Hudson River PCBs Federal Superfund Site

Report on Observations from Phase 1 Dredging Oversight

Recommendations on Changes for Phase 2

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Division of Environmental Remediation
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New York State Report on Observations from Phase 1 Dredging Oversight and Recommendations on Changes for Phase 2

Executive Summary

Section 1 - Introduction

This report is intended to convey to USEPA the State's initial thoughts on issues which were identified during the State's extensive oversight during Phase 1 which the State believes should be addressed in revisions to the design for Phase 2 of the project, and / or in possible revisions to the Engineering Performance Standards for Phase 2. It was prepared with a view toward informing USEPA on issues where a change is appropriate; it does not reflect NYSDEC's view on the overall performance of the Phase 1 work. In moving forward with Phase 1 of the remedial action for the Hudson River PCBs Site, USEPA has been able to accomplish the critical first step in completing the overall remedial action for the site. NYSDEC believes that the overall benefit associated with the removal of an estimated twenty tons of PCB from the river greatly outweighs the short-term impacts associated with the work. NYSDEC recognizes that Phase 1 was conceived of as an opportunity to not only perform a significant portion of the dredging work, but to also allow for lessons learned during Phase 1 to assist in guiding decisions on changes to project design to improve project quality, better meet the human health and environmental risk reduction objectives in the Record of Decision, and to reduce negative project impacts. The State will continue to work with USEPA to accomplish these goals, and will continue to evaluate the results of the Phase 1 efforts and to work with USEPA in developing the project design between now and the start of Phase 2.

For each of the issues identified, a recommendation has been developed by the State to address the concerns raised.

Section 2 – Resuspension Performance Standard

The State has identified multiple issues which arose during the Phase 1 work which contributed to the elevated PCB concentrations measured in surface water samples collected at the far field monitoring stations and to the exceedances of the standard. The State also believes that there are problems with the monitoring program design which limited the ability of USEPA and GE to manage the dredge operations as expected.

1) ***Issue:*** The inability of the near field total suspended solids and turbidity monitoring program to accurately reflect the magnitude of PCB release to the water column contributed to the elevated PCB surface water concentrations and exceedances of the resuspension standard. The near field monitoring program was intended to allow for near real time feedback to help manage the dredging operations to control resuspension losses: it was assumed that PCB resuspension would be correlated with suspended solids. Unfortunately, this approach did not work in Phase 1. As a result, the dredging operations were typically managed by utilizing the far field PCB monitoring results,

which did not allow for a quantified understanding of the relative contribution of the many different dredging operations.

Recommendation - The State believes that the near field solids monitoring program should be significantly reduced, and the resources reallocated to direct near field and mid field PCB measurements.

2) ***Issue:*** The underestimation of the depth of contamination (DoC) and the volume of material to be removed contributed to the exceedances of the resuspension standard, as well as problems with meeting the residuals and air standards. The State believes that multiple repeated dredge passes contributes to greater releases of PCB, in that each dredge bucket "bite" has the potential for uncontrolled releases to the water column.

   Recommendation: USEPA should ensure that the DoC underestimation is corrected before the Phase 2 design is implemented. This will likely entail a combination of additional data gathering and application of a correction factor to existing calculations in the dredge area delineation process to be applied in redrawing the dredge area boundaries and depths in Phase 2.

3) ***Issue:*** Releases of PCB during dredging in the form of a non-aqueous phase liquid (NAPL) contributed to the elevated PCB surface water concentrations and exceedances of the resuspension standard. The dredging program was designed with the basic assumption that if solids releases were controlled, then the PCB releases would be controlled. Estimates of PCB release rates used in developing the resuspension performance standard did not account for the potential for PCB NAPL to be mobilized; as a result, the technologies evaluated for control of PCB release in the project design did not specifically address this pathway. Efforts at controlling NAPL releases during Phase 1 were not as effective as they could have been, which the State believes was due to both the assumptions made during design (solids driven PCB release) and the need to more effectively implement the available NAPL control technologies once the issue was identified in the field during Phase 1.

   Recommendation: Existing project specifications should be modified and expanded to include not only the existing general broad requirement that NAPL sheens be contained and cleaned up, but also to include 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 the minimum effort required to collect and recover the NAPL (response times, staff, equipment and materials to be on hand, require tending of booms / sorbent materials, recovery of sorbent materials within 1 day of deployment or when saturated if sooner than one day).

4) ***Issue:*** Resuspension of contaminated river sediment due to scow / tug traffic contributed to PCB resuspension, which could have been reduced if additional access dredging was done to increase channel depth and allow for more laden draft and propeller driven scour (prop-wash) clearance depth to be available in the channel areas.

Recommendation: Access dredging should be done in areas which would allow full-sized scows to be used in areas which otherwise would be candidates for dredging proposed to be dredged using mini-hoppers. Access dredging in this case would reduce the number of tug trips in a work area to change out the mini-hoppers, allowing for more efficient use of the dredge platforms, and reduce the resuspension due to prop wash and grounding in the shallows.

5) ***Issue:*** Application of the PCB mass load element of the resuspension performance standard was not useful in guiding project operations.

   Recommendation: USEPA should provide a rationale for retaining the load standard. If the standard cannot be used to help guide decisions on managing the dredging operations on a near real time basis, it may be more appropriate to eliminate the PCB mass load standard as an element of the resuspension standard.

6) ***Issue:*** Data developed over the course of Phase 1 has indicated that there is more uncertainty and variability in the far field water sample results than was anticipated.

   Recommendation*:* In order to ensure that the far field surface water monitoring data is usable for the purposes described in the project Quality Assurance Project Plan, supplemental sampling should be done to verify that the data are representative of actual site conditions.

Section 3 – Residuals Performance Standard

The State has identified multiple issues during Phase 1 which impacted the project's ability to meet the Residuals Performance Standard.

1) ***Issue:*** The State believes that, because of the error in DoC in the Phase 1 design, the proportion of river bottom capped during Phase 1 was excessive given that the remedial alternative selected in the ROD was removal.

   Recommendation: The correction of the errors in DoC should result in a significant improvement in the rate at which river bottom is capped in Phase 2.

2) ***Issue:*** Capping decisions at times appeared to be driven not by the ability to successfully remove the inventory of contaminated sediment and achieve the 1 part per million (ppm) PCB residuals standard, but rather by the schedule for ending the dredging season.

   Recommendation: Areas for which there is not remaining time in the dredge season to remove a remaining inventory of un-dredged contaminated sediment should be sampled to determine the remaining surface sediment concentration as well as the remaining thickness of inventory to be removed. In areas where the remaining surface sediment PCB concentration remains significantly elevated, a thin layer of backfill should be

placed to stabilize the area until the remaining inventory can be removed the following dredge season.

3) ***Issue:*** The practice of measuring PCB residuals only in nodes that were re-dredged within a given CU creates a downward bias when calculating statistics to determine whether a certification unit meets the residuals standard.

   Recommendation: In evaluating whether or not a CU has complied with the Residuals Performance Standard, the calculations should only include either the results of a complete re-sampling of the entire CU, or use the results of previous sampling at nodes which were not dredged again. This process is necessary to avoid the possible bias associated with the inherent variability in PCB concentrations in Hudson River sediment; it is possible that simply by re-sampling a subset of sample nodes, a CU could be found in compliance due to variability rather than due to an actual change in the mean surface sediment PCB concentrations.

4) ***Issue:*** Current procedures require that half the detection limit be used for non-detect results when calculating certification unit statistics. This substitution can produce statistically invalid results.

   Recommendation: The State recommends that USEPA recalculate Phase 1 Certification Unit statistics using appropriate methods for censored data to determine whether decisions about re-dredging or certification would have been altered. These methods, though more complicated, should be used for Phase 2 unless demonstrated to have had no practical effect on Phase 1 decision making.

5) ***Issue:*** The underestimation of the DoC to be removed contributed to the problems with meeting the residuals standard. The need for multiple iterations of testing for compliance with the standard between dredge passes, caused by the underestimation of the DoC, resulted in delay.

   Recommendation: 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 collected to check for compliance with the standard, then any subsequent dredge pass would be much more likely to be based upon a correct understanding of the remaining un-dredged inventory of contaminated sediment. 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 potential sampling bias associated with the overlying material on the river bottom which was removed during the first dredge pass.

Section 4 – Productivity Performance Standard

The State also had identified issues which it believes impacted the ability of the project to meet the Productivity Standard.

1) ***Issue:*** Offloading delays at the sediment processing facility decreased empty scow availability and served as a bottleneck relative to productivity.

   Recommendation: 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.

2) ***Issue:*** Canal traffic throughput has an upper bound which may impact productivity.

   Recommendation: The design for Phase 2 needs to take into account factors which impact the ability of the Champlain Canal to handle the planned traffic during Phase 2, including water flow through the Feeder Canal, canal staffing needs, the increased potential for equipment failure due to increased lockages, and limits on future extensions of the Canal season in the fall.

3) ***Issue:*** USEPA should evaluate whether the Productivity Standard should be considered subordinate to the Resuspension and Residuals Standards.

   Recommendation: USEPA should consider that compliance with the elements of the other engineering and quality of life performance standards intended to protect human health and the environment should be given priority over compliance with the Productivity Standard. The basis for the Productivity Standard is removal of the sediment over a six year time frame (one year for Phase 1, and five years for Phase 2) as described in the ROD. The six year time frame, as the State understands, is based primarily upon the differences in predicted recovery time frames generated during the Feasibility Study process. These predicted recovery time frames were generated using a set of assumptions which included an overly optimistic recovery rate under the scenario where no dredging would be done. An evaluation of the data generated during the baseline monitoring program leads the State to the conclusion that an extension of the project duration if this would result in better compliance with the standards established to protect human health and the environment would be appropriate.

Section 5 – Quality of Life Standard for Air

Issues: The State has identified to date several issues which impacted the ability of the project operations to be conducted within the air standards including the presence of uncontrolled NAPL, the use of mini-hoppers, delays in offloading at the dewatering facility, and the presence of sediment and debris in open stock-piles at the dewatering facility.

Recommendations: The State believes that the Phase 2 design should include revisions to the modeling process used to predict exceedances of the quality of life standard for PCB in air, to take into account the data generated during Phase 1 in order to more accurately predict where standard exceedances may occur. At locations where

exceedances are predicted, mitigation measures should be mandated in advance and kept in place during dredging operations. The Phase 2 design should also include specific mitigation measures to control air releases beyond those limited measures taken during Phase 1, including the use of spray-on cover material for use in the scows and more proactive containment and immediate collection of NAPLs generated during dredging operations.

Section 6 – Habitat Reconstruction / Protection

The State has identified several specific detailed issues with the habitat reconstruction program that the State believes need to be addressed in the Phase 2 design in order to better comply with project goals and reduce impacts to post-dredging habitat quality.

1) ***Issue:*** Specific issues related to compliance with project specifications, or the need to modify particular details of specifications, were found. These include disturbances beyond project boundaries, placement of biologs for shoreline stability, and application of backfill along slopes.

   Recommendation: USEPA should follow up on compliance with specifications and ensure that project quality is not impacted by insufficient compliance with project design specifications.

2) ***Issue:*** The State believes that certain elements of the design related to project operations need to be modified.

   Recommendations: Control vessel traffic to limit damage to submerged aquatic vegetation; consider possible omission of sheet piles from the design to limit potential for fish kills; and limit turbidity plumes from backfill operations through further refinement of the backfill placement process.

3) ***Issue:*** Certain constraints contained in the Consent Decree for implementation of the remedy (the 15% limit on additional backfill volume for reestablishment of submerged aquatic vegetation (SAV) habitat and the limits on habitat assessment sample sizes) impact the ability of the project to successfully reconstruct habitat as described in the ROD for this site.

   Recommendation: USEPA should consider revising limits on backfill volume for re-establishment of SAV habitats, and increase the habitat sample sizes for the habitat assessment work.

Section 7 - Additional Recommendations for Changes to Phase 2 Design

The State has also developed specific additional recommendations for changes to the project design for Phase 2.

1 - ***Eliminate intentional decanting***

Decanting should not be allowed as part of the Phase 2 dredging program. 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. Decanting is functionally no different than allowing scow overflow back into the river, which was specifically not allowed under project specifications.

2 – *Perform an ongoing review of project performance*

Experience gained during the performance of Phase 1 was important and should be taken into account in developing the final design and work plans for Phase 2. The State also believes that, as Phase 2 moves forward, the process of evaluating project performance and making appropriate changes to project design and work plans should continue. USEPA should continue to evaluate the data generated during project monitoring, and observations made during project oversight, in order to direct necessary changes to project operations to maximize project quality, minimize any negative impacts related to the work, and to maximize the opportunities for the project work to meet the remedial action objectives set in the ROD. These changes may include changes to the monitoring programs and changes to the plans and specifications in the design documents and to the contractor work plans. USEPA needs to reserve the authority to direct these changes in order to ensure that the project moves forward in a manner which is consistent with the ROD, which states on p. 96 that USEPA will continue to monitor, evaluate performance data, and make necessary adjustments.

3 – *Reduce the frequency of near field metals sampling*

The State believes that the reduction of near field metals monitoring implemented during the latter part of Phase 1 was appropriate given the data generated during the dredging work. The metals monitoring should continue in Phase 2, but only such monitoring as would be required to confirm the existing understanding that the magnitude of metals release from the dredging operations is not going to result in exceedances of the State surface water quality standards.

