# Environmental Clamshell Dredging

## Application of Environmental Dredging Tips

### Lessons learned from more than 10 years of completing environmental dredging projects with Cable Arm Environmental Clamshell Buckets

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CABLE ARM
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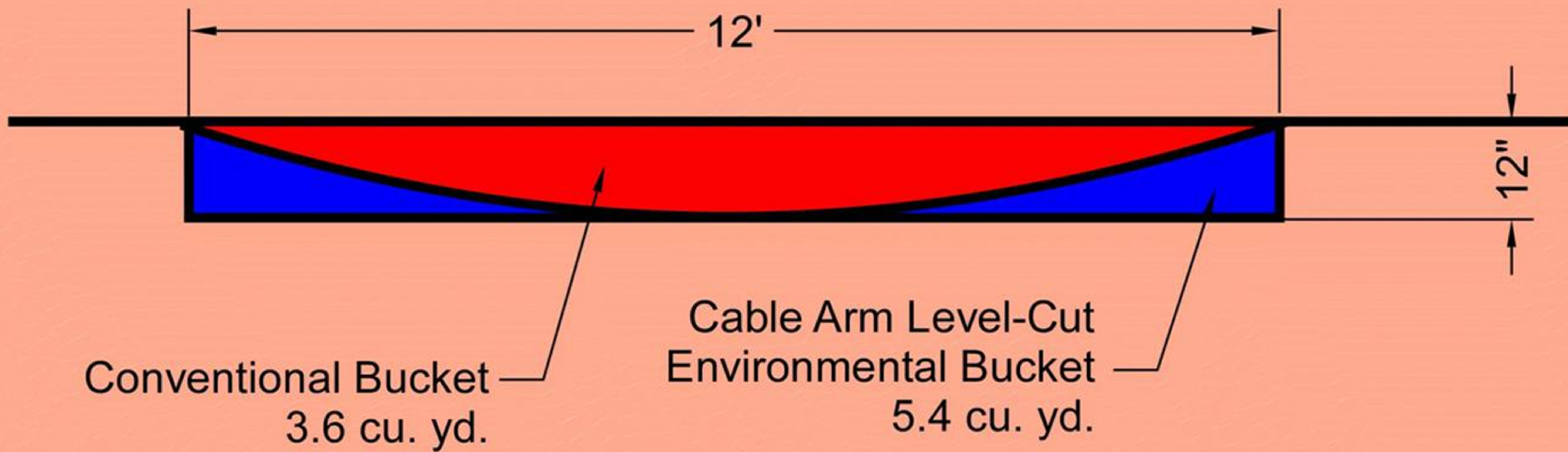
ENVIRONMENTAL
NAVIGATIONAL
BULK
PAST PROJECTS
<< LEVEL CUT
OVERLAPPING SIDES >>
<< CLOSING SYSTEM
RUBBER SEALS >>
<< VENTING SYSTEM

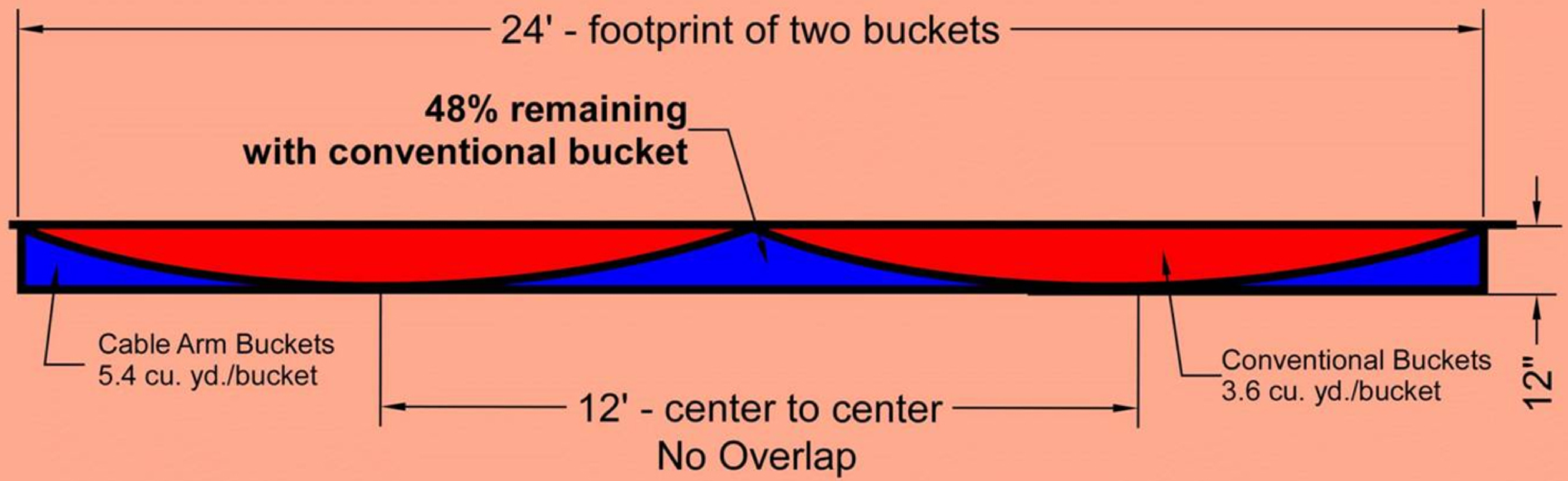
## *Hardware Issues in Environmental Dredging Navigation Buckets vs. Environmental Buckets*




**Level-Cut Clamshell Bucket vs. Conventional Bucket**

50% more material removed
with the same penetration and footprint

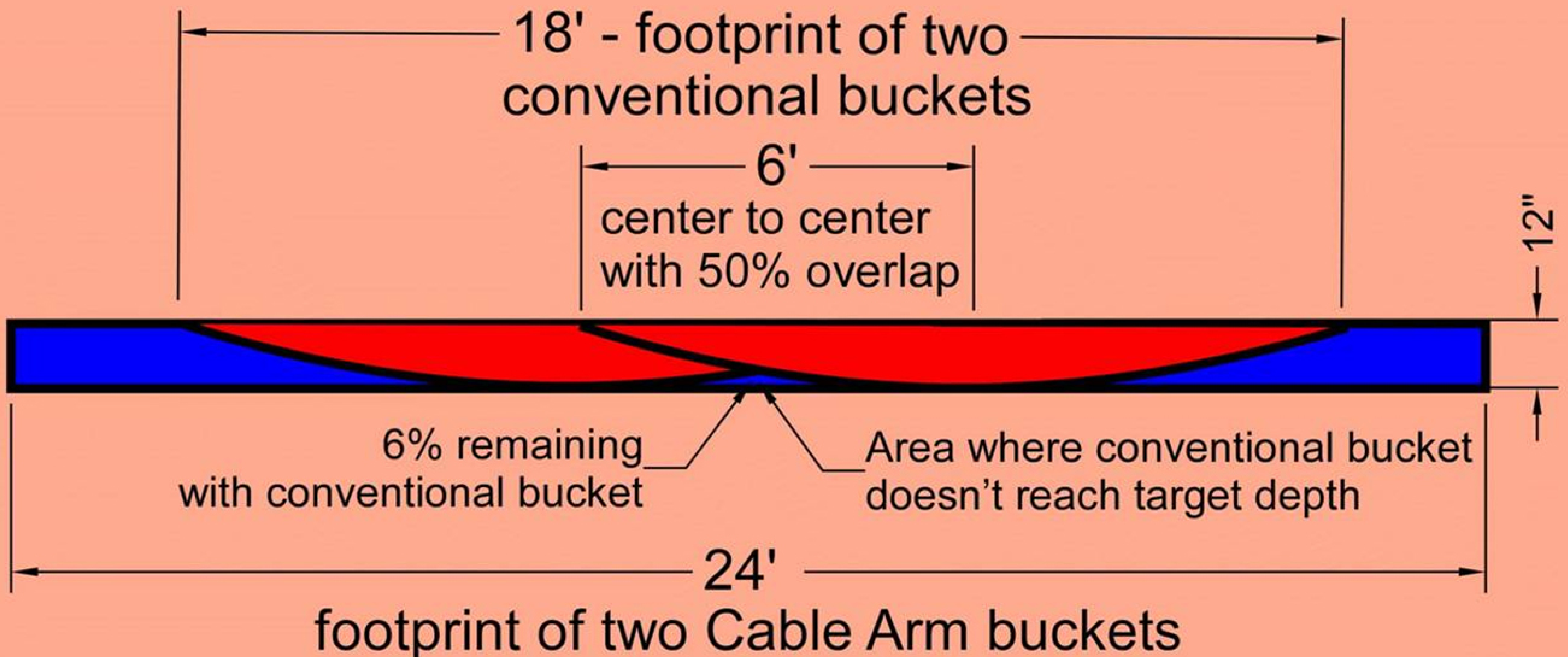
# Hardware Issues in Environmental Dredging
# Navigation Buckets vs. Environmental Buckets




