<table>
<thead>
<tr>
<th>Bayou Bonfouca Slidell, LA</th>
<th>Similarity: 3.7 S:5 E:4 C:2</th>
<th>Dredging Dates: Nov 1993 – Jul 1995 (15 mo)</th>
<th>Shifts: 9 hr/day 5 day/wk</th>
<th>Uptime: Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume: 169,000 CY</td>
<td>Equipment: 5.2 CY custom hybrid (clamshell removal, high solids pumping)</td>
<td>Production Rates: 57.8 CY/hr (working)</td>
<td>Sediment: Fine grained with a lot of debris. 185% water content, ~35% solids.</td>
<td>Contaminant: PAHs</td>
</tr>
<tr>
<td>Percent Solids: 17 – 18%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Typical Water Depths and Cut Depth:** Nominal water depth of 10 ft. Contamination at a maximum depth of about 17 ft.

**TSS / Turbidity Monitoring and Point of Compliance:** Not available.

**Cleanup Goal / Remedial Action Level:** 1,300 mg/kg total PAHs to determine target dredge depth. Based on site-specific risk assessment.

**Cost (Dredging):** $21,100,000. (disposal costs not included)

**Unit Cost (Dredging):** $125/CY.

**Description:**
The dredge area was 4,000 feet long by 250 feet wide. Sheet piling support for bank stabilization. Dredged material placed in slurry processing unit, pumped via 18” pipeline to a 2.5 acre retention basin, decant water directed to an on-site WWTP, Mudcat dredges removed settled sediments to plate and frame filter press, homogenized, incinerated. Placed layer of sand and layer of gravel after dredging to prevent contact with residual contaminants. WWTP capacity 500 gallons per minute (gpm). Difficulties included rocks, debris, logs, and constant oil slick on water during dredging. Operations limited to daylight hours due to residences in area.

† Value was calculated from other parameters provided in the reference.

**References**
### Black River
Lorain, OH

| Volume: 60,000 CY | Equipment:  
Water tight clamshell, then hydraulic cutterhead | Production Rates:  
Not available | Sediment:  
Very fine grained with debris | Contaminant:  
PAHs, Metals | Pre-Dredge:  
4.3 – 8.8 mg/kg PAHs | Post-Dredge:  
16.6 mg/kg PAHs after dredging  
9.8 mg/kg PAHs 4 years later. |
| --- | --- | --- | --- | --- | --- | --- |
| **Similarity:** 3.7  
S:4 E:4 C:3 | **Dredging Dates:**  
Fall 1989 – Dec 1990 (5.5 mo) | **Shifts:**  
1 shift 5 – 6 day/wk;  
24/7 at end | **Uptime:**  
Not available |

**Typical Water Depths and Cut Depth:** Not available.

**TSS / Turbidity Monitoring and Point of Compliance:** TSS sampled 200 yd downstream of dredge.

**Cleanup Goal / Remedial Action Level:** Removal to hard bottom (depth target)

**Cost (Dredging):** $1,500,000. Total cost $5,000,000.

**Unit Cost (Dredging):** $25/CY. Total unit cost $83/CY.

**Description:**
Two hotspots remediated. One was 700 feet long and 3 acres in size. The other was 2,000 feet long and 5 acres in size. Switched from clamshell to cutterhead due to debris (clamshell could not close). Dredged sediments dewatered with upland disposal. No decline in PAH after dredging. Declined with natural recovery thereafter.

† Value was calculated from other parameters provided in the reference.

**References**
### Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>Cherry Farm</th>
<th>Similarity: 2.7</th>
<th>Dredging Dates:</th>
<th>Shifts:</th>
<th>Uptime:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erie, NY</td>
<td>S:2 E:3 C:3</td>
<td>Jun 1988 – Nov 1998 (5 mo)</td>
<td>6 day/wk; 12 hr/day</td>
<td>Not available</td>
</tr>
</tbody>
</table>


| Typical Water Depths and Cut Depth: Not available |

| TSS / Turbidity Monitoring and Point of Compliance: 150 NTU above background sustained for 30 minutes in proximity of work area. |

| Cleanup Goal / Remedial Action Level: 20 ppm PAHs in top foot, and 50 ppm below. Dredging was elevation-based. |

| Cost (Dredging): Total cost $2,200,000. |

| Unit Cost (Dredging): $44/CY. |

| Description: Dredged, pumped 5,000 ft. to an on-site 2-acre disposal pond that was then capped. Polymer flocculent added and settled water discharged back into river. Discharge standard 100 ppm PAHs. No NPDES required. Silt curtains used only to deflect suspended sediments from sensitive aquatic habitat. Sloped areas were capped instead of being dredged. River currents up to 2.57 ft./sec. lifted and tore silt curtains. |

† Value was calculated from other parameters provided in the reference.

**References**
<table>
<thead>
<tr>
<th>Collingwood Harbour Ontario, Canada</th>
<th>Summary of Contaminated Sediment Dredging Projects Evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume:</strong> 3,900 CY</td>
<td><strong>Similarity:</strong> 3.0 S:4 E:3 C:2</td>
</tr>
<tr>
<td><strong>Equipment:</strong> Pneuma pump 150/30</td>
<td><strong>Dredging Dates:</strong> Nov 24 – Dec 8, 1993 (66 hr dredging)</td>
</tr>
<tr>
<td><strong>Percent Solids:</strong> 30% (avg.) 15 – 30% (demo)</td>
<td><strong>Shifts:</strong> 10 hr/day 6 days/week</td>
</tr>
<tr>
<td><strong>Production Rates:</strong> 33 CY/hr (total)† 59 CY/hr (working)</td>
<td><strong>Uptime:</strong> 55.5% efficiency (Down 44.5% of time) (53 hrs down)</td>
</tr>
<tr>
<td><strong>Sediment:</strong> Soft silt over clay and bedrock</td>
<td><strong>Pre-Dredge:</strong> Metals 31 – 180 mg/kg (max); PCB’s 300 – 4,000 mg/kg (max)</td>
</tr>
<tr>
<td><strong>Contaminant:</strong> Metals, PCBs</td>
<td><strong>Post-Dredge:</strong> Not available; “decreased”</td>
</tr>
</tbody>
</table>

Typical Water Depth and Cut Depth: Project removal ranged from 0.7 to 1.6 feet in thickness. Water depth ranged from 10 to 18 feet.

TSS / Turbidity Monitoring and Point of Compliance: Turbidity and TSS monitored 2 – 8 times/day. Turbidity acceptance criteria of less than 30% increase over ambient levels. TSS acceptance criteria of less than 25 mg/L over ambient levels. Surface, bottom samples evaluated at 25 m from dredge.


Cost (Dredging): $635,000. (includes 1992 demonstration)

Unit Cost (Dredging): $67/CY. (includes 1992 demonstration)

Description:

Used a barge-mounted hydraulic dredge set up with guide cables that extended across the harbor channel. The dredge was advanced 13 to 16 feet per minute using a winch system. Three passes were made over each section with overlap (soundings after 2 passes indicated that material remained). Demonstration with Pneuma pump removed 5,200 CY at 15 – 30 percent solids with significant downtime due to debris and clogging. Dredged material pumped through a 6-inch line ~3,300 ft to CDF, no water treatment on decant water.

† Value was calculated from other parameters provided in the reference.

Reference:

**Table D1-3**  
**Summary of Contaminated Sediment Dredging Projects Evaluated**

<table>
<thead>
<tr>
<th>Project</th>
<th>Similarity</th>
<th>Dredging Dates</th>
<th>Shifts</th>
<th>Uptime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duwamish River Dredging</td>
<td>2.3</td>
<td>Mar 5 – 30, 1976 (225 hrs total)</td>
<td>8 to 10 hr days</td>
<td>36% efficiency (Down 64% of time)</td>
</tr>
<tr>
<td>Seattle, Washington</td>
<td>8:2 E:3 C:2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume</th>
<th>Equipment</th>
<th>Production Rates</th>
<th>Sediment</th>
<th>Contaminant</th>
<th>Pre-Dredge</th>
<th>Post-Dredge</th>
</tr>
</thead>
</table>
| 10,000 CY | Pneuma Model 600 dredge operated with a derrick | 44 CY/hr (total)  
123 CY/hr (working) | Silty sand to sandy silt. Typical water content of 36%. | PCBs | Non-detect to 42 mg/kg (average 4 mg/kg) | 0.2 to 140 mg/kg (average of 7 mg/kg) |

**Typical Water Depth and Cut Depths**: Water depths of 20 to 45 feet. Dredge cuts up to 8+ feet.

**TSS / Turbidity Monitoring and Point of Compliance**: Water quality monitoring was completed down tide of the dredging operation.