4 -*USEPA should recalculate the Productivity Standard to account for changes in estimated volume for Phase 2*

Since the development of the engineering performance standards, there has been an adjustment to the estimated volume of material to be dredged in the project. The State has recommended that this volume be reevaluated and adjusted as appropriate to take into account the problems associated with the error in DoC found during Phase 1. The State believes that it is appropriate for USEPA to develop a new productivity standard with accounts for these changes in estimated dredge volume.

Section 1 - Introduction

The New York State Department of Environmental Conservation (NYSDEC), the New York State Department of Health (NYSDOH), and the New York State Canal Corporation (NYSCC) provided extensive oversight of the Phase 1 dredging work done by GE. Typically the State's oversight personnel were present during daytime hours performing field oversight, as well as performing reviewing of data generated during the project in the office and in the field, and participating in daily and weekly project meetings throughout the dredging project period. This effort was supplemented by NYSDEC's contractor, CDM, who was brought in to assist NYSDEC in field oversight of the numerous, simultaneous field activities being performed by the dredging and dewatering facility contractors. During most of the field season, the dredging contractor typically had over ten individual operations active at any one time, including operation of the dredge platforms, movement of scows, transfer of sediment from small barge platforms carrying dredged material ("minihoppers") to large scows, survey and monitoring work, and maintenance of resuspension and NAPL capture systems and controls. Simultaneous operations at the dewatering facility included sediment offloading, size separation processing, sediment dewatering/filter press operations, water treatment operations, sediment and debris transfer and stock-piling/storage activities, and rail car preparation and loading operations. As a result of the large number of simultaneous operations, it was common for individual project operations to be active without direct oversight by USEPA or GE project staff. Anticipation of this condition led NYSDEC to bring in CDM to support the State's efforts.

The State oversight of the dredging operations (including debris removal, inventory dredging, residuals dredging, access dredging, scow movement, sediment transfer, survey work, and monitoring work) was done from the point of view that any one operation could result in an exceedance of the project standards or impact project quality. As a result of the State's oversight efforts, there were numerous times when State representatives contacted USEPA to provide information related to active dredging operations where the State was concerned that the performance of those operations may have been performed outside of project specifications or in a manner which could contribute to an exceedance of project standards. As the field season progressed, the focus of the State's oversight efforts became mainly focused on the following: (1) potential exposures as a result of PCB releases to ambient air during dredging and dewatering facility operations; (2) issues related to PCB releases to the water column during dredging, particularly as is pertained to releases of NAPL; and (3) issues related to productivity, primarily offloading operations at the work wharf and the associated scow availability and dredge down time observations.

The State project team communicated with USEPA on a daily basis at a minimum to relay observations and / or identify any issues or concerns that may have arisen related to the project as appropriate. State project personnel also typically attended the daily and weekly job progress meetings between USEPA and GE either in person or by conference call. Consistent with USEPA's project management role, the State project team did not attempt to provide any direction to GE, GE's oversight staff, or GE's contractors.

This report is intended to convey to USEPA the State's initial thoughts on issues which were identified by the State during Phase 1 which the State believes should be addressed in possible

revisions to the design for Phase 2 of the project, and in possible revisions to the Engineering Performance Standards for Phase 2. It was prepared with a view toward informing USEPA on issues where a change is appropriate; it does not reflect NYSDEC's view on the overall performance of the Phase 1 work. In moving forward with Phase 1 of the remedial action for the Hudson River PCBs Site, USEPA has been able to accomplish the critical first step in completing the overall remedial action for the site. NYSDEC believes that the overall benefit associated with the removal of an estimated twenty tons of PCB from the river greatly outweighs the short-term impacts associated with the work. NYSDEC recognizes that Phase 1 was conceived of as an opportunity to not only perform a significant portion of the dredging work, but to also allow for lessons learned during Phase 1 to assist in guiding decisions on changes to project design to improve project quality, better meet the human health and environmental risk reduction objectives in the Record of Decision, and to reduce negative project impacts. The State will continue to work with USEPA to accomplish these goals, and will continue to evaluate the results of the Phase 1 efforts and to work with USEPA in developing the project design between now and the start of Phase 2.

The report text is formatted in a manner which summarizes the issues identified by the State during oversight of Phase 1, provides a description of how the issue impacted project quality or compliance with standards, and provides a set of recommendations on how to address each of the issues raised. Attachments are also included which (1) detail specifics related to operation of the Champlain Canal and how these operations need to be taken into account in Phase 2; (2) provide graphs illustrating certain points related to NAPL releases as seen in the water column PCB data; and (3) provide photographs illustrating points raised in the report text.

Section 2 – Issues related to Resuspension Performance Standard

The State has identified multiple issues which arose during the Phase 1 work which contributed to the elevated PCB concentrations measured in surface water samples collected at the far field monitoring stations and to the exceedances of the standard in the first week in August and in the second week in September. The State also believes that there are problems with the monitoring program design which limited the ability of USEPA and GE to manage the dredge operations as expected.

Issues related to the resuspension standard identified by the State oversight efforts are:

1) The inability of the near field total suspended solids and turbidity monitoring program to accurately reflect the magnitude of PCB release to the water column contributed to the elevated PCB surface water concentrations and exceedances of the resuspension standard. The near field monitoring program was intended to allow for near real time feedback to help manage the dredging operations to control resuspension losses: it was assumed that PCB resuspension would be correlated with suspended solids. Unfortunately, this approach did not work in Phase 1. As a result, the dredging operations were typically managed by utilizing the far field PCB monitoring results, which did not allow for a quantified understanding of the relative contribution of the many different dredging operations.

2) The underestimation of the depth of contamination and the volume of material to be removed contributed to the exceedances of the resuspension standard, as well as problems with meeting the residuals and air standards. The State believes that multiple repeated dredge passes leads contributes to greater releases of PCB, in that each dredge bucket "bite" has the potential for uncontrolled releases to the water column. Taking less than full bucket "bites" due to underestimation of the depth of contamination, and then having to come back for further bucket "bites" to get to the newly revised depth of contamination results in greater opportunity for PCB loss to the water column.

3) Releases of PCB during dredging in the form of a non-aqueous phase liquid (NAPL) contributed to the elevated PCB surface water concentrations and exceedances of the resuspension standard. The dredging program was designed with the basic assumption that if solids releases were controlled, then the PCB releases would be controlled. Estimates of PCB release rates used in developing the resuspension performance standard did not account for the potential for PCB NAPL to be mobilized; as a result, the technologies evaluated for control of PCB release in the project design did not specifically address this pathway. Efforts at controlling NAPL releases during Phase 1 were not as effective as they could have been, which the State believes was due to both the assumptions made during design (solids driven PCB release) and the need to more effectively implement the available NAPL control technologies once the issue was identified in the field during Phase 1.

4) Resuspension of contaminated river sediment due to scow / tug traffic contributed to PCB resuspension, which could have been reduced if additional access dredging was done to

increase channel depth and allow for more laden draft and prop (prop-wash) clearance depth to be available in the channel areas.

5) Application of the PCB mass load element of the resuspension performance standard was not useful in guiding project operations.

6) The representativeness of the far field monitoring stations should be verified periodically over the course of the project. Data developed over the course of Phase 1 has indicated that there is more uncertainty and variability in the far field water sample results than was anticipated. In order to ensure that the far field surface water monitoring data is usable for the purposes described in the project Quality Assurance Project Plan, the State believes that supplemental sampling should be done to verify that the data are representative of actual site conditions.

Section 2.1 – *Near Field TSS and turbidity monitoring program did not reflect the magnitude of PCB releases*

<u>Assumed TSS surrogate relationship was not observed in near field monitoring results</u>

The Phase 1 Engineering Performance Standards were predicated on the assumption that TSS concentration was a suitable surrogate for PCB concentration in the water column. As part of the Phase 1 near field monitoring program, TSS concentrations were measured both during transect monitoring (twice per day during daylight hours) and buoy monitoring (every 6 hours). This near field monitoring occurred at the compliance point located 300 meters from the dredging operation(s). The monitoring program reported measured TSS concentrations that generally remained well below the near-field resuspension performance standard (control level - 100 mg/l for a daily dredging period). Despite these low near field measurements, the far field measured PCB concentrations varied widely, exceeding the far field performance control level of 350 ng/L (control level) as well as the EPA/DOH resuspension standard (or threshold) of 500 ng/L(which is equal to the USEPA/NYSDOH MCL). Exceedances of the resuspension standard/DOH MCL in the far field occurred at the Thompson Island Dam station on a number of separate occasions. The dredging was shut down due to verified exceedance of the far field standard two times during the Phase 1 project. Because the near field measurements of TSS did not predict the violations of the resuspension standard for PCB's in the far field, and because the far field PCB control standard exceedance caused dredging operations to be suspended, a special monitoring program was proposed by GE and was implemented in August 2009. This special monitoring included water column samples for PCB, POC/DOC and TSS analysis at nine locations within the Phase 1 dredging area. At seven locations, samples were collected along transects perpendicular to river flow to capture PCB transport along the full cross section of the river. The other two individual, depth-integrated, composite samples were collected inside the sheet piling and silt curtains deployed in the EGIA . The purpose of the monitoring program was to quantify the Thompson Island Far-Field PCB concentrations attributable to various dredge certification units. The results of this special monitoring program indicated that the near field PCB concentrations also correlated poorly with TSS and that a very high proportion of measured PCB in the near field was of the dissolved form and not the total form. Since dissolved PCB would not necessarily be associated with particulates, its concentration cannot be represented by

resuspension of particulates during dredging. Therefore, the results of the Phase 1 monitoring indicate that the underlying assumption regarding the suitability of TSS as a surrogate for PCB is not valid.

In order to rectify this situation for Phase 2, some type of direct near field PCB monitoring program should replace the Phase 1 TSS monitoring program. The measured TSS concentrations, in addition to being of little use for predicting PCB concentration, were generally so low as to provide little useful information at all. If TSS is to be measured in Phase 2, it should be at a much reduced frequency. Instead, a monitoring program that includes the direct measurement of PCB in the near field should be implemented and some type of a control level should be designed to provide feedback to provide feedback to the dredge operator so that operations can be modified accordingly. An evaluation level PCB concentration in the near field could be useful to ensure that there will not be forced shut down of the project during Phase 2 due to exceedances of the far field EPA/DOH MCL. The evaluation level would require a quick turnaround time on PCB analyses.

<u>Assumed Turbidity / TSS relationship was not observed in near field monitoring results</u>

Aside from the New York State Water Quality Standard for turbidity which is "no increase that will cause a substantial visible contrast to natural conditions", turbidity was also used as a surrogate for TSS concentration in the near field. Turbidity measurements in the near-field were conducted at 150 meters and 300 meters downstream from dredging operations. Turbidity measurements were to be used for predicting compliance with the near field TSS resuspension standard prior to receipt of the laboratory TSS results. However, there was no prior explanation of how turbidity measurements in the near field would be used with an established TSS/turbidity relationship to ascertain the need to modify the dredging operation (reduce speed, add silt curtains, etc.). A discussion of the feedback mechanism to the equipment operator, with feedback based on the measured turbidity in the near field, should have been provided prior to dredging and measuring near field constituents. Although turbidity measurements were collected during both transect monitoring and buoy monitoring in the near field, it is not clear whether any decisions were made based on the turbidity measurements or whether anything was ever done with the turbidity data.

Measured turbidity in the near field proved problematic at times. For example measurements reported in May ranged from -0.3 to 1,216.7 NTU (May 16th) and -0.5 to 1,201 NTU (May 18-24). On May 16th, negative turbidity measurements were reported at Rogers Island west at the 100 m, 300 m and 10 m side channel transects, all in the near field. On the same date, the measured turbidity at the 100 meter upstream buoy was 1,216.7 NTU at 16:30 hoursand a measurement of 530 NTU occurred at a 100 m downstream transect at 13:13 hours. The May 18 – -24 measurement results included negative turbidity measurements at far field automated stations, with 1201 NTU measured at an upstream transect. No explanation was provided regarding these widely divergent results or the negative turbidity measurements. At near field buoy stations on many dates in May and some dates in June, pH and D.O measurements were also reported as zero. If pH and DO were zero, these results would have violated Water Quality Standards. Also, fish would not be able to survive and fish kills would have been reported throughout these areas. In June there were still negative measurements of turbidity reported for a

far field station and also some D.O measurements were approaching zero. By July the negative turbidity measurements subsided, but there were still some very low pH measurements in August. These results indicate recurring problems with meters used at both the near field (buoy and transect) and the far field stations. During the project, no description of actions taken to deal with random meter readings was provided, nor were there any explanations of obvious outlier measurements (negative turbidity readings, zero D. O.). It is important that an evaluation of Phase 1 results discuss the turbidity, pH and D.O. meter readings, how these measurements were evaluated and what if anything was done to fix the problems with the meters. Any recommended changes to procedures should be proposed prior to implementation of Phase 2, as unreliable results are of no use for evaluation of dredging procedures.

