Hudson River Sloop Clearwater
Natural Resources Defense Council
Riverkeeper
Scenic Hudson
Arbor Hill Environmental Justice Corp.
Clean Ocean Action
Hudson River Fishermen's Association, New Jersey Chapter
W. Haywood Burns Environmental Education Center

April 26, 2010

David King, P .E.
USEPA Hudson River Field Office
421 Lower Main St
Hudson Falls, NY 12839

RE: Comments on EPA and GE Phase I Evaluation Reports

Dear Mr. King:

Hudson River Sloop Clearwater, Natural Resources Defense Council, Riverkeeper and Scenic Hudson, supported by Arbor Hill Environmental Justice Corp., W. Haywood Burns Environmental Education Center, Clean Ocean Action, and Hudson River Fishermen's Association New Jersey Chapter submit the following, provisional comments on the Environmental Protection Agency's (EPA) and General Electric's (GE) March 2010 Phase 1 Evaluation Reports (the "EPA Report" and "GE Report," respectively), for consideration by the Engineering Performance Standards (EPS) Peer Review Panel. Attached to and referenced throughout this letter is a review of the EPA Report and GE Report we commissioned by an independent expert, Dr. Frank Bohlen. Dr. Bohlen's written review (cited herein as "Bohlen Memo") forms the basis for many of the recommendations set forth below.

We note that EPA's delay in releasing certain key reports has, so far, left us unable to consider possibly crucial data relating to many of the issues addressed by our comments. Therefore, we will offer additional, substantive comments after the forthcoming supplement to the EPA Report (the "EPA Addendum") is released. We reserve the right to modify anything presented in these comments, to the extent necessary to account for new information or analyses provided in the EPA Addendum.

Most importantly, we believe that all parties concerned with a successful project outcome must never lose focus on the endgame — the remediation action objectives outlined in the landmark 2002 Record of Decision (ROD). You will note, therefore, that our comments address the EPS, but with the constant reference to achieving those goals.

INTRODUCTION

The EPS — residuals, resuspension and productivity — were intended to provide technical requirements and operational guidelines for the duration of dredging operations and were carefully constructed to allow the EPA and GE flexibility in achieving firmly established remediation objectives. As summarized by EPA in a March 2009 fact sheet (titled "General Overview EPS") the remedial objectives established in the ROD are as follows:

- Diminish PCB levels in sediments in order to reduce PCB concentrations in river water that are above water quality standards.
- Reduce cancer risks and noncancer health hazards to people who eat fish from the Hudson River by reducing the concentrations of PCBs in fish.
- Lower the risks to fish and wildlife by reducing the concentrations of PCBs in fish.
- Reduce the quantity (mass) of PCBs in sediments that may be consumed by fish and wildlife.
- Minimize the long-term movement of PCBs downriver.

Execution, evaluation, and monitoring of the cleanup is governed by the ROD, in which EPA selected the dredging remedy and defined the general rules governing it, and the Consent Decree (CD), whereby General Electric took responsibility for designing and implementing the selected remedy, pursuant to stringent EPA oversight. As provided by the ROD, the Engineering Performance Standards (EPS) developed for and applied during Phase 1 are now being examined, prior to beginning Phase 2. "The information and experience gained during the first phase of dredging will be used to evaluate and determine compliance with the performance standards. Further, the data gathered will enable the EPA to determine if adjustments are needed to operations in the succeding phase of dredging or if performance standards need to be reevaluated."[1]

Unfortunately, EPA's and GE's evaluations of Phase 1 have resulted in two equally complicated and difficult reports that outline vastly different conclusions for many aspects of the first season of dredging.[2] In order to more accurately assess the "performance" of the performance standards, we reviewed the purpose of the EPS as established by the ROD .

The ROD provides that the EPS:

- "will be enforceable, and based on objective environmental and scientific criteria. The standards will promote accountability and ensure that the cleanup meets the human health and environmental protection objectives of the ROD";[3] and
- "will ensure that dredging operations are performed in the most efficacious manner, consistent with the environmental and public health goals of the project."[4]

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[1] ROD Sec. 13.1, p. 97.

[2] *See generally* Bohlen Memo at 2.

[3] ROD Sec. 13.1, p.95.

[4] ROD Sec. 11.5, p. 85.

Although not always comprehensible in EPA's and GE's contradictory reports, it is clear from the information collected during Phase 1 of the dredging project – especially the fact that so much more contamination was discovered than was believed to be present in the targeted dredging areas – that the removal of PCBs to targeted cleanup levels is even more essential than originally believed. We believe the scientific and technical expertise exists within GE and EPA to remove these PCB-contaminated sediments, as they now plan for Phase 2 of the cleanup. The long-term benefits to the whole Hudson River system – the ecology, the economy, and public health – are dependent on GE and EPA utilizing this expertise going forward.

With the above considerations in mind, we offer the following comments on each of the 3 EPS. For each of the standards, we provide a brief summary of issues and observations to provide context; highlight key differences between the EPA Report and GE Report; and provide recommendations for Phase 2, aimed at better addressing critical challenges the project experienced in Phase 1. As to the inter-relationships among the standards, we emphasize that, consistent with the goal of achieving the ROD's remedial objectives of protecting public health and the environment, the productivity standard should be subservient to the goals of minimizing sediment resuspension and remobilization, limiting residual sediment left in the river, and maximizing the river's *long-term recovery* to full health.[5] Productivity should not be an arbitrary standard that prevents the successful application of an adaptive management approach to fully achieve remedial objectives.

I. RESUSPENSION STANDARD

A. Summary of the Issue and Observations

The Engineering Performance Standard for Dredging Resuspension "is designed to limit the concentration of PCBs in river water, such that water supply intakes downstream of the dredging operations are protected, and the downstream transport of PCB-contaminated dredged material is appropriately constrained."[6] Further the EPS determined that "a routine water quality monitoring program will be implemented to verify that the objectives of the Resuspension Standard are met during dredging."[7] The Resuspension Standard as stated, was to be applied in Phase 1 and based upon experience, revised as necessary in Phase 2.[8]

Due to the use of the Hudson as a drinking water supply by certain communities, a central component of the Resuspension Standard correlates directly to the federal drinking water standard of 500 nanograms per liter (ng/L) or 500 parts per trillion (ppt). As a precaution to prevent exceedances, a Control Level of 350 ng/Lwas set, which, if exceeded, would trigger consideration of additional mechanisms to prevent resuspension. Water samples were taken at Halfmoon and Waterford Water Intakes, as well as in Poughkeepsie. As expected, PCBs in the

[5] Following review of the forthcoming EPA Addendum, we anticipate being able to address, in more detail, the issue of the remedy's effect on long-term recovery on how it relates to review of the existing EPS.

[6] EPA Engineering Performance Standards, 2004; v. 2, p. 4.

[7] *Id*.

[8] *Id.* v.1, p.37.

water column were elevated above baseline during dredging. EPA reports that PCB concentrations at the Far-Field Monitoring stations at Thompson Island, Lock 5, Stillwater, and Waterford exceeded the drinking water standard of 500 ppt on three occasions in 5 months and resulted in three work stoppages.[9]

Additional components of the Resuspension Standard are the PCB "Load" criteria,[10] which reference the amount of PCBs resuspended and available to move downstream. The Load criteria were anticipated to be adjusted based on final project design and were based on the recognition in the ROD that "[a]lthough precaution to minimize resuspension will be taken, it is likely that there will be localized temporary increases in suspended PCB concentrations in the water column and possibly on fish PCB body burdens."[11]

Initially, the ROD projected a cumulative load of total PCBs to the Lower Hudson during the dredging project of approximately 650 kg (approximately 1% of the total mass of 70,000 kg of PCBs to be removed), or 65 kg in Phase 1, which was thought to be 10% of the project. However, the Remedial Design, developed several years later, indicated that 18% of the mass would be removed in Phase 1, and the Phase 1 Load Control was revised to 18% of 650 kg, or 117 kg for Total PCBs (TPCB) and 39 kg for Tri+ PCB.[12] The daily average of 600 g/day in Phase 1 was revised proportionally to 1,080 g/day TPCB and 361 g/day of Tri+ PCB as Far-Field Control Levels, based on the revised anticipated PCB mass removal.[13]

The Baseline load to the River refers to that amount which was average in pre-dreding conditions; measurements taken from 2004 through 2008 determined that the average or baseline pre-dredging load was 137 kg per year, with a spike of 364 kg in 2006. EPA calculated that in 2009 the dredging caused an additional 151 kg over baseline, for a total of 288 kg.[14]

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[9] EPA Report at ES-3.

[10] EPA considered and modeled PCB Loads when selecting the dredging remedy, "REM-3/10/Select," and compared the remedy load calculations to that which would occur with natural attenuation. Specifically, in the 2002 ROD, the agency noted that "[b]y greatly reducing the mass of PCBs in the surface sediments, the selected remedy will also reduce the long-term transport of PCBS from each River Section to the next and from the Upper Hudson to the Lower Hudson River." EPA projected that these permanent reductions would lead to at least a 38% reduction of the PCB load that is transported to the Lower Hudson in the 10 years following the remedy as compared to MNA alone (with upstream sources control). ROD Section 14.4, pp. 106-08.

[11] ROD Sec. 11.5, p. 85; *see also* EPA EPS v.2, p. 50.

[12] EPA Report at I-9. (Tri+ PCB refers to the sum of concentrations of cogeners with 3 or more chlorine atoms, which tend to be more hydrophobic and more toxic than mono- or di-chlorinated biphenyls.)

[13] EPA Report at Intro 9. EPA notes that the load criteria were not revised again however, to address the larger than planned PCB mass removed.