**Level-Cut Clamshell Bucket vs. Conventional Bucket**

48% of the contaminated sediment left with a conventional bucket

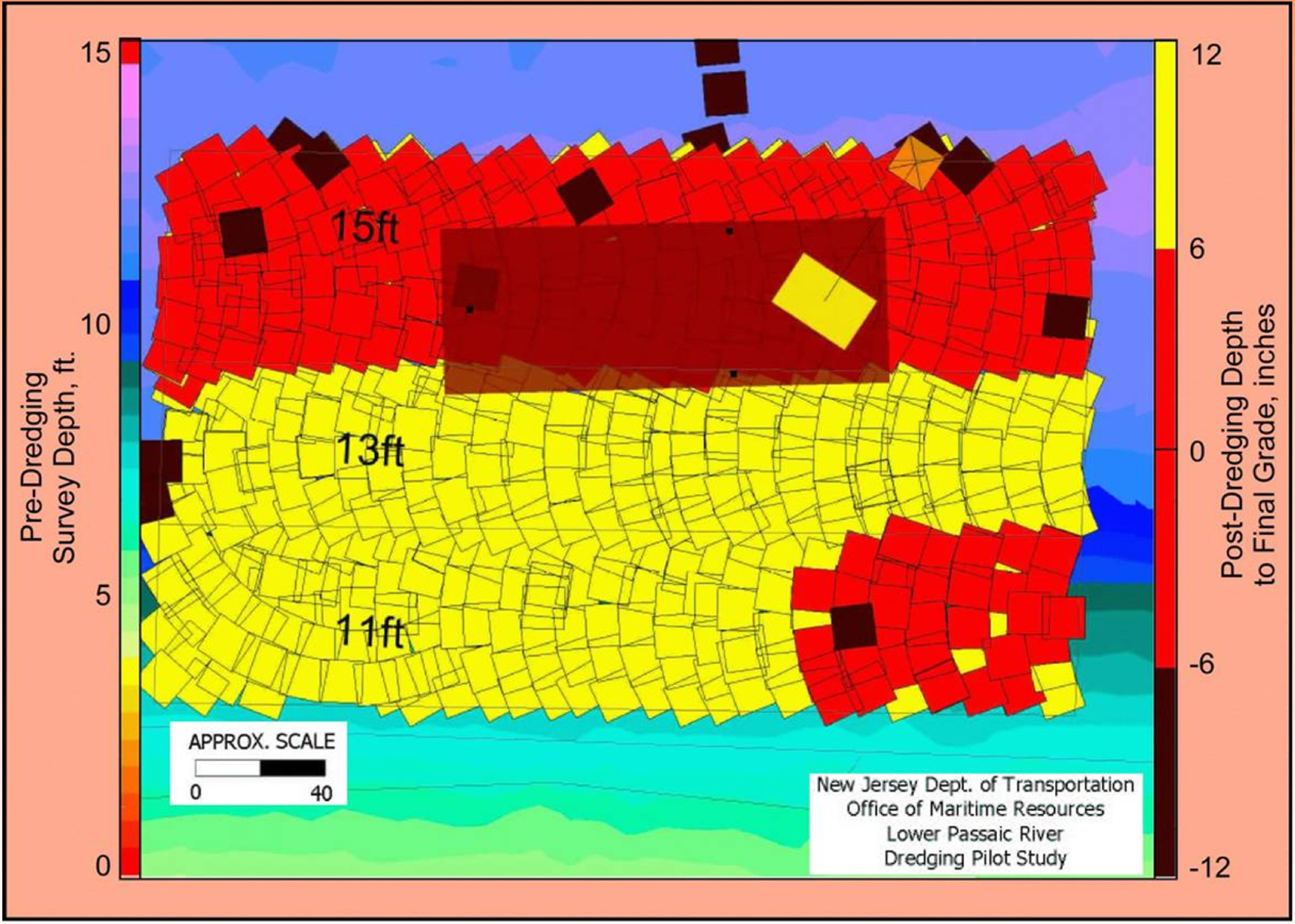
## *Hardware Issues in Environmental Dredging*
## *Navigation Buckets vs. Environmental Buckets*




**Level-Cut Clamshell Bucket vs. Conventional Bucket**

Conventional bucket still leaves **6%** of the contaminated sediment with a 50% overlap

## *Where Have I Been and How Deep Did I Go?*
## *Environmental Dredging = Sensors and Software*



# *Operational Procedures - Where the Bucket Meets the Mud*

## *Same Equipment, But Different Results with Different Procedures*

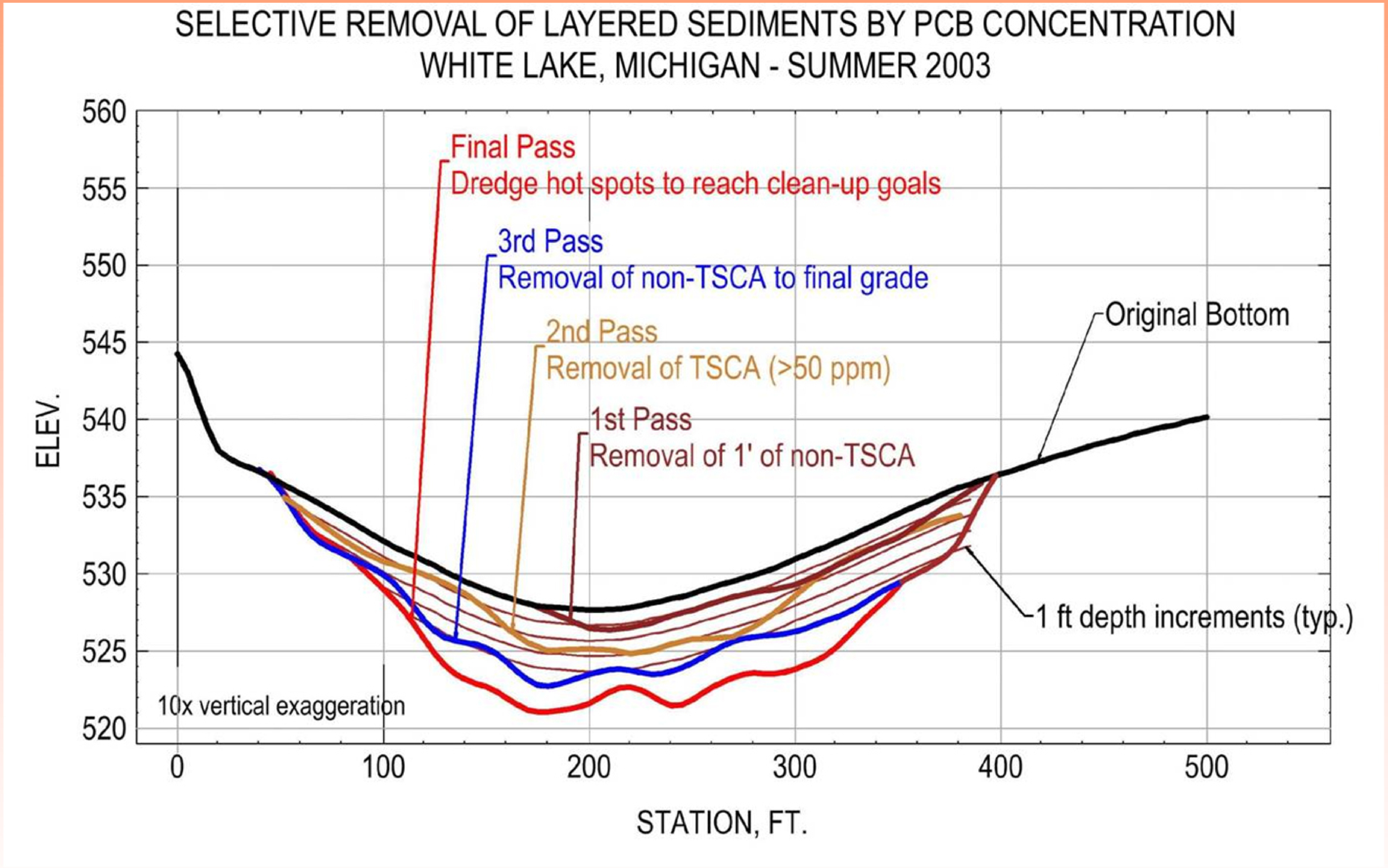
| Navigational Dredging Procedures - Dec. 5, 2005 | | | | | |
|---|---|---|---|---|---|
| **Cycle Time Observations** | | | **Turbidity Measurements** | | |
| **Bucket Position** | **Elapsed Time (sec.)** | **Total Cycle Time (sec.)** | **Elapsed Time (min.)** | **Task** | **Turbidity (NTU)** |
| In wash tank | | | | Background | 28 |
| In water | 23 | | 0 | Dredging begins | 40 |
| Out of water | 29 | | 5 | | 69 |
| Dump in scow | 27 | | 7 | | **79** |
| In wash tank | 20 | **99** | 12 | | 55 |

| Environmental Dredging Procedures - Dec. 8, 2005 | | | | | |
|---|---|---|---|---|---|
| **Cycle Time Observations** | | | **Turbidity Measurements** | | |
| **Bucket Position** | **Elapsed Time (sec.)** | **Total Cycle Time (sec.)** | **Elapsed Time (min.)** | **Task** | **Turbidity** |
| In wash tank | | | | Background | 28 |
| In water | 57 | | 0 | Dredging begins | 30 |
| Out of water | 31 | | 1 | | 35 |
| End of draining | 35 | | 4 | | **39** |
| Dump in scow | 27 | | 5 | | 28 |
| In wash tank | 28 | **178** | 7 | | 29 |

**Communicate project goals to the entire dredging team, thoroughly explaining differences between environmental and navigational dredging.**

