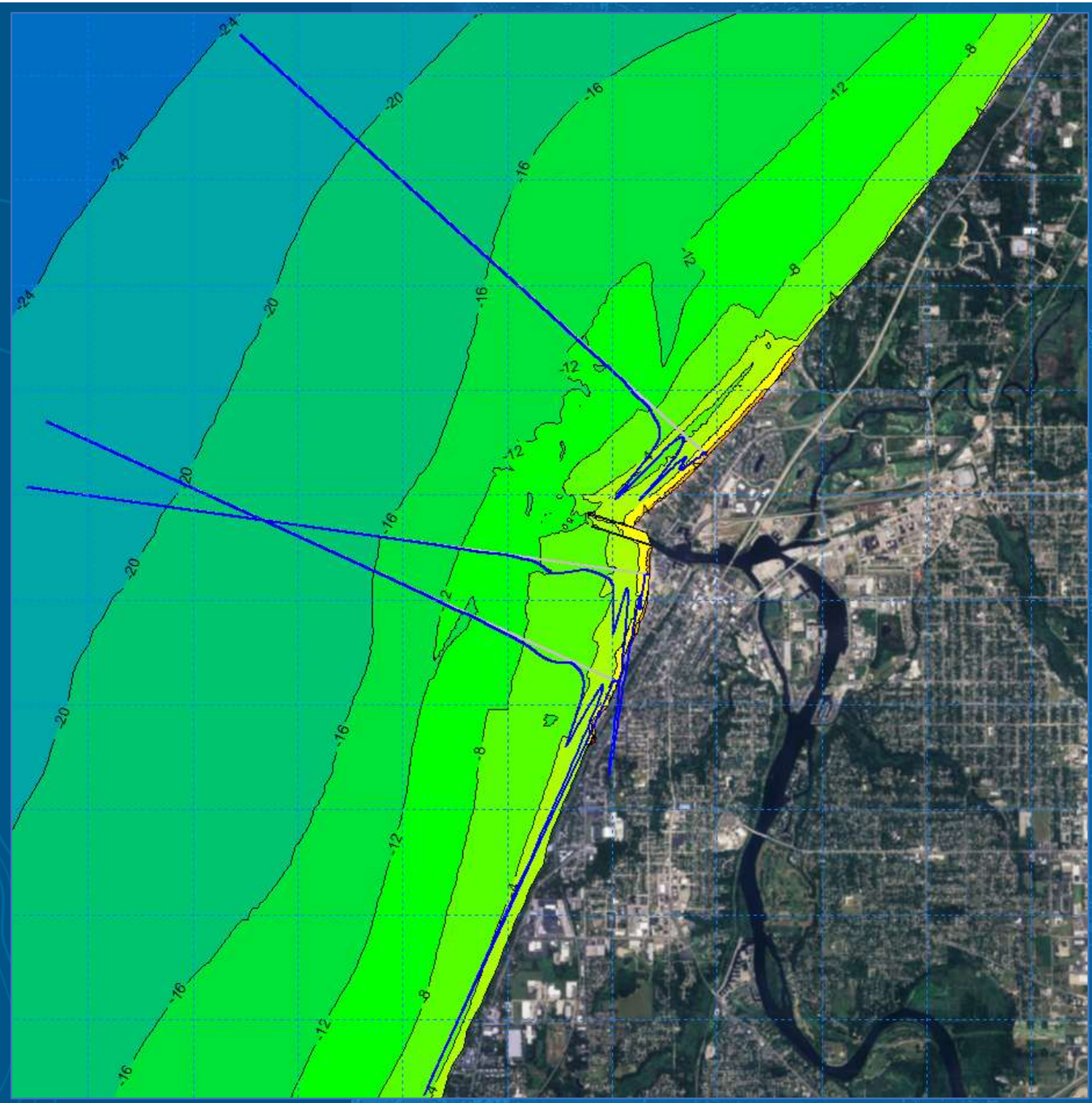


Longshore sediment transport along each profile

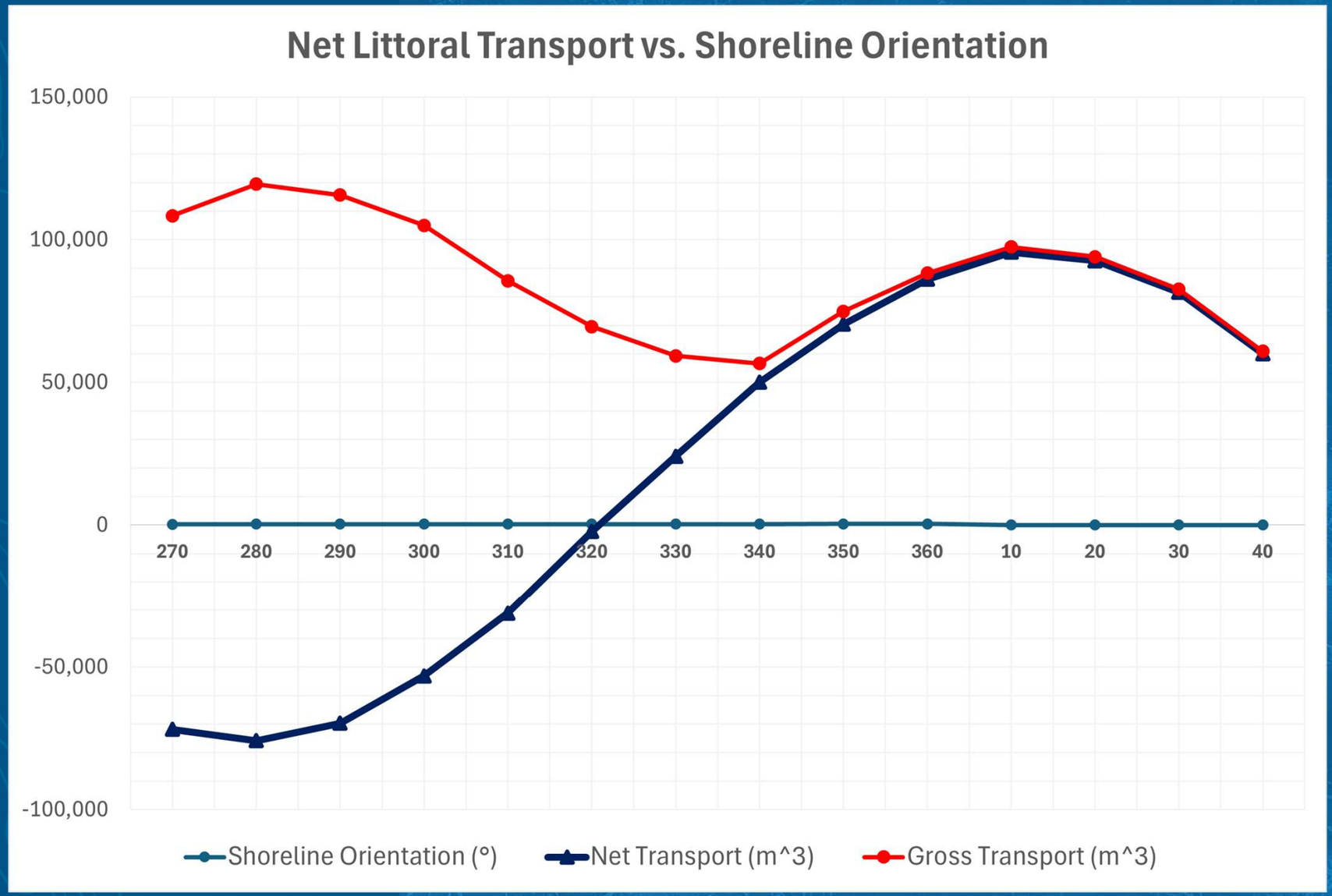
Profile 3, situated between the St. Joseph Water Filtration Plant and Park St., demonstrates that the majority of sediment transport occurs at the shoreline. This aligns with the area's reliance on armoring to mitigate erosion. The graphic also provides valuable insight into the depths at which offshore structures would be most effective in dissipating incoming wave energy before it impacts the shoreline.



This plan view graphic highlights the peaks of littoral drift along each profile. To the north, the peaks align closely with the offshore sandbars, while in the southern area, the majority of sediment transport occurs near the shoreline. This visualization provides a clear understanding of transport dynamics and supports targeted interventions for shoreline management.