**Cleanup Goal / Remedial Action Level**: Cleanup goal.

**Cost (Dredging)**: $109,000. (dredging only)

**Unit Cost (Dredging)**: $11/CY.

**Description**: Dredging was in response to PCB spill in Duwamish River. Work was completed in two phases. The first phase involved using diver assisted dredges to remove sediment. The second phase involved the use of the pneuma dredge described above. Roughly 4 hours was required to clean out debris each time the dredge was plugged. Recovery was estimated to be between 80 to 90 percent of the spilled material.

**References**
- Alex Sumeri, Table 1. Frequency of Duwamish River Surveys for PCB in Sediments, undated.
Eagle Harbor—West Harbor Operable Unit  
Bainbridge Island, Washington

| Similarity: 2.3 | Dredging Dates:  
Underpier dredging from Jun 18-26, 1997 (8 days)  
Open water dredging Jul 14-16, 28, 29, 1997 (5 days) | Shifts:  
Underpier was during low tides ~6 hrs/day  
Open water 10 hrs/day | Uptime: Unknown |

| Volume:  
Underpier volume was 800 CY  
Open water volume was 1,350 CY | Equipment:  
Underpier used bobcats at low tides.  
Open water used 5 CY digging bucket. | Production Rates:  
Underpier 10 to 15 CY/hr (total)  
Open Water 25 to 30 CY/hr (total) | Sediment: Silty sand | Contaminant: Mercury |

| Pre-Dredge:  
Highest value observed in dredge areas was 32 mg/kg mercury. | Post-Dredge:  
All below the 5 mg/kg hotspot requirement. |

Typical Water Depth and Cut Depths:  
Underpier dredging was done in the dry with bobcats at low tide. Dredge cut was 1 to 3 feet thick. Open water dredging was done in 25 to 45 feet of water depending on tide. The typical dredge cut was 1 to 4 feet.

TSS / Turbidity Monitoring and Point of Compliance:  
The point of compliance was established as 200 feet outside of the point of dredging. Monitoring requirements included DO, pH, TSS, turbidity and total mercury. A silt curtain was used around the dredging operation.

Cleanup Goal / Remedial Action Level:  
Hotspots requiring removal were defined as sediments exceeding 5 mg/kg mercury.

Cost (Dredging only): $100,000 to $150,000.

Unit Cost (Dredging only): $20 to $85 per CY for underpier dredging. $35 per CY for open water dredging.

Description:  
Mercury contamination was from sand blast grit that was used to remove mercury tainted ship paint. Underpier and open water sediments were dredged and disposed on site in a nearshore fill. Open water dredging was in confined areas somewhat hampering production.

References
Personal project experience of John Verduin.
## Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>East Waterway Stage I</th>
<th>Similarity: 2.7</th>
<th>Dredging Dates: Dec 7, 1999 – Feb 29, 2000</th>
<th>Shifts: 6 day/wk 24 hr/day</th>
<th>Uptime: 79% efficiency during unsuitable material dredging 73% efficiency during suitable material dredging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port of Seattle, Washington</td>
<td>S:3 E:3 C:2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Volume:**
  - 85,900 CY unsuitable material
  - 125,800 CY suitable material

- **Equipment:**
  - 12 CY and 15 CY rehandling bucket

- **Production Rates (project averages):**
  - Unsuitable material:
    - 80 CY/hr (total)
    - 135 CY/hr (working)
  - Suitable material:
    - 170 CY/hr (total)
    - 235 CY/hr (working)

- **Sediment:**
  - Unsuitable material typically soft to loose organic silty clay. (30 to 55 percent solids)
  - Suitable material typically soft/loose to stiff/medium dense interbedded silt, sand and clay.

- **Contaminant:**
  - Multiple including PCBs, mercury, PAHs

- **Pre-Dredge:**
  - Throughout dredge prism:
    - PCBs 49 to 1,200 mg/kg
    - Mercury 0.48 to 1.7 mg/kg

- **Post-Dredge:**
  - In upper 10 cm:
    - PCBs 190 to 1,400 ug/kg
    - Mercury 0.48 to 0.91 mg/kg

- **Typical Water Depth and Cut Depths:** Water depths ranged from 40 to 65 feet of water depending on tide levels. Cuts were typically 1 to 8 feet.

- **TSS / Turbidity Monitoring and Point of Compliance:** Point of compliance at the 300 foot mixing boundary.

- **Cleanup Goal / Remedial Action Level:** Dredged to a target elevation.

- **Cost (Dredging and Disposal):** $6.8 million.

- **Unit Cost (Dredging):** $68 per CY for dredging, dewatering and disposal of unsuitable material (roughly $10 to $14 per CY for dredging only); $5.7 per CY for dredging suitable material (including open water dumping).

- **Description:** Dredging was completed in the East Waterway to deepen the channel for the Port of Seattle. The majority of the material was suitable for open water disposal at the Elliott Bay PSDDA disposal site. The remaining material exceeded open water disposal criteria. Mixing in granular lime dewatered this material. The dewatered material was then hauled to an upland landfill. Unsuitable material was typically located over suitable material. Post-dredge sampling indicated exceedences in 12 of the 15 surface (0 to 10 cm) samples.

- **References**
  - Personal communication with Bob Parry, Corps of Engineers, Seattle District.
  - Port of Seattle Terminal 18 Sediment Characterization Sampling and Analysis Results. April 1998
  - Post-Dredge Monitoring of Port of Seattle East Waterway Deepening Stage 1 Dredging Area. January 2001
  - Personal project experience of John Verduin
Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>Ford Outfall, River Raisin Monroe, MI</th>
<th>Similarity: 4.3</th>
<th>Dredging Dates:</th>
<th>Shifts:</th>
<th>Uptime:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S:4 E:5 C:4</td>
<td>Jun 25 – Sep 14, 1997; Sep 16 – 26, 1997 (51 dredging days)</td>
<td>8 hr/day; 5 day/wk</td>
<td>Not available</td>
</tr>
</tbody>
</table>

| Volume: 27,000 CY | Equipment: 6 CY Cable Arm clamshell w/vibrator; 4 CY conventional bucket | Production Rates: 66 CY/hr (total)† | Sediment: Soft silty clay over soft to stiff organic silty clay. | Contaminant: PCBs | Pre-Dredge: Surface area weighted average 3,020 mg/kg | Post-Dredge: 20 mg/kg (max) after; 110 mg/kg (max) 2 yrs later |

**Typical Water Depth and Cut Depth:** Water depths range from 4 – 6 ft nearshore, sloping to 18 ft at the bottom of side slope areas, with 30 ft depths in the navigation channel. Deepest sediment cuts of 4 – 6 ft.

**TSS / Turbidity Monitoring and Point of Compliance:** Turbidity monitored 2 times/day at one upstream and one downstream location. No violations of compliance parameters.

**Cleanup Goal / Remedial Action Level:** Mass removal to clay layer and 10 mg/kg verification goal.

**Cost (Dredging):** Not available. Total cost $5,650,000.

**Unit Cost (Dredging):** $62/CY (water-side costs). Total unit cost $198/CY.

**Description:**
Dredge area 750 feet long by 150 feet wide. Conventional bucket for rock/debris along shoreline and removal of hard till. Dredged sediments loaded into a barge with 3 compartments, offloaded with 3.5 CY slim profile Cable Arm, temporarily stockpiled on pad, pugmill with reagent additive, stockpiled for curing, loaded onto trucks, transported to dedicated landfill cell. Initial verification samples (Sep 10) had some results > 50 mg/kg. Residual sediment occurred from passage of lake freighter, settlement of resuspended sediments, nearshore shelf of dredge channel, sloughing of material outside of the area dredged. Residuals consisted of 2-6 inch layer of highly liquid sediment. Redredging was performed assisted by diver inspections. Pugmill problems at start of project delayed dredging. Silt curtain damage, deposition of sediment in dredged areas occurred due to unauthorized commercial vessel traffic.