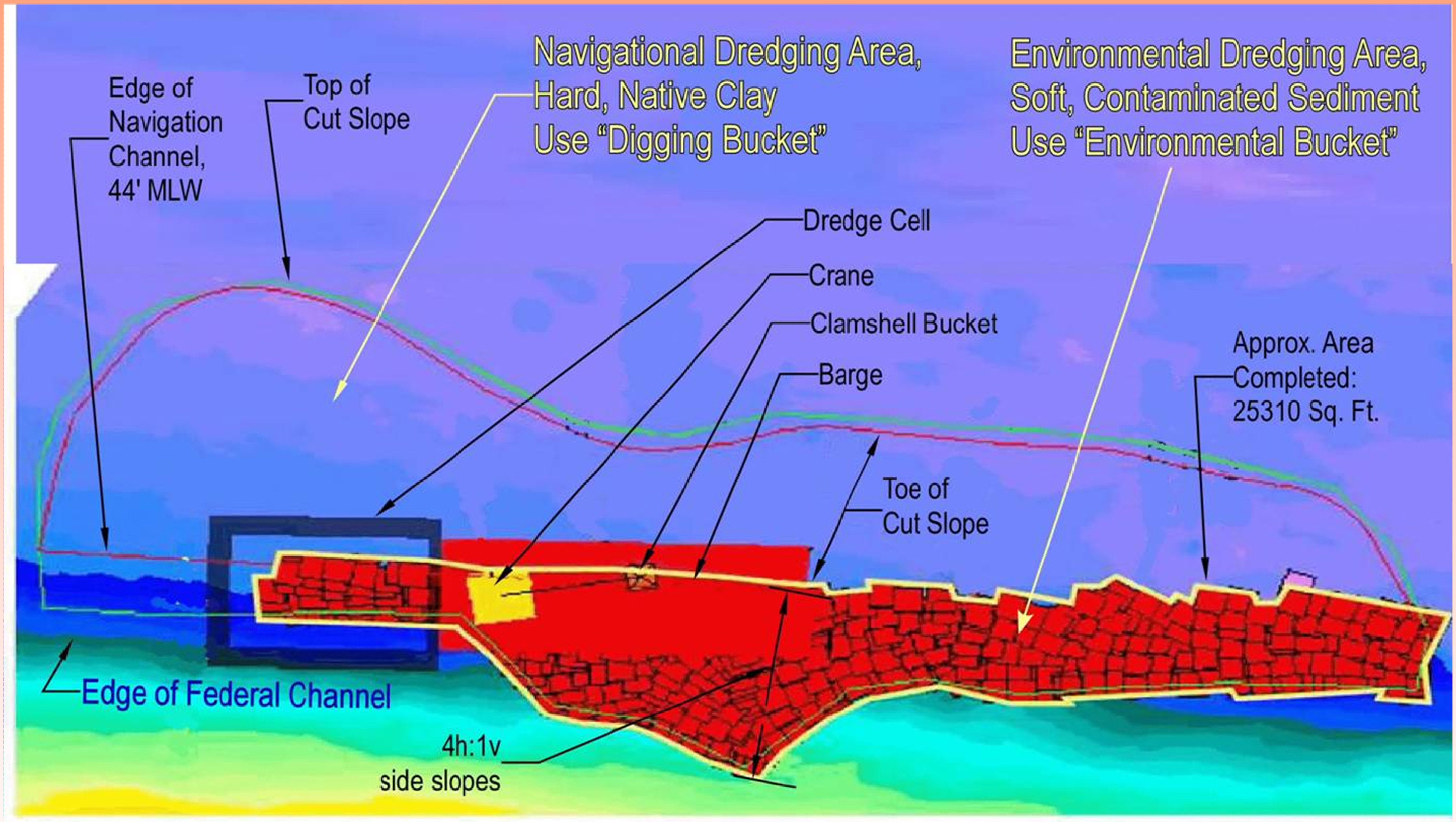
- Production Oriented vs. Removal Oriented (you get what you pay for!)
  - Basis for payment - contract terms & conditions
  - Disposal costs
- Resuspension Control
  - Turbidity & water quality standards
  - Contamination of new areas
  - Recontamination of old areas
- Water Handling
  - Treatment costs
  - Discharge standards
- Debris Handling
  - Effects on water quality & sediment handling

***Precision dredging requires a crane in top mechanical condition; precision instrumentation can be wasted on a poorly functioning crane.***



**_Precision dredging requires a crane in top mechanical condition; precision instrumentation can be wasted on a poorly functioning crane._**

## *Use an Environmental Clamshell Bucket to remove soft, contaminated sediment first. Then remove harder, native material with a "digging" bucket.*



<Navigation

Environmental>

Conventional Clam

Articulated Fixed-Arm Excavator

# MECHANICAL

Enclosed Bucket

Horizontal Auger

Conventional Cutterhead

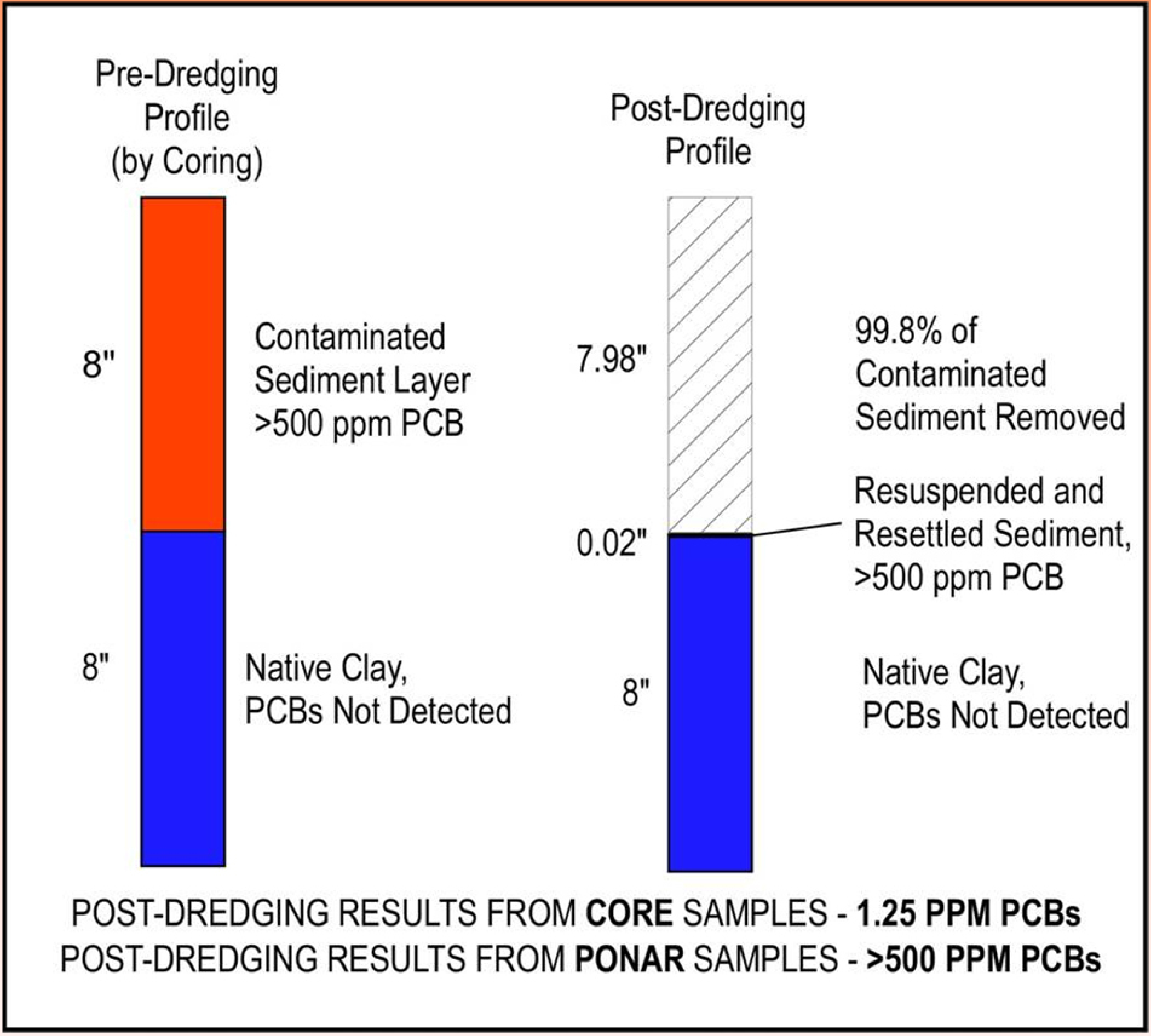
Diver-Assisted

# HYDRAULIC

From "Cleanup and Remediation of Persistent Bioaccumlative Toxics in the Great Lakes Basin, G. Bayer, CH2M Hill, 2005

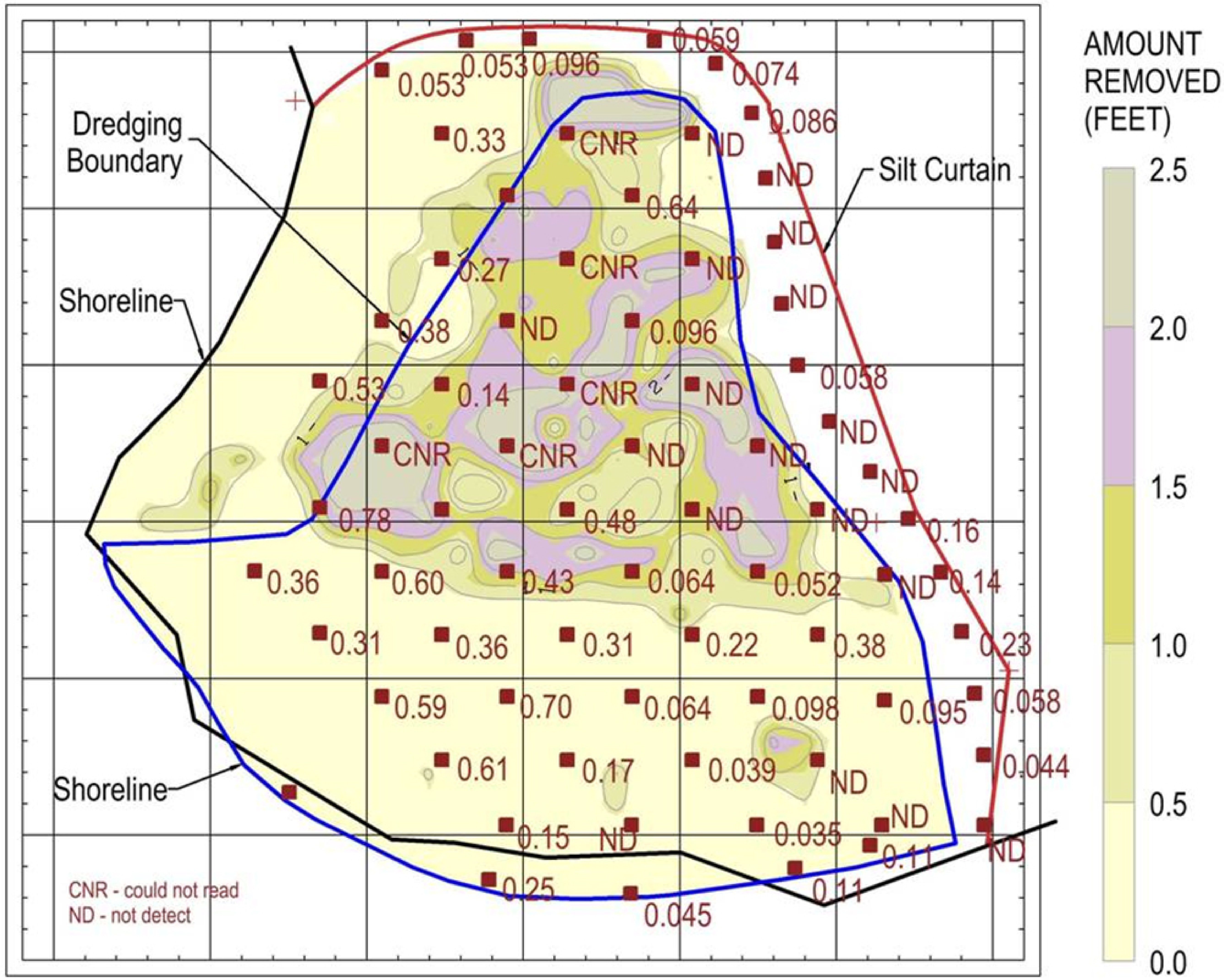
***Minimize sediment volumes by using an Environmental Clamshell Bucket to remove only soft, contaminated sediment.***

