Hudson River Remedy Part I:
Unremediated PCBs and the Implications for Restoration

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Abstract

The Hudson River PCB Superfund Site encompasses approximately 200 miles from Hudson Falls to the Battery in New York City. The dredging remedy, selected in 2002, was estimated to remove 2.65 million cubic yards of sediments from the upper 40 miles (River Sections 1, 2 and 3) between Fort Edward and the Federal Dam in Troy. Characterization of sediment during remedial design found higher and more widespread PCB concentrations in the surface, and much slower natural recovery than models predicted for the 2002 remedy. The first phase of the remediation dredged 48.3 acres of River Section 1 in 2009 and capping was required for about 36% of the dredged area. Phase 2 remediation will commence in 2011 in River Section 1. Phase 1 and Phase 2 combined will remediate at least 493 acres and remove 95% or more of PCBs from within that footprint. However, 136 acres of surface PCBs exceeding 10 ppm Tri+ (25-30 ppm total) PCBs will remain outside of the dredge footprint, and the average PCB concentration in the surface of River Sections 2 and 3 will be five times higher after remediation than predicted by the 2002 remedy. Our analyses evaluate the degree and extent of contamination remaining outside the areas designated for dredging and the potential for impacts of the current remedy on recovery and restoration of the Hudson River.

Introduction

Remedial design sampling in the Upper Hudson (Figure 1) found higher and more widespread PCB concentration in the surface and much slower natural recovery than models predicted for the 2002 remedy.

Average post-remediation surface sediment concentrations will be five times higher in River Section (RS)2 and RS3 than EPA anticipated when developing the ROD (Field et al 2009).

In December 2010, GE agreed to perform the second phase of dredging in the Upper Hudson River. According to EPA, "Phase two will require GE to remove an estimated 95 percent or more of PCBs from the areas designated for dredging." (EPA 2010).

The focus of this presentation:

- What will remain in the surface sediment outside of areas designated for dredging?
- What are the potential impacts of these unremediated PCBs on restoration and recovery of the river?

Methods

Surface sediment concentrations represent the concentration in the top 12 inches (EPA 2004).

Calculation of average concentrations by river section before dredging: Most remedial design data (NOAA 2010) were collected using a systematic grid design. River section average sediment PCB concentrations were calculated as the arithmetic average of surface sediment concentrations (n=8884). For River Sections 2 and 3, most of the cores were collected from fine-grained sediments.

Calculation of estimated post-dredging PCB average concentrations: Cores within the remedial design dredge footprints (GE 2005, GE 2007) were assigned surface sediment Tri+ PCB and total PCB concentrations of 0.25 ppm and 0.5 ppm, respectively, and averages for each river section were re-calculated.

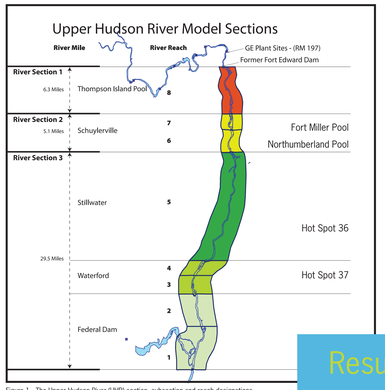

Figure 1. The Upper Hudson River (UHR) section, subsection and reach designations.

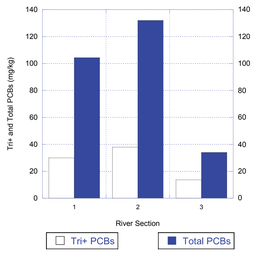

Figure 2. Pre-dredging average Tri+ and Total PCB concentrations (mg/kg) in surface sediment by river section. Target cleanup level for surface is 10 mg/kg Tri+ PCB in River Section 1 and 30 mg/kg Tri+ PCB in River Sections 2 and 3.

Table 1. Target cleanup levels for the Upper Hudson River (EPA 2002).

River Section 1 (Reach 8: Thompson Island Pool):

3 g/m^2 Tri+ PCBs[1] Mass per unit area (MPA)

10 mg/kg Tri+ PCBs in surface sediment (in top 12 inches)

(~ 25-30 ppm total PCBs)

River Sections 2 & 3 (Reaches 1-7)

10 g/m^2 Tri+ PCBs MPA

30 mg/kg Tri+ PCBs in surface sediment (~ 60-90 ppm total PCBs)

[1]Tri+ PCBs: sum of trichloro- through decachlorobiphenyl PCBs

Results

Average surface PCB concentrations pre-remediation in RS1 and RS2 are comparable and exceed 100 ppm total PCBs (Figure 2).

The cleanup levels for RS2 and RS3 are three times higher than for RS1 (Table 1). As a result, estimated post-remediation surface PCB concentrations will be greatly reduced in RS1, but not as much in RS2 and RS3 (Figure 3).

Many of the RS2 and RS3 cores with concentrations exceeding the surface criterion for RS1 (10 ppm Tri+ PCB) are within 200 feet of the Phase 2 areas designated for dredging (Figures 4-7).

Using the surface criterion for RS1 throughout the Upper Hudson would result in comparable surface concentrations (Figure 3) and capture efficiencies in all three river sections (Table 2). Applying the surface criterion for RS1in RS2 and RS3 would require dredging approximately an additional 136 acres (Table 3).

