Long-Term Monitoring of a Thin-Layer Sand Cap in Peninsula Harbour Area of Concern

Ontario

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Environment and Climate Change Canada

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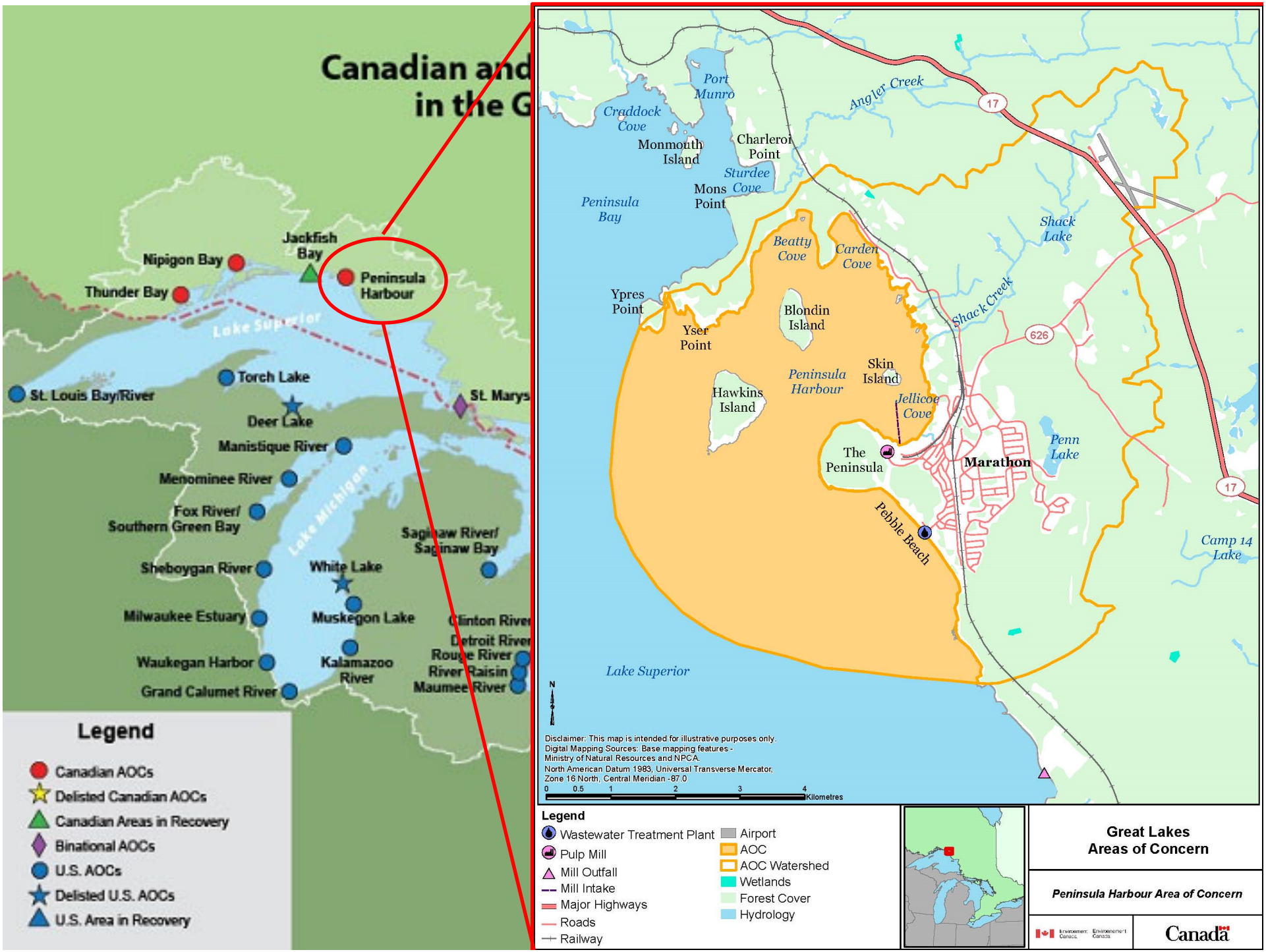

Canadian and
in the G
Jackfish Bay
Nipigon Bay
Peninsula Harbour
Thunder Bay
Lake Superior
Torch Lake
St. Louis Bay/River
St. Marys
Deer Lake
Manistique River
Menominee River
Lake Michigan
Fox River/ Southern Green Bay
Saginaw River/ Saginaw Bay
Sheboygan River
White Lake
Milwaukee Estuary
Muskegon Lake
Clinton River
Detroit River
Rouge River
River Raisin
Maumee River
Waukegan Harbor
Kalamazoo River
Grand Calumet River
Legend
Canadian AOCs
Delisted Canadian AOCs
Canadian Areas in Recovery
Binational AOCs
U.S. AOCs
Delisted U.S. AOCs
U.S. Area in Recovery
Port Munro
Angler Creek
17
Craddock Cove
Monmouth Island
Charleroi Point
Sturdee Cove
Mons Point
Peninsula Bay
Shack Lake
Beatty Cove
Carden Cove
Ypres Point
Blondin Island
Shack Creek
626
Yser Point
Skin Island
Peninsula Harbour
Hawkins Island
Jellicoe Cove
Penn Lake
The Peninsula
Marathon
Pebble Beach
Camp 14 Lake
Lake Superior
N
Disclaimer: This map is intended for illustrative purposes only.
Digital Mapping Sources: Base mapping features - Ministry of Natural Resources and NPCA.
North American Datum 1983, Universal Transverse Mercator, Zone 16 North, Central Meridian -87.0
0 0.5 1 2 3 4 Kilometres
Legend
Wastewater Treatment Plant
Pulp Mill
Mill Outfall
Mill Intake
Major Highways
Roads
Railway
Airport
AOC
AOC Watershed
Wetlands
Forest Cover
Hydrology
Great Lakes Areas of Concern
Peninsula Harbour Area of Concern
Environment Canada
Canada