† Value was calculated from other parameters provided in the reference.

**References:**
Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>Project</th>
<th>Similarity</th>
<th>Dredging Dates</th>
<th>Shifts</th>
<th>Uptime</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM Foundry, St. Lawrence River Massena, NY</td>
<td>3.0 S:1 E:5 C:3</td>
<td>Jun 29 – Nov 6, 1995 (4.5 mo)</td>
<td>8 – 10 hr/day, 6 day/wk. End at 24 hr/day.</td>
<td>Not available</td>
</tr>
</tbody>
</table>

| Volume: 13,800 CY (rock, sediment, filter cake) | Equipment: 8-foot horizontal auger dredge | Production Rates: 8CY/hr (total) † | Sediment: Clay, silt & sand with organic matter and boulders over till | Contaminant: PCBs | Pre-Dredge: ND – 5.700 mg/kg 74 mg/kg (median) | Post-Dredge: 0.036 – 91 mg/kg (range) 5 of 6 quadrants averaged 3 mg/kg; 1 quadrant averaged 27 mg/kg |

**Typical Water Depth and Target Cut Depth:** Water and cut depth not available.

**TSS / Turbidity Monitoring and Point of Compliance:** Turbidity measured outside of modified sheetpile containment system at 13 locations. Turbidity criteria < 28 NTU (above background) was exceeded 18 (out of 923 measurements), with values ranging from 31 to 127 NTU.

**Cleanup Goal / Remedial Action Level:** 1 mg/kg PCBs, remove > 85% of contaminated sediment.

**Cost (Dredging):** $7,000,000. Total cost $10,000,000.

**Unit Cost (Dredging):** $260/CY. Total unit cost $725/CY.

**Description:**
Eleven-acre nearshore hotpsot area dredged. Dredge area isolated from river with sheetpile. Silt curtain used internally around >500 mg/kg hotspot areas. Dredge moved by winching along cable guide anchored at the shore and the sheetpile wall. The dredge advanced 2 to 4 feet per second. Dredge depth 3 to 12 inch cut per pass; typically 4 to 6 passes per lane, relocate 7 ft over allowing 1 foot overdredge (avg. 15 passes per area, with over 30 passes in some areas). Barge-mounted backhoe for debris removal prior to dredging. Shallow shoreline areas dewatered with Portadam system and mechanical removal. Used a vacuum head dredge with metal shroud and backhoe in quadrant with elevated residuals. Cleanup goal of 1 mg/kg PCBs not achieved despite multiple passes; one of six quadrants were capped with sand & activated carbon, gravel, and stone. Large quantities of rocks were not anticipated and required removal, larger rocks left holes, which were not effectively dredged.

† Value was calculated from other parameters provided in the reference.

**References**
Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume: 11,000 CY</td>
<td>Equipment: 10“ horizontal auger</td>
<td>Production Rates: 3.8 CY/hr (total) †</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sediment: Lake sediment with debris</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contaminant: VOCs, herbicides, petroleum, metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pre-Dredge: Not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-Dredge: Not available.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typical Water Depth and Cut Depth: Cut depth 0 – 5 ft. Average of 2 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSS / Turbidity Monitoring and Point of Compliance: Not available.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleanup Goal / Remedial Action Level: Removal to “historic lake” bottom (depth target) and EPA Toxicity Criteria for lead.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost (Dredging): Total cost $3,000,000 excluding landfill costs, but including dewatering.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit Cost (Dredging): Not available.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description: 3.1-acre lake. Extensive debris removal before dredging. More debris removed while dredging. Dredged material dewatered on-site. Along with debris, sediment was disposed in on-site RCRA landfill. Lake backfilled with 6-9 inches of aggregate.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† Value was calculated from other parameters provided in the reference.

Reference
Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>Grasse River Pilot</th>
<th>Similarity: 3.7</th>
<th>Dredging Dates:</th>
<th>Shifts:</th>
<th>Uptime:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massena, NY</td>
<td>S:2 E:5 C:4</td>
<td>Aug 9 – Sep 6, 1995 (29 day)</td>
<td>8 – 10 hr/day 5 day/wk</td>
<td>Not available</td>
</tr>
</tbody>
</table>

| Volume: 2,600 CY sediment (3,000 CY total including boulders) | Equipment: 8 foot wide horizontal auger dredge | Production Rates: 12 CY/hr (total)† | Sediment: Soft sediment with loose gravel, cobble; glacial till with large boulders and rock underneath | Contaminant: PCBs | Pre-Dredge: 518 mg/kg (avg. upper 1 foot) 1,109 mg/kg (avg. over full depth) 11,000 mg/kg (max) | Post-Dredge: 75 mg/kg (avg. upper 1 foot) 75 mg/kg (avg. over full depth) 260 mg/kg (max) |

**Grasse River Pilot**

**Massena, NY**

**Volume:** 2,600 CY sediment (3,000 CY total including boulders)

**Equipment:** 8 foot wide horizontal auger dredge

**Production Rates:** 12 CY/hr (total)†

**Percent Solids:** 2 – 5%

**Sediment:** Soft sediment with loose gravel, cobble; glacial till with large boulders and rock underneath

**Contaminant:** PCBs

**Pre-Dredge:** 518 mg/kg (avg. upper 1 foot) 1,109 mg/kg (avg. over full depth) 11,000 mg/kg (max)

**Post-Dredge:** 75 mg/kg (avg. upper 1 foot) 75 mg/kg (avg. over full depth) 260 mg/kg (max)

**Uptime:** Not available

**Dredging Dates:** Aug 9 – Sep 6, 1995 (29 day)

**Shifts:** 8 – 10 hr/day 5 day/wk

**Equipment:** 8 foot wide horizontal auger dredge

**Production Rates:** 12 CY/hr (total)†

**Typical Water Depth and Cut Depth:** Water depths 2 – 3 ft near shore, maximum 14 ft deep in removal area. Contaminated prism 1 – 2.5 ft thick.

**TSS / Turbidity Monitoring and Point of Compliance:** TSS and turbidity monitored outside the silt curtain. TSS criteria < 25 mg/L above background; turbidity < 30 NTU above background. TSS maximum average 10.7 mg/L. Reduced monitoring to turbidity only 10 days into project.

**Cleanup Goal / Remedial Action Level:** None for pilot removal. Targeted 3,500 CY sediment/material to remove, estimated 25% PCB mass removal.

**Cost (Dredging):** $1,273,000 (includes sediment and boulder removal, dewatering, water treatment).

**Unit Cost (Dredging):** $398/CY†.

**Description:**
Dredged with low speed motors, conducted 2 passes with 1 – 2 ft overlap. Grapple hook to removed large boulders and rocks. Dredged perpendicular to shore. Difficulties due to hidden rocks and boulders (more than anticipated – which deflected the auger) and stepped/sloped bottom surface – which required lifting the auger to conform to the slope. Both of these influenced the efficiency and percent solids achieved. Removed an average 2 ft of material, leaving 4 – 14 in of sediment after completion. Estimated removal of 84% of target sediment, 27% of PCB mass.

† Value was calculated from other parameters provided in the reference.

