

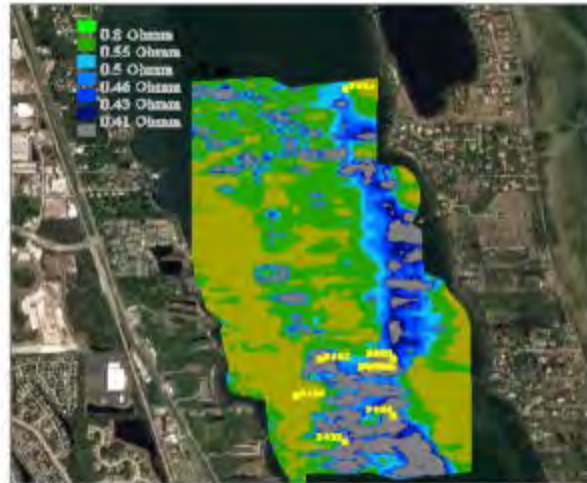
WEDA Midwest Chapter Meeting

Memphis, Tennessee

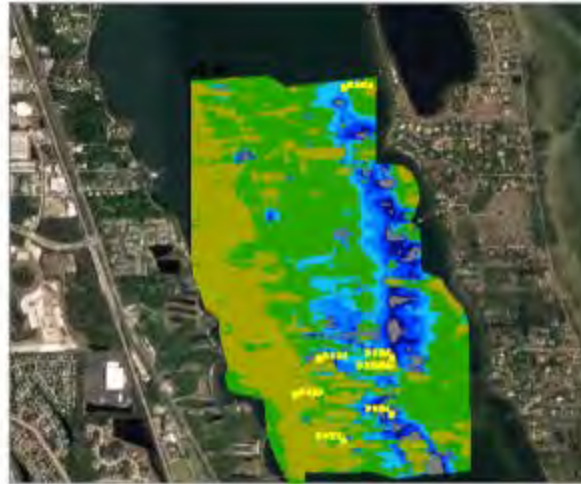
March 6 – 8, 2019



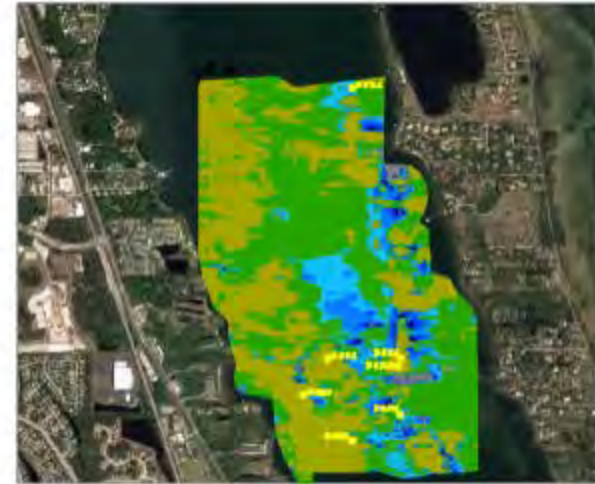
-1 ft



-3 ft



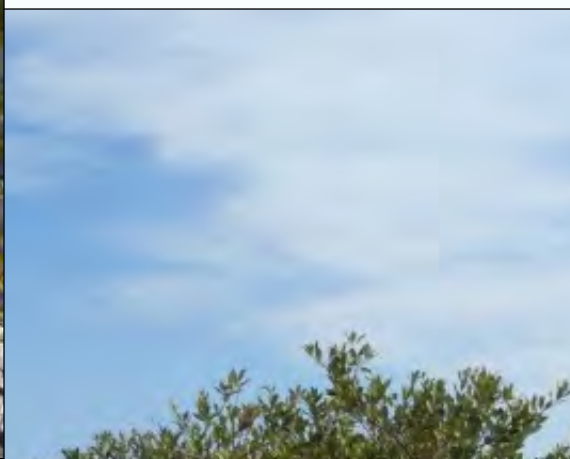
-8 ft



Sediment Investigation & Hydrographic Surveying
For Surgical Dredging

Resistivity Muck Test Survey Rockledge, Florida





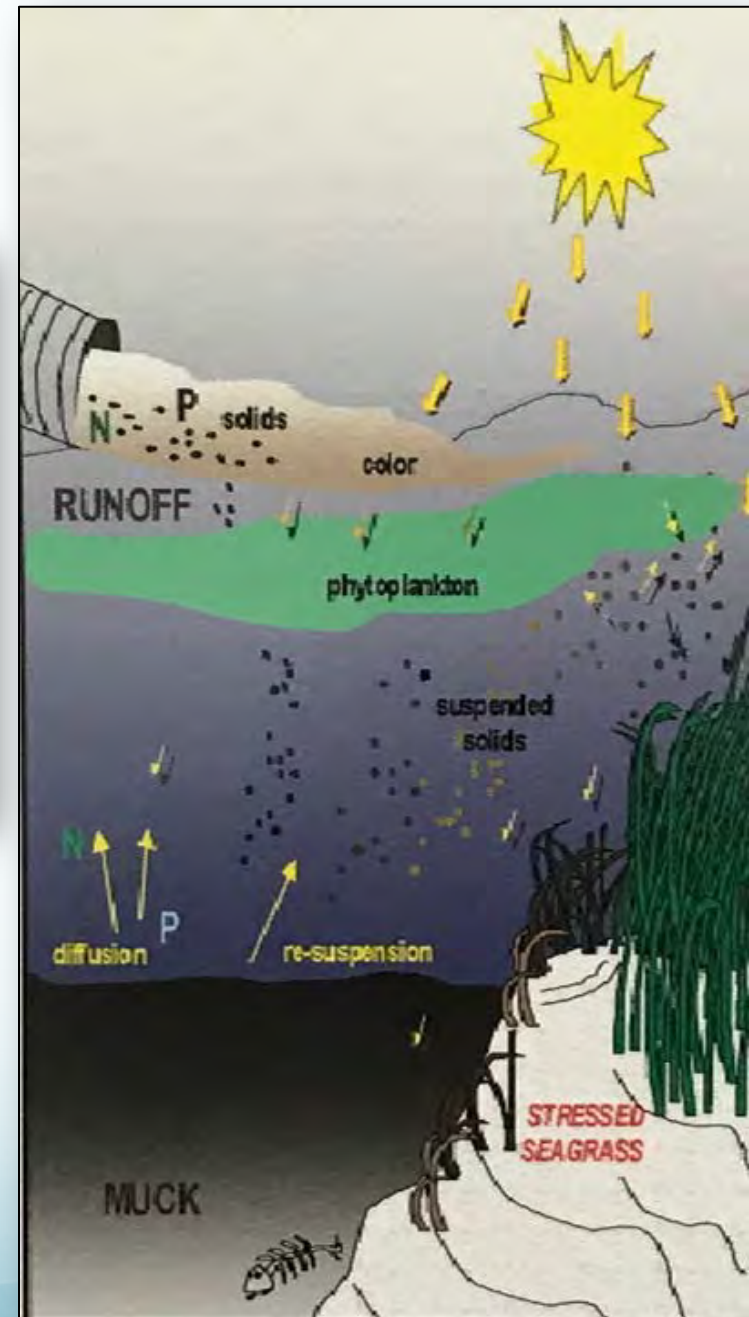
The Indian River Lagoon stretches 156 miles and is home to more than 4,000 plant and animal species with \$700million economic impact to the region Its Estimated that there is over 5 million cubic yards of muck in Brevard County waterways Alone.

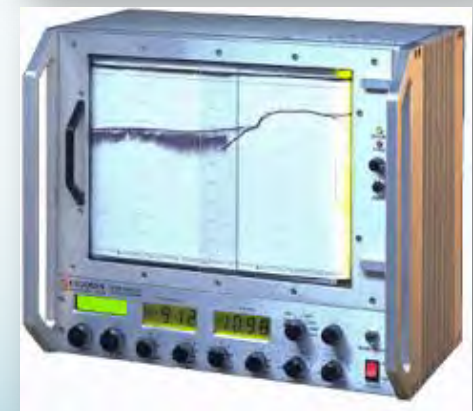
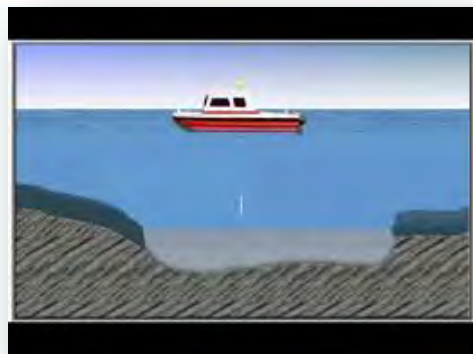


Muck

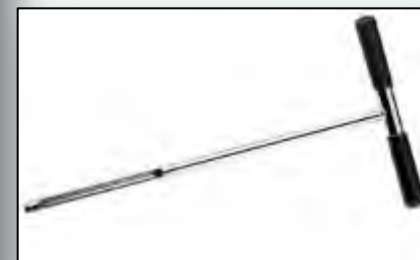
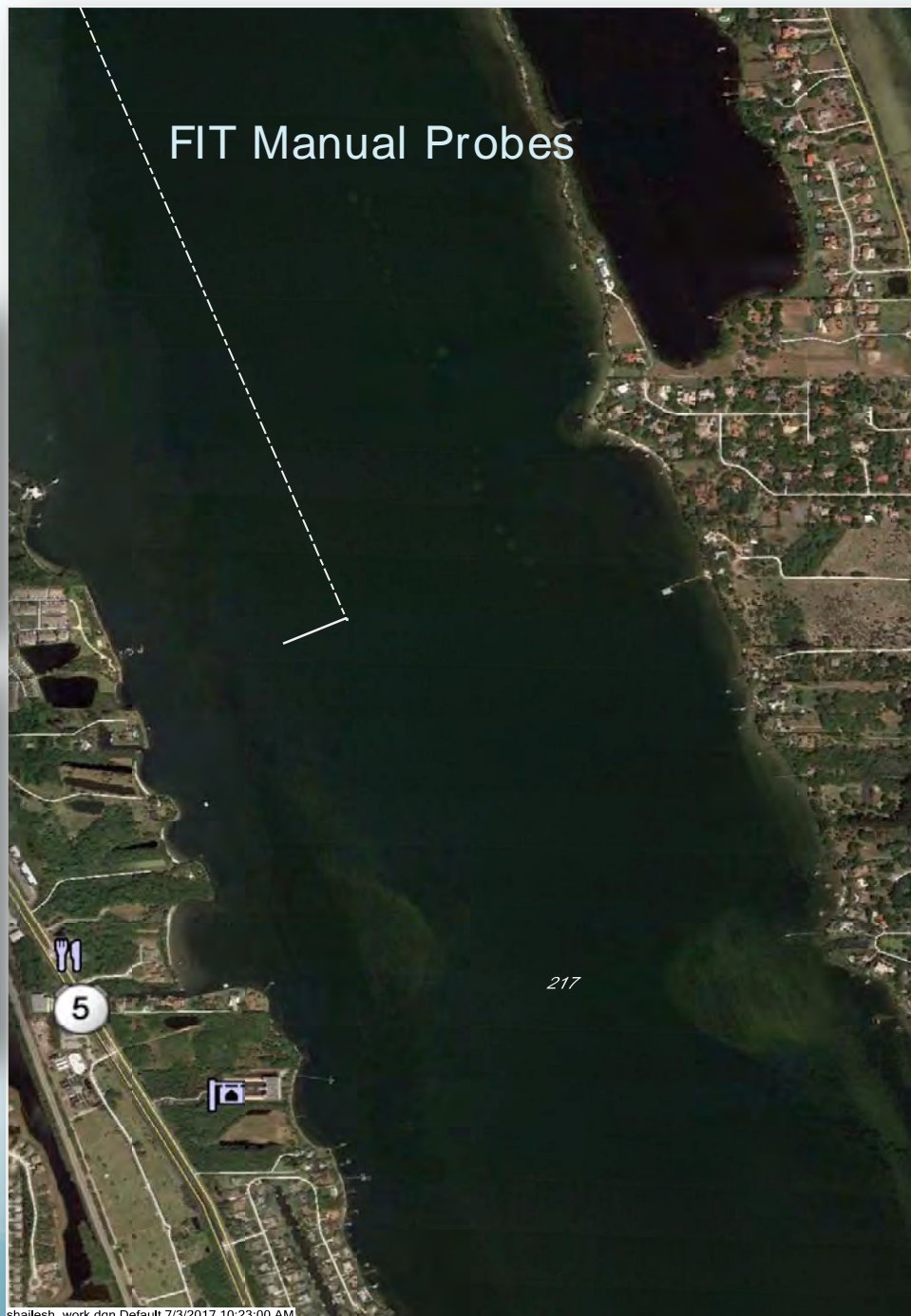


It has been estimated that 5 million cubic yards of fine-grained organic-bearing material currently blanket the lagoon bottom - based on a variety of survey methods including manual probes.

