Dredging, Dredged Material Management and the NJ Marine Transportation System

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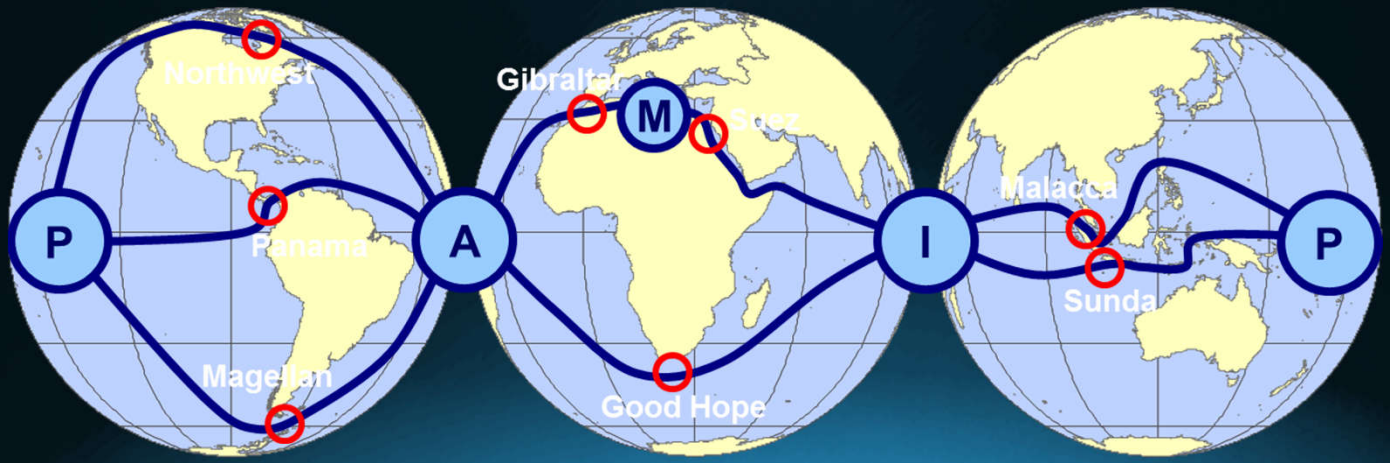
NJDOT Office of Maritime Resources

The Marine Transportation System

The Marine Transportation System, or MTS, consists of waterways, ports, and intermodal landside connections that allow the various modes of transportation to move people and goods to, from or on the water.

The Geographical Space of Marine Transportation



Source: Transport Geography, J.P. Rodrigue, 2004

The Nation's Marine Transportation System

First widely used transportation system in the New World

300 seaports

3700 marine terminals

25,000 miles of engineered waterway

Bays, Harbors, Rivers and Canals

Intracoastal Waterways

Great Lakes and St. Lawrence Seaway

Mississippi, Ohio and Missouri Rivers

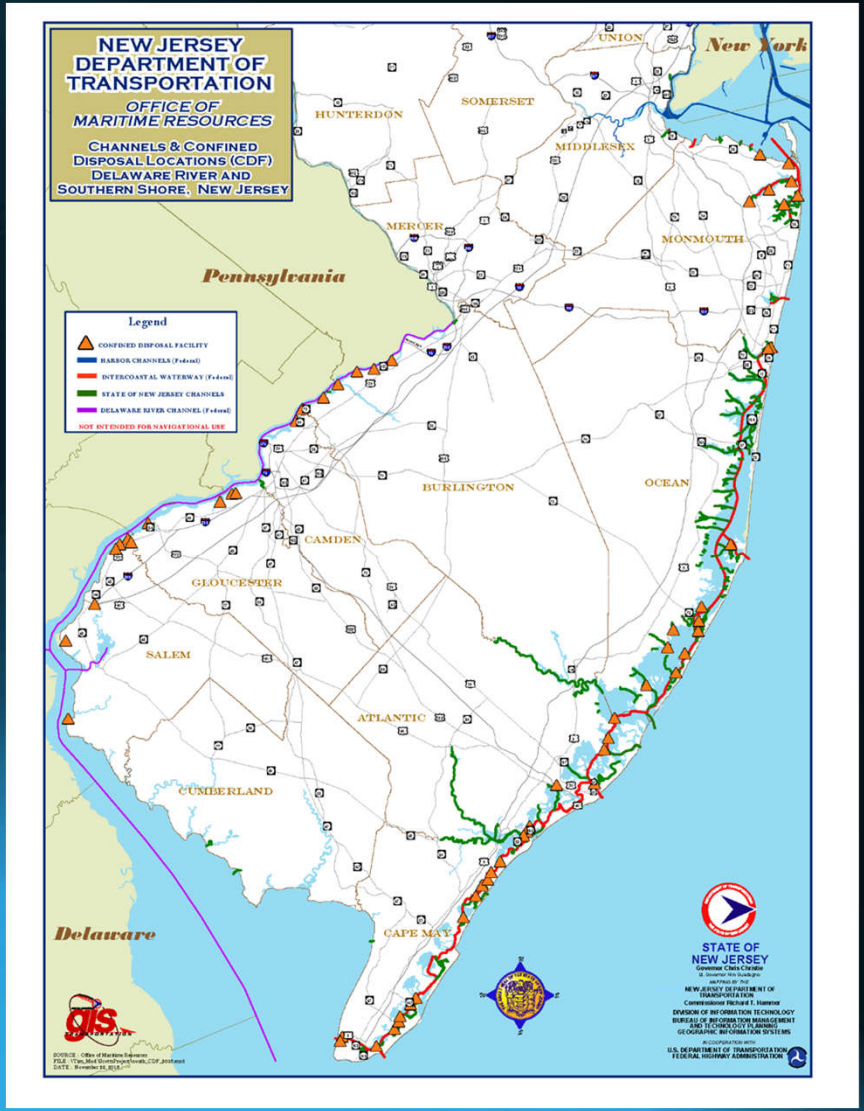
238 locks at 192 locations

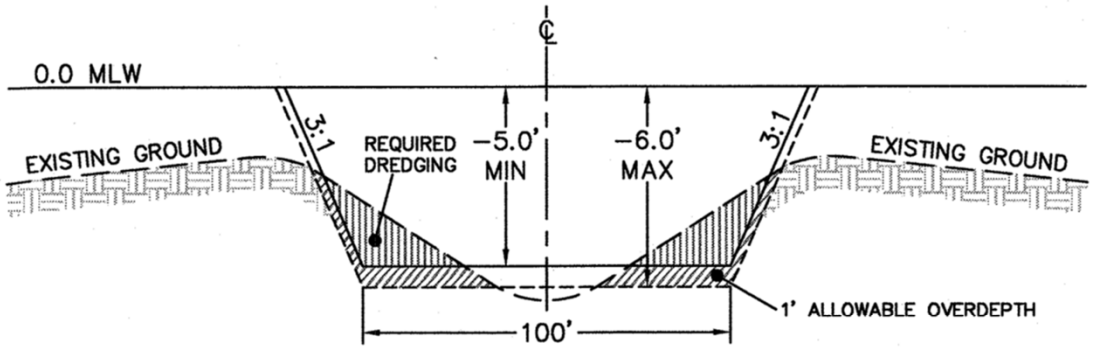
13 million jobs

$750 billion to GDP

New Jersey's Marine Transportation System

- Federal Channels in NY/NJ Harbor, Delaware River, and NJ Intracoastal Waterway; over 465 nm (860 km) of engineered waterways
- State Channel Network - 215 Marked and Identified Channels; over 200 nm (370 km) of engineered waterways
- Two International Ports (PONYNJ and South Jersey Port Corporation)
- Internationally recognized tourism destination
- World Class Fishery (most lucrative shellfishery in the U.S.)
- Worth over $50 billion annually to the New Jersey economy





TYPICAL SECTION: BAY HARBOR STA 0+00.0 to 5+15.0

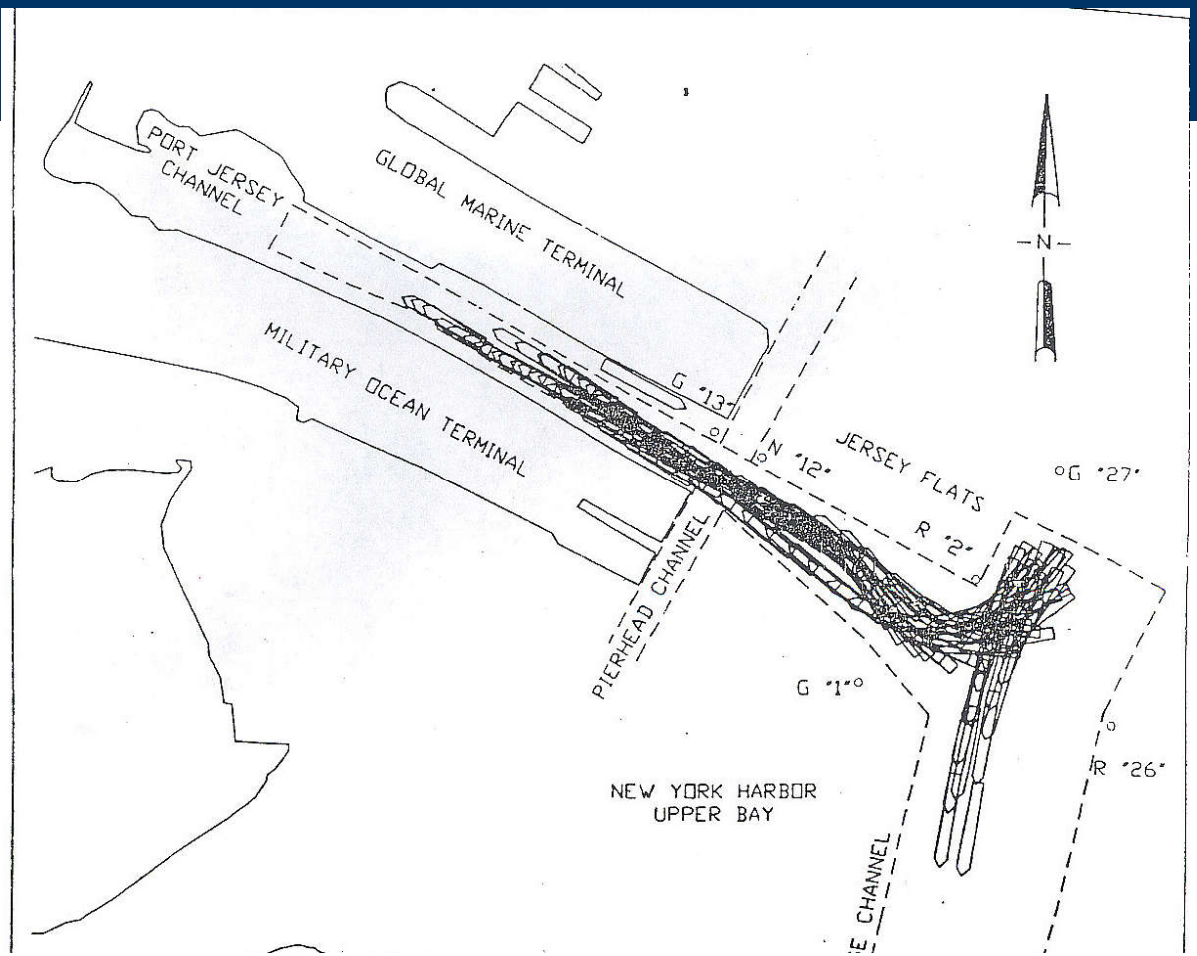
NOT TO SCALE

NOTES:

1. VERTICAL DATUM IS IN REFERENCE TO MEAN LOW WATER (MLW). MLW IS 1.10 FEET BELOW THE NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88). INFORMATION OBTAINED FROM NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION (NOAA) VDATUM DATUM TRANSFORMATION PROGRAM, VERSION 4.0.
2. COORDINATES ARE EXPRESSED IN FEET AND REFER TO THE NEW JERSEY STATE PLANE GRID COORDINATE SYSTEM NORTH AMERICAN DATUM OF 1983 (NAD83).
3. EXISTING SHORELINE (MHWL) & DOCK LOCATIONS ARE BASED ON AERIAL IMAGERY AND SHOULD BE CONSIDERED APPROXIMATE.
4. AERIAL IMAGERY IS FROM GOOGLE MAPS DATED JULY 2018.


