# Grassy Flats Restoration

## Creatively Capping Muck to Restore Lake Worth Lagoon


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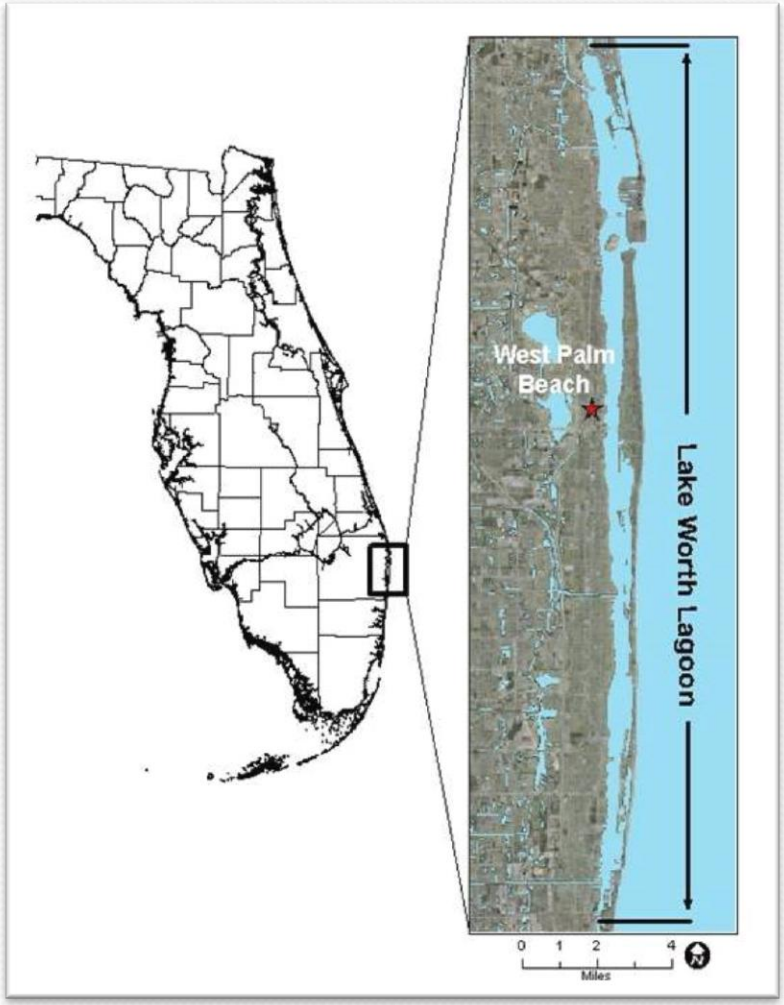
Palm Beach County
Environmental Resources Mgmt

# Presentation Overview

- **Project Introduction**
  - Why cover muck sediments in LWL
  - Project components
- **Project Methodologies**
  - Why the Sand Shooter
  - Project challenges lead to equipment used
  - Innovative technology of the Sand Shooter
- **Projects Instant Impact to our Ecology**

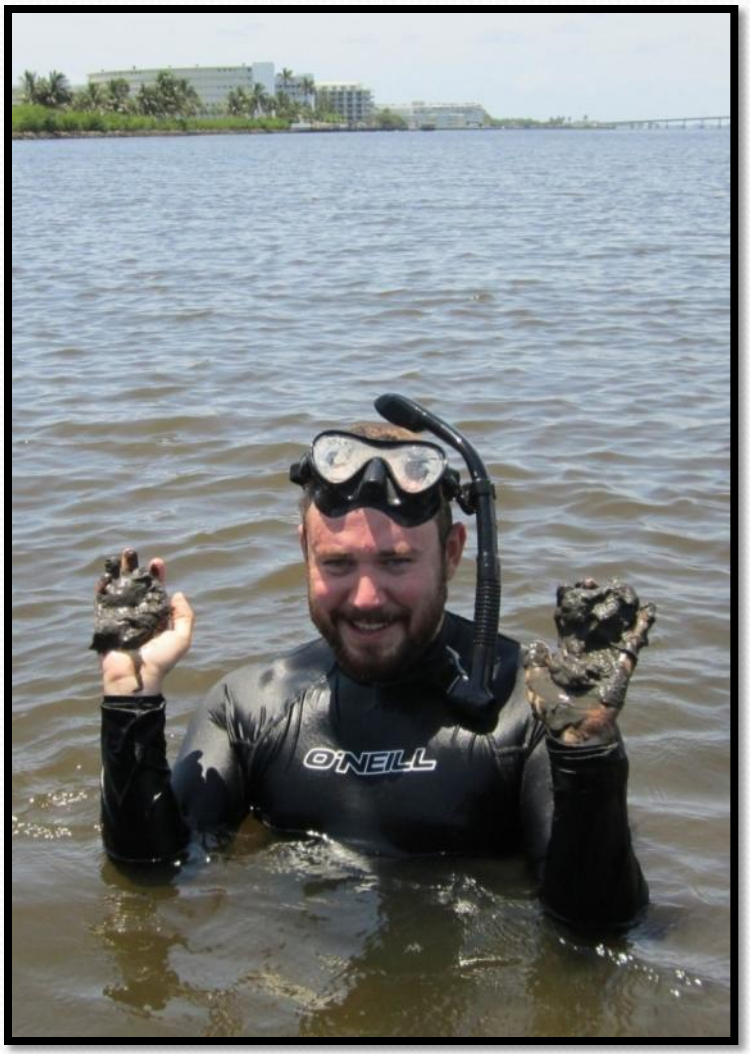
# Lake Worth Lagoon

- Located between Village of North Palm Beach and the Town of Ocean Ridge
- 20 mi long, ½ mi wide, 6-10’ deep
- Resources include:
  - 1,689 acres of seagrass
  - 283 acres of mangroves
  - 5 acres of oysters

