Honeywell

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June 2, 2014

VIA EMAIL AND ELECTRONIC FILE TRANSFER

Mr. Galo Jackson
US EPA Region IV
Waste Management Division
Superfund Program
61 Forsyth Street, SW
Atlanta, Georgia 30303

Re: LCP Chemicals Site, Brunswick, Georgia
Draft Feasibility Study Report for OU1 (Estuary)

Dear Mr. Jackson,

This document responds to the United States Environmental Protection Agency (USEPA) May 1, 2014, comments on the October 2013 Draft Feasibility Study Report for the LCP Chemical Superfund Site, Operable Unit No. 1 (Estuary), Brunswick, Georgia. The Draft Feasibility Study (FS) Report was submitted in accordance with the 1995 Administrative Order on Consent (AOC) (EPA Docket No. 95-17-C).

The May 1, 2014 comments provide General Comments, Specific Comments, and comments on various appendices. Below each of the Specific Comments, USEPA provided modified text to finalize the FS. With this letter, we provide responses to the May 1 comments. These responses, which represent the views of Honeywell, the Atlantic Richfield Company, and the Georgia Power Company, are intended to clarify our understanding of the technical issue(s) at hand. Though we did not always completely agree with EPA's recommended changes requested in the Specific Comments, in the interest of finalizing the FS and bringing closure to this phase of our work together, we agree to incorporate the Specific-Comment text changes as requested, with only one minor exception (see our response to Specific Comment 2). We also wish to reiterate our commitment to moving forward with USEPA and GAEPD to implement a consensus remedy to address OU1 sediments, following production of the final FS.

This June 2, 2014 submittal includes an electronic copy of this cover letter, responses to the May 1, 2014 comments attached to this letter, and the revised FS with changes shown in "redline" format. We understand that EPA and the Georgia Environmental Protection Division (EPD) will review the FS changes before approving the FS for final production and printing.

Please feel free to call me at 973-722-1656 if you have any questions.

Sincerely,

Prashant K. Gupta
Remediation Manager

Attachment – Responses to the May 1, 2014 Agency Comments
Enclosures – Redline version of the final FS

cc: Jim Brown, GAEPD
Jim McNamara, GAEPD
Brett Mitchell, Georgia Power
Paul Taylor, Atlantic Richfield Company
Victor Magar, ENVIRON

Responses to USEPA's May 1, 2014 Comments on the Draft Feasibility Study Report for the Estuary, Operable Unit 1: LCP Chemicals Superfund Site, Brunswick, Glynn County, GA

General Comments

1. Monitoring Strategy – Review of the FS, particularly Table 6-3 and the recommended remedial alternatives presented in Section 7.3.4, shows that the responsible parties' preferred alternative (Alternative 6) leaves in-place 94% of the lead, 80% of the mercury, 75% of the polynuclear aromatic hydrocarbons and 26% of the Aroclor-1268 identified through the surface-weighted average concentration (SWAC) evaluation. Needless to say, leaving such significant quantities of the contaminants of concern brings into question the effectiveness and permanence of the preferred remedies. Should this alternative ultimately be chosen, a robust monitoring program will be required to demonstrate effectiveness and permanence. We have reviewed the case studies presented in Magar *et al.* 2009 and have identified 10 different programs applied to 13 sites in varying combinations. In order of applicability, they are: sediment chemistry (10); biota sampling (9); bathymetric survey (4); sediment coring, modeling, toxicity testing and surface water chemistry (2 ea.); pore water chemistry, radioisotope analysis, and population study (1 ea.). Sediment coring (due to low sedimentation rate) and radioisotope analysis are not applicable to this Site. Bathymetric surveys of the LCP Chemicals Estuary (OU1) have been undertaken. Pore water and other parameters have been modeled, and most others have been baselined through the extensive sampling regime undertaken prior to development of the FS. GAEPD and the EPA expect that a robust monitoring program, based on the baseline (pre-remedial) biologic sampling, including toxicity testing, surface water testing, bathymetric surveying and population studies, will be specified in the Record of Decision and further detailed in the remedial design. This strategy will enable the EPA and GAEPD to determine when the LCP Chemicals Estuary has returned to baseline conditions after the implementation of the active portions of the remedial measures and the effectiveness of the remedy in achieving the Remedial Action Objectives.

    <u>Response</u>: Regarding the amount of mass left in place for Alternative 6, the comment confuses total mass with ecological and human health risk. The chemical mass removed for each remedy was reported in Table 6-3 simply to inform the reader that mass was being removed from the estuary for disposal off-site. However, risk, not mass, informed delineation of sediment management areas and was used to identify and evaluate risk-management alternatives. Because risk is driven by concentration, not mass, remedy effectiveness is not a function of the residual mass left behind. Sediment in areas where concentrations are above the approved RGO range were targeted for removal, capping, or thin-cover placement.

    Regarding the comment on monitoring, we understand and support the need for post-remedy monitoring. Establishing clearly defined monitoring goals and corresponding exit criteria is central to a well-defined and well managed monitoring program. Data should be collected with an understanding of how the data will be used and how they contribute to a validation of remedy performance and success. Toxicity testing is not a good metric for remedy success. Thus, toxicity testing will not be a component of the remedy effectiveness evaluation and will not be performed after remediation.

    Regarding the last sentence in the comment (that "[monitoring] will enable the EPA and GAEPD to determine when the LCP Chemicals Estuary has returned to baseline conditions…") under the National Contingency Plan, the goal of remediation is to reduce chemical concentrations to acceptable risk-based levels, not to return the Site to baseline conditions. CERCLA does not require a return to baseline for remediation purposes.

2. Timeframes – No timeframes for attaining remedial goals have been presented in the FS. The statement on page 8 of the response to comments ignores the body of literature which suggests that

PCB degradation dissipation is likely to occur extremely slowly in this marsh environment. This omission compromises our ability to adequately consider this factor when evaluating the pros and cons of the alternatives which leave residual PCB and mercury in place. Timeframes based on best professional judgment should be provided.

Response: Timeframes are discussed throughout the FS. Excerpts that refer to remediation restoration timeframes include the following:

- Section 2.3: Restoration times are discussed.
- Section 4.2.5: "Sediment capping immediately provides a clean sediment surface and quickly reduces exposure to chemicals in surface sediments."
- Section 5.2.1: "A thin cover of clean sediment immediately reduces surface sediment chemical concentrations and achieves levels below the low-end RGOs in the upper 6 inches (15 cm)."
- Section 5.3.7: "The time to achieve remediation goals (i.e. RGOs) for removal, capping, and thin-cover placement coincides with the time to implement each remedy. That is, because all three technologies rely on the placement of clean material on the sediment bed surface to achieve RGOs, the RGOs are achieved as soon as implementation is complete: approximately 2 years for SMA-2 and SMA-3 and approximately 3 to 4 years for SMA-1. Shellfish and fish concentration reductions will require much longer (years or decades, respectively) to reach equilibrium with reduced surface sediment concentrations. The time for habitat recovery also is expected to be much longer. Within approximately 2 years after construction, Spartina growth is expected to recover. However, full functionality of the marsh ecosystem will require more time—years to decades depending on the remedy. For example, thin cover placement will recover more quickly than removal because it retains the natural organic matter in the sediments."
- Section 6.2.2: "The smaller footprints associated with Alternatives 5 and 6 result in shorter construction schedules for these remedies, thereby reducing the time during which water quality impacts may occur. Alternatives 3, 5, and 6 have estimated construction durations of approximately 17, 10, and 11 months, respectively."
- Section 6.2.3: "…whereas the lower end of the SWAC RGO range provides lower residual COC levels, the overall recovery time would be faster with the upper end of the SWAC RGO range which has a much smaller immediate impact on the ecosystem."

In summary, and as discussed in the response to Comment 4 of the draft FS (Page 8 as referenced in this comment), RGOs will be met upon completion of work. Ecosystem recovery, discussed in Section 2.3, will take more time.

The comment refers to PCB degradation dissipation. We agree that PCB transformation degradation processes are slow. For this reason, the FS does not rely on PCB transformation degradation as a component of the sediment remedy. Neither does the FS rely on transformation processes for mercury, lead, and polycyclic aromatic hydrocarbons (PAHs). This *conservative* approach recognizes that these processes are slow. Therefore, the FS relies on active remedies (removal, capping, and thin-cover placement) to achieve the short-term RGO goals, which are defined by not-to-exceed (NTE) and surface-weighted average concentration (SWAC) criteria. Because RGO goals are met upon completion of each remedy, the ability to evaluate the pros and cons of the different sediment management areas (SMAs) and remedy alternatives is not hindered.

The most significant factor under consideration is the severity of the impact to the marsh if larger remedies are employed (i.e., Remedy Alternatives 2 and 3, which rely on SMA-1) compared to the benefit of achieving the upper-end RGOs while conserving as much of the existing habitat as possible (i.e., Remedy Alternatives 4 through 6, which rely on SMA-2 and SMA-3, respectively). This concern is most effectively addressed in Section 7.2.1, which says:

> …the remedies differ in the amount of risk reduction achieved and with regard to their respective impacts on the existing habitat. Alternatives 4, 5 and 6, which rely on the upper-end RGOs remediate a smaller footprint than Alternatives 2 and 3, but also minimize impacts to the ecosystem by targeting remediation of those areas where COC levels are above the acceptable RGO range. Similarly, when employing combined remedies that include removal plus capping plus thin-cover placement, Alternative 3 and Alternatives 5 and 6 have a smaller environmental impact compared to Alternatives 2 and 4, respectively, because the combined remedies remove only those areas with the highest COC levels that cannot be remediated via capping or thin-cover placement and rely on less intrusive approaches for lower-risk areas.

3. In the revised draft of the FS, it is frequently repeated that "each alternative results in SWACs that meet the RGOs." These statements should be clarified to state that Alternatives 2 and 3 (SMA-1) achieve the low end of the RGO range, while Alternatives 4 and 5 (SMA-2) only meet the high end of the RGO range. The sentences should be modified to state that each alternative results in SWACs that lie within the RGO range and that some creek SWACs (i.e., Domain 3 Creek and the Western Creek Complex) do not meet the upper SWAC RGO for mercury. Specific comments refer to this.

