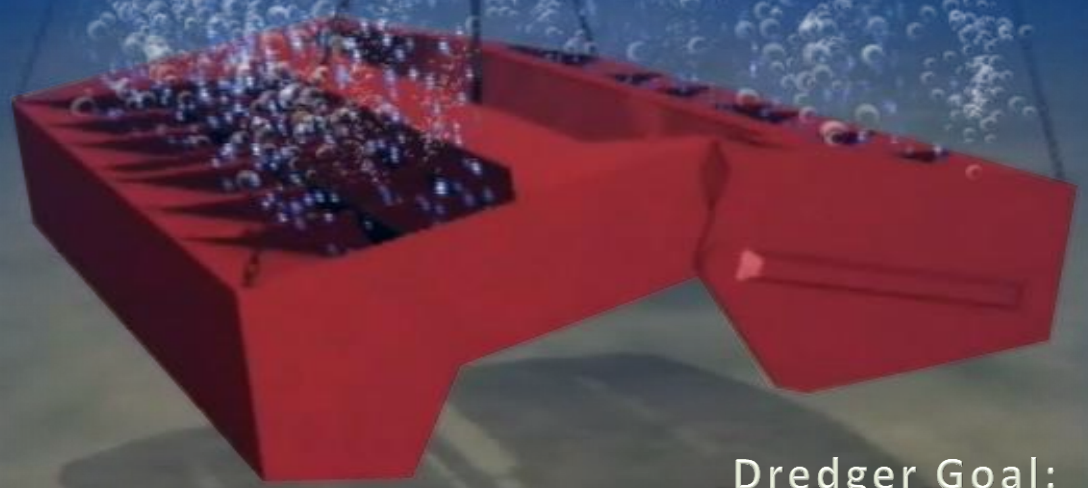
ENVIRONMENTAL CLAMSHELL DREDGING

RAYMOND BERGERON

CABLE ARM, INC

Dredging Engineering Short Course
Texas A&M University
January 2016

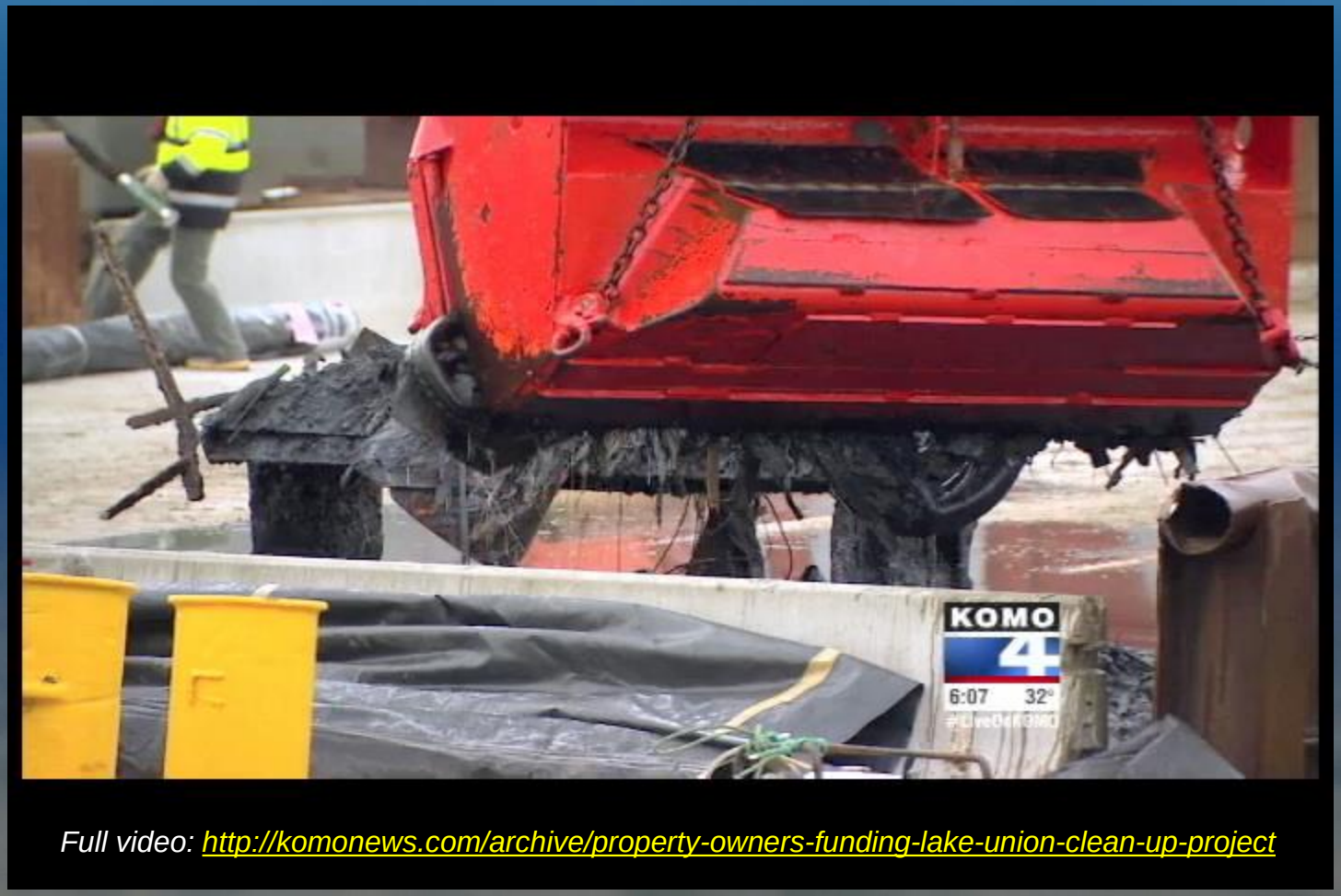


Dredger Goal:

"Achieving total customer satisfaction by increasing dredger sediment removal profit and reducing project owner cost through increased dredging efficiency."