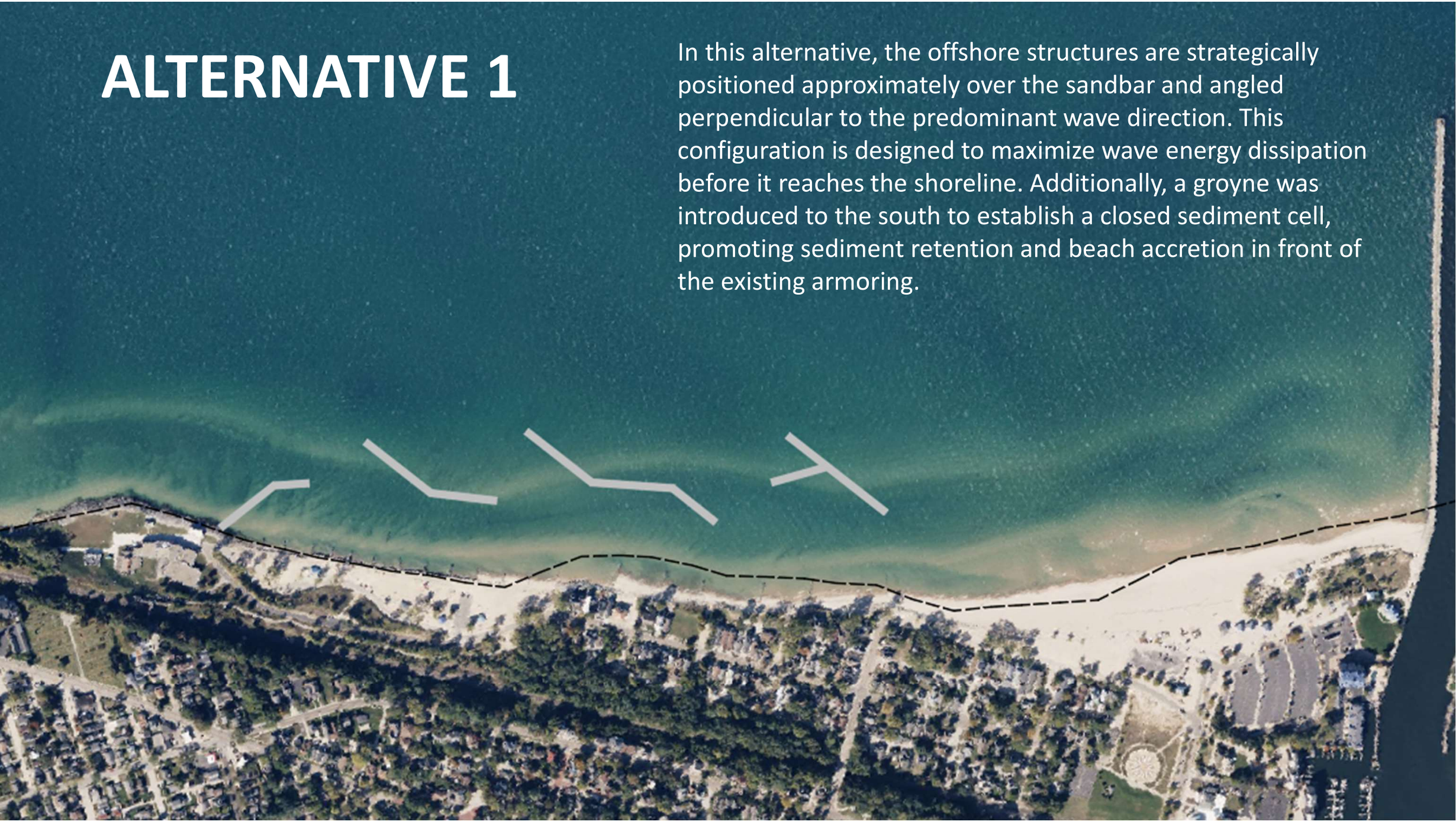


This graph illustrates the relationship between shoreline orientation (°) and littoral transport. The net transport represents the direction and magnitude of sediment movement, ranging from --70,000 to 90,000 m^3 annually. Negative values indicate sediment transport to the south, while positive values reflect transport to the north. These results are critical for understanding sediment budgets and designing effective shoreline management strategies



