

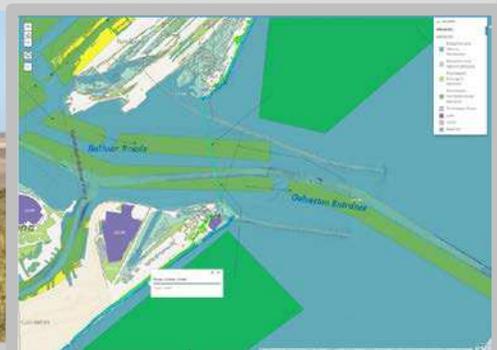
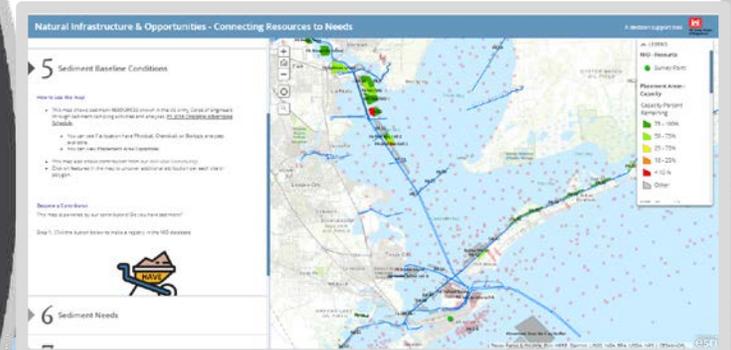


U.S. ARMY

Natural Infrastructure Initiative: Identifying Collaborative Opportunities for Natural Infrastructure and Nature Based Features

Safra Altman, Linda Lillycrop, Rose Dopsovic

US Army Engineer Research and Development Center
USACE Mobile District



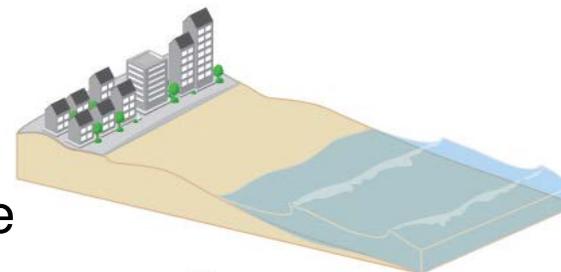
US Army Corps
of Engineers



Importance of Natural Infrastructure

- Natural and hybrid approaches provide important coastal risk reduction.
- Now is the time to incorporate natural and hybrid approaches into coastal planning.
- These approaches are key to increasing coastal resilience to climate change.

Minimal
Defense



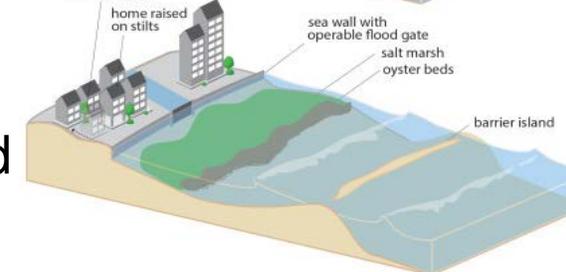
Natural
Defense



Managed
Realignment



Hybrid



Sutton-Grier et al 2015

Evaluation of Natural Infrastructure

- Environmental Defense Fund, 2015
- Summary of risk reduction performance and engineering guidance, costs, and factors relevant to climate change.
 - Risk Reduction Performance
 - Design/O&M Criteria
 - Costs
 - Other Factors

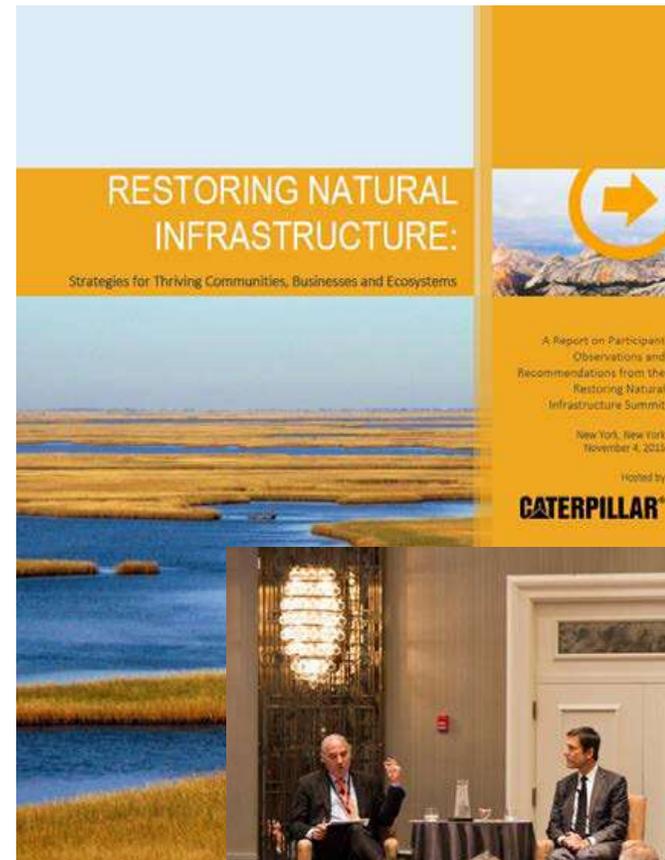
Table 1: Natural Infrastructure and Nature-based Measures: Summary of risk reduction performance and engineering guidance, costs, and factors relevant to climate change.