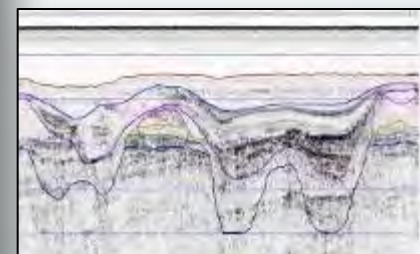




Singlebeam
Dual Frequency
Depth Sounding

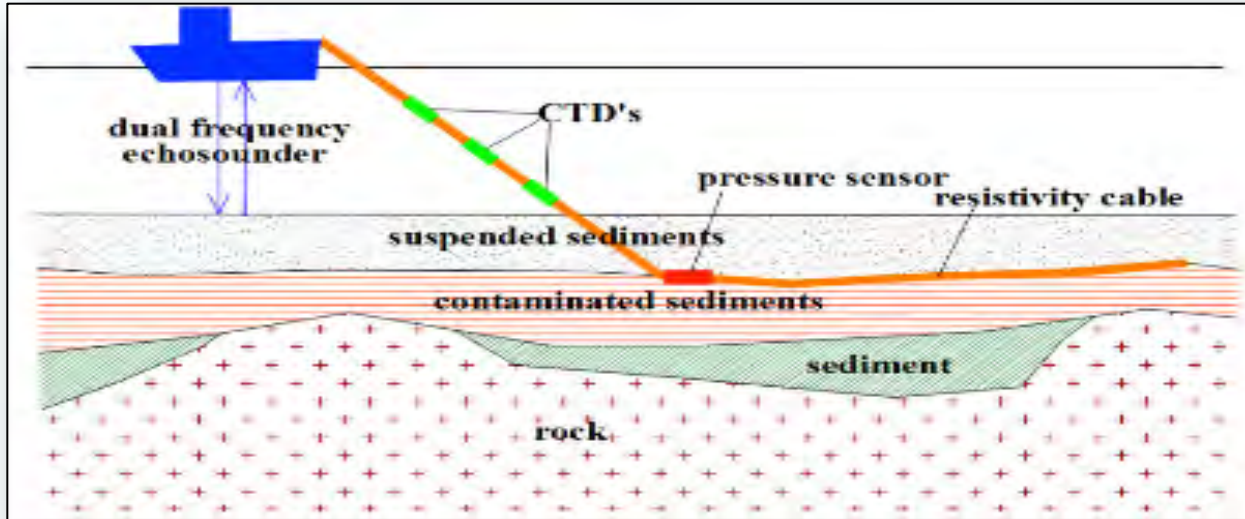


Probing



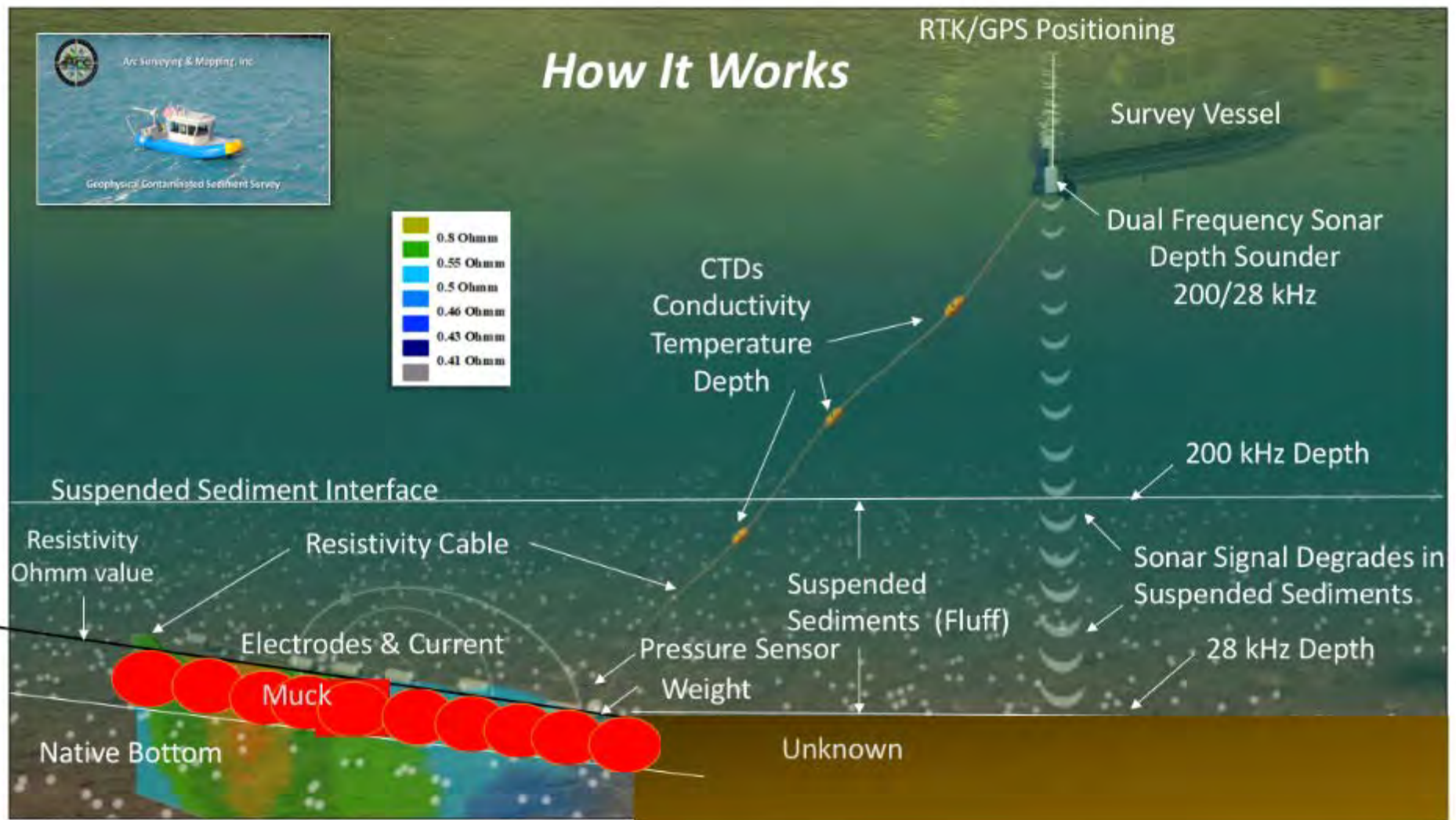
Sub-Bottom
Profiling

Plan & Procedure



- Horizontal & Vertical Control
- Bathymetric Survey
- Geophysical Survey
- 4D Geophysical Model
- Vibracore Verification Testing
- Sediment Characterization & Chemical Testing
- Muck Mapping & Quantities

Aquares Geophysical Surveying System



How It Works

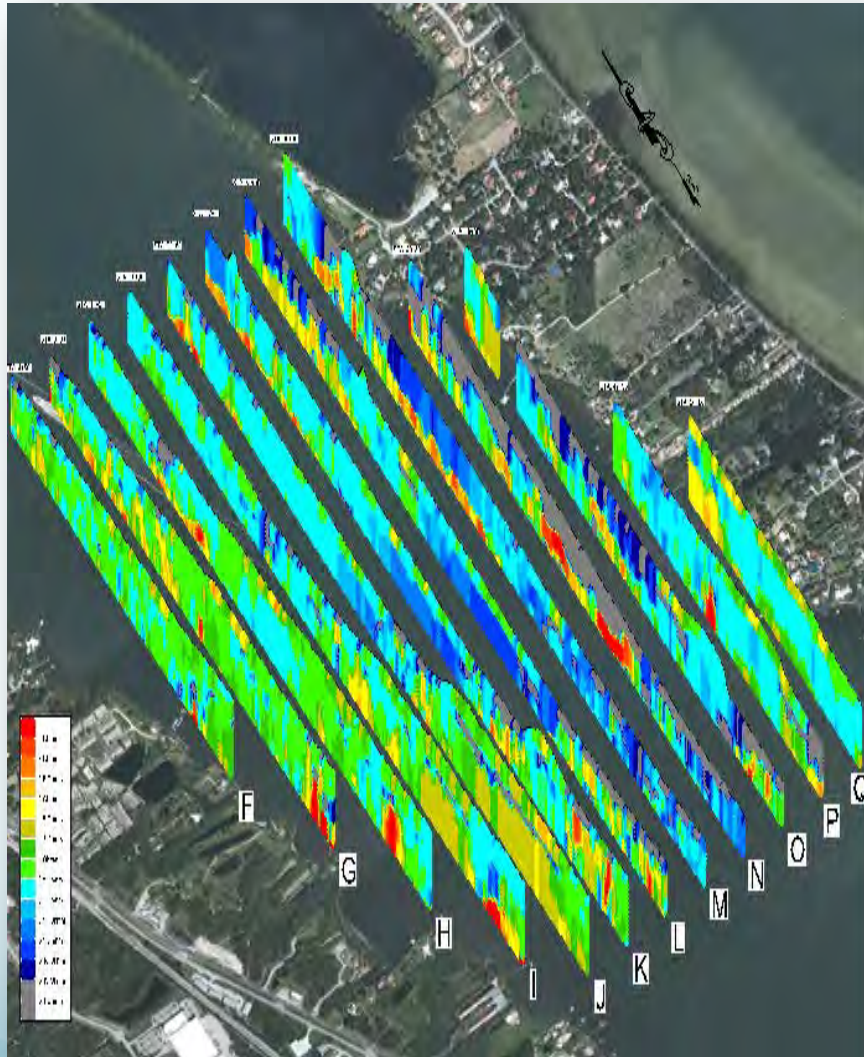


ArcDMC Sediment Solutions, LCC



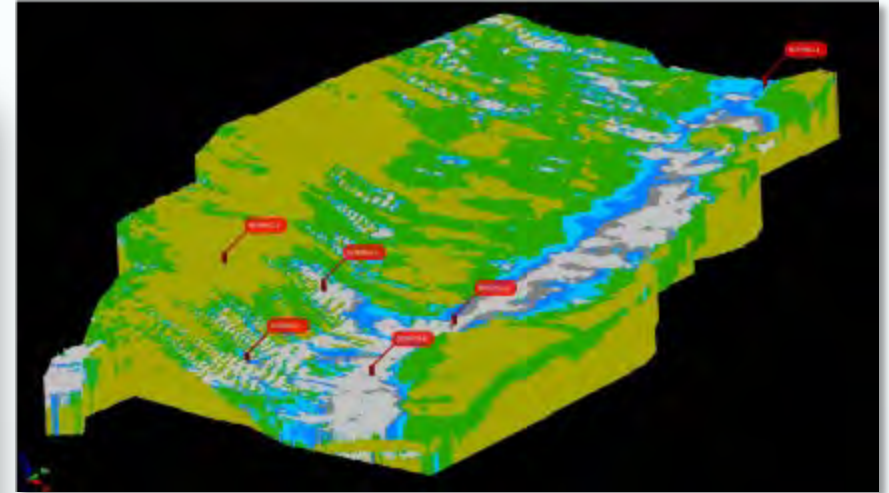
Geophysical Contaminated Sediment Survey