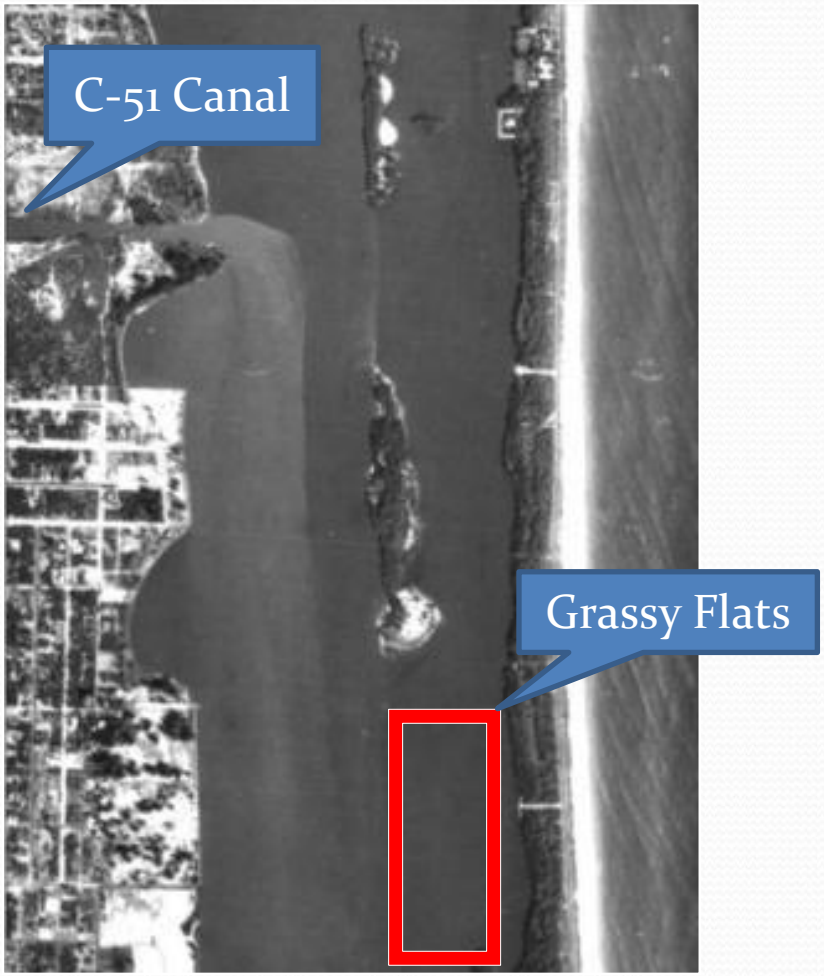


# Muck in the Lagoon

- Fine-grained, organic rich sediment
- Primarily from stormwater discharge
- Blankets natural sand substrate
- Reduces available benthic habitat
- Decreases biodiversity
- Easily re-suspended



# Stormwater Discharges

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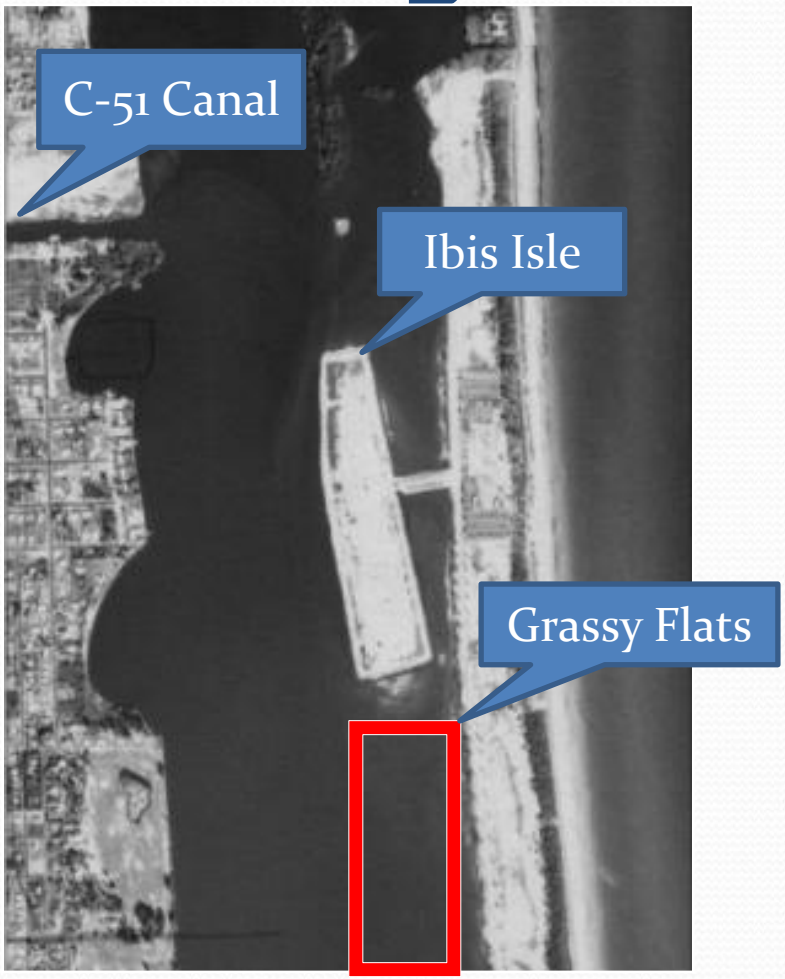



1953

# Muck in the Lagoon


- 2003 Survey
- 423 acres with 1ft or greater
- Estimated 1.2m cy
- Greatest muck deposits south of C-51 Canal.