*For comparability, sample & test sediments using the same methods before & after dredging*



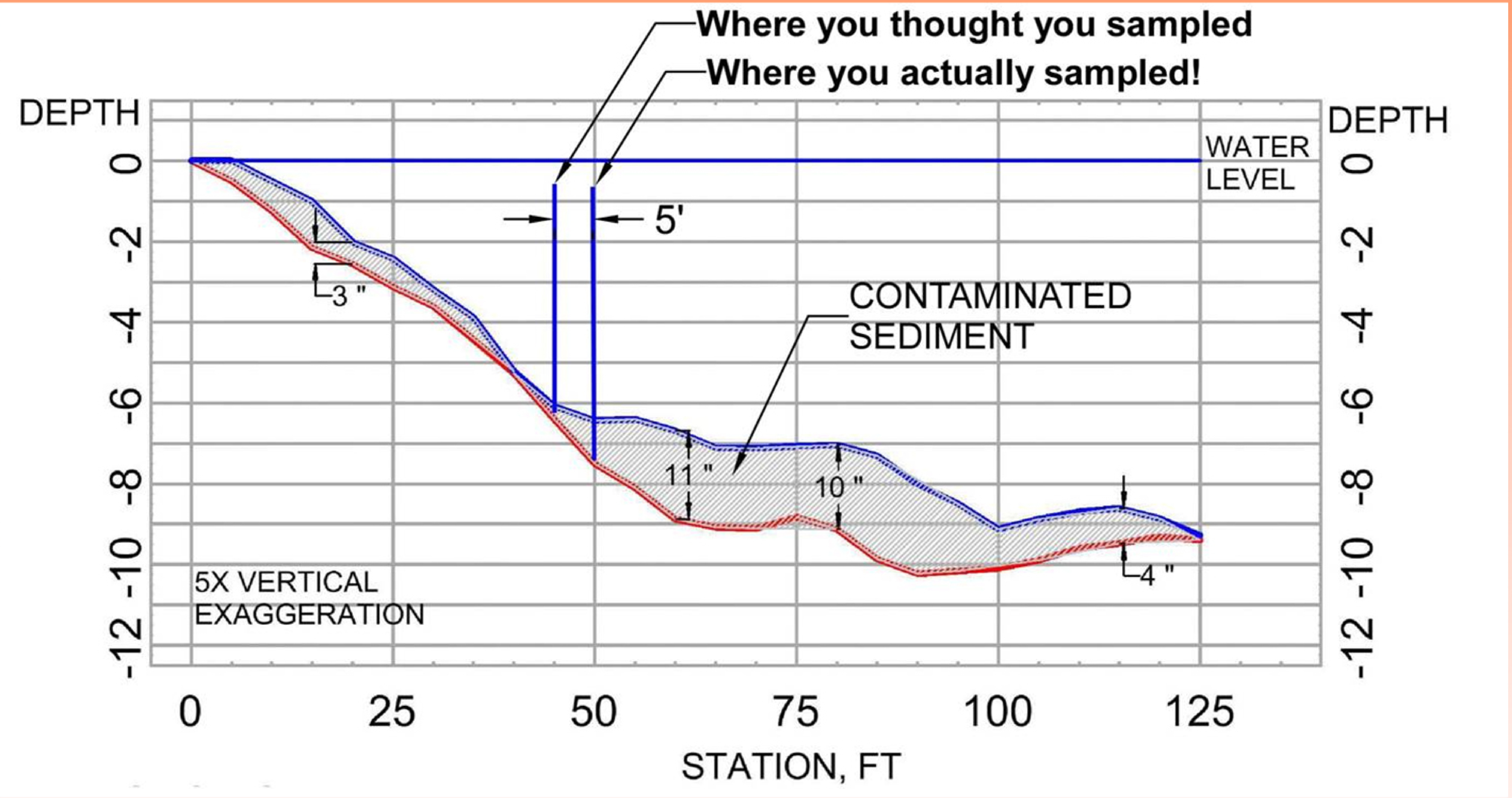

*If you don't sample it correctly, don't expect credit for dredging it correctly!*