Resistivity Profiles

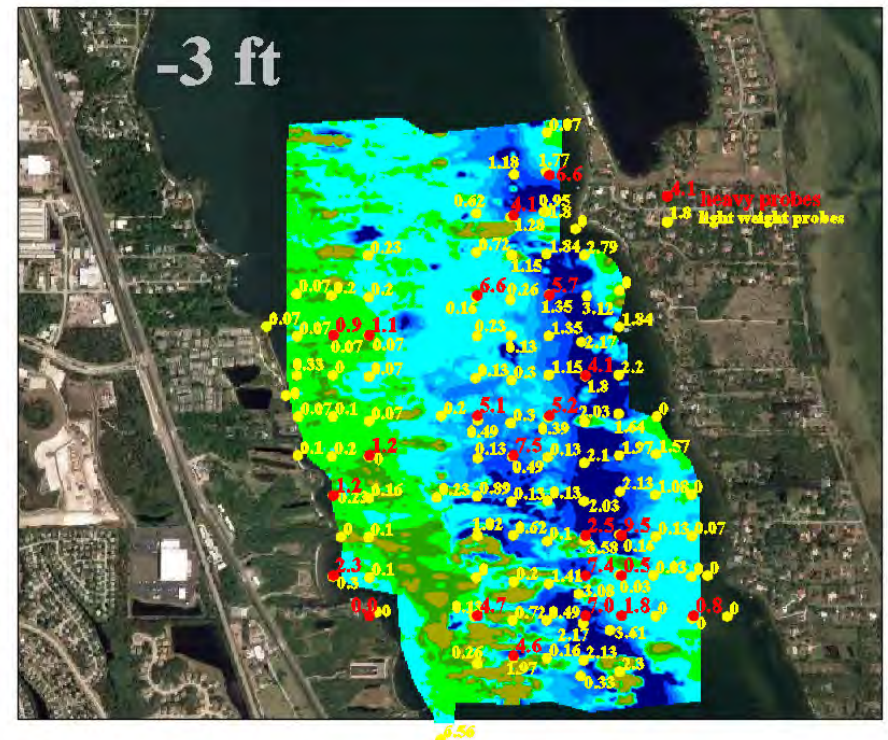


Test area 7000' x 4000' +/-
642 acre survey in 2 days

4D Model & Vibracore Locations

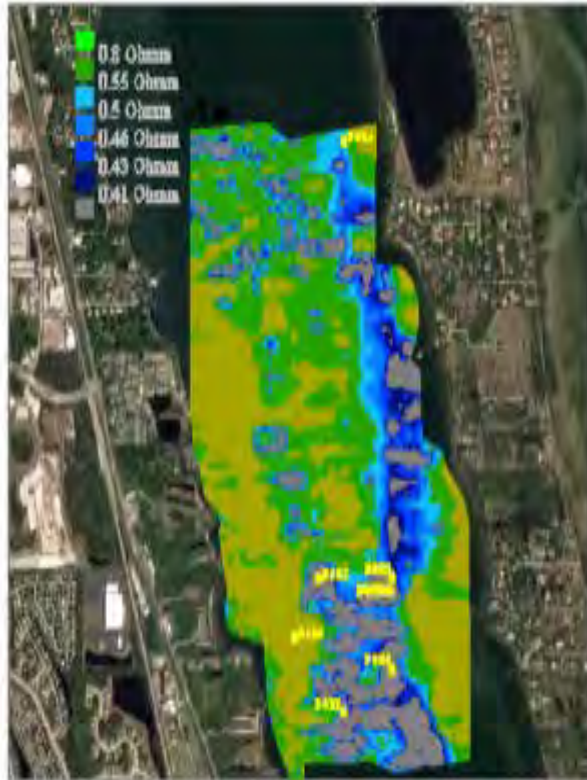


Probes Compared to

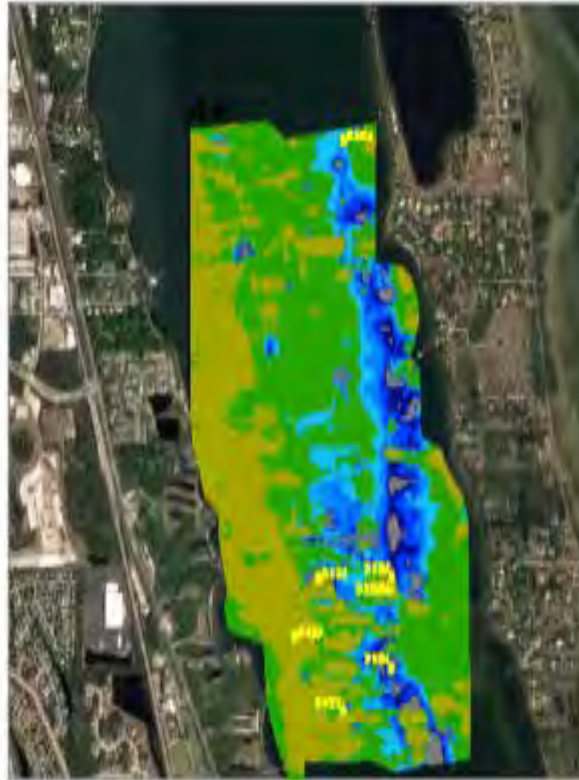


Muck at Various depths Below Lagoon Bottom

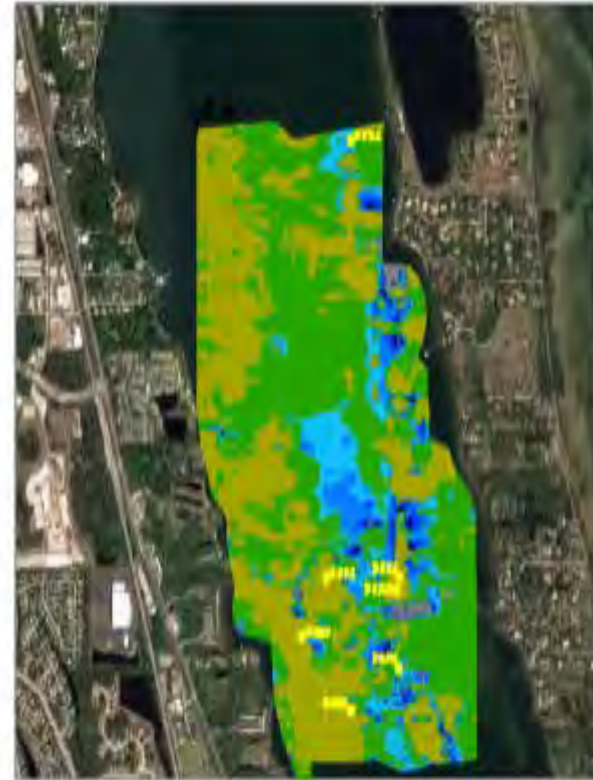
-1 ft



-3 ft



-8 ft



7000' x 4000' = 642.79 acres @ \$ 93.34 / acre = \$60,000

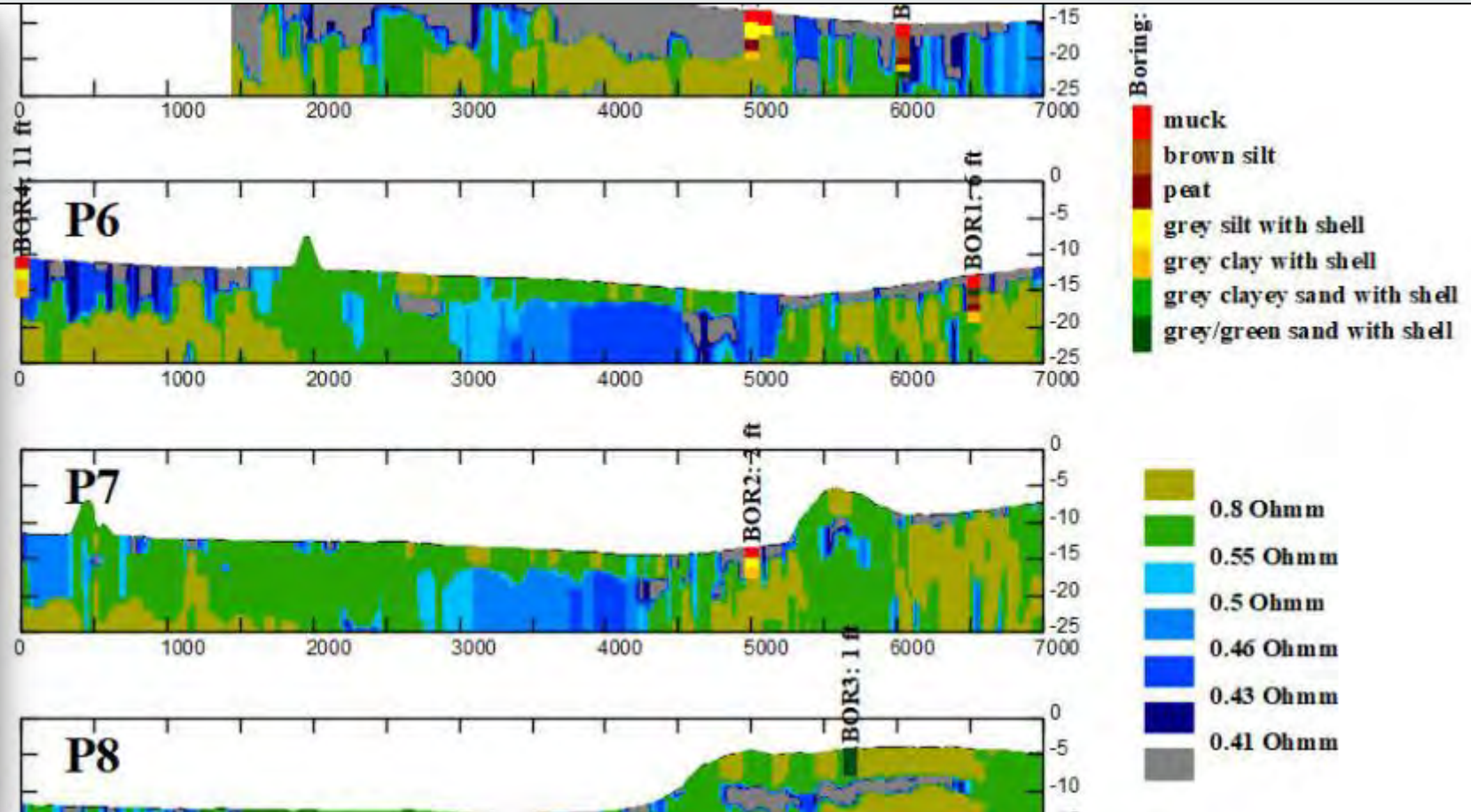
Including mob/demob, hydrographic & geophysical survey, data processing,
4D model, mapping & computing

