Memorandum For: **Ms. Rachael Thompson, Executive Director**
Glynn Environmental Coalition
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From: **Frank Anastasi, P.G., Community Technical Advisor**
(PA PG-2605; WY PG-2001; NC LG-2459)

Date: **September 17, 2021** Frank Anastasi

Subject: **Review of Long-Term Monitoring Plan**
Pre-Final (95%) Remedial Design for Operable Unit 1
LCP Chemicals Superfund Site, Brunswick, GA

Introduction

Anchor Qea prepared the August 2021 *Pre-Final (95%) Remedial Design Basis of Design Report* for Operable Unit 1 (OU1) of the LCP Chemicals Superfund Site on behalf of Honeywell, Inc. and Georgia Power Company, the responsible parties for the site, in accordance with the July 27, 2017, Consent Decree with U.S. Environmental Protection Agency (EPA). OU1 is the 760-acre estuarine portion of the LCP site, consisting of 662 acres of flat vegetated tidal marsh and 98 acres of tidal creeks.

The Basis of Design Report (Anchor Qea, 2021) presents the current state of the remedial design to set the stage for review and approval of the final Remedial Design by EPA and the Georgia Environmental Protection Division (EPD). It explains all aspects of the cleanup project selected in EPA's 2015 Record of Decision (ROD), as modified following pre-design investigation findings, and includes numerous detailed plans and specifications for all tasks to be completed.

Among all of the information included in the Basis of Design Report is the Long-Term Monitoring Plan (LTM), which is Appendix I. The LTM is the subject of this memorandum (The 95% Basis of Design Report will be the subject of a future memorandum).

Background

The LCP site is located between the Turtle River and New Jesup Highway, just northwest of the Brunswick city limits. It is owned by Honeywell, who along with Georgia Power Company are the responsible parties that have cooperated with EPA to investigate and clean up the site.

Various industries operated at the site since the 1920s, including an oil refinery operated by ARCO from 1918 to the early 1930s; a power plant operated by Georgia Power from the 1930s to the 1950s; a paint and varnish manufacturing facility operated by Dixie Paint and Varnish Company from 1941 to 1955; and a "chlor-alkali" facility that produced chlorine gas, hydrogen gas, and caustic solution operated by Allied (now Honeywell) from 1955 to 1979 and by LCP Chemicals from 1979 to 1994.

Remedial actions performed to date have focused on the upland portion of the LCP site where the industrial activities took place. These actions include removal of wastes and contaminated soil and in-

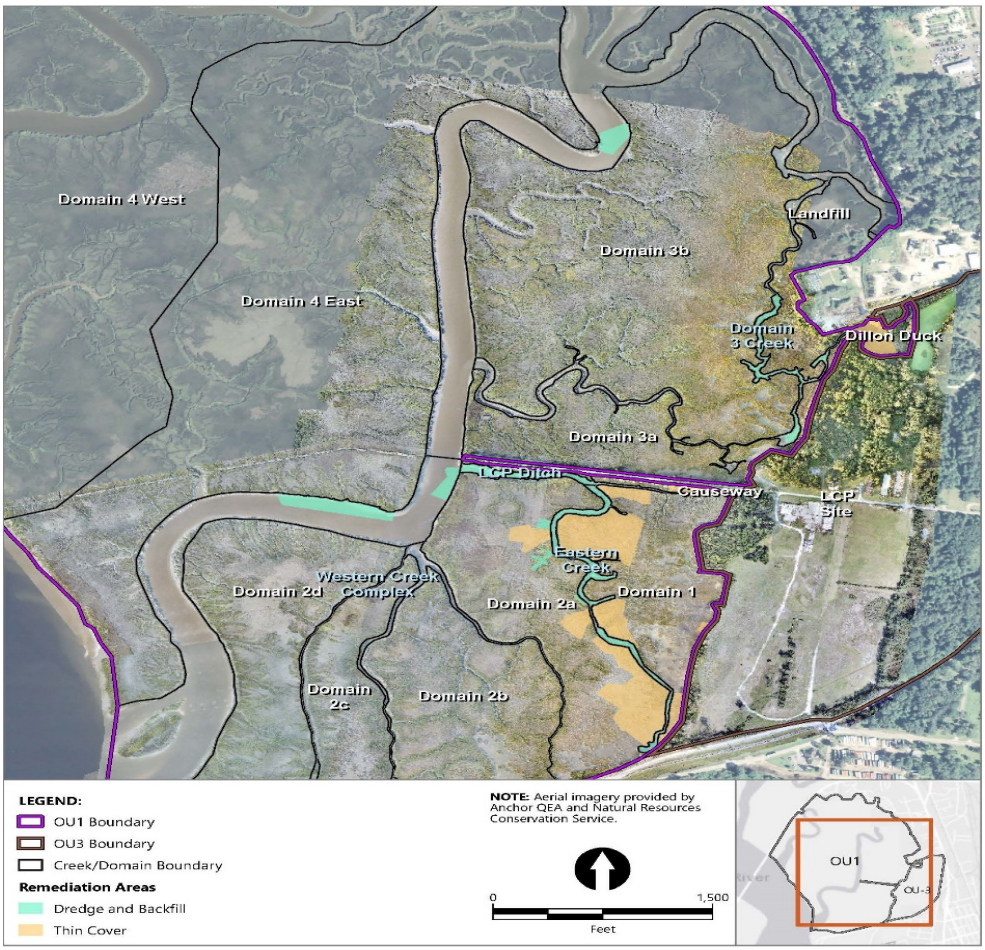
situ treatment of dissolved mercury in ground water, and investigation of contamination in site-wide soil and ground water. A soil cover was placed over the area of the former chlor-alkali operations also.