## *Determine sampling locations & depths precisely, before & after dredging.*



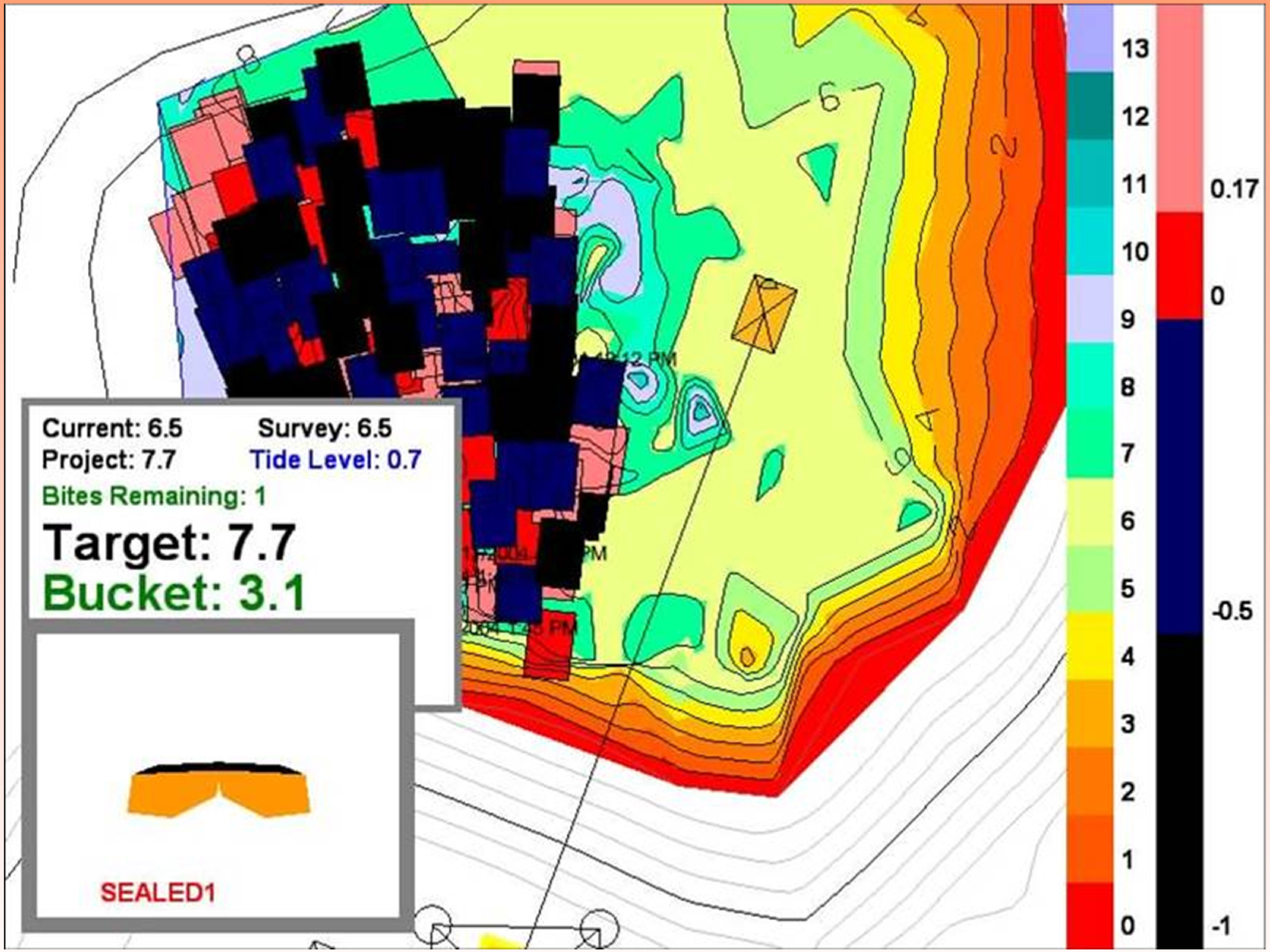

## *Locate samples accurately so "numbers" reflect dredging results; not sampling variability*

## *Determine sampling locations & depths precisely, before & after dredging.*

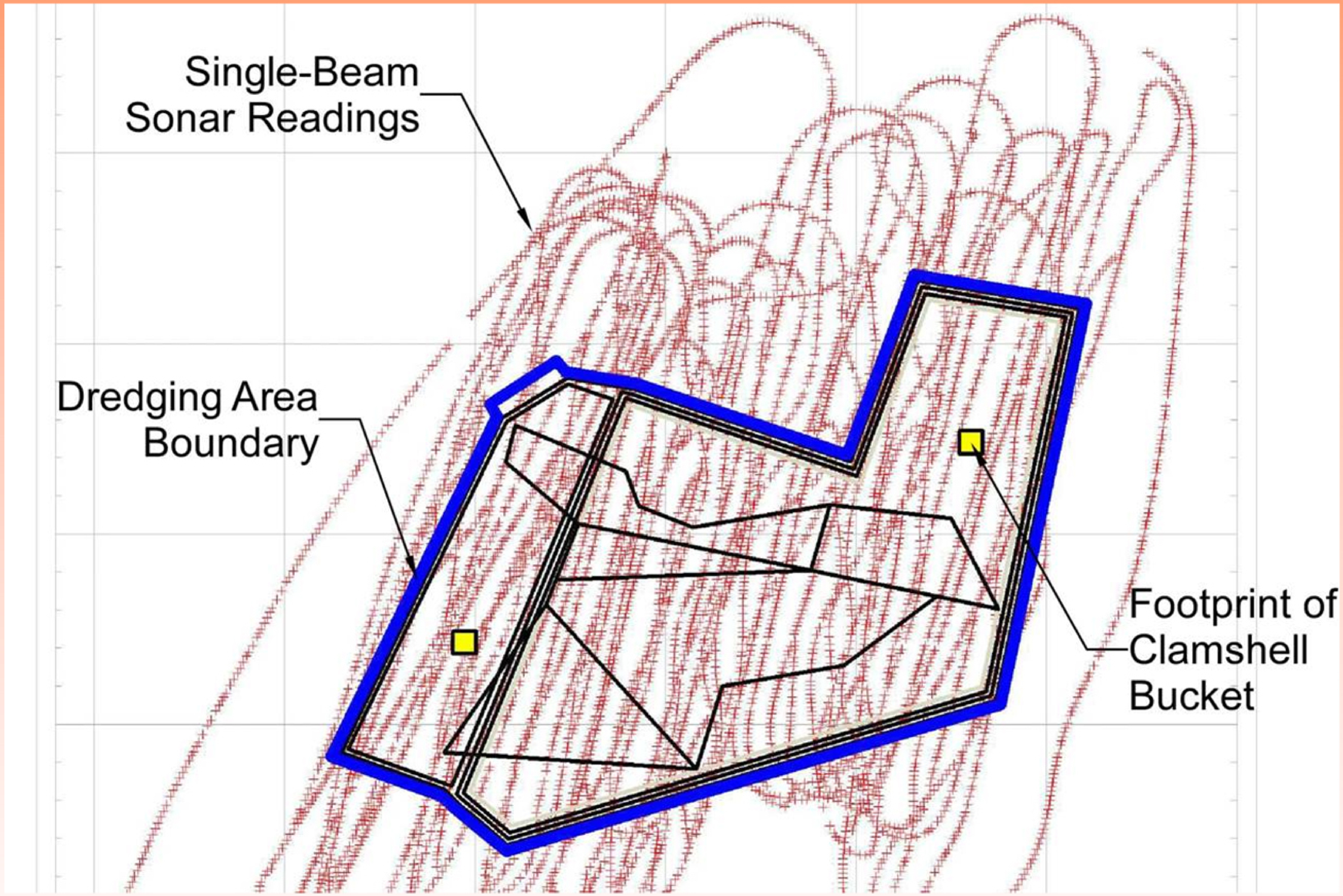



***Be sure your results reflect dredging performance; not sampling bias!***

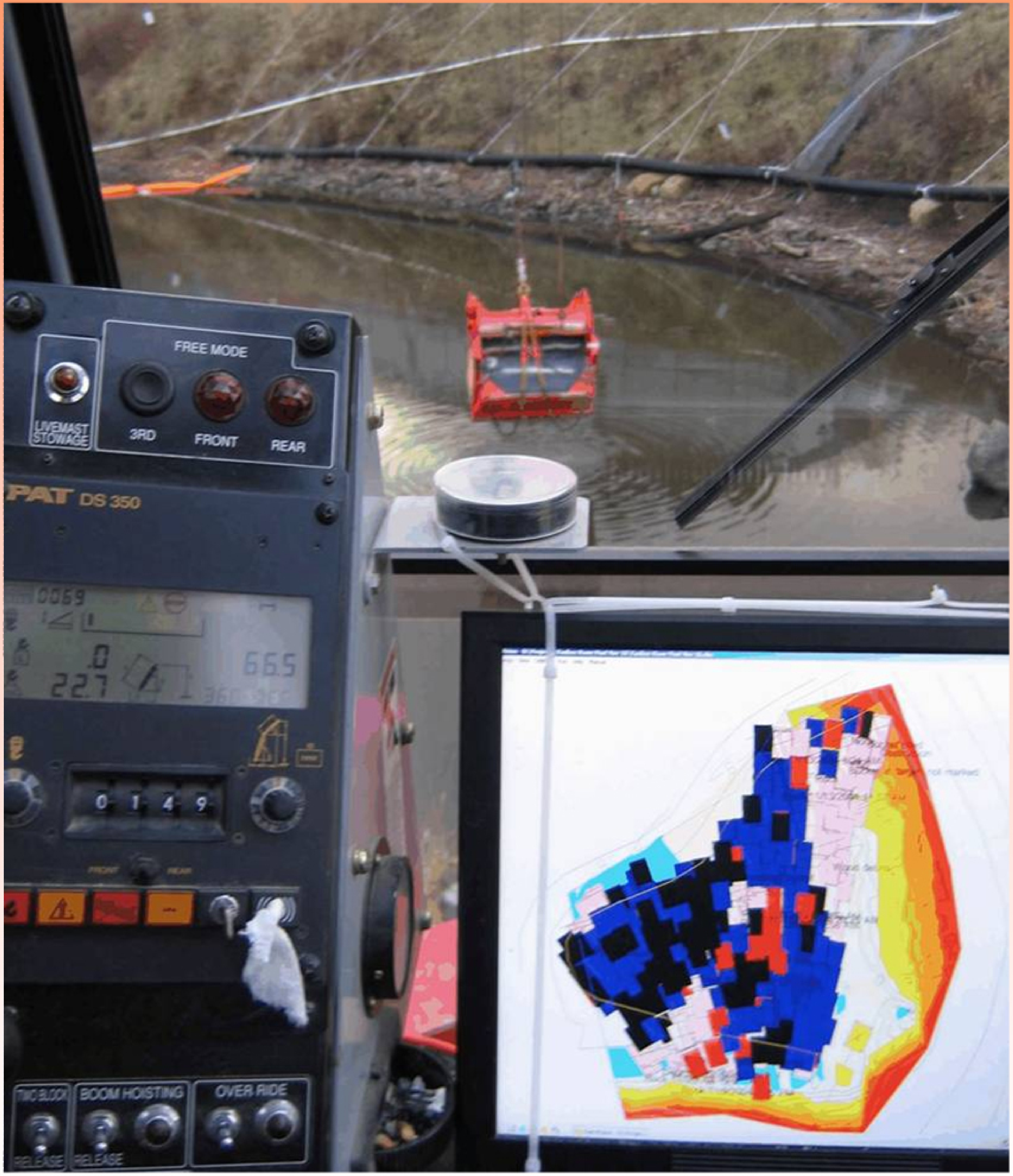
***Use a differential global positioning system, bucket and crane instrumentation, tide gauge, and dredging software (Clamvision) to track bucket location in 3-D.***



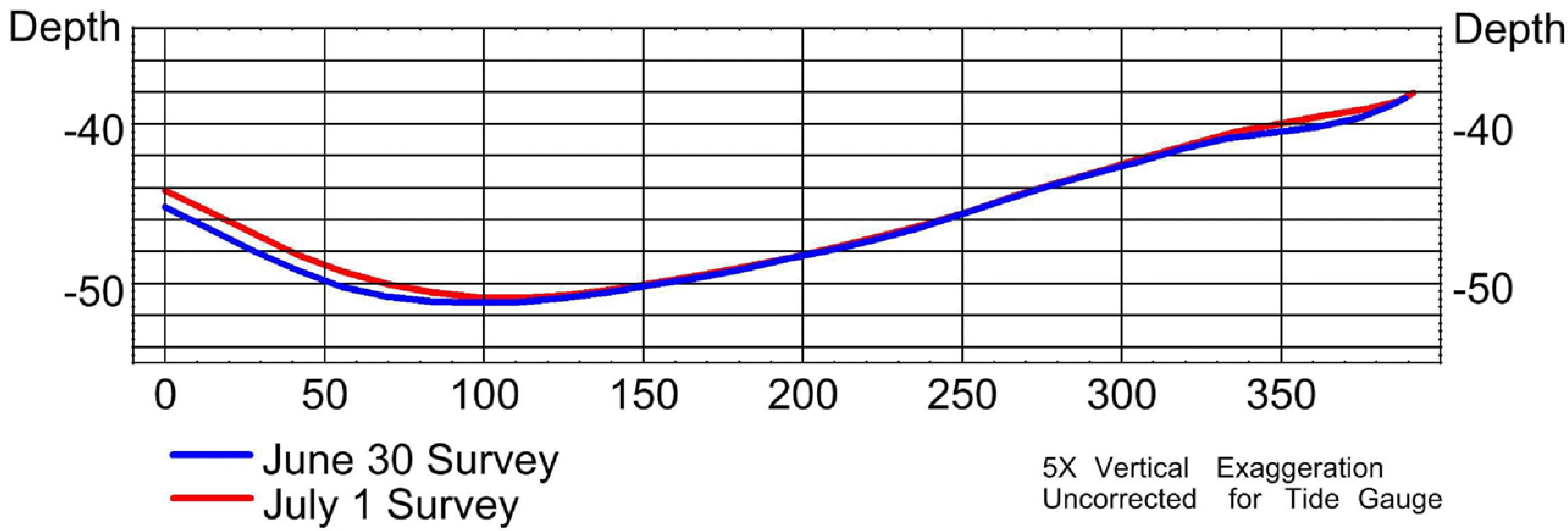
***Provide an accurate predredge survey on a grid dense enough to provide a sounding within every bucket footprint.***



***Provide time in the project schedule to train crane operators to use new instrumentation and procedures for precision dredging.***