[14] It is also important to note that baseline loads are declining more slowly than forecast with the gap between actual and forecast baseline loads widening over ten years from 1998 to 2008. Forecast load over this 10-year period increased from the original pre-ROD modeled prediction of 2,200 kg by 1,800 kg to 4,000. According to EPA's PowerPoint presentation to the Peer Review Panel (slide 20), due to the slow decline, the amount observed by 2008 was 2.5 greater than the model would have predicted for this year. Furthermore, the observed baseline loads to the Lower Hudson prior to dredging were substantially greater than the model forecast and EPA now predicts that over 25 years the loads to the Lower Hudson River under MNA will be substantially greater than those forecast by the model by approximately 6,000 kg over 25 years. See EPA Report at I-14.

Measurements of PCBs in the water column were taken at Fort Edward (grab sample), Thompson Island (24-hr composite), Lock 5 at Schuylerville (24-hr composite), Stillwater (grab sample), Waterford (24-hr composite) and Cohoes (grab sample -- to assess the impact of the Mohawk), with additional grab samples in Albany and Poughkeepsie in the Lower Hudson. NYS Department of Health also monitored water quality at Port Ewen, Rhinebeck and Poughkeepsie, where the Hudson River supplies municipal drinking water.

Elevations in load were measured throughout the dredging season decreasing downstream from the work areas. EPA reports that most of the exceedances of the 1,080 g/day control level were measured at Thompson Island, fewer at Lock 5, and rarely at Waterford. Even at Thompson Island the estimated PCB load above baseline was relatively small – 440 kg, or just over 2 percent of the 20,000 kg removed. It is believed that most of the sediment that was resuspended settled out before being transported downstream to an area that will not be remediated under the remedy selected in the ROD. Elevations in water column concentrations at all far-field monitoring stations decreased rapidly to pre-dredging baseline after dredging ended on October 27.[15] EPA reports that samples taken at Albany and at Poughkeepsie showed no observable impacts of dredging to Tri+ PCB water column concentrations downstream of Waterford.[16]

The Bohlen Memo as well as EPA's and NYS DEC's analyses of Phase 1, indicate that the first season of dredging was complicated by several factors that influenced resuspension, including the following:

- Higher than average precipitation resulted in markedly increased quantity, velocity and force of river flow.

- Far more woody debris at the bottom of the river than expected was encountered which increased the difficulty removing inventory and masked large reservoirs of contaminants. This was also a major cause of the inaccuracy of depth of contamination (DoC).

- Inaccurate DoC led to multiple dredging passes, which increased resuspension.

- Non-aqueous Phase Liquid (NAPL) – raw PCB oil – was released at work sites and observed as atypical oil sheens. EPA has stated in various public fora that these sheens contained high concentrations of PCBs that were difficult to remove from the river system and that hey did not respond well to commonly used absorbent materials. They rose and resettled, as is typical of NAPL, which is heavier than water. PCB-bearing oils were thought to contribute to exceedances of the drinking water standard of 500 ppt.

- More erosion occurred between the original sampling and the start of project, which added to the amount of PCBs to be removed.

[15] EPA Report at ES-4.

[16] EPA Report at I-4.

- Limited scow availability caused work slowdowns so that CUs were exposed and subject to resuspension by river currents for prolonged periods.

The data show that although the resuspension of PCBs was greater than anticipated, the removal of sediment volume and PCB mass exceeded project goals for Phase 1, and there were no measurable impacts to the Lower Hudson or to fish tissue beyond 2 to 3 miles downstream of the Thompson Island Pool.[17]

B. <u>Basic Differences Between EPA and GE Reports</u>

<u>Resuspension Standard:</u> GE states that the Resuspension Standard cannot be met because as the season moved forward and production rates increased, resuspension standards were exceeded and that this will occur more frequently during Phase 2.[18] EPA notes most of the elevations occurred early in the season during start up and that once they had a chance to address these with GE's contractors, the cumulative mass load as a fraction of the mass removed decreased dramatically then stabilized around the 1% target.[19]

<u>Measurement of PCB concentrations</u>: GE notes that average water column concentrations during dredging of 250 ppt, were 5 times baseline and that at Thompson Island Pool (TIP) they ranged from 200-400 ppt and exceeded the control level of 350 ppt 20% of the time.[20] While this may be true, EPA stressed that conditions were unusually unfavorable, that exceedances of the MCL were rare, and that these exceedances decreased with distance and ceased after dredging ended. EPA and GE differed in their reporting of the number of exceedances of the 500 ppt drinking water resuspension standard, with EPA reporting three instances and GE ten. This was due to the use of different methodologies to determine concentrations. GE's method was based on variable concentrations in different types of sediment, while the EPA method was based on a constant concentration in all sediments. EPA notes that the cumulative loads of Total PCB at Waterford, which is the station of importance with respect to downstream impact, did not exceed 1% of the mass removed during Phase 1 (*i.e.*, 200 kg for Total PCB, and 70 kg for Tri+ PCB.[21]

EPA is recommending that Waterford become the single station for compliance with the Performance Standards for resuspension since the purpose is to minimize loads to the Lower Hudson.[22] Similarly, EPA is recommending that exceedances of 500 ppt trigger operational changes, but not necessarily a shutdown, because Waterford and Halfmoon use an alternative of drinking water. They would also maintain the control level of 350 ppt for discretionary use by EPA.

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[17] EPA Report at ES-2.

[18] GE Report, at ES-5.

[19] Hudson River PCBs Site, EPA's Phase 1 Evaluation PowerPoint Presentation to the Peer Review Panel, slide 24, Feb. 17, 2010.

[20] GE Report, at ES-16.

[21] EPA Report at IV-4.

[22] EPA Report at ES-11.

EPA is also recommending constructing an additional sampling station at Stillwater for 24-hr. composite samples, and changes in near and far-field solids criteria, while maintaining the seven-day averaging period for daily loads.

Calculation of Load: We withhold comment on the differences between EPA's and GE's calculations of the downstream flux until we have had an opportunity to review the forthcoming EPA Addendum.

C. Challenges and Recommendations[23]

Challenge: **Inaccurate pre-dredging characterizations of DoC led affected dredging operations in several ways that contributed to increased resuspension.**

Recommendations:

Reduce inaccuracy of DoC by performing targeted additional coring prior to Phase 2. For the reasons detailed in the Bohlen Memo (p.4), we recommend that, as part of the Phase 2 design, sediment sampling data from Phase 1 be reviewed, with particular emphasis on locations where probe depth of penetration exceeded the core depth, in order to identify locations for coring to improve the understanding of DoC prior to Phase 2. The more preliminary information can be gained efficiently, especially with regard to locating layers of debris and assessing contaminated sediment that may lie below it, the less the remainder of the project will be confounded by insufficient information related to Depth of Contamination.[24]

Reduce or eliminate "fine grading" and instead use an "overcut" in each pass to remove more inventory. Multiple passes that resulted from the fine grading (3" – 6" cuts) designed into Phase 1 delayed progress and caused significant amounts of resuspension.[25] For the reasons detailed in the Bohlen Memo, we recommend that an overcut of 9 to 18 inches depending on the degree of confidence of the cores for each pass.[26].

Challenge: **Excessive contamination sometimes leaked from the bucket while it was being moved over the water toward the barge.**

Recommendations:

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[23] Note that many of the recommendations in this letter will help address one or more "challenge" identified by the Phase 1 evaluations. In many instances, this is noted explicitly, but there are likely cases of cross-cutting benefits that are not explicitly identified herein.

[24] *See also* NYS DEC, *Hudson River PCBs Federal Superfund Site, Report on Observation from Phase 1 Dredging Oversight, Recommendations for Changes for Phase 2* (NYS DEC Report), at pp. ii, 6.

[25] *See* Bohlen Memo at 11.

[26] *Id*.

Eliminate decanting to the extent possible, including elimination of all intentional decanting. For the reasons detailed in the Bohlen Memo (at 14), we recommend the minimization of decanting to the extent possible, including elimination of all intentional decanting. We also call to your attention NYS DEC's analysis and recommendation on this point: "Each dredge bucket should be lifted and emptied directly into the scow without intentionally pausing to allow the dredge bucket to drain into the river. The process of decanting water from dredge buckets could have been a significant contributor to the near field PCB surface water concentrations, contributing to the exceedances of the project air standards in the dredge corridor."[27]

Consider alternative dredge buckets and/or the use of closure sensors on the clamshell buckets, for use in sediments containing a high fraction of woody debris. For the reasons detailed in the Bohlen Memo (at 12), we recommend consideration of alternative buckets, such as covered excavators, which may be subject to less debris interference; to evaluate this option, field tests should be conducted this year, prior to the start of Phase 2 dredging. In addition, as detailed in the Bohlen Memo (at 12), we recommend the use of a rugged bucket sensor – such as those routinely used for navigational dredging in contaminated areas of the NY/NJ Harbor– to indicate to the operator whether any mechanical bucket has fully closed before it is hoisted. This would allow for precautions to be taken when debris obstructs closure of the bucket, such as efforts to more fully achieve bucket closure before hoisting, and slowing the hoist speed to minimize loss of material whenever a bucket cannot be fully closed due to debris (which is also a standard practice in NY/NJ Harbor).

Challenge: **Non-sediment-bound PCBs were uncovered and contributed to downstream transport of contamination.**

Recommendation: **Add a surface sorbent mat to the containment booms preventatively around all active dredge areas to intercept oil slicks as they occur.** For the reasons detailed in the Bohlen Memo (at 13), we recommend this as a relatively low-cost means to trap additional PCBs and reduce downstream flux. (Careful analysis of the mat contents would also help clarify the character and source of the PCBs in any observed sheens.) We also call to your attention NYS DEC's related recommendation of including in the EPS an "expanded description of the purpose of the specification (to reduce to the extent practical the releases of NAPL to the water column of the river, contributing to increased concentrations in surface water and air)" and "requiring recovery of sorbent materials within 1 day of deployment or when saturated if sooner than one day."[28]

Challenge: **Scow and tug traffic contributed to PCB resuspension, especially in shallow areas.**

Recommendations:

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[27] NYS DEC Report at p. vii.