		Risk Reduction Performance ¹					Design/O&M Criteria (for performance areas specific to feature)	Costs ² per linear foot		Other Factors		
		Reduce coastal erosion/ Shoreline Stabilization	Nuisance floods (high tides with sea level rise)	Short wave (<2') attenuation (Stabilize Sediment)	Reduce force & height of med. waves (2-3')	Storm Surge (low frequency extreme events)		Construction	Annual O&M ⁴	Mitigates climate change (CO ₂ sequestration)	Adeptability to sea level rise & changing community needs	
Structural	Groins	+ ⁴	-	+			+	\$2-5k	\$1-.5k	No		
	Breackwaters	+ ⁴	-	+	+		+	\$5-10k	>\$5k	No	Variable	
	Seawall/ Revetments/ Bulkheads	+ ⁴	+		+	+	+	\$5-10k \$5-10k \$2-5k	>\$5k \$1-.5k \$1-.5k	No		
	Surge Barriers	-			+	+	+	>\$10k ⁵		No		
	Wetlands	+		+	~	~	N/A	N/A		Yes	Yes	
Existing Natural	Mangroves/ coastal forest	+		+	+	+	N/A	N/A		Yes	Yes	
	Vegetated Dunes	+		+	+	+	N/A	N/A		~	Yes	
	Beach Nourishment	+	+	+	+		+	\$2k-5k ⁶	\$1k-.5k		Yes	
Strategy	Vegetated Dune creation	+	+	+	+	+	+	\$0.03k-.5k ⁶	\$1k-.5k	~	Yes	
	Barrier Island Restoration	+	+	+	+	+	+	\$0.76k- \$1.1k ⁷			Yes	
	Small scale edging and silts (living shorelines)	+	~	+				\$1k-2k	<\$1k	Variable	Yes	
	Restored Oyster/Shell-fish Reefs	+		+	~	~	Possible, akin to low breackwaters	\$23k-.24k ⁸		Yes	Yes	
	Restored/ Created Coral Reefs	+		+	~	~	Possible, akin to low breackwaters	\$2k-50k ⁸		~		
	Restored Maritime Forests (including Mangroves)	+	+	+	+	+		\$23k- 216k ⁹ /ha (mangroves)			Yes	Yes
	Restored Wetlands ¹⁰	+	+	+	~		-	\$0.81k- 36.4k/ha ¹⁰			Yes	Yes

Cunniff and Schwartz 2015

Collaboration with the Private Sector

- Caterpillar Inc.
 - ▶ Restoring Natural Infrastructure Summit; November 4th 2015; New York City
 - ▶ Natural Infrastructure Initiative – USACE Collaboration Work Streams
 1. NI Opportunity Evaluation Tool.
Capitalizing on enterprise-level capability:
CE Dredge Decision Support Tool
 1. Evaluation and Decision Making
 2. Field Application and Demonstration
- Western Dredging Association (WEDA)
 - ▶ Collaborative technical workshop on engineering and construction techniques for Engineering With Nature



<http://www.caterpillar.com/en/company/sustainability/natural-infrastructure.html>

Natural Infrastructure Initiative



Natural Infrastructure Initiative is an informal grouping of companies and organizations working to promote the use of natural infrastructure

High level objectives:

- Accelerate investment in water based natural infrastructure projects as part of a solution set for infrastructure needs
- Embed natural infrastructure as part of ongoing discussions about improving investment in water-based infrastructure. Promote the use of natural infrastructure in general

Vision:

The widespread acceptance of, and increased investment, in natural infrastructure projects as a means to advance the economic vitality, environmental health and security of our nation.

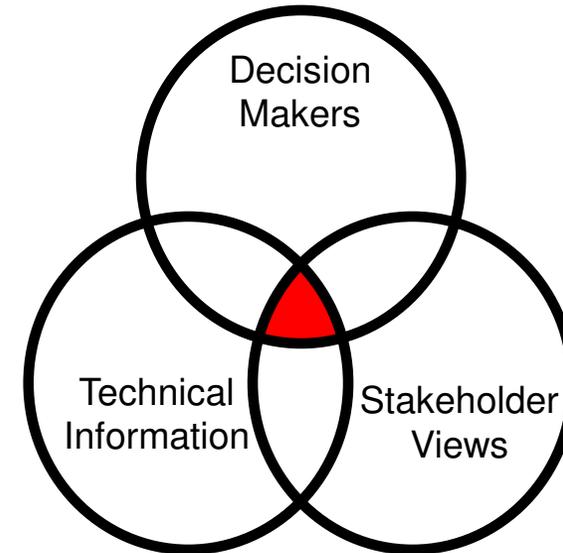
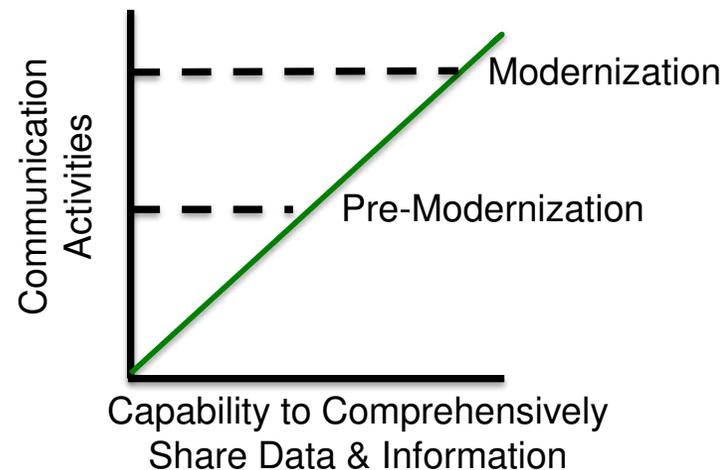
Natural *AND* Built Infrastructure, not *OR*



US Army Corps of Engineers • Engineer Research and Development Center

Increase integration of information through a connected data network

- Consistent access to authoritative data
- Simplified & expedited dredging analyses
- Multi-objective systems optimization
- Dynamic visualization
- Enhances communications
 - Within USACE
 - With non federal sponsors and partners
 - With environmental agencies



**Improved Communication,
Shared Visioning, and
Alignment of Mutual Objectives**

Tool Development: Natural Infrastructure Opportunities Tool

- The public facing *NIO* web-viewer, developed in collaboration with the Natural Infrastructure Initiative, focuses on identifying beneficial use opportunities.
- Prototype version of viewer developed to address a number of questions identified by NII group including:

Where are the sediment sources?

Where are the current placement areas?

Where are the restoration, shore protection, and nearshore placement projects?

What volume of material was (or is planned to be) placed?

Where are potential placement sites?

What capacity is available?

What are the upcoming dredging/navigation needs?

What are the opportunities for new beneficial use?

Are there opportunities to link multiple projects?



What is the NIO Tool?

This portal will help discover the movement and content of dredged material through placement area capacities, dredging plans, and sediment characteristic descriptions and help to identify beneficial use and infrastructure opportunities.

Natural Infrastructure & Opportunities - Connecting Resources to Needs

1 About NIO

Welcome to the Natural Infrastructure & Opportunities (NIO) Tool where we connect your natural resources and needs!

Sponsored by the National Infrastructure Opportunities for Utilizing Dredge Material Initiative Group program, this portal will help discover the movement and content of sediment dredged material through placement area capacities, dredging plans, and sediment characteristic descriptions and help to identify beneficial use and infrastructure opportunities.