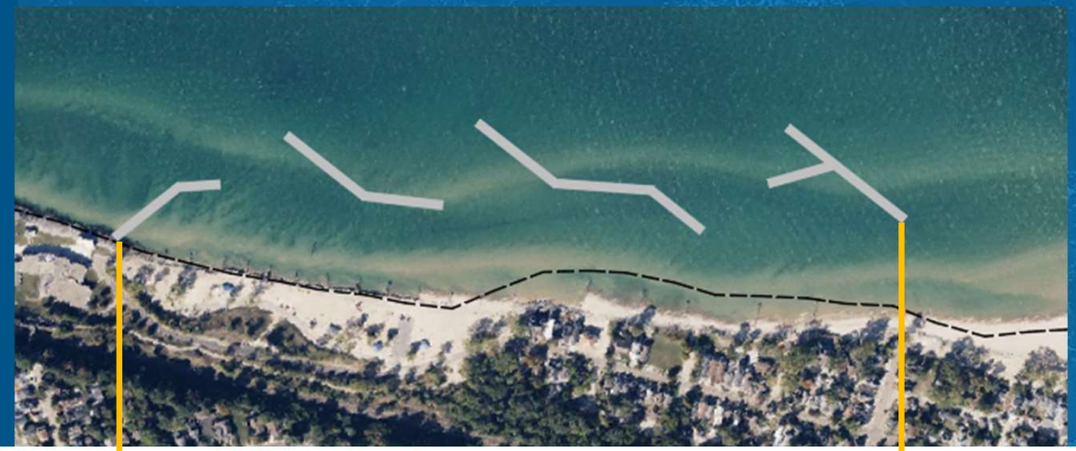
ALTERNATIVE 1

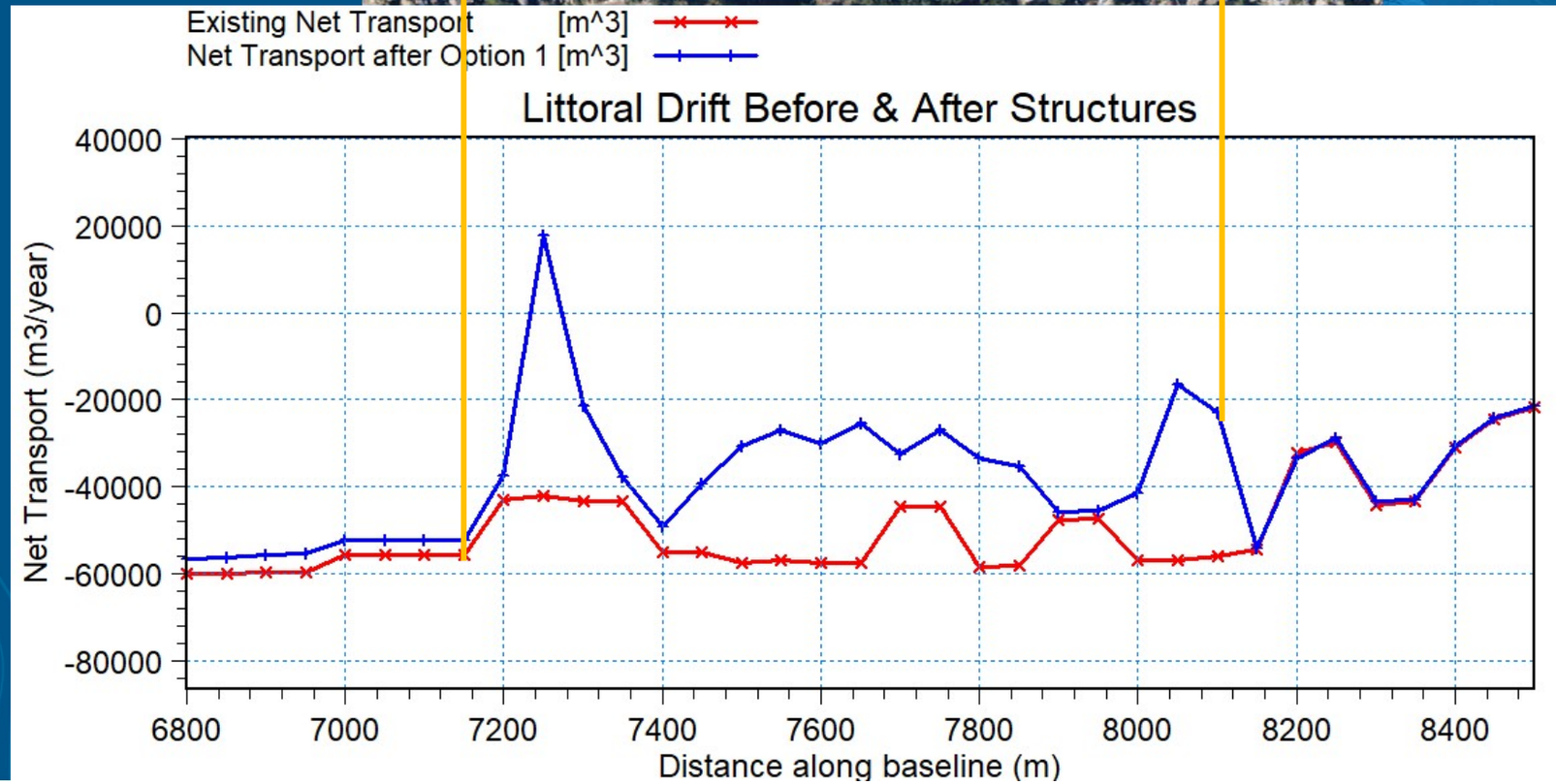
In this alternative, the offshore structures are strategically positioned approximately over the sandbar and angled perpendicular to the predominant wave direction. This configuration is designed to maximize wave energy dissipation before it reaches the shoreline. Additionally, a groyne was introduced to the south to establish a closed sediment cell, promoting sediment retention and beach accretion in front of the existing armoring.