[28] *Id.* at ES-ii.

Extend capacity of unloading wharf to improve scow availability. EPA reports that "problems at the unloading wharf limited scow availability, which was the single largest factor in lost available dredging time affecting productivity."[29] This meant work areas were open to resuspension longer than necessary. NYS DEC recommends that "the Phase 2 design should include installation of redundant offloading and processing equipment at the offloading wharf. The rate at which scows could be offloaded and returned to the dredge platforms would be increased, and sufficient redundant capacity would be available to allow for maintenance and repair of the equipment to reduce down time.[30]

Consider using large, shallow-draft barges with on-board water processing capabilities, in conjunction with selective use of hydraulic dredging and/or with mechanical dredging. As explained in the Bohlen Memo (at 13-14), this should be considered in areas where shallow water depth limited access to dredging areas. A hopper barge modified with water treatment capability could remove enough water to make transportation to the sediment treatment facility efficient.

Increase access dredging where needed. Resuspension from scow and tug traffic can be reduced by additional access dredging to increase channel depth and allow for more laden draft and propeller-driven scour (prop-wash) clearance depth. NYS DEC recommends that access dredging be done to allow full-sized scows to be used in areas which would otherwise be dredged using mini-hoppers to reduce the number of tug trips in a work area to change out the mini-hoppers, allow more efficient use of the dredge platforms, and reduce the resuspension due to prop wash and grounding in the shallows.[31]

<u>Challenge:</u> **Monitoring efforts may not have been optimally deployed.** The Phase 1 EPS were based on the assumption that near-field TSS concentration and turbidity were suitable indicators of PCB concentration in the water column. TSS concentrations were measured both during transect monitoring (twice a day during daylight hours) and buoy monitoring (every 6 hours) located 300 meters from the dredging operation(s). TSS concentrations, which generally remained below the near-field resuspension control level of 100 mg/l per day, did not correlate with far-field measurements that occasionally exceeded control level of 350 ng/L, as well as resuspension standard/MCL, especially at the Thompson Island Dam. In August GE proposed and implemented a special monitoring protocol that included water column samples for PCB, POC/DOC and TSS analysis at nine locations within the Phase 1 dredging area -- seven along transects perpendicular to river flow to capture PCB transport along the full cross section of the river and two inside the sheet piling and silt curtains deployed in the East Griffin Island Area (EGIA). Metals monitoring in Phase 1 indicated that dredging did not result in exceedances of NYS water quality standards and can be reduced in Phase 2.[32]

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[29] EPA Report at Intro 11.

[30] NYS DEC Report at v.

[31] NYS DEC Report at iii.

[32] *Id.* at pp. vii, 4.

Recommendations:

Reduce near-field monitoring of total suspended solids (TSS) and turbidity, as well as heavy metals sampling in near- and far-fields. For the reasons detailed in the Bohlen Memo (at 15-16)**,** these monitoring protocols can be revised, as this data served as poor surrogates for monitoring PCBs suspended in the water column, underestimating this load (DEC).

Give serious consideration to adding an automated 24-hour composite sampling station at Stillwater to better assess load from the southern end of Thompson Island Pool. EPA recommends that this would allow for better assessment of PCB loads during Phase 2.[33]

Give serious consideration to supplemental far-field sampling to reduce uncertainty and address variability in sample results. DEC recommends that supplemental sampling be conducted to ensure that the data are representative of actual site conditions.[34]

Challenge: **The mass of PCBs (and volume of sediment) that must be removed to achieve cleanup targets (*i.e.*, the residuals standard) is greater than anticipated.** Dredging greater amounts of contaminated sediment creates the possibility of re-suspending greater amounts of PCBs.

Recommendation: **Carefully re-evaluate limitations on far-field mass loading (*i.e.*, downstream flux), in light of new information and forthcoming analyses.** All of the recommendations above will tend to decrease resuspension per-unit of sediment dredged. Nonetheless, due to the greater amount of contamination that has been encountered, as compared to pre-Phase 1 estimates, even with the application of these precautions there may be a potential for cumulative downstream flux of PCBs in excess of the existing resuspension standard. The mass loading component of the resuspension standard for Phase 2 should be set at a level that maximizes the river's *long-term recovery* to full health. Accordingly, revisions to the Resuspension Standard recommended by EPA should be seriously considered in light of the analysis forthcoming in the EPA Addendum. We will submit supplemental comments following an opportunity to review the Addendum.

II. RESIDUALS STANDARD

A. Summary of the Issues and Observations

The Residuals Standard is a set of standards and procedures for managing the residual contamination in the sediment that remains following the removal of the contaminated inventory

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[33] Currently, Lock 5 is used as the point of compliance once dredging operations are within 1 mile of the Thompson Island station. EPA's consultants, E&E, recommended that a 24-hr. composite monitoring station constructed at Stillwater should be considered to provide additional automated data collection when dredging is taking place at the southern end of the Thompson Island pool. *USEPA Oversight Team Phase 1 Observations Report, Hudson River PCB Superfund Site Prepared for U.S. Environmental Protection Agency, Region 2 by Ecology & Environment, Inc.*, at 20-21.

[34] NYS DEC Report at iii.

at a particular area (Certification Unit, or "CU"). It includes a post-dredging sampling program to assess the PCB concentrations in remaining sediments. During Phase 1, based on the results and analysis of the sampling and the number of dredging passes that were conducted, a particular CU was either re-dredged, re-evaluated, or closed with backfill or an engineered cap. Pursuant to the ROD, the Residuals Standard calls for removal of PCB contaminated sediments in Phase 1 areas targeted for dredging sufficient to achieve a residual of no more than 1 mg/kg Tri+ PCBs prior to backfilling.[35]

Although seventy-five percent of the 'adjusted area'[36] was completed and closed in compliance with the Residuals Standard, EPA reports that it was necessary to cap portions of several CUs out of compliance with the Residuals Standard – about 25% of the adjusted area. This resulted in capping of approximately one-third of the river bottom dredged during Phase 1 and was approximately four times the percentage contemplated by the Residuals Standard. The two most important factors affecting the project's ability to meet the Residuals Performance Standard appear to have been the significant underestimation of the Depth of Contamination (DoC) and the schedule/dredging season time constraints. Additionally, EPA reports that GE's cost-savings goal was at the expense of the Residuals Standard.[37]

The procedures pursuant to the Residuals Standards interact with both the Resuspension and Productivity Standards. It appears that, in certain instances, the Residuals Standard was made subservient to productivity concerns. We emphasize that capping was not the selected remedy and, therefore, the standards and implementation for Phase 2 must be carefully evaluated to remain faithful to the ROD. Accordingly, we expect to supplement and revise our analysis of this section, after an opportunity to review the forthcoming EPA Addendum.

B. <u>Basic Differences Between EPA and GE Reports</u>

GE recommends that the Residuals standard be "streamlined" so that CUs are closed more quickly and dredging is limited to one or two passes at most.[38] GE asserts that remaining PCB-contaminated sediment should then be capped or covered with backfill. GE's recommendations appear to largely be driven by its goal of adhering to the "time limit"[39] on dredging and its view of a tension between the Residuals Standard and the Productivity Standard, compliance with which is affected by delay in completion of work within a given CU, as well as tension between the Residuals Standard and the Resuspension Standard, compliance with which is adversely impacted by multiple dredging passes.[40]

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[35] EPA EPS, vol. 1, p. 52; ROD Sec. 13.1, p. 95.

[36] EPA Report at ES-2. EPA notes that the adjusted area excludes structure and shoreline setbacks. .

[37] EPA Report at ES-8. Specifically, EPA reports that to minimize the removal and processing of clean material, GE required a tolerance of only 3 inches above or below the DoC, leading to extensive and unnecessary fine grading.

[38] GE Report at ES-6.

[39] GE Report at ES-7.

[40] GE has also stated that they sought to minimize the amount of clean sediment that is dredged, treated and sent for disposal. EPA Report at ES-8.

EPA asserts that, with certain procedural changes, "[t]he ROD objective of removal of all contaminated sediments above 1 mg/kg can be attained"[41] and that most CUs will be completed in less than four, and likely within two, dredging passes.[42] EPA observes that due to the significant underestimation of the DoC, the application of the Residuals Standard served to detect "inventory" rather than to sample and manage thin layers of residuals and notes that total PCB mass and volume were roughly 1.5 times higher than the original estimates in the project design in the ten of 18 CUs scheduled to be dredged in Phase 1. Accordingly, EPA recommends a more robust DoC evaluation with improvements in the collection of cores, thus better targeting remaining inventory and minimizing the number of dredging passes, without limiting them specifically; these steps will also serve to maintain productivity targets and minimize resuspension.[43]

C. Challenges and Recommendations

Challenge: **Multiple dredge passes associated with the significant underestimation of DoC contributed to delays, which increased resuspension and increased the use of capping *in lieu* of removal.**

Recommendations:

Reduce inaccuracy of DoC by performing targeted additional coring prior to Phase 2. This recommendation is detailed in Part I.C., above, in connection with achievement of the resuspension standard. The same recommendation can also greatly improve compliance with the residuals standard, as more accurate DoC will decrease the need for more than two passes in many areas, allowing for more removal of inventory (and hence less residual contamination).