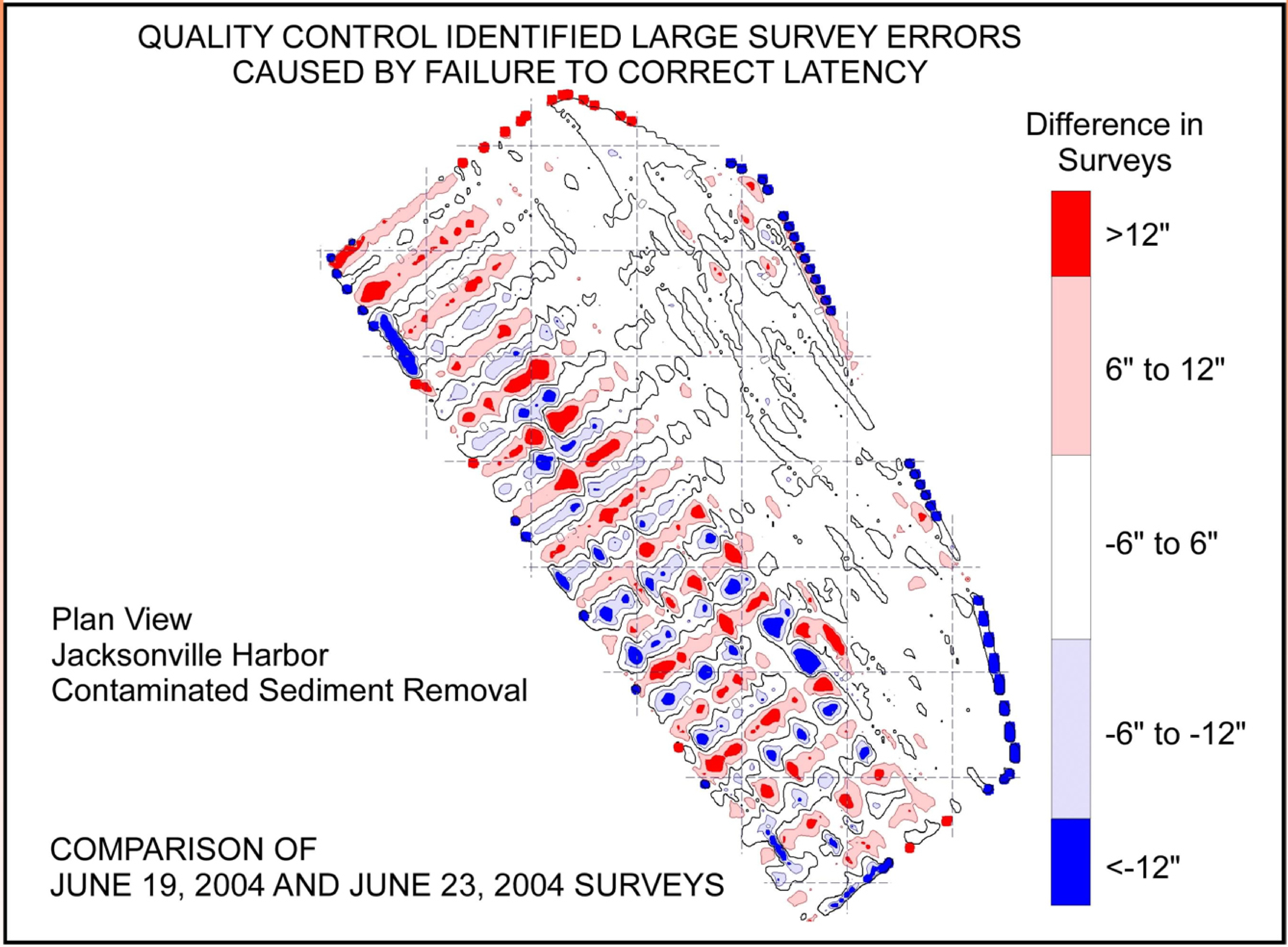


***Provide independent QA/QC of hydrographic surveys. Identify GPS reference marks for confirming surveying & positioning equipment accuracy.***

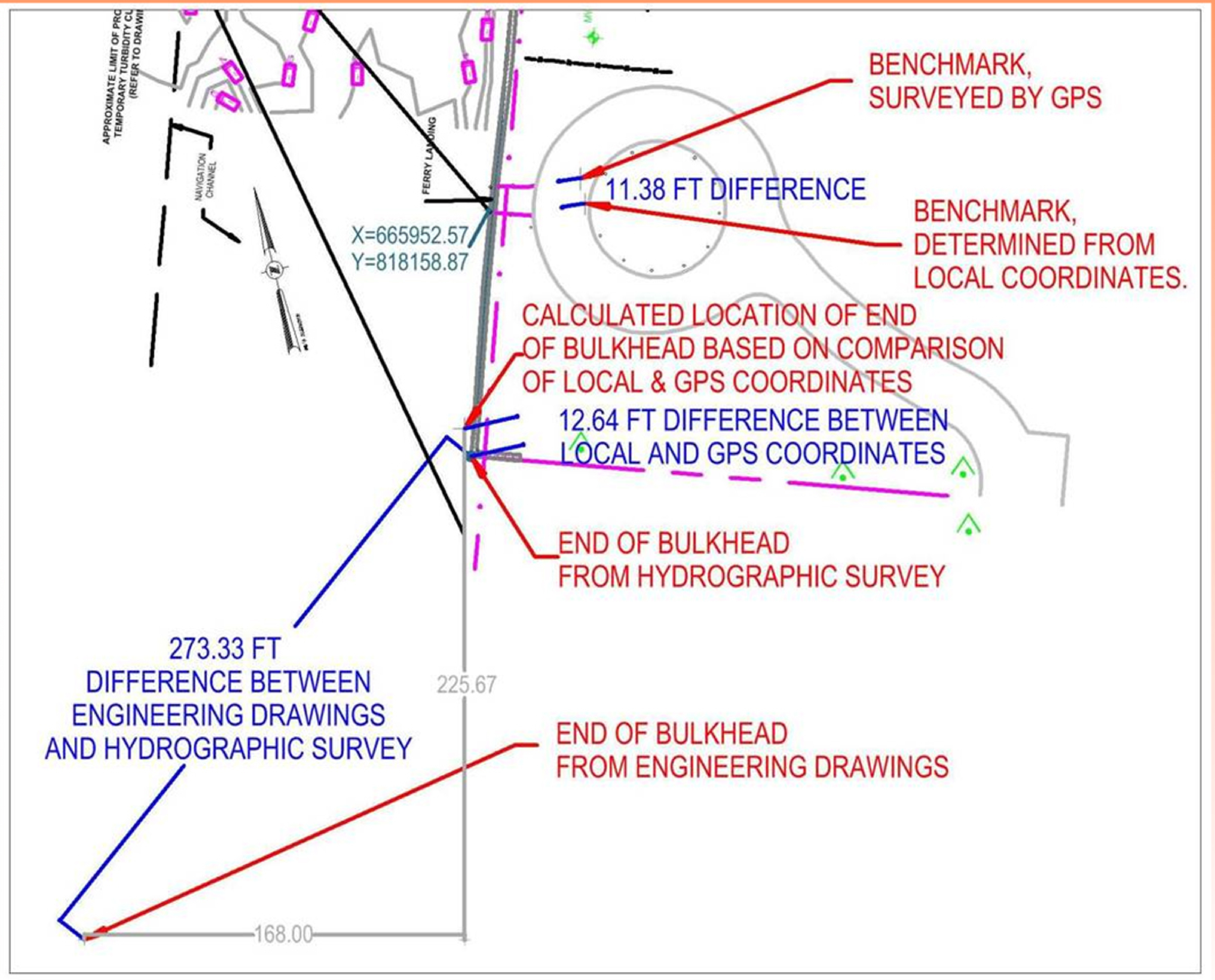



Comparison of Profiles from June 30 & July 1 Surveys
Miller Springs Remediation - Montague, Michigan

## *Provide independent QA/QC of hydrographic surveys.*



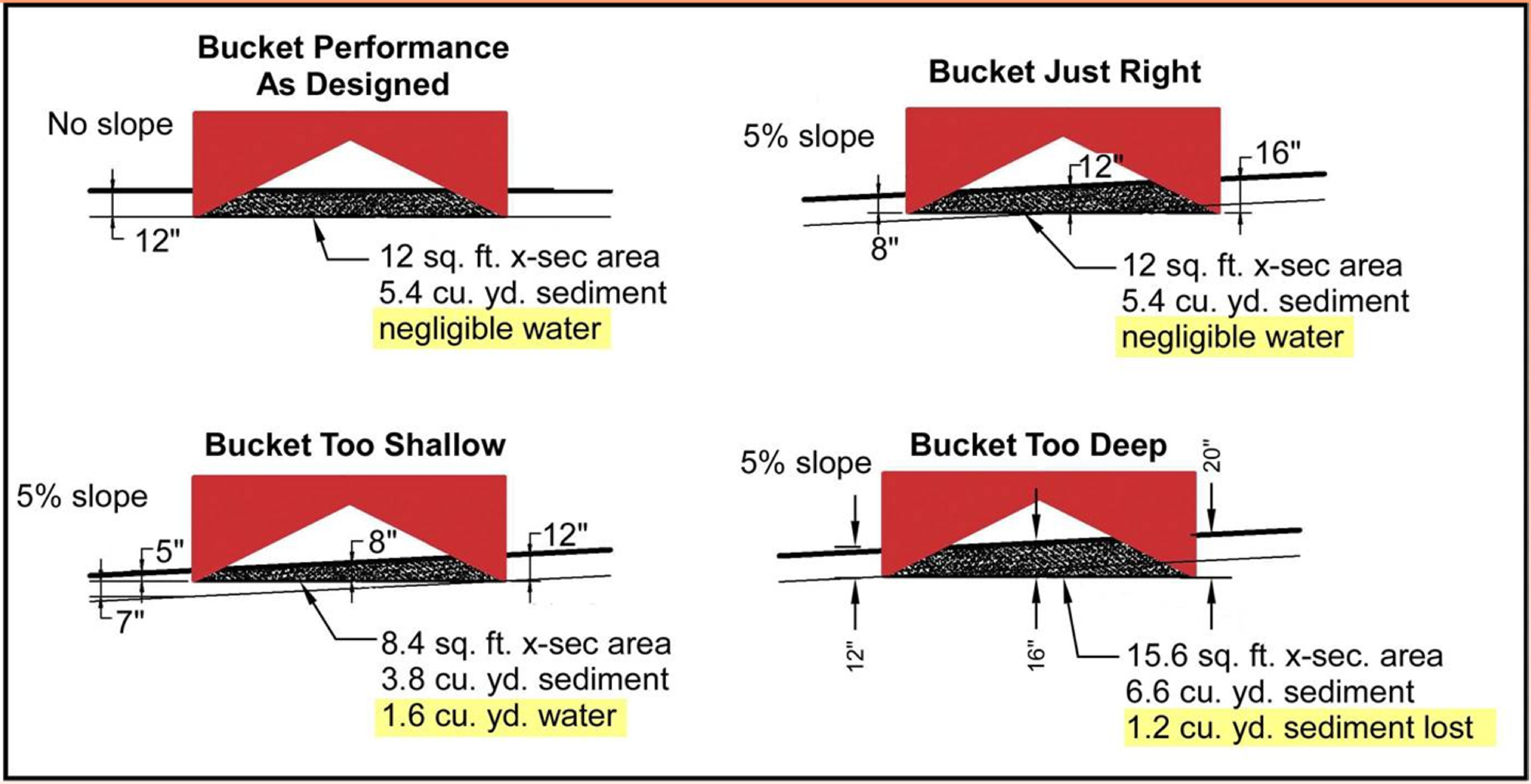
## *Triple check coordinate transformations, datum conversions, and tide settings in the software.*