Muck Quantity of 530,000 cubic yards

Survey cost \$60,000 or \$0.11 per cubic yard

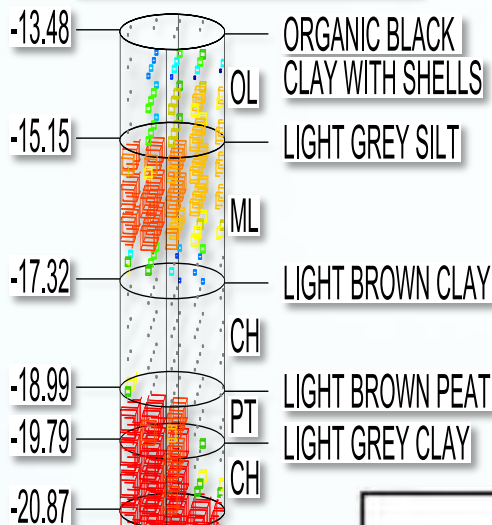
Estimated dredging costs are \$60.00 / cubic yard

Vibracore Verification



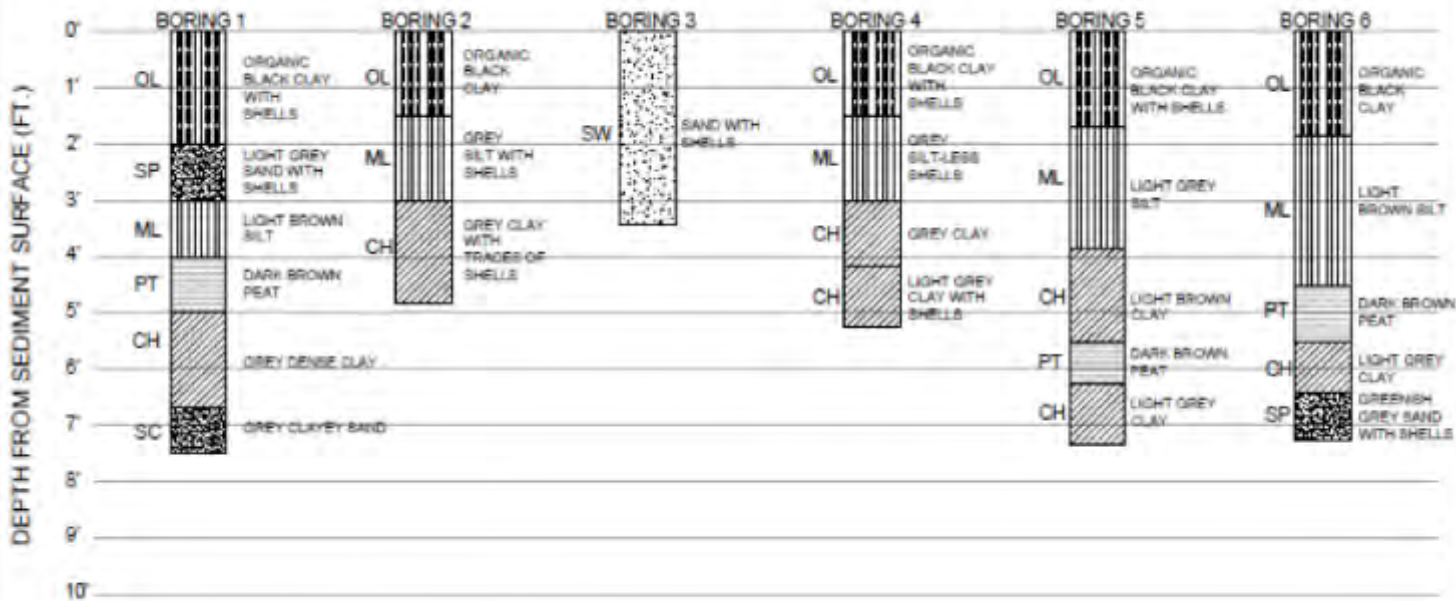
BORING 5

POINT CLOUD DATA & GEOTECHNICAL DESCRIPTION



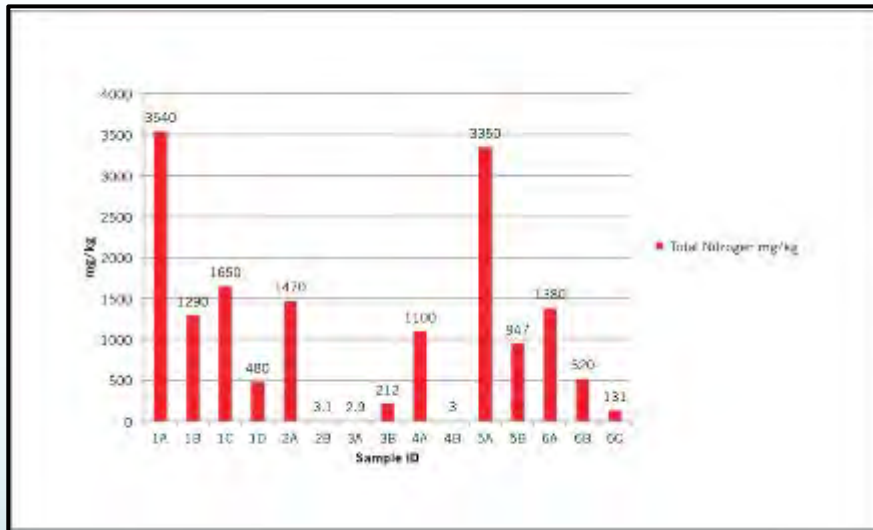
5.0mm
4.0mm
3.5mm
3.0mm
2.5mm
2.0mm
1.5mm
1.2mm
1.0mm
0.8mm
0.6mm
mm

Vibracore Verification

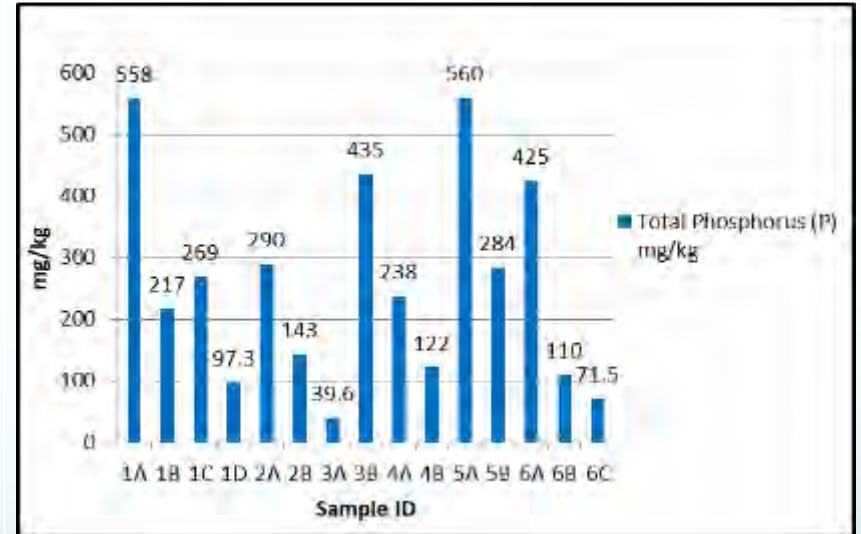


Chemical Analysis

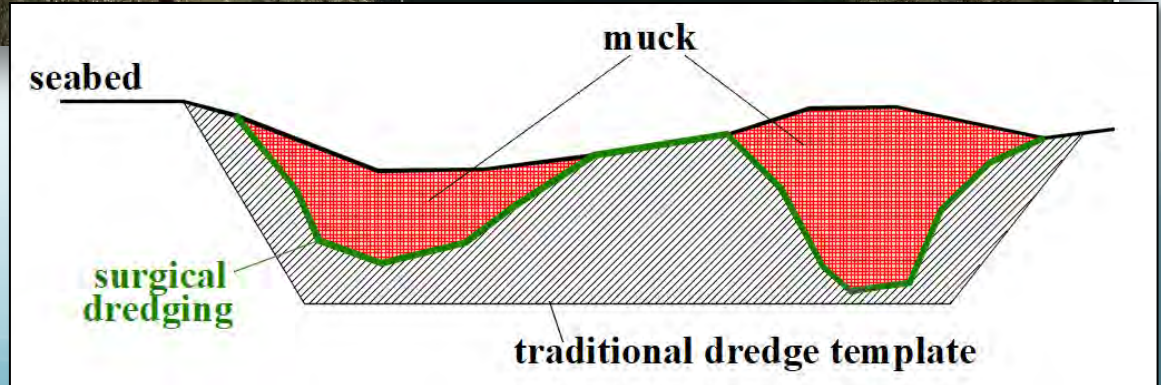
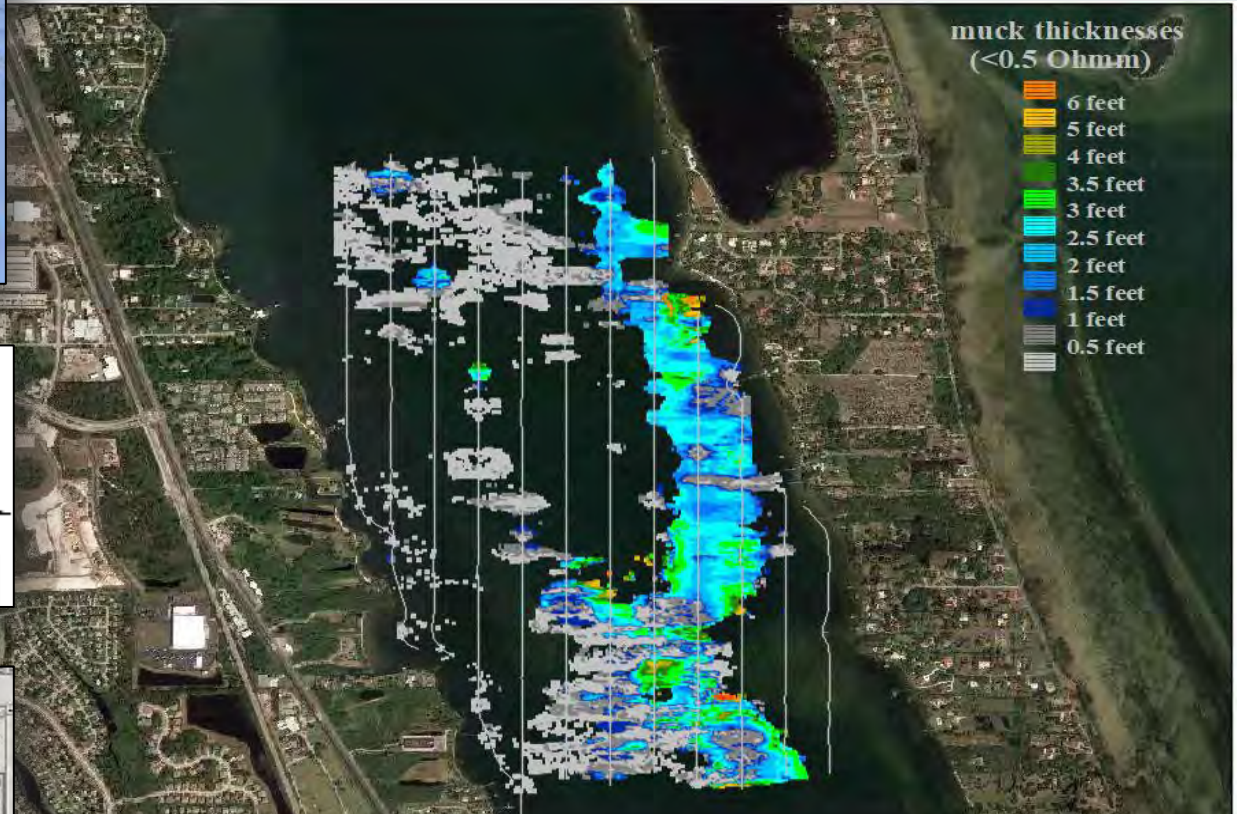
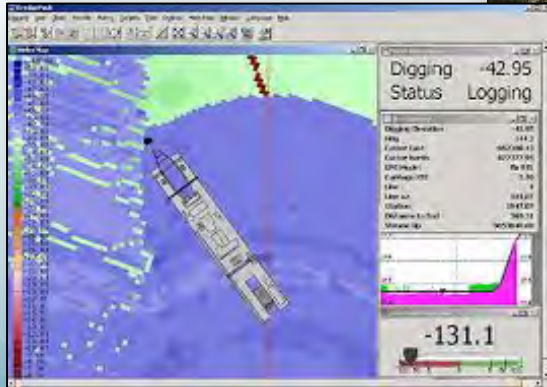
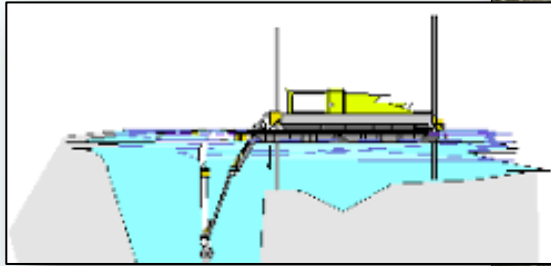
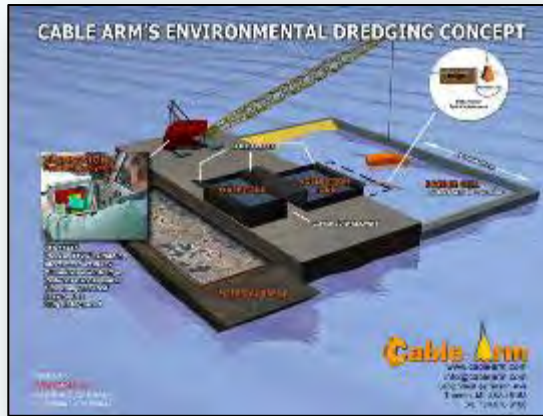
Nitrogen