Resulting Littoral Drifts Before and after Option 1

The littoral drift graphic illustrates the impact of each structure on the net sediment transport per year. The red line represents the existing southward drift (negative values), while the blue line shows the modified drift with the structures in place. The results clearly demonstrate a reduction in overall sediment transport volume across the entire area, highlighting the effectiveness of the proposed structures in managing littoral processes



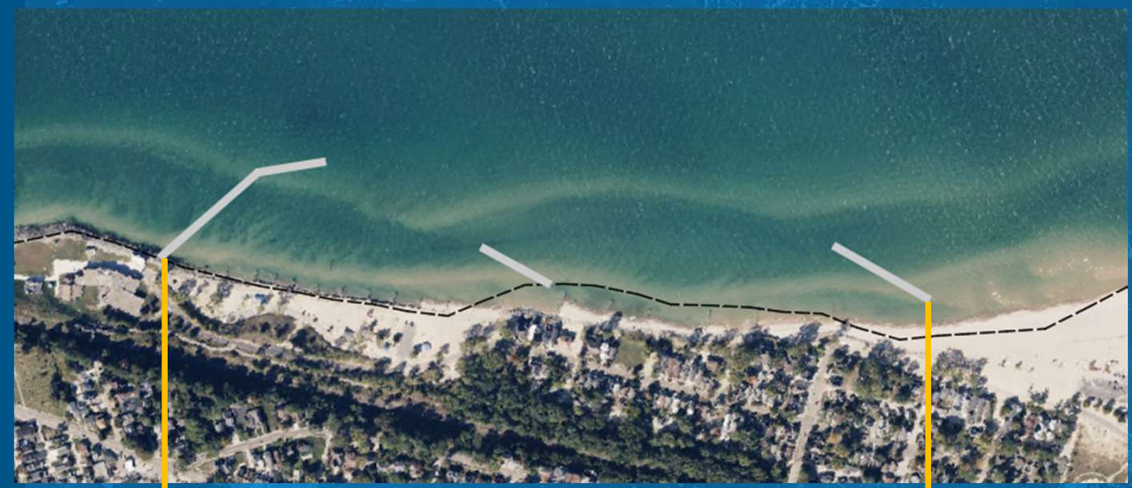


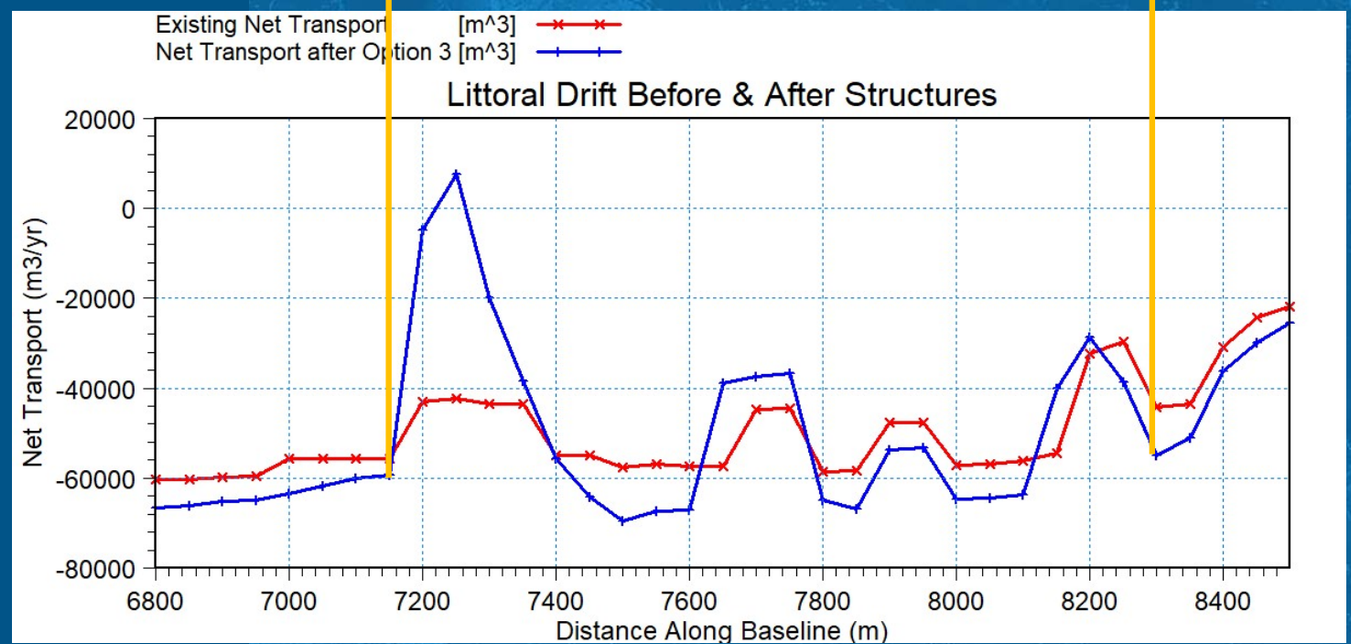
ALTERNATIVE 2