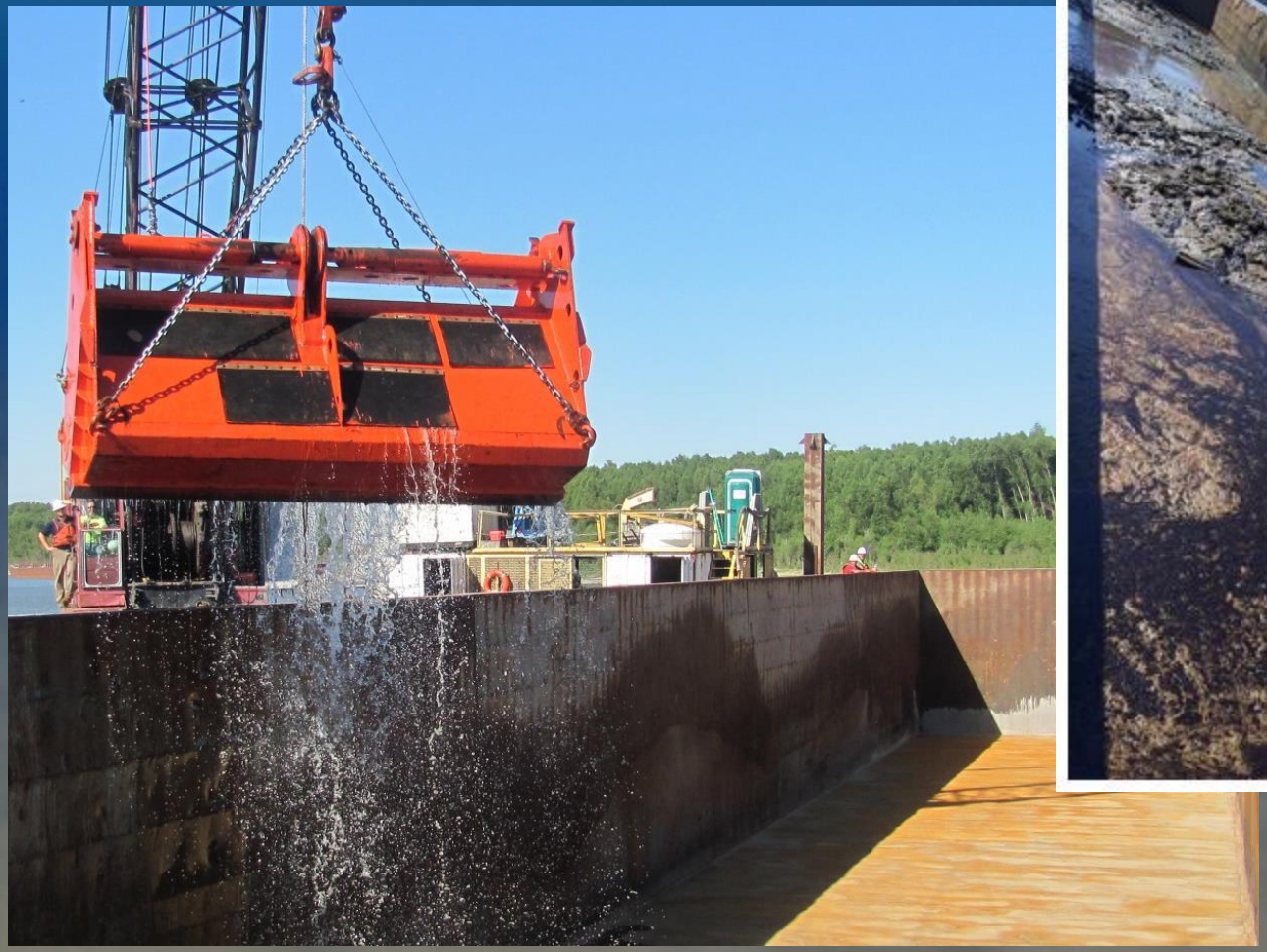
EXPECT

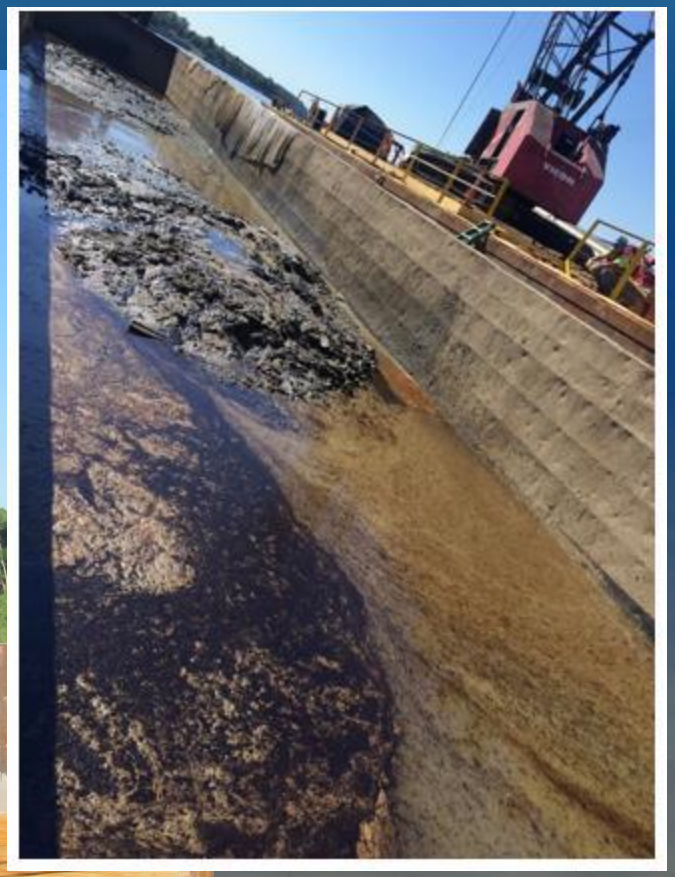
DEBRIS



Full video: http://komonews.com/archive/property-owners-funding-lake-union-clean-up-project

OIL CLEANUP

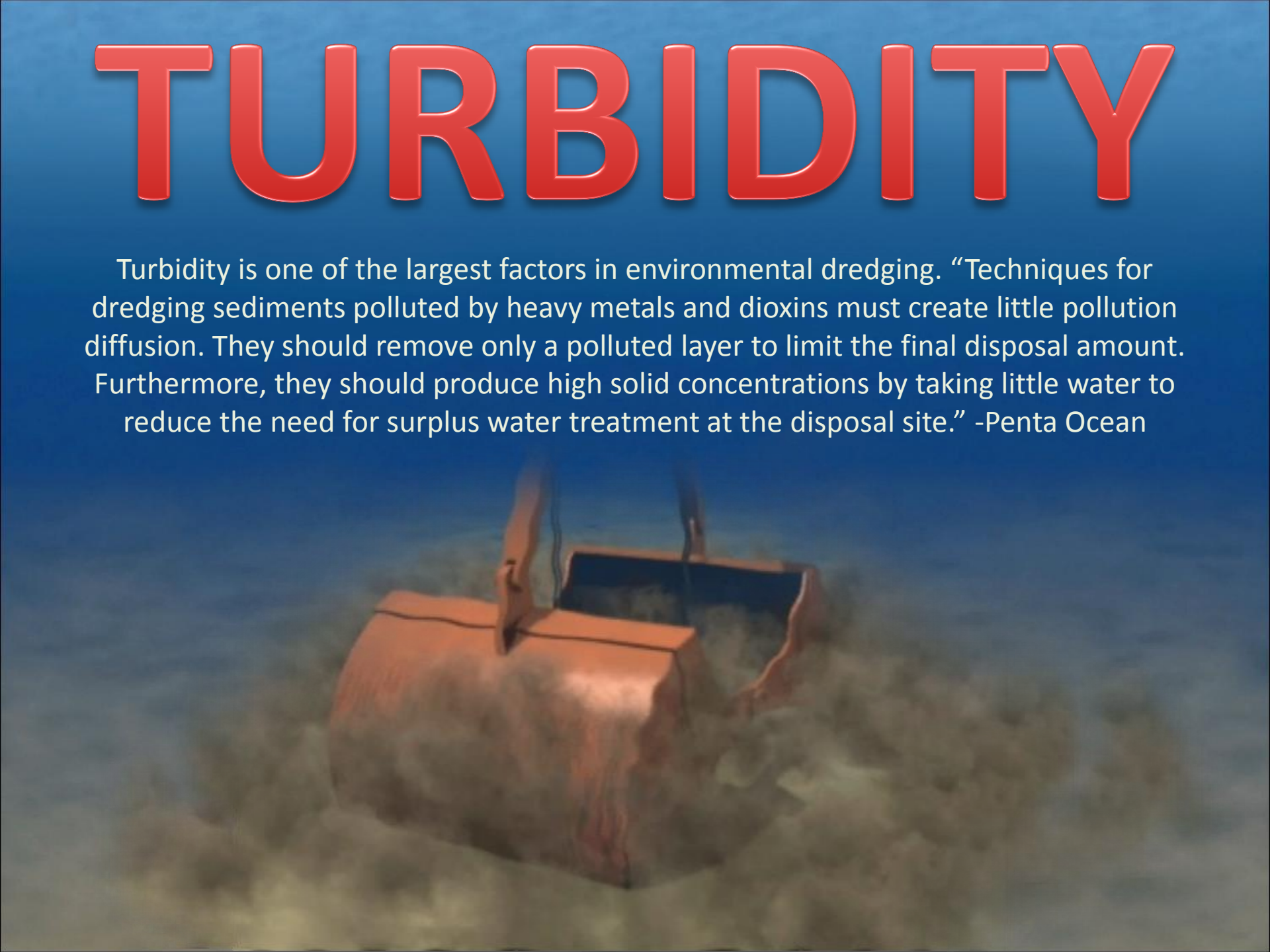




Solids Removed: 2,260 yd^3

TURBIDITY

Turbidity is one of the largest factors in environmental dredging. “Techniques for dredging sediments polluted by heavy metals and dioxins must create little pollution diffusion. They should remove only a polluted layer to limit the final disposal amount. Furthermore, they should produce high solid concentrations by taking little water to reduce the need for surplus water treatment at the disposal site.” -Penta Ocean



TURBIDITY

When choosing a bucket for environmental applications, pay close attention to its specifications. Each feature should aid in the overall reduction of windrowing, the row of material that is pushed out of the bucket during closing. Windrowing is the main cause of residual found in high turbidity ratings.

Windrowing effects can be reduced significantly with a proper bucket design!

Watch full video: http://www.cablearm.com/Buckets/Enviro.html
Or Download: http://www.cablearm.com/downloads/Videos/EnviroVideolow.zip

TURBIDITY

Navigational Dredging Procedures - Dec. 5, 2005

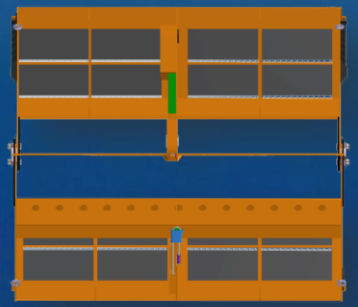
Cycle Time Observations			Turbidity Measurements		
Bucket Position	Elapsed Time (sec.)	Total Cycle Time (sec.)	Elapsed Time (min.)	Task	Turbidity (NTU)
In wash tank				Background	28
In water	23		0	Dredging begins	40
Out of water	29		5		69
Dump in scow	27		7		**79**
In wash tank	20	**99**	12		55

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

Clamshell features that minimize turbidity

RESUSPENSION ⇨ RELEASE ⇨ RESIDUAL = RISK



Over-Square Footprint

Width greater than opened length minimizes outward flow of material during bucket closure.