Phosphorus



Muck Quantity 530,000 Cubic Yards (Based On 450' Line Spacing)



“Surgical” Dredging



Summary and Conclusions

- ArcDMC has successfully shown that our resistivity survey followed by vibracore sampling and testing is an effective approach in determining the presence and precise quantities of muck, in particular contaminated muck, in the Indian River Lagoon (IRL).
- The ArcDMC IRL Test Survey cost \$60,000 or \$0.11 per cubic yard, a minimal amount considering the cost of dredging @ \$60.00 per cubic yard and we can precisely locate muck deposits.
- Our data shows strong correlations between resistivity muck thicknesses and corresponding chemical concentration of the muck layers.
- Our methods will significantly impact restoration-dredging and dredged-material management costs while delivering minimal damage to the lagoon bottom.
- In order to improve survey resolution and muck quantification, a georeferenced bathymetric and an Aquares geophysical resistivity survey at 100 foot line spacing along with additional vibracore sampling for physical and chemical analyses needs to be conducted.



Benefits

- Identify the locations and thicknesses of highly organic, nitrogen and phosphorus laden muck that overly historic and uncontaminated sediments.
- Eliminate the questionable use of manual probes to determine contaminated muck thickness.
- Precisely identify the interface of contaminated and non-contaminated sediments
- Identify the total and more precise quantity of sediments to be excavated
- Avoid the use of use of standard dredging design excavation templates that may include the unnecessary excavation of uncontaminated sediments.
- Reduce the cost of treatment and disposal of contaminated sediments
- Provide dredging excavation limits (xyz) for the precision removal of contaminated sediments only.
- Provide high technology and cost saving excavation designs assuring the stewardship of tax dollars.