Analyze the entire length of each core taken to assess residuals. For the reasons detailed in the Bohlen Memo (p. 11), we agree with EPA's recommendation that post-dredging core analysis should include the analysis of the entire of the cores taken to assess residuals (~24 inches), rather than simply the upper 6 inches, in order to detail inventory and the associated additional dredging requirements. This clearly has the potential to reduce the need for multiple additional passes to achieve target levels. NYS DEC also supports this recommendation, noting:

> If the DoC were redefined after the first dredge pass through analysis of the entire cored interval, instead of only analyzing the uppermost samples of a core… any subsequent dredge pass would be much more likely to be based upon a correct understanding... This change would allow for the setting of up to date target depths for the contractor to meet, take into account any changes to the river bottom since the data upon which the design was based were gathered, and eliminate any

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[41] EPA Report at II-71.

[42] *Id*. at II-75.

[43] EPA Report, at II-68 – II-75. EPA also recommends that the Residuals Standard should be simplified to place cases in one of only four main categories, and identification of non-compliant nodes should also be simplified. The simplification of procedures for the contractors and officials on site seems sensible.

potential sampling bias associated with the overlying material on the river bottom which was removed during the first dredge pass.[44]

Reduce or eliminate fine-grading and instead use an overcut in each pass to remove more inventory. This recommendation is detailed in Part I.C., above, in connection with achievement of the resuspension standard.[45] Additionally, we note that strong consideration should be given to EPA's apparently sensible recommendations that DoC should be confirmed via post-dredging core sampling after every dredging pass,[46] that every core should have contiguous segments with Total PCB concentrations less than 1.0 mg/kg to establish DoC,[47] and that deposits of wood debris should be removed so as to reduce the required number of passes and reduce the need for capping.[48]

Challenge: **The capping rate was too high.** Due to the significant underestimation of DoC in the Phase 1 design, the capping rate was too high, particularly given that the ROD rejected capping in favor of removal. Moreover, problems with the long term stability, monitoring, and responsibility for maintenance of capped areas, as well as navigational needs, render that option clearly sub-optimal.[49]

For example, the area of CU-1 at the Fort Edward Yacht Basin was subject to a very high rate of capping over contaminated sediment. The Canal Corporation reports that the current cap rises to a depth of 12 feet below the surface, and full navigational use of the facility requires a depth of 14 feet. Also, at 12 feet, the current cap will be subject to scour and disturbance by vessels using the Canal. Moreover, use of caps in navigational channels makes the necessary maintenance dredging more difficult to achieve without damaging the caps placed over highly-contaminated sediments.[50]

Recommendations: Improving the accuracy of the DoC, as recommended above, will serve to lessen the rate of capping. Similarly, as noted above, larger overcuts will reduce the need for capping. We add the following additional recommendations to minimize capping, and ensure that any capping that occurs is as stable as possible:

Capping within navigational channels should be avoided where possible, and if necessary, rise only to a maximum of 14 feet below the surface. Regarding CU-1, we recommend that all

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[44] NYS DEC Report at iv.

[45] *See also* EPA Report at II-70 (" A nine inch overcut is deemed to be a 'fair balance' between too much overcutting and more rapid completion;" and recommending that where DoC in a CU is based on incomplete cores, the overcut should be increased to 18 inches).

[46] EPA Report at II-67.

[47] *See* EPA Report at II-67.

[48] EPA Report at II-71.

[49] *See* Bohlen Memo at 16 and letter from Carmella Mantello, Director New York State Canal Corp. to Mr. David King, USEPA (March 29, 2010) raising these and other concerns.

[50] *See* Bohlen Memo at 16; *see also* Testimony of Carmella Mantello, Director of NYS Canal Corporation to EPA Hudson River PCB Peer Review Panel, available at http://readme.readmedia.com/Canal-Corporation-Provides-Testimony-to-EPA-Hudson-River-Dredging-Peer-Review-Panel/1161939.

options be considered to rectify the situation concerning the apparently excessive capping, particularly at such a shallow depth in a navigational channel. Similarly, consideration should also be given to future plans for marinas, docks or waterfront recreational areas,[51] as well as the other insights offered by the NY Canal Corp. regarding specific CU's and maintenance issues.[52]

Conduct differential bathymetric surveys of areas capped during Phase 1 to assess stability. As Dr. Bohlen observes:

> …[U]se of caps should raise concerns regarding stability and the extent to which capping may limit future uses of the capped portions of the river. The EPA recommendation that capping within navigational channels be avoided if possible and come no higher than 14ft below surface if it is not seems reasonable… The stability of caps in all areas warrants careful evaluation. Neither the EPA nor the GE report discussed this matter in any detail. It would be well to more carefully specify stability criteria used in the selection of the cap material (there are a variety of types specified for selected conditions) and the elevations of the cap surface relative to existing and pre-project contours. Requirements detailing post-project monitoring of cap stability should also be clearly specified. There is, for example no indication that the caps placed last fall are being monitored for stability. High resolution bathymetric surveys of these areas should be conducted on several occasions over the next year. The results of these surveys should be incorporated in Phase 2 designs to maximize cap stability under a wide range of flow conditions. This should be considered a factor essential to the long term success of this project.[53]

Challenge: **Capping decisions were driven by time constraints**.

Recommendation: **As recommended by EPA and NYS DEC, capping decisions should not be driven by time constraints.** After evaluation, CU's can be temporarily covered and reopened the following season. Based on calculations by EPA which are being supplemented shortly, the Productivity standard should not be ignored, but rather the duration of the project should be extended if necessary.[54] As Dr. Bohlen (at 14-15) recommends, it is important to "[r]ecognize that consistent and simultaneous satisfaction of the Engineering Performance Standards will most likely require an extension of project duration;" and "[t]he modification proposed by EPA giving them discretion to extend project duration to six years appears a reasonable place to start." In sum, a productivity standard should not be used as an arbitrary rule, in a manner that prevents full achievement of the ROD's remedial objectives through implementation of the ROD's selected *dredging* remedy.

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[51] *See* Bohlen Memo at 16.

[52] *Id.*

[53] Bohlen Memo at 16.

[54] Dr. Bohlen further observes that the April 2010 EPA calculations will allow further analysis of this issue. *See* Bohlen Memo at 15.

III. PRODUCTIVITY STANDARD

A. Summary of the Issue and Observations

The Productivity Standard was designed to keep the dredging work on a projected 6- year schedule, define the total cubic yards (265,000 CY) estimated for removal, maintain this schedule without compromising the other EPS, and preserve effects at or below those produced by monitored natural attenuation (MNA). It should be noted that achieving any productivity standard is totally dependent on key operational procedures, accurate pre-project Depth of Contamination (DoC) analysis and the actual river environment. For Phase 1, the existing river conditions contributed greatly to the delays and unexpected levels of additional PCB-contaminated sediment and debris. It is possible that the Phase 1 conditions may represent a "worst case" scenario due to proximity to the historical site of the Niagra-Mohawk dam which was removed in 1973 resulting in a very large release of PCB laden materials into the initial area designated for remediation.[55]

The total 283,000 CY removed from 48 acres (10 CUs) during Phase 1 exceeded the targeted contaminant cleanup by removing 1.5 times more PCB mass than was originally planned for in the original, designated 90 acres (18 CUs).[56] EPA and GE should be commended for responding to this discovery of unknown amount of toxic sediment by removing as much as possible, but, as noted above, this resulted in repeating dredge passes ("fine grading") and contributed to resuspension. It also slowed productivity, as many CUs were open longer than was scheduled and dredging was not begun at remaining CUs due to time constraints.

High river flows and or natural events such as storms or fog which slowed or shut down operations cannot be predicted or controlled, but expecting these events to occur should be built into the schedule as a proactive measure. Lost productivity due to narrow channel depths, unavailability of empty scows and unloading/treatment back-ups at dewatering and processing facilities are all operational processes that can and should be improved for Phase 2, to improve productivity.

B. Basic Differences Between EPA and GE Reports

GE and EPA have differing calculations of total PCB mass removed during the Phase 1 dredging season. This relates directly to what EPA calls "confusion between EPA and GE on what constitutes an inventory or residual dredging pass"[57] GE's contractors defined inventory and residual dredging differently than EPA and these differences between EPA and GE in describing what type of pass was made through a given CU " making overall decisions on whether to dredge deeper or to backfill/cap more difficult"[58]

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[55] Bohlen Memo at 8.

[56] EPA Report at 7.

[57] *Id.*, Sec. 4.3.2.1, p. 11.

[58] *Id.*, Sec. 4.3.2.1, p. 11.

GE's Phase 1 report focused on the failure to adhere to the designed daily/weekly/monthly productivity schedule during the dredging season, by illustrating exceedances of the resuspension standard that occurred when field operations were being managed to achieve productivity rates.[59]

While EPA's report acknowledges some resuspension events, they gave a thorough accounting of several operational processes which hampered and delayed the ability of dredge operations to function at full capability and which can be improved for Phase 2.

We believe EPA's recommendations to improve productivity should receive serious consideration. It is especially noteworthy that the activity logs maintained by GE's Dredging Contractor show the effective working time of the dredging operations was approximately 60% during Phase 1.[60] EPA makes numerous recommendations – including adjustments to equipment, facilities, and operating procedures – that appear capable of eliminating, or at least mitigating, a significant amount of downtime.

C. Challenges and Recommendations

Challenge: **It took more time than expected to complete a given CU because of additional dredge passes, and the time lost in mapping, sampling, and designing new cut lines, all of which are associated with the underestimation of DoC.**

Recommendation: **Reduce inaccuracy of DoC by performing targeted additional coring prior to Phase 2.** This recommendation is detailed in Part I.C., above, in connection with achievement of the resuspension standard. Conducting the recommended core sampling this year would provide a better understanding of what to expect in Phase 2. This would enable GE and EPA to more accurately set productivity goals in the design of Phase 2.