A paired buoy TSS/turbidity study was conducted in July 2009 to compare measurements/analytical results at mid depth with those results collected near the bottom. The primary purpose was to determine whether or not there was stratification in the water column. The results of the study compared the two TSS results and the two turbidity meter readings to each other, but did not compare the TSS results to the turbidity results. An evaluation of these already collected TSS results and concurrent turbidity measurements should be undertaken to determine whether or not there is a good correlation between turbidity and TSS. Additionally, the collected data in the near and far field should be compared by date, time and location to determine whether there is a good correlation between turbidity and TSS. Also, a complete evaluation of the collected TSS and turbidity data in the near field should be undertaken to determine whether turbidity proved to be a reliable surrogate for TSS. If the two are not properly correlated, then Phase 2 should not rely on turbidity as a surrogate for TSS. In that case, it might be more appropriate to measure near field PCB concentrations, with a quick turnaround time, in order to provide proper feedback to the dredge operator. An appropriate monitoring program, with feedback based upon the measured turbidity or PCB concentration in the near field, should be developed prior to the Phase 2 dredging.

Section 2.2 - *Depth of Contamination ("DoC") underestimation caused significant problems*

The State believes that the discovery during Phase 1 that the actual thickness of contaminated sediment often greatly exceeded the "depth of contamination" developed using the approach in the dredge area delineation (DAD) process has significant implications for Phase 2. This error in the project design needs to be corrected for a number of reasons, and needs to be corrected prior to finalizing the Phase 2 dredge prisms during completion of the Phase 2 final design report.

The State believes that the underestimation of the DoC is based, at least in part, on an unintentional sampling bias during the Sediment Sampling and Analysis Program (SSAP) element of the remedial design. This sampling bias was likely due to a combination of (1) inadequate penetration during the vibracoring process used in the SSAP; (2) core blockage due to the presence of woody debris, limiting the ability of the vibracoring process to collect full depth representative samples; (3) core compression, which also would limit the ability of the vibracoring process to collect true depth representative samples; and (4) application of inaccurate DoC extrapolation methodologies for incomplete cores.

Correction in the Phase 2 design effort is necessary to ensure that the Phase 2 design complies with the Order on Consent for remedial design and with the Record of Decision for this site. In the Consent Decree, Appendix B, Attachment A (Critical Phase 1 Design Elements) Section 2.4 describes the process for developing the dredge prisms to be provided to the contractor to govern where sediment is to be removed from the river. A significant factor in dredge prism development is how the "surface of sediment depth" is generated using the available core data from the Sediment Sampling and Analysis Program. In order to generate this "surface of sediment depth", core data from the SSAP is applied according to the rules laid out in Section 2.4. Unfortunately, application of the core data following the rules in Section 2.4 resulted in the generation of dredge prisms for Phase 1 with set depths of cut for the dredging contractor that left, in many cases, significant thicknesses of contaminated sediment behind. This was most evident in the east channel at Rogers Island, where in Certification Unit 1 several additional feet of removal was done in an attempt to remove the inventory of contaminated sediment. The need for additional sediment removal due to underestimation of the depth of contamination was not limited to the east channel at Rogers Island, but was most significant there.

Underestimation of the depth of contamination resulted in two errors during development of the dredge prisms. Not only was the contractor provided with inaccurate depths for sediment removal, but the State also believes that it is very likely that core locations which were excluded from dredging in the Phase 1 dredge area delineation report due to insufficient PCB mass per unit area (MPA) calculations (less than 3 grams per square meter), may actually have qualified for removal if the actual thickness of contaminated sediments was correctly identified at each core location.

The State believes that, in order for the Phase 2 dredging work to meet the removal criteria set forth in the ROD, an evaluation will need to be done to refine both the depth of contamination in the areas already delineated for removal, and the mass per unit area (MPA) estimates in areas where the estimated MPA is 50 % or more of the removal criteria for that river section. This work should be done utilizing a sampling process which takes into account the potential causes of sampling bias described above.

Section 2.3 - *NAPL releases during dredging impacted resuspension standard and air standard compliance*

New York State has a Water Quality Standard for oil and floating substances which reads, "No…visible oil film nor globules of grease." Floating sheen blebs, blooms, stringers, and mats were repeatedly observed in the vicinity of dredging operations during Phase 1, and control measures, if implemented, were inadequate.

Over the course of the Phase 1 dredging work, State oversight staff paid particular attention to dredging operations and conditions that resulted in the generation of NAPL releases and the techniques used by the contractor to manage those releases of NAPL from the dredging operations. State oversight staff often typically identified the various NAPL releases by direct observations from a boat traverse immediately downstream of dredging operations, but also made observations from the shore and the fixed structures at Champlain Canal Lock 7, the Fort Edward Terminal Wall (Yacht Basin) and the Route 197 Bridge. When NAPL was observed,

State oversight staff would typically contact USEPA by telephone or by email to notify the agency about of the NAPL releases; provide detail about the physical nature (blebs, blooms, stringers, and or mats), the size, and the specific location of the releases; and express the need for response to the releases as appropriate. The State's response to the NAPL releases was in keeping with the State Water Quality Standard and the Project Specification 13801 in Contract 4 – Inventory Dredging.

State oversight staff would also observe the response of GE's contractor when NAPL was observed. When the contractor did respond to the releases of NAPL, the response would often involve the deployment of harbor booms and/or sorbent booms in the immediate vicinity of the specific dredging operation believed to be the source of the observed releases. Unfortunately, the booms were often placed by the contractor and then left unattended for long periods of time or without any active NAPL collection operations; as a result, movement or displacement of the booms by wind, wave action or subsequent dredging operations would allow for uncontrolled downstream releases of NAPL from the deployed booms. State oversight personnel also observed, on several occasions, instances when the booms and secondary sorbent materials used to stem a release of NAPL at a particular operation were left in the river for several days after deployment - a situation conducive to allowing the NAPL contained by the booms or sorbent materials, or which would have sorbed onto the booms or sorbent materials, to be re-released back into the river water column.

On August 7, USEPA recommended that GE proactively place booms around the dredge platforms regardless of the presence or absence of observed sheens as a result of the recurring observations of NAPL releases from the dredging operations. USEPA also recommended to GE at that time to stop decanting from the dredge buckets, to deploy sorbent material as soon as sheens were observed, to minimize the use of minihoppers, to better manage the silt curtain / harbor boom at the south end of the east channel at Rogers Island, and to better manage the number of "bucket bites" to achieve the target cut depths.

The observed releases of NAPL during dredging operations raises several concerns which should be taken into account by USEPA in considering possible changes to the project design for Phase 2 of the project. These concerns include:

1) The PCB mass transfer to the river water column associated with the releases of NAPL was not accounted for, or quantified by, the near field monitoring program. NAPL releases may be responsible for a portion of the "noise" in the far field PCB surface water data gathered at the Thompson Island automated monitoring station. A preliminary evaluation by NYSDEC suggests that the variability in the data may be due to the presence of NAPL. This preliminary analysis looked at the congener distributions from the analyses of duplicate samples collected on the days with the highest PCB concentrations. By examining congener distributions of the duplicate samples, and distribution of the difference between the duplicate samples, one can infer the source of the variability, which NYSDEC believes is the presence of PCB NAPL. See Figure 1 in Attachment 2, which displays the congener distribution of the samples collected on August 6. Figure 2 in Attachment 2 shows the distribution of the difference between the

samples. The congener distribution of the difference appears to closely resemble the congener distribution of aroclor 1016 or aroclor 1242.

2) NAPL releases should be considered as a significant mechanism for PCB transfer to the water column when considering processes and technologies for controlling the downstream movement of PCB from the project area. Controlling NAPL releases may be more important than controlling solids releases from dredging operations.

3) NAPL releases appear to be a significant source of emissions of PCBs to air near dredge operations and sediment handling and storage activities. NYSDEC's evaluation of the ambient air data indicates that NAPL releases need to be controlled and minimized in order to mitigate exceedances of the quality of life standard for PCB in ambient air. A critical evaluation of the techniques and technologies that were evaluated during Phase 1 and shown to be successful should be implemented as mitigation measures in Phase 2. Additional techniques that were not tested during Phase 1 but are proven technologies for NAPL capture and collection, as well as emissions controls, may also need to be examined and incorporated into the Phase 2 design.

Photograph 1 and 2 in Attachment 3 show the typical surface expression of NAPL releases once the droplets of NAPL have coalesced; photograph 3 shows a typical deployment of booms in the vicinity of a dredge platform.

Section 2.4 - *Scow / tug traffic caused resuspension; need to perform additional access dredging*

Operation of the "minihopper" platforms to move dredged material from the dredge areas to the transfer point for loading to a standard scow was driven primarily by limited draft. In some areas, this limited draft was controlled by rock bottom. In many areas, however, the limitations on draft were due to sediment accumulation either within the defined channel or between the defined channel and the dredge area. In these areas, a decision was made to avoid performing access dredging and use the minihopper platforms. This decision led to multiple negative consequences for the project including: (1) increased air releases; (2) increased resuspension due to the increased number of tug trips across areas of shallow draft; and (3) reductions in productivity due to the time needed to repeatedly exchange minihopper platforms. NYSDEC believes that the use of minihopper platforms was a significant contributing factor in air emissions.

The Fort Edward Dam was removed in 1973. This led to the downstream release of contaminated sediment previously held behind the dam and resulted in the mingling of these sediments with the variably contaminated sediments already present downstream of the dam, and / or the covering of the contaminated sediments already present downstream of the dam. As a result of the dam removal and subsequent scouring of the sediments previously held behind the dam, the Hudson River from Rogers Island to a point about one quarter mile below Lock C-7 was clogged with sediment and debris within one year. The NYS Department of Transportation (NYSDOT) conducted two rounds of dredging to clear the river and navigation channel of

sediment and debris. During these dredging activities, the presence of PCBs was discovered in the sediments. Because the Hudson River was thoroughly contaminated with PCBs, the State of New York ceased maintenance dredging of the navigational channel in the Hudson River after 1978. The increased complexity and cost of dredging and disposing of the contaminated sediments made maintenance dredging for navigation essentially impossible as a practical matter.

During the next 30 years, the Hudson River has accumulated sediment in the Champlain Canal navigation channel. The continued accumulation of sediment has restricted navigational access in significant sections of the river. Most notably, the Fort Edward Yacht Basin had only 3-4 feet of draft available before Phase 1 dredging began.

Depth restrictions in the navigation channel resulted in GE conducting limited navigational dredging in Phase 1 to enable deeper draft vessels and barges to maneuver in the river. However, the amount of navigational dredging was very limited and many barges were only partially filled to avoid running aground as they transited the shallow portions of the canal. By only filling barges to half- or less-than-half-full, the number of round trips of barges between the dredge area and the processing facility were substantially increased. In addition to simply increasing the amount of traffic on the river and through Lock C-7, the half-empty barges also resulted in dredges remaining idle for hours each day while they waited for an empty barge to resume dredging.

If additional navigational dredging were included in the design, the productivity of vessel traffic and dredge operating efficiency would be increased substantially. Looking forward to Phase 2, there are additional locations in the River where the available depth will limit the draft of project vessels. As the hauling distance (and therefore round-trip times) between the active dredge areas and the processing facility increases each year in Phase 2, optimizing the number of barge movements will become increasingly important to meeting the productivity standard.

Inadequate draft also contributed to exceedences of the resuspension standards. Vessels occasionally grounded, which caused increased turbidity and water-borne PCB contamination, and significant prop-wash was observed throughout the project, contributing to the same problems.

The State recommends that sufficient access / navigational dredging be conducted during Phase 2 to ensure that vessel draft or navigational limitations do not adversely impact Phase 2 productivity and resuspension. It is notable that USEPA's ROD envisioned dredging approximately 341,000 cubic yards of sediment within the navigational channel. USEPA recognized the productivity and resuspension problems that reduced vessel draft would have on the project and intended to preclude such problems by ensuring adequate channel depth for unimpeded navigation throughout the Canal.

Section 2.5 - *Application of the PCB mass load element of the Resuspension Performance Standard was not useful in guiding project operations*

An element of the Resuspension Standard was the establishment of a standard for how much PCB mass was transported to the Lower Hudson River during dredging. This standard was

established based upon modeling exercises, baseline monitoring of the Upper Hudson, and case studies, as described in the documents published by USEPA defining the performance standards.

The modeling work was done to compare the anticipated impacts of the release of PCBs from dredging at the rates for the evaluation level and control level in the resuspension standard with the anticipated monitored natural attenuation (MNA) alternative as laid out in the ROD for the site. USEPA found during this modeling exercise that the predicted future PCB concentrations in the water column and in fish under the evaluation level and control level rate of PCB release were similar to the predicted future PCB concentrations in the water column and in fish under the MNA scenario. USEPA's rationale in the Engineering Performance Standards (EPS) document is that the rates of resuspension at the evaluation or control levels would not result in a long-term negative impact on future PCB concentrations in the water column and in fish and was therefore acceptable.

In considering the application of the PCB mass load standard in Phase 1, the State is concerned that the use of the load standard as a tool to manage the dredging operations in near real time is infeasible. Understanding what the magnitude of the "baseline" load is given the day to day changes in flow during dredging is nearly impossible; USEPA's definition in the EPS of net load is difficult to calculate on a day to day basis, given the need to understand how to account for flow in predicting which baseline concentration to use in calculating background load. USEPA should consider revising this standard to allow it to be used to guide dredging operations, or eliminate this element of the standard.

Section 2.6 - *The representativeness of the far field monitoring stations should be verified periodically over the course of the project.*

During Phase 1, there were several occasions when there were duplicate or triplicate samples collected from the far field surface water automated monitoring stations. In reviewing the data generated from these sampling events, the State has observed that there have been potentially significant differences between the duplicate or triplicate sample results, both in terms of the magnitude of the total PCB measured and in terms of the congener pattern of the PCB measured in the sample. The State is concerned that this could indicate that the representativeness of the monitoring results is in question.