How the NIO Tool Works

Each tab numbered tab across the top holds a category of data. In any map, zoom to your area of interest. As you browse throughout the tabs, different data layers will appear, allowing you to gather important about the sediment at your site.

Become a Contributor

This map is powered by our contributors! Do you have or need sediment?

Step 1: Click the respective button below to make a registry in the Natural Infrastructure Opportunities database. Once a registry is made, it is visible on the Sediment Baseline Conditions, Sediment Needs, and Sediment Connections tabs.

- I HAVE Sediment
- I NEED Sediment

Step 2: Browse the tabs at the top to find a connection. Each tab contains additional data layers to

2 Local Conditions

3 Explore Subsidence

NIO - Resource

Please fill out the form below to register your resource in the Natural Infrastructure and Opportunity (NIO) database.

Location of Resource*

Where is the resource located?

Eri: FAO, NOAA
Lat: 1,40611 Lon: 0

Submission Date*

9/14/18

Resource Status*

Is this a planned, under contract, or

NIO - Need

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Submission Date*

9/14/18

Location of Need*

Where is the need located?

Eri: FAO, NOAA
Lat: 1,40611 Lon: 0

Area of Interest Buffer*

Enter, in feet, the appropriate width of the area of interest.

How the NIO Tool Works

- The NIO tool brings together datasets from multiple sources all in one place
- Data is organized in a map. The map will change based on what links are clicked – either the category number or any hyperlinks in the category description
- There are 10 tabs. Each tab holds a subset of data organized for that category. Interested in seeing all data together? Tab 10 provides access to all data layers in the NIO tool.

- ▶ 1 About NIO
- ▶ 2 Local Conditions
- ▶ 3 Explore Subsidence
- ▶ 4 Shoreline Rate Change
- ▶ 5 Sediment Baseline Conditions
- ▶ 6 Sediment Needs
- ▶ 7 Sediment Connections
- ▶ 8 Environmental Considerations
- ▶ 9 Environmental Impact
- ▶ 10 All Data

Open, Online Application

1 - 3 of 3

Sort by: Relevance ▾



Natural Infrastructure and Opportunities - Connecting Resources to Needs

Web Mapping Application by usace.com, d2

The story map supports
designed to help identify

Created: Nov 8, 2017 Up

Natural Infrastructure & Opportunities - Connecting Resources to Needs

No issues detected ✕

Edit ✕

A decision support tool



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Supported by Arc Story Maps

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Local Conditions

Natural Infrastructure & Opportunities - Connecting Resources to Needs

A decision support tool



1 About NIO

2 Local Conditions

How to use this map:

- The National Wetlands Inventory (deeper water habitats in the United States) by Cowardin et al. (1979)

3 Explore Subsidence

4 Shoreline Rate Change

5 Sediment Baseline

6 Sediment Needs

7 Sediment Connectivity

8 Environmental Corridors

9 Environmental Impact

10 All Data

Data Layers:

Wetlands

Shoaling Rate

Volume change – with different storms

Shoreline change – with different storms

Elevation change

Geomorphic features

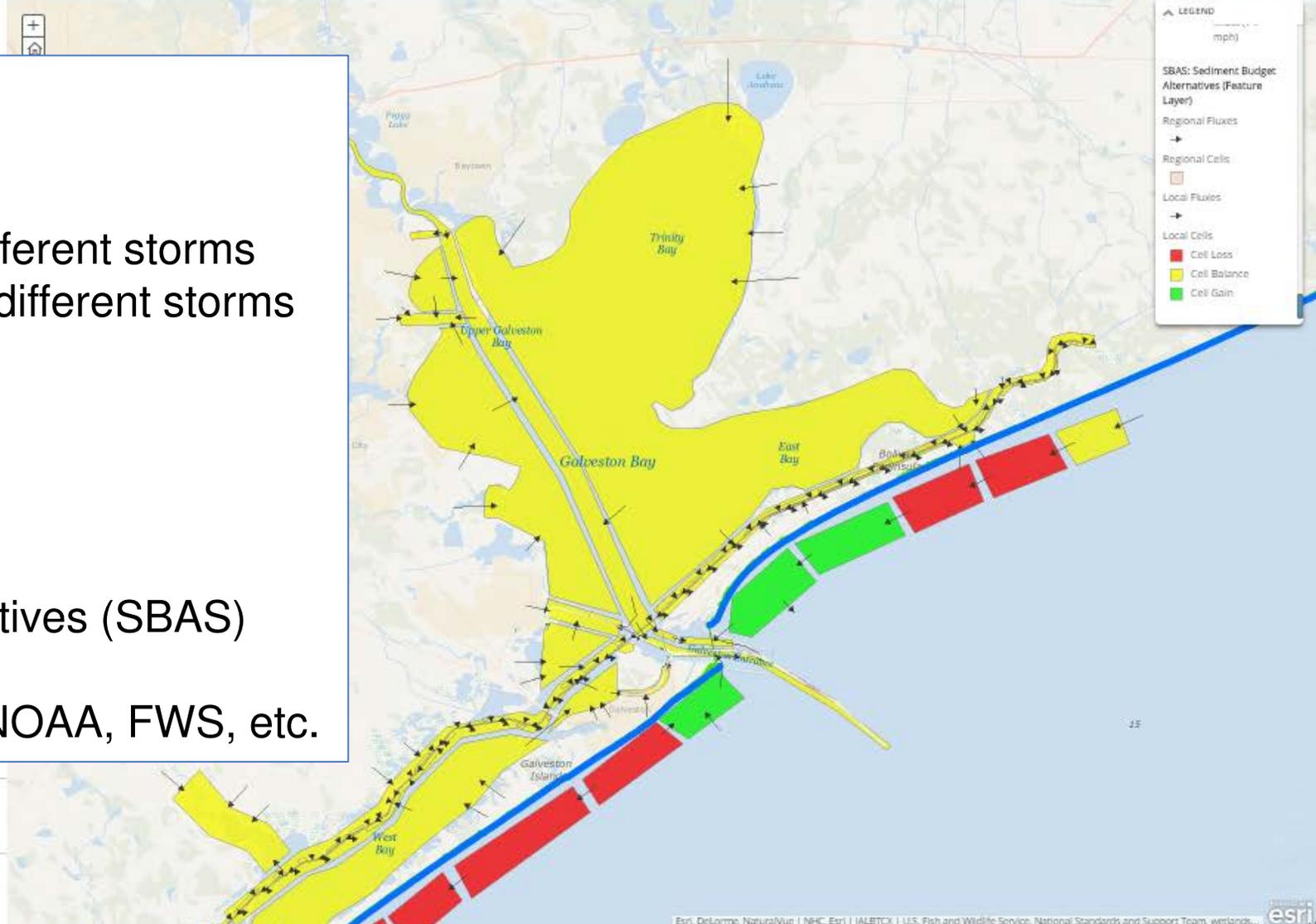
Dune Features

Recent hurricanes

Cyclones

Sediment Budget Alternatives (SBAS)

Data Sources: USACE, NOAA, FWS, etc.