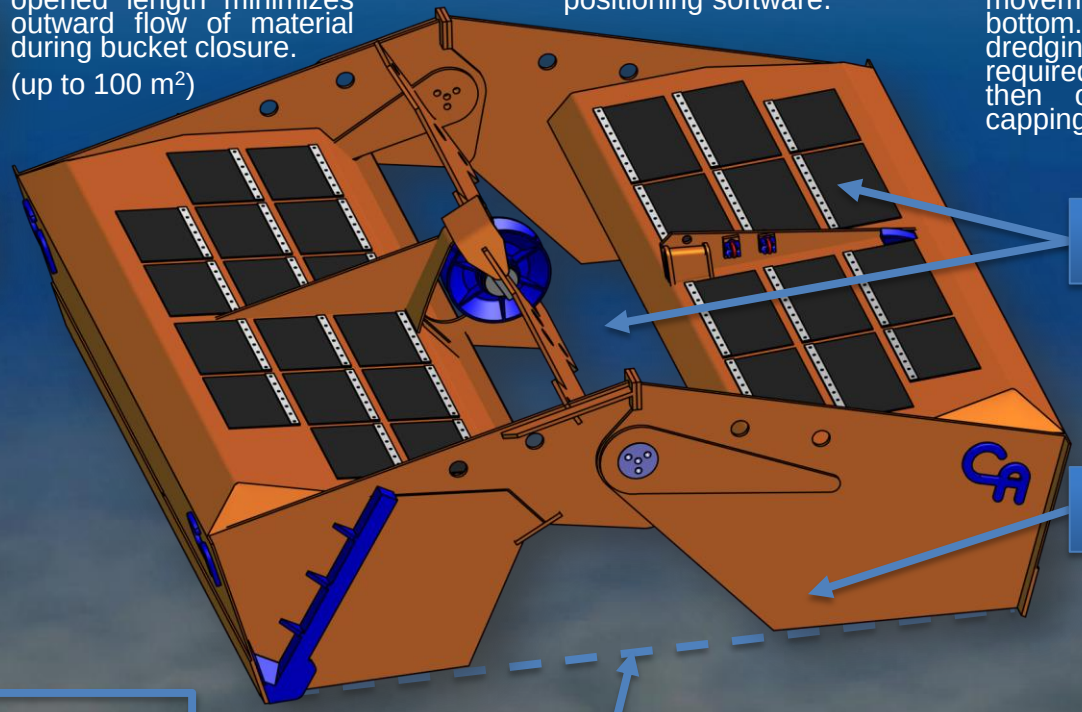
(up to 100 m^2)

ClamVision®

Precise XYZ dredge positioning software.

Sloping Profile

Allows for angled, lateral movement along an inclined bottom. Previously, over dredging in "steps" were required. These steps are then often filled in with capping material.



Venting System with Open Center

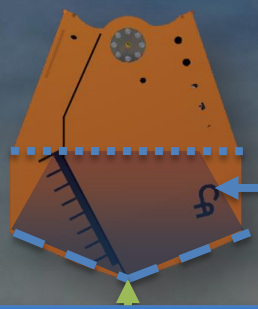
Decreases downward pressure during bucket descent and seals in material during bucket ascension.

Lightweight

Eliminates the processing of hard, uncontaminated sediment.

Overlapping Side Plates

Minimize outward flow (windrowing) of material during bucket closure and seals in material during bucket ascension.



150° Cutting Edge

Allows the bucket to "scoop" material which lowers the materials center of mass within the containment area.

Material Location

Center of Mass of material is located below the center of the bucket's containment area minimizing material washout during bucket closing and ascension.

Level-Cut

Produces a flat surface opposed to the pothole effect which can create a pool of contamination.