In GE's Phase 1 Data Compilation Report, there is also a presentation of data generated during sampling events where samples from the automated station were analyzed and compared to manually collected transect samples from the river water column at the automated sampler location. In these paired data, it appears that there may be a difference in the results such that a daytime manual sample is typically ~50% higher than the automated sample. USEPA should closely evaluate the available data to ensure that the data from the automated sampling stations is representative, and include in the Phase 2 design any supplemental data collection activities such as are needed to confirm that the data from the far field automated monitoring stations are representative and usable to enforce the resuspension standard. NYSDEC and NYSDOH suggest that if the data variability is shown to be sufficiently large, than alternatives to the program including but not limited to reevaluation of the Resuspension Standard should be considered by USEPA.

Section 3 – Issues related to the Residuals Performance Standard

The State has identified multiple issues during Phase 1 which impacted the project's ability to meet the Residuals Performance Standard. These issues are:

1) The State believes that the proportion of river bottom capped during Phase 1 was excessive given that the remedial alternative selected in the ROD was removal. The correction of the errors in DoC should result in a significant improvement in the rate at which river bottom is capped in Phase 2.

2) Capping decisions at times appeared to be driven not by the ability to successfully remove the inventory of contaminated sediment and achieve the 1 part per million (ppm) PCB residuals standard, but rather by the schedule for ending the dredging season.

3) The application of the residuals standard and placement of caps resulted in construction of caps which will complicate the ability of the Canal Corporation to successfully maintain channel depth.

4) The practice of measuring PCB residuals only in nodes that were redredged within a given CU creates a downward bias when calculating statistics to determine whether a certification unit meets the residuals standard.

5) Current procedures require that half the detection limit be used for non-detect results when calculating certification unit statistics. This substitution can produce statistically invalid results.

6) The underestimation of the DoC to be removed contributed to the problems with meeting the residuals standard. The need for multiple iterations of testing for compliance with the standard between dredge passes, caused by the underestimation of the DoC, resulted in delay.

Section 3.1 - *Excessive capping occurred in the Phase 1 Certification Units*

Over one third of river bottom which was dredged during Phase 1 ended up with a cap being constructed after failure to meet the residuals performance standard. The State believes that several issues contributed to this result, including (as described below) schedule / end of season issues and the problems associated with the underestimation of the DoC during design.

The Residual EPS (p. 21) notes that proper design of dredging cut lines would be an "important factor in minimizing the number of redredging attempts." The EPS also predicted (on p. 22) that, at most, 8% of target areas in Phase 1 and Phase 2 would be capped - "Conservative estimates indicate that exceedances of the PL action levels will require redredging or capping of 33 acres, or 8% of the total area targeted for removal." GE's inability to accurately define depth of contamination led to capping approximately 36% of areas dredged during Phase 1, more than four times the percentage contemplated by the Performance Standard.

The State believes that, given the remedial alternative selected in the ROD was a removal alternative which was specifically chosen over a capping alternative, the proportion of river bottom capped in Phase 2 should not approach the amount capped in Phase 1. The correction of the errors in DoC should result in a significant improvement in the rate at which river bottom is capped in Phase 2.

Section 3.2 - *Capping decisions were impacted by schedule*

In several certification units (CUs), the decisions to cap certain portions of the CU (or the entire CU) were apparently driven not by the concentration standards defined in the Residuals Performance Standard, but by the need to close out the unit prior to the close of the dredging season. The remedy as described in the ROD for the site is a dredging remedy; the decision to select the dredging remedy over the capping remedial alternative was made by USEPA for the reasons described in the ROD. The Residuals Performance Standard was developed with a view toward compliance with the ROD; as a result, concentration standards were included in the standard, with allowances for capping in areas where meeting the standards was infeasible due to specific conditions found in that CU. Unfortunately, the condition arose such that the end of the dredging season (not envisioned as an element of the Residuals Performance Standard) drove the decision to cap certain CUs or portions of CUs outside of the parameters set in the Residuals Standard.

The State believes that the decision to cap should not be driven by schedule. CUs containing a remaining removable inventory of undredged contaminated sediment should not be capped until that inventory has been removed. This approach would be consistent with the intent of the ROD and with the Residuals Standard. Areas for which there is not sufficient time at the end of the dredge season to remove a remaining inventory of undredged contaminated sediment, should be sampled to determine the remaining surface sediment concentration as well as the remaining thickness of inventory to be removed. In areas where the remaining surface sediment PCB concentration remains significantly elevated, a thin layer of backfill should be placed to stabilize the area until the remaining inventory can be removed the following dredge season.

The most extreme example of the schedule driving the decision to cap is the example of CU-1. In CU-1, the entire navigation channel was capped with a goal of providing a nominal navigation depth of 12 feet in the navigation channel. CU-1 is located in the Fort Edward Yacht Basin and is adjacent to the Fort Edward Terminal Wall. Nearly the entire basin between the Terminal Wall and Rogers Island is within the navigation channel at CU-1.

Residual contamination beneath the cap in CU-1 is greater than 50 parts per million (ppm) total PCBs for almost the entire CU. Concentrations as high as 534 ppm total PCBs are present within the top two feet immediately beneath the cap. Concentrations of this magnitude indicate that the intent of the Residuals Standard was disregarded and a cap was placed in CU-1 as an expediency to meet schedule demands at the end of the dredge season. It appears that the goal in CU-1 at the end of the season was to meet the 12 -feet navigational requirement instead of reaching a residual of 1.0 ppm PCBs, and that undredged inventory was left behind beneath the cap in this area.

Section 3.3 - *Depth of water over caps compromises future channel maintenance*

The cap, as placed by GE, does not provide for a full 12 feet of depth in the entire navigation channel. As can be seen in the as-built drawings for CU-1, significant areas of CU-1 did not meet the design requirement for 12 feet of depth within the navigation channel.

Because CU-1 was dredged with a revised goal of meeting the navigation depth (even though it was not entirely successful) and the areas surrounding CU-1 were not dredged at all, the remedial dredging effectively created a "bathtub" within the surrounding sediments. The pre-dredge bathymetry in and surrounding CU-1 was only 4-5 feet deep. Post-dredge bathymetry shows that water depth in areas surrounding CU-1 remain at 4-5 feet and surround those areas within the dredge area with steep, 7-8 foot plunging sediment walls to the new basin floor at a water depth of about 12 feet. The State is concerned that the steep, 7-8 foot walls of the "bathtub" will erode into the newly created basin within CU-1, resulting in a need for maintenance dredging within the next few years which would likely not exist had stable side slopes been established at the margins of CU-1.

Further, given the project's underestimated extent of contamination in Phase 1 areas, the State believes there is a strong probability that the areas immediately surrounding CU-1 (including the remainder of the navigation channel that was excluded from the boundaries of CU-1) are likely to contain total PCBs greater than 50 ppm. Erosion of these sediments into CU-1 and onto the cap will create a significant problem for the Canal Corporation. If NYSCC were to attempt dredging of this material, it would likely exceed existing NYSDEC requirements for special handling and disposal of the sediments. In addition, NYSCC is likely to damage and/or penetrate the cap in CU-1 if it were to make any attempt at maintenance dredging. Penetration of the cap in CU-1 would expose sediments that contain over 50 ppm total PCBs at the surface of the river bottom (and in many locations, the concentrations would also be greater than 50 ppm Tri+ PCB). This and could ultimately compromise the effectiveness of the remedy in this area.

NYSCC is required by its regulations (21 NYCRR 155) to maintain a design depth of 12 feet within the navigable channel of the Champlain Canal. When NYSCC identifies an area where significant refill has occurred that affects the navigability of the canal, that area will be scheduled for maintenance dredging. When conducting maintenance dredging, NYSCC routinely incorporates an "over-cut" in the dredge area to ensure that continuing refill will not rapidly compromise the channel depth.

Section 3.4 - *Sampling bias affects calculations for Residuals Standard*

Conformance with the Residuals Standard was determined using statistics calculated from cores associated with 40 nodes within each CU. Multiple dredging passes were required in many locations. In calculating the statistics for Residual Standard, new cores were taken only from redredged nodes - previously obtained values from cores from undredged nodes were retained for the analysis. This procedure will cause a downward bias in the calculated statistics that increases with each dredging pass and set of calculations. The extent of the bias will depend on the spatial granularity of PCBs and the consequent extent to which a single core is representative

of the entire node. The downward bias will increase with greater fine scale variability in PCB concentrations and can become considerable.

Section 3.5 - *Treatment of non-detect values may bias calculations for residuals standard*

The substitution of half the detection limit for PCB results that are below the detection limit can produce statistically incorrect results (e.g., Helsel. 2005. Nondetects and data analysis: Statistics for censored environmental data. Hoboken, N.J. Wiley Interscience). Phase 1 procedures nonetheless required this substitution when calculating CU statistics used to make decisions about additional dredging and capping. Whether this substitution had a meaningful effect on the decisions made during Phase 1 is unknown; USEPA should evaluate whether the calculations used during Phase 1 were impacted by this substitution, and modify how non-detects are used in the calculations during Phase 2.

Section 3.6 - *The underestimation of the depth of contamination to be removed contributed to the problems with meeting the Residuals Standard*

The need for multiple iterations of testing for compliance with the standard caused by the underestimation of the DoC led to multiple iterations of delay between dredge passes. As the season progressed, it became apparent to the State that there were avoidable delays associated with the underestimation in DoC; after each dredge pass, there was a round of sampling and survey work to develop the data necessary to determine if the design cut lines and Residuals Standard were met. The DoC underestimation resulted in the need for multiple interations of this process, which could have been avoided if the initial DoC determinations/estimates were correct. The number of iterations can be reduced through confirmation of the DoC prior to the start of Phase 2 (discussed below) and through a change in the sampling and analysis program for the Residuals Standard compliance sampling. If the DoC were reconfirmed after the first dredge pass through analysis of the entire cored interval, instead of only analyzing the uppermost samples of a core collected to check for compliance with the standard, then any subsequent dredge pass would be much more likely to be based upon a more accurate understanding of the remaining undredged inventory of contaminated sediment.

Section 4 – Issues related to the Productivity Performance Standard

The State has also identified issues which it believes impacted the ability of the project to meet the Productivity Standard, or may in the future. These issues are:

1) Offloading delays at the sediment processing facility decreased empty scow availability and served as a bottleneck relative to productivity. Improving the offloading operations should increase the maximum production rate of the dredging operations.

2) Canal traffic throughput has an upper bound which may impact productivity. The design for Phase 2 needs to take into account factors which impact the ability of the Champlain Canal to handle the planned traffic during Phase 2.

Section 4.1 - *Offloading delays at the sediment processing facility*

Throughout the Phase 1 dredging season, NYSDEC oversight staff and contractors observed that the amount of dredge platform "down time" increased as the week progressed. This delay was observed to be directly related to the availability of empty scows. Early in the week, empty scows were typically available - a result of continued offloading operations at the processing facility on Sundays. The processing facility offloading process ran on Sundays to catch up while dredge operations were suspended for maintenance/time off and typically did not operate on Sundays. As the week progressed, and the rate of dredge production exceeded the rate of sediment offloading at the dewatering facility, the availability of empty scows declined to the point where dredge platforms sat idle waiting for scows to be offloaded and made available to be filled.

Evaluations of the productivity of the dredging operations need to take into account this source of "down time". The State believes that just by simply improving the offloading operations, the potential maximum production rate of the dredging operations can be significantly increased.

Section 4.2 - *Canal traffic throughput has an upper bound which may impact productivity*

Attachment 1 contains a detailed discussion of the potential limits due to the nature of canal operations on productivity during Phase 2. In summary, there are four issues which need to be accounted for in the Phase 2 design relative to Champlain Canal operations.

1) The Feeder Canal may not be able to provide sufficient water flow throughout Phase 2.
2) NYSCC staffing during Phase 2 will need to be supplemented.
3) Increased Canal lock usage creates the increased potential for equipment failures or other problems with respect to sufficient water flow availability.
4) The Canal navigation season can not be routinely extended for the dredging project due to impacts on the need to perform annual maintenance of Canal structures during the off season.

Section 5 – Issues related to the Quality of Life Standard for Air

The State has identified to date several issues which impacted the ability of the project operations to be conducted within the air standards. They are:

1) Presence of uncontrolled NAPL in dredge areas and in scows
2) Use of minihoppers contributed to exceedances of the air standard
3) Delays in offloading at the dewatering facility
4) Presence of sediment and debris in open stock-piles within the temporary material storage basins established in the open areas of the offloading wharf
5) Accumulations of sediment within the Type 1 Storm Water Storage Basin at the north end of the offloading wharf
6) Use of the sheet pile enclosure in the East Griffin Island Area

Section 5.1 - *The presence of uncontrolled NAPL in the dredge areas and in the scows contributed to the elevated PCB concentrations in air measured during Phase 1*

Estimates of PCB concentrations in air made during project design were modeled based upon the data available during design, and did not include the presence of PCB as a separate phase in the contaminated sediment, or as droplets or a film on the surface of the water. Predictions made during design included predicted exceedances of the air standards when dredging in specific CUs. Actual measured exceedances during Phase 1 were often at locations near in-river operations including debris removal and the dredge operations which yielded significant NAPL, near the locations where scows containing NAPL were moored, or at the dewatering facility where scows containing NAPL were staged prior to offloading. The highest air concentrations were measured when heavy sheens of NAPL were observed and where mitigation measures that were supposed to be implemented were not. The monitoring program was not designed to specifically differentiate the source of the exceedances; as a result, the relative impact of PCB releases due to NAPL must be inferred.