Subsidence

Natural Infrastructure & Opportunities - Connecting Resources to Needs

A decision support tool



1 About NIO

2 Local Conditions

3 Explore Subsidence

Explore Groundwater-Level and Compaction Data in the Chicot, Evangeline and Jasper Aquifers

- The map to your right shows the 2018 water levels for the Chicot, Jasper, and Evangeline Aquifers. Use the layer button to toggle different years.
- [Open USGS's Subsidence Viewer](#)

USGS measures over groundwater levels in over 700 wells in an depiction of groundwater levels. The cumulative compaction in this county area.

Water-level altitude contours, wells, and compaction data have altitudes from 1977 through the present, water-level changes over

Data Layers:
USGS Subsidence Viewer

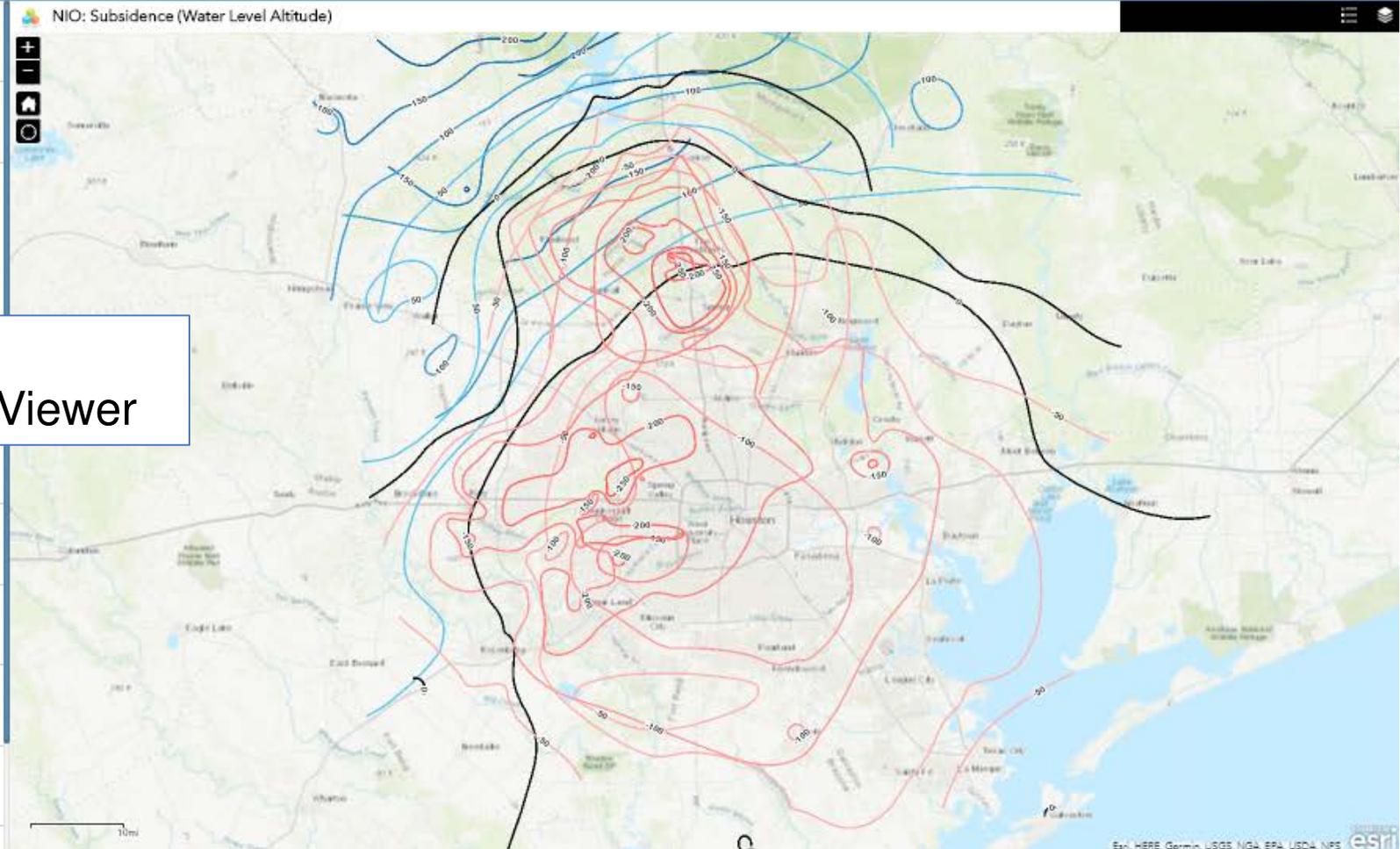
4 Shoreline Rate Change

5 Sediment Baseline Conditions

6 Sediment Needs

7 Sediment Connections

8 Environmental Considerations



Shoreline Change

Natural Infrastructure & Opportunities - Connecting Resources to Needs

A decision support tool



▶ 1 About NIO

▶ 2 Local Conditions

▶ 3 Explore Subsidence

▶ 4 Shoreline Rates

How to use this map:

- [Click to show Corps Shoaling](#)
- [Click to show change rate](#)
- [Click to show change rate](#)
- [Click to show change rate](#)