# Dredge Hole Fill Projects

South Cove 6 acres
155,000 cy of sand

Bryant /Snook 12 acres
235,000 cy of sand

Snook Island 100 acres
1.2 million cy of sand

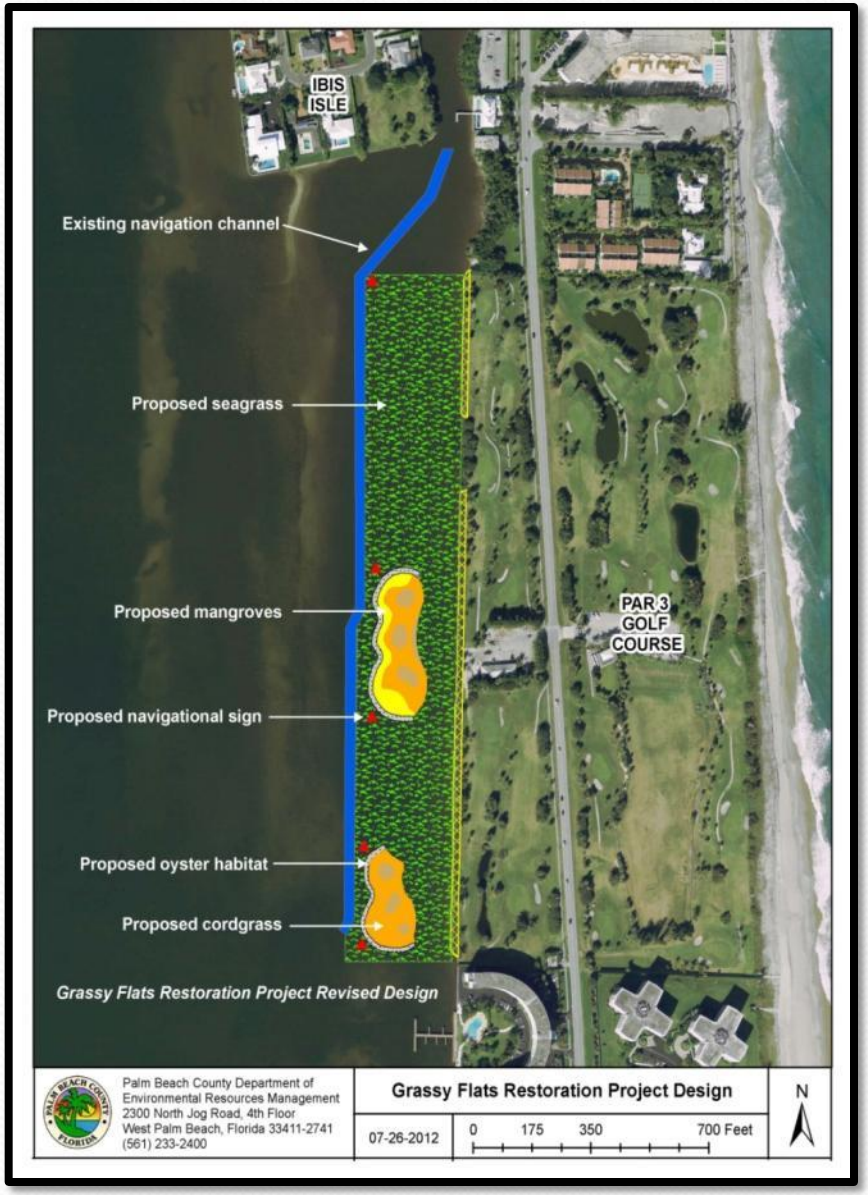
# Ibis Isles Restoration

## Post-Construction, April 20, 2011

# Grassy Flats

- Cap 13 acres of ~30k cy of muck

- To create:
  - 10.5 acres of seagrass habitat
  - 2.5 acres of coastal habitat

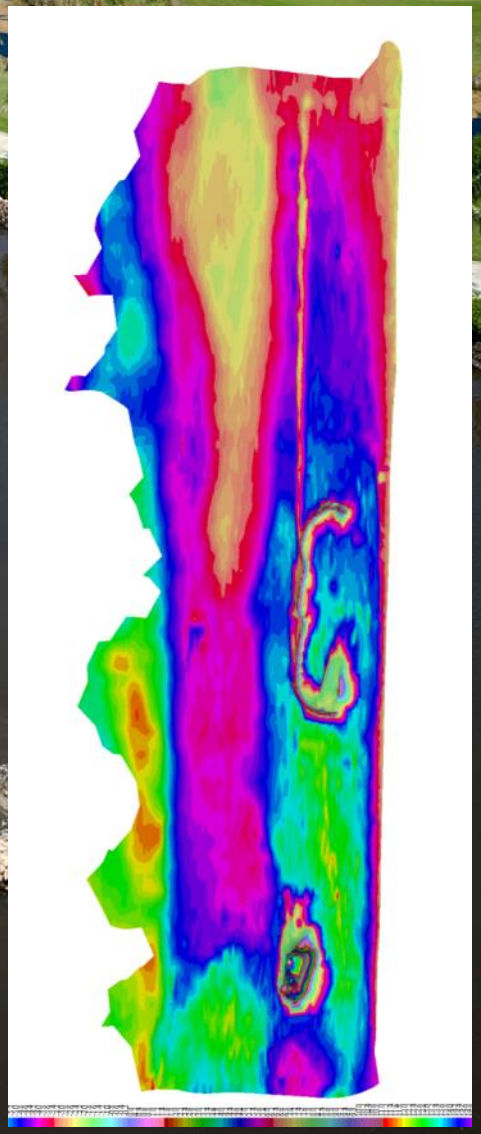


# Challenges

- ✓ **Funding** $3.7m
  - •PBC ($1m)
  - •LWLI / FDEP ($960k)
  - •USACE ($842k)
    - Ranked 1# by the Estuary Habitat Restoration Council
  - •FWC/ USFWS ($777k)
    - National Coastal Wetland Conservation Grant
  - •FDEP / NOAA ($110k)
  - •Received $1.7m Federal $
- ✓ **Sand Source- 52,000 cy**
  - SLWI
  - Hypoluxo Natural Area
  - Okeeheelee Park
- ✓ **Access to the Project**
  - •Conveyors on Barges
- ✓ **How to cap muck**
  - •Sand Shooter / Broadcaster

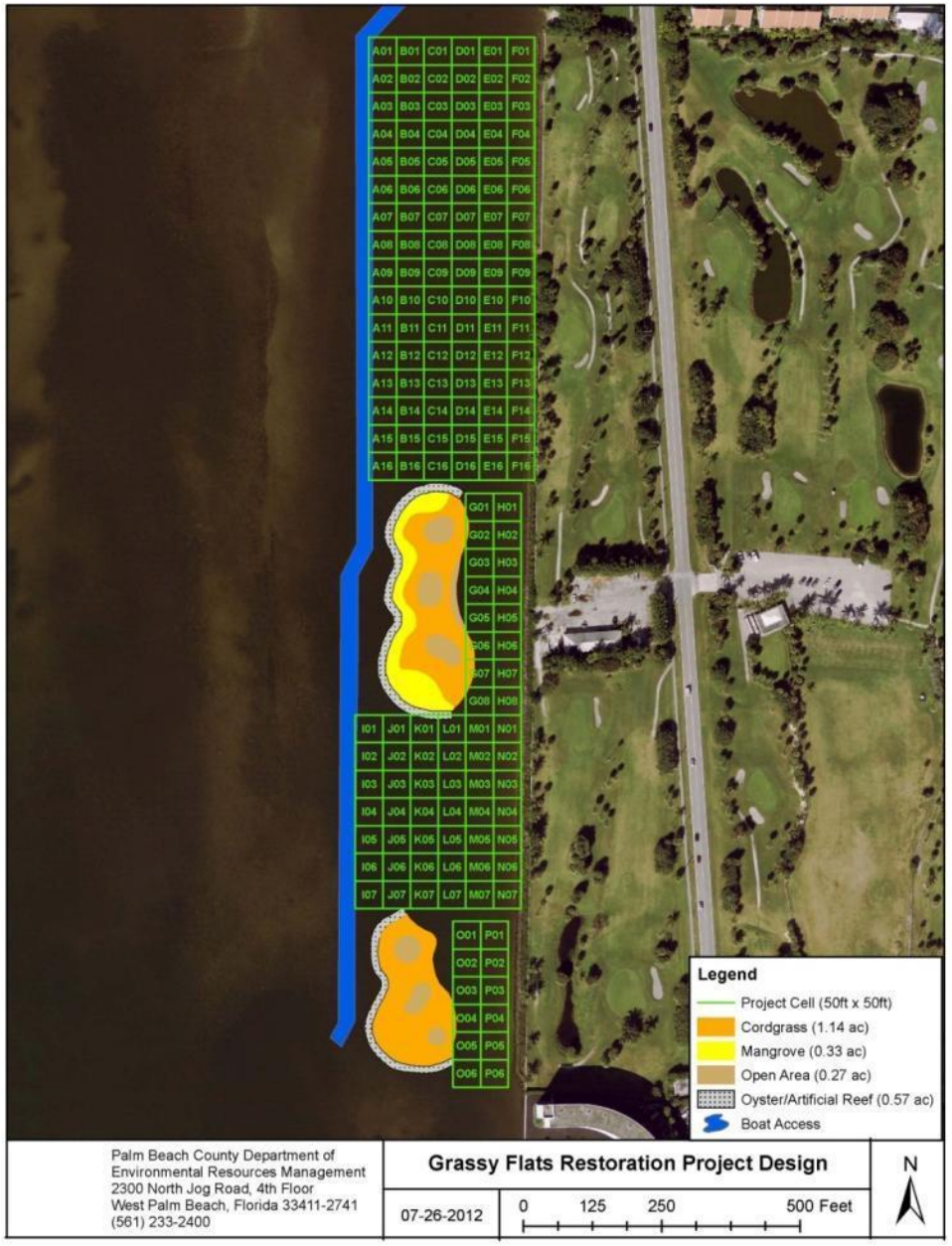
# Project Methods

- Import of 17,000 cy of Sand from SLWI
- Material used as base of island and construct underwater berm
- Placement of 2,800 tons of limestone