   <u>Response</u>: The changes recommended in this comment have been implemented, consistent with the edits provided in the "Specific Comments," below.

4. The FS should adequately describe how Alternatives 4 - 6 achieve Remedial Action Objective (RAO) 4, which reads "*Reduce ecological risks to benthic organisms exposed to contaminated sediment to levels that will result in self-sustaining benthic communities with diversity and structure comparable to that in appropriate reference areas*." Based on the RGO correspondence contained in Appendix G of the revised draft FS, use of the upper RGO range for benthic invertebrates was approved for the purposes of developing and screening alternatives. Such EPA and EPD approval does not imply Agency agreement that the high end RGOs are as protective as the low end of the range, a conclusion which is contrary to the conclusions of the BERA. Although the Honeywell 2012 memorandum provided alternative explanations for using higher sediment effect concentrations (SECs) from the BERA, there are no adequate discussions in the revised FS regarding the reliability of the toxicity data. Regardless of the relatively poor predictive power of the SECs, the toxicity results remain as site-specific fact. For example, from Honeywell's 2006 AET study, in the Western Creek Complex (WCC) 78% of the samples (39/50) were toxic for the reproductive response endpoint and 68% were considered toxic for survival to amphipods. Similarly, most of the grass shrimp toxicity tests conducted in WCC and Purvis Creek were toxic to at least one endpoint (BERA Table 4-21). In general, the higher the concentration above the lower RGO, the greater the potential residual risk. The RGO range is an uncertainty range where cleanup within the range is protective with differing levels of certitude. The revised FS should discuss the consequence of the 30-acre difference in residual benthic community risks between SMA-1 and SMA-2. This 30-acre difference is not trivial and the alternatives cannot be assumed to be similarly protective. Several of the specific comments below address this deficiency.

   <u>Response</u>: The FS does not state or imply that all three SMAs are "similarly protective." The phrase "similarly protective" is not used. The FS includes the following statements, which reflect the balance and objectivity used to evaluate Alternatives 1 through 6.

Section 6.2.1 discusses Alternatives 4 and 5.

> "…concentrations within the RGO range are considered protective. The concentrations within the RGO range may not be as protective as concentrations below the RGO range, but nevertheless, they are protective.

Regarding isolated areas left out of SMAs 1-3, the FS says:

> "While the lower end of the RGO range may be considered more protective than the upper end of the RGO range, the adverse impacts of achieving the lower end of the RGO range must be balanced against the benefits. In this case, the residual risk to the benthic community associated with three isolated samples is small compared to the impact of remediation at these relatively remote locations."

Statements made in the FS about the reliability of the toxicity data were extracted from the BERA prepared by EPA (Black and Veatch 2011). The following FS and BERA statements are quoted verbatim. Italics are used to show where overlap exists between the two documents.

Section 2.4.3 of the FS states:

> The OU1 BERA concluded that the observed toxicity appeared to be caused by COCs, but also acknowledged that there were *no discernible COC exposure response relationships of high predictive value, and toxicity was substantially influenced by other factors including TOC, sulfide, and grain size*. The OU1 BERA concluded that these lines of evidence for collectively evaluating the viability of the structure and function of the benthic estuarine community at the Site indicate that the potential for risk associated with COCs and non-COCs is evident, particularly in LCP Ditch, Eastern Creek and Domain 3 Creek.

FS Appendix L states:

> Based on these evaluations, there was *no discernable COPC exposure-response relationship of high predictive value. Detailed analysis of the toxicity test results indicate that other factors such as the COPC mixtures, total organic carbon, sulfide content, and sediment grain size confounded predictions of sediment toxicity to amphipods.*

BERA Executive Summary – Page S-4 states:

> However, based on these evaluations, *there was no discernable COPC exposure-response relationship of high predictive value. Detailed analysis of the toxicity test results indicate that other factors such as the COPC mixtures, total organic carbon, sulfide content, and sediment grain size confounded predictions of sediment toxicity to amphipods and grass shrimp.*

Amphipod Toxicity: Section 4.5.3 of the BERA states:

> A review of Table 4-19a indicates that for each COPC, over 80 percent of the samples less than their respective AETs for reproduction and survival were toxic. *This suggests that other chemical and physical factors in the sediment such as other chemicals, sulfide content, TOC, grain size, sediment pH, and sediment oxidization-reduction potential, may be affecting bioavailability and contributing to toxic expression.* The 150 AET samples were not analyzed for sulfides, TOC,

> or grain size. *The AET results do not provide a reliable means to assess the numerous toxic responses below the AET levels.* Given the high number of toxicity tests performed, it would be expected that an exposure-response relationship (sediment concentration related to the measured toxic effect) could be obtained for at least one of the COPCs. This is explored in Section 4.6.

Section 4.6 of the BERA states that:

> *Based on the exposure-response relationships and the relatively poor SEC accuracies, the ability to predict sediment concentrations that result in adverse effects to Leptocheirus plumulosus is highly limited.*

General Comment #4 provides specific details about toxicity observed in the 2006 AET study of the Western Creek Complex and the grass shrimp toxicity study conducted in the Western Creek Complex and Purvis Creek. Specific Comments 2 and 10 further expand on this discussion of observed toxicity. The information below is provided in response to these comments.

The FS does not imply or state that OU1 sediments are not toxic. Section 2.4.3 says that "The AET study evaluated survival, growth, and or reproduction of lab-cultured amphipods exposed to surface sediment samples collected from 150 locations in Eastern Creek, LCP Ditch, and Western Creek Complex. Endpoints were often significantly reduced relative to controls and some reference areas." Moreover, Appendix G and Appendix L of the FS state that toxicity testing "study results provided valuable insight for the development of sediment effects concentrations ultimately used to derive the low end and the upper end of the RGO range used in the FS."

The fact is that toxicity was seen at OU1 locations *and* reference locations, which is part of the reason interpretation was so difficult in the BERA. The BERA demonstrated that toxicity was observed on numerous occasions and for numerous endpoints at Troup Creek and the Cresent River reference locations. BERA Table 4-14 shows that toxicity was observed for one or more amphipod endpoints (survival, growth, and reproduction) at Troup Creek and or Cresent River in 2002, 2003, 2004, 2005, and 2006. In 2006, the BERA noted that "four of the five replicates in the Troup Creek reference location did not show any reproductive response." The BERA states "in 2005, the amphipod toxicity tests were expanded to 25 locations, plus the two reference stations (Table 4-14). The three test endpoints at both reference stations were significantly less than controls. Again, it is unclear what factors may contribute to the observed effect in these two areas. All test stations were toxic to the reproductive endpoint relative to the control." Similarly, in the 2005 grass shrimp study, for example, the Troup Creek shrimp embryo development was identified as "toxic." The BERA does not mention this event directly but looking at Table 4-21 and focused on OU1 (i.e., excluding Blythe Island and Turtle River), it can be seen that 11 of the 25 locations within OU1 had embryo development measurements similar to or exceeding the Troup Creek reference location.

Also, there is uncertainty in how toxicity is defined in general. The AET study did not include Troup Creek and Cresent River reference locations, so all toxicity in the AET is based on a comparison to the laboratory controls and the use of a conservative metric (i.e., the 60% confidence interval rather than a 95% or 99% confidence interval) to demonstrate toxicity. The BERA states that the "60% confidence interval to identify reproductive and growth toxicity "was a more conservative approach for determining AETs than would be [considered toxic] if, for example, a 95 or 99% CI were employed (i.e., a fewer number of toxic sediment samples would have been identified…)."

In summary, the FS addressed the BERA results in a fair and balanced manner. However, despite our concerns with this comment, the editorial changes recommended in the Specific Comments, below, have been incorporated into the FS, with only one modification in Specific Comment #2, as indicated below.

Specific Comments

1. **Section 2.2.1, page 6,** the fourth paragraph of the section, characterizes the ''uppermost layer of the Coosawhatchie" as a "...cemented sandstone...confining layer..." between the Satilla and the Coosawhatchie A/B. This should be changed to "...*variably* cemented sandstone...*aquitard*..." for consistency with the documents submitted (and approved) in support of the $C0_2$ sparging groundwater action currently being performed by the responsible parties. Additionally, although commented on previously, this second draft of the FS repeats that an on-site pump test verified the effectiveness of the sandstone layer as a confining layer. This is in conflict with the text in the 1997 unapproved groundwater remedial investigation, which reads, "The sandstone layer is considered a leaky confining unit based upon visual observations of ground-water color contrasts from well clusters (Figure 4.4-6), pumping test response, and distinct chemical concentration contrasts between wells screened above and below this confining layer (Figure 4.4-6)." The basis for the conclusion that the sandstone layer is leaky is, in part, the responses observed in the MW-108 well cluster (Figure 4-4.8 of the 1997 RI). The figure shows water level response in the well installed above the sandstone when the well completed below the sandstone was pumped. This response is cited in the 1997 document as evidence of hydraulic communication.

   <u>Response</u>: The comment is unclear with regard to what is intended by labeling the sandstone as variably cemented. That is, the strength of cementation (the hardness and physical consistency) of the sandstone varies within this layer, but the layer in and of itself is distinguishable from material above and below because it is cemented. In other words, it is consolidated in comparison to the unconsolidated sedimentary deposits of sandy material above and below the layer.

   Text will be revised to be consistent with other submitted documents. Variability in this unit can be used in context with respect to its strength of cementation (hardness and physical consistency) but not as to whether or not the cementation is at places present and at other places not present.

   <u>*Specific comment #1 text revision*</u>

   The Coosawhatchie Formation is Miocene in age and is approximately 180 feet (55 meters) thick. It can be divided roughly into two water-bearing units and two confining layers. The uppermost layer of the Coosawhatchie is approximately 3 to 15 feet (1 to 4.5 meters) of variably cemented sandstone, which acts as a semi-confining layer between the Satilla sand and the Coosawhatchie A/B aquifers (Figure 2-2). The cemented sandstone has an approximate hydraulic conductivity of 10-5 cm/sec. The Coosawhatchie AI B aquifers are approximately 50 feet (15 meters) thick and have an approximate hydraulic conductivity of I0-2 cm/sec. ~~On site pump tests conducted across the cemented sandstone have verified that the cemented sandstone is an effective confining layer hydraulically separating the two water bearing units.~~ The Coosawhatchie C consists of an approximately 30-foot (9-meter)-thick dolomitic mar/stone and acts as a confining layer between the Coosawhatchie A/B aquifers and the Coosawhatchie D aquifer.