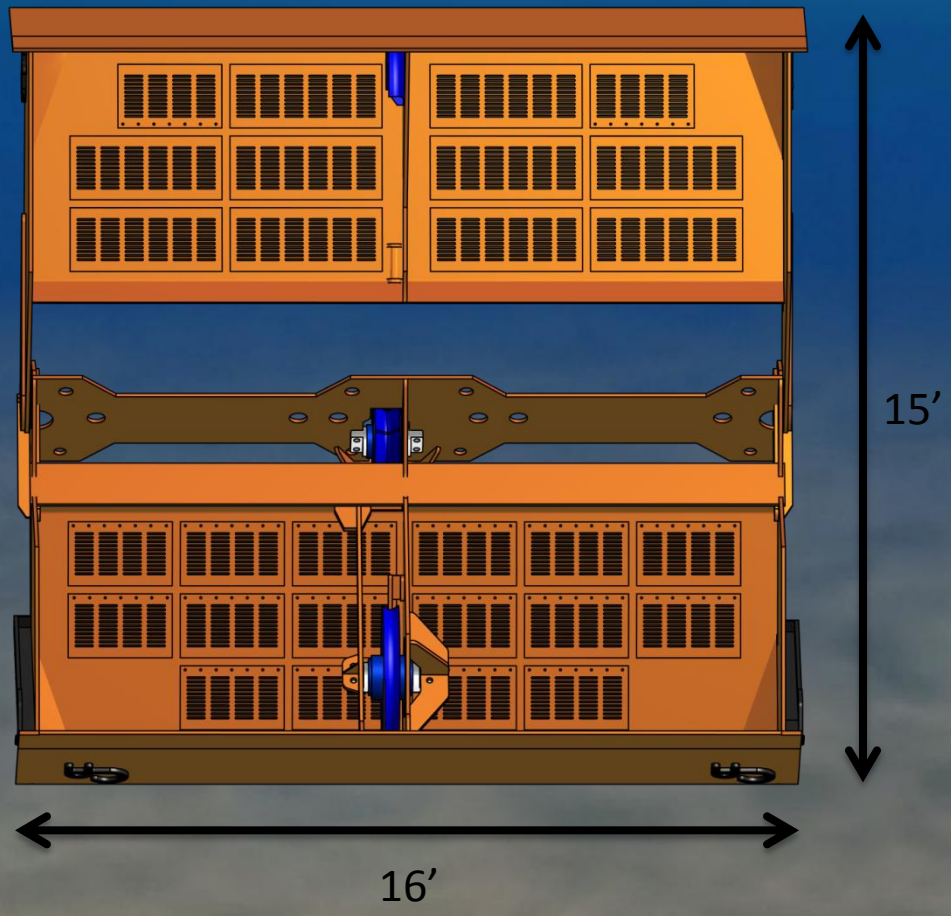
Cable Arm

info@cablearm.com

ClamVision®

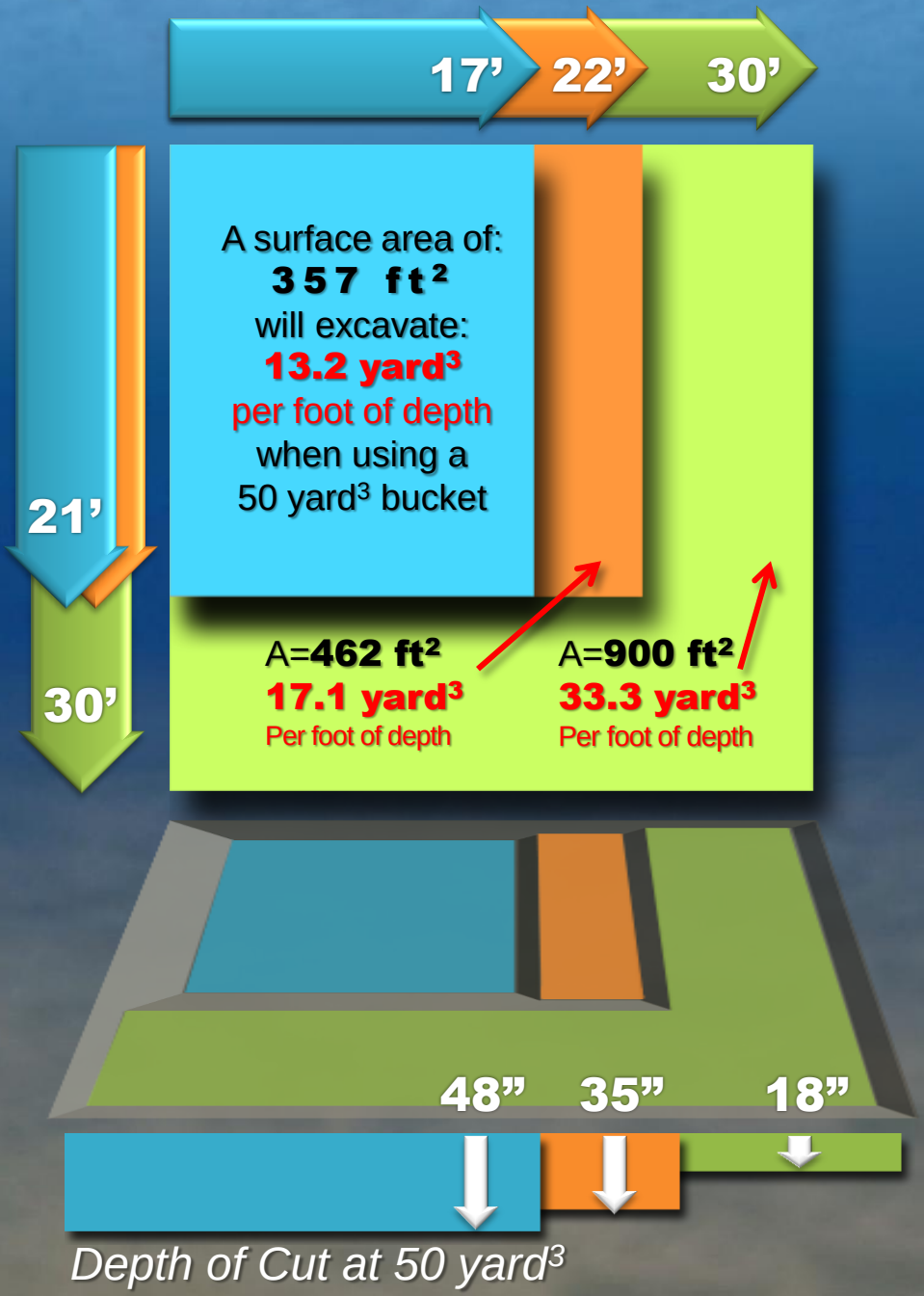
WIRELESS DREDGE POSITIONING SOFTWARE

Over-Square Footprint Design

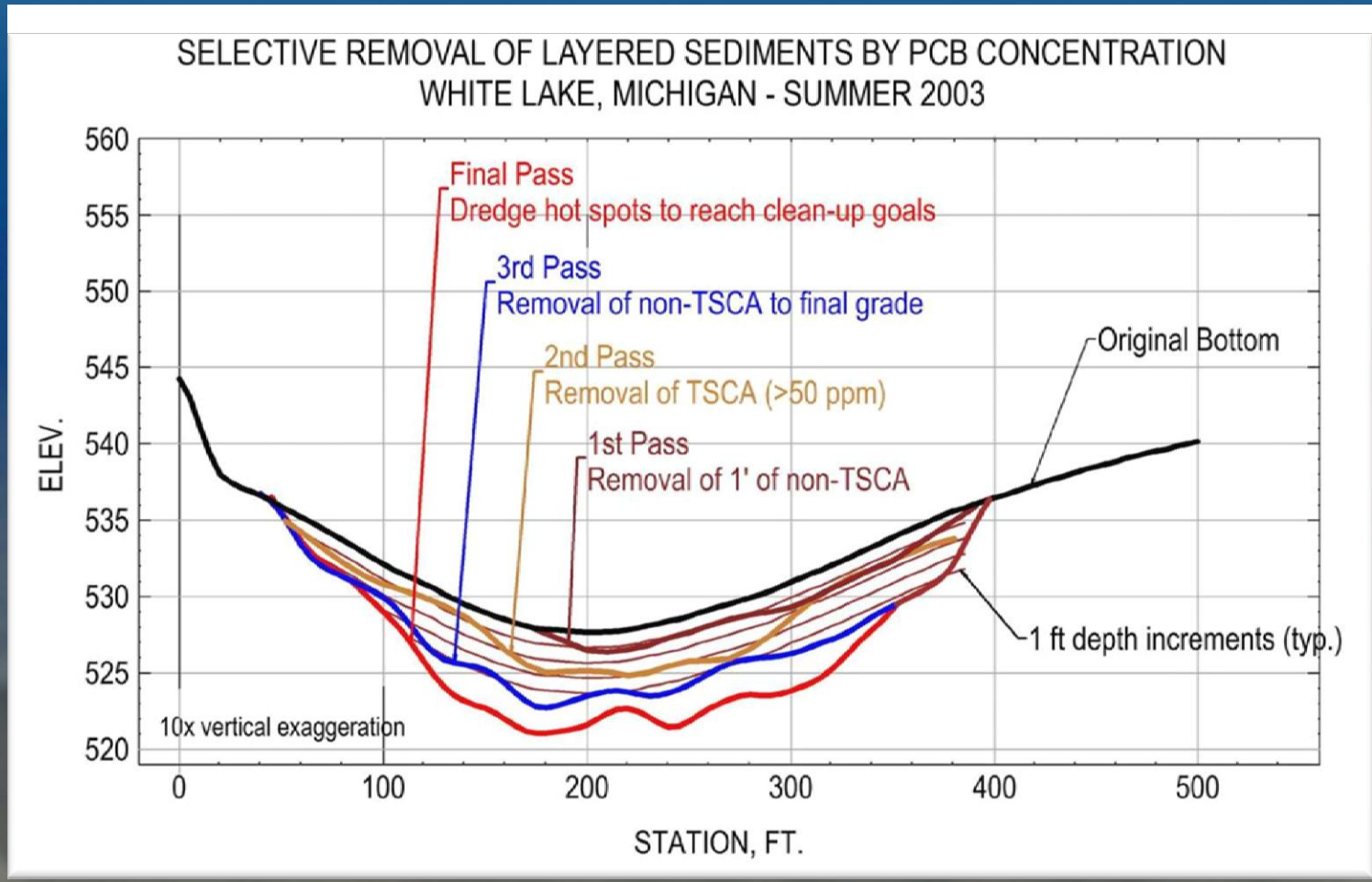


50 yard³

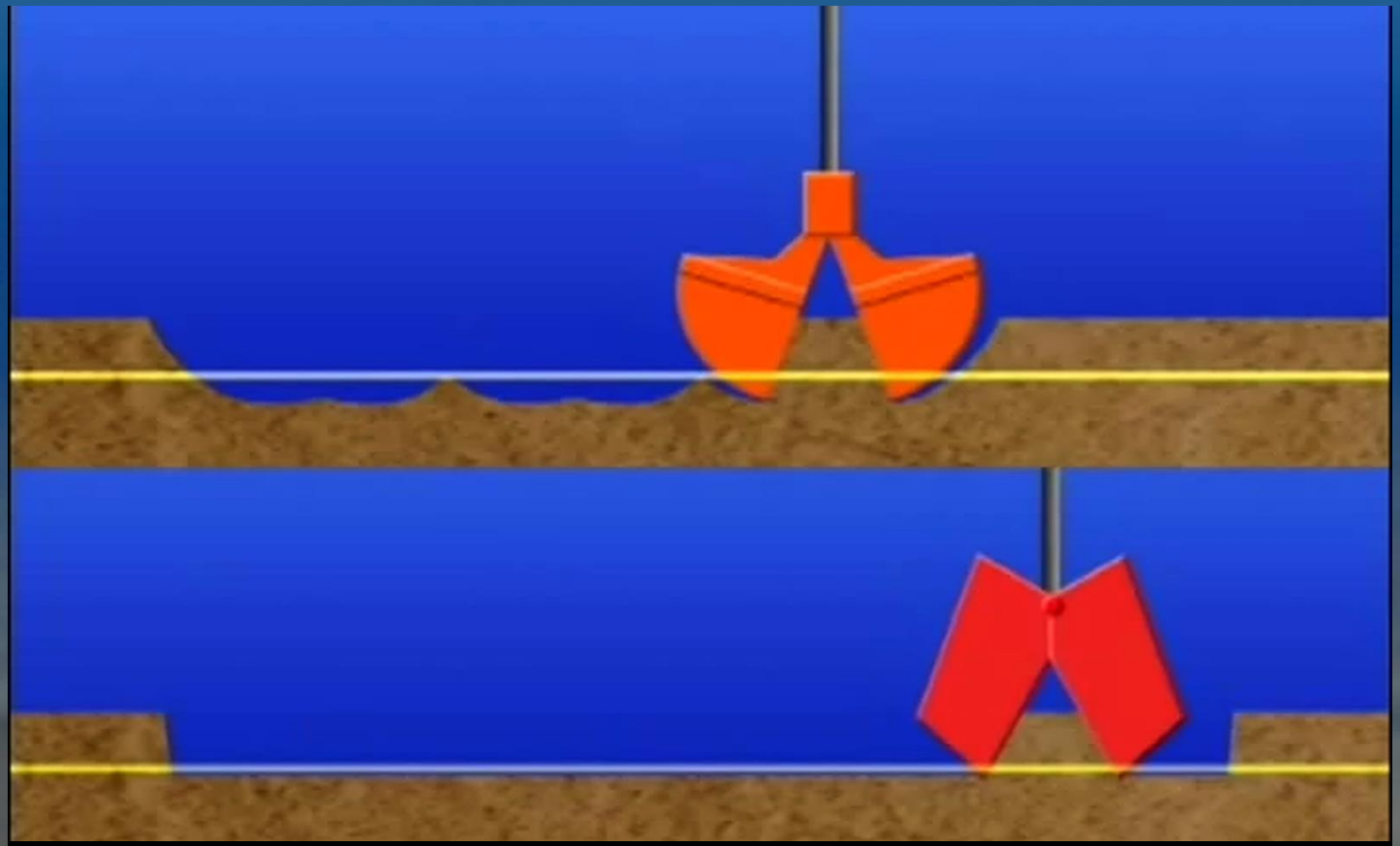
footprint size / depth of cut



Depth of Cut at 50 yard³


SELECTIVE REMOVAL OF LAYERED SEDIMENTS BY PCB CONCENTRATION
WHITE LAKE, MICHIGAN - SUMMER 2003
Final Pass
Dredge hot spots to reach clean-up goals
3rd Pass
Removal of non-TSCA to final grade
2nd Pass
Removal of TSCA (>50 ppm)
1st Pass
Removal of 1' of non-TSCA
Original Bottom
1 ft depth increments (typ.)
10x vertical exaggeration
ELEV.
560
555
550
545
540
535
530
525
520
0
100
200
300
400
500
STATION, FT.