# *Clamshell Advantages*

- Rapid mobilization with usually lower costs
- Equipment and labor readily available in most markets
- Handles deep water greater than 40 feet
- Some rock and debris handling capability
- Much lower water treatment costs

*Use the depth instrumentation & target depths from the software to avoid excess water or overfilling the bucket.*



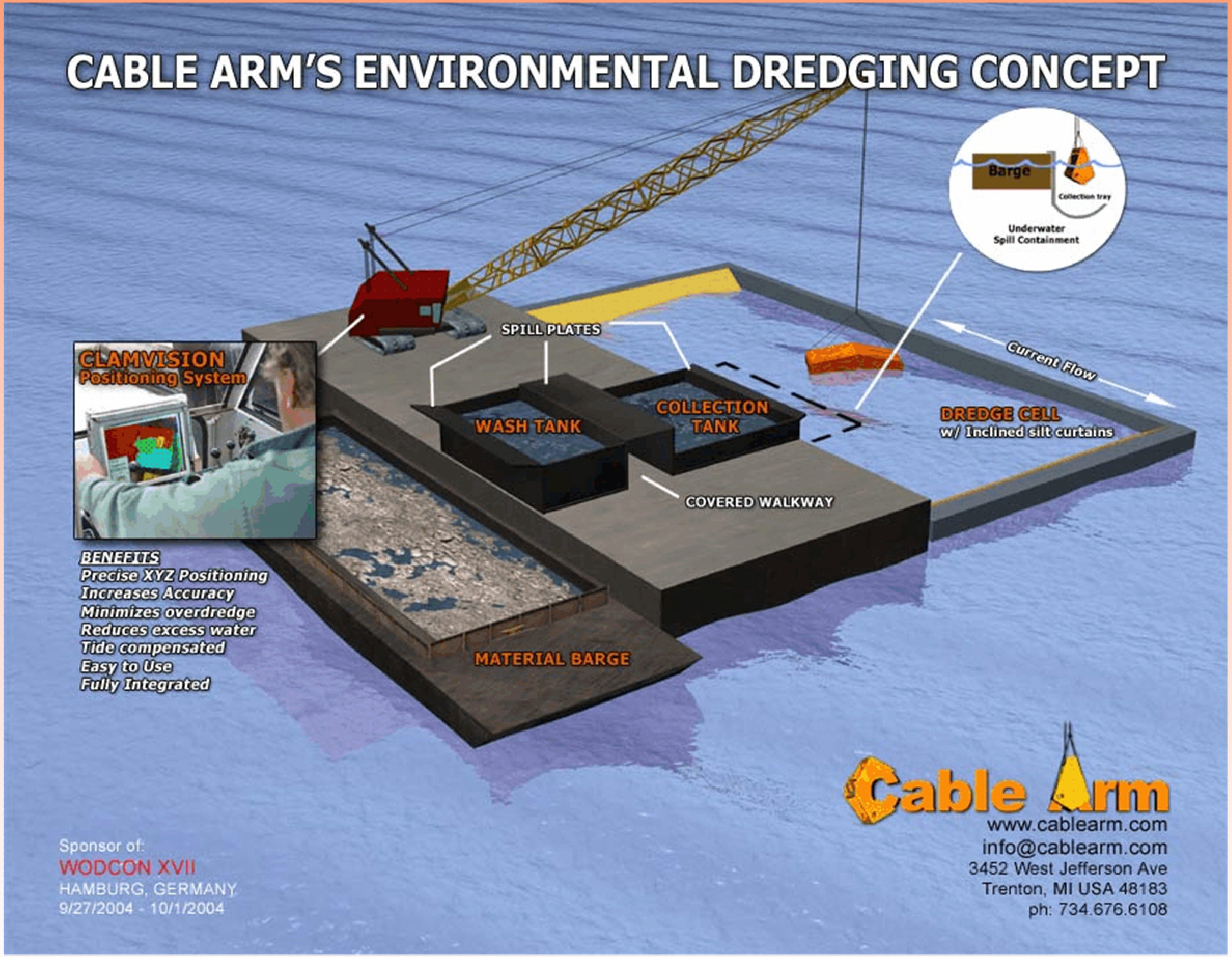

***Bucket overlap is necessary on slopes to achieve project depths without producing excess water or overfilling the bucket.***

## *Use the depth instrumentation & target depths from the software to avoid overfilling the bucket.*


## *Use the horizontal bucket position to provide adequate overlap of each bite.*

## *Locate sediment receiving containers or scows close to the working area to minimize cycle time.*

## *Install drip pan at discharge point to receive the closed, filled bucket. Rinse the empty bucket in a wash tank.*



***Install drip pan at discharge point to receive the closed, filled bucket. Rinse the empty bucket in a wash tank.***

*Continually monitor turbidity in accordance with work plan.*
*Identify & control sources of turbidity other than dredging.*
*Link measurements with activities and show cause-effect to crew.*

**Turbidity Monitoring Report**

**White Lake, Michigan - Cable Arm Clamshell**
**Miller Springs Remediation**

**Date: 8/1/03 00:00 to 8/1/03 23:50**

**Statistical Summary**

| Station | SW 9 Top | SW 9 Bottom | SW 7 Top | SW 7 Bottom | SW 3 Top | SW 3 Bottom |
|---|---|---|---|---|---|---|
| | | | | | | |
| No. of Samples | 144 | 144 | 144 | 144 | 144 | 144 |
| Average | 5.18 | 2.7 | 3.04 | 2.36 | 3.81 | 1.42 |
| Maximum | 10.7 | 12.1 | 6.38 | 10.84 | 5.15 | 2.42 |
| Minimum | 3.2 | 0.8 | 1.84 | 1.67 | 2.65 | 0.8 |
| Std. Dev. | 1.4 | 2 | 0.61 | 0.84 | 0.41 | 0.32 |

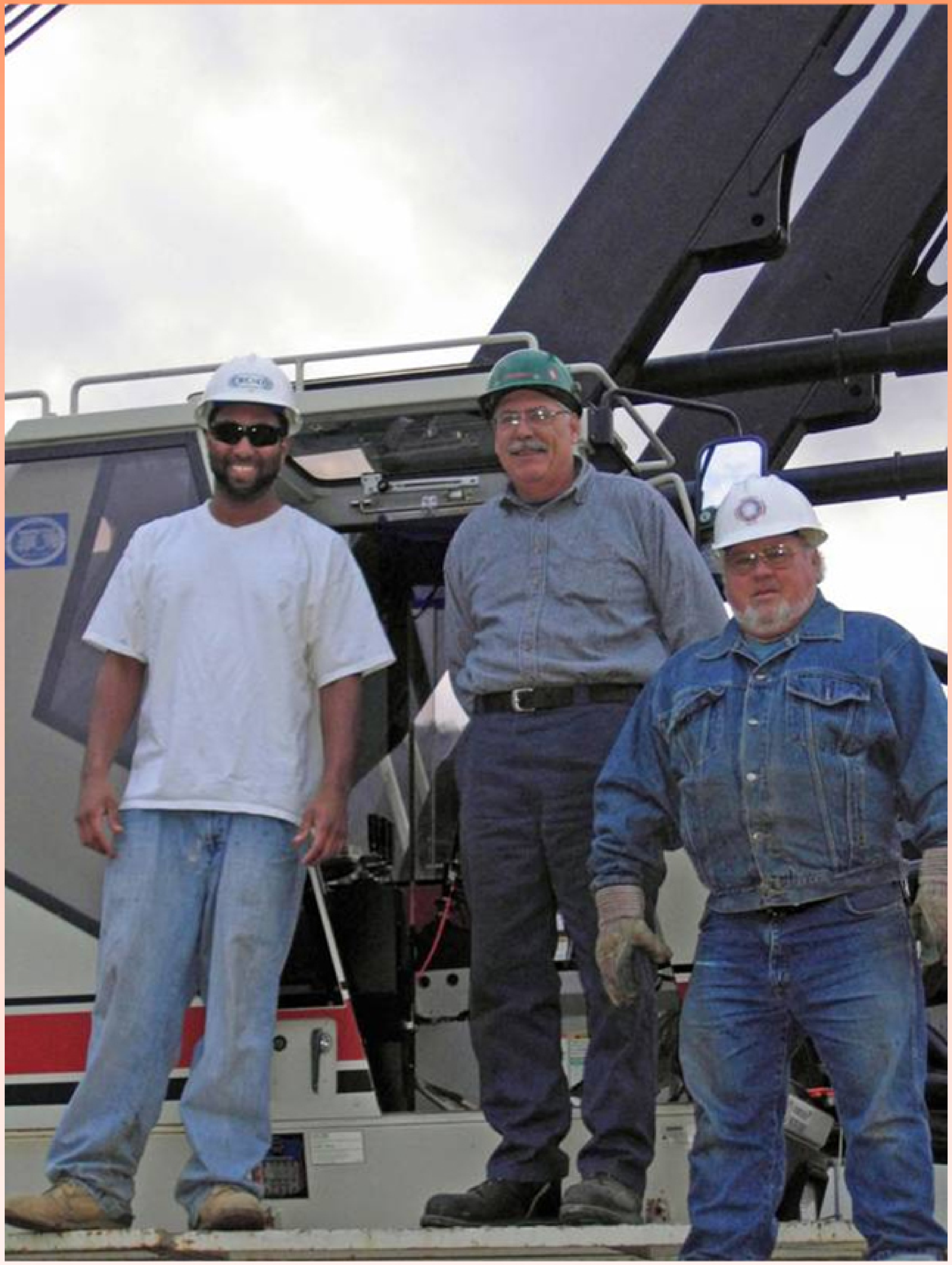
All readings in NTU.