Challenge: **EPA and GE used contradictory definitions of "inventory dredging" vs. "residuals dredging".** GE categorized large masses of contamination, which had not been identified in pre-dredging characterizations of the DoC, as "residuals" that are allowed to be capped, rather than as (previously unknown) "inventory" that must be removed. This also resulted in higher incidences of capping that provided by the ROD, which allowed a capping "remedy" only for genuinely "residual" contamination levels.

Recommendation: **EPA, GE and its contractors should use the same definitions for inventory and residual dredging; those definitions should be consistent with the purpose and intent of the ROD.** Material removed down to the 1 milligram per kilogram (mg/kg) cutline (which includes the recommended overcut), clay layer (*i.e.*, native soils), or bedrock should be considered inventory material.[61] More accurate delineation of the DoC would result in

[59] GE Report at. 24.

[60] EPA Report at 14.

[61] EPA Report at Sec. 4.3.2.2.

the removal of a majority of the contaminated material targeted for remediation during initial passes. This would limit both the need for multiple inventory passes and residual dredging, thereby improving dredging efficiency and productivity, and reduce resuspension caused by dredge bucket disturbance. Capping would then be used in the limited form intended by the ROD.

Challenge: **Bottlenecks unloading barges at the processing facility caused extensive delays.** 26 % of the downtime incurred by the dredge barges was directly related to the off-loading operations at the Processing Facility.[62] This delay also contributed to 1400 hours of "wait" time at the CUs as operations halted for scows.

Recommendation: **Increase off-loading operational ability at the Processing Facility up to and including additional manpower and/or facility equipment improvements.** All of EPA's suggestions for this issue should be implemented:

- Improve management of hopper barges, including increasing the number and types of hopper barges available;
- Plan vessel deployment (e.g., locating dredge barges and/or hopper barges) in a manner that does not hinder work performed by other dredge barges nearby;
- Increase the availability of tug boats to assist in moving dredge and hopper barges;
- Stop the double handling of dredge spoils at the processing facility which reduces speed and efficiency by transferring twice the material in the barge intended for transfer to the CMSA; and
- Build an additional unloading wharf.[63]

Reducing unnecessary downtime of dredge barges would improve individual dredge operation efficiency. This will be an important factor for Phase 2 because a lower number of barges operating on the river would help to reduce the amount of project-related resuspension.

Challenge: **The narrow depths of the river bottom impaired the use of hopper barges within CU 1, limited access to portions of various CUs, and thereby reduced dredging productivity.** Mini-hopper barges used in Phase 1 were able to access shallow areas, but created air emission problems when highly contaminated material was being dredged[64] and could only hold limited amounts of water, thereby reducing the amount of "dredge spoil" which could be sent to the processing facility. Access dredging -- *i.e.*, navigational dredging -- was done to allow deeper drafting hopper barges to certain CUs, but this was done on a limited basis while dredging operations were ongoing.

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[62] EPA Oversight Team Phase 1 Observations Report, Section 5.0, *Facility Operations and Related Activities.*

[63] *Id*. at 14.

[64] EPA Report at 12.

Recommendations:

Consider using large, shallow-draft barges with on-board water processing capabilities, in conjunction with selective use of hydraulic dredging and/or with mechanical dredging. This recommendation is described in Part I.C., above, in the context of reducing resuspension. It would also serve to increase productivity.

Increase access dredging where needed. This recommendation is described in Part I.C., above, in the context of reducing resuspension. It would also serve to increase productivity. (We note that dredge area/navigational channel maps are currently being updated and should be considered as part of the remediation effort going forward.)

Challenge: **The productivity standard may be used as an arbitrary metric to drive critical decisions about dredging and capping, in ways that undermine the effectiveness of the remedy.**

Recommendation: **Recognize that consistent and simultaneous satisfaction of the Engineering Performance Standards will most likely require an extension of project duration, and allow for such an extension up to the point when the long-term results of the project would no longer be an improvement upon the MNA scenario.** As Dr. Bohlen notes (at p. 8), significant improvements in production rates are entirely possible with modifications at both the sediment processing plant and dredge site. But if Phase 2 cannot be completed in 5 years, we believe, for the reasons set forth elsewhere in this letter and in the Bohlen Memo (at p.14), that extending the project length to some degree would be eminently reasonable; we will be better able to speak to this issue after an opportunity to review the forthcoming EPA Addendum. As a general proposition, we emphasize that the productivity standard should not be used as an arbitrary rule, in a manner that prevents full achievement of the ROD's remedial objectives. Rather, the productivity standard should be subservient to the goals of minimizing sediment resuspension and remobilization, limiting residual sediment left in the river, and maximizing the river's *long-term recovery* to full health.[65]

* * * * *

Thank you for your consideration of these comments. If you have any questions or comments, please contact Rebecca Troutman of Riverkeeper at 914-478-4501, ext. 241; or by email at rtroutman@riverkeeper.org.

Sincerely,

/s
Rebecca Troutman
Senior Counsel

[65] Following review of the forthcoming EPA Addendum, we anticipate being able to address, in more detail, the issue of the remedy's effect on long-term recovery on how it relates to review of the existing EPS.

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A Review of the U.S. Environmental Protection Agency and General Electric Company
Phase 1 Reports of March, 2010

W. Frank Bohlen
Mystic, Connecticut

April 26, 2010

Introduction

In April, 2009 the U.S. Environmental Protection Agency (EPA) and the General Electric Company (GE) initiated a major contaminant removal project in the upper Hudson River in the vicinity of Fort Edward, New York. These efforts following from a 2002 Record of Decision were intended to reduce surface sediment concentrations to levels approaching 1 ppm Tri+ PCB in the reach of the Hudson River extending from Fort Edward, New York (near River Mile 195) to Troy Lock, a distance of approximately 40 miles. This project was to be divided into two Phases, 1 and 2 with durations of one (1) year and five (5) years, respectively. Phase 1 was intended to test the feasibility of mechanical dredging to at once remove the contaminated sediments and satisfy a defined set of Engineering Performance Standards (EPS) (MPI/TAMS,2004). These standards, applied for the first time in a major remediation project, specified allowable levels of dredge induced resuspension and the associated PCB concentrations, protocols to deal with residual contamination, and the productivity required if the project was to be completed in the specified time period. The limits associated with each of these standards were set to insure that project implementation would minimize any short term adverse effects on human health or the environment. With completion of the Phase 1 activities in November, 2009 summary reports were prepared by both EPA and GE detailing their individual views of the results of the initial phase of this 6 year project and their recommendations regarding changes needed for successful completion of the Phase 2 work. The following presents a summary review of these reports and their associated conclusions.

n.b. The reports are voluminous and often require use of multiple supporting documents and reports when details are desired and/or required. It's important to realize that this review placed primary emphasis on the Phase 1 reports themselves and did not include exhaustive review of the supporting documents. The time available between the release of each of the Final Phase 1 Reports and required date for receipt of comments makes such a comprehensive review impossible.

Overview

Very little reading of either the GE or EPA reports should serve to convince any reader that this is an ambitious project. Initial designs called for the removal from an energetic, time variant, river system of a total of approximately 2,650,000 cu.yds of sediment containing 100,000 kg of PCBs. Both GE and EPA are to be commended for the effort it took to get the project underway and to remove a significant mass of contaminant under often trying streamflow and weather conditions. The results of this project will find application in a variety of waterway remedial efforts.

Given the history of this project and the extent of previous contention it's not surprising that the GE and EPA reports often disagree. One aspect of the Phase 1 effort that they agree on is the areal extent of completion. As designed, 18 Certification Units (CUs), five acre segments of river bottom and adjoining shoreline, were to be remediated during Phase 1. This effort beginning in April, 2009 and ending in late November, 2009 required the removal of 265,000 cu. yds in combination with some amount of capping (if remedial targets could not be met in specified number of dredge passes) or backfill to satisfy benthic habitat needs. Of the planned number of CUs to be remediated only 10 of the 18 were completed (48.3 out of 88 acres) in Phase 1. However, despite the smaller areal extent, the Phase 1 dredging activities served to remove more sediment from the 10 CUs than planned for the 18 (284,000 vs 265,000 cu. yds). The mass of PCB removed was also larger than expected for the 10 CUs (16,000kg (GE)- 20,000kg(EPA) vs the design estimate of 11,000 kg for those same 10 CUs).

The inability to complete Phase 1 as designed was the result of a number of factors including less than accurate definition of the depth of contamination, streamflow and weather factors that slowed or shutdown operations on 33 days (~ 23% of total dredged time), occasional water or air quality violations leading to project shutdown (resulting in the loss of ~6% of total dredging time) , production difficulties both at the point of dredging and at the sediment processing facility and some landside sediment disposal problems. Of these, difficulties associated with definition of the depth of contamination must be considered to be the most serious.

Issues of Concern

a. Definition of the depth of contamination

Delineation of the horizontal and vertical extent of contamination was the subject of an intensive sediment coring program conducted by GE in 2002 (QEA, 2002). Side scan sonar and multi-beam acoustic surveys were used to map varying surficial sediment characteristics and to provide a basis for the specification of a sampling network in each CU. Following these surveys rod probing and sediment coring was conducted throughout the study area. In each CU, cores were centered in 80ft squares and using a combination of mechanical and vibra-coring techniques driven to refusal. Penetration displayed significant spatial variability as a function of sediment type, varying from silts and sands to clay and woody debris, as well as the presence of rock ledge. Woody debris ranging from limbs and logs to sawdust and wood fragments from historical lathing operations caused particular problems since the materials were often high in PCB content and an extremely effective impediment to core penetration. This variety of materials adversely affected overall core quality and the associated accuracy of the reported depths of contamination. Of the more than 8000 cores taken 36% were considered to provide high confidence indications of contaminant distributions with 39% considered low confidence and 25% no confidence indicators. These classifications are based simply on individual core characteristics depending on the extent to which an individual vertical sample is more or less disturbed. Another factor affecting the adequacy of cores to define the contours of the surface to be dredged between the core locations is the spatial variability of the sediment deposit itself. Neither report makes specific mention of this factor and its potential influence on the accuracy of definitions of the depth of contamination.