   <u>Response</u>: Text revisions were made as specified.

2. **Section 2.4.3, page 29,** second to the last bullet, near the end of the page. Results of the sediment toxicity tests indicated extensive toxicity in the majority of over 200 samples. This is not **uncertainty**, but fact. The uncertainty associated with the lack of a clear dose-response relationship is what is reflected in the development of an RGO range, not any uncertainty in the actual toxicity results.

   The upper end of the RGO range for the benthic community is the apparent effects threshold (AET) for mercury (11 mg/kg) and Aroclor-1268 (16 mg/kg). There is little uncertainty that the sediments with concentrations above the upper end of the RGO range are toxic to the benthic community. The text should be modified as indicated below.

Response: The first sentence explains the context for the uncertainty quoted in the second sentence of this bullet. Please also refer to General Comment 4 for overarching issues related to uncertainties in the sediment toxicity testing. The uncertainty associated with the toxicity test results is due in part to the amount of toxicity observed in reference samples associated with the toxicity tests. Furthermore, the uncertainties discussed in the FS are consistent with those discussed in the BERA, prepared by USEPA (Black & Veatch 2011). The presence of considerable toxicity in reference samples confounds the interpretation of toxicity observed in samples representing the site.

Specific comment #2 text revision

- *The evaluation of potential adverse effects to the benthic invertebrate community relied on hundreds of site-specific acute and chronic toxicity test measurements using both indigenous and laboratory-cultured organisms. The OU1 BERA notes that the development of RGOs for the protection of benthic invertebrates is "highly uncertain with poor accuracies" and that "only conservative assumptions were used" for this purpose. Although the absence of a clear dose-response relationship resulted in uncertainty in developing the RGOs, there was extensive toxicity in the majority of sediment samples.*

Response: The modified text will be revised as: "*Although the absence of a clear dose-response relationship resulted in uncertainty in developing the RGOs, there was extensive toxicity in the majority of sediment samples, including the reference locations.*"

3. **Section 2.5.4, page 37.** In the paragraph that begins, "The BERA used measured methylmercury..." Clarify that the BERA did not simply assume that the fraction of total mercury present as methylmercury was 0.75%, etc., rather the fractions were based on actual measurements of ratios in sediment and biological tissues.

Specific comment #3 text revision

The BERA used measured methylmercury tissue data for a variety of dietary food items that each receptor group consumes. Based on Site methylmercury and total mercury analyses, the BERA calculated the fraction of total mercury present as methylmercury is 0.75% in sediment and from 10% (Spartina) to 100% (spotted seatrout) in tissue.[5] These percentages were used to establish remedial goals that would be protective of wildlife exposures through the bioaccumulation of mercury.

Response: The FS has been modified as indicated.

4. **Section 2.5.4, page 39, 1st paragraph.** Delete the first part of the first sentence, regarding the five measurement endpoints as they are out of context here.

Specific comment #4 text revision

~~Based on an overall evaluation of these five measurement endpoints,~~ The OU1 BERA concluded that there is no risk to fish in the Site from direct exposure to COCs in the water column. However, the bioaccumulation modeling and field data for finfish suggest that chronic risk/rom mercury and Aroclor 1268 to viability of finfish indigenous to the Site is of concern.

Response: The FS has been modified as indicated.

5. **Section 6.2.1. Figures 6-5, 6-7A, 6-7B, and 6-8.** There are inconsistencies between the subject figures and the Section 3 figures. These inconsistencies affect the color coding for sampling areas in the Western Creek Complex (WCC) and Purvis Creek.

Figure 3-1B shows the western limb of the WWC [sic] to have three boxes in the limb to have average mercury concentrations between 4-11 mg/kg (purple). Figure 3-2B shows the western and middle limbs of the WCC to have average Aroclor-1268 of between 6-16 mg/kg (also purple). According to the legend on figures 6-5, 6-7A and B, and 6-8, these colored boxes should be changed from gray to yellow (within the range of the benthic community RGOs).

For Purvis Creek, Figure 3-2A (Aroclor-1268) shows one box in Purvis Creek west of the WCC, with an orange symbol (>16 mg/kg). Similarly, Figure 3-4A shows one box west of the WCC with a PAH concentration of >6 mg/kg. According to the legend on figures 6-5, 6-7A and B, and 6-8, these two boxes should be shown in black (exceeds the range of the benthic community RGOs).

The revised FS should include revisions to these figures in order to accurately portray remedy effectiveness and potential residual risks that would remain.

Response: Revisions have been made to the Section 6 figures and included in the FS. Figures match the updated figures submitted to USEPA (Galo Jackson) on Friday, November 8, 2014.

6. **Section 3.3.3, page 44, 1st paragraph.** "*SWAC RGOs are not a bright line above which adverse impacts will definitively occur. Rather, for example, Table 3-4 shows the range of preliminary SWAC RGOs identified in the BERA for mercury and Aroclor 1268, for birds, mammals, and fish; this range extends between the NOAEL and the LOAEL for each ecological receptor.*" This sentence is misleading and should be modified because the BERA did not characterize risks or develop RGOs based on SWACs.

Specific comment #6 text revision

The technical basis and protectiveness of the SWAC and benthic community RGOs is described in the BERA and the RGO correspondence letters described in Section 3.3.1. ~~SWAC RGOs are not a bright line above which adverse impacts will definitely occur. Rather, for example,~~ Table 3-4 shows the range of preliminary ~~SWAC~~ RGOs identified in the BERA for mercury and Aroclor 1268, for birds, mammals, and fish; this range extends between the NOAEL and the LOAEL for each ecological receptor. Both NOAEL-based and LOAEL-based RGOs can be used to inform risk management decisions that meet the threshold criteria of protection offish, mammal, and bird populations. Shading on Table 3-4 illustrates where the OU1 FS SWAC RGOs fall along the NOAEL and LOAEL range identified in the BERA. In all cases, the SWAC RGOs are at or below the respective LOAEL ~~NOAEL~~ preliminary RGOs established in the BERA, and for several species, the range falls below the preliminary NOAEL RGO value.

Response: The FS has been modified to address these changes in this paragraph and other locations where applicable.

7. **Section 6.2.1, page 102, 3rd whole paragraph.** Change the 3rd and 4th sentences to read "Each alternative result in SWACs that lie within the RGO ranges. Therefore, the SWAC reductions achieved by each alternative result in commensurate reductions of mercury and Aroclor 1268 in fish and shellfish that is expected to lead to reductions..."

Specific comment #7 text revision

Alternatives 1 and 3 (SMA-1), 4 and 5 (SMA-1), and 6 (SMA-3)

Alternatives 2 through 6 are protective of human health and environment, as these alternatives are designed to comply with ARARs, RAOs, and RGOs set forth in Section 3. Therefore, these remedy alternatives meet the threshold criteria of protectiveness for human health. Each alternative results in SWACs that lie within the RGO ranges. ~~meet the RGOs.~~ Therefore, the SWAC reductions achieved by *each alternative will result~~s~~ in commensurate reductions of mercury and Aroclor 1268 in fish and shellfish concentrations are expected to ~~that eventually will~~ lead to reductions in fish and shellfish consumption advis011es within the TRBE. Table 6-IA identifies the SWACs for each of the SMAs and demonstrates that post-remedy SWACs generally fall within the range of RGOs identified in Section 3.*

Response: The FS has been modified to address these changes in this paragraph and other locations where applicable. The word "and" was added to the proposed edits after "shellfish concentrations".

8. **Section 6.2.1, page 103, 2nd paragraph.** The FS addresses finfish exposures inconsistently in discussions about the smaller creeks. The SWAC hazard calculations for finfish assume full utilization of creek habitat for exposure. However, a footnote to Table 6-1B states "*The Domain 3 Creek and Western Creek Complex are very small and cannot support significant exposures to finfish. Therefore, in consideration of protectiveness of human health and finfish, the Total Creeks are most relevant (i.e., current conditions SWAC vs. Total Creek SWAC).*" In the 2nd paragraph on page 103 the document states "*However, because the Domain 3 Creek is not large enough to support finfish, risks to finfish from the Domain 3 Creek are not significant. Domain 3 Creek is only inches deep for much of the tidal cycle.*" Even though exposures may be small, there are no data to suggest they are insignificant. In addition, other receptors in the small creeks such as mummichogs and crabs that comprise the diets of finfish and herons will contribute to residual risks. The table footnote and text paragraph should be modified.

<u>*Specific Comment #8 text revision (or footnote (a) on Table 6-1B*</u>

The Domain 3 Creek and Western Creek Complex ~~are very small and cannot support significant exposures to finfish~~ represent a relatively small portion of the total creek area. Hence, these creeks have a relatively small contribution to the SWAC. Therefore, in consideration of protectiveness of human health and finfish, the Total Creeks are most relevant (i.e., current conditions SWAC vs. Total Creek SWAC).

Response: The FS has been modified as indicated.

<u>*Specific Comment #8 text revision in 2nd paragraph on page 103*</u>

Alternatives 2 through 6 also achieve the SWAC RGOs for individual areas within the SWAC RGO range, except in Domain 3 Creek. ~~However, because the Domain 3 Creek is not large enough to support finfish, risks to finfish from the Domain 3 Creek are not significant. Domain 3 Creek is only inches deep for much of the tidal cycle. Therefore~~ However, as illustrated in Figure 6-2A and 6-2B, when the ~~average~~ conditions of ~~the~~ Domain 3 Creek, Domain 3, and Purvis Creek are ~~considered~~ averaged, the post remedy SWAC conditions for Alternatives 2 through 6 are similarly protective even for species with a small home range, like the green heron.

Response: The FS table has been modified as indicated.

9. **Section 6.2.1, page 103.** The sentence near the bottom of the page that reads "*Furthermore, because the RGOs were developed using the most sensitive among species and while these RGOs provide insight* about *the potential for toxicity, the actual injury to the benthic community associated with these exceedances is expected to be insignificant,*" should be removed. Specifically, there is no basis to support that actual injury is expected to be insignificant. The toxicity test results clearly demonstrate otherwise.