NAPL sheens were observed throughout the course of the dredging in the vicinity of CU-2, CU-3 and CU-4. These sheens led to frequent elevated PCB concentrations in air. The monitoring program was adjusted in this area to assess the impacts to nearby receptors. Active collection of the NAPL sheens would have reduced the potential for releases of PCBs to the air. The State believes the collection of NAPL in a closed and sealed container should be incorporated into the Phase 2 design. A device that would vacuum the sheens into a closed container or tank needs to be designed. The contents of the tank would be delivered to the Process Plant water treatment facility through a dedicated closed pumping system. This would minimize the volatilization of the sheens and air exccedances associated with their presence. Capturing NAPL releases should be considered an integral component of the project design on par with the dredging activities.

Other methods to minimize the impacts of NAPL presence beyond vacuuming would be the to deploy Mycelex sorbent booms in areas where sheens are slight, and to use Mycelex pads as a

cover in the water in scows where sheens are present. These booms and pads should be collected after a predetermined time following deployment.

The decanting of the buckets containing NAPL also allowed for the aerosolization of PCB, contributing to the elevated PCB concentrations in air. NAPL releases within the sheet pile wall in CU-18 also contributed to elevated PCB concentrations in air.

Photographs 4 – 6 in Attachment 3 show a typical scow load of sediment generated during Phase 1. Note the volume of material above the water in the scow, and the presence of the NAPL within the scow. The State believes that the lack of a water cap on the transported barges, and the uneven loading of the barges allowing dredge material to be exposed to the wind, also contributed to the elevated PCB concentrations in air.

Section 5.2 – *Use of minihoppers contributed to exceedances of the air standard*

In planning for Phase 1, estimates were made of predicted PCB concentrations in air based upon the results of a modeling effort which took into account a number of factors. Areas where exceedances of the air standard were predicted were identified. During Phase 1, it was found that the monitoring results indicated exceedances in areas beyond those where the modeling work predicted exceedances. The State believes that the use of mini hoppers, particularly in high concentration areas where exceedances were predicted, contributed to the number and magnitude of exceedances of the air standard. Mini hoppers offer less containment of sediment (reduced freeboard), required additional decanting of the dredge buckets (thereby reducing the amount of water in the sediment) to maintain stability, and required additional handling operations to unload the sediment into larger barges for transport to the sediment processing site. The mechanical agitation of dredge material during transfer from mini-hoppers to larger barges also likely contributed to air releases. Mini hoppers should be excluded from use in Phase 2 areas that exhibit similar sediment conditions as CUs 2, 3, and 18.

Section 5.3 - *Delays in offloading scows at the dewatering facility contributed to exceedances*

The State believes that the exceedances of the air standard measured in the vicinity of the offloading wharf at the dewatering facility were due in part to the increased magnitude of the source at this location, driven by the increased number of loaded scows at the work wharf. Delays in offloading the scows led the contractors to stage increased number of scows at the wharf.

Section 5.4 - *The presence of sediment and debris in open stock-piles within the temporary material storage basins established in the open areas of the offloading wharf contributed to the elevated PCB concentrations in air measured during Phase 1*

The State believes that the exceedances of the air standard measured in the vicinity of the offloading wharf at the dewatering facility were due in part to the presence of sediment and

debris in open-stock piles within the temporary material storage basins established in the open areas of the offloading wharf. Contributions from this source were potentially driven by the volume of the material being held, the PCB concentrations within the material being held, active working and reworking of exposed material, and inadequate cover. Delays in outbound rail shipments and the associated steady loss of storage space within designated material storage enclosures and basins at the dewatering facility resulted in the need for the construction and use of these temporary material storage basins at the offloading wharf.

PCB air measurements at the northeastern perimeter air monitoring location near Lock 8 were low during the month of May generally between 2-20 ng/m3. In July and August, PCB levels at this sample location increased and exceeded 110 ng/m3 on 1 occasion (at a level of 140.9 ng/m3). Most notably, in September PCB levels exceeded 110 ng/m3 on 7 occasions and the commercial standard of 260 ng/m3 on 1 occassion with a maximum concentration of 328.3 ng/m3. This increase in PCB levels measured during the month of September may be a result of the storage of sediment at the unloading wharf, which began in early September, or may be related to the nature and extent of sediment unloaded at the wharf or a combination of factors. The impact to air related to the temporary storage of sediment at the unloading wharf should be further evaluated to determine if this is an acceptable practice for Phase 2.

Section 5.5 - *Accumulations of sediment within the Type 1 Storm Water Storage Basin at the north end of the offloading wharf contributed to the elevated PCB concentrations in air measured during Phase 1*

The State believes that the exceedances of the air standard measured in the vicinity of the offloading wharf at the dewatering facility were due in part to the accumulations of sediment within the Type 1 Storm Water Storage Basin at the north end of the offloading wharf. Contributions from this source were potentially driven by the volume and PCB concentration of the solid material flowing into the basin during storm water events and/or flushed into the basin as a part of operations at the offloading wharf; the volume and PCB concentrations of the solid material being held within the basin; water level fluctuations within the basin and the related exposure of emergent sediment to the air; and the potential for PCBs as a separate phase in the contaminated sediment within the basin to form uncontrolled droplets or a film on the surface of the water during inflow events, episodes of sediment reworking, etc.

Section 5.6 - *Use of the sheet pile enclosure in the East Griffin Island Area may have contributed to the air exceedances measured at this location*

At Griffin Island, PCB levels in air became elevated when dredging began within the sheet pile enclosure. The PCB levels measured near CUs 17 and 18 were lower than those measured near the east channel of Rogers Island but were elevated, exceeding the applicable residential standard (and the commercial standard) on several occasions. Removal of the sheet pile wall reduced PCB levels in air measured at the shoreline. Within the sheet pile enclosure several water samples were collected and analyzed for PCBs, and the maximum level of PCBs measured within the enclosure was 26,000 ng/L. Oils were also observed within the enclosure and downstream. The containment and collection of NAPLs within enclosures must be considered as an element of the Phase 2 design to reduce air releases from within the enclosures, including

where there are no active dredging activities. (Exceedances of the project air standard were measured during inactive periods in the vicinity of the sheet pile enclosure in CU 17/18.) While the sheet pile contained impacted water and may have reduced resuspension releases downstream, it created isolated impacts to air along the shore. Any consideration of using sheet piles or similar enclosures during Phase 2 must evaluate the potential impacts on air quality and depending on proximity of the dredge area to residents or occupied properties, additional planning may be necessary to endure that operations are protective.

Section 6 – Issues related to Habitat Reconstruction / Protection

The State has identified several specific detailed issues with the habitat reconstruction program that the State believes need to be addressed in the Phase 2 design in order to better comply with project goals and reduce impacts to post-dredging habitat quality. They are:

1) Specific issues related to compliance with project specifications, or the need to modify particular details of specifications, were found. These include disturbances beyond project boundaries, placement of biologs for shoreline stability, and application of backfill along slopes.

2) The State believes that certain elements of the design related to project operations need to be modified, including controlling vessel traffic to limit damage to submerged aquatic vegetation, possible omission of sheet piles from the design, and limiting turbidity plumes from backfill operations.

3) The State believes that the project protocol for follow up after fish kill events needs to be better adhered to in Phase 2.

4) Certain constraints contained in the Consent Decree for implementation of the remedy (the 15% limit on additional backfill volume for reestablishment of submerged aquatic vegetation habitat and the limits on habitat assessment sample sizes) impact the ability of the project to successfully reconstruct habitat as described in the ROD for this site.

Section 6.1 - *Compliance with or modifications to project specifications*

Project specifications require no disturbance of the shoreline beyond an elevation of 119 feet. Contrary to these specifications, backfill covered wetlands beyond the dredging limit and Type P armor stone was placed at elevations above 119 feet. The excess fill on the wetlands constitutes serious habitat damage and the armor stone will hinder natural revegetation and reduce habitat quality for many animals.

The State observed that the placement of biologs for shoreline stabilization and as breakwaters for reconstructed wetlands according to specifications was determined to be impractical. Ad hoc procedures were used instead. The State recommends that EPA evaluate and develop specifications for anchoring biologs and consider the use of other non-structural methods to protect shorelines and reconstructed wetlands.

During backfill operations, Type 1 backfill was found to be unstable on slopes at the design slope of 3 horizontal to 1 vertical. It was necessary to substitute Type 2 backfill in these areas, potentially limiting the habitat quality in these areas. During Phase 1 design, EPA's consulting fluvial morphologist predicted that 3:1 slopes would not be stable and recommended side slopes of between 6 and 10 to 1. In light of the failure of Type 1 backfill on 3:1 slopes and the advantages of Type 1 backfill over Type 2 backfill for plant and animal habitat, the State

recommends that EPA consider more gentle side slopes that would have greater stability and support the placement of Type 1 backfill.

Section 6.2 - *Modifications to project operations*

Powerful tug boats and numerous water taxis moving at considerable speeds, along with anchored barges, may adversely affect submerged aquatic vegetation (SAV). The State believes that limits on vessel traffic, including speed, should be considered by USEPA in areas where vessel traffic could impact SAV.

The sheet pile wall used at Certification Unit 18 produced conditions unfavorable for biota, including a minor fish kill. The State believes an evaluation should be performed by USEPA which considers the benefits and drawbacks of using sheet piles.

Backfilling operations produced extensive sediment plumes. The specific techniques used in the placement of backfill should be evaluated and revised as necessary to reduce, to the extent practicable, the solids plumes generated during backfilling.

Section 6.3 - *Fish kill follow up*

Procedures established in the project specifications for investigating distressed fish and fish kills do not appear to have been followed. The response to two small fish kills highlights the need for improved procedures including unambiguous identification of the species involved, collection of dead fish, and involvement of a qualified fisheries biologist in assessment of the cause.

Section 6.4 - *Constraints on remedy implementation*

Project design allocated an additional 15% backfill to raise bottom elevations to a depth that would better support growth of submerged aquatic vegetation (SAV) in reconstructed habitat areas. This allocation of 15% additional backfill appears to be insufficient to support adequate reconstruction of submerged aquatic vegetation. It appears that the vast majority of the 15% additional backfill allocated for SAV restoration in the 18 planned Phase 1 certification units was placed in the 60% of Phase 1 Certification Units that were completed in 2009. This indicates that the 15% backfill was likely to have been insufficient if the entire planned acreage for Phase 1 had been completed.

Existing limits on habitat assessment sample sizes have constrained the rigor with which habitat reconstruction success for submerged aquatic vegetation can be evaluated. The State recommends that sample sizes for habitat assessment be sufficient to provide high confidence that habitats were successfully reconstructed.

Section 7 Recommendations for Changes to Project Design for Phase 2

NYSDEC has several recommendations, listed below, which are intended to address the issues related to project design which were identified during oversight of Phase 1.

Section 7.1 - *Control NAPL releases*

One of the project specifications in Contract 4, 13801, reads as follows:

Contract 4 Specification 13801 - Inventory dredging

Section 1.07 Material to be Removed

A. (Second Paragraph)

All pollutants, other than sediment, that occur onsite during construction shall be handled and disposed of in a manner that does not contaminate surface water runoff. Equipment shall not be fueled while operating per Section 01140 – Work Restrictions. Any sheens due to leakage or spills, or that occur during dredging operations from any source, shall be contained by a boom and cleaned up with oil absorbent materials.

The State believes that this specification clearly required that the NAPL releases generated by the dredging operations were to be contained and removed by the contractor. However, during discussions with USEPA and GE during the Phase 1 dredging operations, GE staff expressed the position that this specification did not require containment and recovery of the NAPL sheens. This specification should be modified and expanded to include not only the existing general broad requirement that NAPL sheens be contained and cleaned up, but also to include 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 the minimum effort required to collect and recover the NAPL (response times, staff, equipment and materials to be on hand, require tending of booms / sorbent materials, recovery of sorbent materials within 1 day of deployment or when saturated if sooner than one day). An example of a control technology would be the collection of NAPL using a skimmer system, with collection in a closed container, which would reduce the surface area of NAPL available for volatilization.

Section 7.2 - *Eliminate intentional decanting*

At the direction of USEPA, GE performed sampling of the water being decanted from the dredge buckets in three sampling events between August 13 and August 19. Results of this sampling were reported on November 4 in a technical memorandum by Anchor QEA. In the technical memorandum, an estimate of the relative contribution of the decanting process to the overall estimate of the far field total PCB load at Thompson Island is approximately 3 percent or less of the load. No estimate is made, however, as to how much the near field PCB concentrations were

increased as a result of the decanting process, or of how much NAPL was released as a result of the decanting process. The process of decanting 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.

The State does not believe that decanting should be allowed as part of the Phase 2 dredging program. From the point of view of the State, 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. Decanting is functionally no different than allowing scow overflow back into the river, which was specifically not allowed under project specifications.

PCB releases due to the decanting process should not be judged solely by the estimated proportion of the PCB releases due to decanting as compared to other mechanisms of PCB release. A relatively simple change to project operations which can reduce or eliminate a known source of additional PCB release, such as this change, should be implemented.