This alternative was designed to minimize the structural footprint while still aiming to reduce sediment transport rates effectively. It includes a larger end groyne to the south and two smaller offshore breakwaters strategically placed to protect the critical areas.

Resulting Littoral Drifts Before and after Option 2

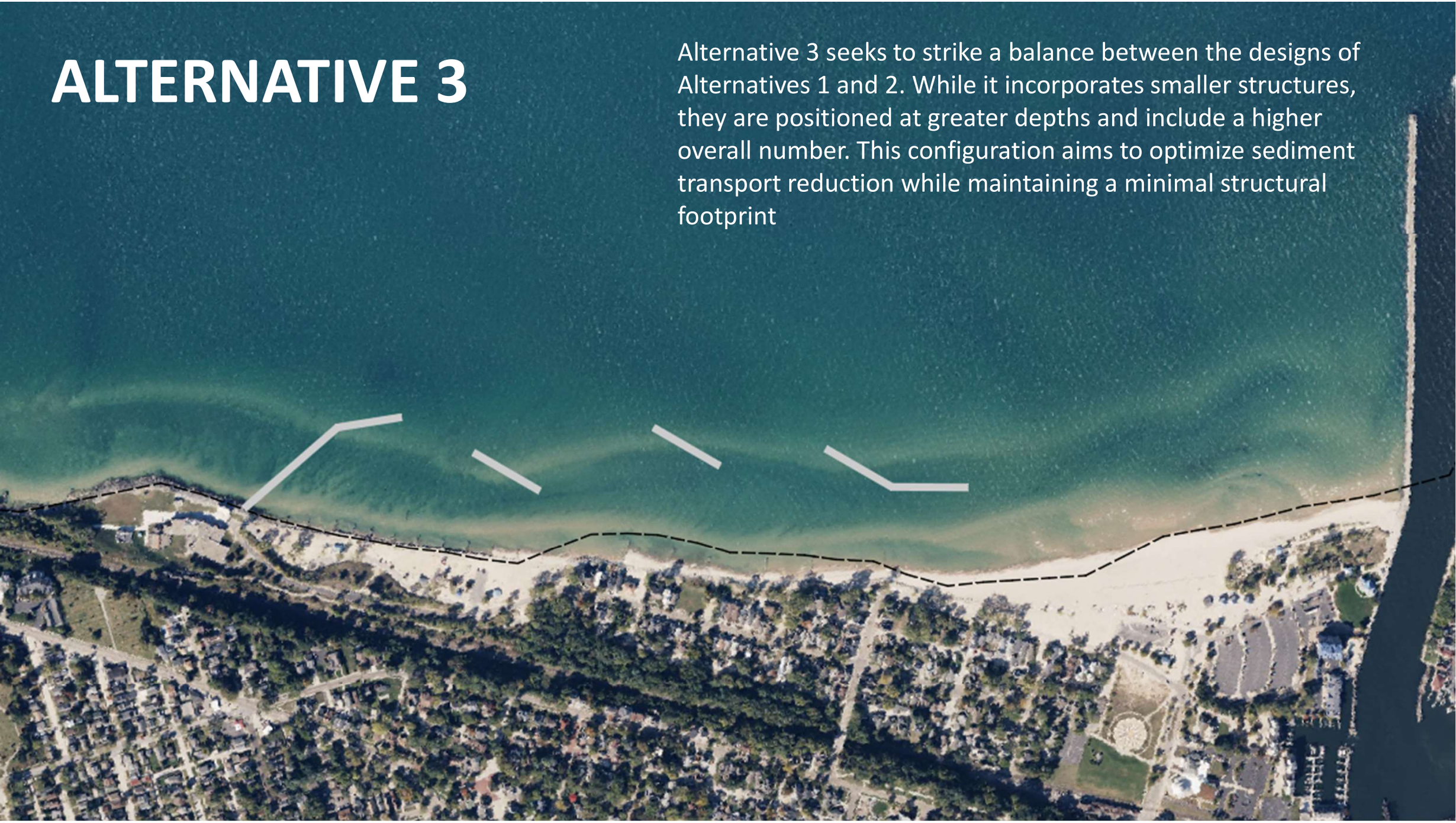
The results indicate that this alternative was not effective in significantly reducing littoral drift along the shoreline. While the larger end groyne demonstrates some success in retaining sediment, the two smaller offshore structures do not contribute to an overall reduction in transport rates, limiting the effectiveness of this configuration.