US Army Corps of Engineers
New York District
NEW YORK AND NEW JERSEY
50' HARBOR DEEPENING PROJECT
Newark Airport
Port Newark Channel
Port Newark
Newark Bay
Jersey City
Port Elizabeth Channel
Elizabeth Port Authority Marine Terminal
NEW JERSEY
Elizabeth
NEW JERSEY
Bayonne
Constable Hook
Bergen Point
Kill Van Kull Channel
St. George
Arthur Kill Channel
Goethals Bridge
Bayonne Bridge
Staten Island NEW YORK
Brooklyn NEW YORK
Upper New York Bay
Peninsula at Bayonne Harbor

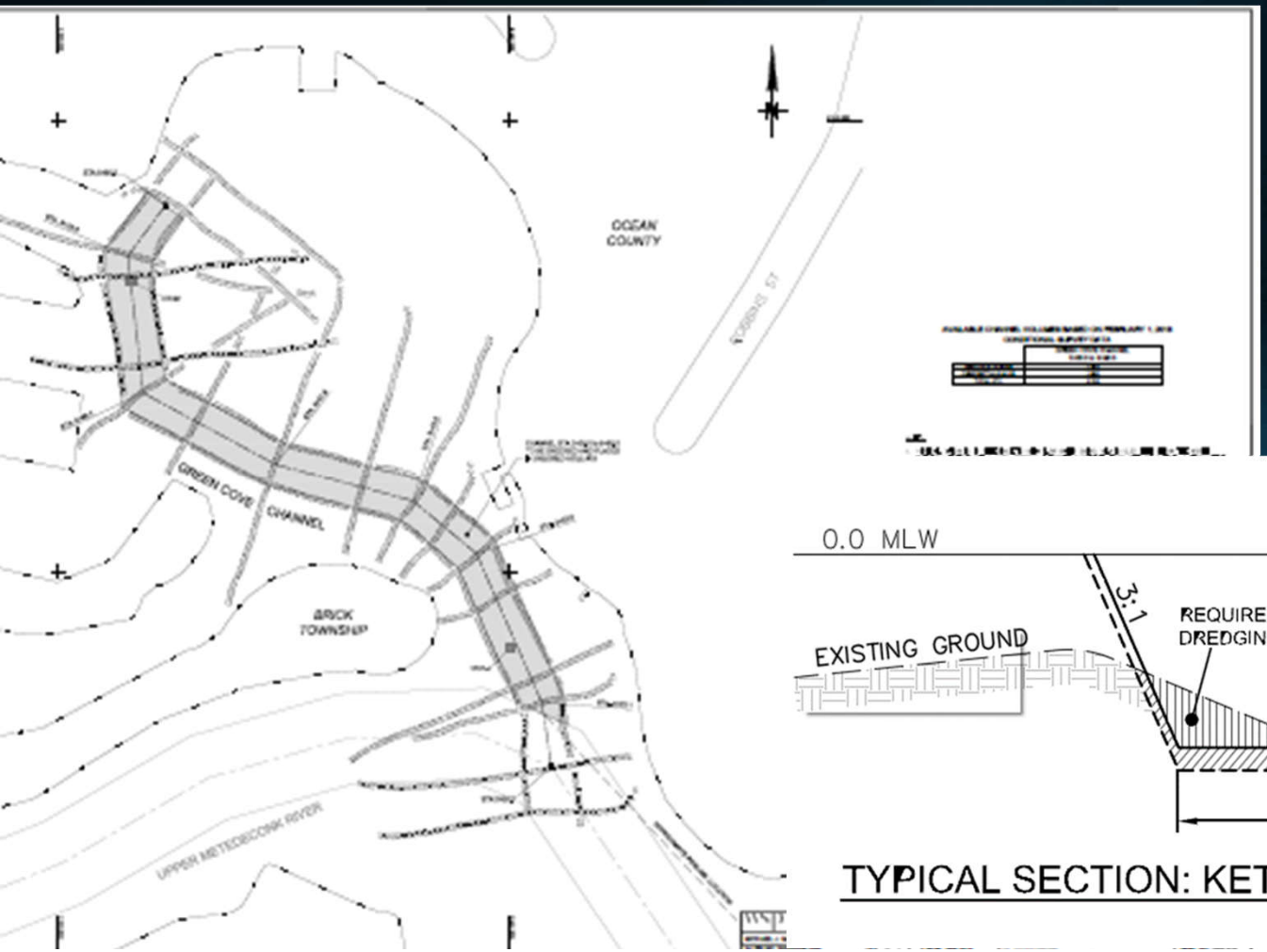
Ship Simulators

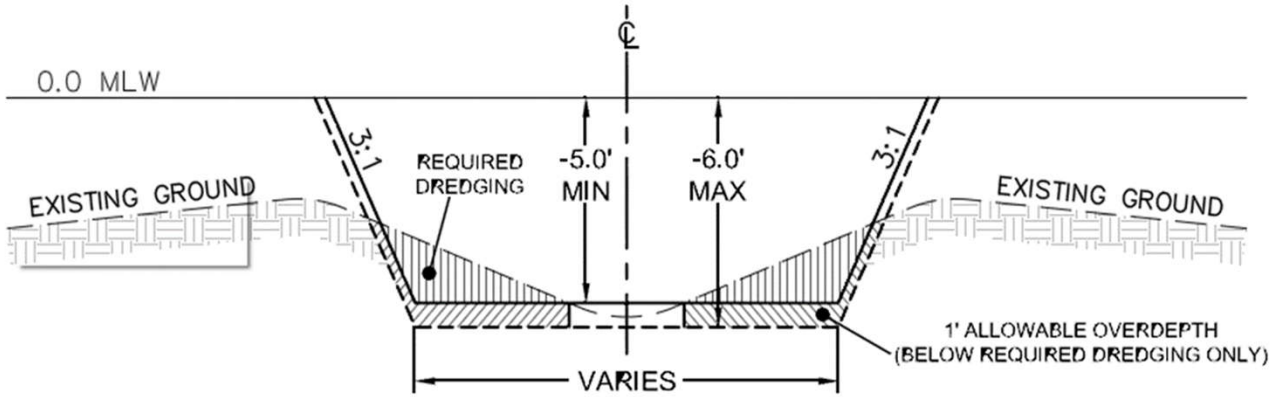


Dredging and Dredging Engineering

Engineered Waterways

- Provide access between shore and deep water for rec. and comm. vessels
- Width and depth are a function of vessel type, location, traffic and sea condition





TYPICAL SECTION: KETTLE CREEK STA 0+00.0 to 152+06.3

NOT TO SCALE

Understanding the Channel Network

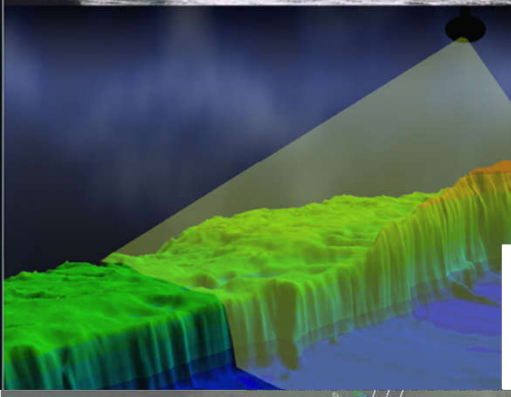
Federal Channels – Access to ocean. Analogous to Interstate Highway System.

State Channels – Connects local and private facilities to the Intercoastal. Analogous to State Highway System.

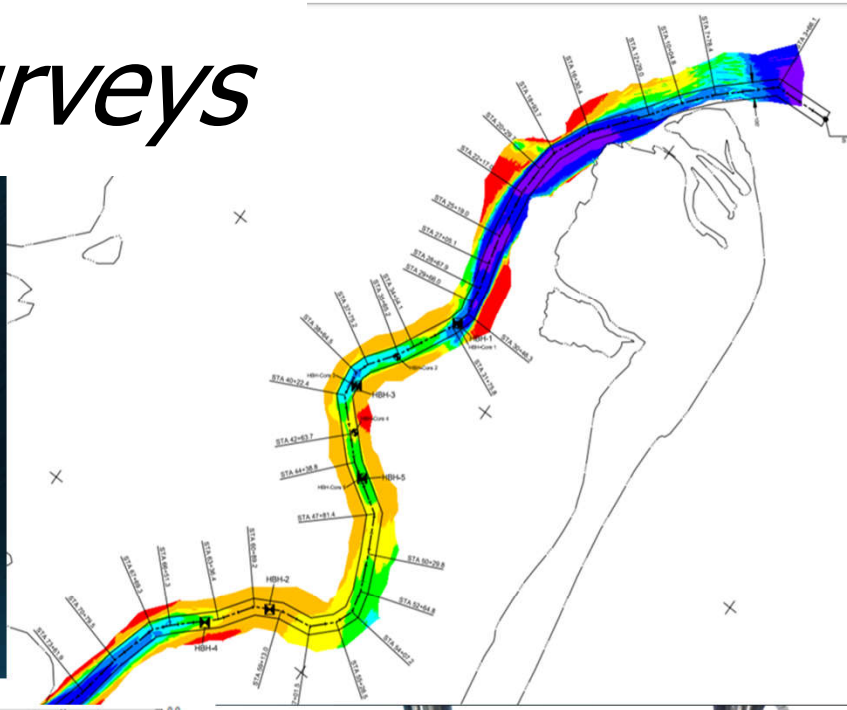
Local Channels – Lagoons, lakes, and low volume use channels. Analogous to County and local roads.

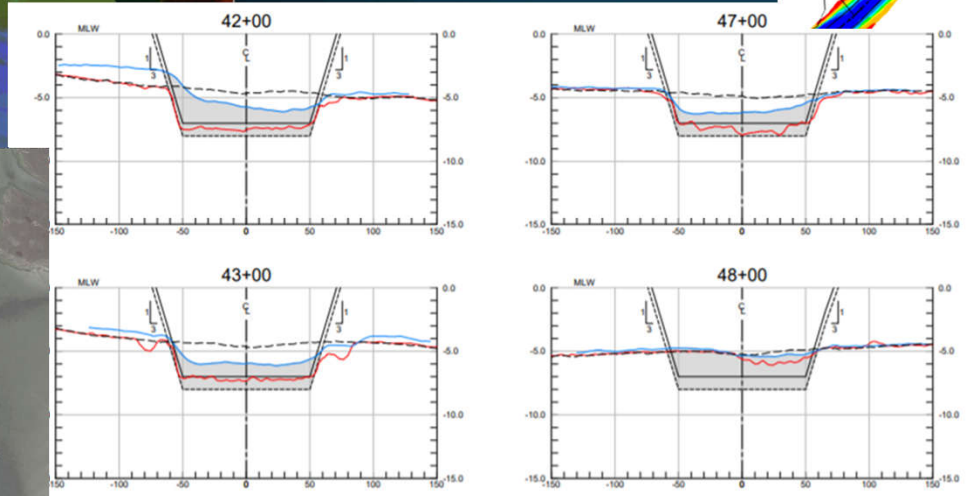
Private Channels – Private residential docks and commercial berths. Analogous to driveways.

Bathymetric Surveys

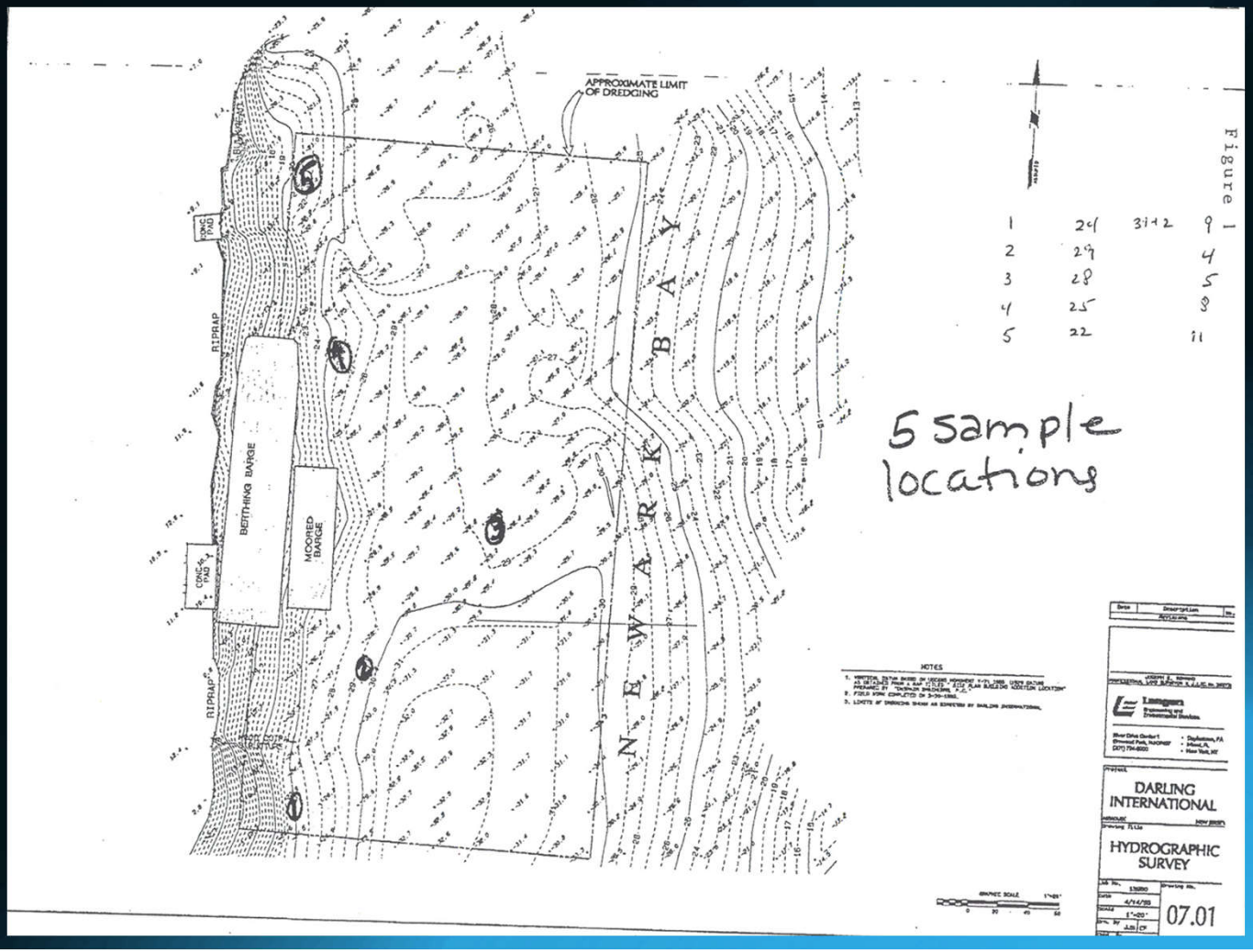


- Boat mounted sonar
- Single-beam or multibeam
- Identify shoal locations/volumes
- Establish navigability