Sediment transport and the associated erosion and deposition in an energetic river system can be expected to display significant spatial and temporal variability. Turbulent flows acting across and along the river channel will tend to produce deposits of materials that are far from homogeneous. For some period of time one area might experience deposition while another sees erosion. A bit later the sequence might reverse to a greater or lesser extent. The process proceeding through time tends to produce a less than homogeneous or orderly distribution of sediments, and their associated contaminants, over the vertical. These patterns, noted in previous studies of the Thompson Island Pool (e.g. Baker, et.al., 2001) as resembling a "patchwork quilt", complicate efforts to radio date the sediment column and make it difficult, if not impossible, to define sedimentation rates and associated contaminant fluxes at a given vertical location let alone accurately define contours over the surface of a five acre CU. The comparative bathymetric data discussed in the EPA Phase 1 Report (Fig. II-2.6c attached) provide clear indication of the scale of this variability showing significant differences in erosion or accretion over distances small relative to the core spacing (80ft). Given this variability in combination with the textural (sandy silts, wood chips, saw dust and occasionally clay) character of the sediment column it's not surprising that predictions of the depth to be dredged to achieve project goals often differed substantially from those actually found. The resulting "inaccuracies" affected the extent to which operations were able to satisfy each of the Engineering Performance Standards as designed and implemented in Phase 1.

b. Resuspension

Inaccuracies in the definition of the depth of contamination made it difficult to achieve the desired reduction in contamination with a one or two pass dredging sequence. This increased the number of passes and the time over which the CUs remained "open" (i.e. uncovered with cap or backfill). By its very nature mechanical dredging serves to "disturb" the sediments with a fraction being placed in suspension and subject to downstream transport. A variety of field investigations have shown that this fraction ranges between 1-5% depending on dredging methodology, production rates, sediment types and the hydrodynamic regime (e.g. Bohlen,et.al. 1978; Hayes,et.al.,2000). Additional factors such as agitation associated with the release of trapped gas deposits and/or oils would tend to increase these values. On the assumption that contaminants are uniformly distributed throughout the sediments being dredged these data suggest that a flux of PCBs to the water column in the range of at least 1-5% should be expected. Analyses provided by both GE and EPA indicate that such losses were experienced during Phase

1 with values on the order of 3%.

In addition to losses from the dredging operation, the surface of the open CU itself is subject to resuspension and erosion by ambient flows making it a source of sediments which typically have higher contaminant concentrations than those along the undisturbed sediment bed. These sources in combination with dredge induced resuspension resulted in significant downstream PCB flux both particulate and dissolved, often resulting in cumulative transport past the Thompson Island Dam and the Waterford Dam in excess of the mass loading targets. On some few occasions this contaminant transport also resulted in water column concentrations in excess of federal drinking water standards leading to project shutdowns. The potential for this combination of exceedances would be reduced by modifications in dredging protocols and/or the time during which the CU remains open.

The increased downstream flux of PCBs, anticipated during any dredging project, has some potential to increase the exposure of aquatic biota and the associated body burdens. Data developed by both GE and EPA indicate that body total and lipid-normalized PCB concentrations increased to some extent above pre-project levels in target fish species during Phase 1 activities. The increases are often quite small however, and sometimes within the annual range of variability. The major effects display limited areal extent beginning abruptly near Fort Edward and typically extending downstream for a distance of approximately 15mi south of River Mile 195, the northern end of the Project Area. The effects noted in the GE report in the vicinity of Albany were very small in late 2009 and early 2010. Most effects are seen in the Pumpkinseed population. It seems reasonable to suppose that these effects will decay to background occurring within two to three years of the completion of dredging or times similar to those observed following the Allen Mill gate failure in 1991-93. The fact that available data are yet to show this decrease is not surprising given the limited time since completion of the Phase 1 activities and low metabolic rates expected during the winter months. Some effects may be observable by the fall of 2010. These monitoring data warrant careful scrutiny and should be considered an essential part of the ongoing efforts to recompute the target downstream flux of PCBs .

c. Residuals

Increases in the amount of dredging activity required to achieve project goals affects residuals to some extent and the achievement of the associated Standard. Residuals must be considered to consist of two classes of contaminated sediment. One, residing at the point of dredging, consists of materials with PCB concentrations in excess of target limits that have not yet been dredged (i.e. some mass of “original” sediments or inventory waiting to be removed). The other consists of the variety of sediments resuspended by the dredge and/or eroded from the exposed face of the CU while it is open. These latter materials are subject to transport by the ambient flows and may subsequently settle to the interface at the point of dredging and/or at points downstream. Let’s call them an immobile and mobile fraction, respectively.

Efforts to remove the immobile fraction in order to achieve the targeted goals often resulted in additional rounds of dredging beyond the first pass which I believe was classed by EPA under the category “fine grading” since they were based on analysis of relatively thin surficial analyses of cores obtained following the initial series of passes. If subsequent thin section coring still showed contamination another pass was initiated. In many cases these efforts seem to have removed relatively little additional mass of contaminants relative to the effort involved. They did however, contribute to the length of time over which the CUs were open (an average of 130 days +/- (EPA)) leaving the surfaces exposed to erosion with the potential to contribute to downstream contaminant flux.

Transport of the mobile fraction of residuals is expected to contribute to a small extent to the downstream contaminant flux. Most of the data indicate that the majority of the downstream PCB flux was dissolved with the particulate component representing approximately 10% of the flux. This implies a dominance of waterborne over particle bound transport. Although this seems a very unusual distribution given the hydrophobic nature of most PCBs, it may be the result of the generally low suspended material concentrations in the area. This distribution in combination with the energetic streamflows affecting the project area, at least initially, favors rapid downstream transport of the residual associated PCBs. During this transport some fraction will be adsorbed by suspended and/or surficial deposit sediments and subsequently become part of the ongoing exchange of materials between the water column and the bottom. Some indications of the extent of this exchange are provided by the sediment trap data reported by GE. The trapped mass is expected to consist of varying amounts of sediments resulting from processes independent of this project as well as some dredging resuspended materials, residual particulates and/or particles affected by the dissolved phase residuals. Although the actual percentage of each fraction in a given trap cannot be simply defined, the residual fractions are expected to low. This in combination with the fact that the majority of the materials settling to the interface will in a short period of time be resuspended, implies that the effects of residual-both dissolved and particulate will be short lived and transient.

The implication in the GE report that the settlement of materials, some fraction of which being composed of mobile residuals, represents a significant long term source fails to recognize that sediment trap data represent an upper limit to the amount of suspended material being supplied to the sediment-water interface. Actual sedimentation rates are significantly less due to the continuing exchange of materials to and from the interface requiring radionuclide dating to accurately define the amount of sediment trapped long term in the sediment column. The sediment trap only provides an indication of the transient flux of materials to the bottom. Much of this is rapidly re-suspended leaving only a small fraction behind and resident in the column. Given these characteristics it's likely that the contribution to the total downstream flux of PCB supplied by the mobile fraction of residuals associated with this project's dredging activities will decrease rapidly with time. The ongoing monitoring provides a mean of verifying this as well as verifying the extent to which the effect of residuals was essentially confined to the dredging site and associated simply with productivity. Again these data warrant careful scrutiny in the ongoing effort to define the Phase 2 EPSs and the associated operational protocols.

c. Productivity

The difficulties with the less than accurate definition of the depth of contamination lead to a significant increase in the amount of sediment that had to be removed to achieve (or approach)the targeted contaminant levels at each CU. As a result, while the Phase 1 productivity satisfied (and exceeded) the Productivity Standard by dredging more sediment (284,000 cu.yds) than the design called for (265,000 cu.yds) it did not succeed in completing the desired number of CUs (10 completed (to some extent) with 18 desired). The factors responsible for this, including both definition of the extent of contamination and the resulting sediment dredging and handling, have the potential to affect the duration of the project beyond the 6 year limit specified as the goal of the defined Productivity Standard. Completion of the remaining 8 CUs would have required a significantly higher throughput of sediment at the processing plant than achieved during Phase 1 (variously estimated at approximately 18,000 cu.yds/week max). These Phase 1 results suggest that completion of the remaining project CUs to existing target contaminant levels may require removal of substantially more material than originally anticipated. It is possible that the Phase 1 conditions may, to some extent, represent the "worst case" due to proximity to the historical site of the Niagara-Mohawk dam. This dam was removed in 1973 resulting in the release of a large mass of PCB laden materials (sediments and sawdust) sufficient to affect navigation over a significant portion of the proximate downstream areas including the entrance to the Champlain Canal. Portions of the area were subsequently dredged in the 1980s to facilitate navigation. Despite this work however, samples obtained in Phase 1 showing deep deposits of PCB contaminated sediments and debris with thicknesses up to 13ft in areas to the east of Rogers Island near Fort Edward indicate that significant fractions of the original deposit remained in place prior to the Phase 1 efforts. It's likely however, that the extent of such deposits decreases with distance downstream. The associated reduction in the mass of wood chips and sawdust in the vertical sediment column would favor deeper core penetration and less disturbance of the recovered strata. This may well be the reason that the cores obtained in the Phase 2 area are generally considered to provide "high confidence" indications of the depth of contamination (GE reports (pg.167) 64% of the cores as High Confidence indicators in the Phase 2 area).