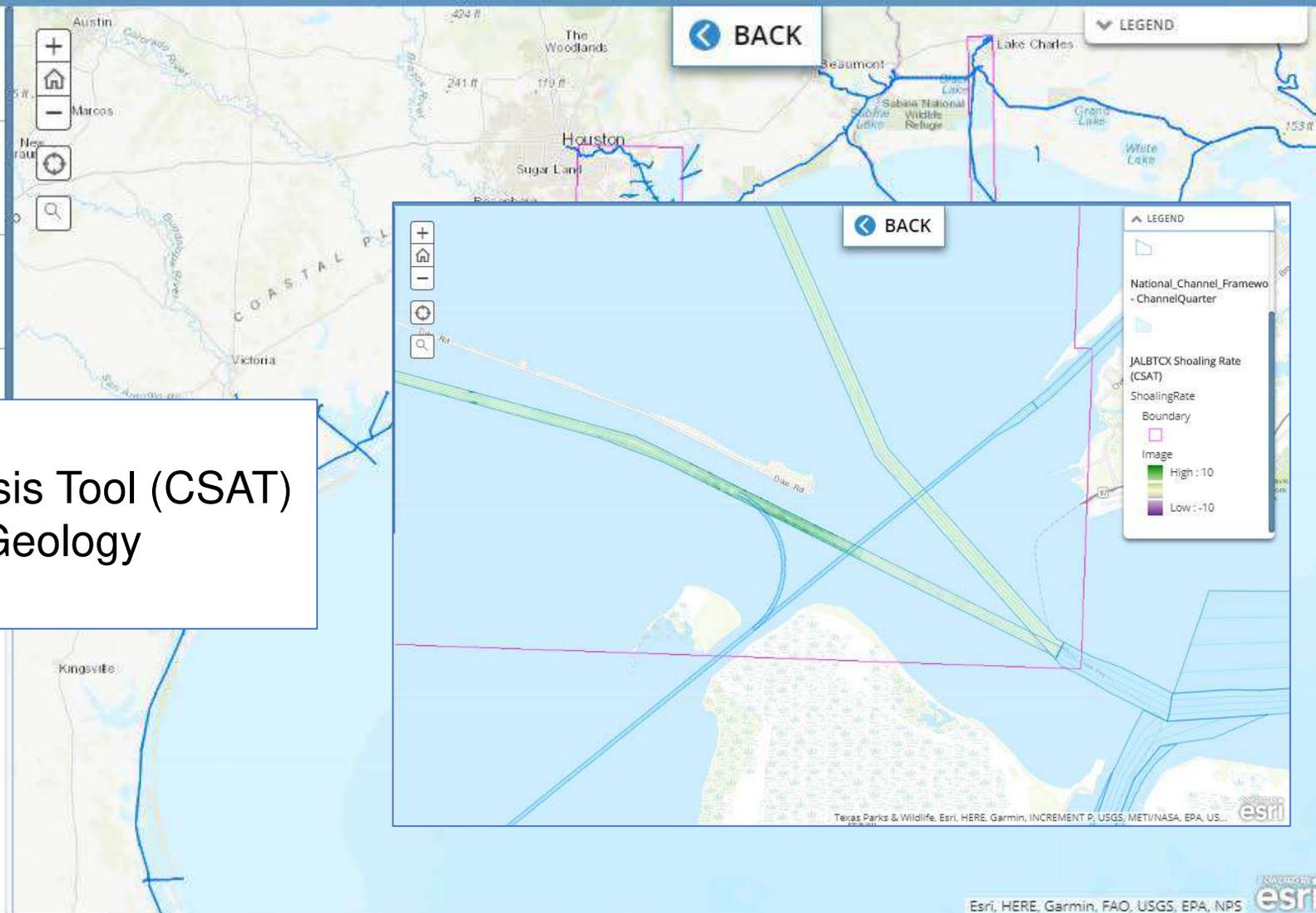
Other options to explore:

- [Bureau of Economic Geology's Shoreline Change Map](#)
- [CSAT mapping application](#)
- [CSAT data sources](#)

Note:

Data for this change rate (1930s - 2012) application are taken from Paine, Caudle, and Andrews (2014), where the methods, data sources, and results are discussed. The individual data points (shoreline movement rates at 11,497 points along the 2012 Texas Gulf coast shoreline) can be downloaded from the Bureau's coastal studies download page. Project sponsored by the General Land Office of Texas under CEPR contract no. 09-074-000.

Sponsoring and Participating Organizations



Data Layers:
 Corps Shoaling Analysis Tool (CSAT)
 Bureau of Economic Geology
 Shoreline Change

Baseline Conditions

Natural Infrastructure & Opportunities - Connecting Resources to Needs

A decision support tool



5 Sediment Baseline Conditions

How to use this map:

- This map shows sediment through sediment sampling [Schedule](#).
 - You can see if a location is available.
 - You can view Placement Area Capacity
- This map also shows contractor availability.
- Click on features in the map to view details.

Data layers:
 NIO – Resource
 National Channel Framework
 Placement area Capacity
 FY18 Advertising Schedule
 Available Sediment Analysis