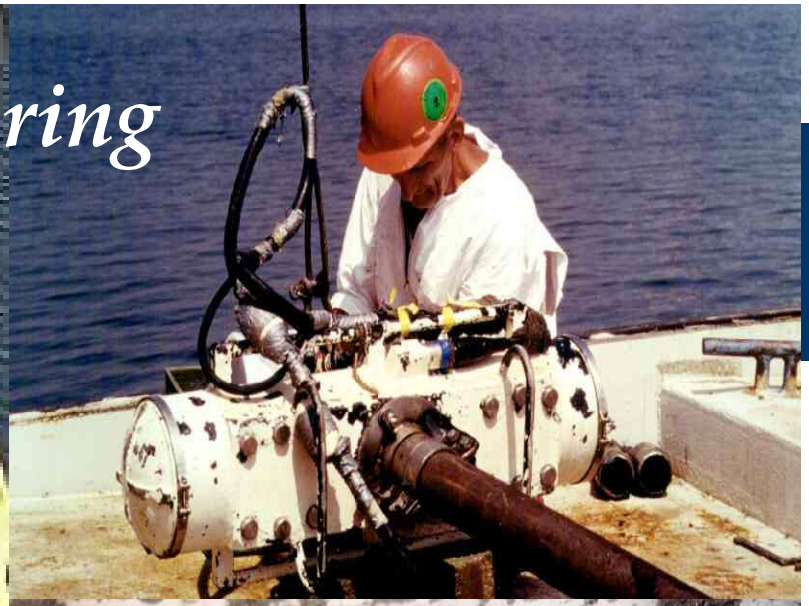


Sediment Sampling and Analysis



- Physical characteristics
- Chemical characteristics
- One sample every 3000 cyd
- Bulk sediment chemistry
- Elutriate testing
- Leachate testing
- Bioaccumulation and Toxicity Testing

Vibracoring



Sand

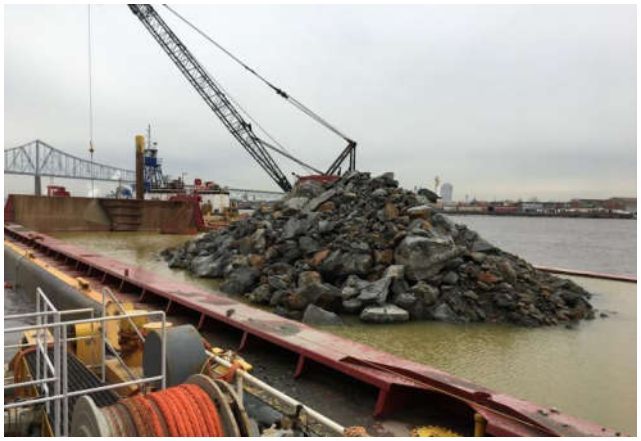
Consolidated Clay

Silt

Glacial Till

Clay

Rock

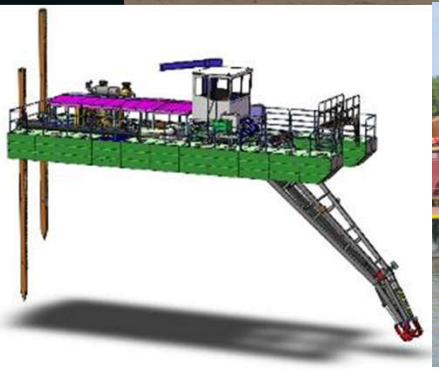


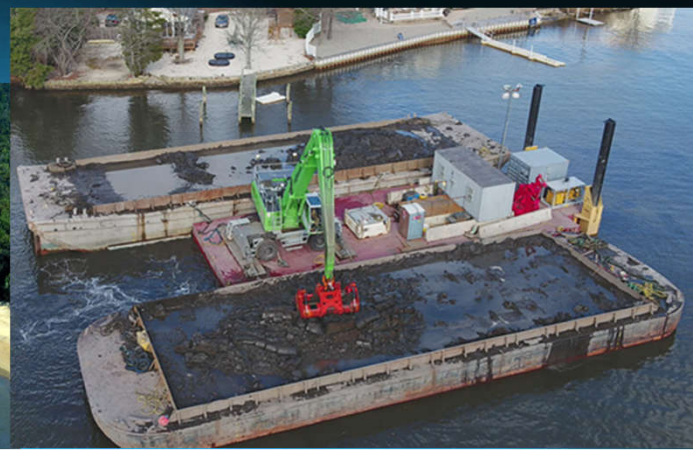
Navigation Dredging in New Jersey

- Deep draft navigation is often performed with large mechanical equipment. Fine grained material is dredged with environmental buckets that limit loss of fines.
- For sand, and on the Delaware River, large hoppers and cutterhead dredges are also used.

Navigation Dredging in New Jersey

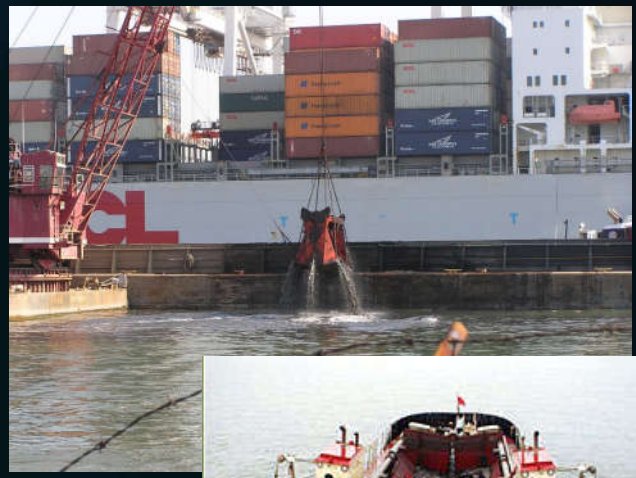
- Shallow draft navigation requires smaller equipment.
- Usually performed using hydraulic cutter head pipeline dredges.
- Can also be performed mechanically with conventional excavators or environmental buckets that limit loss of fines.





NY/NJ Harbor Region

- Clamshell dredging
- Silty clay material
- 2-3 million m^3/yr
- High Debris
- Moderate to High Contamination
- High volume projects
- High economic value

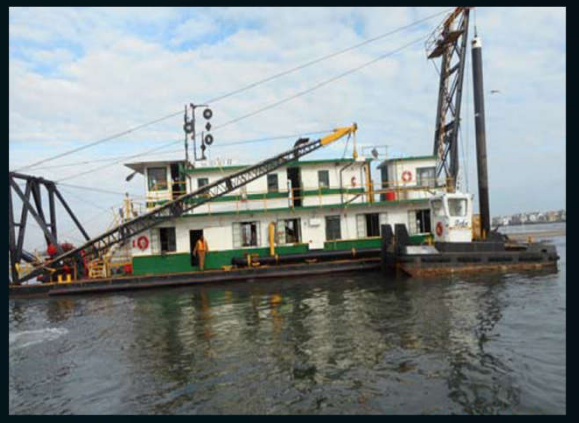


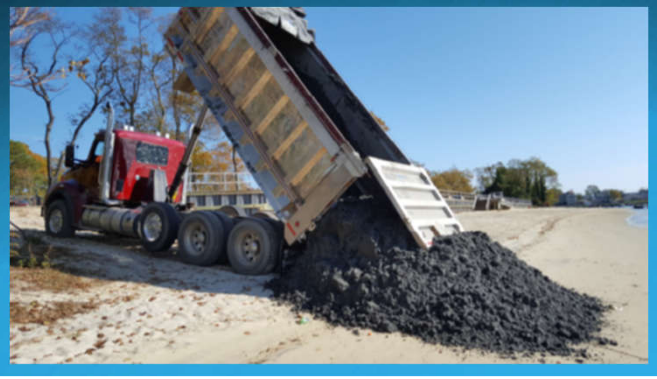
Delaware River Region

- Mixed fine sand to gravel, some silt
- Hydraulic dredging to large, Federally owned and operated CDFs
- 3-4 million m^3/yr
- Moderate economic value
- Low to moderate contamination
- Variable volume jobs
- Low debris

Atlantic Shore Region

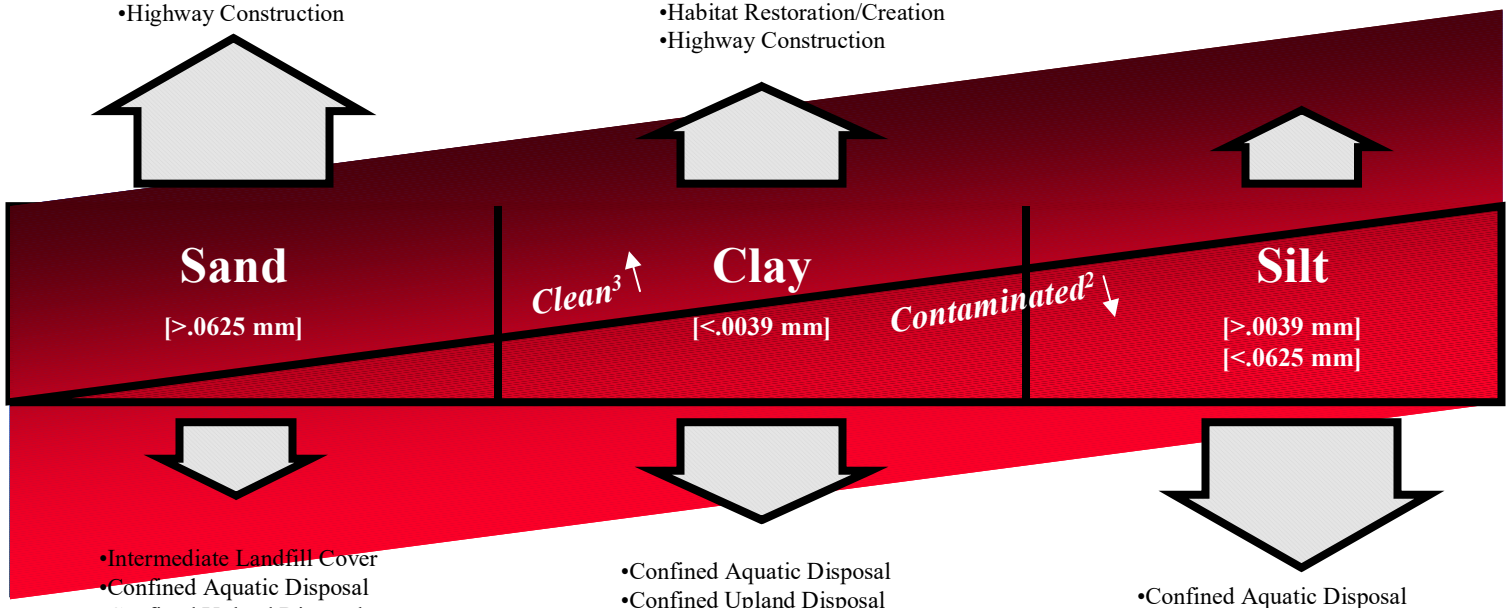
- Mixed from fine sand to silt
- Hydraulic dredging to CDFs
- Less than 400,000 m^3/yr
- Low volume jobs
- Low debris
- Low contamination
- Low economic value





Dredged Material Management

What Happens to Our Dredged Material?



- Manufactured Soil
- Aggregate
- Intermediate Landfill Cover
- Ocean Disposal
- Beach Nourishment[1]
- Habitat Restoration/Creation
- Upland Fill
- Highway Construction

- Manufactured Soil
- Ocean Disposal
- Landfill Final Cap
- Landfill Liner
- Upland Fill
- Nearshore Fill
- Brownfield Cover
- Habitat Restoration/Creation
- Highway Construction

- Upland Fill
- Brownfield Cover
- Habitat Restoration/Creation
- Nearshore Fill
- Manufactured Soil
- Highway Construction

- Intermediate Landfill Cover
- Confined Aquatic Disposal
- Confined Upland Disposal
- Upland Fill
- Nearshore Fill (with Capping)

- Confined Aquatic Disposal
- Confined Upland Disposal
- Nearshore Fill (with Capping)
- Landfill Cap (with Clean Cover)
- Brownfield Cap (with Clean Cover)
- Mine Reclamation

- Confined Aquatic Disposal
- Confined Upland Disposal
- Nearshore Fill (with Capping)
- Landfill Intermediate Cover
- Mine Reclamation
- Brownfield Cap (with Clean Cover)
- Decontamination and Disposal

[1] 75% Sand; grainsize distribution must be equivalent to existing conditions
[2] Uses assume no decontamination
[3] Uses assume clean or decontaminated

Confined Disposal Facilities (CDFs)

- Open earthen berm settling ponds designed to hold slurry from dredge for at least 24 hours. Range in size from 5 acres to over 100 acres

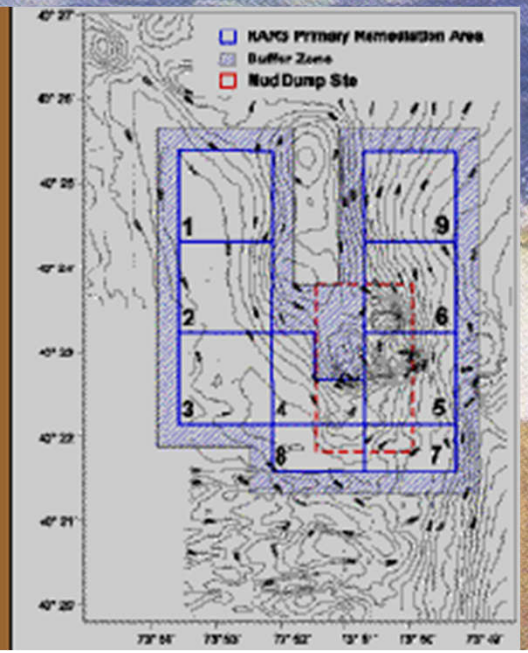
- Requires ample, inexpensive open space. Service area limited by size of dredge.