## *Expect debris.*
## *Have a plan for dealing with materials that won=t allow the bucket to seal.*

## *Have a plan for dealing with debris and excess water both on the water and at the shore.*

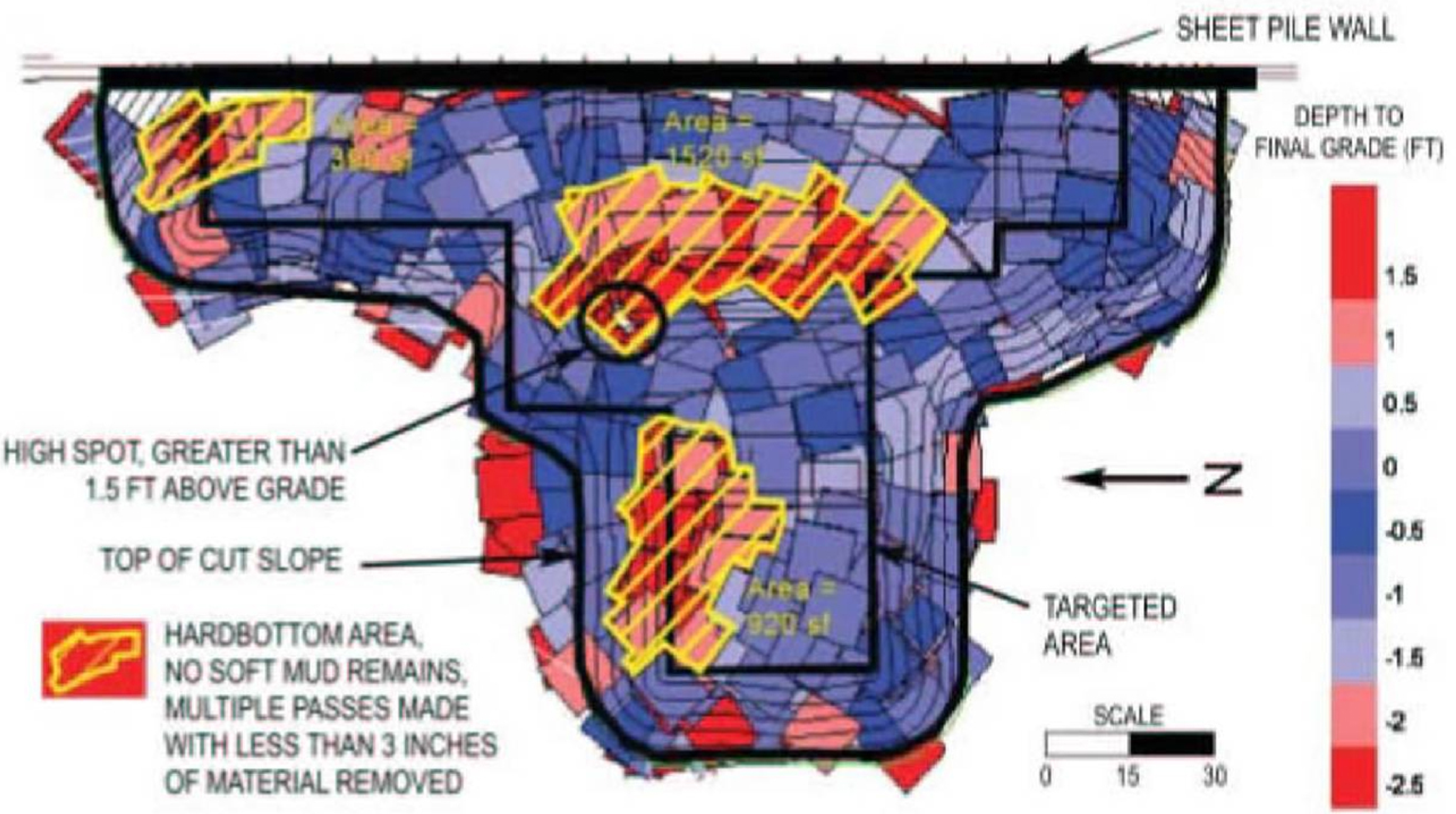
*Involve the crew.*

*Track project status on a real-time basis and provide daily updates.*



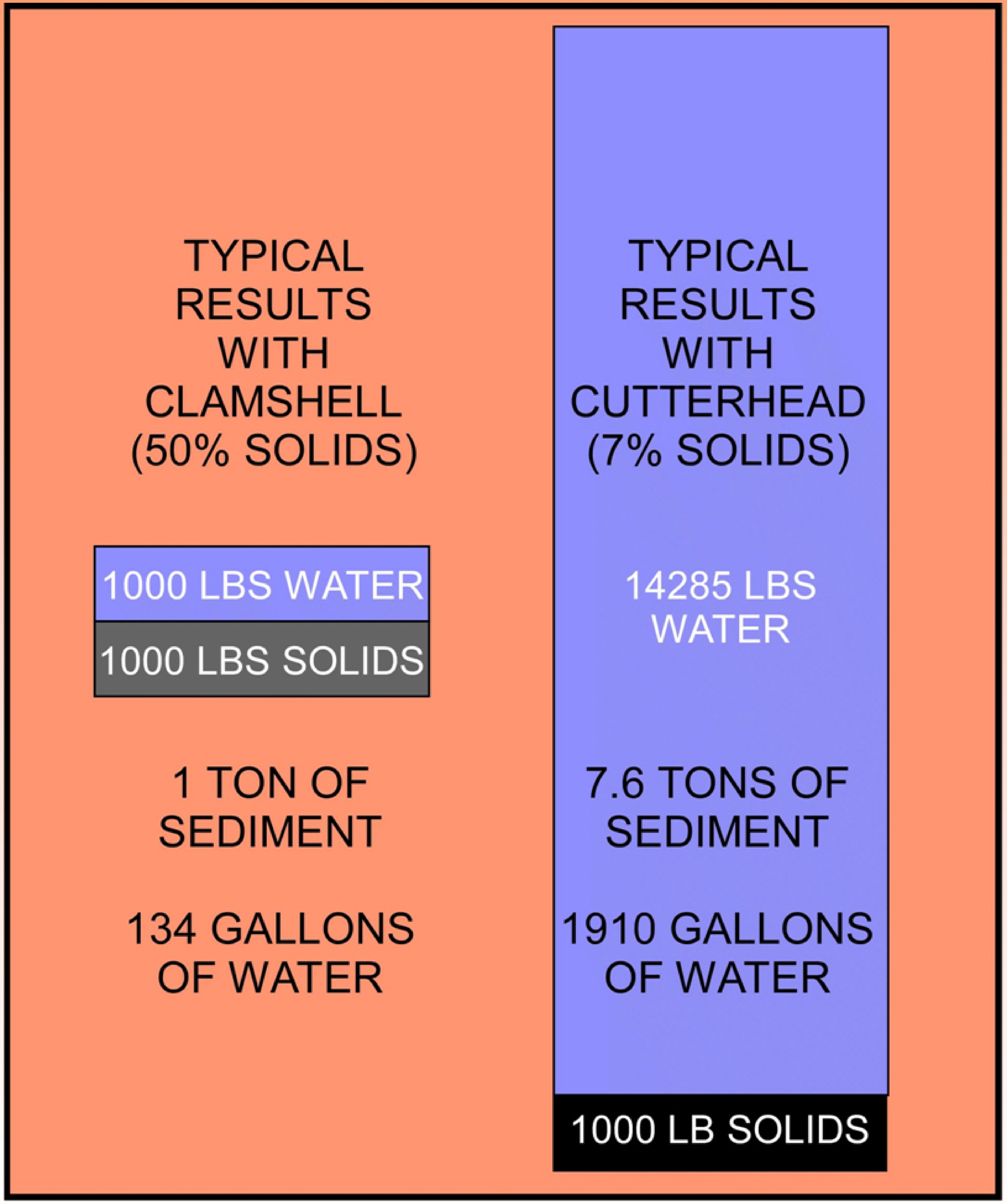
*Provide feedback that includes both successes and areas for improvement. Establish realistic expectations for performance.*

***Combine hardware, sensors, and software with operational controls for success on your next environmental dredging project.***




CUMULATIVE AREA DREDGED - OCTOBER 8, 2004

# Comparison of Water Treatment Needs
# Environmental Clamshell vs. Cutterhead




***Cutterhead dredging typically produces 4 to 14 times more water than environmental clamshell dredging.***

# *Sherman Reservoir – Fall 2004*

**Another Site 100% Successfully Remediated**
**By Combining the Right Hardware, Software & Procedures**

*Applying the lessons learned from past environmental dredging experience with the right hardware, software, and procedures can produce results that are easy to explain to your clients, to the public and to the regulators.*

# Comparison of Typical Water Treatment Costs Environmental Clamshell vs. Cutterhead

## *Treat more water, spend more money!*

| DREDGING TYPE | CLAMSHELL | | | HYDRAULIC | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| Sediment Volume Removed, cu. yd. | 30,000 | | | 30,000 | | |
| **Water Volume, Million Gallons** | **26.8** | | | **133.8** | | |
| | | | | | | |
| **Treatment Process** | **Cost Range** | | | **Cost Range** | | |
| | | | | | | |
| Coagulation & Precipitation | $8,028 | - | $18,732 | $40,140 | - | $93,659 |
| Sand Filtration | $36,928 | - | $122,024 | $184,642 | - | $610,121 |
| Carbon Absorption | $32,112 | - | $168,586 | $160,558 | - | $842,931 |
| | | | | | | |
| **TOTAL WATER TREATMENT COST** | **$77,068** | **-** | **$309,342** | **$385,340** | **-** | **$1,546,711** |

Unit Treatment Costs from Federal Remediation Technologies Roundtable Web Site, www.frtr.gov

Based on 12% solids for cutterhead dredging and 60% solids for clamshell dredging.

# *Clamshell Disadvantages*

- Lower production rates usually vs. hydraulic
- Need for onshore unloading/transfer facilities, trucks
- Loss of volatile organic compounds from open barges
- Need for secondary spill containment at transfer points

# *When Selecting Environmental Dredging Technologies, Evaluate Total Project Costs*

- Investigations, Lab, Pilot Tests & Engineering Studies
- Administrative – Cost, Schedule, Work Plans
- Mobilization & Demobilization
- Shore Facilities – Docks, Roads, Storage, Processing
- Silt Containment & Turbidity Mitigation
- Water Treatment & Air Pollution Control
- Solid Waste Treatment & Disposal
- Sampling, Monitoring & Regulatory Compliance
- Health & Safety
- Dredging Equipment & Operations

# *Navigational vs Environmental Dredging*

- Battling Misconceptions about Clamshells

A hydraulic (vacuum-style) dredge should be used. A horizontal auger cutterhead seems to stir sediments  less than a swinging ladder style.

(Don't allow clamshell dredging --- it’s very messy!)

From Fox River Watch Web Site,
http://www.foxriverwatch.com/index.html

# *Navigational vs Environmental Dredging*

- Hardware
- Sensors and Software
- Operational Controls