**References**

Table D1-3  
Summary of Contaminated Sediment Dredging Projects Evaluated

| Gruber’s Grove Bay Baraboo, WI | Similarity: 3.7  
S: 4 E: 4 C: 3 | Dredging Dates:  
May – November 2001 | Shifts:  
1, 12 hr shift | Uptime:  
~ 80% efficiency  
(20% down time) |
|---|---|---|---|---|
| Volume: 87,000 CY | Equipment:  
MudCat MC-2000 auger dredge | Production Rates:  
75 – 90 CY/hr (typical) | Sediment:  
Fine grained.  
Limited debris – more near shoreline. | Contaminant:  
Heavy metals  
(lead, copper, mercury) | Pre-Dredge:  
Maximum mercury  
~2 mg/kg | Post-Dredge:  
None collected. |
| Typical Water Depth and Cut Depth:  
Water depths ranged from 0 to 2 feet. The dredge cut varied from 2 to 7 feet. |
| TSS / Turbidity Monitoring and Point of Compliance:  
None. State did visual observations. |
| Cleanup Goal / Remedial Action Level:  
Ecological risk based. Goal was to remove mass. |
| Cost (Dredging):  
$4.5 million (construction only).  
$6.0 million (design, permitting, and construction). |
| Unit Cost (Dredging):  
$52/CY |
| Description:  
Eight foot widths, typically 400 feet long were dredged at a time (width of the dredge). The edge of the dredge was moved over 7 feet each time before starting the next 400 foot lane, causing a 1 foot overlap. |
| References |
Personal communication with Charles Bursich of Stone & Webster.  October 31, 2002.
<table>
<thead>
<tr>
<th>Lake Jarnsjon, Sweden</th>
<th>Similarity: 3.7 S:4 E:4 C:3</th>
<th>Dredging Dates: May – Nov 1993, summer 1994 (8.5 mo)</th>
<th>Shifts: Not available</th>
<th>Uptime: Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume: 196,000 CY</td>
<td>Equipment: Auger dredge, conventional bucket for dense sand &amp; gravel areas</td>
<td>Production Rates: Not available</td>
<td>Sediment: Very soft organic sediment mixed with mineral silts, some sand pockets</td>
<td>Contaminant: PCBs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percent Solids: Not available</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Typical Water Depth and Cut Depth:** Water depths 5 – 8 ft deep, 13.5 ft maximum. Sediment removal depths of up to 5.2 feet (1.6 m).

**TSS / Turbidity Monitoring and Point of Compliance:** Turbidity and TSS measured each shift (2 samples each shift). Locations upstream and downstream of lake, within protective screens.

**Cleanup Goal / Remedial Action Level:** To protect human health and the environment.

**Cost (Dredging):** Not available. Total cost $6,400,000.

**Unit Cost (Dredging):** Not available. Total unit cost $40/CY.

**Description:**
Removed sediments in 1.3 feet (0.4 m) lifts. Estimated removal of 394 kg PCBs (97 – 99% of mass). Dredged sediments were dewatered with a mechanical filter press; had to add sand to achieve 35% dry solids requirement (due to the high fines content in dredged sediments).

† Value was calculated from other parameters provided in the reference.

**References**
### Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>Lavaca Bay Dredging Treatability Study (Phase II)</th>
<th>Similarity:</th>
<th>Dredging Dates:</th>
<th>Shifts:</th>
<th>Uptime:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcoa (Point Comfort)/Lavaca Bay Superfund Site</td>
<td>4.7 S:4 E:5 C:5</td>
<td>Jan 18 – Feb 5, 1999 (17 days)</td>
<td>10 hr/day</td>
<td>73.2% efficiency (Down 26.8% of time)</td>
</tr>
<tr>
<td>Lavaca Bay, Texas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Volume: 9,500 CY | Equipment: 10-inch hydraulic dredge with a 14-inch suction pipe and 36-inch cutterhead | Production Rates: 51 CY/hr (total) 70 CY/hr (working) | Sediment: Soft plastic clay over med stiff clay. The percent solids ranged from 50 – 65% (55 – 100% moisture content) | Contaminant: Mercury | Pre-Dredge: 0.65 – 1.14 mg/kg (surface) | Post-Dredge: 0.1 – 4.5 mg/kg (surface immediately after) 0.82 – 1.09 mg/kg (surface 2 mo. after) |

**Typical Water Depth and Cut Depths:** Water depths ranged from 0 to 4 ft deep. A cut depth of 4 to 5 ft was required to float the dredge, necessitating a 1 to 2 ft overdredge.

**TSS / Turbidity Monitoring and Point of Compliance:** Turbidity monitored on fan array (3 transects) downstream of dredge. Agency notification if TSS at 50m = 150 mg/L above background. Modify dredge program if TSS at 50m = 500 mg/L above background.

**Cleanup Goal / Remedial Action Level:** None established for the Treatability Study; cores indicated low concentrations (<0.1 mg/kg) below 3 ft.

**Cost (Dredging):** $251,000 (disposal costs not included).

**Unit Cost (Dredging):** $26/CY.

**Description:**
Phase II of the dredging treatability study evaluated the efficiency, effectiveness, and operational constraints of dredging Lavaca Bay sediments in a shallow water environment with a hydraulic cutterhead dredge. The Phase II area was about 1.5 acres. Operational parameters that were altered included: forward advance rate, swing speed, cut depth, cutter rotation speed, and number of sweeps. Working production rates during the project ranged from 43 to 177 CY/hr. Dredged material was pumped to an upland disposal CDF.

**References**
Personal project experience of John Verduin
### Table D1-3
**Summary of Contaminated Sediment Dredging Projects Evaluated**

<table>
<thead>
<tr>
<th>Los Angeles River Estuary Dredging and Aquatic Capping Pilot Study Los Angeles, California</th>
<th>Similarity: 2.0 S:2 E:2 C:2</th>
<th>Dredging Dates: Aug 2-25, 2001 (20 days)</th>
<th>Shifts: 6 day/wk 24 hr/day</th>
<th>Uptime: 67% efficiency (Down 33% of time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume: 139,000 CY</td>
<td>Equipment: 12 CY rehandling bucket that had teeth welded on later.</td>
<td>Production Rates: 285 CY/hr (total) 425 CY/hr (working)</td>
<td>Sediment: Very silty to silty sand with organics, debris. Pockets of organic silt. Percent solids typically 65% to 80% (moisture contents of 20% to 65%)</td>
<td>Contaminant: Metals, pesticides, PAHs</td>
</tr>
</tbody>
</table>

**Typical Water Depth and Cut Depths:** The water depth ranged from 3 to 6 feet. The dredge cut was typically around 18 feet.

**TSS / Turbidity Monitoring and Point of Compliance:** Because this was a pilot study no compliance requirements were established. Monitoring points were at a distance of 25, 50, 100, and 200 meters from the point of dredging.

**Cleanup Goal / Remedial Action Level:** Dredge to target elevation.

**Cost (Dredging and Disposal):** ~ $1.6 million.

**Unit Cost (Dredging and Disposal):** $9.60 per CY.

**Description:** This project was a pilot study to demonstrate the effectiveness of confined aquatic disposal of contaminated sediment. Dredging was done for navigational purposes. The site was advanced dredge to provide a sediment trap. The dredge material was dredged and placed on a bottom dump haul barge. The barge was hauled to a pit in Los Angeles harbor and dumped. The material will eventually be capped.

**References**
- Personal project experience of John Verduin.
### Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>Lower Fox River Deposit N and O Pilot</th>
<th>Similarity: 3.7</th>
<th>Dredging Dates:</th>
<th>Shifts:</th>
<th>Uptime:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kimberly, WI</td>
<td>S:3 E:5 C:3</td>
<td>Oct – Dec 31, 1998</td>
<td>5 day/wk</td>
<td>Not available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aug 20 – Oct 14, 1999</td>
<td>24 hr/day (1998)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(104 day)</td>
<td>10 hr/day (1999)</td>
<td></td>
</tr>
</tbody>
</table>

| Volume: 8,190 CY                     | Equipment: 8-inch cutterhead dredge | Production Rates: 80 CY/day (total)† | Sediment: Soft silty clay in western lobe of Deposit N and sandy in eastern lobe | Contaminant: PCBs | Pre-Dredge: 186 mg/kg (max 1994) 11.7 mg/kg (avg.) 85.4 mg/kg (max) | Post-Dredge: 7.5 mg/kg (avg.) 43 & 130 mg/kg (max) |
| Deposit N Phase I 4,100 CY Phase II 3,100 CY Deposit O 1,000 CY | | | | | |

**Typical Water Depth and Cut Depth:** Water depths 8 ft deep; target removal thickness about 1.5 to 2.5 ft thick.

**TSS / Turbidity Monitoring and Point of Compliance:** Turbidity monitored downstream; turbidity levels averaged slightly below background during Phase I and slightly above background during Phase II.