<u>*Specific comment #9 text revision*</u>

The residual risks in Domain 4 would not adversely impact the entire sediment-dwelling community. The RGO exceedances in Domain 4 are small and represent isolated samples surrounded by much lower COC concentrations throughout the remainder of Domain 4. ~~Furthermore, because the RGOs were developed using the most sensitive among species and while these RGOs provide insight about the potential for toxicity, the actual injury to the benthic community associated with these exceedances is expected to be insignificant. As such,~~ The overall community in this Domain as a whole would not be adversely impacted. Therefore, Alternatives 2 and 3 are protective of the sediment-dwelling community.

<u>Response</u>: The FS has been modified as indicated.

10. **Section 6.2.1, page 104, last paragraph continuing on page 105.** There are several issues with the discussion on these two pages that require clarification. First, the statement from the BERA regarding the lack of a discernible dose-response relationship refers to the uncertainty in the lower end of the RGO range for the benthic community, which was derived from the SECs that statistically evaluated measurable differences. The low end of the RGO range is less reliable since it was not readily apparent but was derived by statistics. However, there were many observed discernible differences in the response of organisms in the toxicity tests below the AET levels. The text appears to imply that there was no toxicity observed to the benthic community up until the AET. This is simply not true. The toxicity tests results presented in the BERA (e.g., Tables 4-14, 4-15, 4-21, and 4-23) indicate toxic effects in the majority of tests. The text should be modified to include other SECs rather than strictly focus on mercury AETs.

    Second, the discussions on page 105, in Appendix L, and in the response to comments regarding grass shrimp toxicity and exposure that are misleading and should be clarified. The laboratory-raised and indigenous grass shrimp toxicity tests endorsed by Honeywell and its contractor were considered to be representative of exposure because the tests covered a range of sediment concentrations that the shrimp would be exposed to. The longer (2-month) exposure duration in the test on laboratory-raised grass shrimp was necessary to measure the sensitive reproductive endpoint, embryo development, which was used to help establish the benthic RGO. While the toxicity tests run in the laboratory on field-collected (indigenous) grass shrimp observed toxicity only in the LCP Ditch and the Eastern Creek, these tests were stopped early because the field-collected grass shrimp endpoint measured the percent of embryos hatched, which is a less sensitive test relative to the embryo development endpoint. Although most of the toxicity to field-collected grass shrimp was observed in some of the highest sediment concentrations (up to 88 mg/kg of Aroclor 1268 and 8.5 mg/kg mercury), toxicity to the indigenous shrimp was also observed at concentrations of 1.7 mg/kg Aroclor 1268 and 1.2 mg/kg mercury. Revise the text to differentiate between the laboratory-raised and indigenous grass shrimp toxicity studies.

    The drifting movement of grass shrimp in response to the tides over a range of differing sediment concentrations is captured by the range of sediment concentrations in the tests. Moreover, the contaminants in creek sediments were averaged over 50 meter segments before they were compared to the benthic RGO ranges. The first paragraph on page 105 should clarify the uncertainty associated with laboratory and field-collected grass shrimp exposure to sediment.

    The same paragraph mentions grass shrimp populations. There were no grass shrimp population studies conducted in the estuary. The sentence should refer to the toxicity tests. In addition, the text should include discussion of the amphipod toxicity studies since the benthic RGOs were also based on those test results as well.

Furthermore, Alternatives 4 and 5 are not comparatively protective to the benthic community, relative to Alternatives 2 and 3. Since there is an approximately 30-acre difference between the footprints for Alternatives 2 and 3 compared with Alternatives 4 and 5, which is not trivial, the alternatives cannot be assumed to be similarly "protective." Delete the last sentence in this paragraph and replace with brief sentences noting the general differences between the Alternatives.

Response: Regarding the first paragraph of the comment, this issue was already addressed in General Comment #4.

The second paragraph of the comment refers to laboratory-raised grass shrimp, laboratory grass shrimp study durations, and the range of concentrations selected for use in the grass shrimp toxicity studies. Given the general reference to the FS, Appendix L, and the draft FS response to comments, it is unclear what exactly is considered misleading; however, the following appears relevant to explain:

- The FS did not dispute the duration of the grass shrimp experiment, which was established based on the endpoint being considered. Figure L-5A of the FS states "monitoring between 2000 and 2007 focused on endpoints of embryo hatching and DNA damage, which were not the most sensitive endpoints identified in the BERA, but do inform some understanding of improvements over time and areas of toxicity." This statement acknowledges the difference in endpoints. The basis of statements about study duration and how animals like grass shrimp use the OU1 environment are made because these issues inform risk managers about how toxicity may be expressed in a natural setting when exposure is not the same as a laboratory environment. These issues are the technical basis of statements that the SECs are not definitive concentrations above which toxicity will absolutely be observed, which allow risk managers to balance damage to the marsh from the remedial action against potential toxicity related to residual chemicals.

- The toxicity seen at lower concentrations (1.7 mg kg Aroclor 1268 and 1.2 mg kg mercury) has not been disputed. However, comparable conditions were observed in reference samples. As stated in the response to General Comment 4 and described in detail in the BERA, there was observed toxicity in one or more endpoints for the grass shrimp in the reference locations. Those locations had mercury and Ar1268 concentrations less than 0.1 mg kg.

The third paragraph of the comment discusses grass shrimp movement and suggested edits.

- The FS discussion does not challenge the range of concentrations considered in the grass shrimp toxicity testing. However, the animals are not exposed in a single environment at a designated concentration, resting on the sediment surface. These animals spend substantial time among the grasses in the water column, moving over large areas with the tide. They very likely have exposures much lower than any concentration tested because they do not sit on the sediment surface for 60 consecutive days.

- Fifty-meter averaging is another reasonable attempt at estimating exposure to inform decisions, but as the tide moves out the LCP marsh, the grass shrimp move with it over areas much greater than 50 meters.

The fourth paragraph of the comment mentions reference to grass shrimp populations. This correction was made to the Revised FS. The comment indicates some discussion of amphipod toxicity studies should be included but the suggested edits do not include this. The reference to the AET is provided only as an example, so more discussion is not warranted in this section.

Section 3 and Appendix G provide that level of detail. No further edits are provided in this section.

The fifth paragraph of the comment refers to issues raised and discussed in General Comment 4. The sentence edited out of this paragraph in the suggested redline says that "*these alternatives (Alternatives 2 through 6) are protective…*" It does not say or imply they are "comparatively" protective or "similarly" protective. Nonetheless, the Specific Comment #10 text revision was incorporated into the revised and final FS.

Specific comment #10 text revision

Appendix L summarizes indigenous grass shrimp and sediment-dwelling community studies, and provides a brief overview of extensive sediment toxicity testing that was identified in the BERA. The indigenous shrimp toxicity tests ~~study monitored~~ evaluated stations within OU1 during six events from 2000 to 2007 (Appendix L; Figure L-5A). Benthic community assessments were conducted from only four stations within OU1 during one event in1995 (Horne et al, 1999) and one event in 2000 (as cited in Black & Veatch (2011). Extensive sediment toxicity testing (i.e., more than 200 tests on two species using multiple endpoints) was also conducted using sediments from OU1 from 2000 to 2007 (Appendix L). Results of the laboratory sediment testing were used in the BERA to derive several COC-specific sediment effects concentrations, such as probable effect levels and apparent effects thresholds (AETs). ~~of 11 mg/kg for mercury).~~

The indigenous and laboratory-raised grass shrimp toxicity tests, benthic community, and amphipod sediment toxicity study, collectively suggest that the RGOs are not thresholds above which adverse effects are definitive and absolute. For example, the BERA indicates that ~~all~~ locations with residual mercury concentrations above the AET of 11 mg/kg are expected to be toxic to grass shrimp, based on testing that continuously exposed developing shrimp to sediment for two months, which ~~is an exposure that is far greater than~~ is conservative and may not necessarily be representative of how grass shrimp are exposed in OU1 in-situ. Nevertheless, Alternatives 2 and 3 ~~through 6~~ address locations with mercury and Aroclor 1268 that exceed their ~~mercury,~~ respective AETs. ~~Furthermore, in situ impacts~~

Although toxicity to laboratory-raised grass shrimp was evident at many stations in the estuary, toxicity to indigenous grass shrimp were observed only in LCP Ditch and Eastern Creek, where OU1 COC concentrations are highest. ~~n~~No significant differences in indigenous grass shrimp ~~populations~~ toxicity were seen in other areas, even in areas where in situ COC concentrations were above the RGD range (Appendix L; Figure L-5A). Similarly, benthic community impacts were observed in Eastern Creek, also where COC concentrations were well above the RGD range (Appendix L; Figure L-6). Alternatives 2 and 3 ~~through 6 all~~ capture the areas where differences were observed in grass shrimp, amphipods, and the benthic community, and the ~~vast majority of~~ areas that ~~are above~~ exceed the lower end of the RGO range developed using the site specific toxicity testing data. ~~Hence, all of these alternatives (Alternatives 2 through 6) are protective against levels where measureable differences have been observed.~~ Alternatives 4 and 5 capture the majority of areas above the RGO range except in the Western Creek Complex upper Domain 3 Creek, and in Purvis Creek. Alternative 6 captures the majority of areas in Purvis Creek above the RGO range.

Response: The FS has been modified as indicated.

11. **Section 6.2.3, page 108,** last sentence of the second paragraph. Modify the sentence to read that each alternative provides varying degrees of risk reduction and residual risks.

Specific comment #11 text revision

In Alternatives 2 through 6, sediments contributing to RGD exceedances would be targeted for removal, capping, and/or thin-cover placement, thus ~~eliminating~~ reducing potential risk of exposure to contaminated material. Sediment removal permanently removes contaminated material; backfilling addresses dredge residuals that otherwise pose risks. Capping and thin-cover placement leave contaminants in place. Capping isolates COCs and reduces bioavailability through burial with clean material; caps are armored against erosion, and thus can be placed in relatively high-energy areas. Thin-cover placement creates a clean sediment surface in low risk, low-energy areas; the clean sediment surface allows for the colonization of plants and animals that are then exposed to lower COC levels ~~below RGOs~~. Alternatives 2 through 6 ~~are each protective with regard to~~ have varying degrees of risk reduction and residual risks.