Despite the possibility that Phase 1 had encountered "worst case" conditions it is probably not unreasonable to design the Phase 2 effort with an expectation of 10-50% more volume removal than originally planned for. This could very well require production rates in the 95,000 to 120,000 cu.yds/mo, well in excess of the 77,300 cu.yds/mo max achieved in Phase 1(GE Number), if the project is to be completed in five years. Such production rates will require modifications at both the sediment processing plant and the dredge site. These modifications look to be possible. What is less clear is what the increased production rates will mean in terms of resuspension and the associated contaminant fluxes both dissolved and particulate.

The Phase 1 design criteria appear to be based on the assumption that approximately 1% of the PCBs removed would be made mobile and subject to downstream transport. The project data indicate that loss rates were higher with values approaching 3% by mass. The mechanism of loss (mechanical resuspension, PCB laden oils etc.) is subject to debate but it's clear from both reports that whatever the mechanism the downstream transport resulted in cumulative fluxes over the Thompson Island Dam and the Waterford Dam in excess of the targeted levels. In addition, transport also affected air and water quality on some occasions. Efforts to reduce this transport using silt curtains or sheet piling were largely ineffective. I would have expected such results given the morphology and flow characteristics of the River in this area in combination with the data showing the preponderance of dissolved phase PCBs able to easily move through porous structures.

The anticipated increase in mass to be removed in Phase 2 will necessarily result in an increase in the amounts of PCB removed. This will tend to increase the downstream flux of contaminants to levels in excess of the initial Phase 1 targets. The total inventory now being addressed is in excess of 115,000 kg with some numbers in excess of 200,000 kg included in the EPA report (pg I-52). Assuming loss rates of 1 to 4% to accommodate the differences between EPA and GE would suggest that downstream PCB fluxes will range between a low of 1150 kg (230kg/yr over the planned five year duration of Phase 2) (1% of 115,000 kg) and high of 8000 kg (1600 kg/yr) (4% of 200,000 kg) during Phase 2. The extent to which these fluxes will affect achievement of Project goals cannot be simply specified at this time requiring well structured model evaluations. EPA is in the process of conducting these evaluations apparently with the goal of revising the resuspension standard. Their Report indicates that this evaluation will be completed in April, 2010. The implications of this additional flux on the lower river and the goals of maintaining effects at or below those produced by MNA (monitored natural attenuation) need careful consideration within the ongoing efforts to design and plan Phase 2 activities.

Discussion and Recommendations

Careful reading of both the EPA and GE Phase 1 reports indicates that as currently structured the Engineering Performance Standards were not consistently and simultaneously satisfied within the project as conducted. Of particular concern is the Resuspension Standard intended to control and ultimately limit the bioavailability of PCBs. Satisfaction of the accompanying Performance Standard relating to productivity, to the extent that it was satisfied in Phase 1 (volume/mass rather than area/time), clearly resulted in a downstream flux of contaminant in excess of targeted goals. This is recognized by both EPA and GE. There are many factors responsible for this increased flux including direct dredging activities, complications associated with the presence of "debris", the introduction of PCB laden oils from dredged sediments, the duration of CU exposure, bucket decanting, and agitation of the sediment-water interface resulting from prop wash and/or direct ground contact from the numerous support vessels operating in the vicinity of the dredge. All vary as a function of the amount of material to be dredged and its location. Reviews of these factors provide a basis for the following recommendations.

Recommendation #1 - As part of Phase 2 designs initiate a review of the sediment sampling data with particular emphasis on the probe data. Specify additional coring or probing locations following this review

The designation of the dredging areas and the associated depth of contamination was based on the results of an intensive sediment sampling program (QEA,2002). Phase 1 results indicate that this designation was often less than accurate due to the combination of the spatial variability of the sediment deposits throughout the project area and sampling limitations caused by the presence of woody debris in the sediment column as well as occasional clay strata and/or ledge. Given these characteristics with spatial scales of variability of less than 50ft it's unlikely that the accuracy will be significantly increased by additional generalized coring. Some few additional cores in selected locations might be of value. To supplement these selective observations additional detailed reviews of the probe data should be conducted particularly at those locations where probe depth of penetration exceeded the core depth. These probe observations have the potential to define sediment column characteristics over the vertical providing indications of the presence or absence of sawdust and chips, sands, silts and ultimately the sediments most probably free of contamination. This effort might begin with an analysis of the data from the dredged portion of the Phase 1 area to determine whether the incorporation of probe data during initial designs would have improved the probability of reaching "clean" sediments within one or two dredge passes.

Recommendation #2 Eliminate "fine grading" in favor of overcuts during each dredge pass

Recognizing that direct dredging activities represent the single most important factor affecting resuspension and the supply of sediments and PCBs available for downstream transport every effort should be made to limit the number of dredging passes required to achieve target goals. In addition to better initial definition of the depth of contamination this task would benefit from the specification of an overcut of 9 to 18in depending on the degree of confidence of the cores used to designate depth of contamination, as proposed by EPA. This will necessarily increase the volume of sediment to be removed but it should also serve to reduce to some extent the mass of PCB introduced into the water column if it serves to reduce the number of dredge bucket passes needed to complete remediation even if such overcuts result in the removal of some mass of clean sediment. The relationship between dredging effort, resuspension, and contaminant loss suggests that every effort should be made to eliminate "fine grading" activities and/or the removal of thin layers of sediment (3-6in in thickness) from Phase 2. The reduction in inventory contamination does not appear to warrant the flux of resuspended PCBs associated with fine grading.

In addition to the overcut and the elimination of "fine grading", minimization of dredging activity will benefit from the EPA proposed revisions in post-dredging core analysis. The analysis of the entire length of the cores taken to assess residuals (~24in), rather than simply the upper 6in, in order to detail inventory and the associated additional dredging requirements clearly has the potential to reduce the need for multiple additional passes to achieve target levels. Here again such analysis will also benefit from coincident mechanical probing to detail sediment column characteristics in the vicinity of the core location.

Recommendation #3 Consider alternative dredge buckets and/or the use of closure sensors on the clamshell buckets for use in sediments containing a high fraction of woody debris

The matter of debris will continue to some extent to affect dredging operations throughout the project area. The settlement of water logged wood fragments and tree limbs as well as the variety of residential debris (e.g. shopping carts) is characteristic of an inland water way. Hopefully the influence of such debris, and in particular the remnants of the Niagara-Mohawk dam deposit, over the vertical will decrease with distance downstream. The experience of Phase 1 indicates that the presence of debris must be taken into account in the selection of the dredging equipment for Phase 2. The buckets used in Phase 1 seemingly did an acceptable job in the removal of large debris. Smaller debris remained a problem and was observed to often impede bucket closure sufficient to allow drainage of overlying waters and the loss of some fraction of the dredged sediment. If smaller fragments of wood debris, including sawdust, continue to regularly impede bucket closure sufficient to cause sediment loss during bucket ascent consideration should be given to the addition of a rugged bucket sensor to provide the operator with an indication of the degree of closure prior to removing the bucket from the bottom. Such sensors are routinely used in areas of New York Harbor (see e.g. U.S. Army Corps of Engineers NY/NJ Harbor Deepening Project specifications for Contract Area S-NB-1 (Section 02900 para.6.3c)). This would provide an opportunity for additional closure prior to retrieval and or the slowing of ascent if the sensor indicates less than complete closure. In addition, alternatives to the clamshell bucket such as covered excavators should be evaluated to see if they may be less subject to debris interference. These factors should be considered in the contract bid process with bucket evaluations being conducted over the next year preceding the initiation of Phase 2 and/or during the non dredging periods of the following years.

Recommendation #4 Add a surface sorbent mat to the containment booms adjoining the operating dredge to intercept oil slicks as they occur

The extent to which “oil sheens” serve as a source of PCBs to the downstream is difficult to assess from the information provided in the two reports. EPA believes them to be significant while GE presents data showing no correlation between the occurrence of sheens and the flux of PCBs over the Thompson Island Dam. In addition GE logs show minimal occurrence of surface oils in the sediment coring program and at the sediment processing facility. The presence of oils - floating- following sediment disturbance is not at all unusual in many riverine and estuarine areas. A variety of natural organic oils and residual man-made hydrocarbon product may be sequestered in the sediment column. Dredging frees these materials to float to the surface. It seems likely that these are the products producing the observed sheens. As they pass through the sediment and water column they may acquire a burden of PCB laden sediment which results in the finite concentrations in subsequent bulk analysis of the oil. It seems unlikely that these sheens are representative of non aqueous phase liquids due to density considerations and as a result they will probably display relatively low concentrations and, due to near mono-molecular thickness as evidenced by the optical diffraction, contain a relatively small mass of contaminant. Despite these characteristics the placement of a sorbent mat on the containment boom that is shown in many photos to be in-place along the downstream edge of the dredge area should be considered. It may at once provide a relatively low cost means to trap additional PCBs and remove a bit of the downstream flux. Careful analyses of the mat contents would also serve to define the character and source of PCBs in the sheens.

Recommendation #6 - Consider incorporation of selected hydraulic dredging during Phase 2 using a combination dredge and purpose built barge equipped with water processing capabilities.

Shallow water depths limited access to many of the CUs in Phase 1. This required some amount of access dredging and affected the type of hopper barge being used and the exchange of these barges at the dredging site. The combination affected both resuspension and productivity. It seems possible to reduce the effect of these conditions by the use of larger-shallow draft-barges specially constructed for use in this area in combination with selective use of a hydraulic dredge.