Port Canaveral Resistivity & Bathymetric Survey

A CH2M / Jacobs Engineering Project

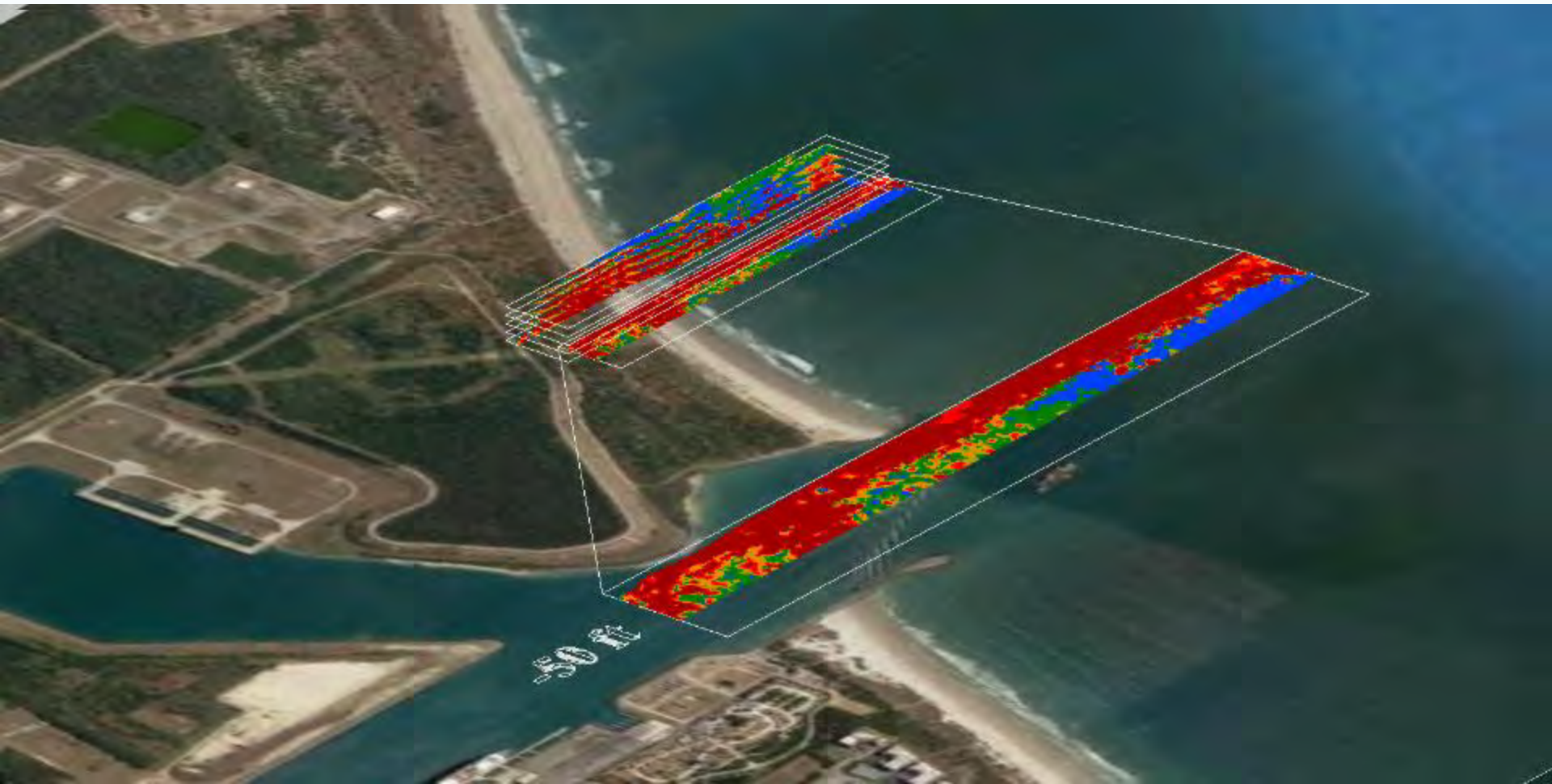


Port Canaveral

Vertical Resistivity Sections



Port Canaveral Horizontal Resistivity Sections



Major Geophysical Projects

Bahrain Sand Searches

Kill van Kull

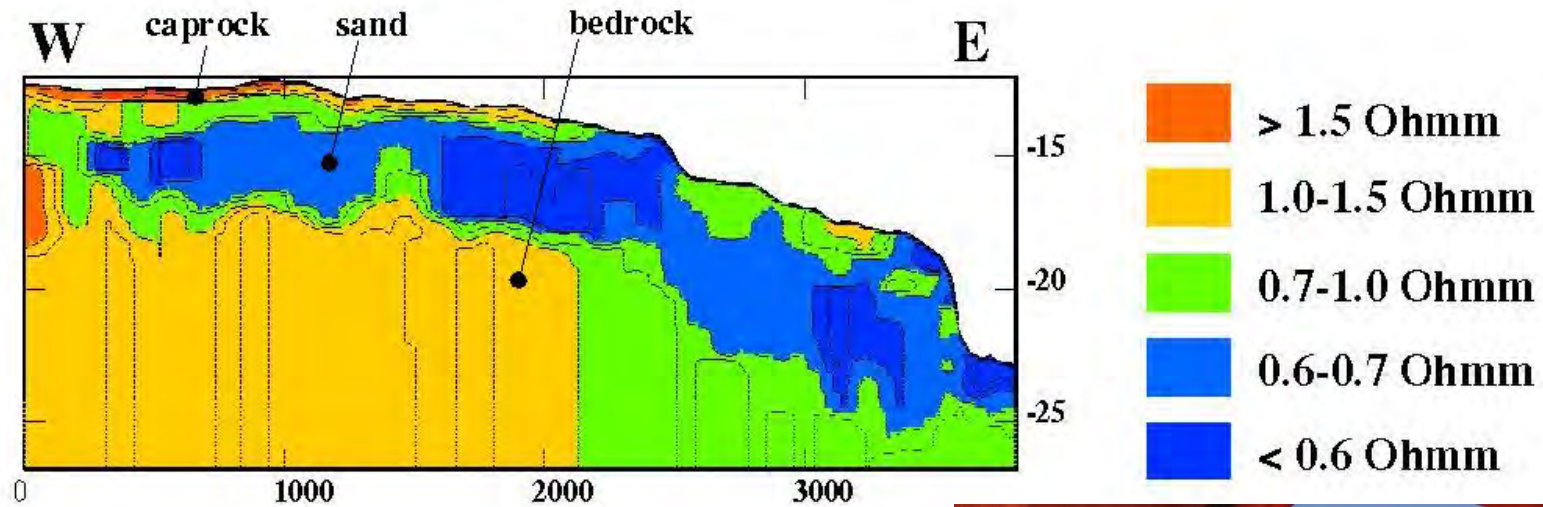
Miami Harbour Deepening

Delaware Deepening

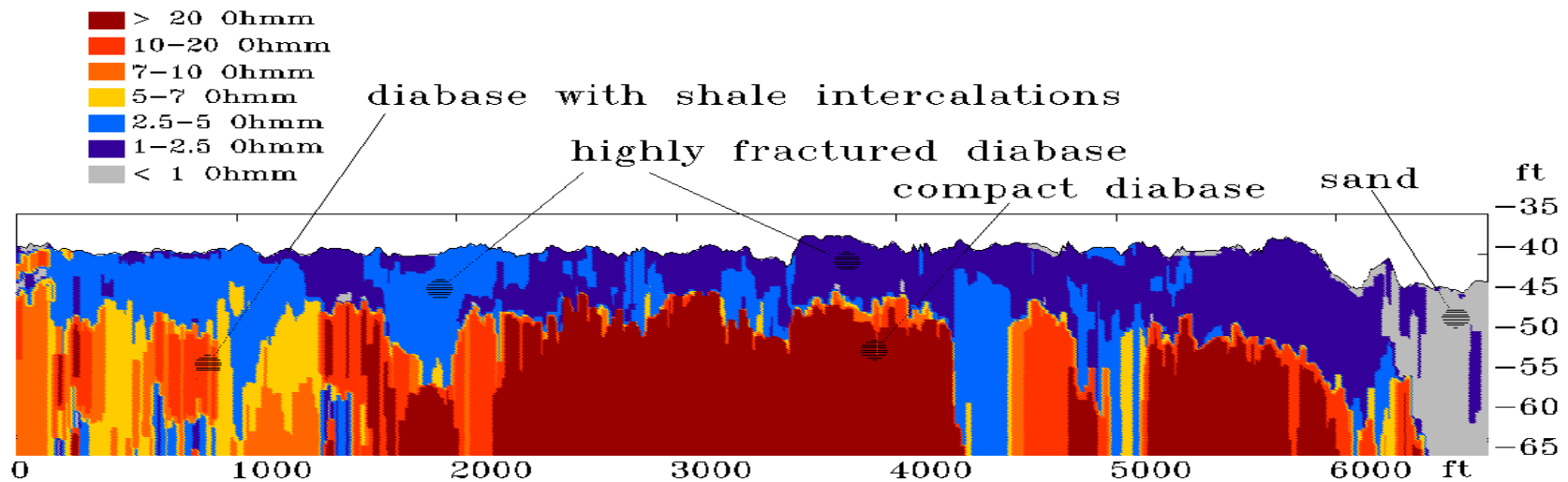
St Johns River Deepening

Sand Searches in Bahrain

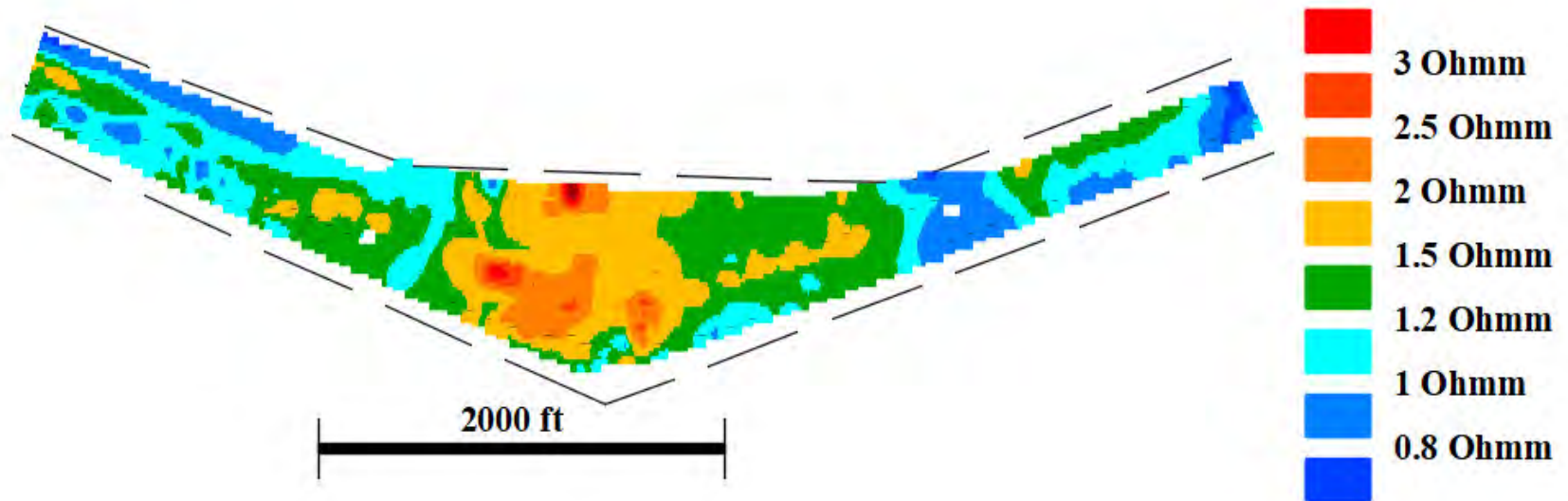
Caprock



Kill Van Kull New York

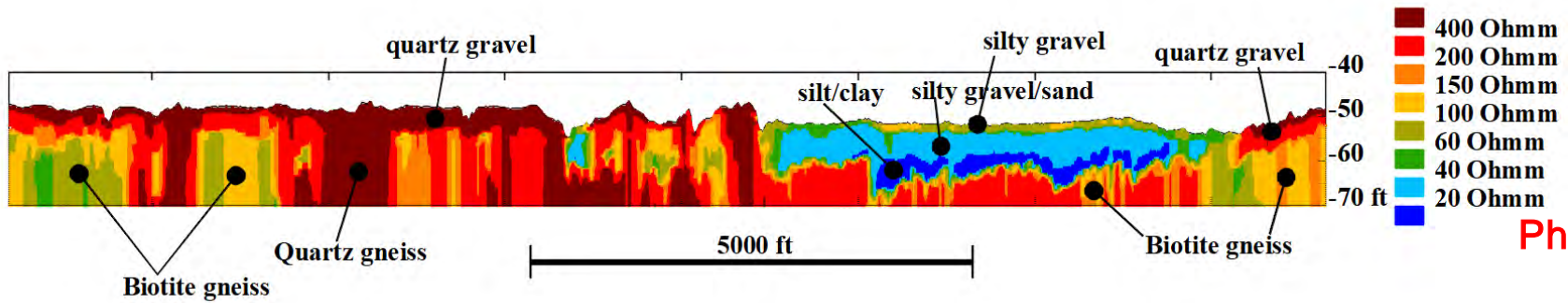


Miami Harbor Deepening



Horizontal Resistivity Section at 50 ft below chart datum

Delaware Deepening



Philadelphia

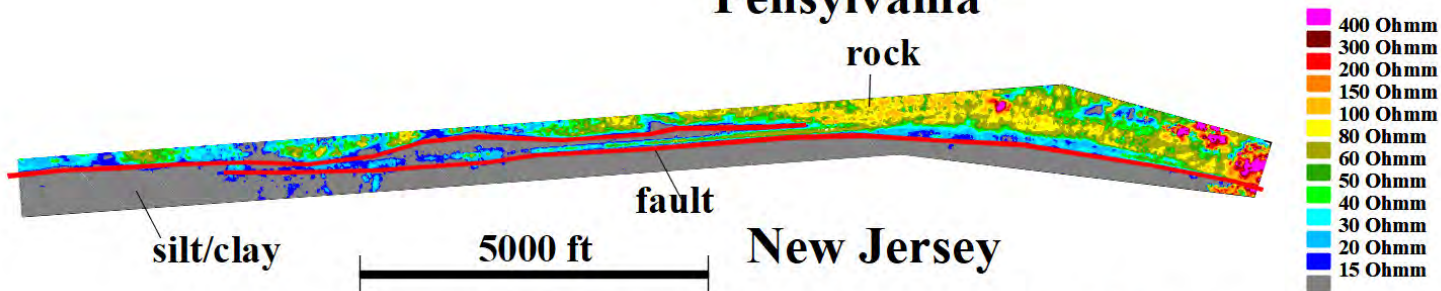