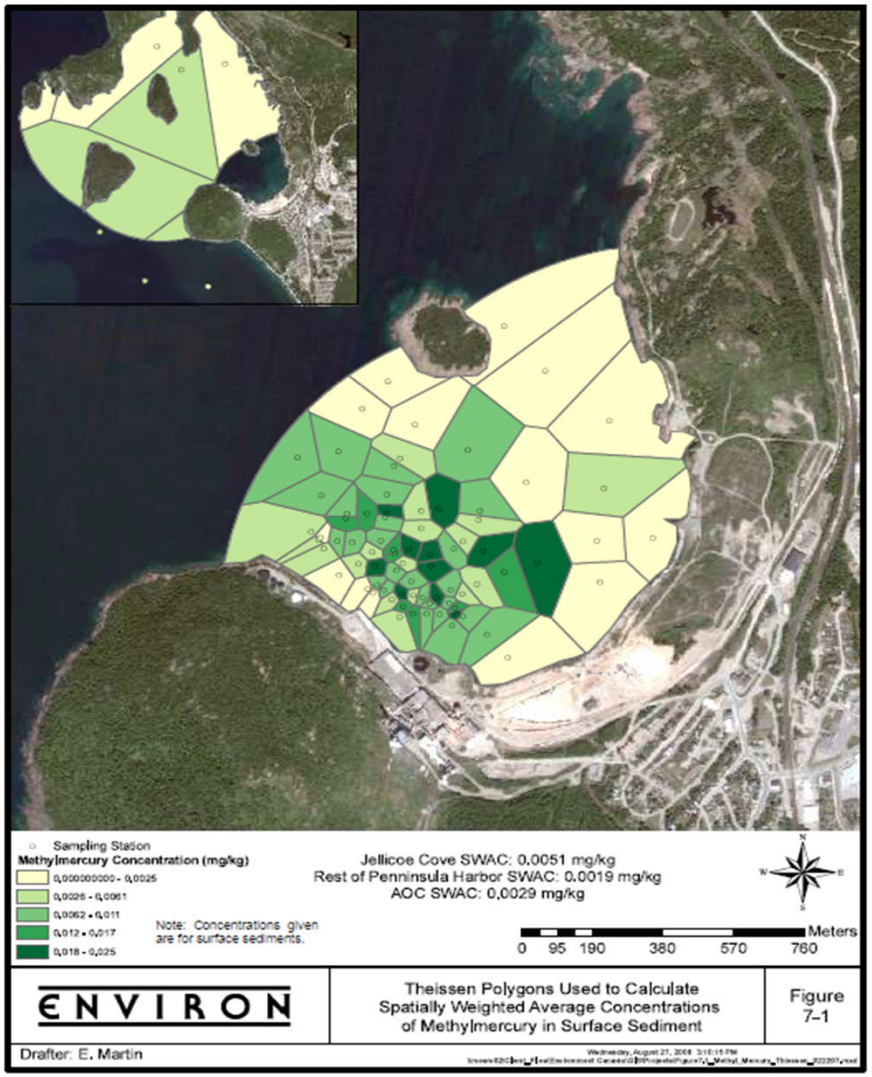
Peninsula Harbour Area of Concern

- COCs: Hg and PCBs
- Environmental degradation due to:
  - pulp mill and chlor-alkali plant;
  - discharge of wastewater from WWTP; and
  - log booming

Remedial Actions

- Cessation of chlorine bleach and chlor-alkali plant
- Treatment of mill effluent
- Treatment of municipal wastewater
- Thin-Layer Sand Cap

Spatially Weighted Average Concentration (SWAC) – MeHg



Selected Management Goal

- Hot-spot management selected:

3 mg/kg total Hg in sediment

- Total Hg:
  - Source of MeHg
  - Rapid analysis and field screening methods
  - PCB hotspots co-located and generally smaller

Thin-Layer Cap Long-Term Monitoring

- LTM monitoring goals:
  - Performance monitoring
    - Cap placement
  - Remedial monitoring
    - Cap effectiveness
  - Ecological recovery
    - Benthic community re-colonization
    - Re-colonization of aquatic vegetation
    - Fish tissue contaminant concentrations