Response: The FS has been modified as indicated.

12. **Section 6.2.4, page 110, 2nd whole paragraph.** Change "RGOs" to RAOs because the alternatives only achieve a selected range of RGOs.

Specific comment #12 text revision

Alternatives 3 (SMA-1), 5 (SMA-2), and 6 (SMA-3)

Alternatives 3, 5, and 6 achieve ~~RGOs~~ RAOs through a combination of sediment removal, sediment capping, and thin-cover placement within SMA-I, SMA-2, and SMA-3 respectively. Removal of sediment with the highest concentrations of COCs from the SMAs reduces the volume of COCs in DU1, thereby reducing COC toxicity and mobility.

Response: The FS has been modified as indicated.

13. **Section 7.1, page 120.** The first two sentences of this section should be clarified to indicate that the upper range of the benthic RGOs was designed for use in developing and screening remedial alternatives in the FS. They were not designed to have equal acceptability in managing benthic invertebrate risks.

Also, in the first paragraph it is stated that "All five alternatives reduce surface sediment concentrations to levels at or below the site-specific RGO range …" Similar to comment #10, the problem with the sentence is that it implies that there were no adverse effects observed on the benthic community until the concentrations were above the AETs (beyond the RGO range). The RGO range for the benthic community represents an uncertainty range around the unknown true threshold of adverse effects to the benthic community. The text in this section should be clarified to reflect varying degrees of benthic protection between each alternative.

In addition, the first sentence of the second paragraph should be deleted because "...insignificant residual risks...," is not supported by the analysis in Section 6 or in Appendix L.

Response: Please refer to General Comment 4 and Specific Comment 10.

Specific comment #13 text revision

With the exception of the No Action alternative, all remedies considered in the FS are expected to significantly reduce risks to human health and the environment ~~to acceptable levels~~. ~~USEPA defined acceptable risk based levels as RGOs protective of human and ecological receptors (Section 3).~~ The

SWAC RGOs were developed to be protective of Receptors/pathways that integrate exposure over larger areas (e.g., fish and wildlife), while the benthic community RGOs were developed to ~~be~~ assess protectiveness ~~of~~ to receptors exposed over relatively small areas (e.g., benthic invertebrates). With the exception of a few isolated sample locations with elevated COC concentrations, all five active alternatives reduce surface sediment concentrations to levels at or below the site-specific RGO range that provide varying degrees of protectiveness. ~~which is well below mercury, Aroclor 1268, lead, and PAH concentrations at locations where adverse benthic effects were observed in the marsh.~~ Alternatives 2 through 6 also comply with ARARs~~. All of Alternatives 2 through 6~~ and achieve the threshold criteria of protection of human health and the environment ~~and compliance with ARARs~~.

~~The analysis provided in Section 6 supports this conclusion as each alternative meets the SWAC and benthic community RGOs leaving behind insignificant residual risks. All~~ Alternatives 2 and 3 capture the areas exceeding the low range of the RGOs but may result in more destructive impacts to the estuary from implementing their proposed remedies. Alternatives 4 and 5 capture the majority of areas above the RGO range except in the Western Creek Complex, upper Domain 3 Creek, and in Purvis Creek. Alternative 6 captures the majority of areas in Purvis Creek above the RGO range. Each of these alternatives provide for long-term human health and ecological risk reduction by decreasing surface sediment COC concentrations, which leads to reduced chemical bioavailability and chemical uptake by human and ecological receptors, which in tum leads to reduced risks to human health, mammals, birds, fish, and the benthic community. Long-term monitoring measures long-term remedy integrity and effectiveness.

Response: The FS has been modified as indicated.

14. **Section 7.1, page 121, third bullet, second paragraph.** Although most individual creeks and domain areas have concentrations within the RGO range, they are not equally protective for all human receptors. For example, in the November 2011 EPA letter regarding RGOs, EPA provided sediment RGOs for human health. For protection from 1E-04 cancer risk for the high finfish consumer, the sediment RGO is 2.7 and the narrative stated "The contaminant concentration RGOs of 3.0 for Aroclor 1268 and 1.0 for mercury are based on consumption of finfish." Alternatives 4 and 5 do not change the SWAC concentration of 3.6 mg/kg Aroclor 1268, which is above the 1E-04 cancer risk for the high finfish consumer. Clarify the text accordingly.

    Response: The November 2011 EPA letter regarding RGOs uses a calculation approach that is based on the weighted average of Purvis Creek, LCP Ditch, Eastern Creek, and Western Creek Complex. The weighted average approach is more consistent with recreational use of this area which would not be restricted to Purvis Creek alone. This is particularly true because the risk estimates are based on fish consumption rates for the much larger Turtle River watershed and so do not represent potential consumption from Purvis Creek alone. The same weighted approach was used for the FS. To apply the RGOs only to Purvis Creek and then to state that human health protection is underestimated is not accurate and is incorrect. Table 6-1A shows the Total Creek concentrations reflective of human health exposures and risk reductions and Alternatives 4 and 5 do show a reduction of SWACs into a range that is protective of human health for the high fish consumer. Table 6-1B is provided for transparency, and while it is noted that the concentrations in Purvis Creek do not change for Alternatives 4 and 5, it is not appropriate to apply the SWACs in the manner recommended by this comment.

Specific comment #14 text revision

Alternatives 2 through 6 reduce human exposure to COGs through ingestion of fish and shellfish associated with Site contaminants. Each alternative results in total creek and total marsh SWACs that meet the SWAC RGOs, leading to reductions of mercury and Aroclor 1268 in fish and shellfish *concentrations that ~~eventually will~~ is expected to reduce fish and shellfish consumption advisories within the TRBE. Moreover, the analysis provided in Section 5 shows that the individual area ~~meet~~ lie within the SWAC RGOs, which were based on protection of human health, as well as ecological receptors. Sediment concentrations in Purvis Creek are not reduced by Alternatives 4 and 5 which may underestimate human health protection for the high finfish consumer. However, Alternatives 2, 3 and 6 are protective of this receptor group.*

<u>Response</u>: Although it is unclear regarding what is meant by suggesting that Alternatives 4 and 5 may underestimate human health protection for the high finfish consumer, the changes have been incorporated as requested.

15. **Section 7.1, page 122.** The first two sentences relating to RAO #4 state *"...concentrations within the RGO range are considered protective of the sediment-dwelling community. Thus, all five alternatives are protective of the benthic communities."* Delete these phrases as there are substantial differences in the levels of protection between alternatives that should be presented.

<u>Response</u>: Please refer to responses to General Comment #4 and Specific Comment #10.

<u>Specific comment #15 text revision</u>

Alternatives 2 through 6 reduce ecological risks to benthic organisms exposed to contaminated sediment to levels that are consistent with the benthic community RGOs. The remedies address the areas containing the highest COC concentrations in the marsh and reduce surface sediment concentrations to levels at or below the site-specific RGO range. Alternatives 2 and 3 would result in the lowest residual risks to the benthic community; however disturbing the large areas for remediation may significantly impact not only the sediment- dwelling communities but the habitat structure for many other organisms. Alternatives 4 and 5 would result in greater residual risk, but would be the least destructive to the environment. Alternative 6 provides a blend, and targets some of the higher contaminated sediments in Purvis Creek. ~~through 6 very little in terms of the residual risks related to locations where COC concentrations exceed the RGO range. The alternatives differ in terms of the number of residual locations within the RGO range, but as noted in Section 3, concentrations within the RGO range are considered protective of the sediment dwelling community. Thus, all five alternatives are protective of benthic communities.~~

<u>Response</u>: The FS has been modified as indicated.

16. **Section 7.3, page 126, second bullet.** Change "There is not significantly greater improvement in risk..." to "There may not be..."

<u>Specific comment #16 text revision</u>

- *Though residual COC concentrations in the estuary differ among the remedies, ~~all~~ most are within the benthic community RGO range. There ~~is~~ may not be significantly greater improvement in risk reduction to the benthic community when achieving the lower end of the RGO range, particularly given the adverse impacts from the remedy itself to the benthic community in efforts to address the larger footprints that correspond to the lower NTE values.*

<u>Response</u>: The FS has been modified as indicated.

17. **Section 7.3, page 126, third bullet.** The 2nd sentence of the bullet states: "There is not significantly greater improvement in risk reduction to the benthic community when achieving the lower end of the RGO rang, particularly given the adverse impacts from the remedy itself to the benthic community in

efforts to address the larger footprints that correspond to the lower NTE values." The first part of the sentence regarding significance is not supported by the BERA or the draft FS.

Specific comment #17 text revision

There ~~is~~ may not be ~~significantly~~ greater improvement in risk reduction to the benthic community when achieving the lower end of the RGO range, particularly given the adverse impacts from the remedy itself to the benthic community in efforts to address the larger footprints that correspond to the lower NTE values.

Response: The FS has been modified as indicated.

18. **Section 7.3.1, page 127, fourth paragraph.** Modify the first three sentences because there are no supporting benthic community monitoring data that suggest the recovery would be protective under all the alternatives, especially given the fact that many of the toxicity test results suggest otherwise.

Response: Please refer to responses to General Comment #4 and Specific Comment #10.

Specific comment #18 text revision

Except for the No Action alternative, each of the remedial alternatives addresses concentrations in various areas that are above the RGO range~~, so Alternatives 2 through 6 are protective of the benthic community. All five alternatives~~ and reduce ecological risks to benthic organisms exposed to contaminated sediment. ~~to achieve concentration levels that will result in self-sustaining benthic community with diversity and structure comparable to reference areas. All five alternatives reduce surface sediment concentrations to levels within or below the site specific RGO range.~~ Figures 6-6 through 6-8 identify differences among the footprints relative to the RGO range, and show where residual chemical risks may remain. ~~Section 3 explains why both ends of the range are considered protective.~~

Response: The FS has been modified as indicated.

19. **Section 7.3.2, page 128, fourth paragraph.** Please change the first sentence "Because all alternatives except for the No Action alternative (Alternative I), meet the ARARs, RAOs, and RGOs, ..." to "With the exception of a few isolated sample stations with elevated concentrations, Alternatives 2 through 6 meet the ARARs, RAOs, and are within the RGO ranges."