**Cleanup Goal / Remedial Action Level:** Mass removal down to design elevation. Removal to 3 – 6 in above bedrock.

**Cost (Dredging):** Not available. Total cost $4,300,000.

**Unit Cost (Dredging):** $20.70/CY. Total unit cost $525/CY.

**Description:** Sediment over fractured bedrock. An 80 mil HDPE perimeter barrier, silt curtain, and deflection barrier used in 1998. Silt curtain and deflection barrier in 1999. Estimate 112 lb PCBs removed, and 82% mass removal overall. Estimate 111 lb PCBs removed from Deposit N, estimate 1 lb PCBs removed from Deposit O. Actual dredging hours averaged 3 to 5 hr/day due to upland dewatering constraints. Target removal volume of 7,060 CY to allow for residual volume to be left behind. Difficulties during Phase I included insufficient dewatering capacity, limiting dredging to 15 – 20 min/2 hr period.

† Value was calculated from other parameters provided in the reference.

**References**
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume:</strong> 31,346 CY</td>
<td><strong>Equipment:</strong> 12-inch cutterhead initially for 1 week, then 10-inch horizontal auger dredge w/12” pump.</td>
<td><strong>Production Rates:</strong> 67 CY/hr (total) <strong>Percent Solids:</strong> 4.4% (avg.)</td>
<td><strong>Sediment:</strong> Soft organic silt over firm native clay</td>
<td><strong>Contaminant:</strong> PCBs <strong>Pre-Dredge:</strong> ND – 710 mg/kg (over full depth) 2 – 5 mg/kg (surface) <strong>Post-Dredge:</strong> 32 – 280 mg/kg (areas with no final pass) 0.01 – 17 mg/kg (areas with cleanup pass)</td>
</tr>
</tbody>
</table>

**Typical Water Depth and Cut Depth:** Water depths ranged from 2 – 14 ft. Sediment deposits ranged from 1 – 16 ft thick, with 10 ft thick as average.

**TSS / Turbidity Monitoring and Point of Compliance:** Monitored TSS and turbidity upstream and downstream of dredge site.

**Cleanup Goal / Remedial Action Level:** Dredge to a target elevation. Confirmational samples with goal of < 1 mg/kg.

**Cost (Dredging):** Not available. Total cost $8,970,000.

**Unit Cost (Dredging):** $27/CY. Total unit cost $286/CY.

**Description:**
Nine acre site dredged. Estimate removal of 1,326 lb PCBs. Dredging commenced with a 12-inch cutterhead. One week into the project, switched to an auger dredge to help increase slurry percent solids. Later increased the dredge pump (from 10 inches to 12 inches) and added a larger booster pump to transport the slurry to the equalization basins. Then changed to a wider cutter (9 feet). Several passes were used to try to achieve target elevations. Onset of winter weather forced a demobilization.

† Value was calculated from other parameters provided in the reference.

**References**

## Table D1-3
### Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>Location</th>
<th>Volume: 50,316 CY</th>
<th>Equipment: 12-inch horizontal Auger (1), 10-inch horizontal Auger (2). 3 dredges on site, only used 1 at any time.</th>
<th>Production Rates: 35 CY/hr (total)</th>
<th>Percent Solids: 3.5 – 14.4% Avg. 8.4%</th>
<th>Sediment: Soft organic silt over firm native clay</th>
<th>Contaminant: PCBs</th>
<th>Pre-Dredge: 47.9 mg/kg (avg.) 310 mg/kg (max)</th>
<th>Post-Dredge: ND – 9.5 mg/kg 2.2 mg/kg (avg.)</th>
<th>Dredging Dates: July – late Oct, 2000 (69 days)</th>
<th>Shifts: 7 day/wk 24 hr/day</th>
<th>Uptime: 87% efficiency (of equipment in operation) (Down 13% time)</th>
</tr>
</thead>
</table>

**Lower Fox River SMU 56/57 (2000) Kimberly, WI**

**Summary:**
- **Similarity:** 4.0 S:4 E:5 C:3
- **Dredging Dates:** July – late Oct, 2000 (69 days)
- **Shifts:** 7 day/wk 24 hr/day
- **Uptime:** 87% efficiency (of equipment in operation) (Down 13% time)

**Volume:** 50,316 CY

**Equipment:**
- 12-inch horizontal Auger (1),
- 10-inch horizontal Auger (2).
- 3 dredges on site, only used 1 at any time.

**Production Rates:** 35 CY/hr (total)

**Percent Solids:** 3.5 – 14.4%

**Avg. 8.4%**

**Sediment:** Soft organic silt over firm native clay

**Contaminant:** PCBs

**Pre-Dredge:**
- 47.9 mg/kg (avg.)
- 310 mg/kg (max)

**Post-Dredge:**
- ND – 9.5 mg/kg
- 2.2 mg/kg (avg.)

**Dredging Dates:** July – late Oct, 2000 (69 days)

**Shifts:** 7 day/wk 24 hr/day

**Uptime:** 87% efficiency (of equipment in operation) (Down 13% time)

- **Typical Water Depth and Cut Depth:** Water depths ranged from 2 – 14 ft. Sediment deposits ranged from 1 – 16 ft thick, with 10 ft thick on average.

**TSS / Turbidity Monitoring and Point of Compliance:** Monitored TSS and turbidity upstream and downstream of dredge site.

**Cleanup Goal / Remedial Action Level:** Dredge to a target elevation.

**Cost (Dredging):** Not available. Total costs reported $8,200,000 - $14,900,000.

**Unit Cost (Dredging):** Not available. Total unit cost $163/CY - $296/CY.

**Description:**
Initial dredging was completed on areas dredged in 1999 that had higher surface concentrations (Areas 1 and 2). Three dredges on-site: one actively dredging, one positioned in a new area, one maintained as back-up. Divers to assist with debris removal and visual inspections. Nine to 12-inch sand cap placed over entire dredged area (the requirement was to place a 6-inch cap over areas with surface concentrations exceeding 1 mg/kg PCBs).

† Value was calculated from other parameters provided in the reference.

**References**
Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>LTV Steel East Chicago, IN</th>
<th>Similarity: 3.7 S:3 E:5 C:3</th>
<th>Dredging Dates: Jun 1994 – Oct 1996 (18 mo)</th>
<th>Shifts: 6 day/wk (1994); 5 day/wk, 10 hr/day (after)</th>
<th>Uptime: Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume:</strong> 109,000 CY</td>
<td><strong>Equipment:</strong> Diver assisted vacuum (1994) – 12,000 CY 10 – 12” cutterhead dredge (1995 &amp; 1996)</td>
<td><strong>Production Rates:</strong> 20 CY/hr (total – divers) 65 cy/hr maximum (total – cutterhead)</td>
<td><strong>Sediment:</strong> Very fine grained oily material</td>
<td><strong>Contaminant:</strong> PAHs and oils</td>
</tr>
<tr>
<td><strong>Percent Solids:</strong> 3 – 5% (12% max) – cutterhead</td>
<td><strong>Pre-Dredge:</strong> Not available</td>
<td><strong>Post-Dredge:</strong> Not required</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Typical Water Depth and Target Cut Depth:** Impacted sediment thickness ranged from 3 – 12 ft deep.

**TSS / Turbidity Monitoring and Point of Compliance:** Continuous turbidity monitoring at intake (process), daily monitoring 200 ft downstream. Turbidity limit of 10 NTU above background. Average turbidity ranged from 2 – 10 NTU; background averaged 3.8 NTU.

**Cleanup Goal / Remedial Action Level:** Removal of all settled sediment to hard slag or natural “hard pan” layer without interrupting supply of process water.

**Cost (Dredging):** Not available. Total cost $12,000,000.

**Unit Cost (Dredging):** Not available. Total unit cost $110/CY.

**Description:**
Ten to 15 percent of volume removed 1994 with diver-assisted vacuum. Eighty-five to 90 percent of volume removed in 1995 and 1996 with open suction dredge & cutterhead dredge. Switched to cutterhead dredge due to numerous suction plugs. Pumped sediments screened, pumped to processing area, mixed with coagulant, thickened in clarifiers, fed to belt presses, dewatered, transported to off-site landfill.