# Project Methods

- How to estimate sand Qty to cap muck sediments
- **Project Goal**
  - 6” to 18” sand cap
- **Created** 166 cells of
  - 50’ x 50’ grids
- **Estimated per cell**
  - 6” = 46cy or 65 tons
  - 12” = 92cy or 130 tons
  - 15” = 115cy or 160 tons
  - 18” = 138cy or 200 tons
- **Estimated needing:**
  - ~29,000cy for islands
  - ~25,000cy broadcasting



# Project Methods

- Import 10,600 cy of Sand Hypoluxo Natural Area
- Import  24,000 cy of Sand from Okeeheelee Park

# Project Methods

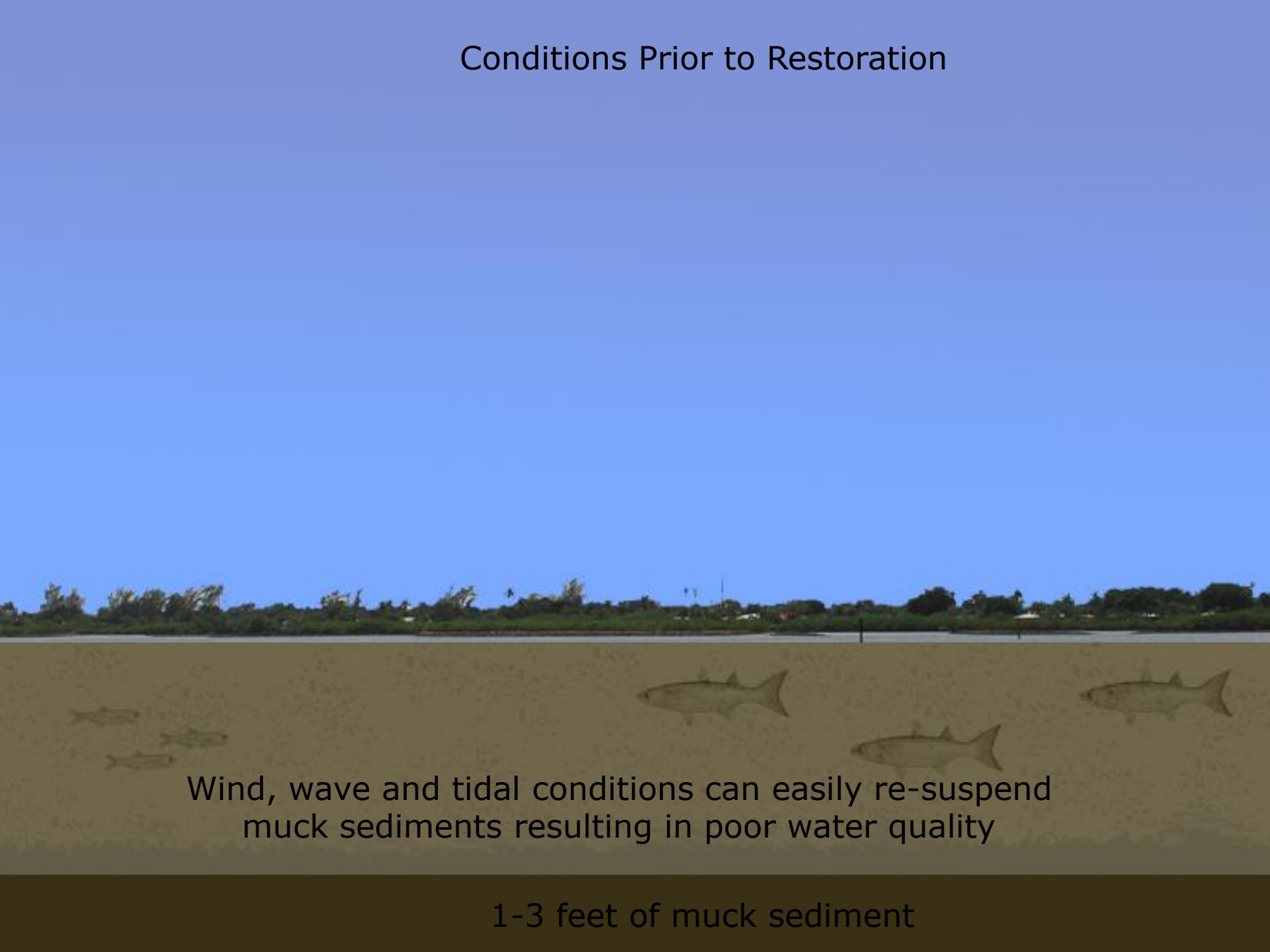
- From July 31, 2014 – Oct 27, 2014
  - Project Averaged 557 cy a day (Max was 925 cy)
- Stockpiled 27,400 cy of sand on north island
- Stockpiled 7,200 cy of sand on south island

# Sand Shooter / Sand Broadcaster

- Hooper holds 18 tons
- Speed of conveyor: Variable speed, angle height, direction
- Maximum distance ~100’
- Minimum distance 0’
- Hourly production ~125 tons hours
- All electric quiet & eco-friendly design
- It can be loaded with a loader, excavator, bobcat, or conveyor.