Specific comment #19 text revision

~~Because all the alternatives, except for the No Action alternative (Alternative 1),~~ With the exception of a few isolated sample stations with elevated concentrations, Alternatives 2 through 6 meet the ARARs, RAOs, and are within the RGO ranges. Alternatives 4, 5 and 6 are most cost-effective in achieving goals while minimizing vegetated marsh disturbance and recovery. These alternatives will comply with project goals and limit vegetated marsh disturbance to approximately half of what would result from implementing Alternatives 2 or 3 (Figure 7-2).

Response: The FS has been modified as indicated.

20. **Section 7.3.4, page 129, last sentence.** Please replace the phrase "...achieve the site-specific RGOs..." with "are within the RGO ranges". Also, based on the above comments, Alternative 5 may be cost effective but not as environmentally protective as other alternatives.

Specific comment #20 text revision

Throughout the preparation of the FS, practices employed were well aligned with USEPA guidance and policy. Based on all the remedy selection criteria- including the ecosystem impact analysis, marsh recovery analysis, and cost-effectiveness analysis discussed above- Alternative~~s 5 and~~ 6 ~~are~~ appears to be the most effective remedial alternatives for OU1. Th~~ese~~ is alternative~~s~~ satisfies the site-specific RAOs, ~~achieve~~ is within the site-specific RGO ranges, and meets the NCP criteria of overall protectiveness, implementability, and permanence while limiting risks associated with disturbing sensitive habitat.

Response: The FS has been modified as indicated.

21. **Appendix A** – changes needed for clarity, accuracy, and consistency with other documents:

a. Background

i. First paragraph states that there is "cemented sandstone", but should state "partially cemented sandstone", and further states it is a "confining" layer, but should state "semi-confining" layer.

Response: See Specific Comment 1. The FS has been modified as requested.

Specific comment #21 a (i) text revision

Slug tests conducted in the Upper and Lower Satilla sand indicate a horizontal hydraulic conductivity on the order of 10^{-2} centimeters per second (cm/sec). Beneath the Satilla formation is the partially cemented sandstone of the Coosawhatchie Formation (approximate hydraulic conductivity of 10^{-5} cm/sec (GeoSyntec 2002)), which forms a semi-confining layer between the Satilla sands and underlying aquifers within the Coosawhatchie Formation. Figure A1 shows a conceptual cross-section of the site layering for the local flow system.

Response: The FS has been modified as indicated.

ii. Second paragraph states that the groundwater and surface water interactions are "attenuated," should say "partially attenuated", then further that the sediments provide "confined" conditions, should say "semi-confined."

Response: To describe attenuation as partially implies that the clay layer in places allows chemical transport to pass through from the underlying aquifer to the marsh surface. There is no evidence to support this contention. Attenuation is by definition partial and the insertion of the word "partial" is redundant. Nonetheless, this change has been incorporated into the FS. Semi-confined is an acceptable modification to the description of the hydraulic conditions.

Specific comment #21 a (ii) text revision

Groundwater and surface water interactions at the Site are partially attenuated by the marsh sediments that overlie the Satilla formation and locally provide semi-confined conditions for groundwater flow. Measured hydraulic conductivities of the marsh clay are consistently low (1.3xl0-7 to 1.8xl0-8cm/sec) (GeoSyntec 1997) and texture is consistently fine-grained as well. The marsh sediments are typically 7-8 fi thick; locally, marsh sediment may be thicker, and near the uplands, it may be thinner.

Response: The FS has been modified as indicated.

iii. Fourth paragraph states "any transport is likely attenuated'', should state "transport is likely partially attenuated..."

Response: See previous response regarding the use of "partially attenuated."

Specific comment #21 a (iii) text revision

Groundwater seepage to the surface water may occur as diffuse flow through the marsh sediments or as focused flow through seeps. It should be noted that, while groundwater seepage is a potential pathway into the upland fringe marsh areas, any transport is likely partially attenuated by the dense organic rich clay sediments along the marsh.

Response: The FS has been modified as indicated.

iv. Fifth paragraph states that "seepage events are typically brief and are observed to occur during high water table conditions following extended or intense rainfall events." The IR Study indicated that seeps are ongoing, are not brief, and did not provide evidence that these are related to rainfall events.

Response: Comments 21a.iv through vii, collectively, seek to discredit elements of the "seep study" and thereby perhaps discredit the overall groundwater/marsh interaction flux analysis. For example, Comment 21a.iv provides a conclusion not reached by the Thermal IR contractor, stating that the study "indicated that seeps are ongoing and not brief, and did not provide evidence that these related to rainfall events." This conclusion was not reached in the contractor's report, and was not reached in the Remedial Investigation report.

The IR study identified 14 specific areas where focused upwelling of groundwater was possible or likely. The IR study report does not draw conclusions regarding the duration of the seeps or their relationship to rainfall events. The purpose of the IR study was to identify targeted locations for installation of peepers.

Specific comment #21 a (iv) text revision

Groundwater seeps were first noted (during the initial Site characterization studies in1995) as occurring along the marsh edge, where the marsh clay was absent and the underlying sand was exposed. ~~Seepage events are typically brief (on the scale of a few days) and are observed to occur during high water table conditions following extended or intense rainfall events.~~ Depending upon the intensity and duration of the rainfall event, the seepage occurs mostly at isolated locations.

Response: The FS has been modified as indicated.

v. Sixth paragraph states that the IR study identified 14 areas of focused groundwater discharge. Actually, the IR study identified 1,000 of discharge areas, but only focused on the largest 14 areas.

Response: The IR study identified 14 specific areas where focused upwelling of groundwater was possible or likely. The IR study report does not draw conclusions identified in Comment 21.v. The purpose of the IR study was to identify targeted locations for installation of peepers.

Comment 21.a.v provides another conclusion not reached by the contractor, that the study identified "1,000s of discharge areas." Nor did the study "focus on the largest 14 areas."

vi. Sixth paragraph states that "The seeps in locations adjacent to contaminated upland wells are isolated and do not form a thermal trace." There is no data presented that supports this statement. Please remove.

Response: The edit below, requested in response to Specific Comment 21.a.v and vi, requires deletion of a factually correct statement in the FS, based on direct observation and measurement. However, the edit is captured in the revised FS.

Specific comment #21 a (v and vi) text revision

In order to determine whether preferential groundwater pathways exist that could result in focused groundwater discharge in the marsh, a thermal IR study was conducted on June 15, 2009 (Stockton Infrared Thermographic Services 2009). This study identified 14 areas of focused groundwater discharge or seeps at the marsh surface, near the marsh shoreline, and along the channel edges. Seeps identified in the thermal IR study show a low intensity of groundwater discharge. ~~*The seeps in locations adjacent to contaminated upland wells are isolated and do not form a thermal trace that impacts the temperature in a marsh surface channel:*~~

Response: The FS has been modified as indicated.

vii. Seventh paragraph, last two sentences discuss the peeper study and indicates the approach was "conservative." The approach was not conservative. It was not approved by GAEPD, and was strongly criticized as flawed because it had no ability to predict groundwater discharge flux to the marsh. Unless the study is thoroughly discussed and presented in full in this text, with the weaknesses of the study included, no discussion of this study should be included in the FS.

Response: Peeper locations were selected based on areas that showed the greatest potential for unattenuated groundwater upwelling into the marsh. Measurement of this water using peepers addresses the most severe potential upwelling locations and is therefore noted as conservative in the text.

The contention that the peeper study was "not approved by GAEPD, and was strongly criticized as flawed because it had no ability to predict groundwater discharge flux to the marsh" is unfounded. USEPA Region 4 and Georgia EPD were closely involved in all decisions and interpretation of results regarding the groundwater IR study, the peeper study, and the more recent groundwater flux study incorporated into the FS. The technical team went so far as to resample all the groundwater monitoring wells and additional groundwater monitoring points identified by the Agencies in support of the groundwater flux model, and provided the Agencies with all the raw data and the live groundwater flux model to allow the Agencies to thoroughly review and analyze the model and model results. The outcome of that process was USEPA Region 4 and Georgia EPD's concurrence that the groundwater flux model is sound, acceptably conservative, and appropriately applied to conditions at the Site.

The remainder of this comment is refuted by the following facts:

1. A comprehensive Work Plan for Marsh Seep Investigation (Revision 1 dated June 1, 2009) was prepared by EPS that laid out <u>four</u> steps to the program. Step 1 was the thermal IR study, to be followed by the first phase or "pilot scale" installation of peepers (Step 2), then full scale installation of peepers in Step 3 (as needed, to be based on interaction with the agencies on results of phase 1), and finally Step 4 Data Evaluation for the calculation of flux.

2. EPA issued a letter of approval of the Work Plan on July 7, 2009 indicating that EPA, GAEPD, and NOAA collectively "determined that this [work plan] is acceptable and is hereby approved by this letter". Mr. Jim McNamara (GAEPD) was copied on the approval letter.
3. A meeting convened on August 27, 2009 with all parties to identify specific locations from the IR survey for the installation of peepers. After further dialogue on implementation details, EPS documented this agreement and plan details in a letter to EPA dated February 26, 2010. This letter also agrees to an added element of temperature probing into the marsh clay as a means of aiding in the specific site selection for peepers.
4. EPA and GAEPD personnel were on site during the peeper installation in 2010.
5. EPS provided a summary of findings via email on October 27, 2010. This was done to facilitate the dialogue with respect to the need and approach for additional peeper installations.
6. During the early discussions regarding the OU1 FS, ENVIRON submitted a modeling analysis of groundwater flux to the marsh. Later a meeting convened with all parties (April 2012) where the agencies made a request for 1) updated groundwater sampling results from upland wells and 2) installation of additional well clusters along the flux border (at locations intervening between existing monitoring wells along the OU3/OU1 border). EPS prepared a Work Plan subsequent to this meeting, issued in late April 2012. This plan was approved by the agencies on May 10, 2012 and work commenced shortly thereafter.
7. ENVIRON updated the flux analysis in the current draft of the FS Report.