† Value was calculated from other parameters provided in the reference.

**Reference:**
<table>
<thead>
<tr>
<th>Manistique River and Harbour Manistique, MI</th>
<th>Similarity: 2.3 S:1 E:4 C:2</th>
<th>Dredging Dates: 1995 – 1998 (20 mo)</th>
<th>Shifts: 7 day/wk 6 hr/day</th>
<th>Uptime: Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume: 120,000 CY</td>
<td>Equipment: Multiple equipment used over time</td>
<td>Production Rates: Not available.</td>
<td>Sediment: Silty/clayey sand with wood chips and sawdust</td>
<td>Contaminant: PCBs Pre-Dredge: ND – 90 mg/kg Post-Dredge: ND – 4,200 mg/kg</td>
</tr>
<tr>
<td>Typical Water Depth and Cut Depth: Water depths ranged from 15 – 20 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSS / Turbidity Monitoring and Point of Compliance: Turbidity monitored outside the silt curtain, limit of twice background levels.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleanup Goal / Remedial Action Level: Mass removal using 10 mg/kg PCBs as goal.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost (Dredging): Not available. Total cost through 1998: $25,000,000.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Unit Cost (Dredging): Not available. Total unit cost $208/CY.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description: Project continued into 2000. Volumes, quantities, estimated rates based on removal through 1998. Used slurry barges to transport dredged material. Several sizes of hydraulic dredges were used depending on site conditions. Diver assistance was used when slab-wood was encountered.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† Value was calculated from other parameters provided in the reference.

References
### Table D1-3
**Summary of Contaminated Sediment Dredging Projects Evaluated**

<table>
<thead>
<tr>
<th>Marathon Battery</th>
<th>Cold Springs, NY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume:</strong></td>
<td>100,200 CY 77,000 CY dredged: 23,000 CY dry-excavation</td>
</tr>
<tr>
<td><strong>Equipment:</strong></td>
<td>Horizontal auger and barge-mounted clamshell. Marsh excavation with LGP tires/tracks.</td>
</tr>
<tr>
<td><strong>Production Rates:</strong></td>
<td>Not available</td>
</tr>
<tr>
<td><strong>Percent Solids:</strong></td>
<td>Not available</td>
</tr>
<tr>
<td><strong>Sediment:</strong></td>
<td>Loose silty clay over hard clay-like material</td>
</tr>
</tbody>
</table>
| **Contaminant:** | Metals  
Cd primarily  
(Ni and Co also)  |
| **Pre-Dredge:**  | Area III  
2.700 mg/kg Cd (max.)  
179.3 mg/kg Cd (avg.)  |
| **Post-Dredge:** | Area III  
81.2 mg/kg Cd (max.)  
10.9 mg/kg Cd (avg.)  |

**Similarity:** 3.3  
S:4 E:3 C:3  
**Dredging Dates:** Aug 1993 – Apr 1995  
(21 mo)  
**Shifts:** Not available  
**Uptime:** Not available

**Typical Water Depth and Cut Depth:** Water depths from 0 – 18 ft. Average target removal depth of 1 ft.

**TSS / Turbidity Monitoring and Point of Compliance:** Not available.

**Cleanup Goal / Remedial Action Level:** Depth of 1 foot.

**Cost (Dredging):** Not available. Total cost ranged $9,000,000 - $11,000,000.

**Unit Cost (Dredging):** $35/CY. Total unit cost ranged $110/CY - $142/CY.

**Description:** Initially fed slurry directly to screens and centrifuges for dewatering. Replaced process to discharge to a settling basin to maintain feed quality.

† Value was calculated from other parameters provided in the reference.

**References:**  
Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>New Bedford Harbor Bristol County, MA</th>
<th>Similarity: 4.0 S:3 E:5 C:4</th>
<th>Dredging Dates: Apr 26, 1994 – Sep 5, 1995 (261 day)</th>
<th>Shifts: 6 hr/day (tides and WWTP)</th>
<th>Uptime: Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume: 14,000 CY</td>
<td>Equipment: 12” cutterhead dredge (Ellicott 370)</td>
<td>Production Rates: 13 CY/hr (working)</td>
<td>Sediment: Fine sandy silt with some clay</td>
<td>Contaminant: PCBs</td>
</tr>
</tbody>
</table>

Typical Water Depth and Cut Depth: Water depths from 1 – 6 ft deep. Maximum of 4 ft deep removal.

TSS / Turbidity Monitoring and Point of Compliance: Monitoring for dissolved and suspended PCBs.

Cleanup Goal / Remedial Action Level: Hotspot removal of area >4,000 mg/kg PCBs.

Cost (Dredging): $1,740,000. Total cost $20,100,000.

Unit Cost (Dredging): $124/CY. Total unit cost $1,430/CY.

Description:
Estimate removal of 240 kg PCBs. Estimate 57 kg PCBs transported downstream during dredging. Made 3 swings to remove 1.5 ft lift of material. At times the dredge was used to “remove” oil floating on water surface. Dredging limited to 4 – 6 hr/day due to tides to float the dredge. WWTP capacity of 4 – 6 hours of 2,100 gpm feed.

† Value was calculated from other parameters provided in the reference.

References
### New Bedford Harbor – Pre-Design Field Test
(Branch County, MA)

<table>
<thead>
<tr>
<th>Volume: 4,000 CY</th>
<th>Equipment: Mechanical excavation/hydraulic transport 4.5 CY bucket</th>
<th>Production Rates: 80 CY/hr (total)</th>
<th>Sediment: Fine grained. Water contents of 133 to 213% (percent solids of 32 to 43%)</th>
<th>Contaminant: PCBs</th>
<th>Pre-Dredge: 857 mg/kg (average of upper foot)</th>
<th>Post-Dredge: 29 mg/kg (average of upper foot)</th>
</tr>
</thead>
</table>

**Similarity:** 4.7  
S:4  E:5  C:5

**Dredging Dates:** August 10-18, 2000  
**Shifts:** 10 hrs/day  
**Uptime:** Not available

**Volume:** 4,000 CY  
**Equipment:** Mechanical excavation/hydraulic transport 4.5 CY bucket  
**Production Rates:** 80 CY/hr (total)  
**Sediment:** Fine grained. Water contents of 133 to 213% (percent solids of 32 to 43%)  
**Contaminant:** PCBs  
**Pre-Dredge:** 857 mg/kg (average of upper foot)  
**Post-Dredge:** 29 mg/kg (average of upper foot)

**Typical Water Depth and Cut Depth:** Dredge cuts of 1 to 4 feet. Water depths 0 to 5 feet MLLW.

**TSS / Turbidity Monitoring and Point of Compliance:** Monitoring at the point of dredging and downstream.

**Cleanup Goal / Remedial Action Level:** Pilot study that did not have remediation targets. Goal for the area was to remediate to below 10 mg/kg PCBs in this area.

**Cost (Dredging):** Not known.

**Unit Cost (Dredging):** Not known.

**Description:**

Pilot study was completed to evaluate a new dredge technology. The system uses a mechanical bucket to dredge the material and then a hydraulic system to pump the material. The material was pumped 2,800 feet to an upland disposal site. Recirculation of water was used to minimize the water requiring treatment.