Beach Replenishment

- Highly desirable beneficial use of clean dredged material
- Can use material from navigation dredging
- Greater than 90% sand for bathing beach
- Greater than 70% sand for non bathing (natural) beach
- Quick and cost effective

Ocean Disposal

- Very efficient and inexpensive way to manage large volumes of dredged material.
- Primary method of disposal for all NY/NJ Harbor sediments for decades
- Fell into disfavor in 1990s due to concerns over contaminants in sediments and risk to fisheries



- Mud Dump became Historic Area Remediation Site (HARS) in 1997
- 1-meter cap
- 40 million cubic yards
- Non-toxic, Non-bioaccumulative


DEFEAT
the MUCK MONSTER

Landfill Capping

Brownfield Reclamation

Raw Dredged Material

Sediment Stabilization

Dredging and Barge Transport

Dewatering (decanting)

- 24 Hour Settling time
- Discharge to same water body or through permitted discharge

Offloading and Debris Screening

Debris

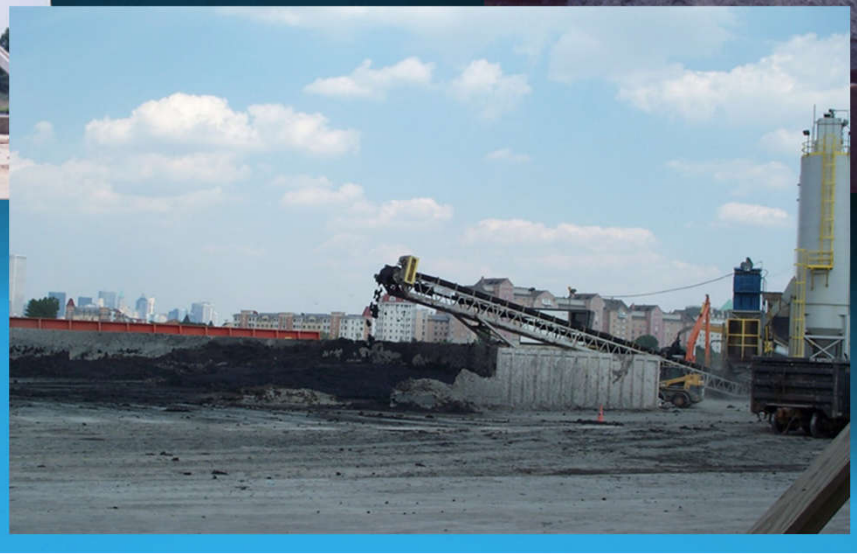
In-Barge Mixing

- 18,000 CY/day
- Poor control of mix

- Must be offloaded within 24 hours
- Low capitalization costs
- High wharfage requirements

Pugmill Mixing

- Good mix control
- 4-6,000 cyd/day

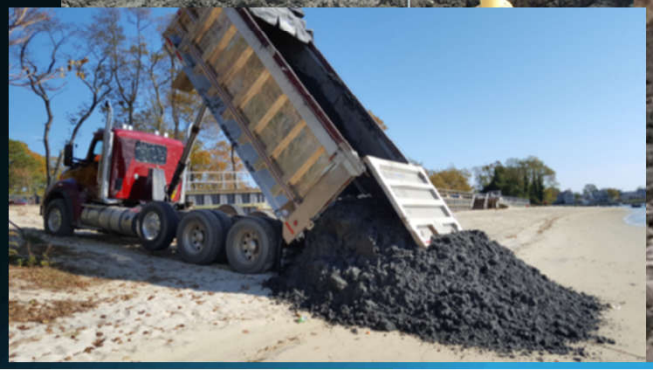


- Can be offloaded directly into trucks or stockpile
- High capitalization costs
- Low wharfage requirements

Processed Dredged Material (PDM)

Curing and Loading

Transportation and Placement

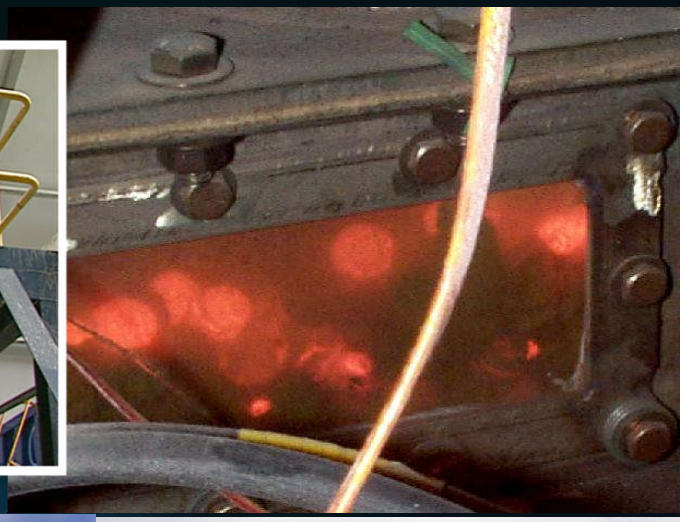


Compaction and Grading

Redevelopment

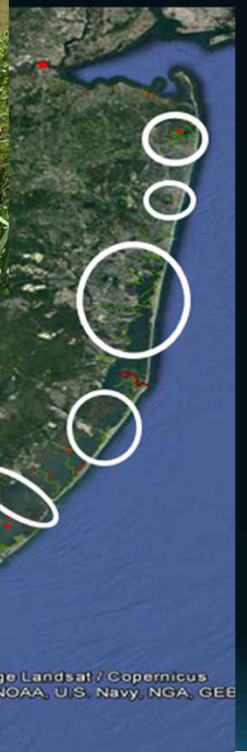
Environmental Manufacturing (decon)

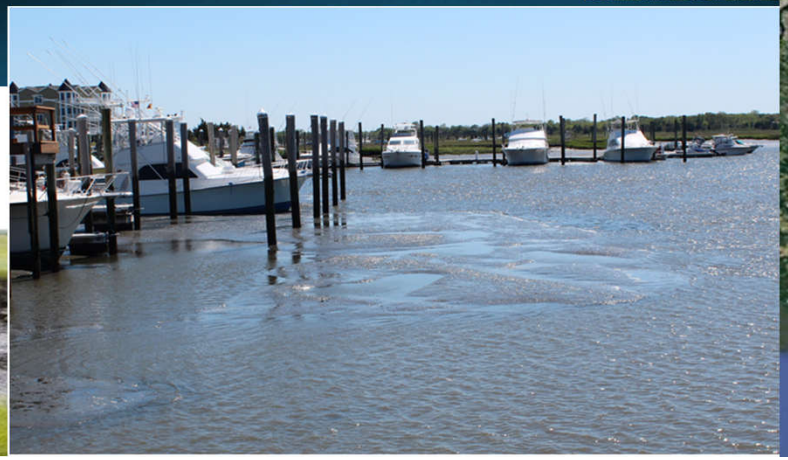
- EPA/NJDOT sediment decontamination technology demonstration program
- Thermal desorption
- Sediment washing
- Chemical destruction
- Enhanced geoamendments
- Theoretically unlimited capacity
- Cost and capitalization



What about clean, small quantity, shallow draft, lower economic value channels?

- Value of a cubic yard
- The GAP problem
- Innovative solutions
- Land use conflicts
- Sea level rise
- Superstorm Sandy
- Resiliency
- Sustainability





Beneficial Use of CDF Material

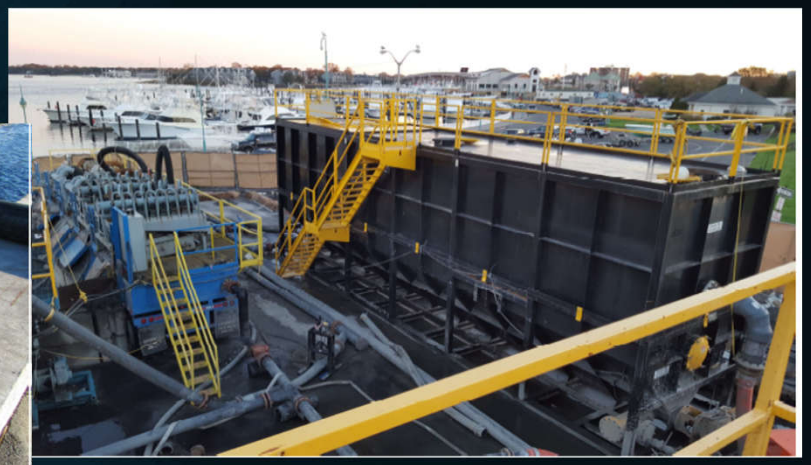
- New CDF locations are difficult if not impossible to find
- Material usually meets residential standards
- Material is suitable for a variety of structural and non structural purposes
- Access can be an issue
- Excavation is costly
- May need to be blended or processed for some uses

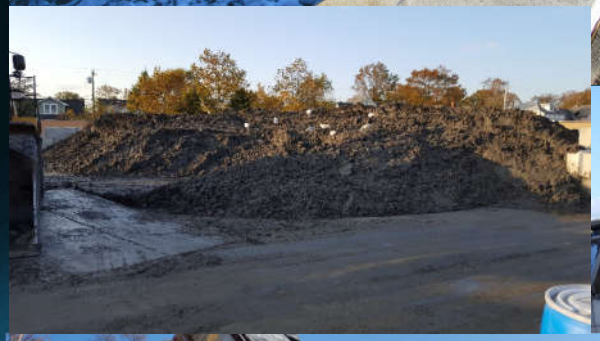
Dredged Material Management Facilities (DMMFs)

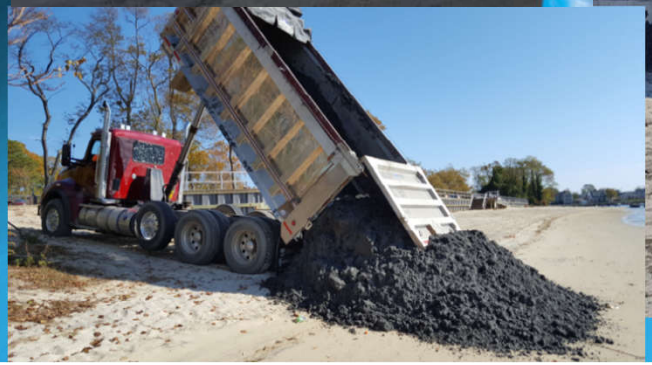
- Renewable Capacity
- Manage material inputs and outputs to increase options, decrease dewatering time and lower costs
- Permanent access roads or docking facilities; staging areas; pipelines
- Regional Sediment Management

Mechanical Dewatering

- What to do when there is no CDF available?
- Dewatering, de-sanding, belt filter presses for fines
- Modular, flexible, and capable of working efficiently on a small footprint
- Produce truckable, stackable solids
- $80-100 per cyd