Specific comment #21 a (vii) text revision

The peeper investigation targeted locations where the IR imagery results showed the greatest potential for groundwater seepage into the marsh. Thus, the approach ~~was inherently conservative,~~ targeteding the greatest potential for contaminant migration into the marsh. The remedial investigation tor OU1 presents that data acquired by the peeper investigation. The peeper results suggest that transport of mercury, Aroclor 1268, lead, and total PAHs via focused groundwater pathways in the marsh result in nominal concentrations at the point of discharge.[1]

Response: The FS has been modified as indicated.

b. Conceptual Site Model

i. The CSM includes groundwater flow from the uplands to the marsh along four flow paths, moving from the uplands to the marsh. However, the flow paths are also tidally reversed, flowing from the marsh to the uplands. This must be explicitly shown on Figure A3.

Response: The CSM represents the *net* flow of water, which is from the uplands to the marsh. The figure has been modified to describe each flow path as "Net flow path to…"

Specific comment #21 b

Please add a footnote on Figure A-3 noting the reversal of flow.

Response: The following note has been added: "Tidal forces can reverse groundwater flows beneath the marsh."

22. **Page ES-13, first whole paragraph.** The second sentence should be changed to reflect the varying degrees of protectiveness to the benthic community between Alternatives 2 and 3 relative to Alternatives 4 through 6, which is approximately a 30-acre difference.

In addition, delete the last sentence of this paragraph because there was no analysis in the FS regarding cost-effectiveness commensurate with benthic community protection. Alternatives 2 and 3 provide the most benthic protection even though costs and impacts to the existing estuarine habitat would be higher.

Response: Cost effectiveness was discussed in Section 7. See also Figure 7-1 and Executive Summary Figures 7.

Specific comment #22 text revision for 2nd sentence

Except for the No Action alternative, all the alternatives reduce surface sediment concentrations to levels within or below the site-specific RGO ranges to varying levels of protectiveness.

Response: The FS has been modified as indicated.

Specific comment #22 text revision for last sentence:

~~*Accordingly, Alternatives 5 and 6 re the most cost effective remedies for the protection of benthic communities.*~~

Response: The FS has been modified as indicated.

23. **Page ES-14, second and third paragraphs under Conclusions.** Modify the 2nd sentence because not all alternatives address exceedances of the upper benthic RGOs. In addition, delete the last sentence as it is contrary to the BERA and the data used to establish the RGOs.

In the third paragraph, the 2nd sentence should be deleted because"...insignificant residual risks...," is not supported by the analysis in Section 6 or in Appendix L. Refer to comment #12.

Specific comment #23 text revision for 2nd paragraph

With the exception of the No Action Alternative, all remedies considered in the FS are expected to reduce risks to human health and the environment to acceptable levels. With the exception of a few isolated sample stations with elevated concentrations, all five active alternatives (Alternatives 2 through 6) reduce surface sediment concentrations to levels at or below the site-specific RGO ranges established for protection of human health and site- specific sensitive ecological receptors. ~~*The RGOs are protective of the benthic community because the benthic community RGOs are well below COC concentrations at locations where adverse benthic effects were observed in the marsh.*~~

Response: The FS has been modified as indicated.

Specific comment #23 text revision for 3rd paragraph

Alternatives 2 through 6 comply with ARARs. Hence, all achieve the threshold criteria of protection of human health and the environment and compliance with ARARs. ~~*This conclusion is supported by the analysis provided in Section 6, as each alternative meets the SWAC and benthic community RGOs, leaving behind insignificant residual risks.*~~ *All active alternatives provide long-term human health and ecological risk reduction by decreasing surface sediment COC concentrations, leading to reduced chemical bioavailability and chemical uptake by human and ecological receptors. This, in turn, leads to reduced risks to human health, mammals, birds, fish, and the benthic community. Long-term monitoring ensures long-term remedy integrity and effectiveness.*

Response: The FS has been modified as indicated.

24. **Page ES-14, last paragraph.** Replace the phrase "...achieve the site-specific RGOs..." with "are within the RGO ranges". Also, based on the above comments, Alternative 5 may be cost effective but not as environmentally protective as other alternatives. Suggest modifying text accordingly. Refer to comment #19.

Specific comment #24 text revision

Based on all the remedy selection criteria, including the cost effectiveness and impact analysis summarized above, Alternative~~s 5 and~~ 6 ~~are~~ is the most effective remedial alternative~~s~~ for OU1. Th~~ese~~ is alternative~~s~~ satisfies the site-specific RAOs, ~~achieve~~ is within the site-specific RGO ranges, and meet the NCP criteria of overall protectiveness, implementability, and permanence while limiting risks associated with disturbing sensitive habitat.

Response: The FS has been modified as indicated.

ATTACHMENT A

Acronym not defined

Appendix L – page L-11 discusses BSAF. Please add biota sediment accumulation factor to the list of acronyms.

> **<u>Response</u>:** Appendix L text has been modified to address this change.

Typographic errors

Page 106 – First paragraph after bullets, second sentence; "Troup" Creek, not Troop.

Table 6-1C – There is something missing at the end of the explanation for the blue highlighting in the key.

Appendix B – page B-5, third paragraph, second sentence; "ratio", not ration.

Appendix F - page F-4, second paragraph; Appendix *F*, not K.

Appendix K – page K-4, fourth bullet, second sentence; data handling is presented in Appendix *E*, not D.

Appendix K – Figure K-1; should reference Figure *K-6* instead of J-5, and Figures *K-9A* through *K-13* instead of J-8A - J-13

> **<u>Response</u>:** The FS and figures have been modified to address these changes.

Other

A column with the RGOs from the BERA should be added to the table on page ES-3.

> **<u>Response</u>:** SWAC and Benthic Community RGOs were developed based on the results of the USEPA-approved HHBRA and the USEPA-led BERA. The RGOs presented in the FS (e.g., p. ES-3), were approved by USEPA for the purposes of evaluating potential remedial alternatives in OU1. Including RGOs from the BERA is redundant and will be confusing to the reader. For this reason, an additional column that identifies BERA RGOs is not included in the revised FS.

Concerns relating to implementability of dredging options in the LCP Ditch due to debris should be removed. It is GAEPD's understanding that this debris, as shown in Figures 2-6 (M&N) and 6-9 (O&P), was placed there by the RPs.

> **<u>Response</u>:** Regardless of the source of debris, debris removal must be addressed during design, and impacts remedy implementability.

Tables 3-1 and 3-3 still fail to incorporate previously-supplied GAEPD comments.

> **<u>Response</u>**: Table 3-3 has been updated. As requested, the following changes were made to Page 2 of the table: 1) Air Pollution Act – add "requirement" after "specific", 2) Hazardous Waste Management Act & Hazardous Site Response Act – strike 12-8-200 (not applicable to NPL sites), add 391-3-11, 391-3-19, note that 391-3-4 are rules for the Comprehensive Solid Waste Management Act, 12-8-20, and 3)Water Quality Control Act – 391-3-6-.06.
>
> The responses to the March 2013 draft FS comments addressed comments referring to Table 3-1, and requested clarification. Further changes were not made to Table 3-1.

Figures 2-18 and 2-19 – The scale of the graph should be expanded at the lower concentrations so that the bars, which can barely be seen, may be seen.

> **<u>Response</u>**: The scales of both graphs have been expanded to make the data more visible, as requested.

Appendix B – page B-5, last sentence of third full paragraph; page A-13 states that 130 cfs is the tidally influenced effective surface water flow south of the causeway, not "...the peak groundwater flow entering the estuary." Correct the flow rate cited in Appendix B.

> **<u>Response</u>**: Appendix B – page B-5, last sentence of third full paragraph has been revised as follows: "The Appendix A groundwater analysis estimated a peak surface water flow rate of 130 cfs entering the estuary."

Table H-2 – If the dewatering area will be in on OU3, the OU3 area of its footprint should be removed from the table.

> **<u>Response</u>**: All acreages in table H-2 refer to acreages where there are impacts to the marsh. These do no refer to upland staging areas.

Tables H-10 and H-11 – The capping and thin layer cover unit costs should be broken-down.

> **<u>Response</u>**: The capping and thin layer costs have been broken down in Tables H-10 and H-11.

Appendix F – A complete key is not provided for on all figures. In the F-3C through F-3W series, only the F3B and F-3C figure provide the key for the black and gray dashed lines. Please add similar keys for the remainder of the F-3 figures.

> **<u>Response</u>**: The Appendix F figures have been corrected, as requested.

Appendix I – page I-9. Need a conversion factor from parts per thousand to practical salinity units (psu).

> **<u>Response</u>**: This has been clarified in the text of Appendix I.

Appendix J still doesn't contain case studies regarding the long-term stability and effectiveness of thin layer caps. Specifically,Honeywell committed to providing these regarding cap stability after Sandy hit the northeast. These case studies should be added to the appendix.

> **<u>Response</u>**: A case study has been included in Appendix I for the Lower Hackensack River thin-layer cap project, which was hit by Hurricane Sandy. Results showed that the cap was appropriately designed and withstood the flows associated with Sandy, maintaining stability of the cover.

ATTACHMENT B

APPENDIX B

General comment

The outcome of a mass balance study needs to be included in Appendix B to give the reader greater confidence in the outcome of the hydrodynamic modeling.

> **Response:** We disagree that conducting a mass balance study would increase confidence in the predictive capability of the hydrodynamic model for the following reasons. It is highly unlikely that sufficient site data are available to conduct a mass balance study that would produce reliable results. Unless the mass balance study produced highly reliable results with a low level of uncertainty (which has a low probability of occurrence), those results could not be used to inform the predictive capability of the hydrodynamic model.

Specific Comments

Section 2.5. Quantitative measure of the degree of model calibration achieved should be added to this Appendix to support the statement shown below, regarding successful calibration.

> **Response:** A quantitative analysis of model predictive capability will be conducted and the results included in Appendix B.

The last sentence in this section, which states that, "successful calibration of the model indicates that the model can be used as a management tool to reliably evaluate remedial alternatives for a range of flow and tidal conditions". This is an overstatement since validation of the model is not presented in the Appendix.