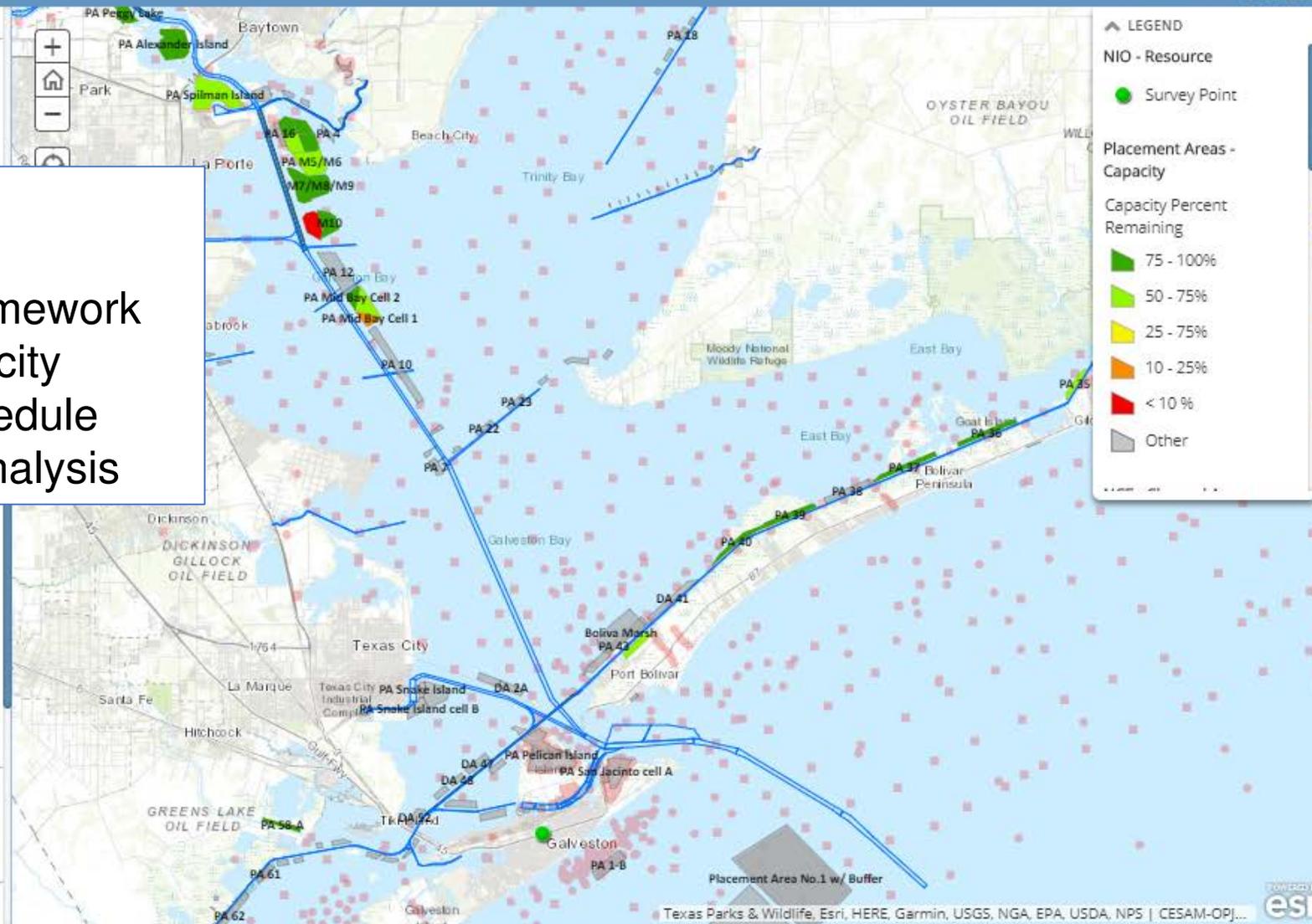
Become a Contributor

This map is powered by our contributors! Do you have sediment?

Step 1: Click the button below to make a registry in the NIO database.



6 Sediment Needs



Texas Parks & Wildlife, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS | CESAM-OPJ...



Environmental

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- ▶ 3 Explore Subsidence
- ▶ 4 Shoreline Rate Change
- ▶ 5 Sediment Baseline Conditions
- ▶ 6 Sediment Needs

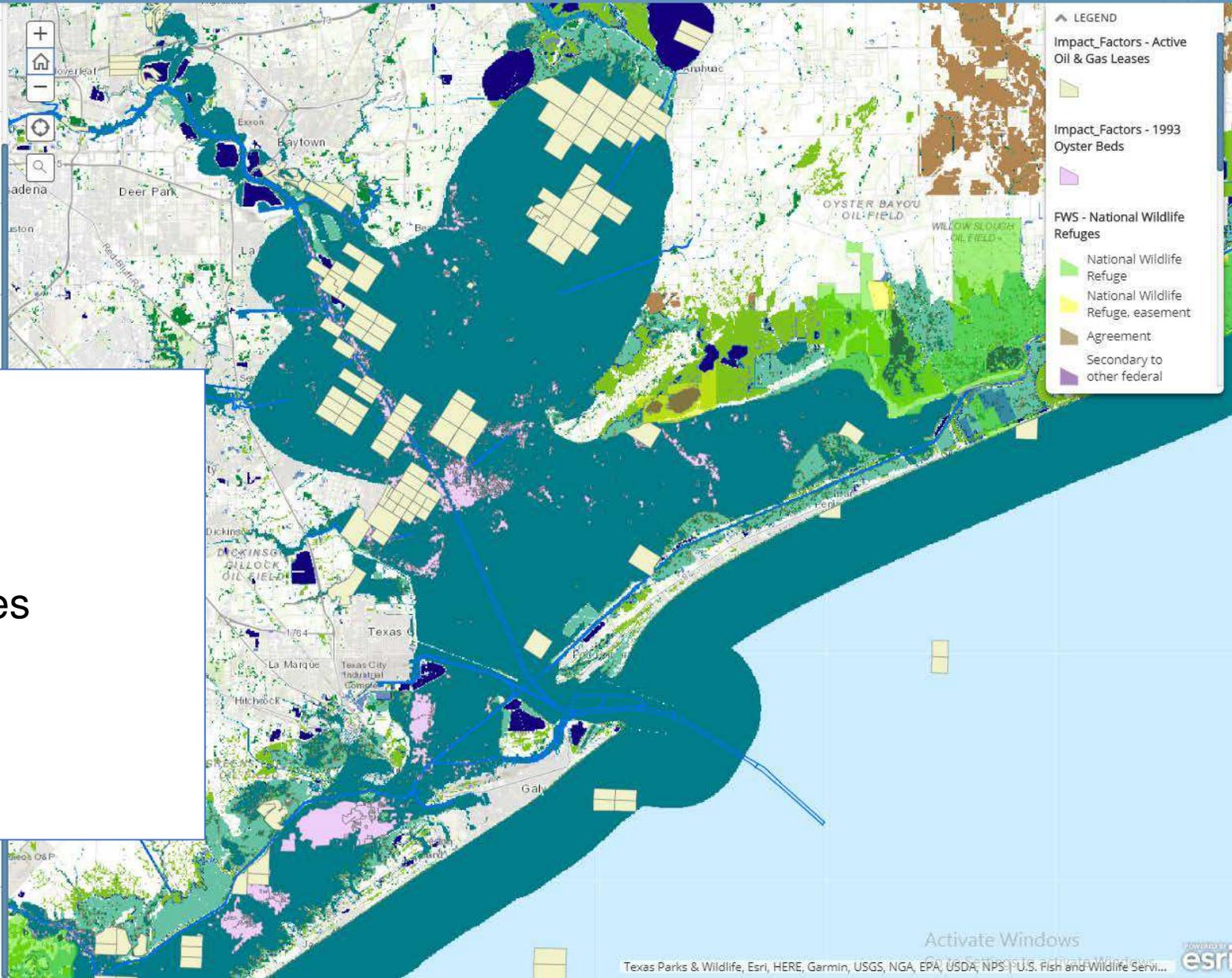
- ▶ 7 Sediment Conn
- ▶ 8 Environmental
- ▶ 9 Environmental

How to use this map:

- Zoom to your area of interest
- Click on the Legend button
- Click on features in the map

- National Wildlife Refuge
- Wetlands
- Oyster Reefs
- Active Oil & Gas Leases

Data Layers:
 Essential Fish Habitat
 Oyster Beds
 Seagrasses
 National Wildlife Refuges
 Wetlands
 Major Global Cyclones
 Hurricanes
 NCF-Channel area