Section 7.3 - *Perform additional access dredging to improve productivity, reduce resuspension, and reduce air releases*

USEPA should direct that an evaluation be done as part of the Phase 2 design and work planning process which estimates how the performance of access dredging would impact the performance of the work. Access dredging in this context is defined as sediment removal beyond the scope of the removals needed to meet the ROD goals for mass per unit area or surface sediment concentration, but which is performed as needed to allow for such removal to be done in a manner which is more efficient and allows the project to better meet the project standards.

Access dredging would, for example, potentially allow full-sized scows to be used in areas which otherwise would be candidates for dredging proposed to be dredged using minihoppers. Access dredging in this case would reduce the number of tug trips in a work area to change out the minihoppers, allowing for more efficient use of the dredge platforms, and reduce the resuspension due to prop wash and grounding in the shallows. Access dredging in this case would also reduce the likelihood of scows grounding, which caused significant resuspension events during Phase 1.

Section 7.4 - *Dredge to the depth of contamination on the initial dredge pass*

The project dredging operations should be specifically designed to dredge to the depth of contamination on the initial pass. This would entail multiple changes; the most important of which is confirmation of the depth of contamination in Phase 2 areas. While there are several approaches that could be followed to revise the Phase 2 dredging work to more closely meet the removal criteria in the ROD, the State recommends that USEPA perform a field sampling program under which a representative number of core locations could be resampled, both within existing delineated dredge areas and adjacent to existing delineated dredge areas, in order to gather sufficient data to develop revised dredge prisms which are likely to meet the removal criteria in the ROD. This resampling would need to be done using a method which is designed to overcome any anticipated sampling bias which may have led to the underestimation in DoC

and mass per unit area found during the Phase 1 dredging work. This approach is similar to that used during Phase 1 design in sampling a representative number of near shore areas to determine if the dredge cut lines could be moved off of shorelines. USEPA could then use the data gathered in this sampling program to inform a process similar to the first option above, where the information gathered would allow for a correction to the dredge area boundaries both laterally and with depth for use in the development of revised dredge prisms for Phase 2.

Section 7.5 – *Perform an ongoing review of project performance*

The State believes that the experience gained during the performance of Phase 1 was important and should be taken into account in developing the final design and work plans for Phase 2. The State also believes that as Phase 2 moves forward, the process of evaluating project performance and making appropriate changes to project design and work plans should continue. USEPA should continue to evaluate the data generated during project monitoring, and observations made during project oversight, in order to direct necessary changes to project operations to maximize project quality, minimize any negative impacts related to the work, and to maximize the opportunities for the project work to meet the remedial action objectives set in the ROD. These changes may include changes to the monitoring programs and changes to the plans and specifications in the design documents and to the contractor work plans. USEPA needs to reserve the authority to direct these changes in order to ensure that the project moves forward in a manner which is consistent with the ROD, which states on p. 96 that USEPA will continue to monitor, evaluate performance data, and make necessary adjustments.

Section 7.6 - *Provide redundant offloading and processing equipment at the unloading wharf to reduce delays associated with offloading "bottleneck"*

The State believes 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.

Section 7.7 - *Provide proactive mitigation to reduce the frequency, duration and magnitude of exceedances of the quality of life standard for PCB in air*

The State believes that the Phase 2 design should include revisions to the modeling process used to predict exceedances of the quality of life standard for PCB in air, to take into account the data generated during Phase 1 in order to more accurately predict where standard exceedances may occur. At locations where exceedances are predicted, mitigation measures should be mandated in advance and kept in place during dredging operations. The Phase 2 design should also include specific mitigation measures to control air releases beyond those limited measures taken during Phase 1, including the use of spray-on cover material for use in the scows and more proactive containment and immediate collection of NAPLs generated during dredging operations. The monitoring program for air should include the use of fixed dredge corridor monitors that are not moved or shut down, in order to systematically evaluate the effectiveness of mitigation measures.

Section 8 Recommendations for Changes to Performance Standards for Phase 2

Section 8.1 – *Recommended Changes to the Resuspension Standard*

NYSDEC has several recommendations, listed below, which are intended to address the issues related to Engineering Performance Standards which were identified during oversight of Phase 1.

8.1.1 - *Reduce near field solids monitoring*

The State believes, as discussed above, that the near field solids monitoring was of little use in helping to understand or predict PCB concentrations. As such, these data were of little use in helping direct the dredging operators in managing their operations to reduce PCB losses due to resuspension at the dredge. The State believes that the near field solids monitoring program should be significantly reduced, and the resources reallocated to direct PCB measurements. Such a change would require a modification to the Remedial Action Monitoring - Quality Assurance Project Plan (RAM QAPP) for Phase 2.

8.1.2 - *Reduce near field metals monitoring*

The State believes that the reduction of near field metals monitoring implemented during the latter part of Phase 1 was appropriate given the data generated during the dredging work. The metals monitoring should continue in Phase 2, but only such monitoring as would be required to confirm the existing understanding that the magnitude of metals release from the dredging operations is not going to result in exceedances of the State surface water quality standards.

8.1.3 - *Include near field surface water PCB transect sampling*

The State believes that the data quality objectives for near field PCB transect monitoring should include the gathering of such data as would be required to (1) quantify the rate of PCB release from each dredge operation; (2) compare the rate of PCB release during different conditions such as varying river flow rates / flow velocities, sediment types, debris presence and composition, NAPL presence and composition, and specific dredge operational characteristics (ie. depth of cut, size of bucket, rate of bucket movement); (3) understand the phase in which the PCB is being released (NAPL, dissolved, sorbed); and (4) quantify the source strength for use in estimating rates of PCB release to air associated with the dredging operations.

8.1.4 - *Include "mid field" surface water PCB transect sampling*

The State believes that the surface water monitoring program should include PCB transect sampling at locations between dredging operations. The data quality objectives for this monitoring program would include: (a) to quantify changes in relative proportion of sorbed / dissolved / NAPL phases (as needed); (b) to track changes in PCB concentration and makeup

over distance and time as water impacted by resuspended material moves away from dredging operations; and (c) to differentiate between impacts of different dredging operations.

8.1.5 - *Develop an approach to application of the mass loading standard to inform decision making on project operations in near real time, or consider eliminating this portion of the standard*

The basis for the load standard includes a conceptual site model under which there are anticipated significant declines in water column and fish PCB concentrations under a MNA scenario. Measured PCB concentrations in water column and in fish over the several years since issuance of the ROD have shown, however, that the predicted reductions in PCB concentrations have not occurred; as a result, the benefits of the MNA remedy scenario appear to have been overstated. The State believes that, if the PCB mass load standard is to be useful in guiding project operations, it is important to update the understanding of site conditions to include a realistic trend in PCB concentrations under the MNA scenario, and use this updated realistic understanding of site conditions to help inform and revise the load standard.

The State also believes that USEPA should provide a rationale for retaining the load standard. If the standard can not be used to help guide decisions on managing the dredging operations on a near real time basis, and the PCB mass that the standard represents is not put into perspective as discussed above, it may be more appropriate to eliminate the PCB mass load standard as an element of the resuspension standard.

8.1.6 - *Verify the representativeness of the far field automated monitoring stations*

USEPA should closely evaluate the available data to ensure that the data from the automated monitoring stations are representative, and include in the Phase 2 design any supplemental data collection activities such as are needed to confirm that the data from the far field automated monitoring stations are representative and usable to enforce the resuspension standard. This verification could include regular periodic sampling to compare results from river samples and samples from the automated sampler, as well as regular periodic duplicate samples from the automated samplers. NYSDEC and NYSDOH suggest that if the data variability is shown to be sufficiently large, than alternatives to the program including but not limited to reevaluation of the Resuspension Standard should be considered by USEPA. USEPA should also consider setting criteria by which to judge the representativeness of the data from the automated sampler. A review of the program by which the automated sampling apparatus is maintained and cleaned may also be appropriate.

Section 8.2 – Recommended Changes to the Residuals Standard

8.2.1 - *Eliminate capping due to the end of the dredge season*

The State believes that the decision to cap should not be driven by schedule. CUs containing a remaining removable inventory of undredged contaminated sediment should not be capped until that inventory has been removed. This approach would be in keeping with the intent of the ROD and with the residuals standard. The State believes that allowing undredged inventory of contaminated sediments within areas delineated for removal under the project design is not consistent with the ROD for the site.

Areas for which there is not remaining time in the dredge season to remove a remaining inventory of undredged contaminated sediment should be sampled to determine the remaining surface sediment concentration as well as the remaining thickness of inventory to be removed. In areas where the remaining surface sediment PCB concentration remains significantly elevated, a thin layer of backfill should be placed to stabilize the area until the remaining inventory can be removed the following dredge season.

8.2.2 - *The depth of contamination (DoC) should be redefined after each dredge pass*

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 collected to check for compliance with the standard, then any subsequent dredge pass would be much more likely to be based upon a correct understanding of the remaining undredged inventory of contaminated sediment. 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 potential sampling bias associated with the overlying material on the river bottom which was removed during the first dredge pass.

8.2.3 - *The entire certification unit should be sampled when evaluating compliance with the Residuals Standard after a second or subsequent dredge pass, or the existing data should be used for non-redredged nodes*

In evaluating whether or not a CU has complied with the Residuals Performance Standard, the calculations should only include either the results of a complete resampling of the entire CU, or use the results of previous sampling at nodes which were not dredged again. This process is necessary to avoid the possible bias associated with the inherent variability in PCB concentrations in Hudson River sediment; it is possible that simply by resampling a subset of sample nodes, a CU could be found in compliance due to variability rather than due to an actual change in the mean surface sediment PCB concentrations.

8.2.4 - *The calculations used to determine if the Residuals Standard has been met should take into account the potential for bias associated with the use of ½ the detection limit for non-detect results*

The State recommends that USEPA recalculate Phase 1 CU unit statistics using appropriate methods for censored data to determine whether decisions about redredging or certification would have been altered. These methods, though more complicated, should be used for Phase 2 unless demonstrated to have had no practical effect on Phase 1 decision making.

Section 8.3 – Recommended Changes to the Productivity Standard

8.3.1 - *USEPA should evaluate whether, in managing Phase 2, the agency should consider the Productivity Standard a "second tier" standar*d

The State recommends USEPA consider that compliance with the elements of the other engineering and quality of life performance standards intended to protect human health and the environment should be given priority over compliance with the Productivity Standard. The basis for the Productivity Standard is removal of the sediment over a six year time frame (one year for Phase 1, and five years for Phase 2) as described in the ROD. The six year time frame, as the State understands, is based primarily upon the differences in predicted recovery time frames generated during the Feasibility Study process. These predicted recovery time frames were generated using a set of assumptions which included an overly optimistic recovery rate under the scenario where no dredging would be done. An evaluation of the data generated during the baseline monitoring program leads the State to the conclusion that an extension of the project duration would be appropriate if this would result in better compliance with the standards established to protect human health and the environment.

8.3.2 - *USEPA should recalculate the Productivity Standard to account for changes in estimated volume for Phase 2*

Since the development of the engineering performance standards, there has been an adjustment to the estimated volume of material to be dredged in the project. The State has recommended that this volume be reevaluated and adjusted as appropriate to take into account the problems associated with the error in DoC found during Phase 1. The State believes that it is appropriate for USEPA to develop a new productivity standard with accounts for these changes in estimated dredge volume.

Attachment 1:

Evaluation of Canal System and Potential Impacts on Traffic and Productivity

Description of Champlain Canal System

The New York State Canal System is comprised of four historic waterways, the Erie, the Champlain, the Oswego, and the Cayuga-Seneca Canals, all under the jurisdiction of the New York State Canal Corporation (NYSCC). Spanning 524 miles across New York State, the waterway links the Hudson River, Lake Champlain, Lake Ontario, the Finger Lakes and the Niagara River with communities rich in history and culture.

The Champlain Canal, which first opened in 1823, is approximately 63 miles in length from the Hudson River in Waterford to Lake Champlain in Whitehall. In order to accommodate larger vessels, the State of New York enlarged the canals and the Champlain Canal as it exists today was opened in 1913. As it approaches its 100th birthday, the infrastructure on the Champlain Canal has been rebuilt and maintained and the waterway continues to be operated in much the same manner as it was a century ago.

Between Troy and Fort Edward, the Champlain Canal and the Hudson River share a common navigation channel. Locks C-1 through C-6 are all associated with dams on the river and provide navigational access around these obstructions. Upon reaching Fort Edward, the Champlain Canal separates from the Hudson River, south of Lock C-7, and then proceeds through a man-made canal to Whitehall. The sediment processing facility is located on the Champlain Canal between Locks C-7 and C-8. Therefore, all barges transporting contaminated sediment must pass through Lock C-7 to reach the processing facility.

Topographically, the Champlain Canal continues to climb in elevation up to the level between Locks C-8 and C-9. From there, the canal gradually drops in elevation from Lock C-9 to Lock C-12 at Whitehall. The pool between Locks C-8 and C-9 is the summit level of the Champlain Canal. Water is supplied to this summit from the Hudson River via the Glens Falls Feeder Canal (feeder canal). All traffic transiting Lock C-7 draws water from the summit elevation, requiring equal volumes of water to be replaced by the feeder canal.