# Muck Capping Process with Sand Shooter

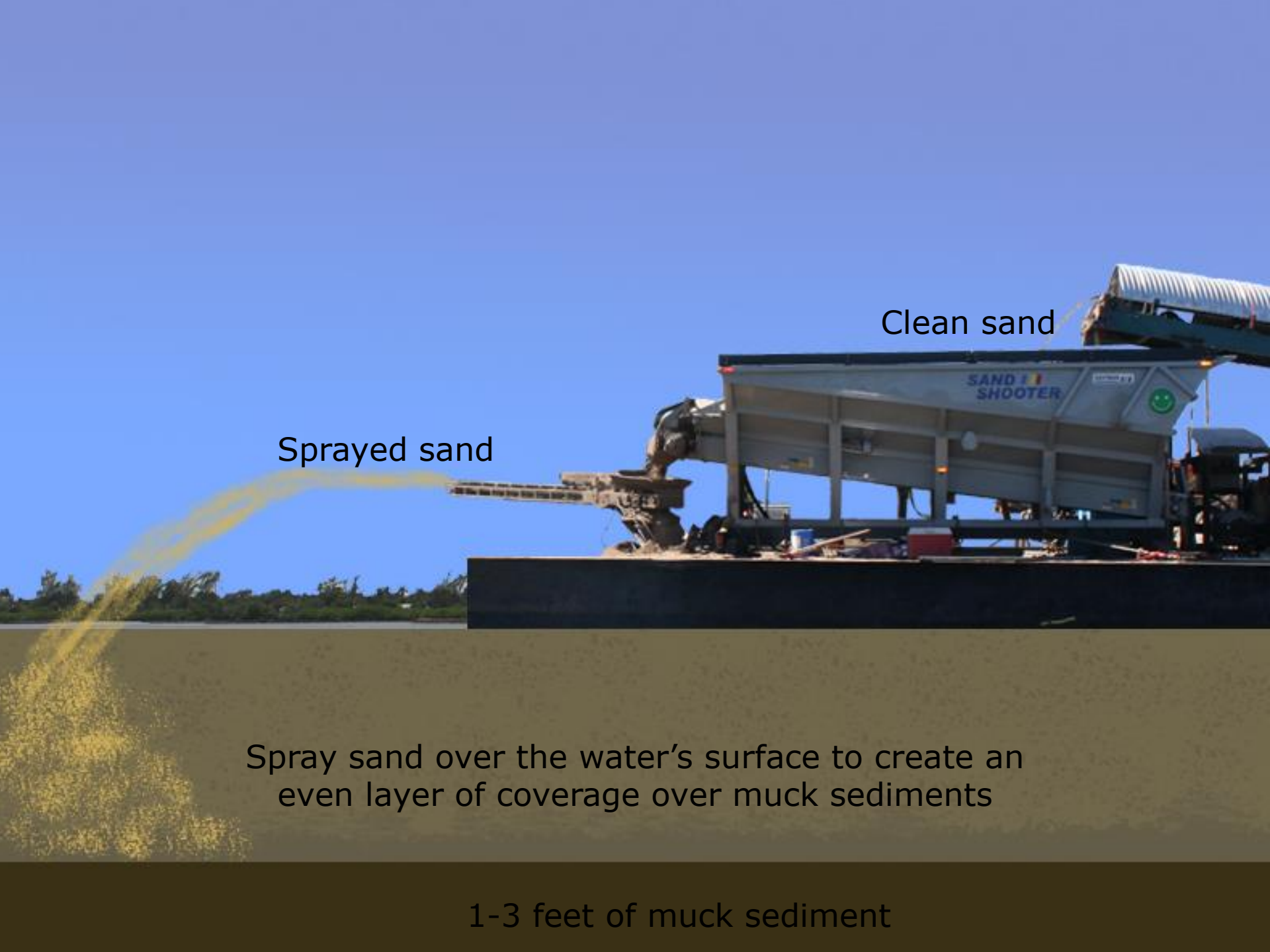
# Conditions Prior to Restoration

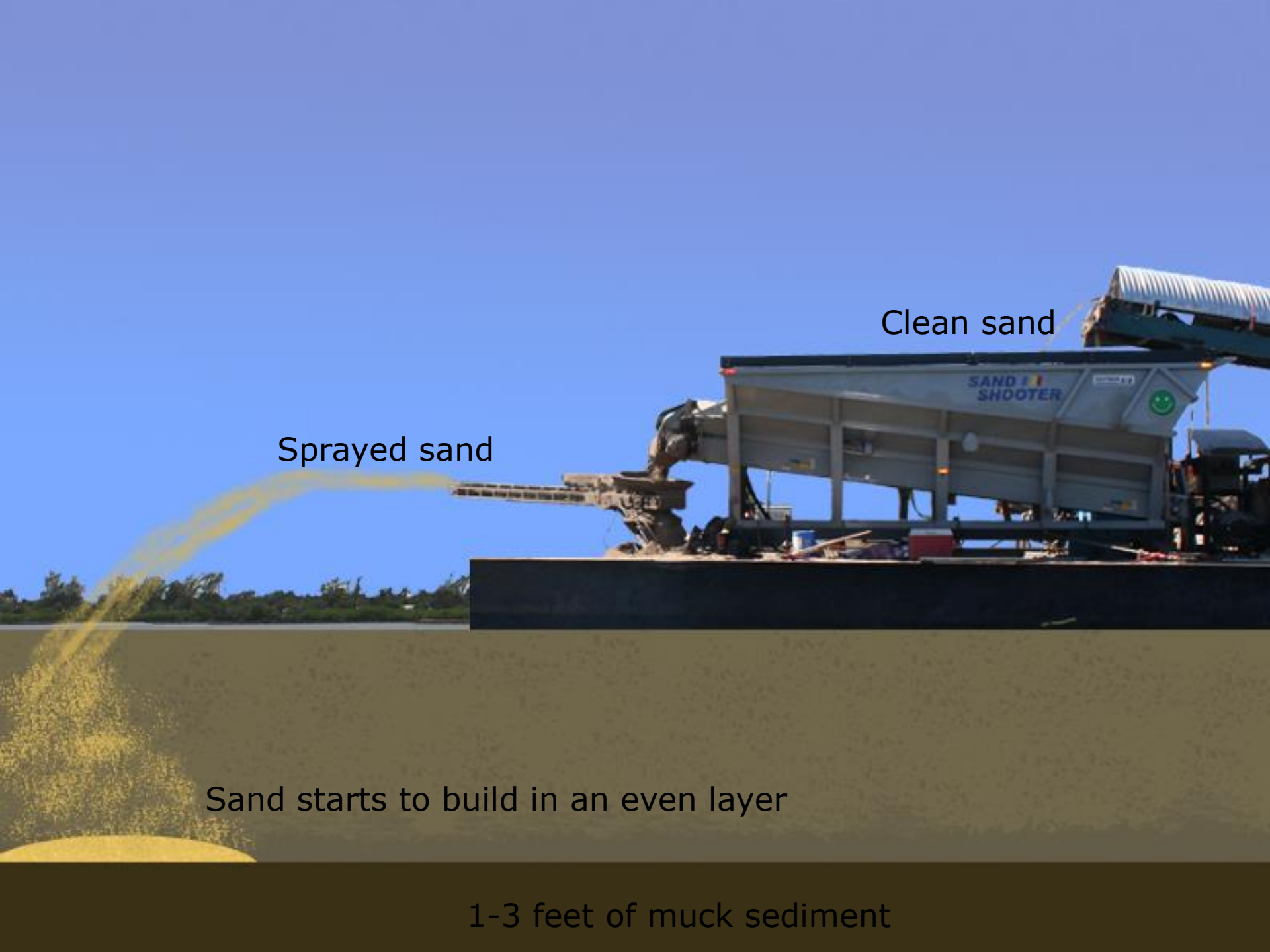


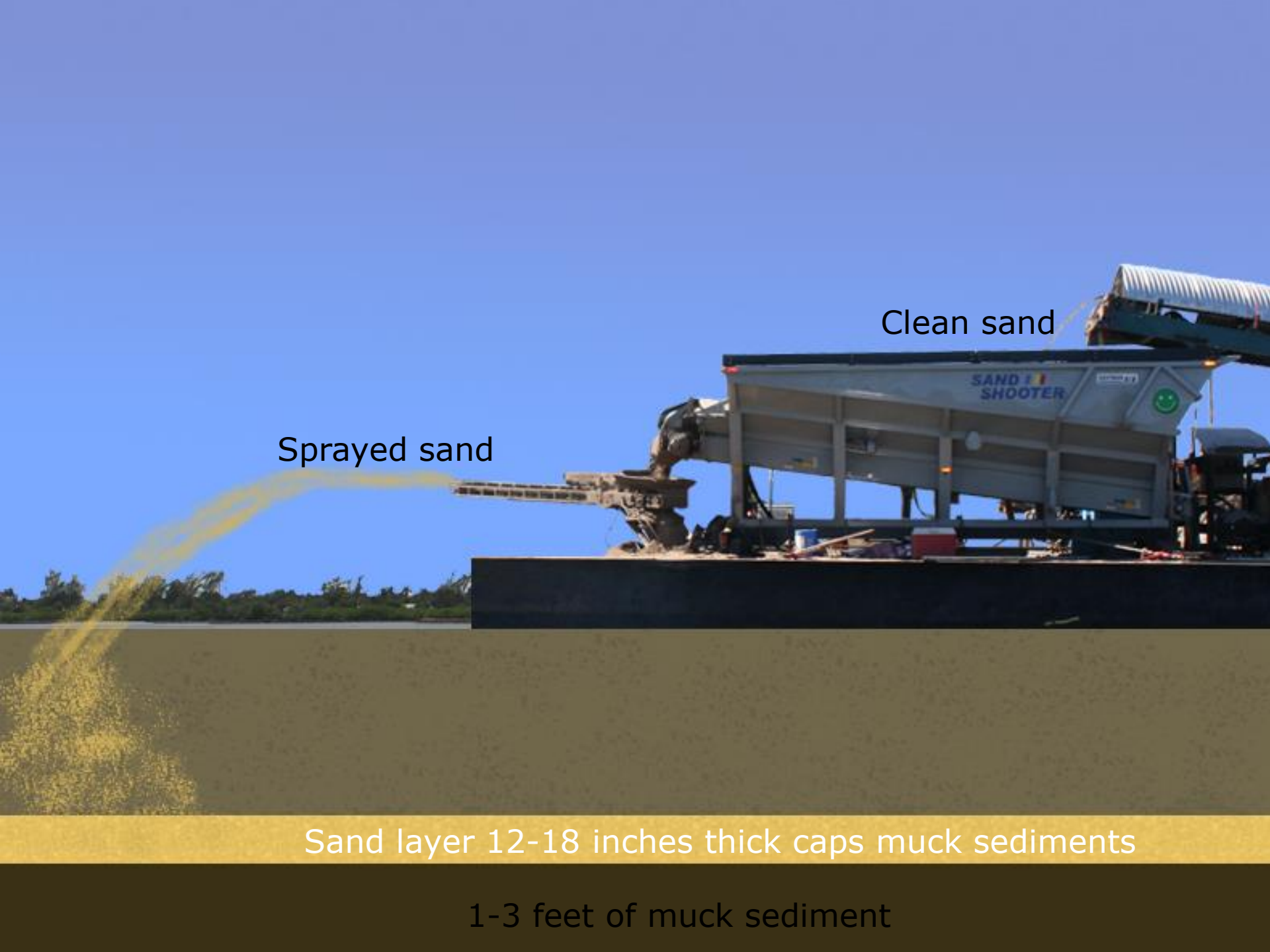
Wind, wave and tidal conditions can easily re-suspend muck sediments resulting in poor water quality

1-3 feet of muck sediment

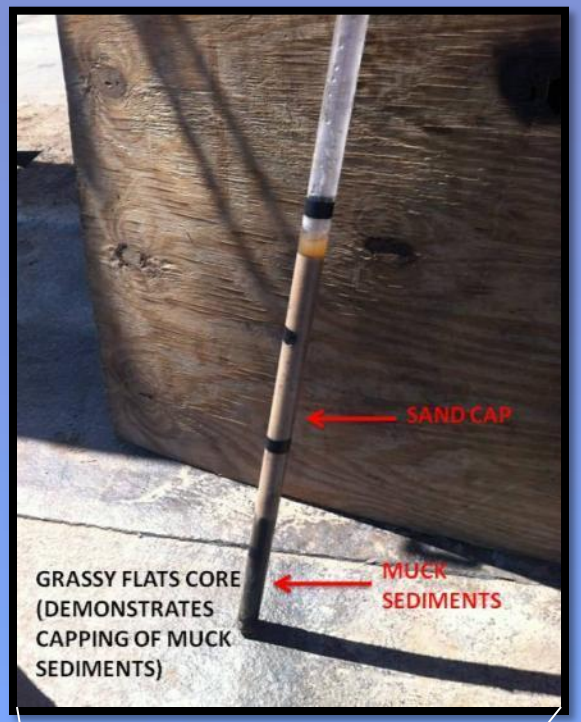

SAND
SHOOTER
Water column with suspended sediments
1-3 feet of muck sediment


Clean sand
Sprayed sand
SAND SHOOTER