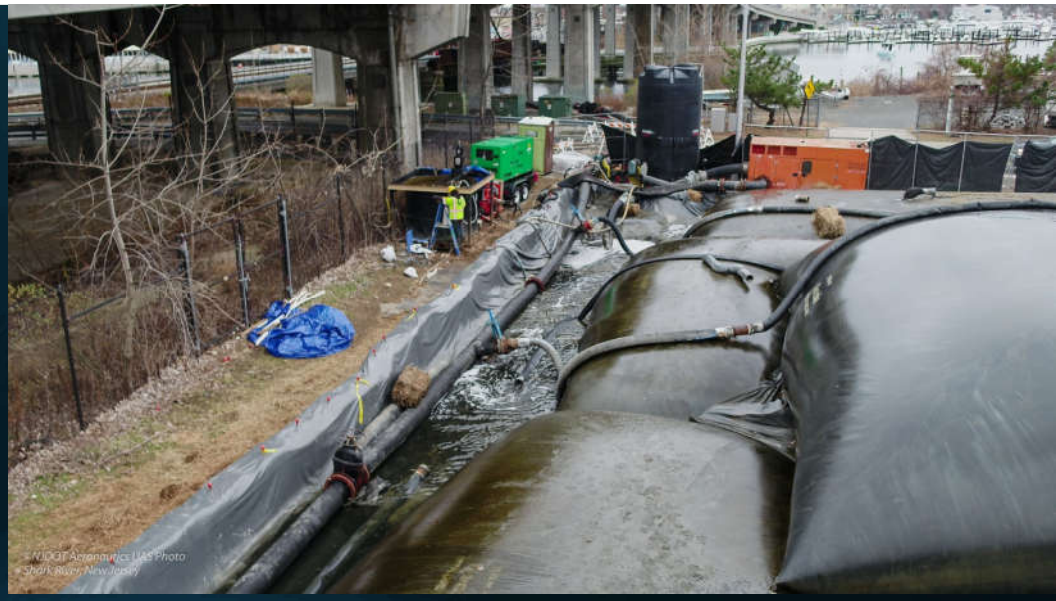


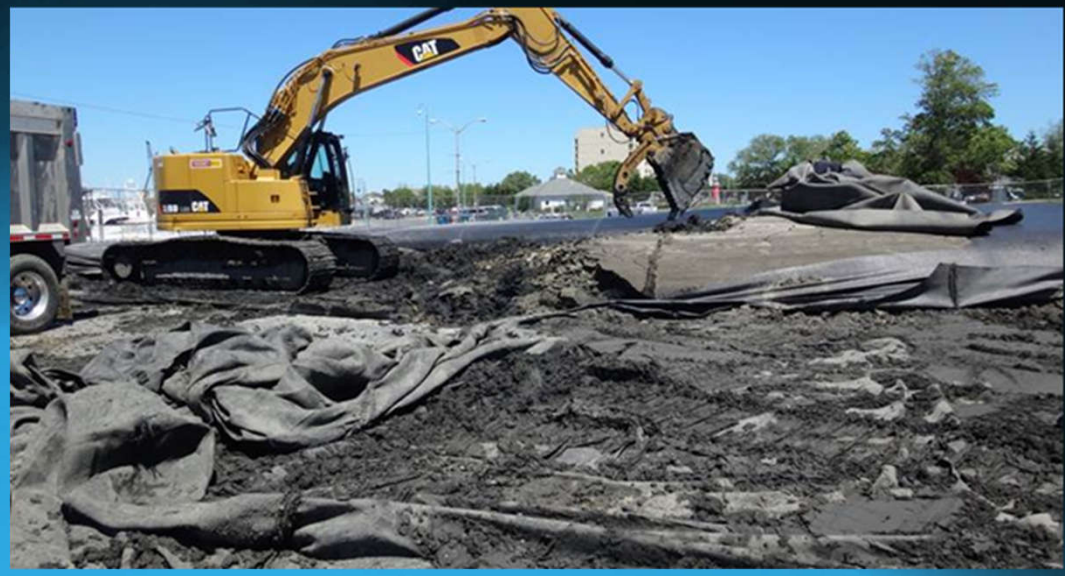




Passive Dewatering

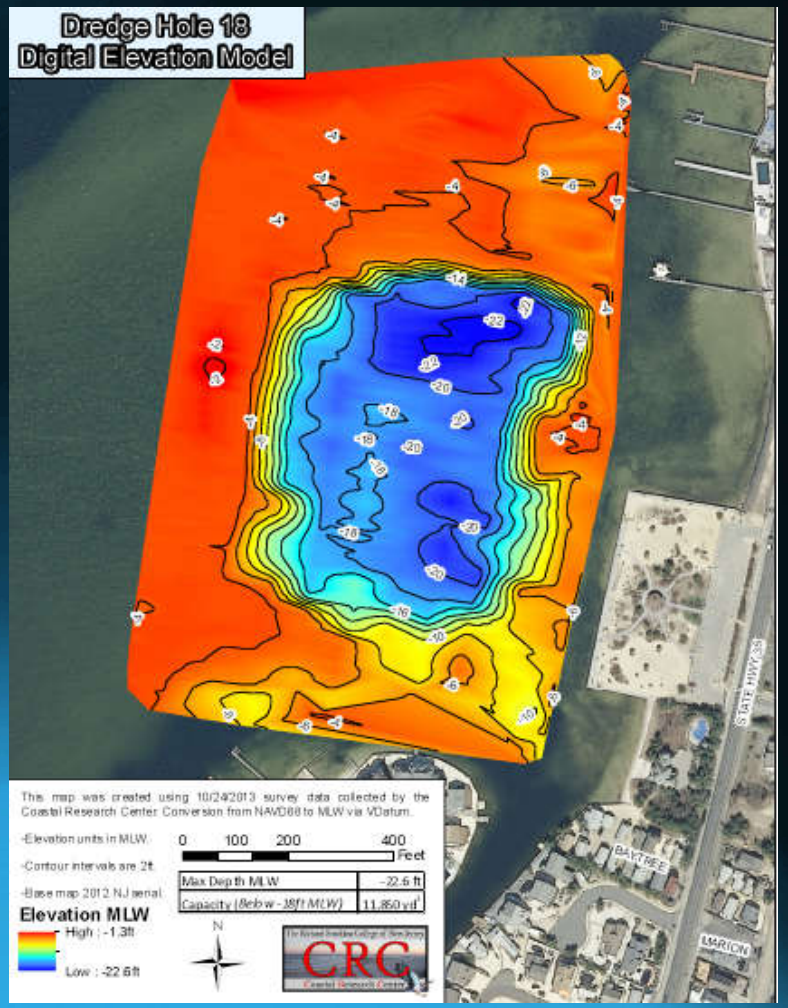
- Geotubes composed of synthetic fabric retain fines, allow water to drain
- Fill directly from hydraulic pipeline
- Polymers used to increase flocculation
- Effluent retained and directed to storage or point discharge
- Custom sizes, stackable
- 16 weeks from silt to transport
- $45-90/cyd



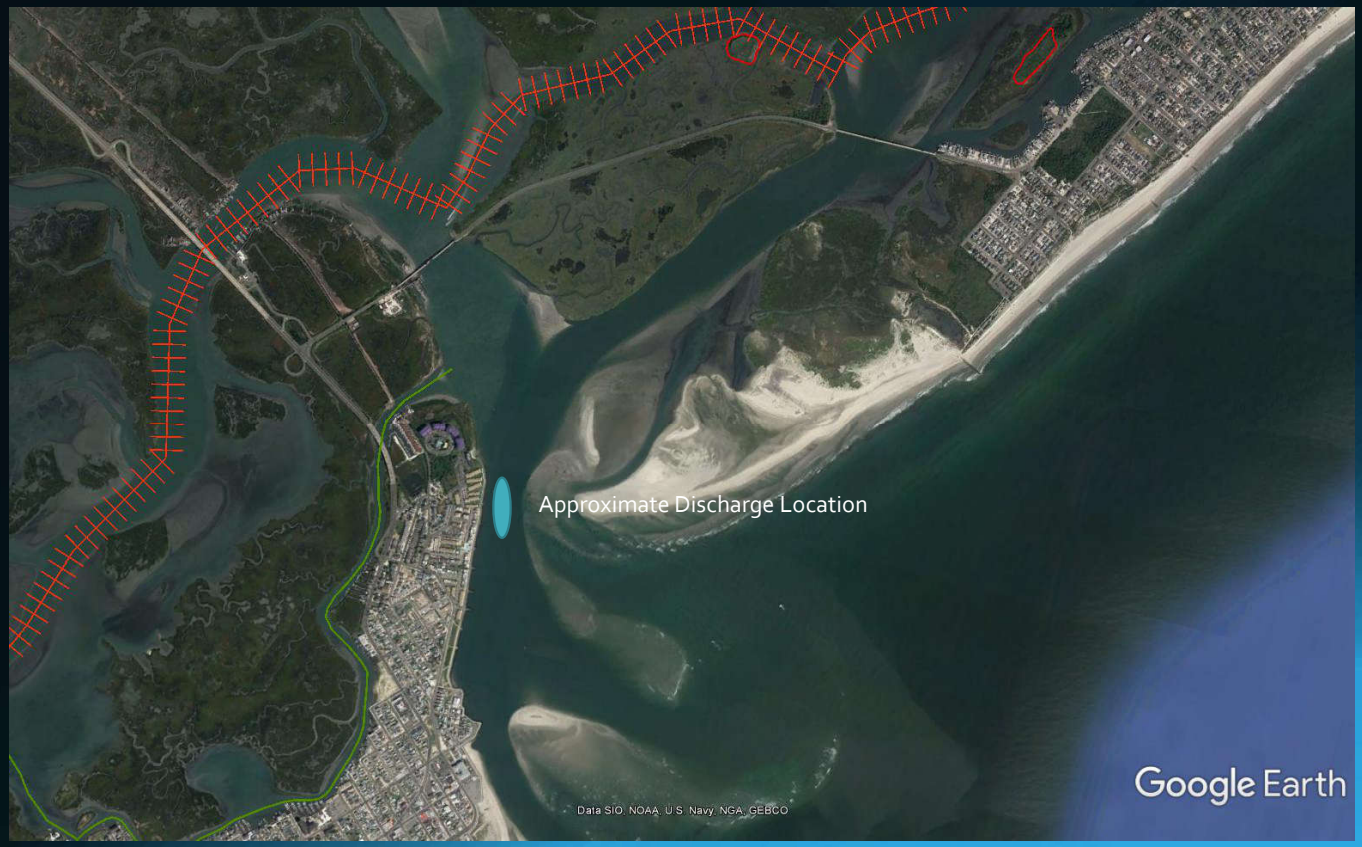


Dredged Hole Restoration

- 5 priority sites identified by Stockton CRC, over 1.1 million cyd of capacity already permitted
- Anoxic or Hypoxic conditions all or part of the year, no benthic life
- Filling will restore shellfish or SAV habitat
- Mechanical or hydraulic dredging and placement
- Cap of coarse grained material to match surrounding bottom
- Monitoring of turbidity during construction
- Monitoring of recovery/restoration after construction
- $50-60 per cubic yard

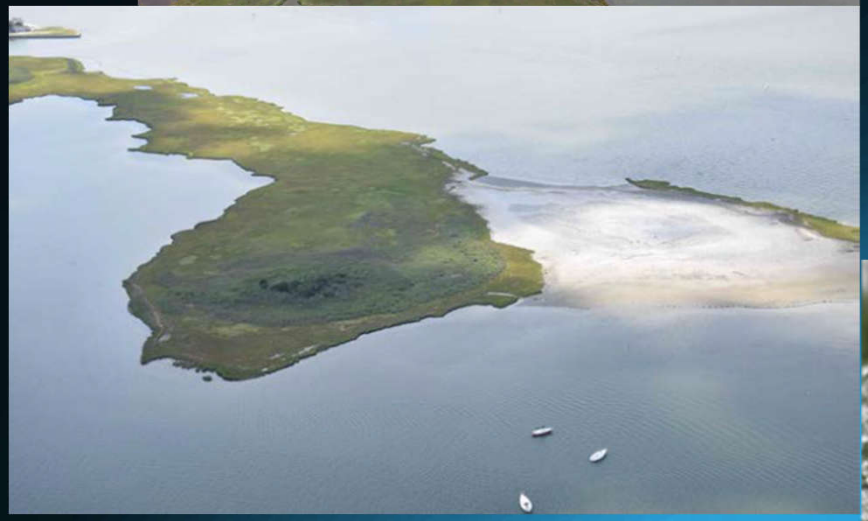


Unconfined Open Water Placement



- High energy environments
- Clean material only
- Use of ebb tide to move material to desired location
- No visual plume or detectable solids in water column
- Seven Mile Island Living Laboratory
- $20/cyd

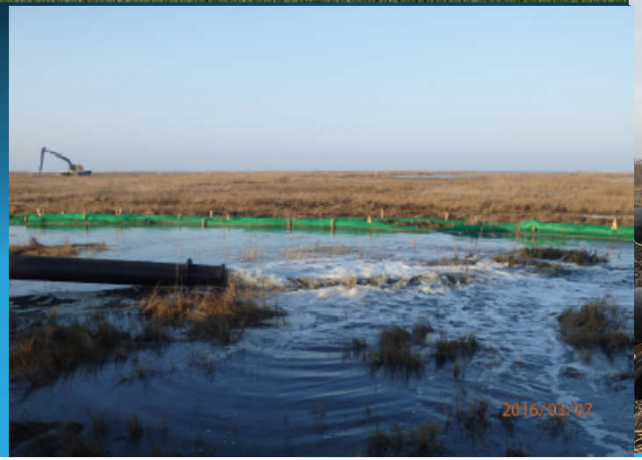
Habitat Creation



- Clean dredged material only
- Usually sand, but other material types could be used
- Refugia from humans and predators in high use areas
- Repeated applications possible
- Highly successful
- $30-60/cyd

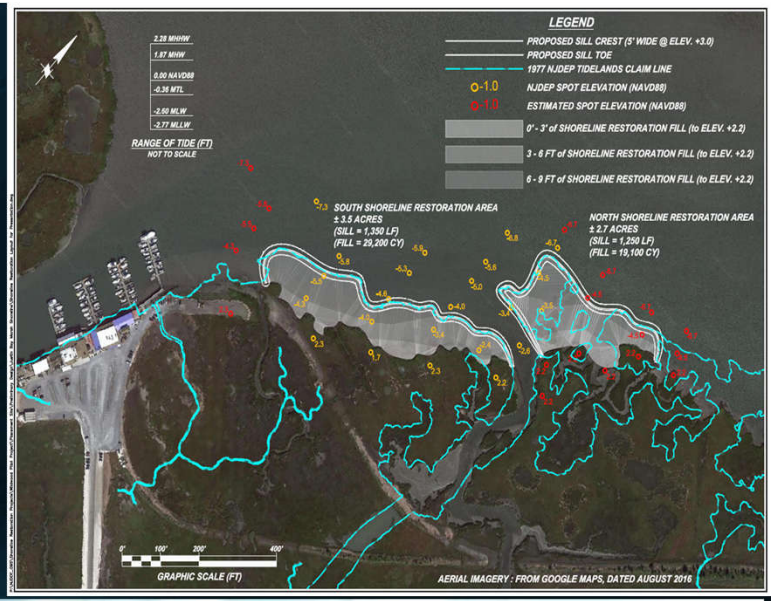
Marsh and Dune Restoration

- Coastal erosion and sea level rise has taken a toll on NJ coastal wetlands
- Dredging has further reduced natural accretion
- Dredged material can be used to restore lost sediment and improve habitat
- Dunes can provide resiliency to restored marsh
- 6,500 cy to marsh, 18,500 cy to dune, 7,000 cy to beach
- $65-105/cy