The feeder canal is approximately 7 miles long and much of its infrastructure predates the construction of the modern Champlain Canal in 1913. Historically, the feeder canal has experienced problems with dissolution of the limestone that underlies it in some areas. When this has occurred, the feeder canal has leaked large volumes of water until repairs could be made. Leaks of this nature are not infrequent and can be expected to occur at least every few years. Larger failures may also occur. A feeder canal embankment failure occurred near the end of navigation season a decade ago, when piping action washed out the embankment into the Hudson River. While the feeder canal was shut down for the remainder of the season, low traffic and non-drought conditions allowed the Champlain Canal to remain open until the normal closing date. However, lockings were not allowed on demand, but were done on a schedule, to

preserve the remaining limited source of water. If a similar situation were to occur during Phase 2, there would not be enough water available to accommodate project traffic.

The available flow to the feeder canal from the Hudson River has been estimated at approximately 300 cfs. However, this information dates from 1905 and only estimates flow entering the feeder canal. A 1951 report (Schermerhorn) indicated that reconfiguration of the supply gates at the feeder dam have reduced the available flow. He indicates that unless 2 -foot flash boards are installed at the feeder dam, there is insufficient head to maintain 250 cfs entering the feeder canal. Currently, flash boards are present on the dam, but the gate configuration was redesigned again in 1985. The maximum flow available at the feeder dam gates under the current configuration is not known. The Canal Corporation will be investigating the flow conditions at the feeder dam in 2010.
Schermerhorn reported about 122 cfs entered the summit level from a combination of the feeder canal and the natural flow in Bond Creek in 1951. Additionally, losses within the feeder itself approached 30 cfs. Assuming that Bond Creek contributed a small fraction of the total water, losses in the feeder canal can be assumed to have been no less than 20-25% in 1951. Present-day losses in the feeder canal are unknown, but are expected to be significant, based on visual observations and inspections. The NYSCC cannot predict how the feeder canal will respond to sustained high flow rates resulting from large amounts of project traffic in Phase 2. The potential for the feeder canal to develop significant leaks or to become obstructed with debris and leaves leading to localized flooding will also increase as the flow in the feeder canal increases.

During Phase 1, water levels above Lock C-8 were unusually consistent for most of the season. In most years seasonal rainfall variations will affect the ability of the feeder canal to maintain a stable water elevation at the summit level. The only problem experienced in 2009 was during a brief dry period in September when the summit level was one foot below normal for about one week until a rain storm was able to replenish the water level. During Phase 2, seasonal variations must be expected to occur and their impact on the feeder canal cannot be fully predicted.

Analysis of Phase 2 Traffic – Lock C-7

At Lock C-7, average vessel traffic during the 2009 dredging season was approximately 29 vessels per day (both project-related and non-project-related), accounting for an average of 18 lockings per day. The table below illustrates the traffic patterns observed at Lock C-7 between May 1 and October 31, 2009.

Table 1: Lock C-7 Traffic between May 1 and October 31

	Project Vessels	Non-Project Vessels	Total Vessels	Project Lockings	Non-Project Lockings	Total Lockings
Daily Maximum	40	35	60*	23	22	34*
Daily Average	20.2	9.1	29.3	11.5	6.8	17.6**

* Numbers do not add up because peak project traffic and peak non-project traffic occurred on different days.

** Numbers do not add up because a small number of lockings contained both project and non-project vessels. NYSCC staff at Lock C-7 passed project and non-project traffic through separate lockings whenever possible during the season. Predictions for Phase 2 assume project and non-project traffic are kept separate.

In general, the NYSCC was able to efficiently balance and manage both project and non-project traffic during the dredging season. This was accomplished in part because operational staffing was supplemented at Locks C-7 and C-8, through an agreement with, and funded by, General Electric. This agreement allowed 24-hour lock access to project vessels. The production rate in Phase 2 and the availability of additional operational staff funding will determine the NYSCC's ability to continue to successfully manage all traffic on the Champlain Canal.

Instead of analyzing the whole navigation season, NYSCC recommends focusing on the peak of the navigation season, from July 1 to September 30. During this time period, non-project traffic is at its peak and project traffic is expected to be operating at full production. Daily impacts on canal operations can be more conservatively predicted using this approach. The remainder of this analysis is conducted using traffic data from the three month peak period.

Table 2: Lock C-7 Traffic Between July 1 and September 30

	Project Vessels	Non-Project Vessels	Total Vessels	Project Lockings	Non-Project Lockings	Total Lockings
Daily Maximum	38	30	60*	23	22	34*
Daily Average	24.5	12.3	36.8	13.7	8.5	21.3**

* Numbers do not add up because peak project traffic and peak non-project traffic occurred on different days.
** Numbers do not add up because a small number of lockings contained both project and non-project vessels. NYSCC staff at Lock C-7 passed project and non-project traffic through separate lockings whenever possible during the season. Predictions for Phase 2 assume project and non-project traffic are kept separate.

The Phase 2 production rate was originally projected to increase from 260,000 cy in Phase 1 to 306,000 cy per year in Phase 2 (Phase 2 DAD). In light of the fact that Phase 1 discovered far more contaminated sediments than anticipated around Rogers Island and did not address CUs 9-16, those additional Phase 1 sediments must also be included in the Phase 2 totals. Furthermore, a conservative assumption is that the remaining Phase 1 dredge areas will also be more extensively contaminated than previously believed as well as some of the Phase 2 dredge areas. Three scenarios are presented below; representing that anticipated Phase 2 dredge volumes will increase by 0%, 25% and 50%, respectively. All analyses are based on the peak navigation season, from July 1 – September 30.

Table 3: Traffic Projection Scenarios for Phase 2

	Phase 1 (actual values)	Phase 2 Scenario 1 (projected values)	Phase 2 Scenario 2 (projected values)	Phase 2 Scenario 3 (projected values)
Annual Sediment Volume (cy)	296,000	306,000	382,500	450,000
Percent Increase From Phase 2 Design Volume	N/A	0%	25%	50%
Percent Increase From Actual Phase 1 Volume	N/A	3.4%	29%	52%

Barge and other project traffic at Lock C-7 are assumed to be proportional to the volume of sediment being removed in Phase 2. The following table illustrates predicted traffic volumes at Lock C-7 during the various Phase 2 scenarios. Peak total traffic (project traffic plus non-project traffic) is modeled using simple linear regression, assuming that the same non-project traffic patterns experienced in Phase 1 will continue unchanged in Phase 2.

Table 4: Lock C-7 Traffic Projections for Phase 2

		Project Vessels*	Non-Project Vessels**	Total Vessels***	Project Lockings*	Non-Project Lockings**	Total Lockings***
Phase 1 (Actual)	Daily Maximum	38	30	60	23	22	34
	Daily Average	24.5	12.3	36.8	13.7	8.5	21.3
Phase 2 Scenario 1	Daily Maximum	39.3	30	51.5 (37-66)	23.8	22	30.7 (23-38)
	Daily Average	25.3	12.3	37.6	14.2	8.5	22.7
Phase 2 Scenario 2	Daily Maximum	49	30	61.1 (46-76)	29.7	22	36.1 (28-44)
	Daily Average	31.6	12.3	43.9	17.7	8.5	26.2
Phase 2 Scenario 3	Daily Maximum	57.8	30	69.8 (54-85)	35	22	41 (33-49)
	Daily Average	37.2	12.3	49.5	20.8	8.5	29.3

* Average and Peak Project Traffic are assumed to be proportional to total sediment volume.

** Non-Project Traffic is assumed to be constant year-after-year.

*** Peak Total Traffic is not a simple sum of project and non-project traffic because the peaks of both types of traffic do not occur simultaneously. A simple linear regression model is assumed to represent the relationship between project traffic and total traffic. Regression was performed using StatCrunch web-based software (www.statcrunch.com). Peak Total Traffic Values are reported as the predicted value from the regression model along with the 95% confidence interval.

These analyses indicate that Lock C-7 is expected to experience between 23 and 29 lockings per day, on average, during Phase 2. This value is larger than what was experienced in Phase 1, but is not likely to be an unreasonable amount of traffic, assuming funding for 24-hour staffing is provided. However, the peak traffic analysis indicates that Phase 2 could generate peak traffic levels that would be challenging for the NYSCC staff and could very well tax the infrastructure to a level not seen in several decades.

In 1951, a study (Schermerhorn) of the water supply available for the summit level of the Champlain Canal concluded that, "unless some changes are made in the manner of supplying water to that portion of the Champlain Canal from above Lock No. 7 to Lock No. 9 the canal cannot be satisfactorily operated under present traffic conditions, not to mention more serious consequences if traffic were to increase." The Schermerhorn report is attached as an appendix to this report.

Combining the findings of the Schermerhorn report with the above predictions for traffic during Phase 2 (Scenario 3), the peak water demand at the summit from the feeder canal would approach 150 cfs. Given estimated losses of 50 cfs in the Champlain Canal itself, approximately 200 cfs would be needed from the feeder canal to maintain the summit level. If conveyance losses in the feeder canal are estimated at 20-25%, then upwards of 250 cfs would be needed at the feeder dam gates. As noted above, the maximum flow available at the feeder dam gates under their current configuration is not known. The Canal Corporation will be investigating the flow conditions at the feeder dam in 2010.

Traffic that regularly approaches 35-40 lockings per day for more than a few days could present problems if any adverse conditions accompany the peak. Adverse conditions might include poor weather leading to high river flows, drought leading to insufficient water supply to the canal, mechanical failures of the lock or equipment, or problems with the feeder canal's ability to supply water to the Champlain Canal. Many of the same problems could occur regardless of the volume of project-related traffic in Phase 2. The adverse conditions in themselves have varying risks of occurring, i.e. droughts or major feeder failures will bring long term water supply problems, extending well beyond a week or partial week issue; mechanical failures traditionally can be repaired relatively quickly, although there is always the possibility of a more serious issue.

An issue of major concern is the availability of water from the Great Sacandaga Lake (GSL) as this is the primary source of water conveyed by the Hudson River for the feeder canal. In an average year, there is sufficient water in the Hudson River to divert 300 cfs into the Feeder Canal. However, during extremely dry years, there has been insufficient water to maintain normal navigation, which has resulted in an implementation of scheduled lockings to conserve water. The most extreme circumstance in recent times, occurred when there were problems with the structural integrity of the feeder canal (as referenced above).

As a result of competition for water in the GSL, the Hudson River Black River Regulating District (HRBRRD) that manages the GSL changed its operations in 1999 through the Upper Hudson/Sacandaga River Offer of Settlement (OoS). Therefore the historical perspective may not reflect current conditions. The OoS established higher minimum GSL water levels that are to

be maintained during the summer months (Memorial Day through Labor Day) each year as well as a settlement target elevation curve that is used to establish releases from the GSL.

The OoS; however, includes drawdown exceptions during the Champlain Canal Navigation Season, as follows:

> "*During the Champlain Canal Navigation Season (approximately May 1 through mid-November), if the elevation of Great Sacandaga Lake drops below level 1.2 (interpolated between Level Curves 1 and 2) and an interim minimum average daily flow has not been invoked per subsection 3.4.3, the minimum average daily flow on the Hudson River just below the confluence with the Sacandaga River shall be increased by the flow being diverted from the Hudson River to the Feeder Canal. The resulting minimum average daily flow will remain in effect until either Great Sacandaga Lake rises above level 1.2 or an interim minimum average daily flow is established per subsection 3.4.3."*

However, since 1999 there has not been a drought of sufficient magnitude coupled with a high Champlain Canal traffic volume such that the canal drawdown exception has had to be implemented.

There was a drought in 2002 where the regulating district did not release the minimum flows listed in the OoS due to several reasons.[1]What changes the HRBRRD will be willing to accommodate during Phase 2 is beyond the Canal Corporation's ability to predict.

The NYSCC cannot guarantee any specific level of service, but the projected Phase 2 traffic patterns at Lock C-7 appear to be manageable with supplemented staffing, barring any unforeseen complications. However, if such problems occur, or if the volume of sediment in Phase 2 is substantially larger than estimated, the probability of experiencing project delays at Lock C-7 begins to increase accordingly.

Analysis of Phase 2 Traffic – Locks C-1 to C-6

Locks C-1 to C-6 ("the river locks") on the Champlain Canal are located on the Hudson River and therefore do not rely on a supplemental supply of water to function. Consequently, the river locks are not as vulnerable to drought and interruptions in water supply as Lock C-7.

However, the traffic projections made above for Lock C-7 are not adequate to predict traffic patterns at the river locks. Lock C-7 did not experience any project traffic related to backfilling or capping operations. The backfill barges were directly loaded at the GP property facility in Moreau and never had to transit Lock C-7. When evaluating traffic at the river locks in Phase 2, the additional traffic from backfill barges will need to be added to the dredging scows and other equipment that was counted at Lock C-7.

[1] These included low water levels on GSL and the effect on the public of accelerated lake level reductions.

In addition, all general project traffic that originated at the Work Support Marina (survey boats, crew boats, etc.) will also need to be incorporated into the traffic impact analysis for the river locks.

Because little information is presently available regarding future marina or backfill loading operations to potentially be located at downriver locations, making estimate of traffic at river locks is difficult. However, it should be assumed that some fraction of the backfill and general project traffic will be transiting locks in River Sections 2 and 3.

Consideration must be given to the productivity standard's dependence on uninterrupted access to all locks on the Champlain Canal. To the extent that any one of the locks experiences a significant mechanical problem, the entire project can be delayed accordingly. Additional consideration should be given to the increased likelihood of mechanical problems and the increased need for maintenance when the number of daily lockings begins to regularly exceed recent normal levels.