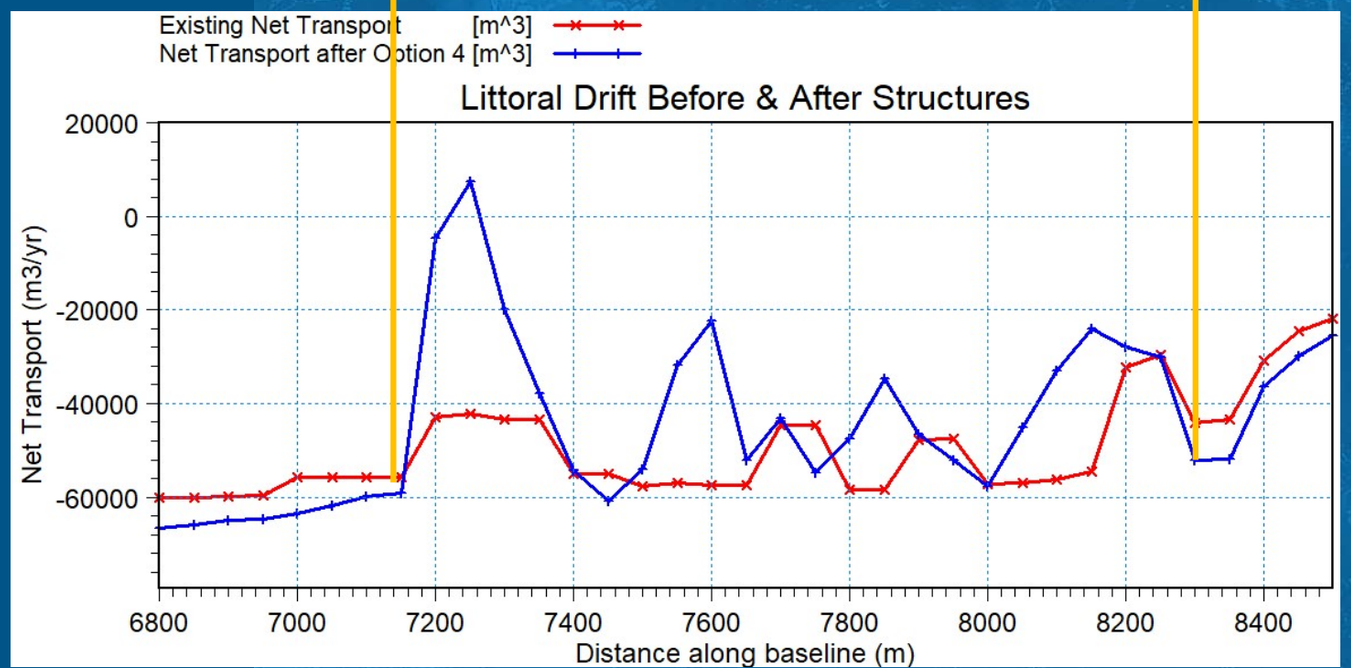
ALTERNATIVE 3

Alternative 3 seeks to strike a balance between the designs of Alternatives 1 and 2. While it incorporates smaller structures, they are positioned at greater depths and include a higher overall number. This configuration aims to optimize sediment transport reduction while maintaining a minimal structural footprint