Jellicoe Cove Capping

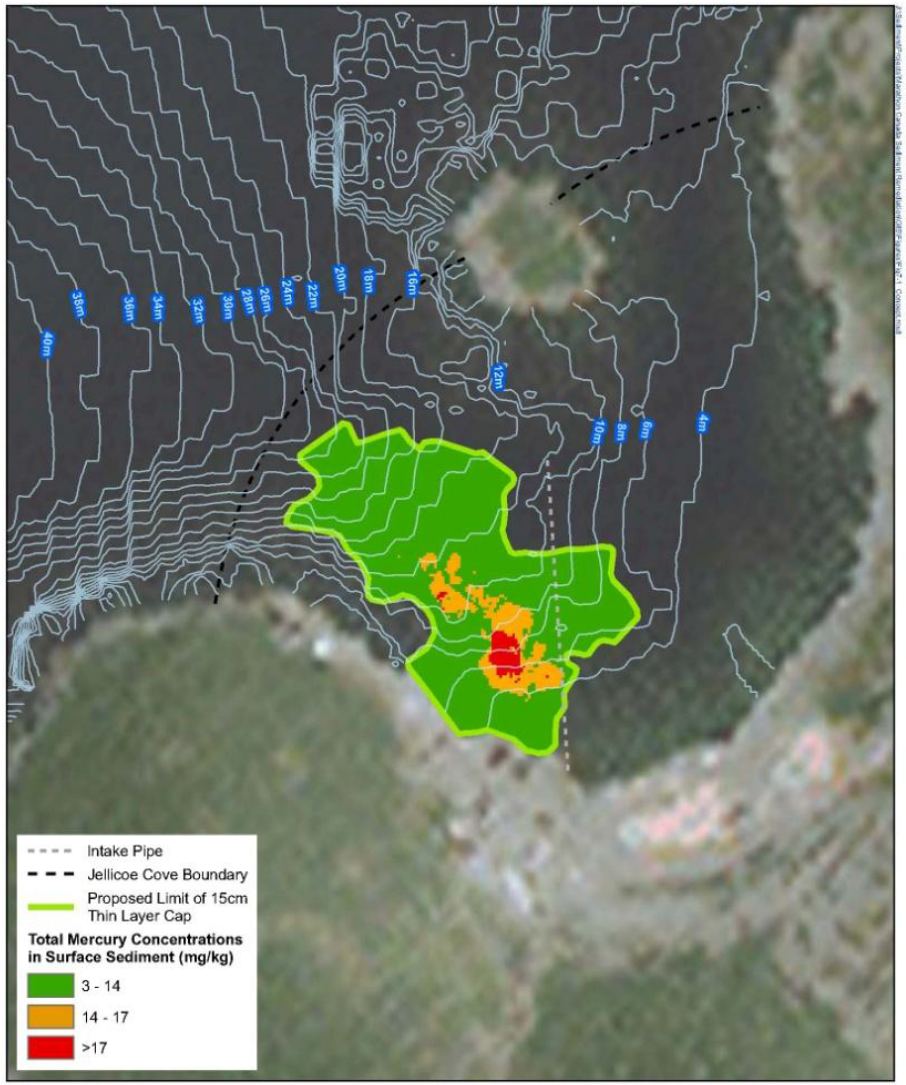