Wilmington



Pennsylvania

rock

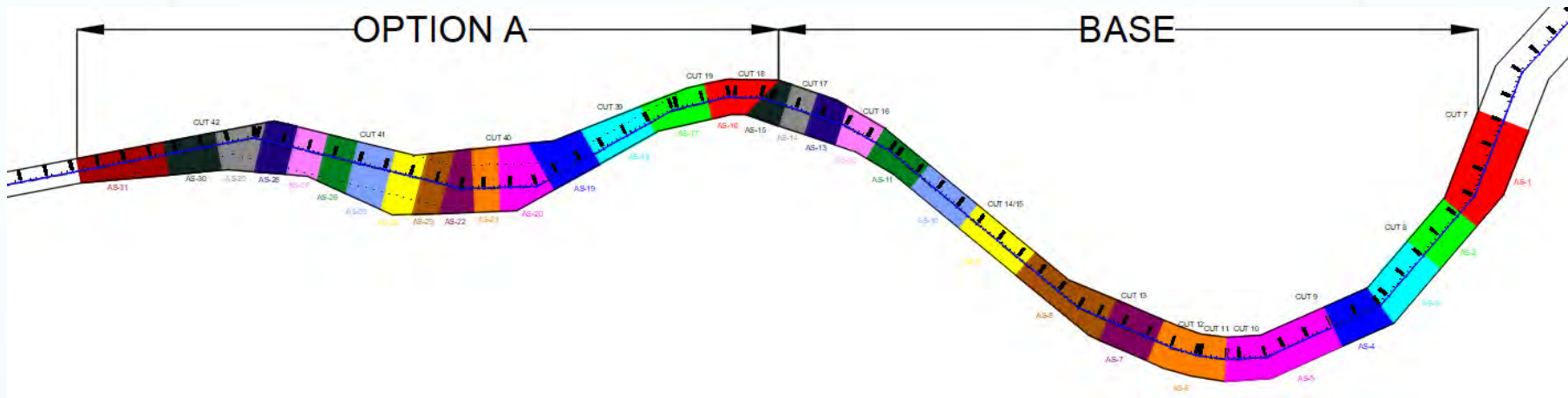
New Jersey



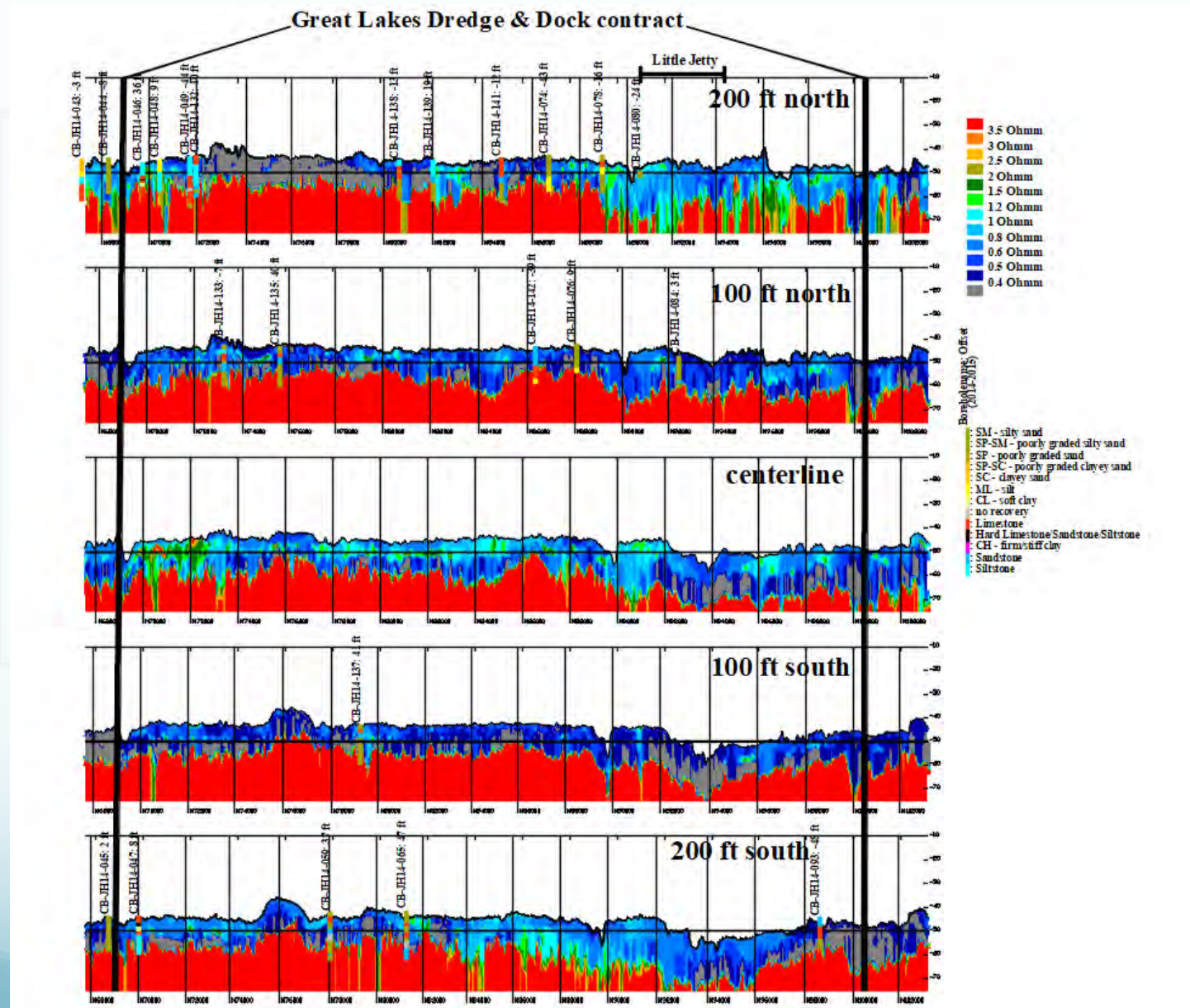
Horizontal Resistivity Section at -55 feet

Jacksonville, Florida

St. Johns River Deepening

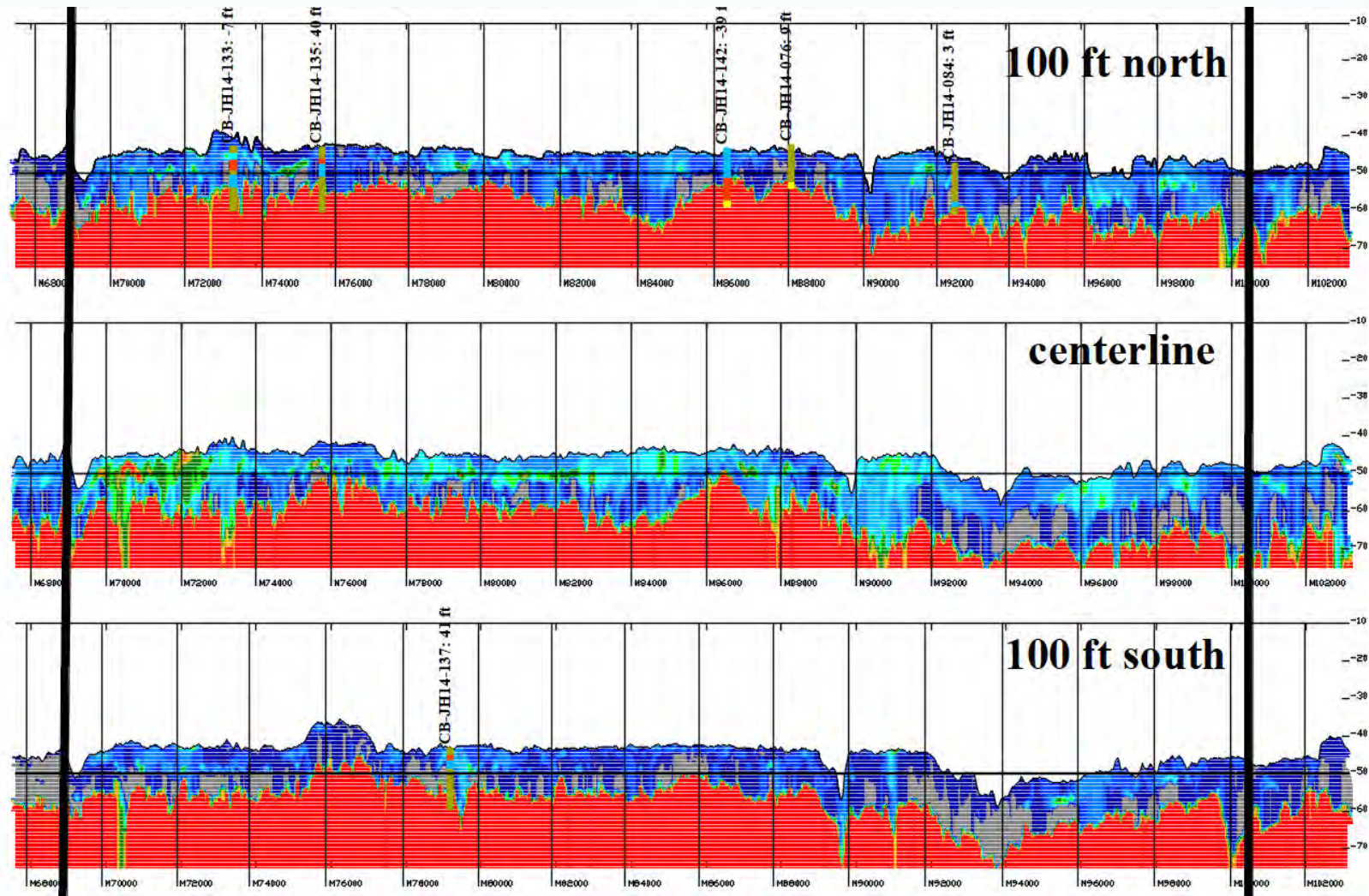


St. Johns River Deepening



Vertical Resistivity Sections

St. Johns River Deepening

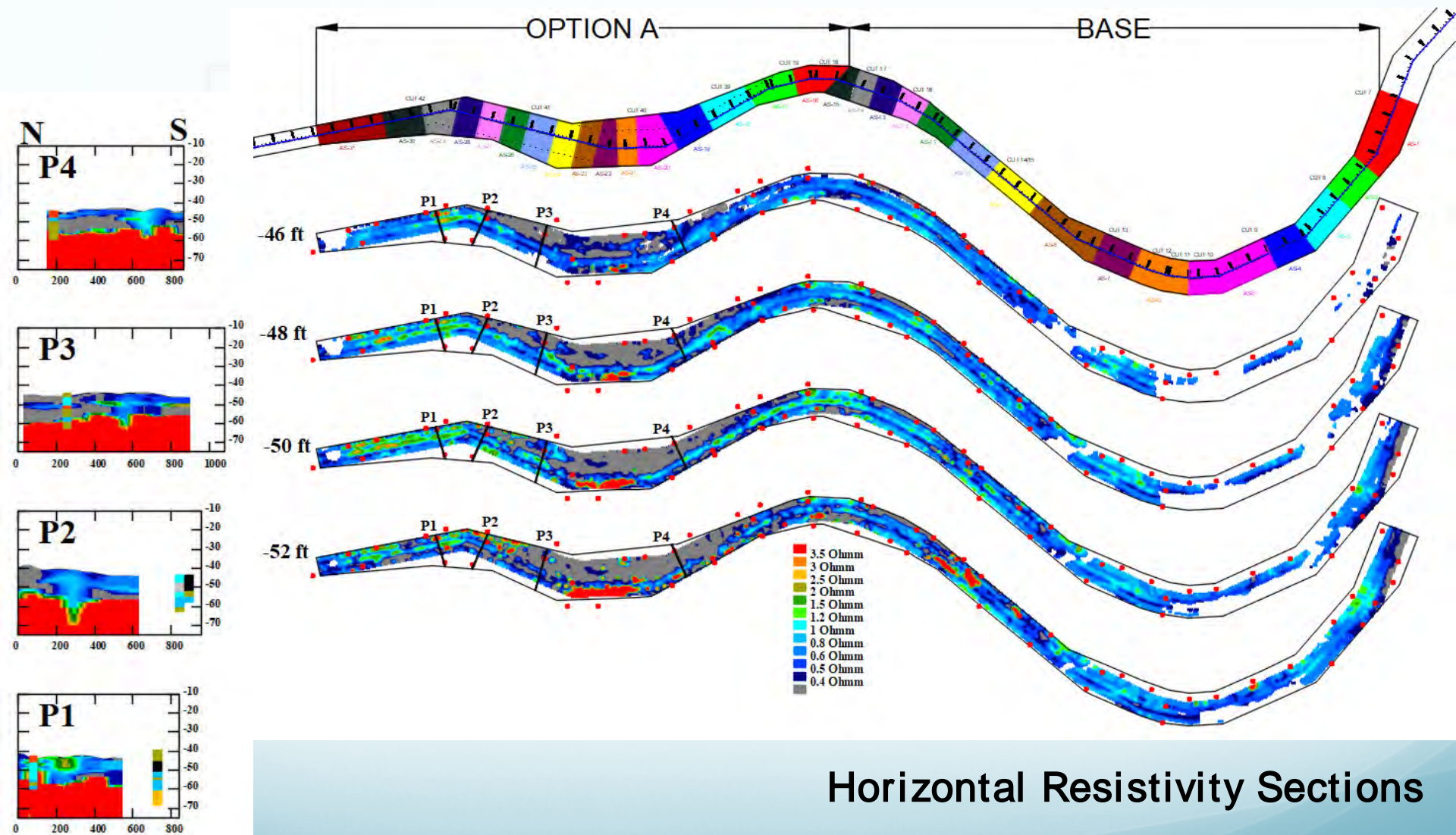


Borehole name: Offset
(2014-2015)

- : SM - silty sand
- : SP-SM - poorly graded silty sand
- : SP - poorly graded sand
- : SP-SC - poorly graded sand with clay
- : SC - clayey sand
- : ML - silt
- : CL - soft clay
- : no recovery
- : Limestone
- : Hard Limestone/Sandstone/Siltstone
- : CH - firm/stiff clay
- : Sandstone
- : Siltstone