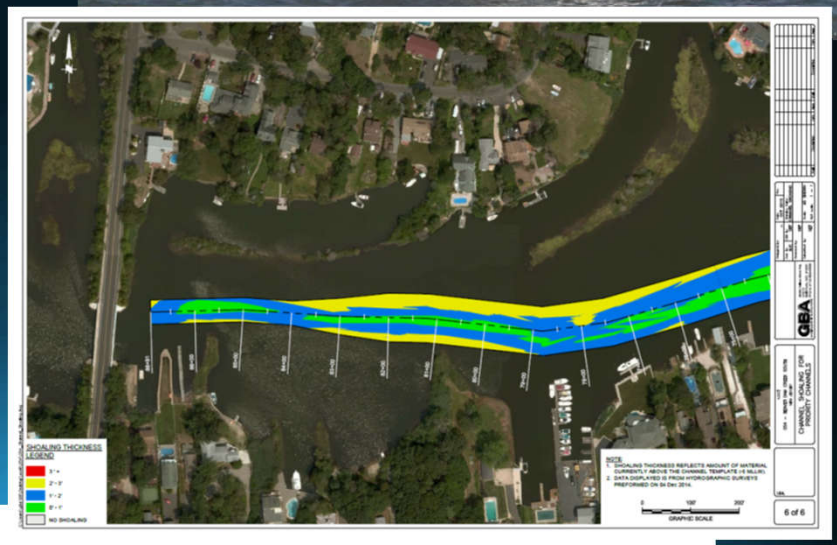
Shoreline Stabilization and Marsh Creation

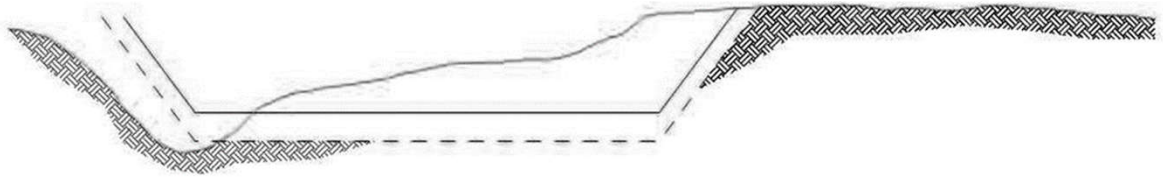
- Replace up to the 1977 shorelines
- Need to retain material, but allow for tidal flushing
- Rock sills are not a natural feature, and very costly
- Replanting accelerates recovery
- High cost >$100/cubic yard



Waterway Linear Segmentation

- Similar to NJDOT Straight Line Diagrams
- User Groups
  - NJDOT OMR
  - State/Federal
  - Public (restricted)
- Data Management
  - Waterway referencing model
  - Navigation channel limits
  - Notable waterway features (marina, boat ramp, CDF, bridge, …)
  - Collected data
- Data Collection
  - Bathymetric survey data
  - In-situ sediment
- Data Analysis
  - Channel conditions
  - Dredging demand





Dredged Material Management System

Data Collection

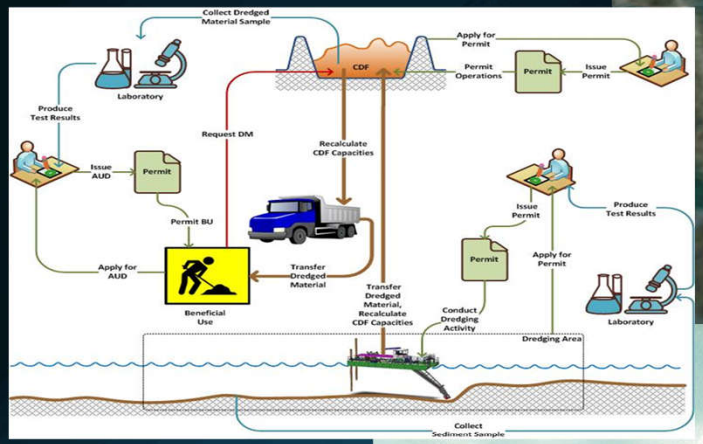
- CDFs map/survey
- Dredged material sampling/analysis
- Permit data
- Beneficial use options

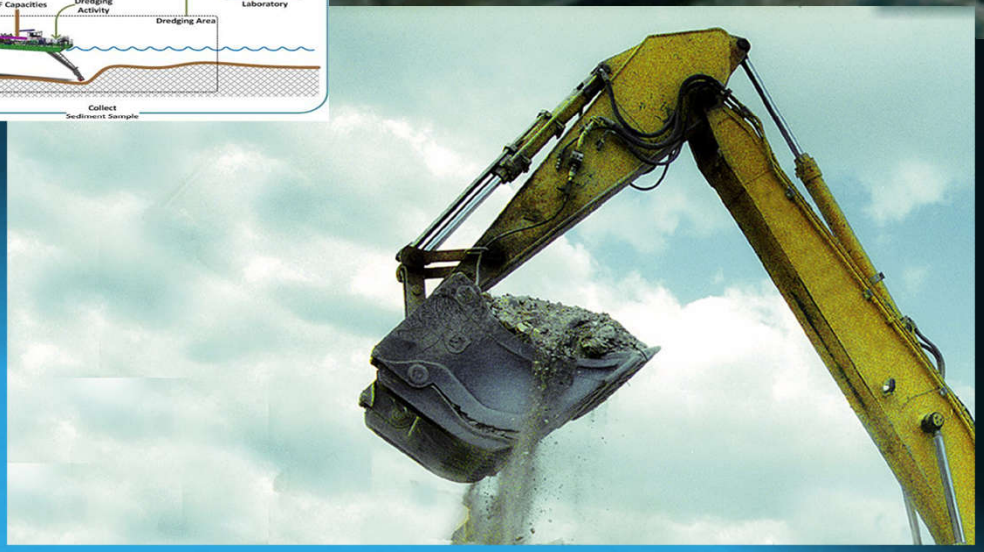
Data Analysis

- CDF capacity
- DM physical/chemical

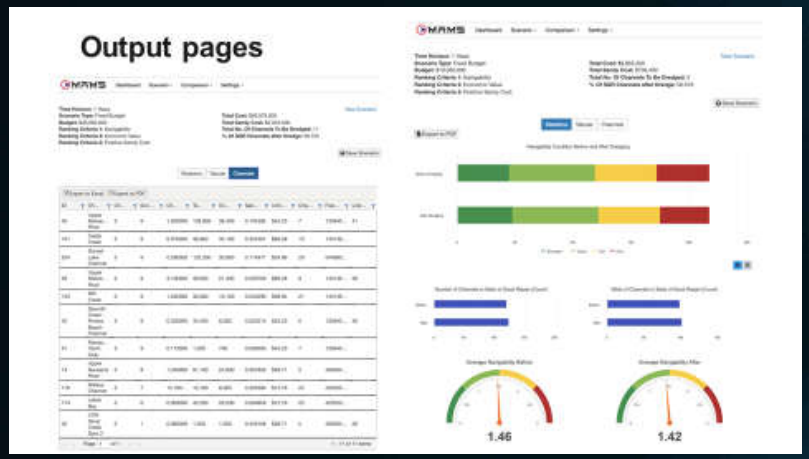
Dredged Material Management

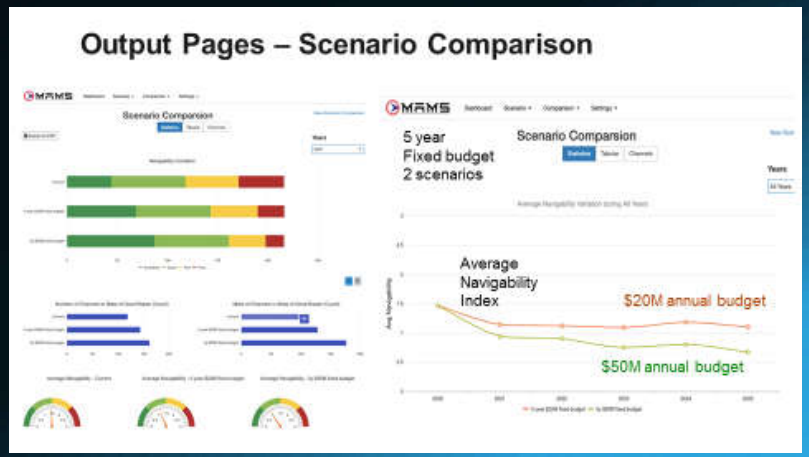
- "Dredged Material Marketplace"
  - Placement options
  - Match dredged material with beneficial use
- CDF planning





Maritime Asset Management System





- Ability to rank channels by condition and value
- Ability to set available funding
- Ability to set goals for "state of good repair"
- Dashboard mimics those used in highway and bridge programs
- Objectively determines channels for "just in time" maintenance
- Future versions will be "smart" enough to evaluate shoaling patterns and predict rate of "decay".

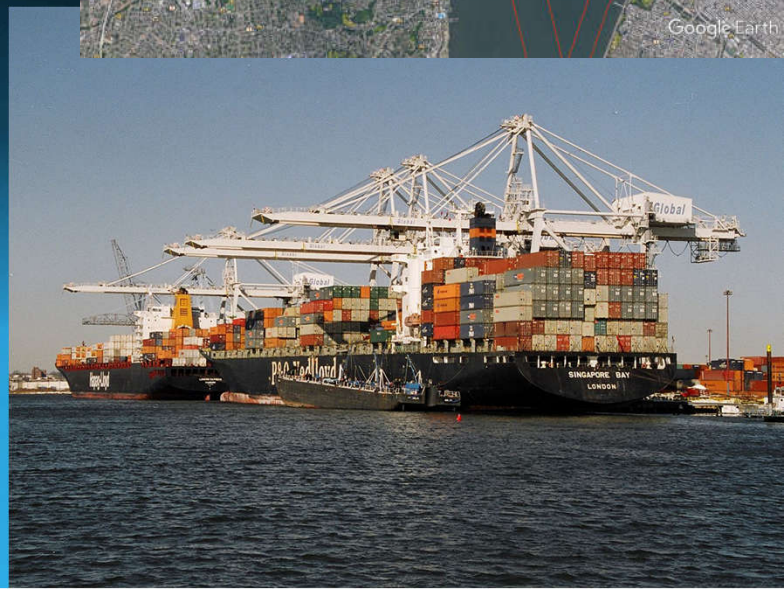
State Channel Dredging Program Success to Date

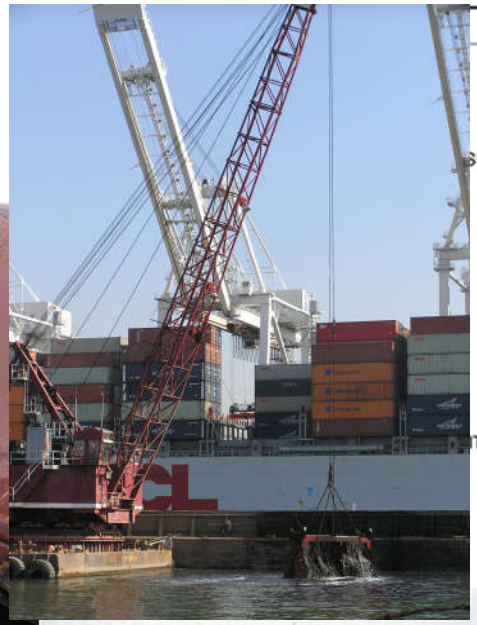
- >1.2 million cubic yards dredged and placed
- 54 channels cleared
- 45 nautical miles of waterway opened
- Cost of >$75 million
- ~25 percent FEMA reimbursed to State
- 2 new CDFs
- 5 CDFs restored capacity

Case Studies

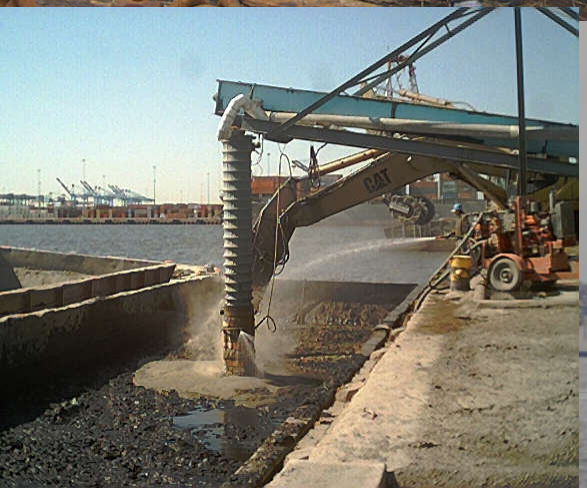
Case Study One: Port Jersey Channel

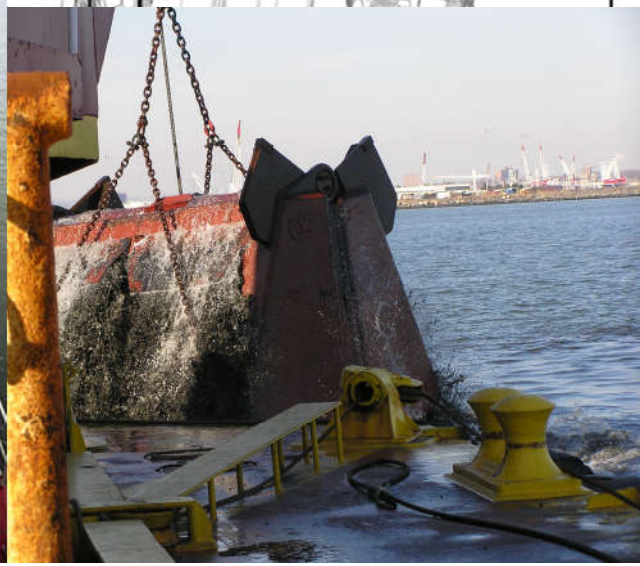
- Super Post Panamax capability Room for expansion of container capacity
- Easiest navigation pathway to Port from Ocean
- Jersey Flats (mitigation required)
- PVSC Tunnel (protection required)
- HARS placement – 2.2 million cy
- Upland placement – 1.6 million cy
- South MOTBY channel restoration/Jersey Flats mitigation – 0.94 million cy
- 475-1700 ft wide x 1.6 miles long x 50 ft deep
- $120 million (cost to State)
- 10 years to complete