**References**


Personal communication with John Lally of Bean Environmental, L.L.C.
### Port of Portland T4 Pencil Pitch

Portland, OR

<table>
<thead>
<tr>
<th>Volume: 35,000 CY</th>
<th>Equipment: Enclosed clamshell bucket. Airlift pump to “sweep” nearshore sediment over rip rap to bucket</th>
<th>Production Rates: 115 CY/hr (total)†</th>
<th>Sediment: Fine grained sediments</th>
<th>Contaminant: Pencil pitch</th>
<th>Pre-Dredge: 1 – 33% pencil pitch (surface)</th>
<th>Post-Dredge: &lt;0.5% pencil pitch (surface)</th>
</tr>
</thead>
</table>

**Dredging Dates:** Dec 19, 1994 – Jan 7, 1995 (19 days)

**Shifts:**
- 24 hr/day dredge
- 16 hr/day dredge, 8 hr/day maintenance

**Uptime:** Not available

**Volume:** 35,000 CY

**Equipment:** Enclosed clamshell bucket. Airlift pump to “sweep” nearshore sediment over rip rap to bucket

**Production Rates:** 115 CY/hr (total)†

**Sediment:** Fine grained sediments

**Contaminant:** Pencil pitch

**Pre-Dredge:** 1 – 33% pencil pitch (surface)

**Post-Dredge:** <0.5% pencil pitch (surface)

**Typical Water Depth and Cut Depth:** Pencil pitch primarily limited to upper surface. Water depths from –36 to –45 Columbia River datum.

**TSS / Turbidity Monitoring and Point of Compliance:** Turbidity collected daily. TSS samples collected when turbidity >10 NTU above mean background.

**Cleanup Goal / Remedial Action Level:** <0.5% pencil pitch.

**Cost (Dredging):** $212,000 (dredging only).

**Unit Cost (Dredging):** $6.2/CY.

**Description:** Removal of pencil pitch sediments from a navigation slip. Contaminated sediments had settled on the riprap banks located under docks. A hand-operated airlift pump was used to resuspend the material and “sweep” it into the middle of the slip.

† Value was calculated from other parameters provided in the reference.

### Table D1-3
**Summary of Contaminated Sediment Dredging Projects Evaluated**

<table>
<thead>
<tr>
<th>Port of Vancouver Copper Spill</th>
<th>Volume: 1,900 CY</th>
<th>Equipment: Small cutterhead dredge with diver-assisted redredging</th>
<th>Production Rates: Not available</th>
<th>Sediment: Poorly graded med – fine sand with 10% fines</th>
<th>Contaminant: Copper</th>
<th>Pre-Dredge: ND – 68,000 mg/kg</th>
<th>Post-Dredge: ND – 4,790 mg/kg</th>
<th>Uptime: Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vancouver, WA</strong></td>
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<tr>
<td>Dredging Dates: J 17 – Aug 16, 1990</td>
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<tr>
<td>Shifts: 24 hr/day</td>
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<tr>
<td><strong>Production Rates:</strong></td>
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<tr>
<td><strong>Sediment:</strong></td>
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<tr>
<td><strong>Contaminant:</strong></td>
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<tr>
<td><strong>Pre-Dredge:</strong></td>
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<tr>
<td><strong>Post-Dredge:</strong></td>
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<tr>
<td><strong>Typical Water Depth and Cut Depth:</strong></td>
<td>Water depths 5 to 40 ft below river datum. Target sediment removal of 2 ft with 6 in overdredge.</td>
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</tr>
<tr>
<td><strong>TSS / Turbidity Monitoring and Point of Compliance:</strong></td>
<td>Monitored turbidity 3 times/wk at onset. Sampled locations 225 ft and 450 ft downstream of dredge (midpoint and dilution boundary).</td>
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<td></td>
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</tr>
<tr>
<td><strong>Cleanup Goal / Remedial Action Level:</strong></td>
<td>&lt; 1,300 mg/kg copper.</td>
<td></td>
<td></td>
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<tr>
<td><strong>Cost (Dredging):</strong></td>
<td>$1,000,000 total costs.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Unit Cost (Dredging):</strong></td>
<td>$526/CY total.</td>
<td></td>
<td></td>
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<tr>
<td><strong>Description:</strong></td>
<td>Believed high concentrations of copper remained due to heavier copper particles not being entrained by the hydraulic dredge. Cutterhead performed initial dredging and diver-assisted redredging occurred underneath the dock and in areas where threshold was not achieved. Under dock areas had steep, unstable gravel slopes and removal was difficult. Isolated spots underneath the dock and in the river channel exceeded 1,300 mg/kg cu despite repeated dredging attempts.</td>
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</tbody>
</table>

† Value was calculated from other parameters provided in the reference.

<table>
<thead>
<tr>
<th>Puget Sound Naval Shipyard Pier D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bremerton, WA</td>
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</tbody>
</table>

### Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S:2 E:3 C:1</td>
<td>Shifts: 5 day/wk 1 shift/day</td>
</tr>
<tr>
<td>Uptime: Not available</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume: 53,400 CY</th>
<th>Equipment: 6.5 CY flat rehandling bucket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Rates:</td>
<td>Sediment: Fine grained silts with sands (&gt;70% fines)</td>
</tr>
<tr>
<td></td>
<td>Contaminant: PCBs, PAHs, metals</td>
</tr>
<tr>
<td></td>
<td>Pre-Dredge: 4.9 mg/kg PCBs</td>
</tr>
<tr>
<td></td>
<td>Post-Dredge: 32 mg/kg PCBs (avg.) 104 mg/kg PCBs (max)</td>
</tr>
</tbody>
</table>

**Typical Water Depth and Cut Depth:** Water depths 40 – 50 ft deep. Sediment removal cut estimated at 3 to 7 ft thick.

**TSS / Turbidity Monitoring and Point of Compliance:** Turbidity measured first week of operations.

**Cleanup Goal / Remedial Action Level:** Increase water depth from –42 ft MLLW to –44.4 and –49.4 ft MLLW.

**Cost (Dredging):** Not available.

**Unit Cost (Dredging):** Not available.

**Description:**
Dredge depth as target removal. Dredged material loaded onto scows, rehandled onto paved upland area, stockpiled, loaded onto trucks for upland disposal.

† Value was calculated from other parameters provided in the reference.

**Reference:**
### Table D1-3
Summary of Contaminated Sediment Dredging Projects Evaluated

<table>
<thead>
<tr>
<th>Saginaw River and Bay</th>
<th>Similarity: 2.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bay City, MI</td>
<td>S:2 E:2 C:3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume:</th>
<th>Equipment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>205,000 CY (2000) 342,433 CY (total for both 2000 &amp; 2001)</td>
<td>6 CY and 16 CY Cable Arm; 4, 5, 8 &amp; 10 CY conventional bucket (used 2/3 of time)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Production Rates:</th>
<th>Sediment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 CY/hr (total) – 2000 dredging</td>
<td>Variety of sands, silts, clays with debris</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dredging Dates:</th>
<th>Uptime:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 13 – Dec 6, 2000 (209 day) End Apr – Jul 22, 2001</td>
<td>49.5% efficiency (Down 50.5% of time)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shifts:</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 day/wk 24 hr/day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contaminant:</th>
<th>Pre-Dredge:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCBs</td>
<td>&lt;0.4 – 34 mg/kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post-Dredge:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not collected</td>
</tr>
</tbody>
</table>

**Typical Water Depth and Target Cut Depth:** Not available

**TSS / Turbidity Monitoring and Point of Compliance:** Planned to monitor turbidity at 3 locations: one 300 ft upstream, two 300 ft and 600 ft downstream. Monitor 1 time/shift, 2 hr into shift, mid-depth. Upstream will represent “background,” downstream values cannot exceed background by 50% or more.

**Cleanup Goal / Remedial Action Level:** Removal to target elevations, remove 80% of PCB mass.

**Cost (Dredging):** $9.7 million.

**Unit Cost (Dredging):** $28/CY.

**Description:**
Dredging ceased in early December 2000 due to ice formation, which hampered movement of scows. Contract was supposed to be complete in Nov 2000, but lost time due to weather (wind prevented movement of scows) and an inability to achieve anticipated production rate (twice of what was actually achieved) prevented project completion in Nov 2000. Conventional bucket used when insufficient penetration was achieved with the Cable Arm, and for areas with pilings and sand. The sediment was barged to a confined disposal facility just outside the mouth of Saginaw River.

† Value was calculated from other parameters provided in the reference.