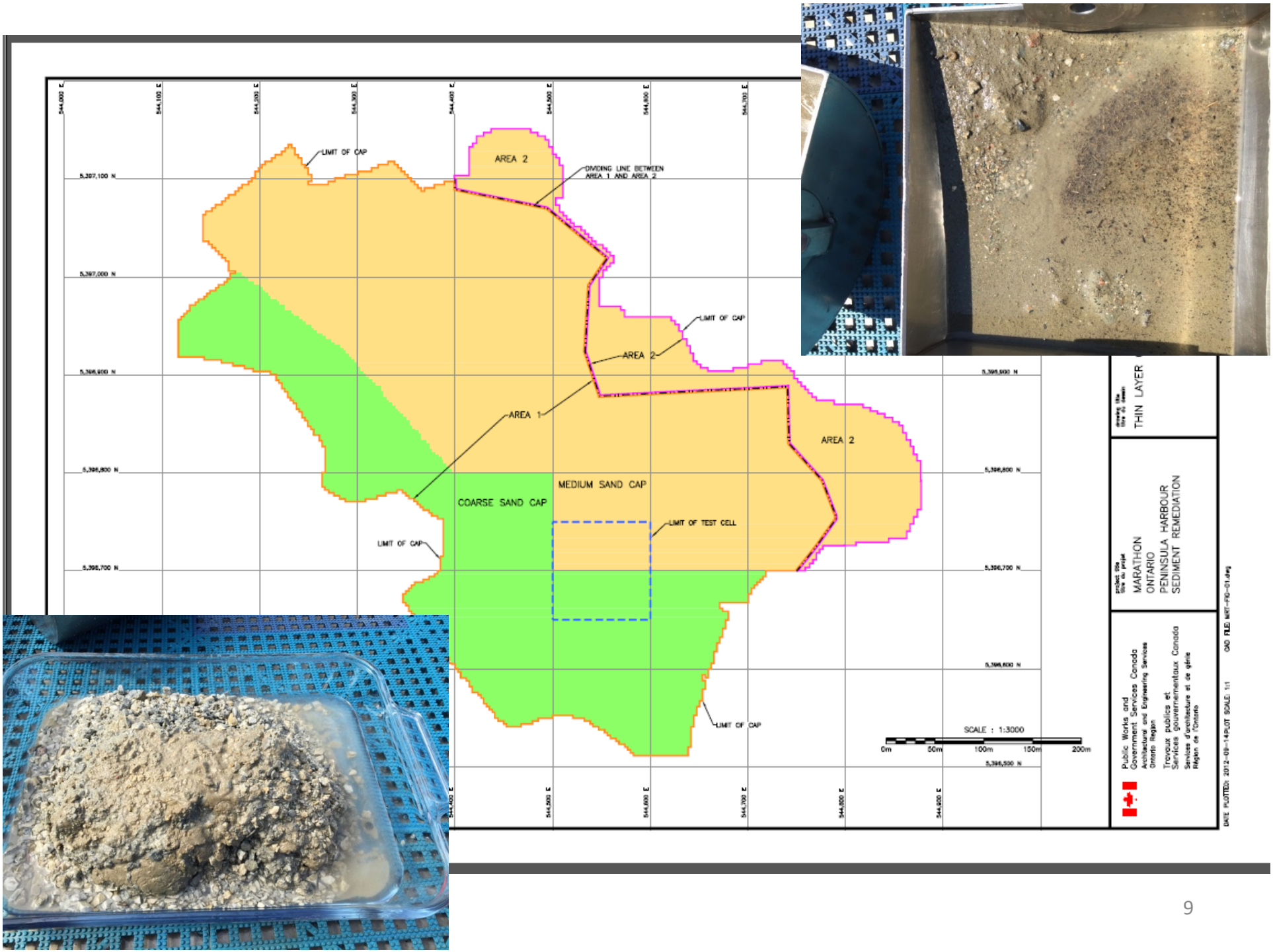
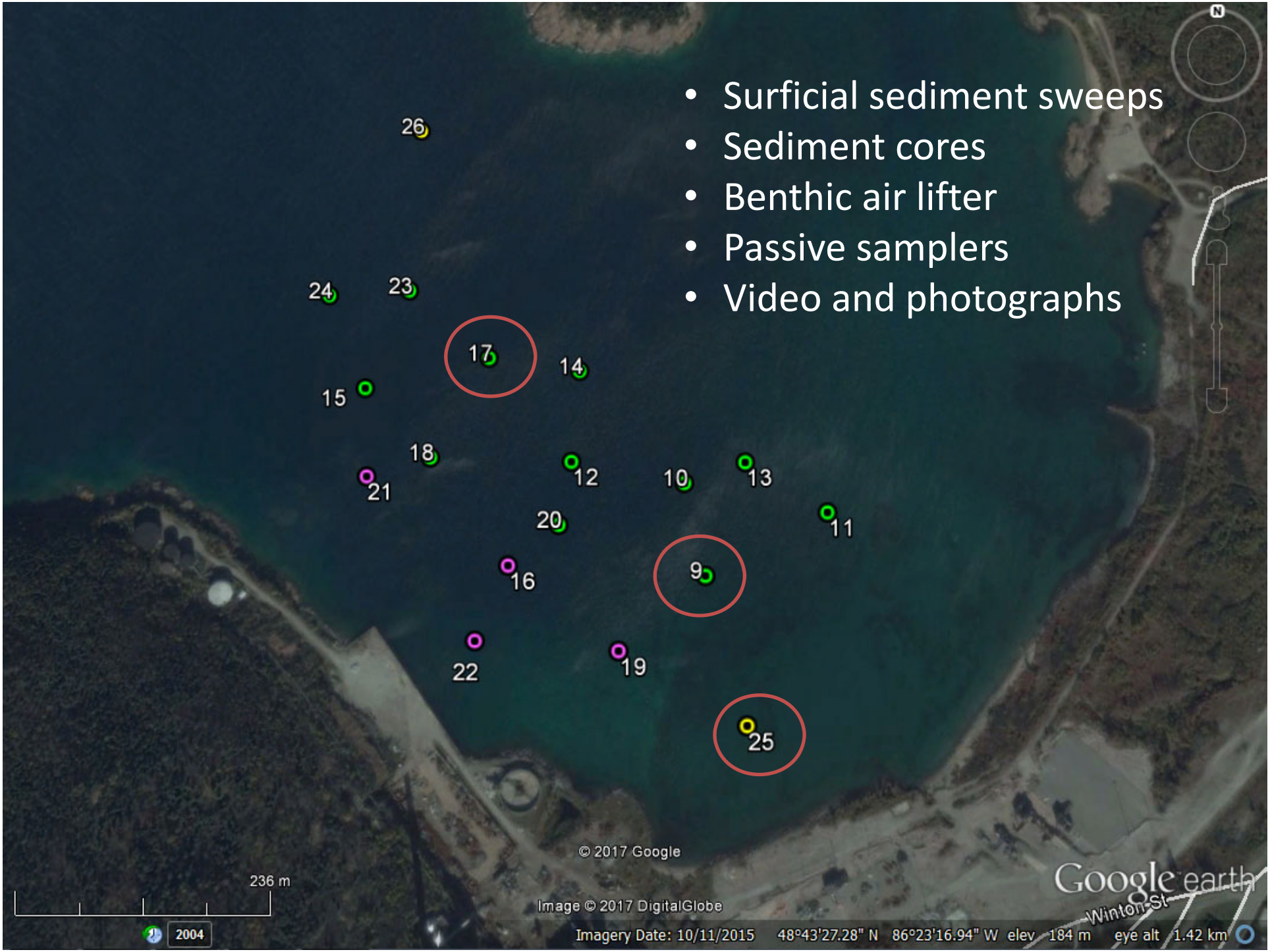