Spray sand over the water's surface to create an even layer of coverage over muck sediments
1-3 feet of muck sediment


Clean sand
Sprayed sand
SAND SHOOTER
Sand starts to build in an even layer
1-3 feet of muck sediment


Clean sand
Sprayed sand
SAND SHOOTER
Sand layer 12-18 inches thick caps muck sediments
1-3 feet of muck sediment

End of restoration







Water quality improves as muck layer is capped by sand and is no longer re-suspended

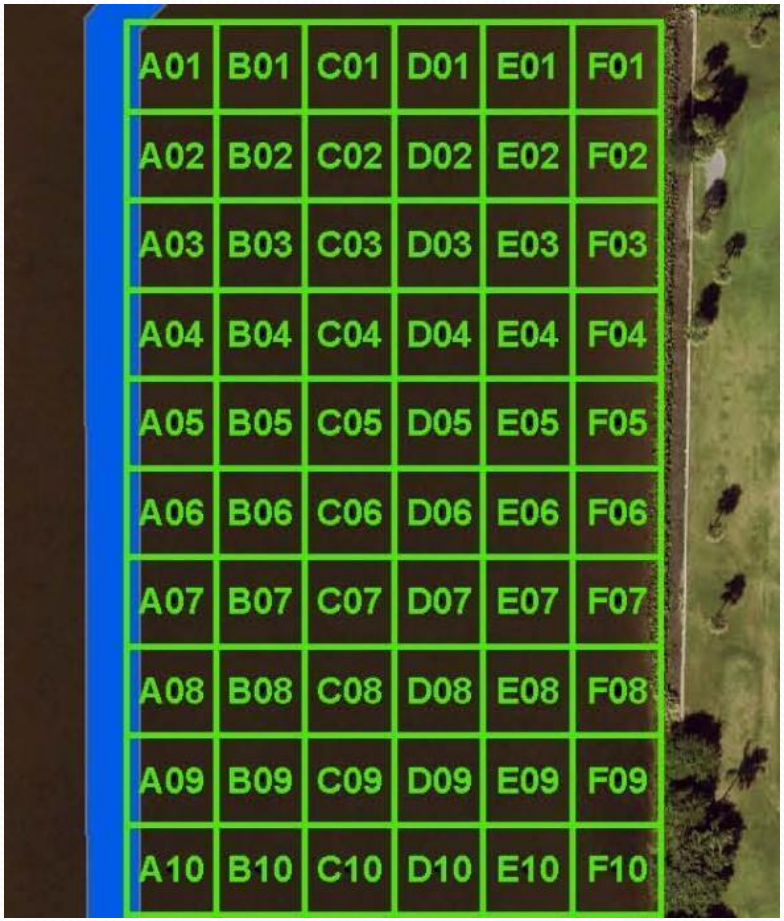
Sand layer 12-18 inches thick caps muck sediments