Level-Cut Design



Watch full video: http://www.cablearm.com/Buckets/Enviro.html
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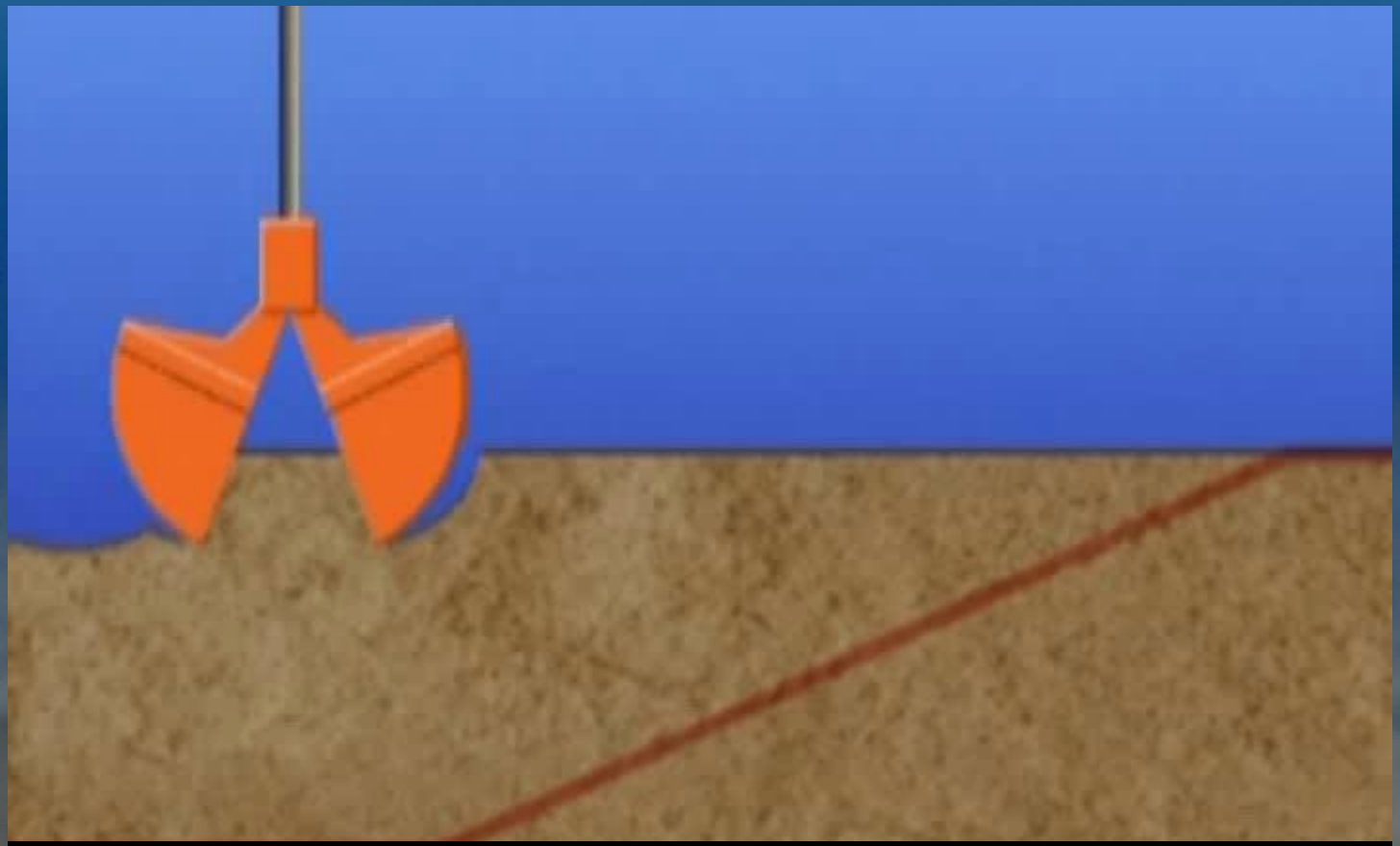
Level-Cut Design

Sloping Level-Cut Design



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Environmental Hydraulic Design

Environmental Hydraulic Design

Venting System

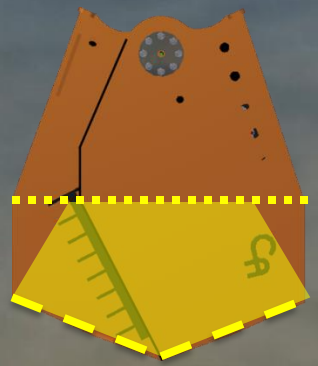
decreases downward pressure during bucket descent and seals in material during bucket ascension.

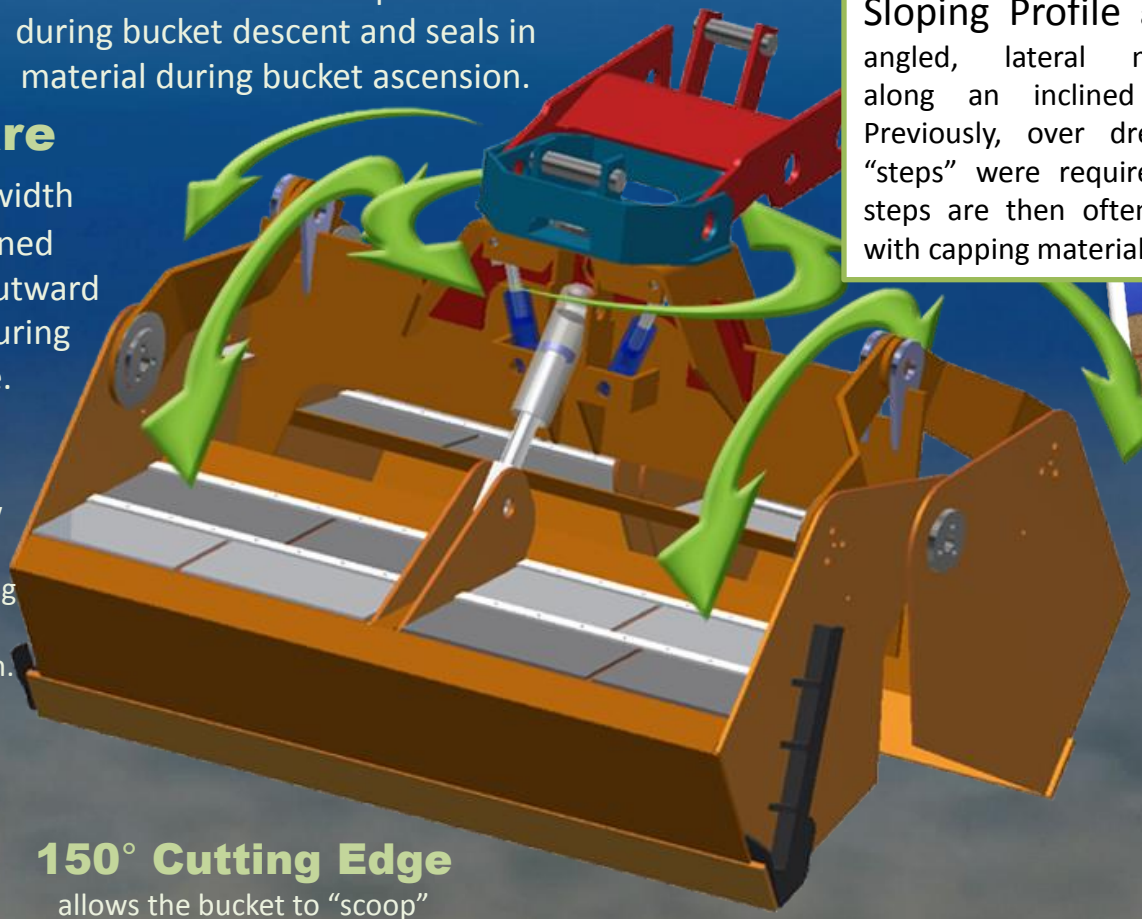
Over-square Footprint

(width greater than opened length) minimizes outward flow of material during bucket closure.

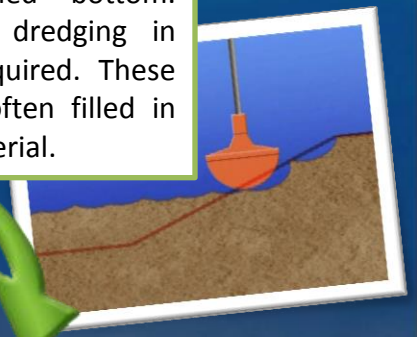
Center of Mass

of material is located below the center of the bucket's containment area minimizing material washout during bucket closing and ascension.





Sloping Profile allows for angled, lateral movement along an inclined bottom. Previously, over dredging in "steps" were required. These steps are then often filled in with capping material.



Overlapping Side Plates

minimize outward flow (windrowing) of material during bucket closure and seals in material during bucket ascension.

150° Cutting Edge

allows the bucket to "scoop" material which lowers the materials center of mass within the containment area.