Figure 7-1 Conceptual Plan for Remedial Alternative 1 (Thin Layer Capping)
Marathon Canada Sediment Remediation

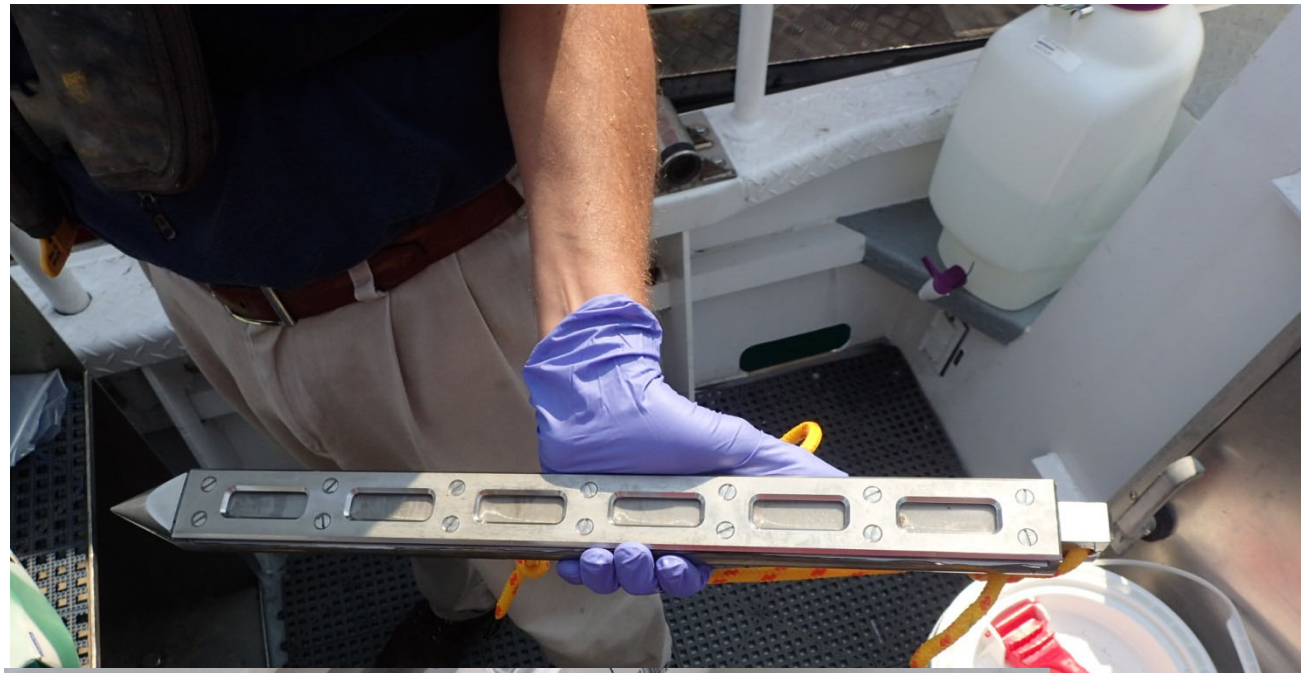
- 15 – 20 cm of sand cap over areas > 3 mg/kg Hg
- coarse and medium sand over 23 hectares


LIMIT OF CAP
AREA 2
DIVIDING LINE BETWEEN AREA 1 AND AREA 2
LIMIT OF CAP
AREA 2
AREA 1
AREA 2
MEDIUM SAND CAP
COARSE SAND CAP
LIMIT OF TEST CELL
LIMIT OF CAP
LIMIT OF CAP
SCALE : 1:3000
0m 50m 100m 150m 200m
THIN LAYER
MARATHON
ONTARIO
PENINSULA HARBOUR
SEDIMENT REMEDIATION
Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

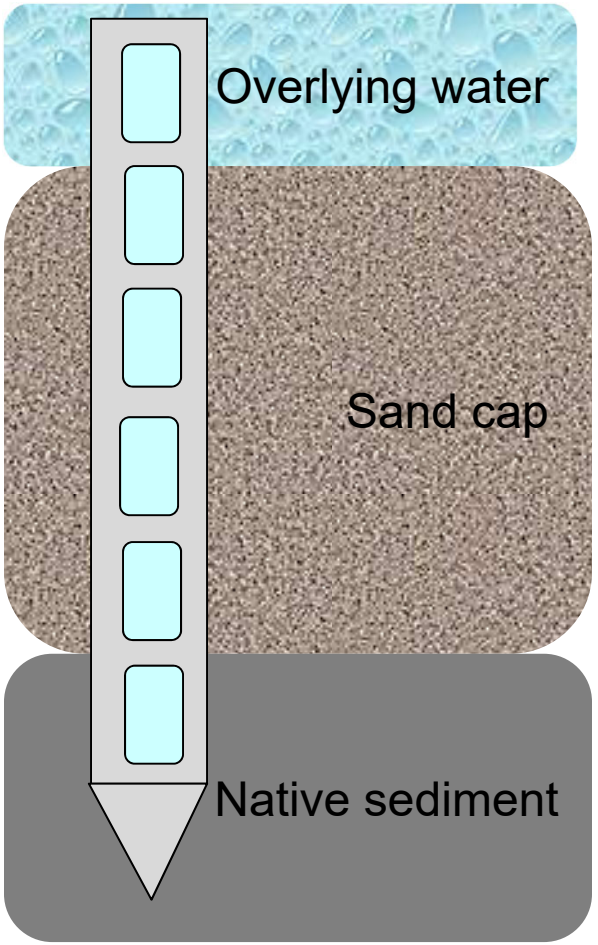


- Surficial sediment sweeps
- Sediment cores
- Benthic air lifter
- Passive samplers
- Video and photographs