Sources: USACE's National Channel Framework (NCF), USFWS, NCDDC

- ▶ 10 All Data

Activate Windows



NI Resource Need

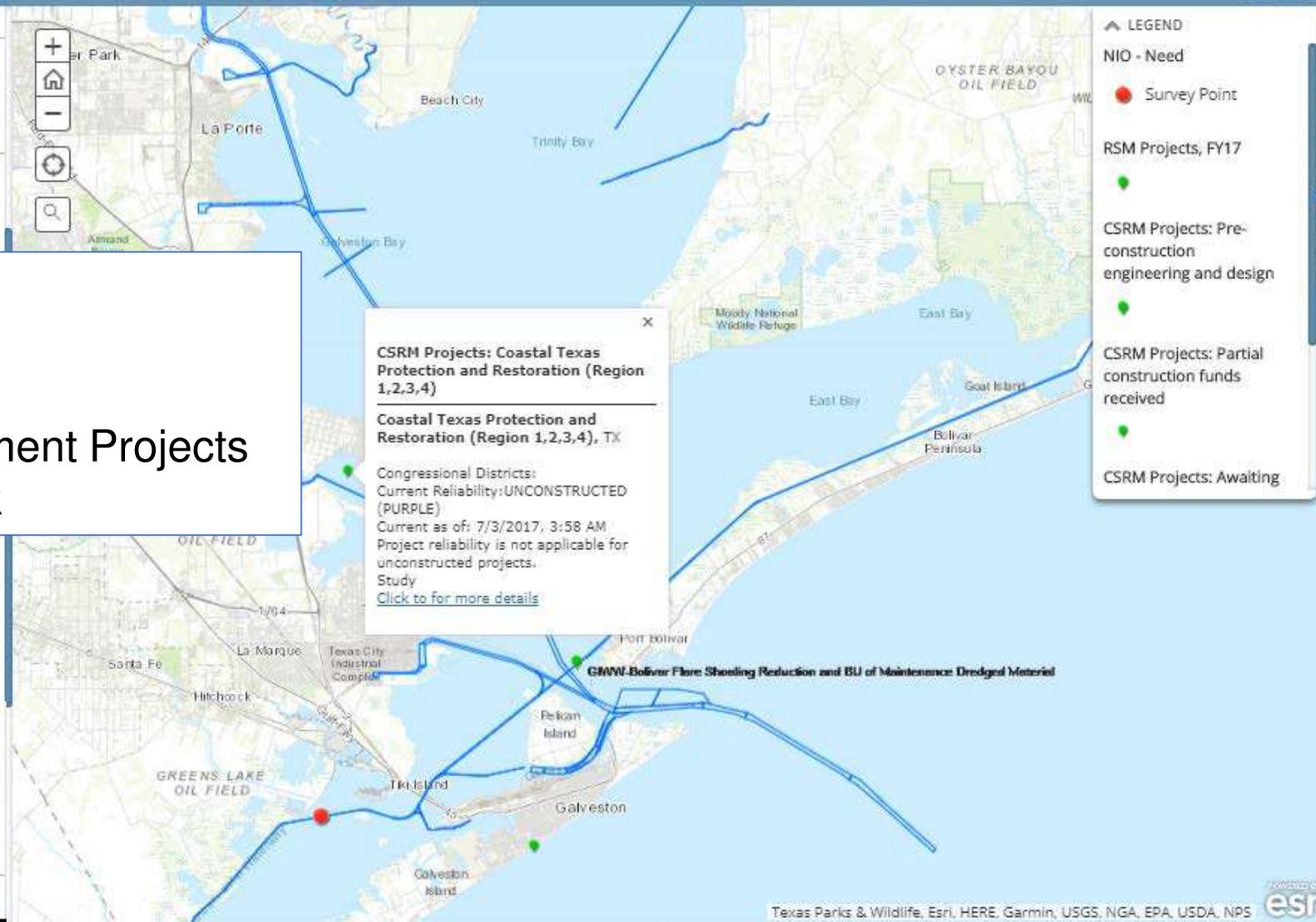
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A decision support tool



5 Sediment Baseline Conditions

6 Sediment Needs



Data Layers:
 NIO – Need
 RSM Projects
 Coastal Storm Risk Management Projects
 National Channel Framework



How to use

- This r
- sedim
- Click
- polyg

Become a C

This map is

Step 1: Click

Step 2: Browse the tabs at the top to find a connection. Each tab contains additional data layers to help you find the perfect match!

Legend

- USACE Projects
- NIO Need

CSRM Projects: Coastal Texas Protection and Restoration (Region 1,2,3,4)

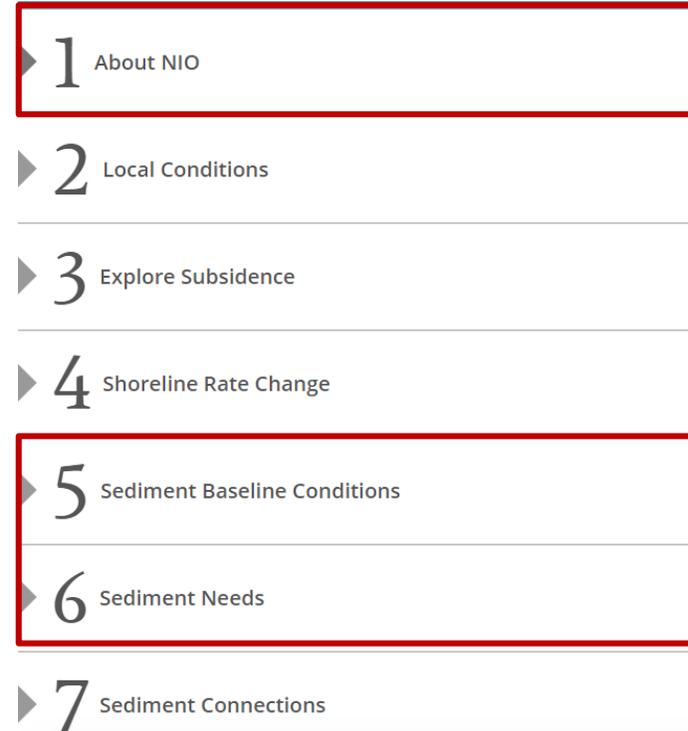
Coastal Texas Protection and Restoration (Region 1,2,3,4), TX

Congressional Districts:
 Current Reliability: UNCONSTRUCTED (PURPLE)
 Current as of: 7/3/2017, 3:58 AM
 Project reliability is not applicable for unconstructed projects.
 Study
[Click to for more details](#)



NIO Contributors

- The mapping tools allows the community of users to submit “announcements” of resources or needs.
- Tabs 1, 5, and 6 have links to create a mapped “announcement” of Sediment Resources (Have) or Sediment Needs.
- Click the respective link to open the online entry form
 - Users supply location and basic descriptions of resources that they need or have.