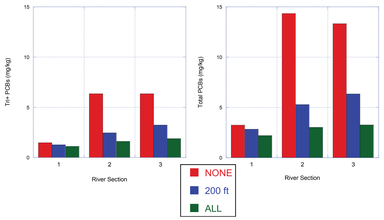

Figure 3. Post-dredging estimated average Tri+ and Total PCB concentrations (mg/kg) in surface sediment by river section under three scenarios: 1) current remedial design; 2) additional removal of cores with surface Tri+ concentration exceeding 10 ppm that are within 200 feet of existing dredge areas; 3) additional removal of all cores with surface Tri+ PCB concentration exceeding 10 ppm.

River Section 2

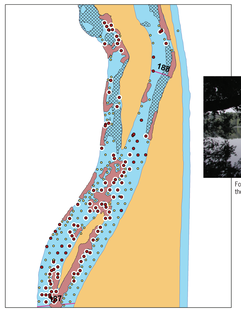

Figure 4. Map of the Upper Fort Miller Pool (River Section 2, river mile 187-8) showing cores outside of Phase 2 dredge prisms that exceed 10 ppm Tri+ PCB (red circles) and are within 200 feet of dredge prism boundary (red circles with white halo).

Fort Miller Pool (river reach 7) in the vicinity of Thompson Island.

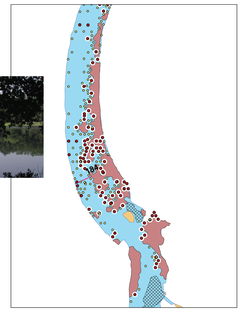

Figure 5. Map of the Northumberland Pool (River Section 2, river mile 184) showing cores outside of Phase 2 dredge prisms that exceed 10 ppm Tri+ PCB (red circles) and are within 200 feet of dredge prism boundary (red circles with white halo).

River Section 3

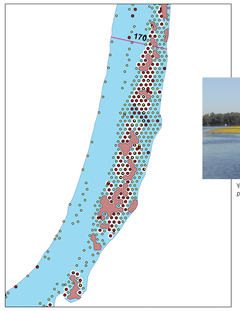

Figure 6. Map of area in the vicinity of Hot Spot 36 (River Section 3, river mile 170) showing cores outside of Phase 2 dredge prisms that exceed 10 ppm Tri+ PCB (red circles) and are within 200 feet of dredge prism boundary (red circles with white halo).

Yellow floating heart, Nymphoides peltata, at Hot Spot 36.

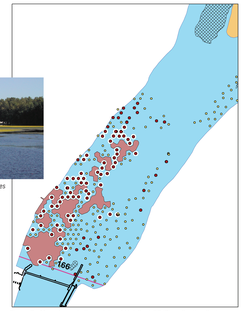

Figure 7. Map of area in the vicinity of Hot Spot 37 (River Section 3, river mile 166) showing cores outside of Phase 2 dredge prisms that exceed 10 ppm Tri+ PCB (red circles) and are within 200 feet of dredge prism boundary (red circles with white halo).

Table 2. Estimated capture efficiency of cores with surface concentrations greater than 10 ppm Tri+ PCBs by River Section based on Phase 1 (GE 2005) and Phase 2 (GE 2007) dredge prisms. Capture efficiency is calculated as the number of cores with surface concentration exceeding 10 ppm Tri+ PCB removed divided by the total number of cores with surface concentration exceeding 10 ppm Tri+ PCB.

	Capture Efficiency of Cores with Surface Tri+ PCBs > 10 ppm	
River Section	Current Dredge Area Delineation	Removal of Additional Cores Within 200 feet
1	0.97	0.99
2	0.64	0.94
3	0.45	0.84

Table 3. Estimated number of acres and post-remedial surface Tri+ PCB concentrations based on additional removal of cores outside of the current Phase 2 dredge prisms exceeding the River Section 1 surface criterion.

River Section	Total Number of Acres Outside Dredge Prisms with Surface Tri+ PCB >10 ppm		Estimated Tri+ PCB (ppm) in Surface Following Additional Removal of Cores with Surface Tri+ PCB >10 ppm		
	Cores within 200 ft of Dredge Prism	All Cores Outside Dredge Prism	Cores within 200 ft of Dredge Prism	All Cores Outside Dredge Prism	No Additional Removal
RS2	37	45	2.5	1.6	6.4
RS3	62	91	3.2	1.9	6.4

Note: Basis for the acreage estimate: one core=1-/8 acre from E. Garvey personal communication 2010. Surface PCB concentrations as defined by EPA (2004).

Impacts on Recovery and Restoration

Recovery of the Upper and Lower Hudson River will be delayed longer than anticipated in the 2002 ROD due to elevated PCBs remaining in the surface sediment – equivalent to a series of Superfund-caliber sites being left behind.

The majority of the elevated post-construction sediment concentrations are adjacent to planned dredge areas. This will result in the high likelihood of remediated areas becoming recontaminated.

Appropriate restoration of injured natural resources under the Natural Resource Damage Assessment (NRDA) process, should take place where those resources were most impacted. The magnitude of contamination remaining post - dredging likely will make this infeasible, and restoration projects may need to be located further from the site of injury.

Restoration of the Hudson could be significantly accelerated through additional remediation of highly contaminated surface sediments adjacent to currently delineated dredge areas. Failure to remediate those sediments will eliminate significant opportunities for restoration of natural resources in precisely those locations where it would be most valuable.

References

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