1-3 feet of muck sediment


Sand layer compacts muck and stabilizes sediments

Ideal for seagrass and shallow water habitat

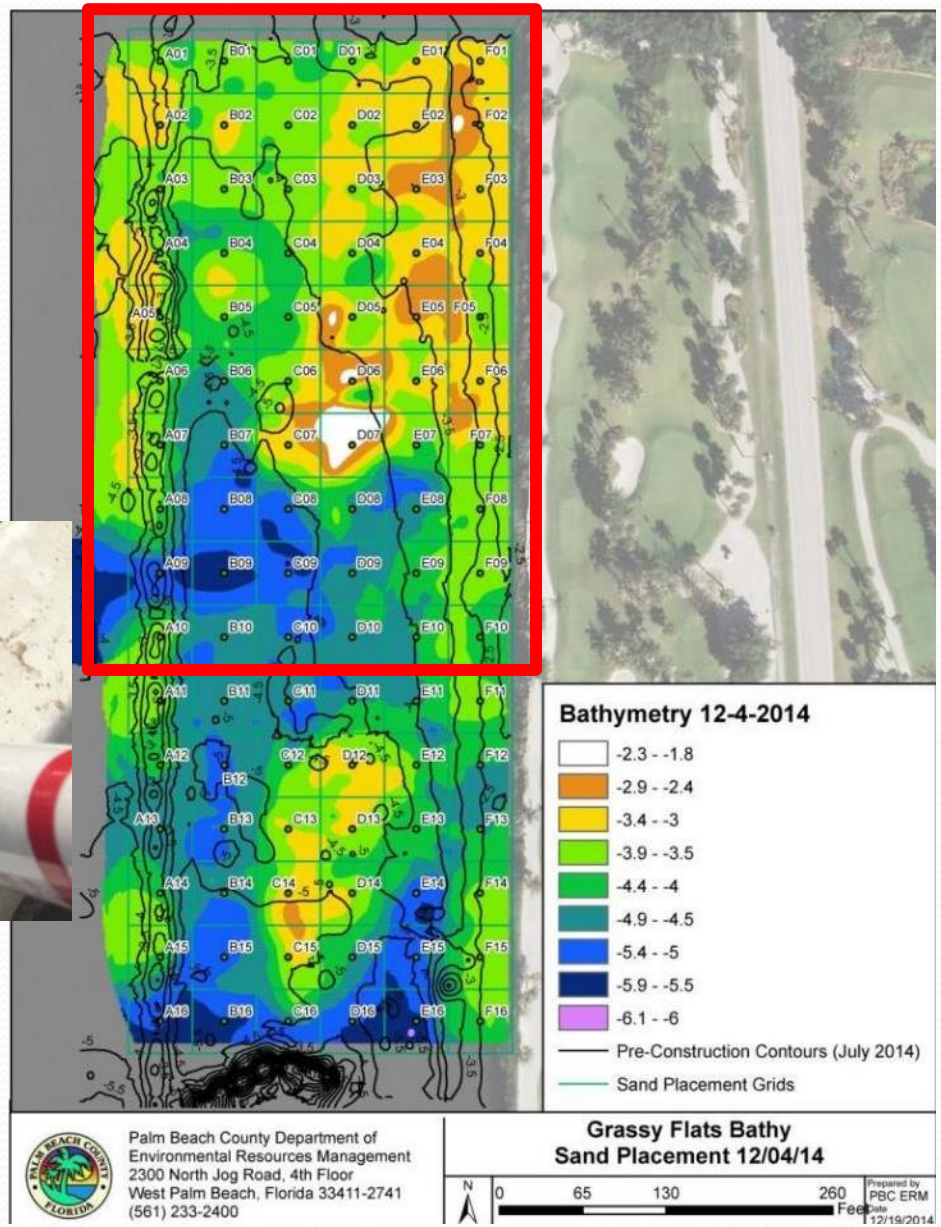
# Tools used to check progress




Note: Numbers in blue are proposed

| Cell | A1 | | B1 | | C1 | | D1 | | E1 | | F1 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | 7-Nov | 40 | 7-Nov | 100 | 7-Nov | 100 | 10-Nov | 125 | 10-Nov | 125 | 10-Nov | 75 |
| Tons | | | | | | | | | | | | |
| Cell Totals | 40 | | 100 | | 100 | | 125 | | 125 | | 75 | |
| | A2 | | B2 | | C2 | | D2 | | E2 | | F2 | |
| | 7-Nov | 25 | | | 7-Nov | 25 | 10-Nov | 30 | 14-Nov | 150 | 10-Nov | 30 |
| | 12-Nov | 75 | 12-Nov | 155 | 13-Nov | 125 | 13-Nov | 33 | | | 14-Nov | 75 |
| | | | | | | | 14-Nov | 87 | | | | |
| | 100 | | 155 | | 150 | | 150 | | 150 | | 105 | |
| | A3 | | B3 | | C3 | | D3 | | E3 | | F3 | |
| | 13-Nov | 25 | 17-Nov | 175 | 13-Nov | 25 | 14-Nov | 25 | 19-Nov | 175 | 14-Nov | 25 |
| | 17-Nov | 100 | | | 17-Nov | 100 | 19-Nov | 150 | | | 19-Nov | 75 |
| | | | | | 18-Nov | 50 | | | | | | |
| | 125 | | 175 | | 175 | | 175 | | 175 | | 100 | |
| | A4 | | B4 | | C4 | | D4 | | E4 | | F4 | |
| | 17-Nov | 35 | 20-Nov | 150 | 17-Nov | 50 | 19-Nov | 30 | 21-Nov | 150 | 19-Nov | 30 |
| | 20-Nov | 100 | | | 20-Nov | 100 | 21-Nov | 75 | | | 21-Nov | 90 |
| | 135 | | 150 | | 150 | | 105 | | 150 | | 120 | |
| | A5 | | B5 | | C5 | | D5 | | E5 | | F5 | |
| | 20-Nov | 25 | 24-Nov | 175 | 20-Nov | 35 | 21-Nov | 30 | 26-Nov | 150 | 21-Nov | 30 |
| | 24-Nov | 100 | | | 24-Nov | 130 | 26-Nov | 120 | | | 26-Nov | 95 |
| | 125 | | 175 | | 165 | | 150 | | 150 | | 125 | |
| | A6 | | B6 | | C6 | | D6 | | E6 | | F6 | |
| | 24-Nov | 25 | 1-Dec | 175 | 24-Nov | 0 | 26-Nov | 50 | 2-Dec | 150 | 26-Nov | 30 |
| | 1-Dec | 100 | | | 1-Dec | 175 | 2-Dec | 125 | | | 2-Dec | 95 |
| | 125 | | 175 | | 175 | | 175 | | 150 | | 125 | |
| | A7 | | B7 | | C7 | | D7 | | E7 | | F7 | |
| | 1-Dec | 25 | 3-Dec | 175 | 1-Dec | 50 | 2-Dec | 20 | 4-Dec | 150 | 2-Dec | 30 |
| | 3-Dec | 100 | | | 3-Dec | 125 | 4-Dec | 130 | | | 4-Dec | 100 |
| | 125 | | 175 | | 175 | | 150 | | 150 | | 130 | |
| | A8 | | B8 | | C8 | | D8 | | E8 | | F8 | |
| | 3-Dec | 25 | 5-Dec | 225 | 3-Dec | 50 | 4-Dec | 50 | 9-Dec | 140 | 4-Dec | 30 |
| | 5-Dec | 125 | | | 5-Dec | 10 | 9-Dec | 100 | | | 9-Dec | 80 |
| | | | | | 8-Dec | 140 | | | | | | |
| | 150 | | 175 | | 175 | | 150 | | 140 | | 110 | |
| | A9 | | B9 | | C9 | | D9 | | E9 | | F9 | |
| | 8-Dec | 25 | 10-Dec | 225 | 8-Dec | 60 | 9-Dec | 50 | 11-Dec | 140 | 9-Dec | 25 |
| | 10-Dec | 100 | | | 10-Dec | 150 | 11-Dec | 125 | | | 11-Dec | 95 |
| | 125 | | 175 | | 210 | | 175 | | 140 | | 120 | |
| | A10 | | B10 | | C10 | | D10 | | E10 | | F10 | |
| | 10-Dec | 25 | 12-Dec | 200 | 10-Dec | 50 | 11-Dec | 50 | 17-Dec | 140 | 11-Dec | 25 |
| | 12-Dec | 125 | | | 11-Dec | 50 | 17-Dec | 100 | | | 17-Dec | 75 |
| | | | | | 12-Dec | 40 | | | | | | |
| | | | | | 16-Dec | 35 | | | | | | |
| | 150 | | 200 | | 175 | | 150 | | 140 | | 100 | |