Level-Cut produces a flat surface opposed to the pothole effect which can create a pool of contamination.

RESUSPENSION ⇨ RELEASE ⇨ RESIDUAL = RISK

CORRECT DESIGN FEATURES REDUCE WINDROWING

Cutting Edge lips are at a near 150° angle in the closed position.

Large Overlapping Side Plates reduce cross-sectional area during closing.

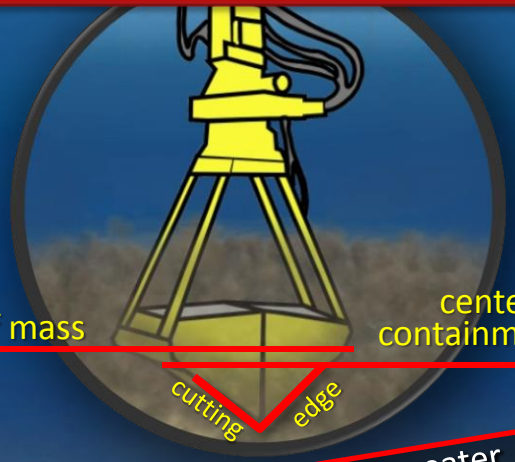
Footprint is over-square with the width greater than the length, when open.

Center of Mass of material is located below the center of the bucket's containment area.

Level-Cut provides an even surface after the removal of the contaminated material.

Light Weight bucket eliminates the unnecessary processing of hard, uncontaminated sediment.

WRONG DESIGN FEATURES *CAUSE* HIGH RISK DREDGING



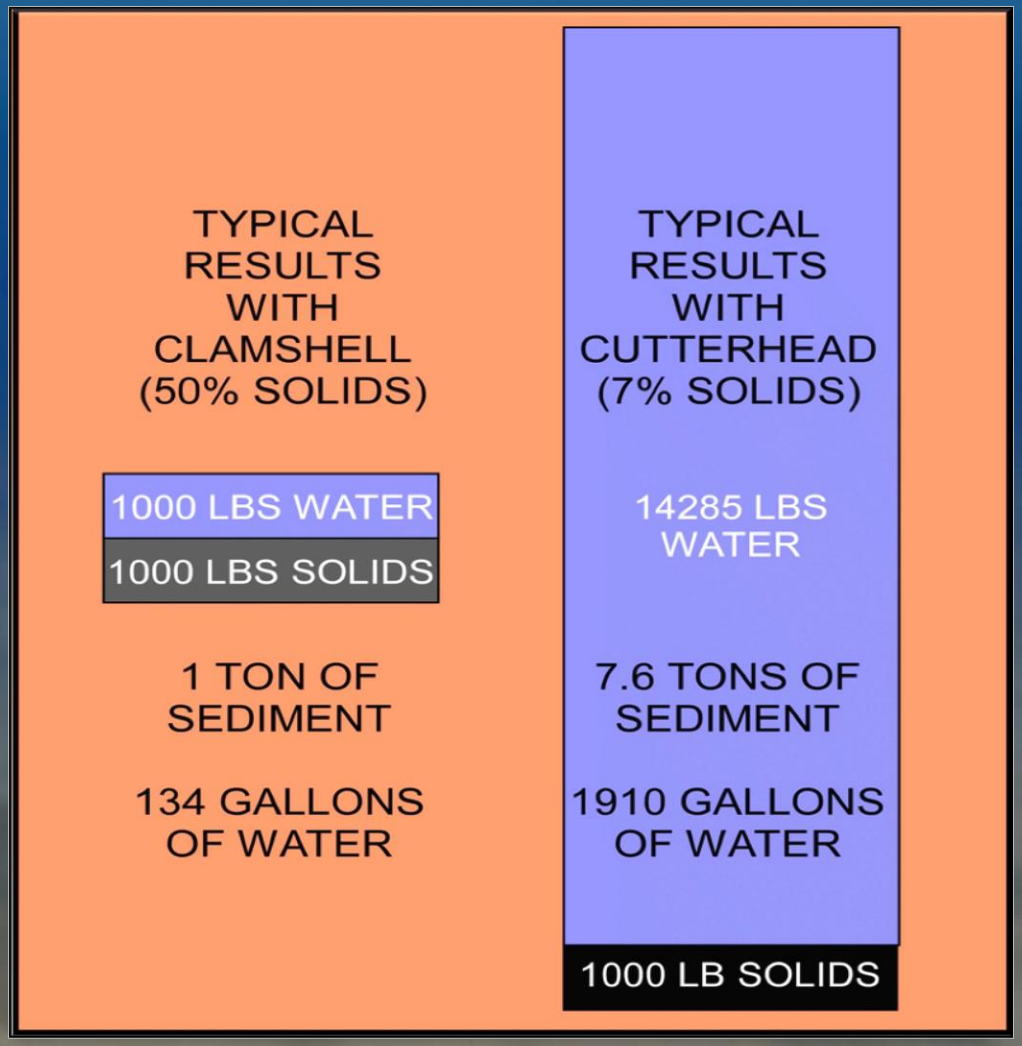
Length of open bucket is greater than width causing sediment loss

Cross-sectional area is not reduced during closing

Material mass is above the center of the bucket containment area

Cutting edge at too sharp of an angle (V-shaped) causes sediment to be pushed out at sides

Environmental VS Cutterhead



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

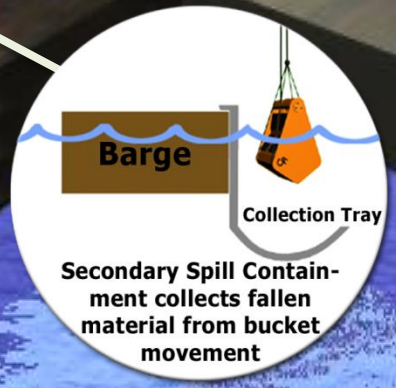
Customize Size to Maximize Removal

Complete Environmental Dredging System

WASH TANK
Removes loose adhering material on the bucket

DREDGE CELL
Portable cell with inclined silt curtain helps contain material that becomes suspended

CLAMVISION®
Precise XYZ wireless positioning software







MUD


LIEBHERR
HS 895

Contaminated Sediment Disposal Process

1

Removed top, soft, contaminated layer

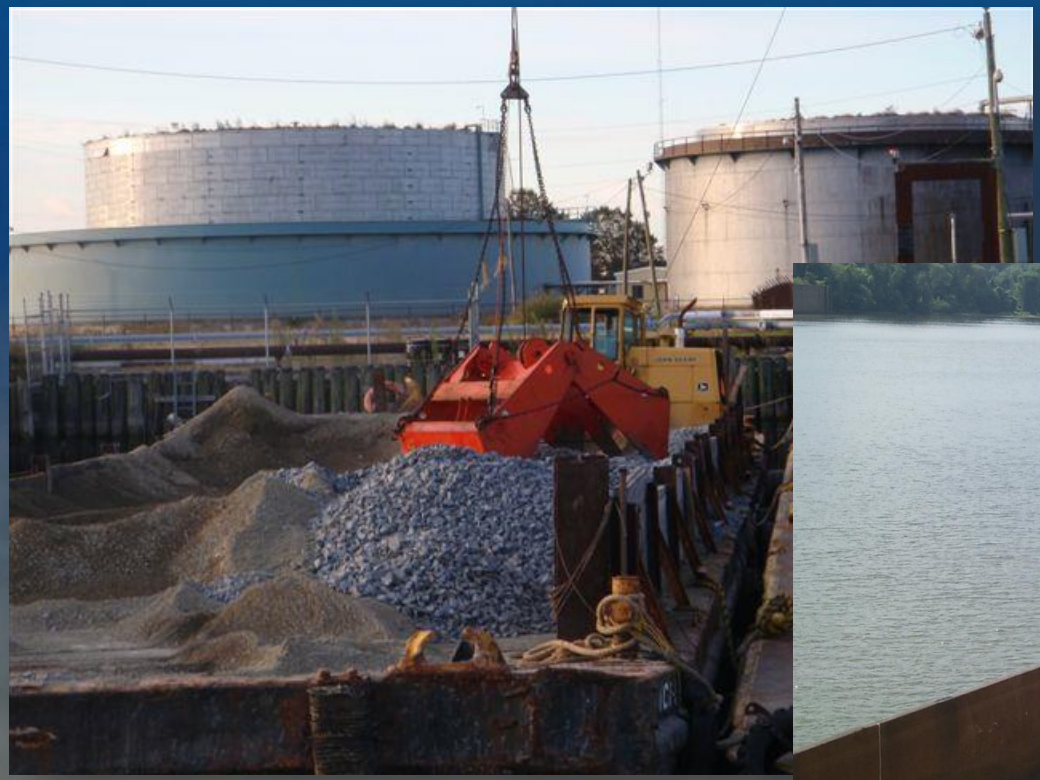
2

Solidify material by adding blown lime

3

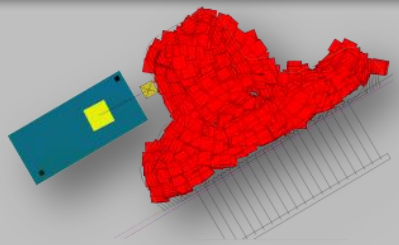
Solidified material can be transported to disposal site