The Role of Lock C-8

While very little project traffic actually passed through Lock C-8 during Phase 1 and the same could be the case in Phase 2, this lock plays a major role in the success of the project. The feeder canal meets the Champlain Canal approximately 1.6 miles north of Lock C-8. Any and all water used for locking vessels through Lock C-7 must first pass through Lock C-8.

NYSCC policy and procedures prohibit the passing of water through a lock by use of the lock chamber and miter gates, except in very extreme situations. This would not allow any regulation of the passing volume and result in loss of pool levels. Instead, when water must be passed through a lock without a conventional locking, it is passed through the valves. In the case of the GE dredging project, since Lock C-7 was operated much more than Lock C-8, water had to be passed from the summit level on a regular basis. This was accomplished by "valving" the water, a practice that involves opening the valves in the lock to pass water from the upper to the lower level. During days with high non-project traffic volumes, the valves at Lock C-8 cannot be left open since they must be used to regulate lockings instead. This can lead to a situation, observed several times during Phase 1, when project traffic at Lock C-7 causes a drop in the pool elevation between Locks C-7 and C-8 that cannot be adequately replaced during the day. In these circumstances, the pool level above Lock C-7 could take all day to recover any lost volume. When forecasting the effects of increased traffic during Phase 2, it will be important to consider the "valving" of water through Lock C-8 as a choke point for managing water levels, even if the feeder canal (discussed above) can supply adequate volumes of water to the summit level. The practice of "valving" also has its own inherent problems. The wear and tear on the valves, operating machinery and valve tunnels is magnified and creates another possible failure mode that could lead to costly maintenance and unscheduled down time.

Length of Navigation Season

The Champlain Canal regularly opens on May 1 and closes on November 15 each year. Operational hours from approximately Memorial Day to Labor Day are 7 AM to 10 PM, while

during the remainder of the Navigation Season the locks operate from 7 AM to 5 PM. During Phase 1, the canal was kept open to accommodate the dredging project until November 24 and 24-hour service was provided during this entire time through an agreement with GE that included funding for the additional resources. In addition, Lock C-7 remained open for local project traffic until mid-December. While the NYSCC accommodated the project's need to extend the navigation season during Phase 1, it cannot continue to do so every year.

Each winter, the Champlain Canal has numerous maintenance needs including the scheduled dewatering of selected locks for major maintenance. The winter dewatering and maintenance of locks usually requires all of the non-navigation season to complete. Any delays in beginning the work increases the likelihood of delaying the opening of the canal the following May. Additionally, floating stock assigned to the Champlain Canal normally winters over in the Waterford Flight, utilizing the Waterford Dry Dock for any necessary maintenance and/or repairs. Subsequently, the delay in closing the Champlain Canal in 2009 had a substantial effect on the Waterford Section of the Erie Canal and the ability of Corporation staff to drain the Waterford flight and initiate winter work projects.

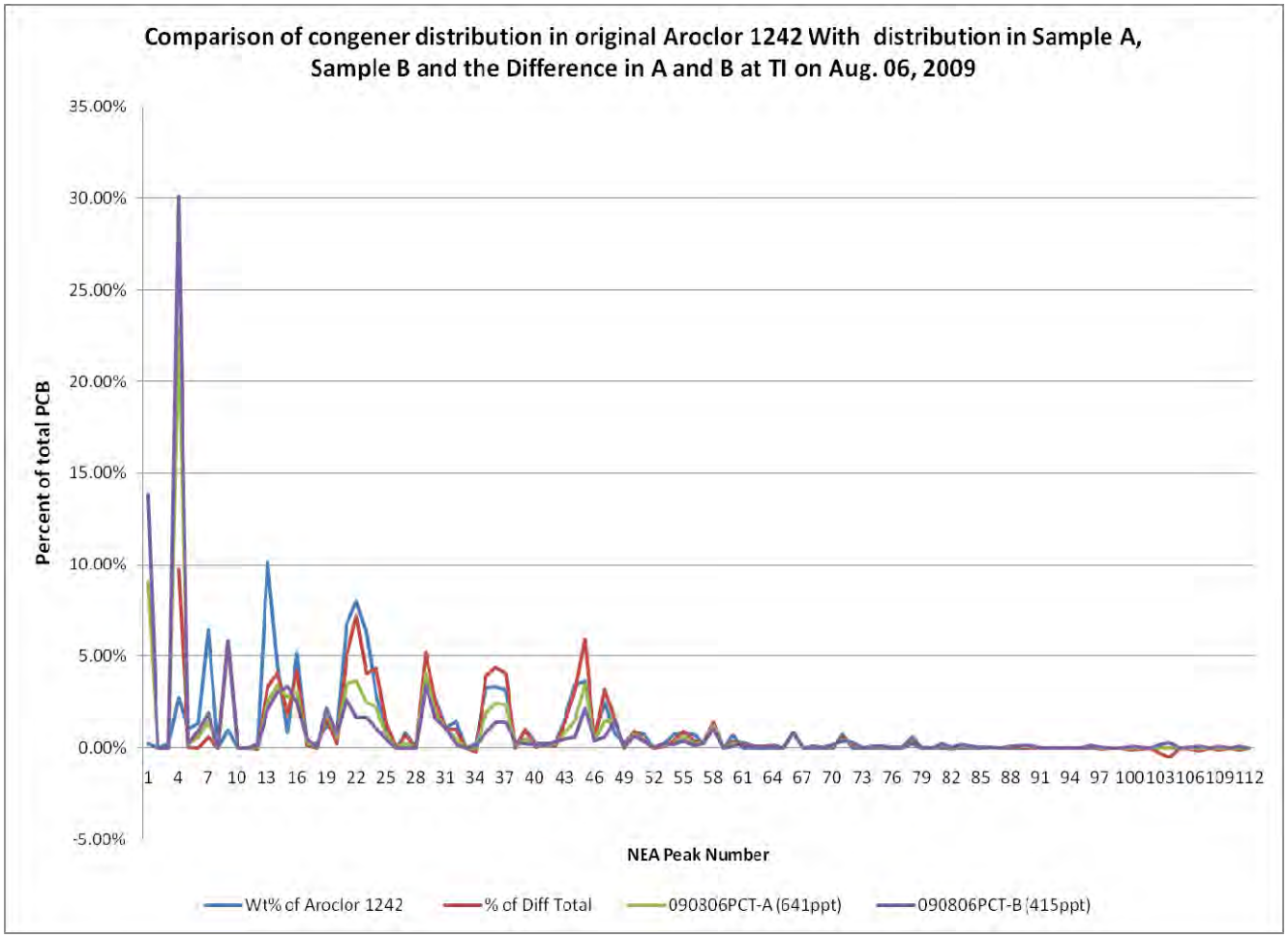
It is apparent in hindsight that the season extension in Phase 1 was largely due to the inadequate characterization of the depth of contamination (DoC) in the Phase 1 dredge areas. The discovery of significant contamination at depths well below the previously assumed DoC caused dredging activities to extend almost until the end of October. Consequently, the backfill and capping of the final CUs required barges to be demobilized through the canal as late as November 23. Incidental near-shore backfill and restoration continued past November 23, and lasted until December 7. Keeping the Champlain Canal open until November 23 had a substantial impact on the Corporation's ability to place dams at, and dewater, Locks C-2 and C-3 for winter work projects. In addition, as mentioned above, these delays also impacted the Corporation's ability to conduct winter work projects on the Erie Canal in Waterford.

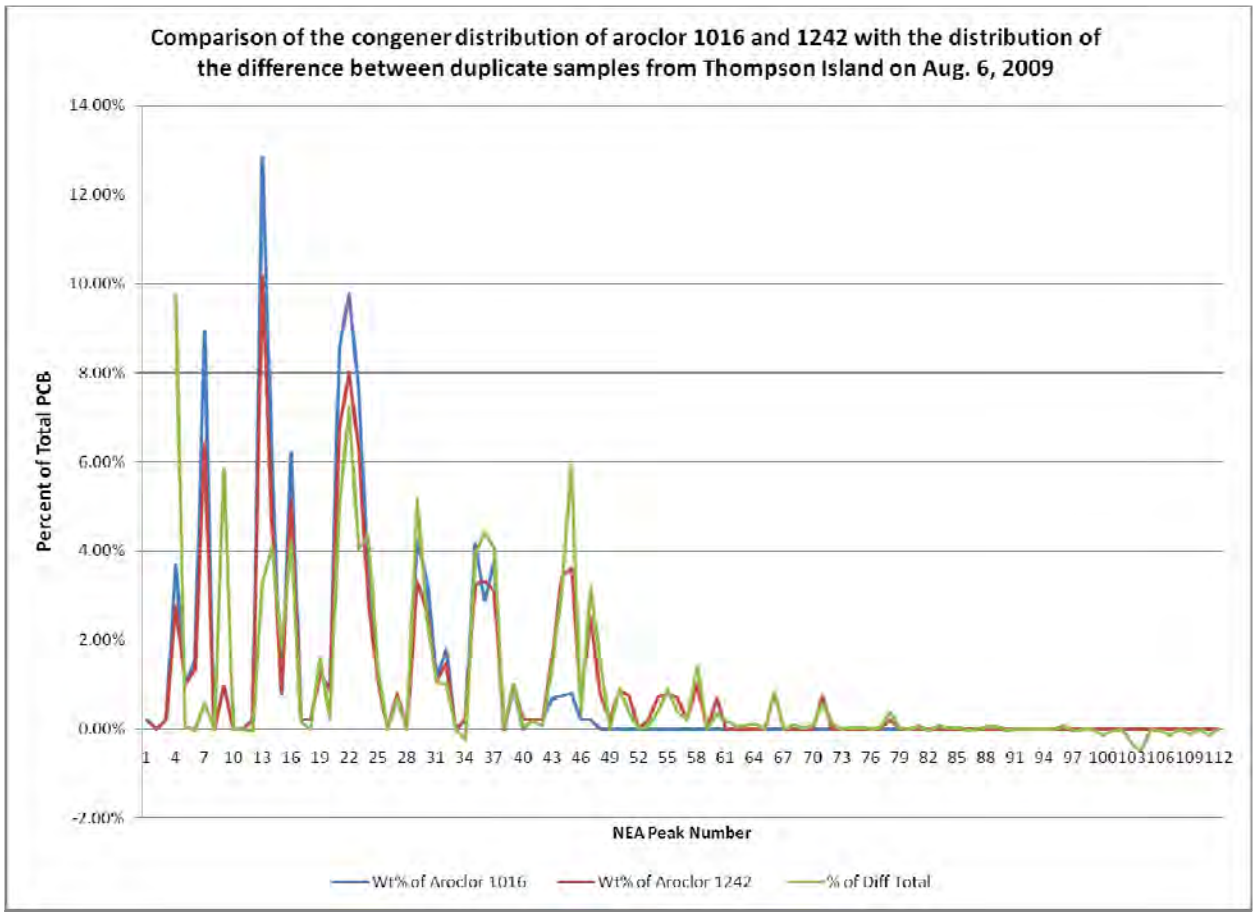
While the rest of the Champlain Canal was able to close on November 23, the last locking at Lock C-7 occurred on December 11, well beyond any date that NYSCC can accommodate on an annual basis.

Weather conditions can dramatically impact the closing schedule and operations in the Champlain Canal. Because the weather can be greatly unpredictable, any operations beyond November 1, other than demobilization, should be discouraged and all backfill and capping work should be scheduled for completion by the end of October. The Canal Corporation recommends that Phase 1 schedules be evaluated to estimate the latest date a new CU should be "opened" for dredging in order to ensure that the inventory dredging, residual dredging, and all backfilling and capping will be completed by the end of October.

NYSCC believes that planning for all work to be completed by October 31 will allow enough flexibility in the remaining two weeks of the season to accommodate unexpected changes in dredging/backfilling volumes, weather delays, or other conditions that would otherwise require an extension of the navigation season. During Phase 2, NYSCC will insist that all project-related operations, including winterization, will be completed by November 15 of each year.

Attachment 2 – Congener Distribution of Selected Samples




Comparison of the congener distribution of aroclor 1016 and 1242 with the distribution of the difference between duplicate samples from Thompson Island on Aug. 6, 2009
Percent of Total PCB
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
-2.00%
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79 82 85 88 91 94 97 100103106109112
NEA Peak Number
Wt% of Aroclor 1016
Wt% of Aroclor 1242
% of Diff Total

Attachment 3 – Select Project Photographs

Photo 1: Taken at Canal Lock C-7 on Sept. 11; shows typical expression of NAPL sheen after NAPL droplets have coalesced

Photo 2: Taken at Canal Lock C-7 on Sept. 11; shows typical expression of NAPL sheen after NAPL droplets have coalesced

Photo 3: Taken in CU-17 on July 24. Note the layout of the booms intended to control NAPL releases from the dredging operation

Photo 4: Taken at Canal Lock C-7 on July 31, showing a loaded scow in transit through the lock.

Photo 5: Closer view of scow transiting Canal Lock C-7 on July 31; note the nature of the dredged material

Photo 6: Close-up view of scow transiting Canal Lock C-7 on July 31; note NAPL on surface of water within scow

Photo 1

[b]

Photo 2

[c]

Photo 3

Photo 4

Photo 5

Photo 6