It is my understanding that hydraulic dredging was considered early in the project but rejected due to need to pump sediments and water over long distances to the processing plant as well as the possibility that debris would affect dredge efficiency and operation. Assuming that the debris problems are surmounted it seems possible to construct a modified hopper dredge consisting of a dredge (cutter head) and pipeline passing materials to a relatively large deck barge located in deeper water. This barge would have water treatment capabilities to allow filtration of supernatant water prior to its return to the river. Such barge mounted filtration has been used successfully at other dredge sites (C.F. Bean Dredging Incorporated). This combination could at once minimize the need for access dredging in the shallow water areas while reducing the number of barge transits with their associated prop wash. At the very least consideration should be given to the replacement of some number of the hopper barges by project specific shallow draft, large volume, deck barges taking full advantage of the 45ft beam available within Lock 7. The availability of such barges would benefit the project in terms of both resuspension and production whether mechanical or hydraulic techniques were ultimately selected.

Recommendation #7 - Eliminate decanting to the extent possible

The use of the recommended hydraulic techniques and/or the large volume shallow draft barges would, in addition to reducing the potential for sediment resuspension in shallow waters due to access dredging and prop wash, reduce the need for bucket decanting either incidental or intentional from ascending buckets or the supporting mini-hopper barges. Such decanting has the potential to introduce sediments and associated PCBs and independent of the barge in use should be reduced to the extent possible.

Recommendation #8 Recognize that consistent and simultaneous satisfaction of the Engineering Performance Standards will most likely require an extension of project duration

The recommended modifications including the general improvement in the definition of the depth of contamination, overcuts, and some modification in dredging methodology will in addition to reducing resuspension aid in the achievement of the residuals standard. During Phase 1 the need for multiple dredging passes to meet the target remediation goals resulted in additional downstream PCB flux and effectively set the residual standard in opposition to the resuspension standard. The extent to which this conflict can be resolved will be difficult to quantitatively define until completion of the EPA modeling intended to define the acceptable downstream target PCB flux -i.e. the resuspension standard. Even without this value however, it would seem wise to make every effort to reduce downstream flux. Both EPA and GE appear to be sensitive to this need.

Both the resuspension and residual standards affect the productivity standard. With an evident relationship between the mass of sediment being disturbed and the coincident downstream flux of PCBs, it's clear that efforts to reduce this flux tend to involve some reduction in productivity. Such reductions may make it difficult if not impossible to complete the required Phase 2 dredging in the desired 5 years given the unexpectedly large mass of PCBs to be removed. The modification proposed by EPA giving them discretion to extend project duration to six years appears a reasonable place to start. Add to this the recognized need for continual evaluation of project success in meeting the Performance Standards and the hope that this will be done collaboratively and there seems a possibility that the EPSs can be satisfied consistently and simultaneously. The extent to which this goal is achievable however, very much depends on the yet to be calculated downstream flux criteria.

Recommendation #9 **Consider eliminating most near-field sampling of TSS and turbidity as well as all heavy metals sampling, near and far-field.**

Complementing all aspects of the remedial phase of this project is the intensive monitoring program consisting of both near-field observations in the vicinity of the dredge and more distant far-field measurements at points more than 1mi downstream of the dredging operation. Reviews of the variety of these data provided in the EPA and GE reports indicate that several of the protocols could be modified without loss of value. In particular there appears to be no convincing need for the heavy metals analyses as well as the extensive sampling of water column concentrations of suspended solids (TSS) and/or turbidity in the areas adjoining the dredge. In general, these observations showed minimal increases in TSS concentrations suggesting that the dredge induced plume by-passed the sampling point. Again this is a matter of spatial and temporal variability often making it difficult to find and coincidentally sample the plume. Since these data are difficult to obtain and seem to have little place in overall project management consideration should be given to their elimination. The associated reduction in vessels operating in the area and the effects of their prop wash appears to be of more value than the observations. Near field compliance does not seem to be an issue that will be of any consequence except when dealing with human health standards-air quality, noise, light and this latter sampling will continue. It is the downstream fluxes that warrant attention. Care in sampling at the first far-field station will ensure accurate initialization of factors affecting the downstream. There was no indication in Phase 1 that near-field sampling, as designed- would assist in this effort. It seems that emphasis through all of this should be placed on the fact that the effort is removing a very large mass of this contaminant of concern.

Recommendation # 10 Conduct differential bathymetric surveys of areas capped during Phase 1 to assess stability

It is anticipated that capping will be considered only after every practicable effort is made to achieve the remedial targets and not as a means of closure to satisfy project schedules. Nonetheless even such narrowly tailored use of caps should raise concerns regarding stability and the extent to which capping may limit future uses of the capped portions of the river. The EPA recommendation that capping within navigational channels be avoided if possible and come no higher than 14ft below surface if it is not seems reasonable. Such consideration with specified depths might also be added for areas that might in the future be considered for waterfront recreational or commercial operations such as marinas or docks. Local planning authorities should be invited to discuss their plans. The stability of caps in all areas warrants careful evaluation. Neither the EPA nor the GE report discussed this matter in any detail. It would be well to more carefully specify stability criteria used in the selection of the cap material (there are a variety of types specified for selected conditions) and the elevations of the cap surface relative to existing and pre-project contours. Requirements detailing post-project monitoring of cap stability should also be clearly specified. There is, for example no indication that the caps placed last fall are being monitored for stability. High resolution bathymetric surveys of these areas should be conducted on several occasions over the next year. The results of these surveys should be incorporated in Phase 2 designs to maximize cap stability under a wide range of flow conditions. This should be considered a factor essential to the long term success of this project.

Conclusion

The Phase 1 reports provide clear indication of the overall success of the effort. A significant mass of contaminated sediment was removed while many lessons were learned that will benefit Phase 2. While still dependent on the results of the ongoing EPA efforts to specify the resuspension standard there does not appear to be any inherent reason why, with some work and accommodation by all parties, the EPSs cannot be consistently and simultaneously satisfied in Phase 2.

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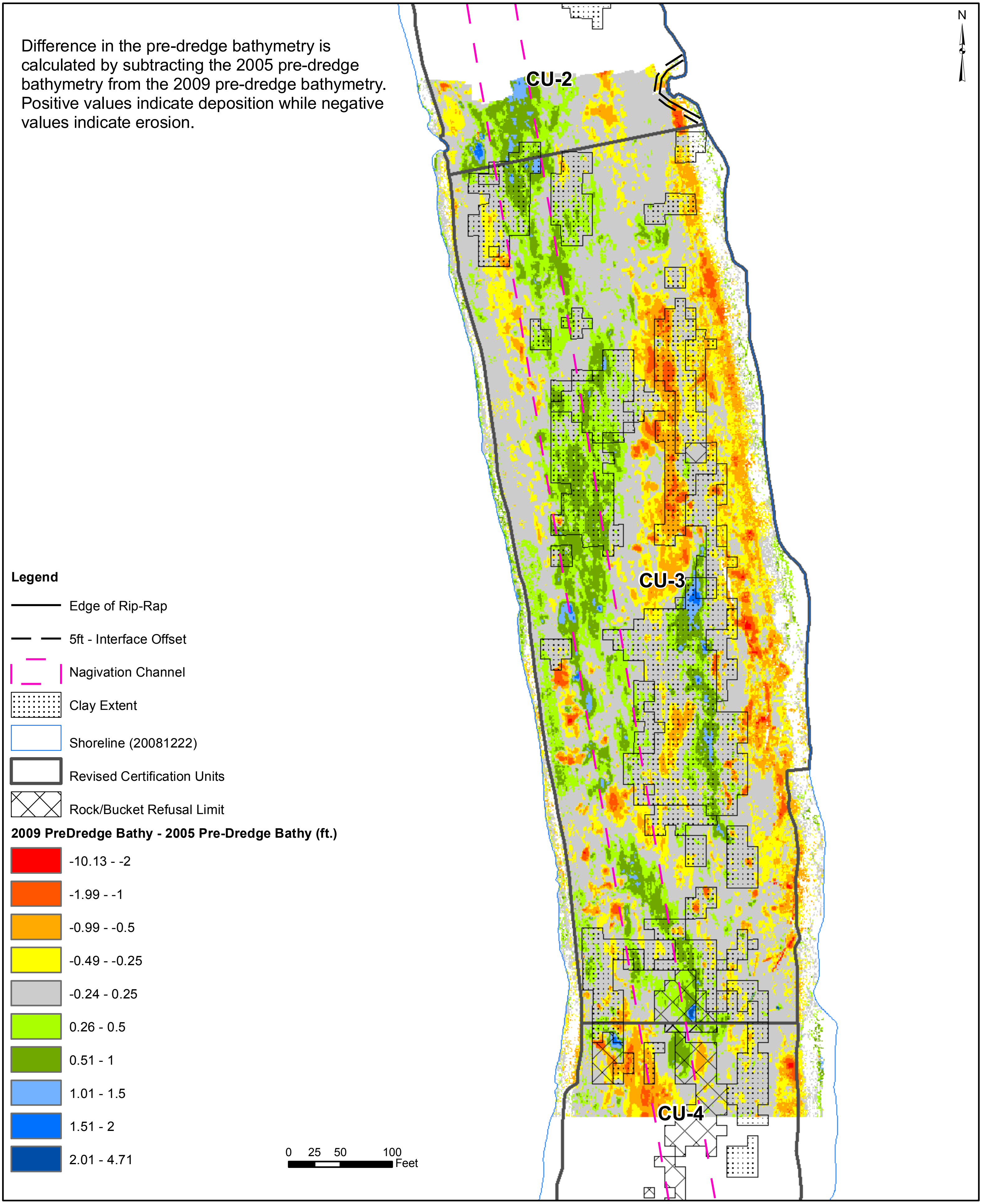

Comparison of the 2009 and 2005 Pre-Dredge Bathymetry

Hudson River PCBs Site - EPA Phase 1 Evaluation Report

Figure II-2.6c

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