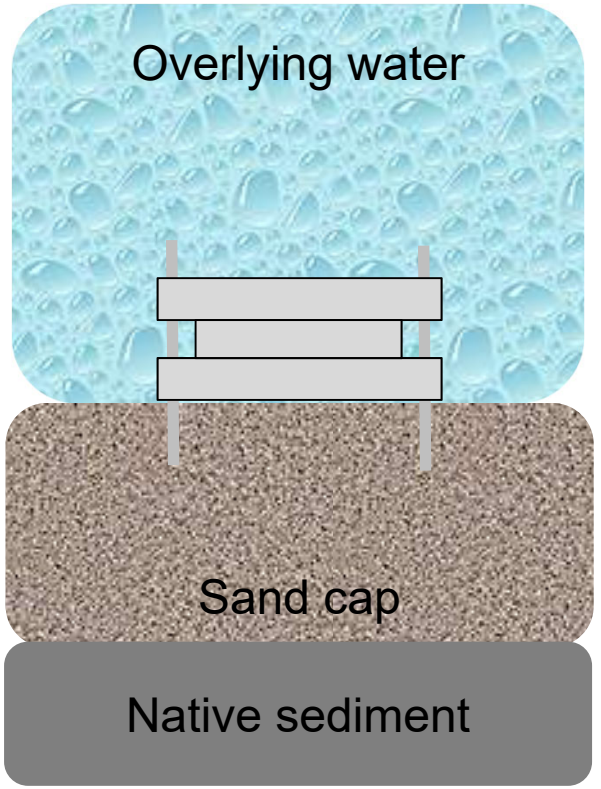
Peepers




NOT FOR PRESSURE
7/12/17
Peeper 1
Br


Overlying water
Sand cap
Native sediment

Horizontal Flux Chambers

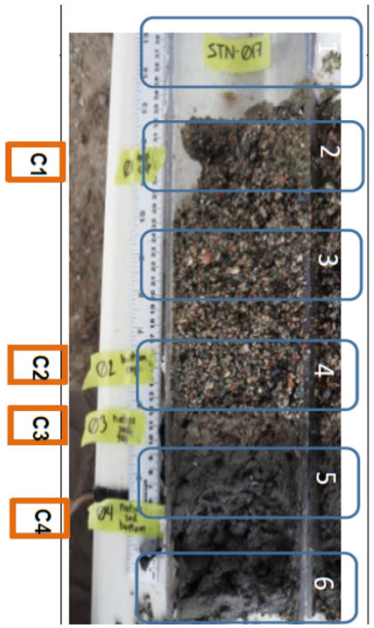


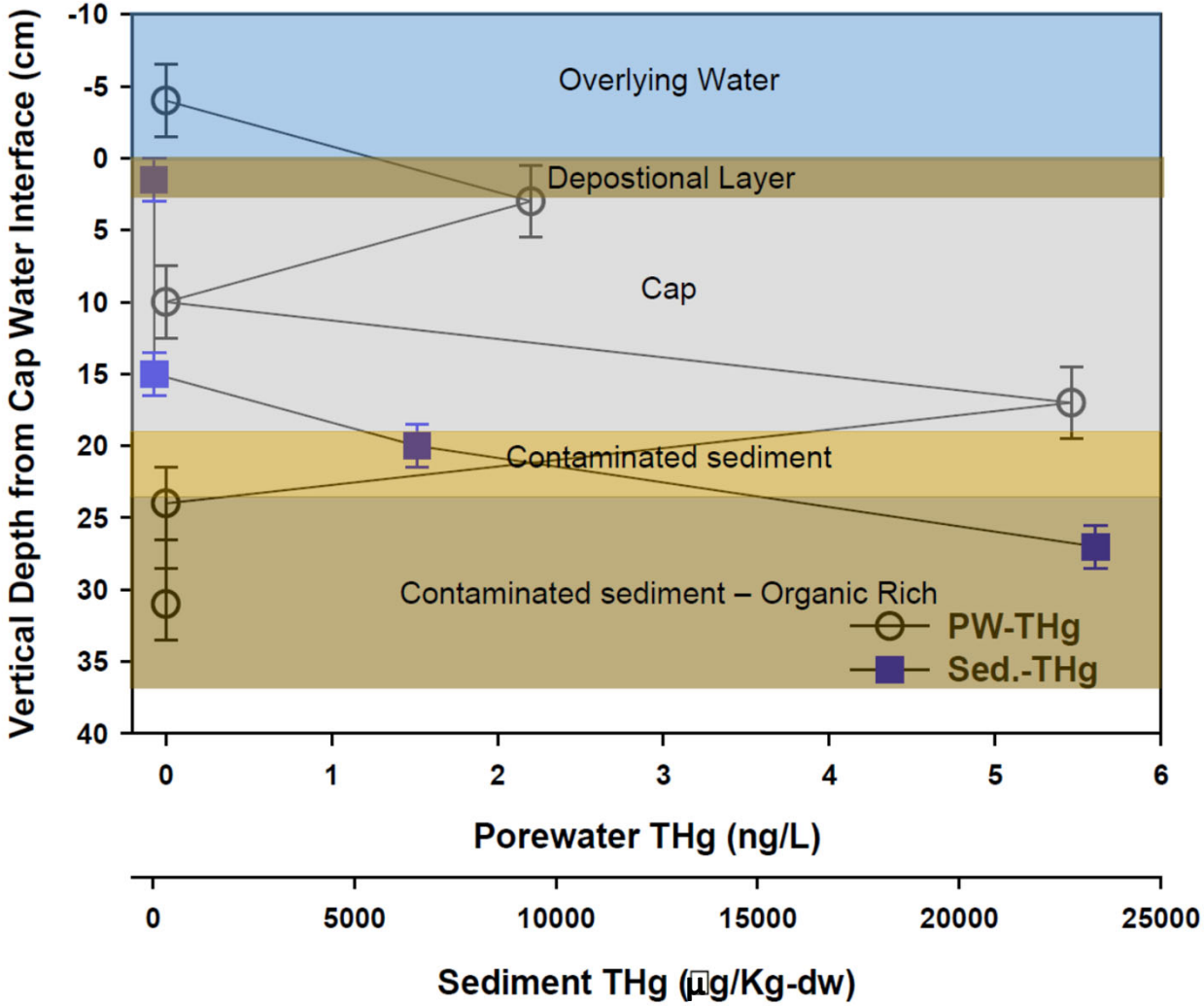
Sediment Cores

General Results

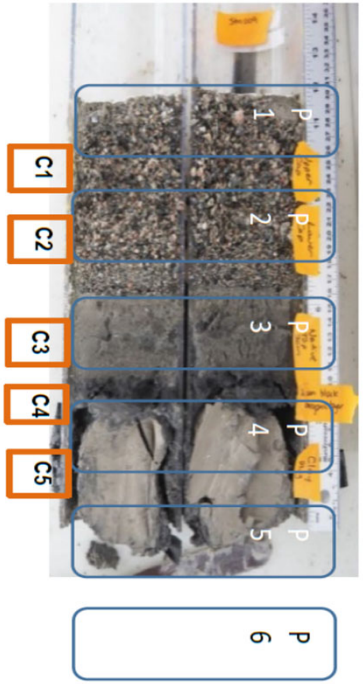
- Cap effectively contained solid phase Hg
- Minimal migration of Hg in porewater
  - 13 of 15 locations porewater Hg ~0 (<4.7 ng/L.. $p<0.05$)
  - Flux
- Deposition of new sediments on surface
  - From area surrounding cap
  - Containing low levels of Hg but > cap material
  - Leading to some recontamination at surface