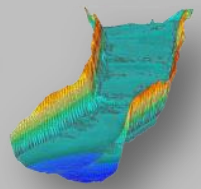
Post-Dredge Capping

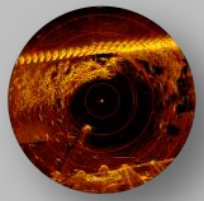


CLAMVISION® SOFTWARE IS A FULLY WIRELESS INTEGRATED DREDGE POSITIONING SYSTEM

CLAMVISION®

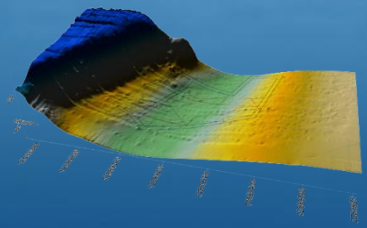




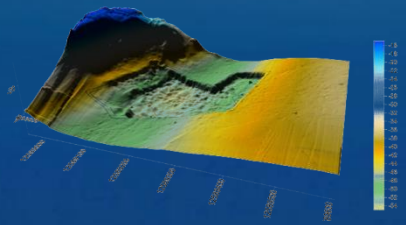


Minimize over dredging
Precise XYZ positioning
Real time view

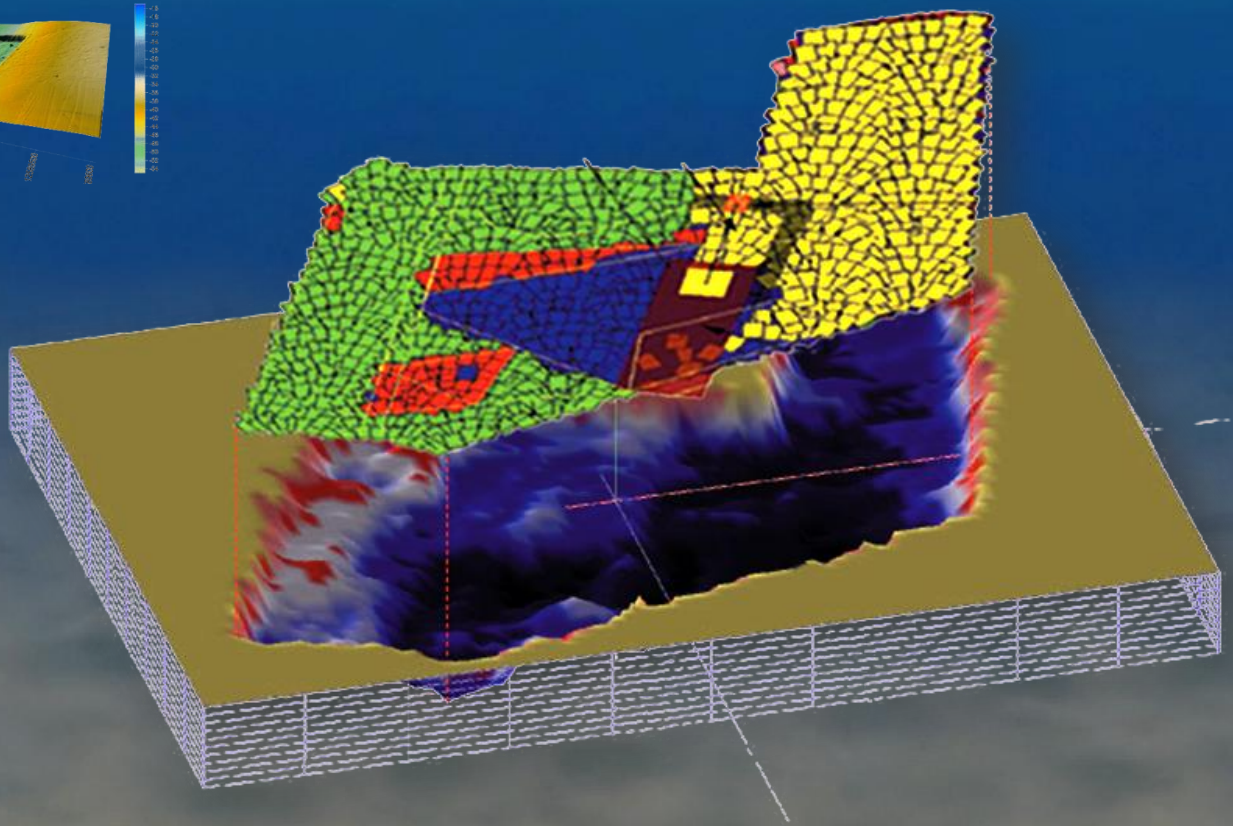
CLAMVISION®

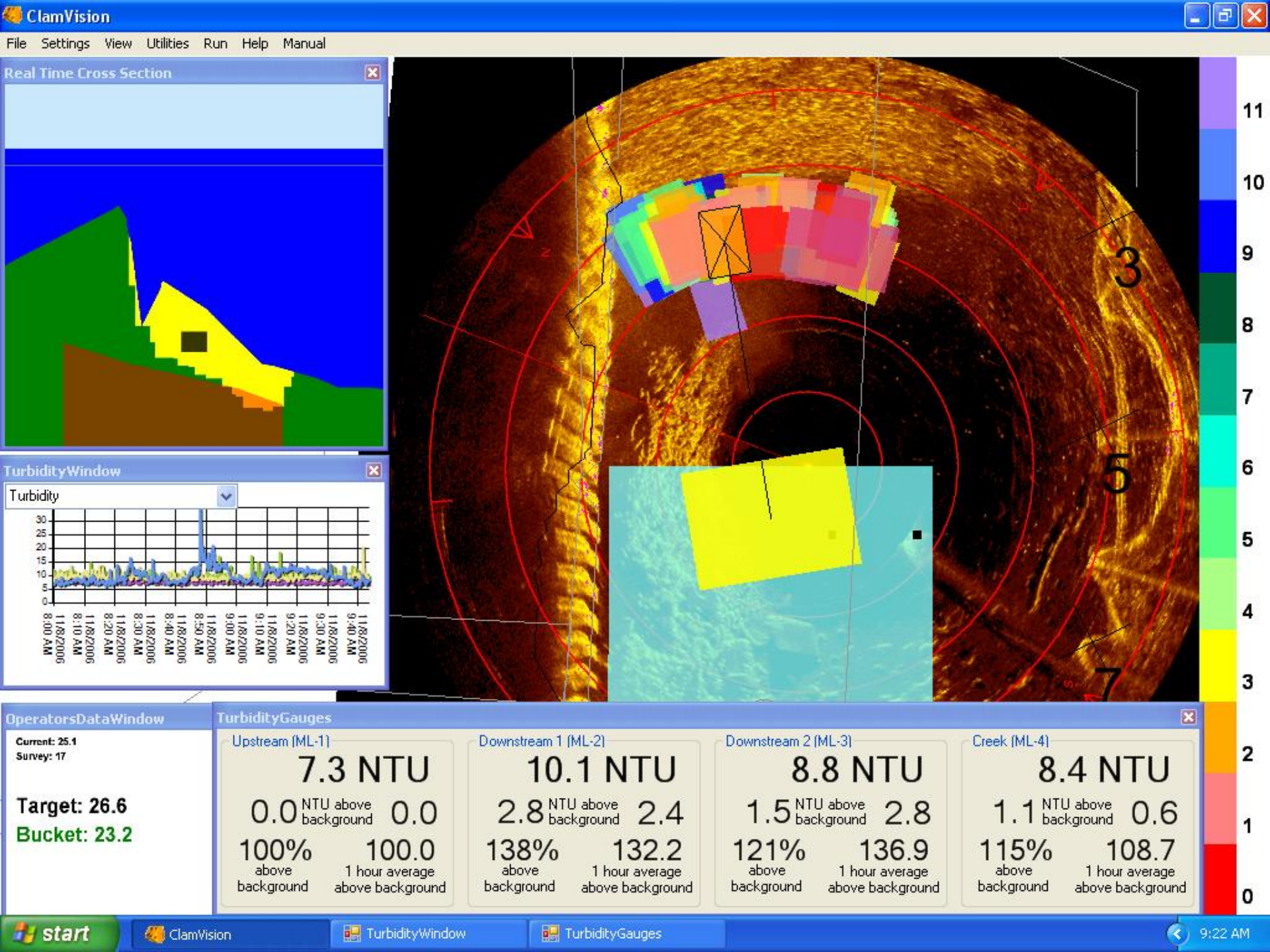


Pre-Dredge Survey



Preliminary Post
Dredge Survey




ClamVision
File Settings View Utilities Run Help Manual
Real Time Cross Section
TurbidityWindow
Turbidity
30
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8:00 AM 11/8/2006
8:10 AM 11/8/2006
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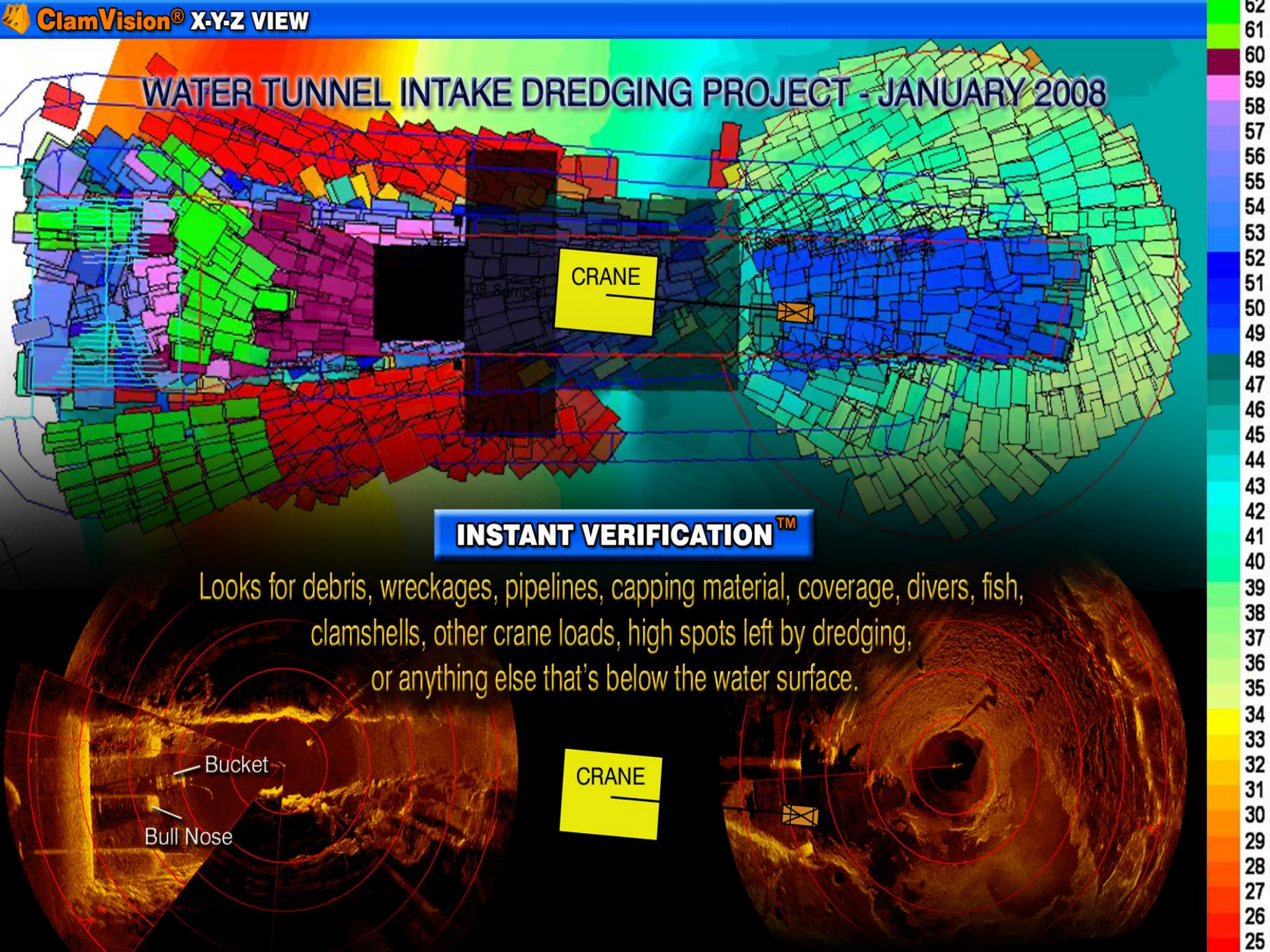
OperatorsDataWindow
Current: 25.1
Survey: 17
Target: 26.6
Bucket: 23.2
TurbidityGauges
Upstream (ML-1)
7.3 NTU
0.0 NTU above background
0.0
100% above background
100.0 1 hour average above background
Downstream 1 (ML-2)
10.1 NTU
2.8 NTU above background