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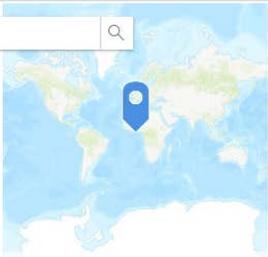
NIO Contributors | Forms

NIO - Resource

Please fill out the form below to register your resource in the Natural Infrastructure and Opportunity (NIO) database.

Submission Date*

Location of Resource*
Where is the resource located?



Esri, FAO, NOAA
Powered by Esri

📍
Lat: 1.40611 Lon: 0

Resource Status*
Is this a planned, under contract, or current availability?

Planned

Under Contract

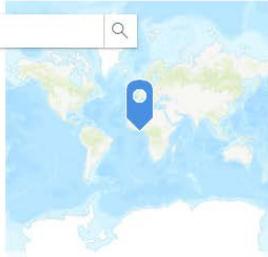
Currently Available

NIO - Need

Please fill out the form below to register your resource in the Natural Infrastructure and Opportunity (NIO) database.

Submission Date*

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Where is the need located?



Esri, FAO, NOAA
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📍
Lat: 1.40611 Lon: 0

Area of Interest Buffer*
Enter, in feet, the approximate width of the area of interest.

Need Description*

NIO Resource Connections

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A decision support tool



7 Sediment Connections

How to use this map:

- This map only shows contributions from our *NIO User Community* Sediment Management (RSM) Projects for the current fiscal year.
- Click on the Legend and Layers buttons at the bottom of the map to view the data is available.
- Click on features in the map to uncover additional attribution information.

Legend

- USACE Projects
- NIO Resource
- NIO Need

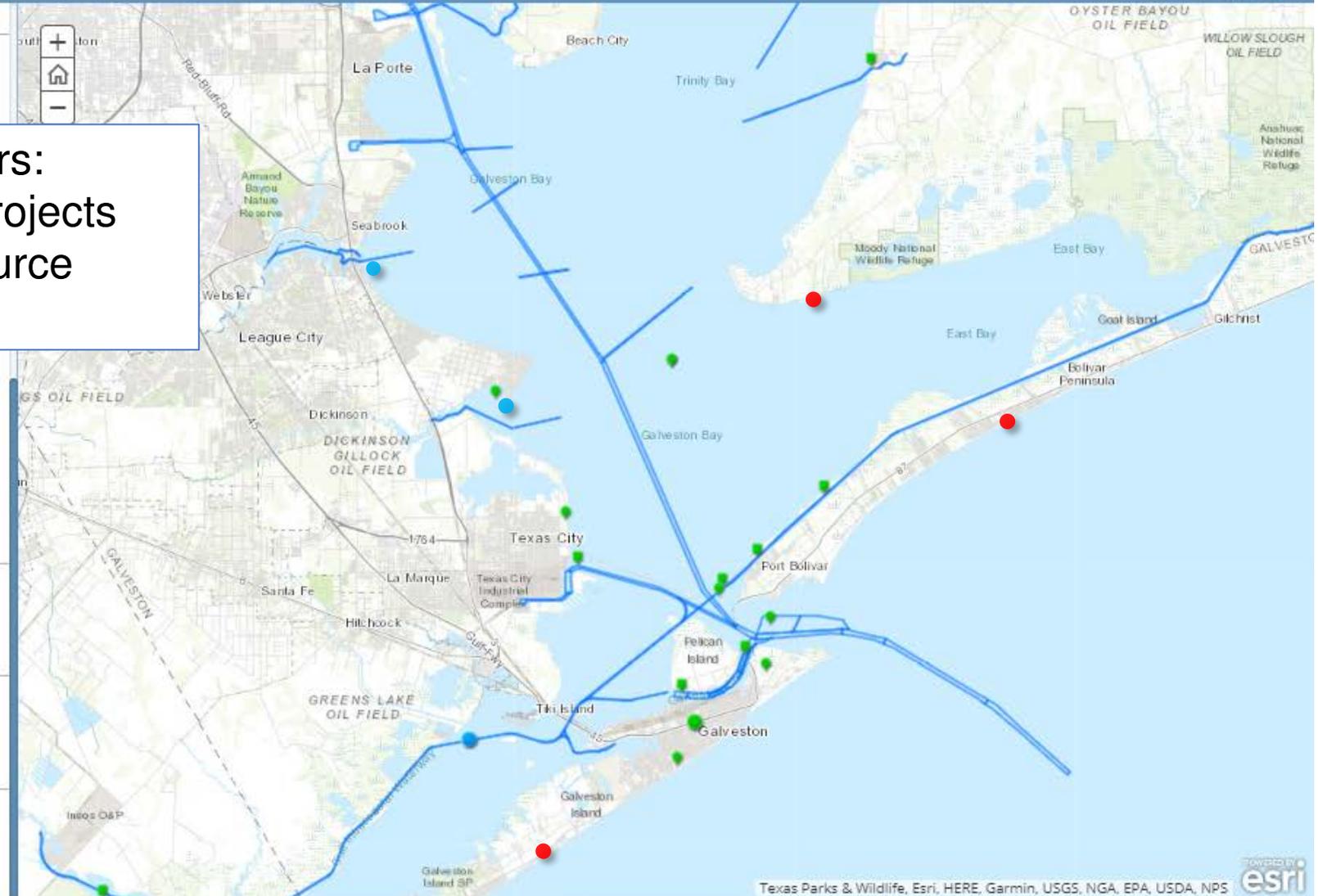
Sources: NIO, RSM

8 Environmental Considerations

9 Environmental Impact

10 All Data

Data Layers:
USACE Projects
NIO Resource
NIO Need



Texas Parks & Wildlife, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS



Concluding Thoughts

- USACE ERDC, Galveston and Mobile Districts have developed an extensible framework that uses available Corps enterprise databases and integrates data collection and analysis tools.
- Database capabilities, tools, and methods are extendable to other projects, USACE Districts, and infrastructure opportunities.
- In collaboration with the Natural Infrastructure Initiative the public facing *NIO* web-viewer focuses on identifying beneficial use and infrastructure opportunities.
- The viewer is currently undergoing beta testing and revision within the NII group.