- Highest concentration/fluxes at surface associated with this redeposition
  - Up to 560 µg/kg and > 15 ng/L in porewater
  - Fluxes up to 60 ng/m^2/day
  - Similar to uncapped location 25 (187 µg/kg and 68 ng/m^2/day)

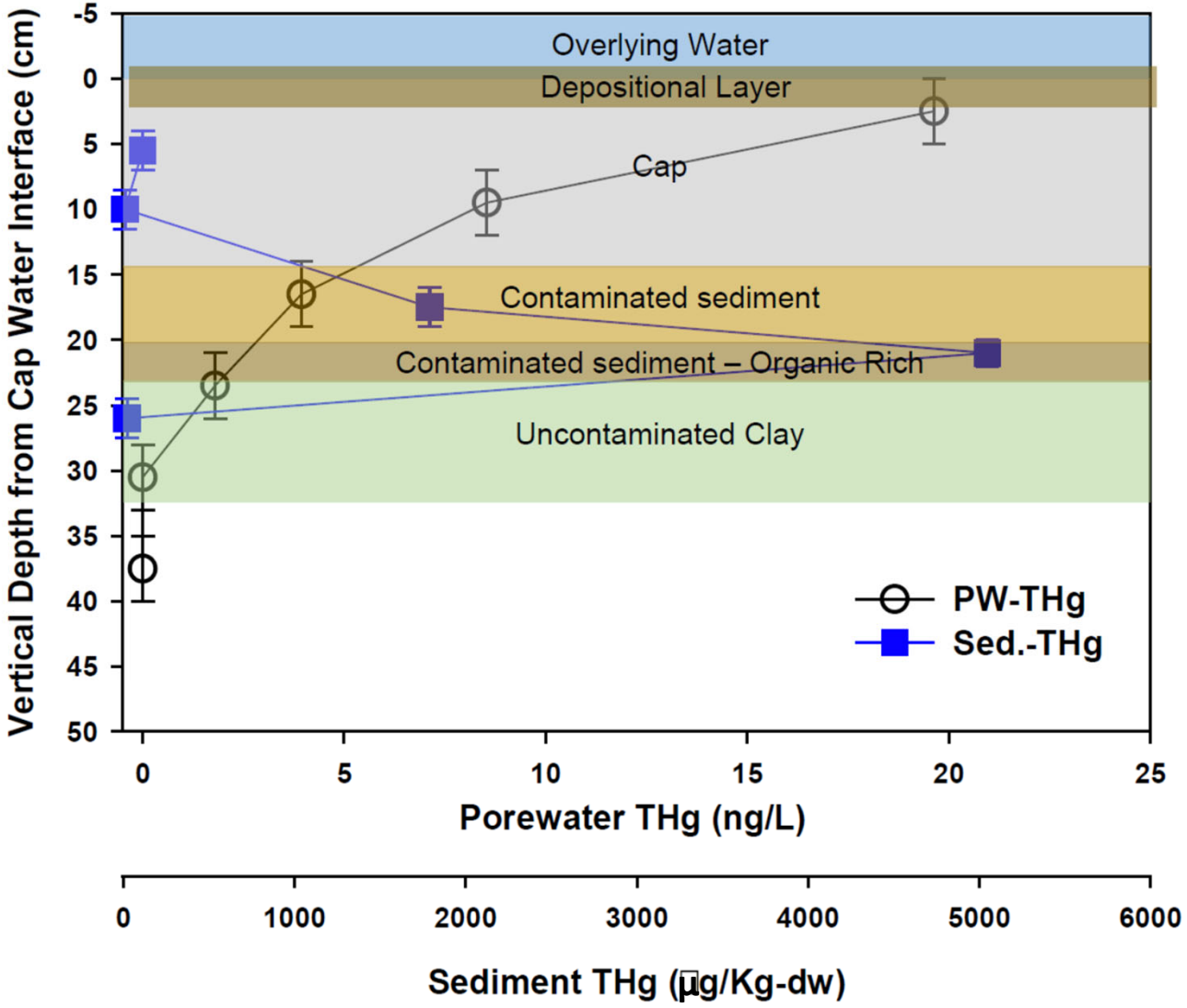
Location 17


C1
C2
C3
C4
2
3
4
5
6

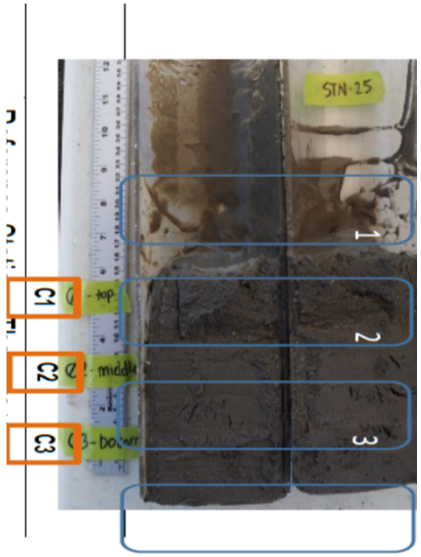

Overlying Water
Depostional Layer
Cap
Contaminated sediment
Contaminated sediment – Organic Rich
PW-THg
Sed.-THg
Vertical Depth from Cap Water Interface (cm)
-10
-5
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6
Porewater THg (ng/L)
0
5000
10000
15000
20000
25000
Sediment THg (µg/Kg-dw)