# Tools used to check progress



# Equipment

- 17 - 50’ conveyors (totaling 850’)
- 24 platform barges
- 1 sand broadcaster
- 2 generators
- 1 loader
- 2 long stick excavator
- 1 transport barge

EASTMAN
AGGREGATE ENTERPRISES, LLC

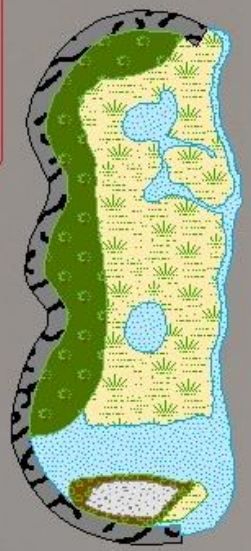
Grassy Flats

SMITH AERIAL PHOTOS 12-06-14

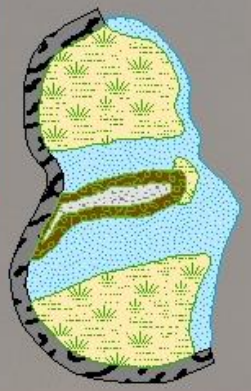
# Creating the intertidal habitat

AMERICAN OYSTERCATCHERS AT GRASSY FLATS


# Least Terns



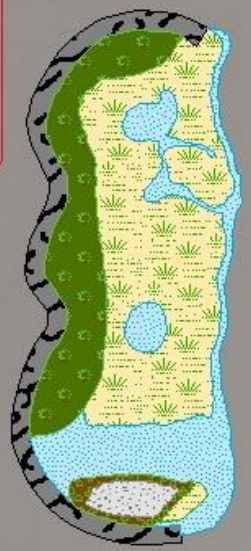
August 2015



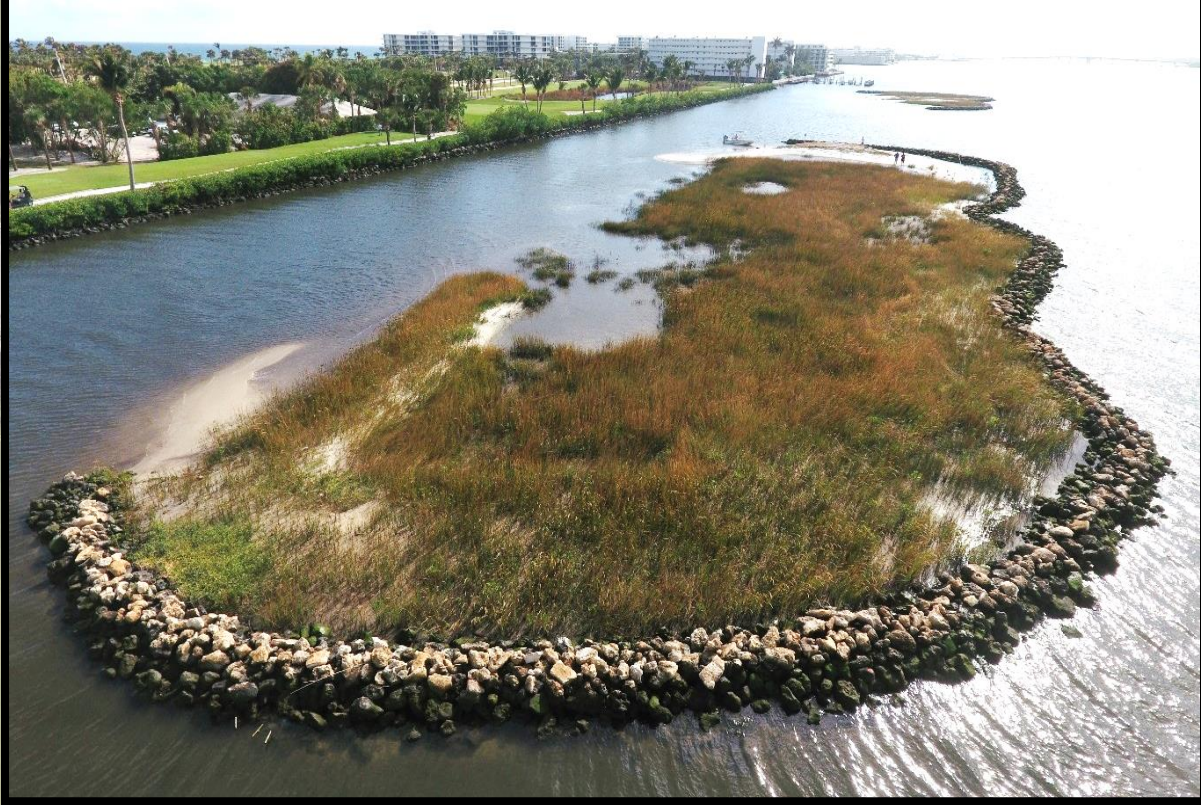
Restored Seagrass Habit

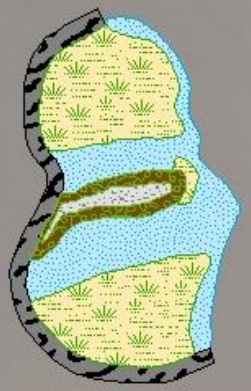
**Restored Coastal Habitat (2.45**

- Oyster (0.4 acre)
- Cordgrass (1.0 acre)
- Mangrove (0.3 acre)
- Open (0.6 acre)
- Coastal (0.09 acre)
- Bird (0.06 acre)



November 2016





Restored Seagrass Habi
**Restored Coastal Habitat (2.4**
Oyster (0.4 acre)
Cordgrass (1.0 acre)
Mangrove (0.3 acre)
Open (0.6 acre)
Coastal (0.09 acre)
Bird (0.06 acre)


## Project Partners

US Army Corps of Engineers.

U.S. Fish & Wildlife Service

National Oceanic and Atmospheric Administration — NOAA — U.S. Department of Commerce

Florida Fish and Wildlife Conservation Commission

Florida Department of Environmental Protection

West Palm Beach Fishing Club

Marine Industries Association of Palm Beach County, Inc.

Endorsed by Atlantic Coastal Fish Habitat Partnership

Lagoon Keepers .org

City of Lake Worth Florida

Town of Palm Beach Florida