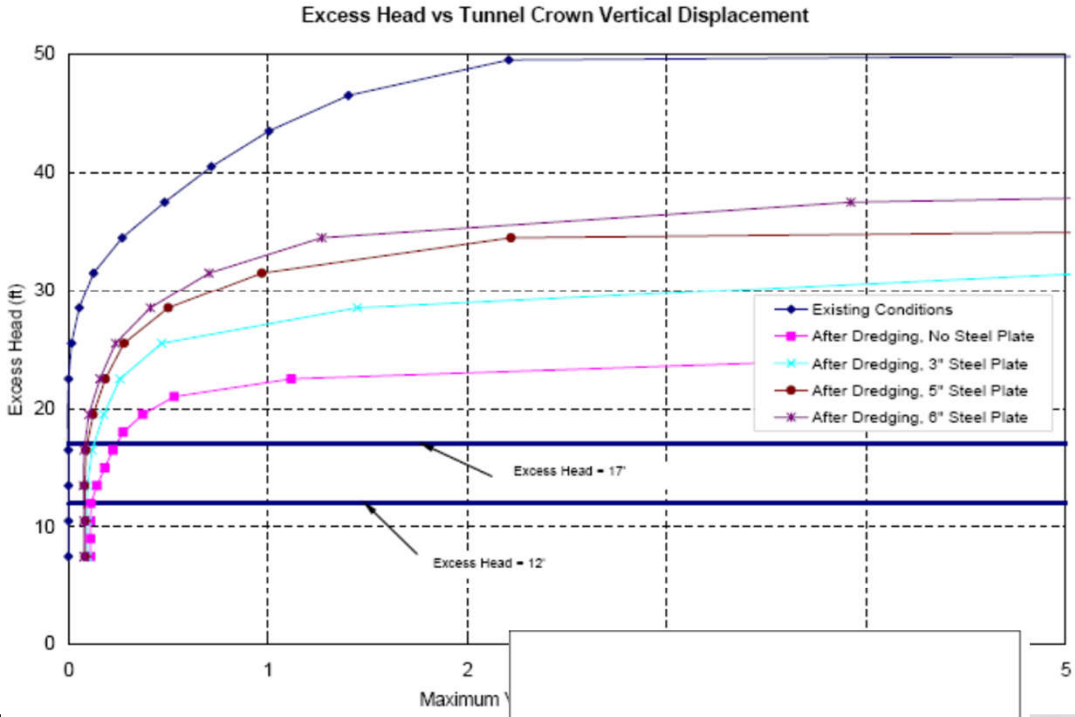


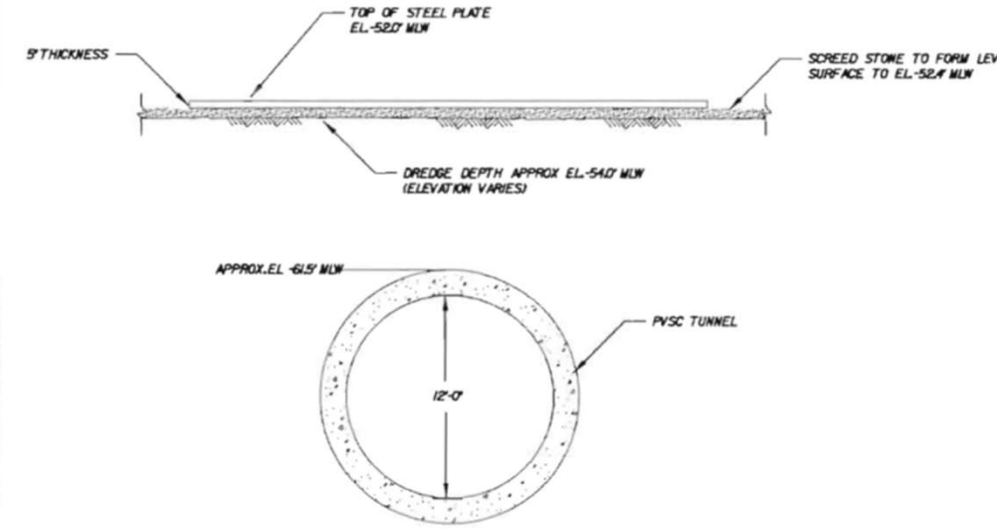


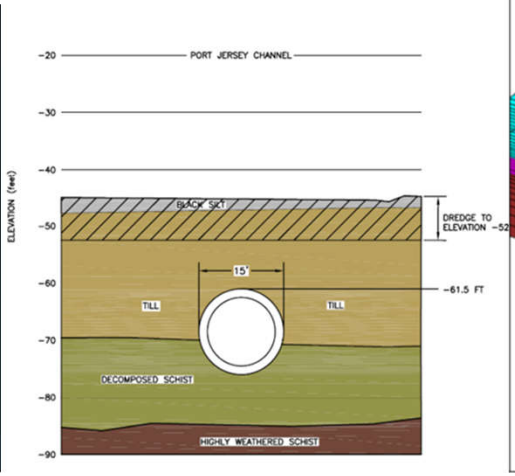

SITE 3
ITE 1
ITE 2

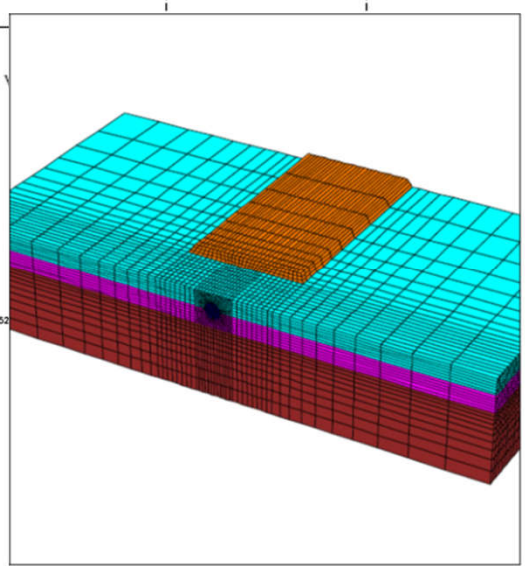


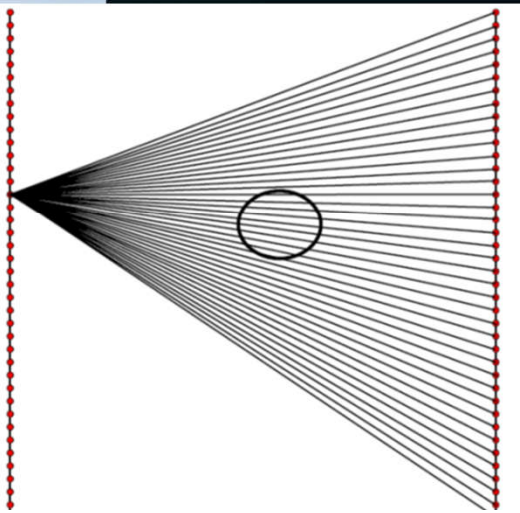



Excess Head vs Tunnel Crown Vertical Displacement
Excess Head (ft)
Existing Conditions
After Dredging, No Steel Plate
After Dredging, 3" Steel Plate
After Dredging, 5" Steel Plate
After Dredging, 6" Steel Plate
Excess Head = 17'
Excess Head = 12'
0
10
20
30
40
50
0
1
2
5


TOP OF STEEL PLATE
EL.-52.0' MLW
5" THICKNESS
SCREED STONE TO FORM LEV
SURFACE TO EL.-52.4' MLW
DREDGE DEPTH APPROX EL.-54.0' MLW
(ELEVATION VARIES)
APPROX.EL -61.5' MLW
PVSC TUNNEL
12'-0"

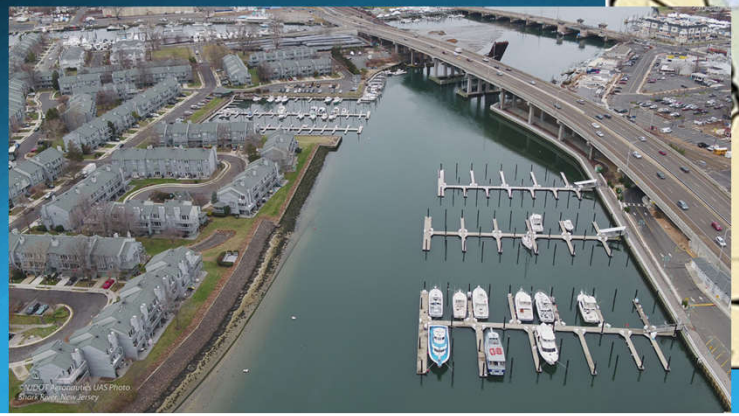

PORT JERSEY CHANNEL
BACK SLT
DREDGE TO
ELEVATION -52
15'
-61.5 FT
TILL
TILL
DECOMPOSED SCHIST
HIGHLY WEATHERED SCHIST
ELEVATION (feet)
-20
-30
-40
-50
-60
-70
-80
-90

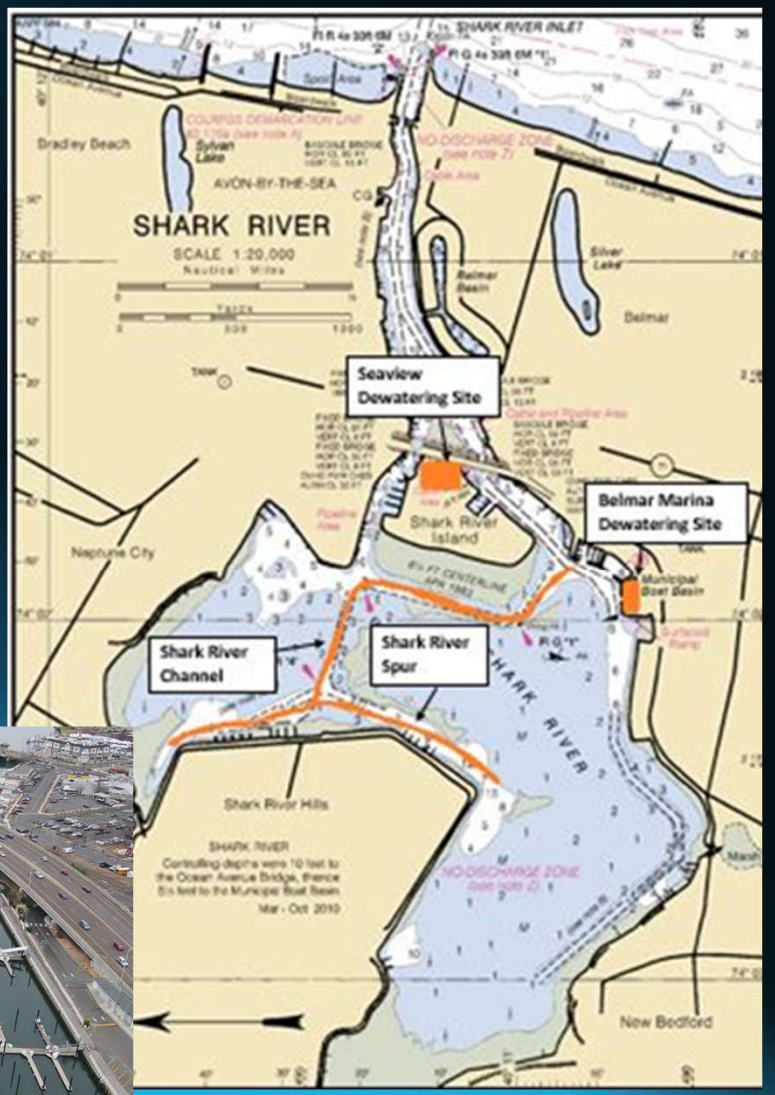


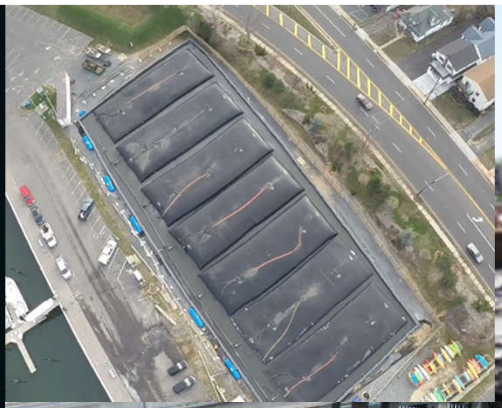


Case Study Two: Shark River

- Severe shoaling, significantly worsened by Superstorm Sandy
- Lack of disposal options
- Site availability issues
- Weather issues
- Mechanical dewatering
- Passive dewatering
- Beneficial use at Monmouth County Landfill
- 1.5 miles of channel
- 6-7 ft x 100 ft
- 68,500 cy
- $7 million
- 3 dredging seasons