2.4
138% above background
132.2 1 hour average above background
Downstream 2 (ML-3)
8.8 NTU
1.5 NTU above background
2.8
121% above background
136.9 1 hour average above background
Creek (ML-4)
8.4 NTU
1.1 NTU above background
0.6
115% above background
108.7 1 hour average above background
start
ClamVision
TurbidityWindow
TurbidityGauges
9:22 AM


ClamVision® X-Y-Z VIEW
WATER TUNNEL INTAKE DREDGING PROJECT - JANUARY 2008
CRANE
INSTANT VERIFICATION™
Looks for debris, wreckages, pipelines, capping material, coverage, divers, fish,
clamshells, other crane loads, high spots left by dredging,
or anything else that's below the water surface.
Bucket
Bull Nose
CRANE
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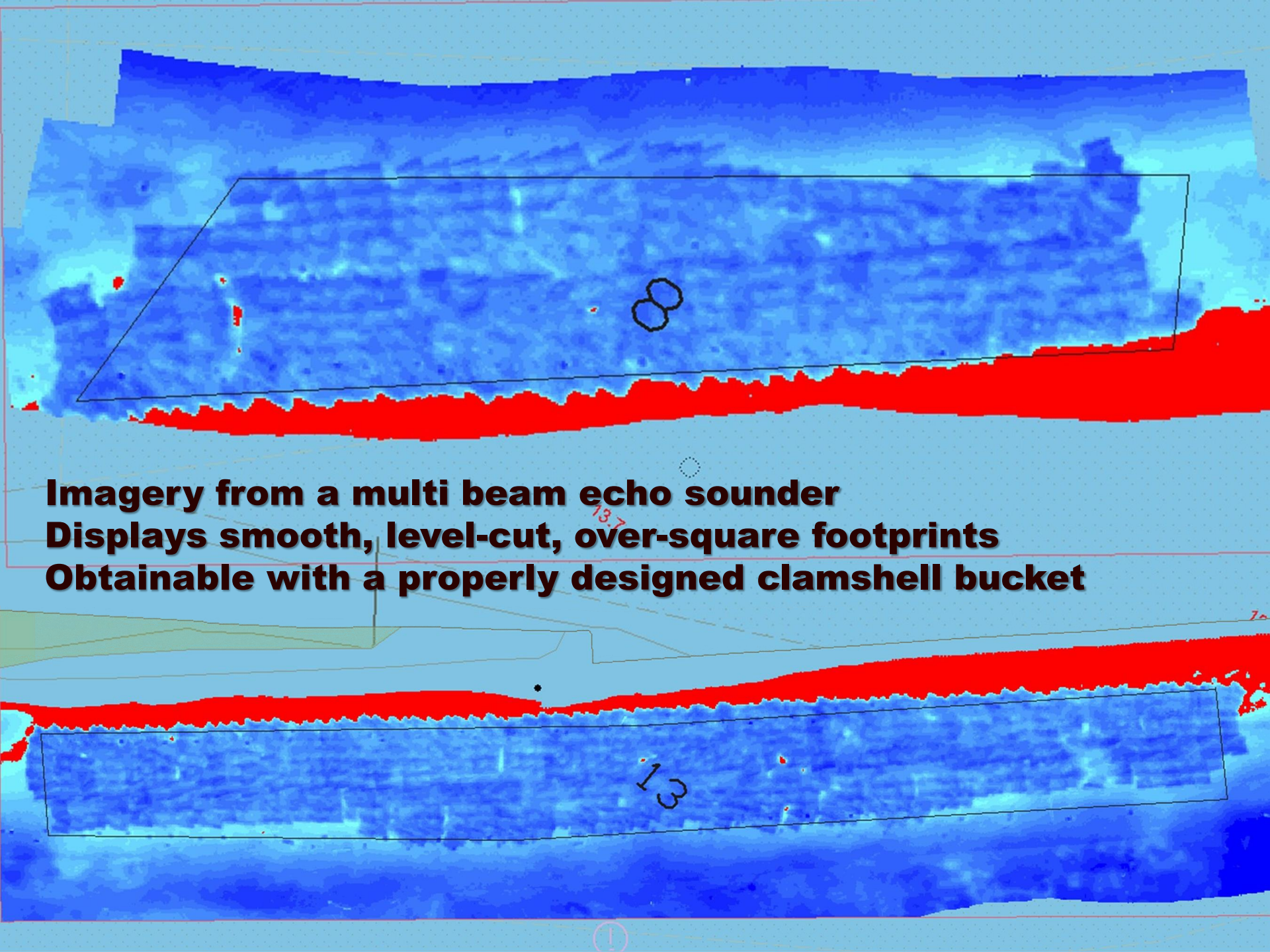

Imagery from a multi beam echo sounder
Displays smooth, level-cut, over-square footprints
Obtainable with a properly designed clamshell bucket


LARGE OVERSQUARE FOOTPRINT
OVERLAPPING SIDEPLATES
LIMITED PENETRATION
SHALLOW CUTS
LEVEL-CUT
MADE FOR SEDIMENT DREDGING