“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
Solids Removed: 2,260 yd$^3$
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
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!**


### Navigational Dredging Procedures - Dec. 5, 2005

<table>
<thead>
<tr>
<th>Bucket Position</th>
<th>Elapsed Time (sec.)</th>
<th>Total Cycle Time (sec.)</th>
<th>Turbidity Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>In wash tank</td>
<td>20</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td>In water</td>
<td>23</td>
<td></td>
<td>Background 28</td>
</tr>
<tr>
<td>Out of water</td>
<td>29</td>
<td></td>
<td>0 Dredging begins 40</td>
</tr>
<tr>
<td>Dump in scow</td>
<td>27</td>
<td></td>
<td>5 69</td>
</tr>
<tr>
<td>In wash tank</td>
<td>20</td>
<td></td>
<td>7 79</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12 55</td>
</tr>
</tbody>
</table>

### Environmental Dredging Procedures - Dec. 8, 2005

<table>
<thead>
<tr>
<th>Bucket Position</th>
<th>Elapsed Time (sec.)</th>
<th>Total Cycle Time (sec.)</th>
<th>Turbidity Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>In wash tank</td>
<td>28</td>
<td>178</td>
<td></td>
</tr>
<tr>
<td>In water</td>
<td>57</td>
<td></td>
<td>Background 28</td>
</tr>
<tr>
<td>Out of water</td>
<td>31</td>
<td></td>
<td>0 Dredging begins 30</td>
</tr>
<tr>
<td>End of draining</td>
<td>35</td>
<td></td>
<td>1 35</td>
</tr>
<tr>
<td>Dump in scow</td>
<td>27</td>
<td></td>
<td>4 39</td>
</tr>
<tr>
<td>In wash tank</td>
<td>28</td>
<td></td>
<td>5 28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 29</td>
</tr>
</tbody>
</table>
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 m²)

**Lightweight**
Eliminates the processing of hard, uncontaminated sediment.

**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.

**Overlapping Side Plates**
Minimize outward flow (windrowing) of material during bucket closure and seals in material during bucket 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.

**Venting System with Open Center**
Decreases downward pressure during bucket descent and seals in material during bucket ascension.

**CLAMVISION®**
Precise XYZ dredge positioning software.

infocablearm.com

Cable Arm
CLAMVISION®
WIRELESS DREDGE POSITIONING SOFTWARE
Over-Square Footprint Design

16'

15'

16'
A surface area of:

357 ft^2

will excavate:

13.2 yard^3

per foot of depth

when using a 50 yard^3 bucket

A = 462 ft^2

17.1 yard^3

Per foot of depth

A = 900 ft^2

33.3 yard^3

Per foot of depth

Depth of Cut at 50 yard^3
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.

STATION, FT.
Level-Cut Design

Watch full video: http://www.cablearm.com/Buckets/Enviro.html
Or Download: http://www.cablearm.com/downloads/Videos/EnviroVideolow.zip
Level-Cut Design
Sloping Level-Cut Design

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

**Over-square Footprint** (width greater than opened length) minimizes outward flow of material during bucket closure.

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

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

**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.

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

**150° Cutting Edge** allows the bucket to “scoop” material which lowers the materials center of mass within the containment area.
CORRECT DESIGN FEATURES
REDUCE WINDROWING

WRONG DESIGN FEATURES CAUSE
HIGH RISK DREDGING

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.

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

<table>
<thead>
<tr>
<th>Typical Results with Clamshell (50% Solids)</th>
<th>Typical Results with Cutterhead (7% Solids)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 LBS Water</td>
<td>14285 LBS Water</td>
</tr>
<tr>
<td>1000 LBS Solids</td>
<td>7.6 Tons of Sediment</td>
</tr>
<tr>
<td>1 TON OF SEDIMENT</td>
<td>1910 GALLONS OF WATER</td>
</tr>
<tr>
<td>134 GALLONS OF WATER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1000 LB SOLIDS</td>
</tr>
</tbody>
</table>
Customize Size to Maximize Removal
Complete Environmental Dredging System

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

**WASH TANK**
Removes loose adhering material on the bucket.

**CLAMVISION®**
Precise XYZ wireless positioning software.

Secondary Spill Containment collects fallen material from bucket movement.
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

Minimize over dredging
Precise XYZ positioning
Real time view
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.
Imagery from a multi beam echo sounder
Displays smooth, level-cut, over-square footprints
Obtainable with a properly designed clamshell bucket
MADE FOR SEDIMENT DREDGING

LARGE OVERSQUARE FOOTPRINT
OVERLAPPING SIDEPLATES
LIMITED PENETRATION
SHALLOW CUTS
LEVEL-CUT