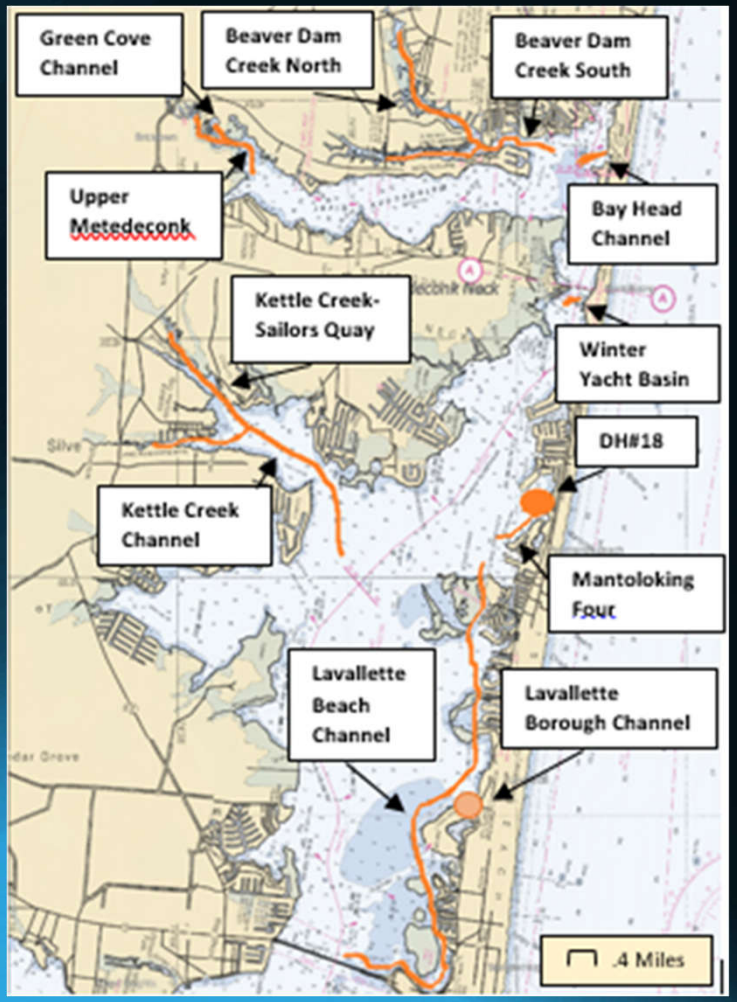




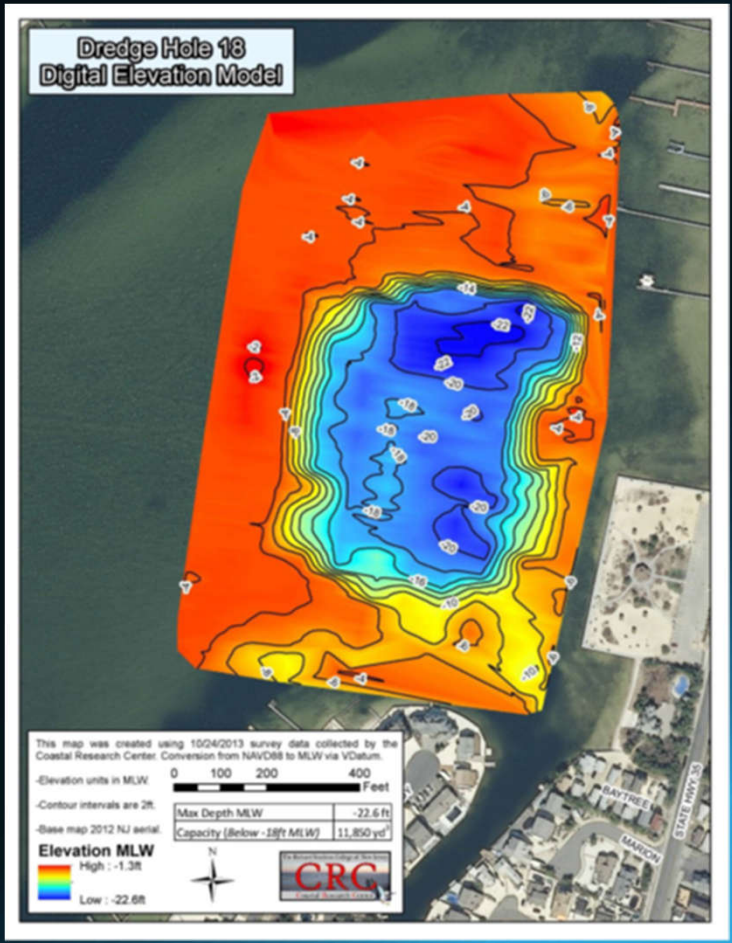


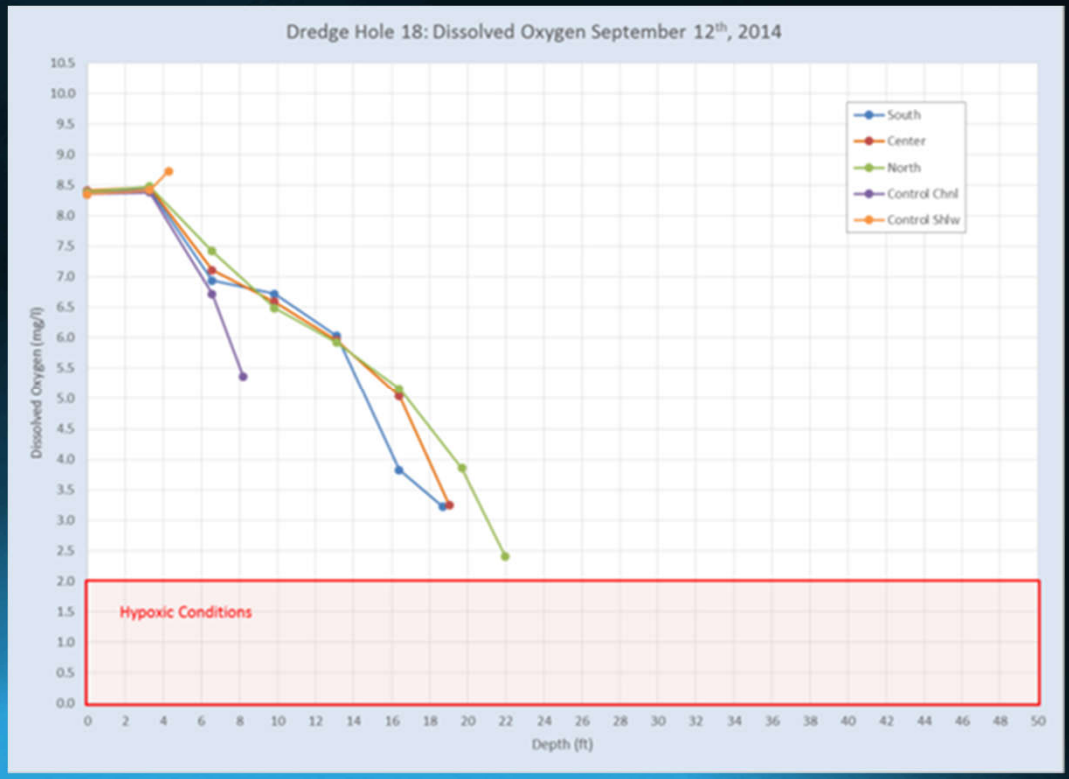
Case Study Three: Upper Barnegat Bay

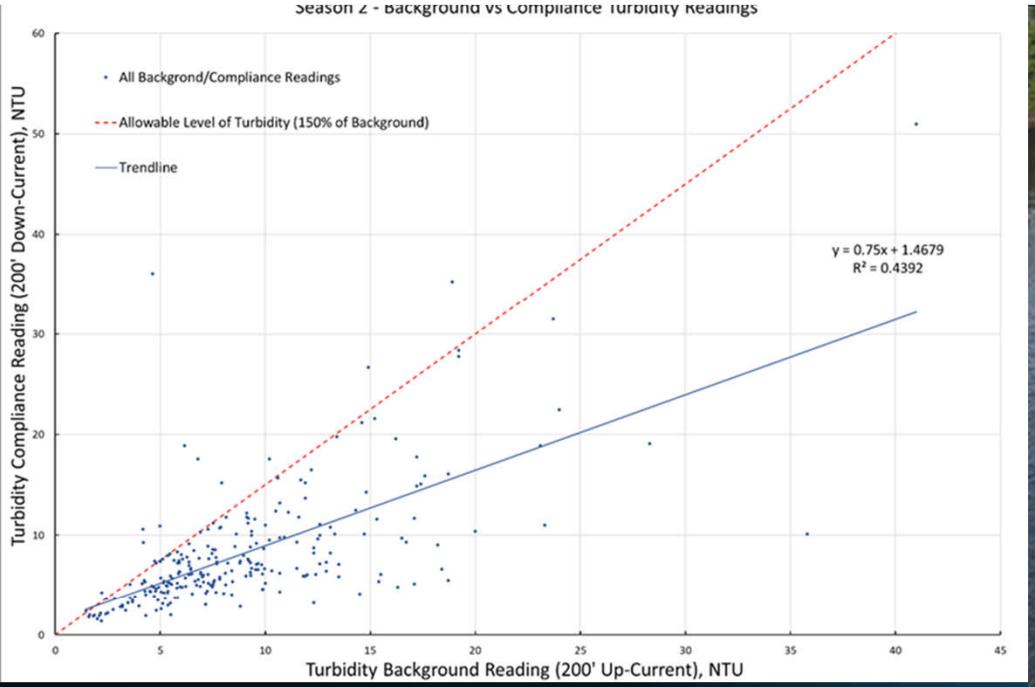
- Lack of disposal options
- 10 channels (6 were severely shoaled)
- 1 municipal boat ramp
- Restoration of dredged hole 18
- Turbidity monitoring
- SAV/benthos/wq monitoring plan
- 13.25 miles of channel
- 6-7 ft x 100 ft
- 210,000 cyd
- $18 million
- 2 dredging seasons



Restoration of Subaqueous Borrow Pits






Season 2 - Background vs Compliance Turbidity Readings
All Backgrond/Compliance Readings
Allowable Level of Turbidity (150% of Background)
Trendline
y = 0.75x + 1.4679
R² = 0.4392
Turbidity Compliance Reading (200' Down-Current), NTU
Turbidity Background Reading (200' Up-Current), NTU
0
10
20
30
40
50
60
0
5
10
15
20
25
30
35
40
45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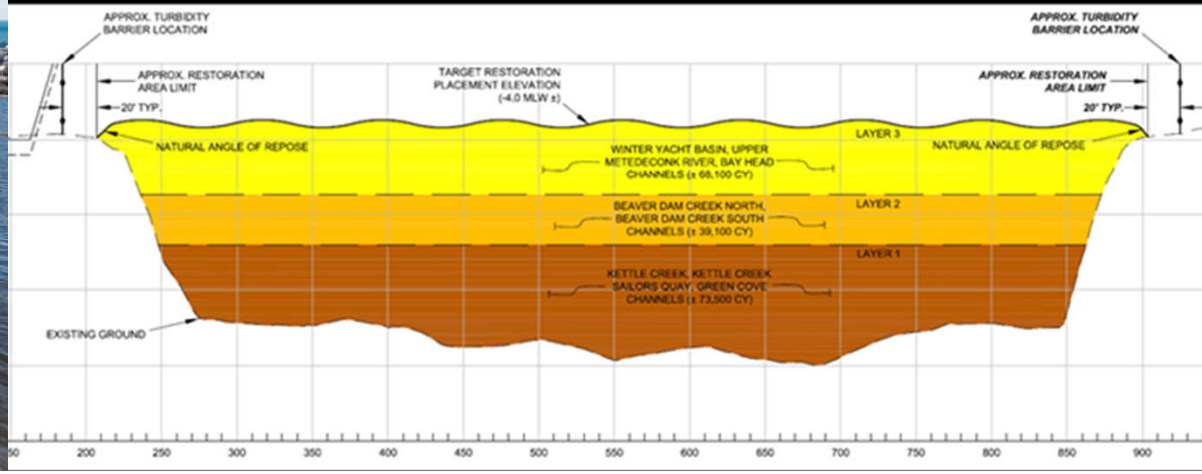
Metedeconk River, 20181203


APPROX. TURBIDITY BARRIER LOCATION
APPROX. RESTORATION AREA LIMIT
20' TYP.
TARGET RESTORATION PLACEMENT ELEVATION (-4.0 MLW ±)
NATURAL ANGLE OF REPOSE
WINTER YACHT BASIN, UPPER METEDECONK RIVER, BAY HEAD CHANNELS (± 68,100 CY)
BEAVER DAM CREEK NORTH, BEAVER DAM CREEK SOUTH CHANNELS (± 39,100 CY)
KETTLE CREEK, KETTLE CREEK SAILORS QUAY, GREEN COVE CHANNELS (± 73,500 CY)
LAYER 3
LAYER 2
LAYER 1
EXISTING GROUND
APPROX. TURBIDITY BARRIER LOCATION
APPROX. RESTORATION AREA LIMIT
20' TYP.
NATURAL ANGLE OF REPOSE
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900

2020 Projects

Ongoing Dredging Projects:

- Beach Haven Complex
  - 10 channels ~ 39,000 cubic yards
- Ludlam CDF Repair
  - Capacity: 195,000 cubic yards
- Story Island CDF Repair
  - Capacity: 82,000 cubic yards
- Gateway DMMF Construction
  - Capacity: 525,000 cubic yards

Upcoming Dredging Projects:

- Good Luck Point (4 channels)
  - Marsh enhancement
  - Near shore berm
- Toms River North (5 channels)
  - Dredged hole restoration
- Lakes Bay (4 channels)
  - Dredged hole restoration
- Brigantine (2 channels)
  - Beach replenishment
  - Mudflat restoration

Upcoming Dredging Plans

Projects:

- Absecon Creek
- West Creek Complex- 4 Channels
- Tuckerton Complex – 3 Channels
- Shrewsbury Navesink – 26 Channels
- Manasquan Phase II – 5 Channels
- Wildwood Complex- 5 Channels
- Ship Bottom Complex- 5 Channels
- Patcong Creek
- Berkeley Township – 7 channels

Innovative Technologies:

- Shoreline Stabilization
- Mud Flat Augmentation
- Marsh Restoration
- Island Creation
- Feeder Berms
- 1122 Program
- EWN Program

Want to learn more?

www.state.nj.us/transportation/airwater/maritime