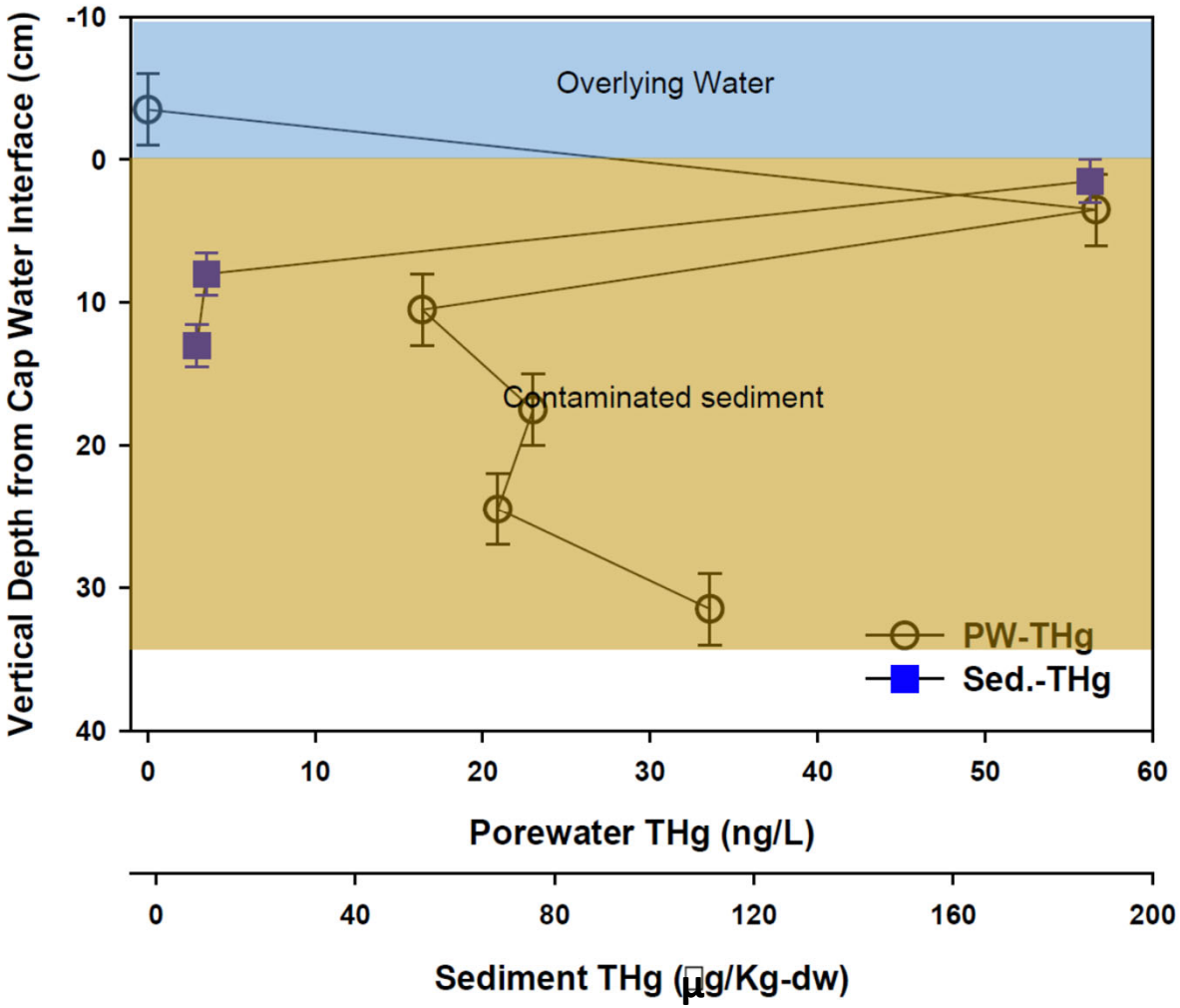
Location 9


C1
C2
C3
C4
C5
P 1
P 2
P 3
P 4
P 5
P 6


Overlying Water
Depositional Layer
Cap
Contaminated sediment
Contaminated sediment – Organic Rich
Uncontaminated Clay
PW-THg
Sed.-THg
Vertical Depth from Cap Water Interface (cm)
-5
0
5
10
15
20
25
30
35
40
45
50
0
5
10
15
20
25
Porewater THg (ng/L)
0
1000
2000
3000
4000
5000
6000
Sediment THg (µg/Kg-dw)

Location 25 (uncapped)





Conclusions

- Sand cap functioning as expected and good containment of Hg
  - MeHg not monitored but burial of Hg contaminated sediment and lack of organic matter in capping layer leaves little opportunity for MeHg flux
- Finite capping area has led to some surficial recontamination
  - Clearly not associated with migration through the cap
  - Recontamination all <<1 mg/kg
- Passive diffusion samplers capable of defining flux and concentration profiles