Bathymetric & Geophysical Port Surveys
GIS/BIM Technology
The Subsurface Problem

How do you describe subsurface conditions between individual borings?
The Geophysical Solution

Resistivity Profiles

Generate a 4D Model
Choose Boring Locations
The Aquares System
Geophysical Survey Procedure

- Horizontal & Vertical Control (RTK/GPS)
- Bathymetric Survey
- Resistivity Geophysical Survey
- Generate a 4D Geophysical Model
- Select Vibracore or Core Boring Locations
- Import Geotechnical Data into Model
- Characterization & Chemical Testing
- Provide Maps & Quantities
ArcDMC Sediment Solutions, LCC

Geophysical Contaminated Sediment Survey
Site Investigation Methods

Geophysics

• Defining horizontal and vertical extent of geological structures
• Defining dredge volumes
• Relatively fast and inexpensive

Boreholes

• Targeting geophysical structures defined by geophysical methods
• Defining geotechnical parameters
• Expensive and time consuming
Borings Alone Can’t Describe the Subsurface

Boreholes alone can not define the extent of geological structures!
What if Major Geological Structures Remain Undiscovered?

Previous investigations:
- seismic reflection
- 77 vibracores and 116 random boreholes
- 12 million dollar exploration costs
- no sand
- undefined dredging risks
- uncertainty regarding project viability
Kill Van Kull
Miami Harbor Deepening

Horizontal Resistivity Section at 50 ft below chart datum
St Johns River Plan Views @ 2 Ft Intervals

Horizontal Resistivity Sections

Vertical Cross sections
Multibeam Bathymetry & Resistivity Track lines

Geophysical Track Lines
Port Canaveral – test
Vertical Resistivity Sections

P1
5 Ohmm
4 Ohmm
3.5 Ohmm
3 Ohmm
2.5 Ohmm
2 Ohmm
1.6 Ohmm
1.2 Ohmm
1 Ohmm
0.8 Ohmm
0.6 Ohmm
0.5 Ohmm
0.4 Ohmm

P2
THAKA-1.0 t
THAKA-2.0 t
THAKA-3.0 t
THAKA-4.0 t
THAKA-5.0 t

P3
green silty sand
green clayey sand
green clay
green silty clay
green coquina sand
organic clay
silty sand
Port Canaveral – test
Horizontal Sections

relative to chart datum

-35 ft

-37.5 ft

-40 ft

-42.5 ft

-45 ft

Color Legend:
- 5 Ohmm
- 4 Ohmm
- 3.5 Ohmm
- 3 Ohmm
- 2.6 Ohmm
- 2 Ohmm
- 1.6 Ohmm
- 1.2 Ohmm
- 1 Ohmm
- 0.6 Ohmm
- 0.5 Ohmm
- 0.4 Ohmm
Boring # 2

Note: Blow Counts = 15 Blows Per Ft.
Resistivity Measures  4.0 to 5.0 Ohmm

Both indicating the presence of firm materials
Resistivity Test Conclusions

- A resistivity survey describing subsurface material structures should be performed prior to obtaining core borings.
- A resistivity survey will help determine where borings are necessary rather than guessing best locations.
- NOTE: During the test it is observed that high resistivity values (red) fall between pre construction borings verifying that a resistivity survey should be performed before core boring locations are determined.
Port Canaveral – test

Detailed Interpretation
Port Canaveral Borings

- **2012**
- **Green sand/silt/clay**
Port Canaveral
SPT-Values

Dredge level
Coincidence?
Port Canaveral
Glauconite
Artesian ground water

- Green sand
- Clay mineral \((K,Na,Ca)(Mg,Fe^{+++},Al,Fe^{++})(Fe^{+++},Al)_{4}O_{10}(OH)_{2}.nH_{2}O\)
- Formation in reduced oxygen conditions – contains Fe^{++}
- Genesis in association with micro organisms (foraminifera)
- Unstable when exposed to oxygen (f.e. oxygen rich seawater)
- Turns into clay
- Existence known in Florida geology
Port Canaveral test
Glauconite and Artesian water

clay cap trapping fresh water

no clay cap
salt water intrusion
Bathymetric & Geophysical Survey
Of the Port Canaveral Entrance Channel
Port Canaveral
Horizontal Resistivity Sections Relative to Chart Datum
Cost savings related to Aquares technology
Dredging project Buenaventura, Colombia

30% sediments at 20 $/m³
70% hard rock at 100 $/m³
Average: 76 $/m³

70% sediments at 20 $/m³
25% rock at 50 $/m³
5% hard rock at 100 $/m³
Average: 31 $/m³

Estimated savings: 160 million $
Summary and Conclusions

Advanced 4D geophysical site investigations provided by Arc Surveying & Mapping, Inc. are useful on dredging projects:

- Competitive response to dredging tenders based on high-quality geological information
- Identify selection of dredging equipment based on accurate geological information
- Efficient planning of dredging operations
- Compatible with popular dredging software formats
- Geological documentation identifying the subsurface
- Avoid changed/differing site conditions
Thank You For Your Interest
Any Questions?

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