Resulting Littoral Drifts Before and after Alternative 3

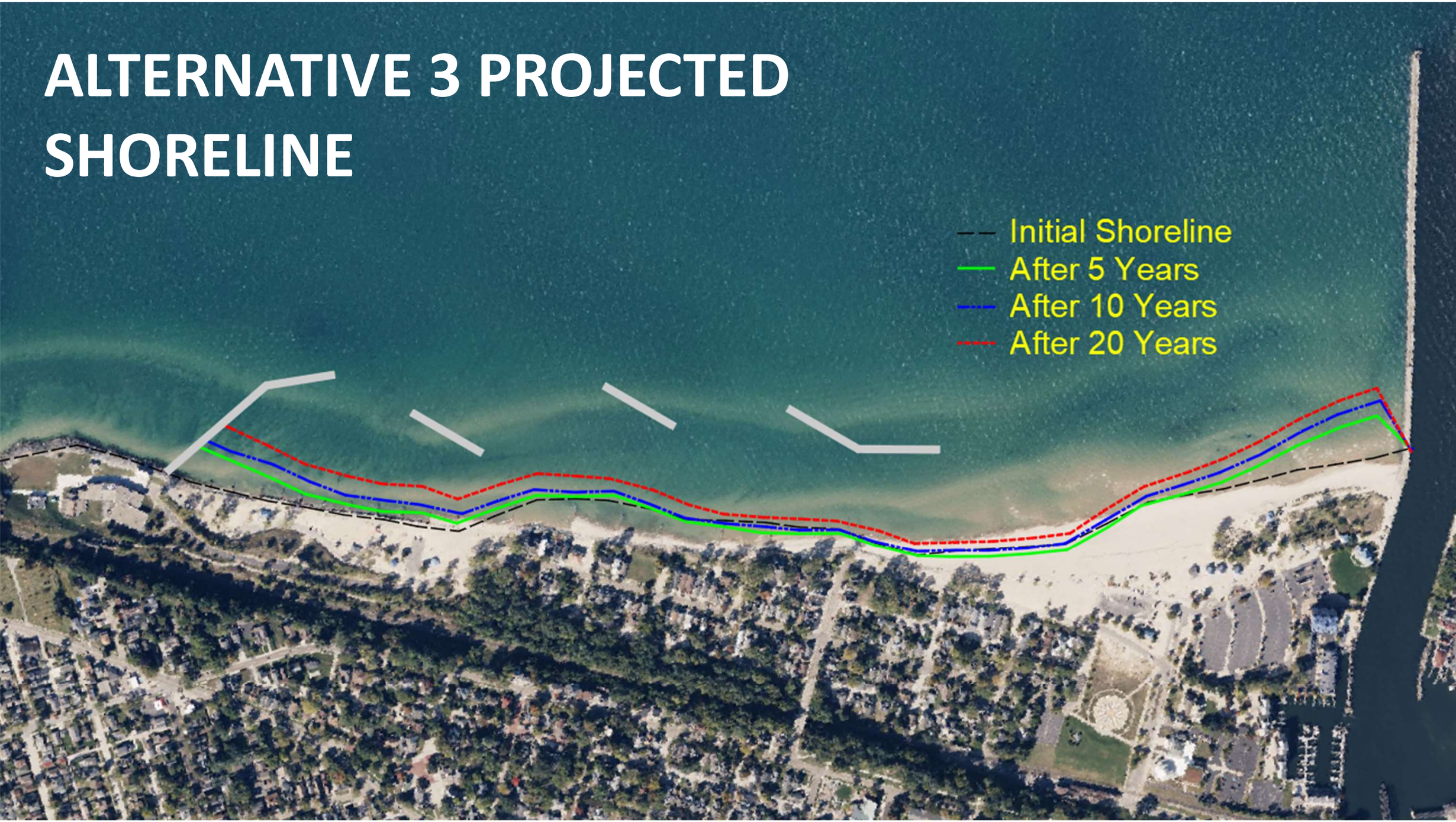
The results confirm that Alternative 3 serves as a middle ground between the previous two options. While it achieves a reduction in overall sediment transport rates, its effectiveness falls short compared to Alternative 1.



ALTERNATIVE 1 PROJECTED SHORELINES

ALTERNATIVE 2 PROJECTED SHORELINE

ALTERNATIVE 3 PROJECTED SHORELINE



Next Steps

- Collect Your Feedback Tonight
- Finalize Report
- Explore Strategies to Fund Preliminary Engineering
- Explore Strategies to Fund Project

Thank You

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