Vertical Resistivity Sections at 100 ft North, centerline and 100 ft South

St. Johns River Deepening

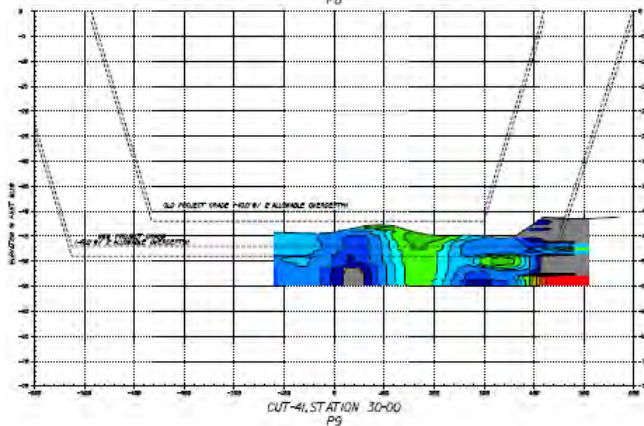
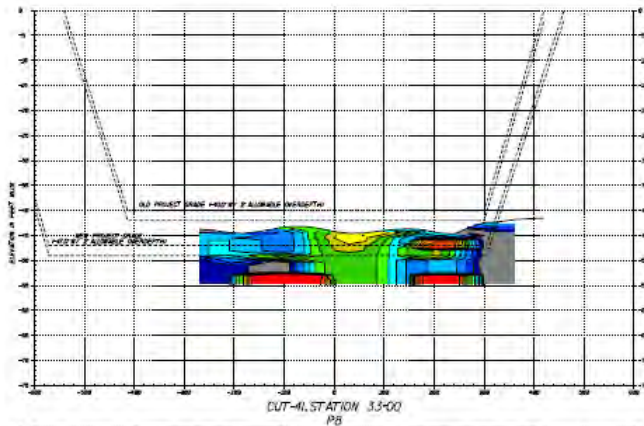


Horizontal Resistivity Sections

Vertical Cross sections

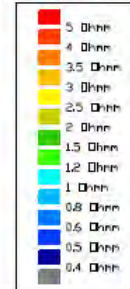
St. Johns River Deepening

2009 GEOPHYSICAL SURVEY, JACKSONVILLE HARBOR DEEPENING PROJECT

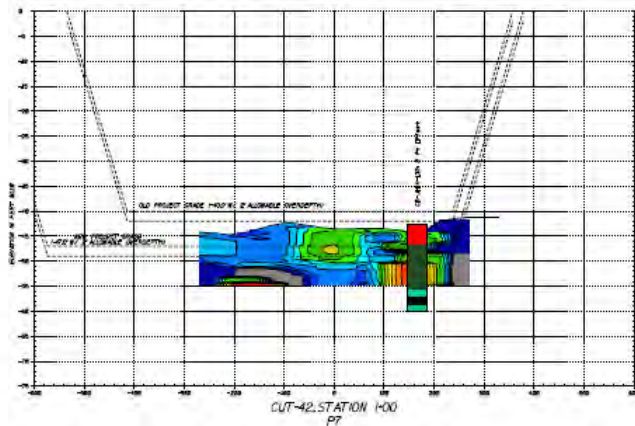
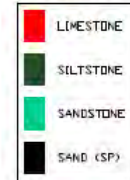


VICINITY MAP
(NOT TO SCALE)

RESISTIVITY VALUES



BORING LITHOLOGY



PROJECT INFORMATION	
Project Title:	St. Johns River Deepening Project
Client:	U.S. Army Corps of Engineers
Location:	Jacksonville, FL
Date:	10/1/2009

BORING LOG	
Boring No.	42
Station	100
Depth (ft)	0 to 20
Lithology	SAND (SP)
Remarks	

REVISIONS	
No.	Description
1	Initial Survey
2	Processing & Plotting
3	Final Review

DATE	BY	REVISION

Project Title: St. Johns River Deepening Project
 Client: U.S. Army Corps of Engineers
 Location: Jacksonville, FL
 Date: 10/1/2009

Prepared by: Arc Surveying & Mapping, Inc.
 Professional: Surveying & Mapping
 License: 121212
 Jacksonville, FL 32202

ARC
 Arc Surveying & Mapping, Inc.
 Professional: Surveying & Mapping
 License: 121212
 Jacksonville, FL 32202

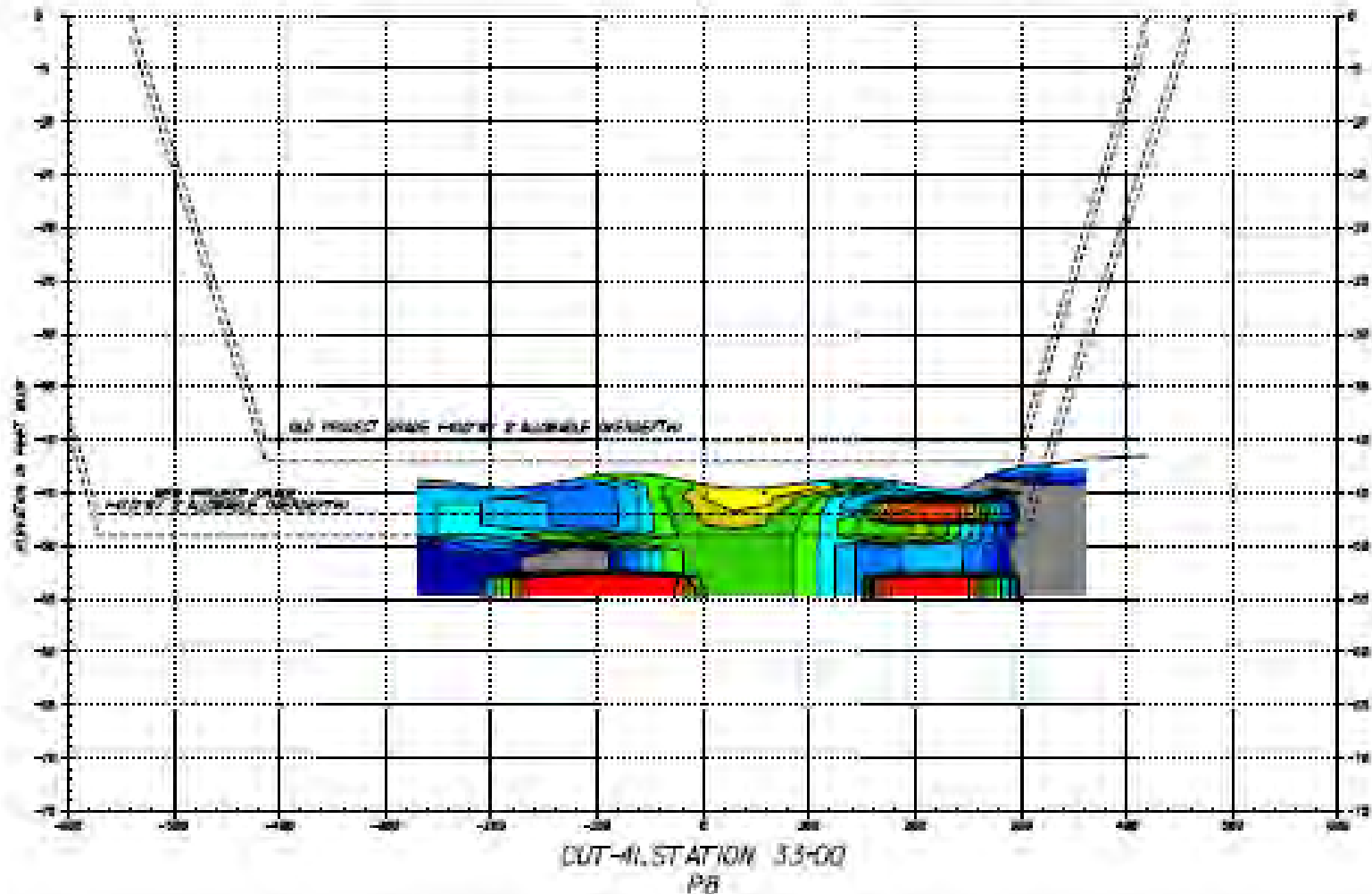
10/1/2009
 Drawn by: M. J. JAMES
 Scale: 1"=100'
 The Date: 10/1/2009
 Unpublished: S.W.T.
 File No: Fig. 30A
 AND: Project No. 10A1008
 10A1008

SHEET 1 OF 1

NOTES:

THE 2009 GEOPHYSICAL DATA SHOWN ON THE DRAWING IS FOR ILLUSTRATION PURPOSES ONLY AND NOT TO BE USED FOR CONSTRUCTION.

Typical Cross Section



Summary and Conclusions

Advanced 4D geophysical site investigations provided by ArcDMC are useful on dredging projects regardless of material types.

Competitive response to dredging tenders based on high-quality geological information included in contract documents – everyone has the same information – eliminates guessing.

Best selection of dredging equipment based on accurate geological information.

Efficient planning of dredging operations.

Compatible with popular dredging software formats.

Geological documentation eliminating changed/differing site conditions.

Thank you for viewing this presentation

For more information contact:

John F. Sawyer, VP (904) 237-5949

ArcDMC Sediment Solutions, LLC

www.arcdmcsediment.com

jsawyer@arcsurveyors.com

Jeremy Loudenbeck, VP, RLS (901) 867-5333

Arc Surveying & Mapping, Inc

www.arcsurveyors.com

jloudenbeck@arcsurveyors.com



Innovative Surveying Technique Locates Contaminated Sediments for Surgical Removal

Contact information: jsawyer@arcsurveyors.com 904-237-5949 | spatel@dmces.com 386-304-6505



INTRODUCTION

The Indian River Lagoon (IRL) is the most biologically diverse estuary in North America. Decades of anthropogenic activities has led to poor water quality and the accumulation of muck (contaminated sediment), resulting in algal blooms and adverse impacts such as seagrass losses and fish kills. ArcDMC Sediment Solutions, LLC performed an innovative geophysical study of the IRL near Rockledge, Florida to more precisely identify these muck areas. Previous attempts to determine the location and quantities of muck were performed using sonar based systems and manual probes, leaving much to the imagination. ArcDMC's mission was to test new technology that would clearly identify the interface of muck with natural sediments. Our survey tested Aquares, a new and advanced geophysical system developed in Belgium and in use worldwide on port development subsurface investigations. The survey clearly identified muck from other sediments in a precise, timely and cost effective manner.



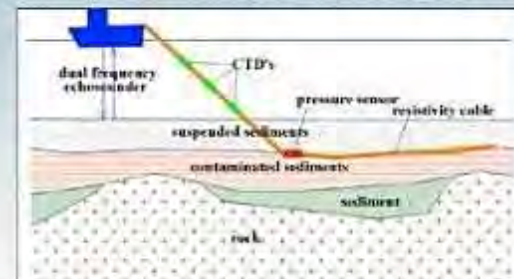
What is IRL Muck?

- "...black, fine-grained...high water content, composed of partly decomposed organic matter and a considerable amount of admixed silt and clay material." Trefry et al., 1987.
- Silt + Clay > 60% dry wt., Organic matter > 10% dry wt. with sand and shell being the remainder.
- Contains nutrients and other contaminants that blankets the Lagoon's bottom.



METHODS

- A multichannel cable was towed behind the survey vessel along the same transect lines as dual frequency depth soundings (450 ft. line spacing)
- The multichannel resistivity measurements were calibrated to reach penetration depths of approximately 40 ft. below the lagoon bottom. The electrical current was injected into the subsurface by means of two current electrodes
- The voltage gradient associated with the electrical field of this current is measured between a number of voltage electrodes placed in between the current electrodes
- The system measures the electrical resistivity of subsurface structures in ohmm. All changes in the subsurface are observed in a color coded 4D geophysical model (X,Y,Z & Ohmm)



- The geophysical survey was performed simultaneously during the bathymetric survey, providing a georeferenced model of the surface and subsurface to be excavated
- The Rockledge site was chosen because FIT had extensive probe data available for comparison (4D Model with FIT locations shown below)
- Vibracore data was also collected to verify the resistivity data

