Randle Reef
Sediment Remediation Project
Hamilton, Ontario, Canada

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Environment Canada

October 25, 2012
Hamilton Harbour

Canadian and U.S. Areas of Concern in the Great Lakes–St. Lawrence River Basin

Legend:
- Canadian AOCs
- Delisted Canadian AOCs
- Canadian Areas in Recovery
- Binational AOCs
- U.S. AOCs
- Delisted U.S. AOC
- U.S. Area in Recovery
Randle Reef Sediment Remediation Project
Hamilton Harbour, Lake Ontario, Canada
Randle Reef Site Specifics

- Impacted by historic operation of coal gasification plant and steel operations;
- Approximately 675,000 m$^3$ of contaminated sediment (PAHs & metals); and
- Average total PAH concentration near 5,000 ppm with peaks over 73,000 ppm.

- **Site Area:** ~60 ha (148 acres)
- **Depth of Water:** Ranges from ~4 m to 12 m
- **Sediment Depth:** Ranges from ~0.1 m to >3 m
Basic Project Design

- Construct a 7.5 hectare (18.5 acres) **Engineered Containment Facility (ECF)** over the most highly contaminated sediment (130,000 m³ *in-situ*);

- Using primarily hydraulic dredging (minor mechanical dredging component), remove 500,000 m³ and place within ECF;
Isolation Structure

• A double steel sheetpile wall with sealed interlocks
Dredging Design

- Dredging Challenges:
  - Dredging of firm clay and volatile management;
  - Finite capacity of the ECF;
  - Dredging offsets from existing dock walls;
  - Residuals management;
  - Dredging prohibitive in one section due to existing structure stability.
Site Specific Clean-Up Criteria

100 mg/kg (ppm) Total PAHs based on the consideration of:

- Background levels of PAHs in the Harbour (30 - 45 mg/kg);
- Average concentrations of PAHs in the Harbour (~68 mg/kg);
- Uncontrollable indirect inputs of PAHs to the Harbour (i.e. vehicular emissions);
- Toxicity data from another similar contaminated sediment site located in Hamilton Harbour as well as Randle Reef itself;
- Other clean-up criteria for PAH-contaminated sediment sites (NOWPARC - Thunder Bay Canada (150 mg/kg), St. Marys River – Sault Ste. Marie (USA) (115 mg/kg)).
Approach to Remediate Sediment

**Priority 1**
Avg [PAHs]=2,000 ppm and toxic

Most P1 sediment is contained within ECF footprint. If not, it is dredged and placed within ECF.

**Priority 2**
[PAHs]>100 ppm and toxic

P2 sediment is dredged and placed within ECF.

**Priority 3**
[PAHs]>100 ppm and not toxic

P3 sediment will be placed in the ECF or capped with a thin-layer of clean sediment.

**Priority 4**
[PAHs]<100 ppm and toxic

P4 sediment left for natural attenuation
Dredging Sequence

Notes:
1. Drawing units are in metres.
2. Bathymetric data are based on the Canadian Hydrographic Service study dated 2002.
3. Historical datum in HN03.
4. Relative Lake Levels and Vertical Datum Conversion.
5. SEAST: Sediment Assessment of Sediment
   TPA: Total PAHs
   SELs: Sediment Effect Levels
   Total PAHs: total concentration of polycyclic aromatic hydrocarbons (mg/kg)
# PAH Mass Distribution

<table>
<thead>
<tr>
<th>Subarea</th>
<th>Priority Designation</th>
<th>Volume (m³)</th>
<th>Average [Total PAHs] (ug/g)</th>
<th>Mass of PAHs for a Subarea (kg)</th>
<th>Percentage of PAHs in a Subarea Compared to the Site (%)</th>
<th>Cumulative Percentage of PAHs (%)</th>
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1. Gravity settling of decant water within the ECF
2. Polymer-assisted settling in a final settling cell (area between the walls)
3. Additional treatment using sand filtration and (GAC) adsorption
4. Discharge to Hamilton Harbour
Dredgeate Management

Dredge - 1,250 m³/hr

Final Settling Cell
(tₘᵟᵣᵦ = 8.5hrs)

Cell 1

Cell 2

To water treatment plant

From polymer tank

Polymer Addition
Isolation Cap Design

US Steel Channel

Accommodates intakes and dock wall stability concerns.

SEDIMENT CAP CROSS SECTION

ORGANOCLAY RCM (NOT TO SCALE)

ARMOR MAT

TRANSITION

ARMORED RCM CAP

55m

3m

105m

ARMORED SAND CAP

61m

GABION STONE

NON WOVEN GEOTEXTILE (NOT TO SCALE)
ECF Multi-layer Cap:

- **Foundation Layer** - provides a stable surface on which to construct the overlying layers;

- **Underliner Drainage System** - critical for the removal of pore water during consolidation and for the control of groundwater upwelling after consolidation;
ECF Multi-layer Cap: Hydraulic Barrier

- Prevents infiltration into the underlying sediments and upwelling of pore water/groundwater into the cap materials.
ECF Multi-layer Cap: Preload

- Total anticipated settlement = 85 - 110 mm
- 30 – 50 KPa crushed rock
- 1 to 1.5 year duration
- Porewater channeled to perimeter collection trenches
- Pumped & treated
ECF Multi-layer Cap: Completed

3 m
ECF Multi-layer Cap: Drainage Systems

- Underliner Drainage
- Overliner Drainage
- Stormwater Drainage
Draft Construction and Cost Schedule

$138.9M

- ECF Construction: $53.5 M
- Dredging/Management: $36.4 M
- ECF Capping + Long Term Monitoring: $49 M

Years 2013 to 2022
Thank-you

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