**References:**
Website http://midwest.fws.gov/nrda/saginaw/
| Sheboygan River and Harbor | Similarity: 2.7  
S:1 E:2 C:5 | Dredging Dates:  
Nov 1989 – Nov 1991 | Shifts:  
Not available | Uptime:  
Not available |
<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>Sheboygan Falls, WI</td>
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</tbody>
</table>
| **Volume:** 3,800 CY      | **Equipment:**  
Sealed clamshell.  
Land-based backhoe for nearshore areas | **Production Rates:**  
Not available | **Sediment:**  
Rocks, cobbles, sand, and soft pockets | **Contaminant:**  
PCBs |
|                           | **Pre-Dredge:**  
0.065 – 4,500 mg/kg | **Post-Dredge:**  
0.3 – 38.7 mg/kg |                |

**Typical Water Depth and Cut Depth:** Water depths range 2 – 4 ft deep. Average sediment removal 2 ft thick.

**TSS / Turbidity Monitoring and Point of Compliance:** TSS and turbidity monitored daily during removal. Turbidity criteria based on comparison of average upstream and downstream values; was exceeded 8 times during removal. TSS to correlate with turbidity.

**Cleanup Goal / Remedial Action Level:** None stated.

**Cost (Dredging):** Not provided. Total cost $7,000,000.

**Unit Cost (Dredging):** $450/CY (includes dredging and silt curtains). Total unit cost $1,842/CY.

**Description:** Shallow water depths limited ability to fill/achieve capacity with barges. Multiple passes used. Weather conditions (ice formation) hampered production rates in Dec 1989. Dredged areas were capped/armored either completely or partially due to elevated PCB concentrations.

† Value was calculated from other parameters provided in the reference.

**References:**
## Table D1-3
### Summary of Contaminated Sediment Dredging Projects Evaluated

|---|---|---|---|---|

| Volume: 428,000 CY contaminated from Sitcum Waterway | Equipment: Majority of dredging was with a 26-inch cutterhead. Small 8-inch dredge with draghead used under piers. Also 8 and 15 CY mechanical digging buckets used on slopes. | Production Rates: 12,200 CY/day (total) This was estimated by taking the total project time divided into the total dredge volume. | Sediment: Silty sand and sandy silt. | Contaminant: Metals and PAHs | Pre-Dredge: Unknown | Post-Dredge: Unknown |

**Volume**: 2.4 million CY clean from other waterways

**Equipment**:
- Majority of dredging was with a 26-inch cutterhead.
- Small 8-inch dredge with draghead used under piers.
- Also 8 and 15 CY mechanical digging buckets used on slopes.

**Production Rates**: 12,200 CY/day (total)

This was estimated by taking the total project time divided into the total dredge volume.

**Sediment**:
- Silty sand and sandy silt.

**Contaminant**:
- Metals and PAHs

**Pre-Dredge**:
- Unknown

**Post-Dredge**:
- Unknown

**Typical Water Depth and Cut Depths**: 40 to 50 foot water depths with cuts of 1 to 10 feet.

**TSS / Turbidity Monitoring and Point of Compliance**: Compliance boundary at 330 feet from point of dredging.

**Cleanup Goal / Remedial Action Level**: Sediment quality objectives established for Commencement Bay CERCLA site.

**Cost (Dredging)**: $17.5 million.

**Unit Cost (Dredging)**: $6.20 per CY overall average. $1.50 per CY in navigational channel and $25 per CY in underpier areas.

**Description**: Contaminated sediments from the Sitcum Waterway were dredged and placed into a nearshore fill in an adjacent abandoned waterway (Milwaukee Waterway). The Sitcum Waterway remediation was part of a larger dredging project for the Port of Tacoma. Dredge depths were established as 1 foot below chemical exceedences observed in sediment cores. An allowable overdredge depth of 1 foot was given below this target dredge depth. Only a few areas of exceedences after dredging were observed.

**References**
- Personal project experience of John Verduin
| United Heckathorn  | Similarity: 3.3  | Dredging Dates: Sep 1996 – Apr 1997  | Shifts: 6 day/wk 24 hr/day  | Uptime: Not available |
| Richmond, CA | S:4 E:3 C:3  | (7 mo.)  |  |
| Volume: 108,000 CY | Dredging Dates: Sep 1996 – Apr 1997  | Shifts: 6 day/wk 24 hr/day  | Uptime: Not available |
| [105,300 CY (Lauritzen); 2,700 CY (Parr)]  | (7 mo.)  |  |
| Equipment: 12 CY Cable Arm  | Equipment: 12 CY Cable Arm  | Equipment: 12 CY Cable Arm  | Equipment: 12 CY Cable Arm  | Equipment: 12 CY Cable Arm  |
| 7 CY conventional bucket (Lauritzen) Long-reach excavator (Parr)  | Production Rates: 24 CY/hr (total Lauritzen)†  | Production Rates: 24 CY/hr (total Lauritzen)†  | Production Rates: 24 CY/hr (total Lauritzen)†  | Production Rates: 24 CY/hr (total Lauritzen)†  |
| Contaminant: DDT, dieldrin  | Contaminant: DDT, dieldrin  | Contaminant: DDT, dieldrin  | Contaminant: DDT, dieldrin  | Contaminant: DDT, dieldrin  |
| Pre-Dredge: 1 – 633 mg/kg DDT  | Pre-Dredge: 1 – 633 mg/kg DDT  | Pre-Dredge: 1 – 633 mg/kg DDT  | Pre-Dredge: 1 – 633 mg/kg DDT  | Pre-Dredge: 1 – 633 mg/kg DDT  |
| Post-Dredge: 263 ppb DDT (avg.)  | Post-Dredge: 263 ppb DDT (avg.)  | Post-Dredge: 263 ppb DDT (avg.)  | Post-Dredge: 263 ppb DDT (avg.)  | Post-Dredge: 263 ppb DDT (avg.)  |
| 44 ug/kg DDT (median)  | 44 ug/kg DDT (median)  | 44 ug/kg DDT (median)  | 44 ug/kg DDT (median)  | 44 ug/kg DDT (median)  |
| 1.3 mg/kg DDT (max) (Lauritzen)  | 1.3 mg/kg DDT (max) (Lauritzen)  | 1.3 mg/kg DDT (max) (Lauritzen)  | 1.3 mg/kg DDT (max) (Lauritzen)  | 1.3 mg/kg DDT (max) (Lauritzen)  |

**Typical Water Depth and Target Cut Depth:** Not available.

**TSS / Turbidity Monitoring and Point of Compliance:** Not available.

**Cleanup Goal / Remedial Action Level:** 590 ppb DDT. Dredge target to “old bay mud.”

**Cost (Dredging):** Not available.

**Unit Cost (Dredging):** Not available.

**Description:**
Originally estimated 65,000 CY would require removal. Used Cable Arm to achieve level cut and minimize turbidity. Allowed free water to drain into the channel prior to placement in scow to minimize water. Used a conventional bucket in areas with known pilings and debris. Loaded removed sediments into scow, sediments placed into dewatering cell. Used grizzly atop scow to separate large debris – grizzly clogged frequently causing positioning/transferring of debris to amount to about 30% of dredge shift. Pneumatically placed a sand cap (6 – 8 in) after dredging.

† Value was calculated from other parameters provided in the reference.

Reference:
## Summary of Contaminated Sediment Dredging Projects Evaluated

### Waukegan Harbor/Outboard Marine

**Waukegan, IL**

| --- | --- | --- | --- | --- | --- | --- |

### Similarity: 3.7 S:5 E:5 C:1

| --- | --- | --- |

### Typical Water Depth and Cut Depth:

Water depths from 14 – 25 ft. Target sediments 1 – 7 ft thick.

### TSS / Turbidity Monitoring and Point of Compliance:

Turbidity samples collected daily 500 ft south of silt curtain at 10 ft and 20 ft below water surface. Criteria of <50 NTU outside of silt curtains. All turbidity readings <17 NTU.

### Cleanup Goal / Remedial Action Level:

50 mg/kg PCBs.

### Cost (Dredging):

Not available. Total cost (entire remedial action) $21,000,000.

### Unit Cost (Dredging):

Not available. Total unit cost $552/CY.

### Description:

Physical data (depth and physical sediment characteristics) were used to verify removal initially. Sediment samples for PCB analysis were not collected until 4 yrs after dredging.

† Value was calculated from other parameters provided in the reference.

### References