> **Response:** We disagree with this assessment about the reliability and utility of the hydrodynamic model for the following reasons. Model performance was evaluated using two independent metrics: 1) water surface elevation; and 2) current velocity. Model-data comparisons of water surface elevation and current velocity were conducted at multiple sites located within areas of the model domain that had significantly different physical characteristics (i.e., Turtle River, Purvis Creek, and Eastern Creek). Quantitative assessment of model performance showed that the skill level was very high (i.e., 0.99 for water surface elevation at all locations; 0.98 or greater for current velocity at 3 locations and 0.82 at 1 location, where a skill level of 1 is perfect agreement). These multiple lines of evidence demonstrate that the predictive capability of the hydrodynamic model is sufficiently reliable for use as a management tool during the FS to evaluate remedial alternatives.

Section 3.3. The modeling performed of the 100-year storm surge requires re-examination. The 6.8 feet found for the Fort Pulaski station should have been added to the spring tide instead of only adding a few feet so that the maximum water elevation during the simulation was 6.8 ft. This procedure should be corrected and the modeling performed again if the objective was to simulate the storm surge during a hurricane with a 100-year recurrence interval that would hit the Site area at the same time as the occurrence of a spring tide, as the language in the section is interpreted.

> **Response:** The 100-year storm surge was simulated correctly because the water surface elevation at the Fort Pulaski gauging station was an absolute value with respect to a datum (i.e., 6.8 feet

NAVD88), which is how it was incorporated into the hydrodynamic model. This value does not represent a storm surge that needs to be superposed on top of a regular spring tide.

Figure B3-3 et al. In this figure as well as in other similar figures that show a color contour plot of the maximum predicted currents, the upper scale shown in the legend box should not be '> 2'; it should be, for example, '2 – 2.5' so as to show what the maximum predicted current is not higher than 2.5 ft/s (or whatever the maximum current is).

<u>Response</u>: Figures have been revised as suggested in the comment.

Figure B3-7. The reviewer did not see any red colored areas/elements (that indicate the difference in maximum predicted currents is > 0.5 ft/s) in this figure. Assuming there are none, then it would be good to split the 0.1 -0.5 ft/s range into two, i.e., one 0.1 - 0.3 interval and one 0.3 - 0.5 interval so as to depict in what areas velocity differences in the 0.3 - 0.5 ft/s range occur. This comment also applies to all other similar figures.

<u>Response</u>: Figures have been revised as suggested in the comment.

APPENDIX J

Specific Comments

Executive Summary. Improve the wording in the third bullet near the bottom of Page J-ES-1 for clarity.

> **Response:** Text has been revised as suggested in the comment.

Page J-3, Section 2.1, 2nd paragraph. The phrase "and contaminated sediment would only be retained near the bottom of the thin-cover layer", is not clear Please improve the wording for clarity.

> **Response:** Text has been revised as suggested in the comment.

Page J 3, Section 2.2, 1st paragraph. The phrase "due to bioturbation" should be added to the end of the third sentence. Other mechanisms, e.g., diffusion, might result in the movement of contaminants into the thin cover material. A reference should be given to support the statement made in the last sentence in this paragraph.

> **Response:** Text has been revised as suggested in the comment.

Page J-4, Section 2 3. Even with the fastest deposition rate given in the last sentence, it would take over four years for one inch of sediment to deposition. This slow rate needs to be quantitatively taken into account in the analysis performed later in this appendix.

> **Response:** The quantitative analysis of thin cover presented in Section 2.5 is a conservative instantaneous mixing calculation that assumes no deposition. The purpose of the analysis was to provide a bounding calculation to demonstrate the suitableness of a 6-inch cover layer.

Page J-4, Section 2.5. Please explain why the assumption that the thin cover material is instantly mixed with the underlying marsh sediment is a highly conservative approach?

> **Response:** The analysis is conservative for 2 reasons:
>
> 1) It assumes that the mixing occurs immediately upon placement. In reality, it would take years for that mixing to occur and the concentrations to increase from the initial value of zero (i.e., clean sand) to levels consistent with the % reductions shown on the figure.
> 2) The assumption ignores the effects of net deposition as stated in the text. Deposition would act to reduce the amount of mixing because the distance between the mudline and contaminated sediment would increase over time, limiting the effects of bioturbation (which is over a fixed depth).

In the fourth sentence in the first paragraph, define what is meant by 'long-term'. Also, state the mechanism(s) that would cause the long-term reductions in the surface concentrations.

> **Response:** Text has been clarified by stating that "long-term" refers to steady-state, in this calculation. The time to reach that condition is when complete mixing by bioturbation is achieved. This depends on the depth and rate of bioturbation, as explained at the end of this section.

The methodology or model that was used to calculate the reductions in the surface concentrations as a function of thin cover thickness needs to be referenced and described.

> **<u>Response</u>:** The model relied on widely published and accepted methods in chemical fate transport analysis. Those methods have been referenced and summarized as necessary in the appendix.

The qualitative results from this modeling are not unexpected, but the quantitative results cannot be properly evaluated until responses to the previous three comments are provided.

> **<u>Response</u>:** Comment noted.

A reference is needed to support the statement in the first sentence of the 2nd paragraph (page J-5) that the rate of bioturbation below 6 inches is slow. Mention of the natural deposition processes needs to incorporate the maximum expected rate of less than ¼ inch per year (i.e., 6 mm/yr).

> **<u>Response</u>:** As discussed previously and in the FS, the model assumed no deposition. This conservative approach allowed the model to independently assess the effects of bioturbation on mixing and contaminant transport. Bioturbation is thought to behave as a first-order process, where the most significant and rapid mixing occurs at the sediment surface and decreases with depth. Below a depth of 6 inches, bioturbation is slow and is an insignificant mixing process. Bioturbation is extensively reviewed in Appendix I of the FS. Appendix J references Appendix I more clearly.

Delete the second "to reach these" in the 2nd sentence in the 2nd paragraph (page J-5). Referring to the shorter timescales mentioned in the last sentence of this paragraph, there are no time scales presented in Figure J-2.

> **<u>Response</u>:** Text has been revised as suggested in the comment.

Page J-7, Section 3.1.1. In the second bullet, the phrase "resulting from flow through the cap as well as tidal action" is unclear. Is the meaning that the concentration gradient generated by both groundwater discharge through the cap during low tides as well as the gradient produced by the advective flow of surface water into the top of the cap during the higher tide stages and the reverse flow out of the cap during the lower tide stages?

> **<u>Response</u>:** The model includes the ability to account for advective flow through the cap. This could include groundwater flow from beneath the cap, or tidally influenced flows. For the purposes of the FS model, the following simplifying assumption was made: tidal conditions were assumed to be at low tide, thus maximizing the advective flow potential of groundwater flow through the cap. This allowed for the most conservative assessment of groundwater impacts to the cap (or thin-cover) performance. This has been clarified in the revised FS appendix.

Page J-8, Section 3.1.3. In the 5th bullet, the third sentence should be reworded to more clearly express the meaning of "groundwater seepage flux at the Site would be much less due to tide ranges".

> **<u>Response</u>:** See response to the previous comment. As discussed, the model conservatively assumed consistently low tides to maximize groundwater advection potential. However, we know that tides fluctuate and that the head difference between groundwater and offshore elevations will generally be less than the condition imposed when we assume low-tide conditions. This has been clarified in the revised FS appendix.

Page J-10, Section 3.1.3. In the 1st paragraph of the Groundwater Seepage Velocity section, is the 9 foot tide range mentioned in the 2nd sentence the mean or spring tide range?

> **Response:** The 9 foot tide range is the spring tide range and has been clarified in the text.

Page J-11, Section 3.1.3. In the next to last sentence in the Organic Carbon section, were the sites where experience was gained, highly productive tidal marshes as at this Site? A value of 0.1 seems very low for a productive tidal marsh. At a minimum, a sensitivity study should have been performed on this parameter.

> **Response:** The 0.1 percent TOC is used for sand capping material, not the sediments. It is independent of the site conditions. This has been clarified in Appendix J.

Page J-11, Section 3.2. Why was a vertical average of sorbed-phase concentrations over the bioturbation zone used in the modeling instead of using the actual vertical concentration gradient?

> **Response:** A vertical average within the bioturbation zone is more representative of the concentration to which biota are exposed and is thus directly comparable to the RGOs. The model computes the vertical gradient, but it is the average over the depth of mixing that is relevant to the cap effectiveness analysis. This approach is also consistent with precedents from several other contaminated sediment sites. Text has been clarified and revised as requested.

FEASIBILITY STUDY

Specific Comments

Section 2.2.4, page 9. Estuary Sediment Transport Processes: Because a formal sediment stability analysis was not performed, the statement regarding the depth of bed scour (1 to 2 mm) in the first paragraph should be qualified as being professional judgment, since a formal stability analysis was not performed.

> **Response:** The FS was changed, accordingly.

Section 2.5.2, page 33. Surface Water-Sediment Flux and Sediment Stability: Since a formal sediment stability analysis was not performed, statements regarding erosion and bed scour in the first paragraph should be qualified using text along the lines of: "in our professional judgment, minimal erosion occurs", or "it is likely that only minimal erosion occurs".

> **Response:** The FS was changed, accordingly.

Section 4.2.4. Appendix J should be cited for the modeling described in footnote 6.

> **Response:** The FS was changed, accordingly.

Identify which of the listed case studies, where thin-layer capping was used for sediment remediation, involved placement of the thin-layer cap in tidal marshes/wetlands as would be at this Site.

> **Response:** Thin-cover placement has not been used for remediation in southeastern marshes, though it has been used extensively for restoration. Further, the approach has been used extensively for remediation, but at sites that differ from the marsh habitat at the Brunswick site. The two concepts are not mutually exclusive; combining the remediation successes at sediment remediation sites with the restoration successes in southeastern marshes provides a unique opportunity to implement this technology at the Brunswick Site.

"Results of the modeling analysis show that thin-cover placement does not significantly impact marsh hydrology, so that wetting and drying cycles for marsh areas remain effectively unchanged." This is too definitive a statement and requires qualification, since only one component of marsh hydrology was modeled, that being the flooding and draining of marshes over the course of a tidal cycle. The flux of water, e.g., surface water-groundwater interaction and flow of water both horizontally and vertically through a thin-layer cap, was not modeled. In addition, the phrase "thin-cover placement does not significantly impact marsh hydrology" should be deleted, or explained.

> **Response:** This statement is clarified in the revised FS.