OU1 Remedy

The refined remedy for the marsh and creeks of OU1 consists of the following elements:

- Dredging 18 inches of sediment in eight acres of LCP Ditch and Purvis, Eastern, and Domain 3 creeks;
- Backfilling dredged areas with 12 inches of clean sand;
- Replanting the disturbed marsh areas with native plants and restoring all disturbed areas;
- Thin-layer cover placement over approximately 12 acres of marsh;
- Dewatering dredged sediments on site and disposing of them at licensed off-site facilities;
- Monitoring during construction to document that all work is implemented as planned;
- Long-term Monitoring to document the remedy's effectiveness; and
- Institutional controls to prevent unauthorized site use in the future.

The LCP site and OU1 remediation areas appear on the below figure from the LTM.



LCP Chemicals Site Estuarine Areas and Locations of OU1 Remediation
Source: Anchor Qea 2021, Appendix I Long-Term Monitoring Plan, Figure 2

Long-Term Monitoring Overview

Monitoring after all elements of the OU1 remedy are completed will be conducted to evaluate the remedy's effectiveness in enhancing ecosystem recovery and reducing risks to human health and the environment. The LTM presents the general approach for post-remedy monitoring based on the requirements set forth in Section 6.7 of Appendix B of the Consent Decree. Sampling procedures, analytical methods, and quality assurance/quality control (QA/QC) protocols will be presented in a field sampling plan (FSP) and a quality assurance project plan (QAPP), which will be submitted after the LTM is approved.

The goals of the sediment remediation are to reduce the levels of contaminants in creek water and in fish, shellfish, and other aquatic and benthic organisms to protect human health and ecological resources. After the designated areas of the marsh and creeks are dredged and covered, vegetation will be restored to promote a healthy and sustainable estuarine environment.

Success in achieving the remediation goals will be measured by sampling and chemical analysis of water and organisms to observe reduced contamination burdens, and physical measurement of cover and cap thicknesses, numbers of organisms, and revegetation of disturbed areas. The overall framework of the LTM activities is illustrated in the following table.

Summary of LCP Chemical Site OU1 Remedy Long-Term Monitoring Plan
Source: Anchor Qea 2021, Appendix I Long-Term Monitoring Plan, Table 3

Activity	Media	Sampling Summary	Schedule	Analyses
Thin Layer Cover Monitoring	Cover/ Sediment	• Five cores collected per acre (total of approximately 60 cores) • 12-inch target recovery • Sample intervals will include: – 0–6 inch – 6–12 inch	• Years 1, 3, and 5 following remedy completion	Mercury, Aroclor 1268, lead, PAHs, total organic carbon, grain size
	Benthos	• Five locations in thin layer cover area	• Years 1 and 5 following remedy completion	Benthic invertebrate numerical abundance and diversity, sediment total organic carbon and grain size
	Vegetation	• Fixed plots of 1 square meter randomly placed • Five plots per acre of thin layer cover (approximately 60 locations) and other areas impacted by remedy implementation activities (number of locations to be determined based on final design) • Minimum of two reference sites included • Aerial photography by drone	• Years 1, 3, and 5 following remedy completion	Species present, percent cover, plant height
Disturbed Areas Monitoring	Vegetation	• Approach consistent with vegetation monitoring in thin layer cover areas	• Years 1, 3, and 5 following remedy completion	Species present, percent cover, plant height

Summary of LCP Chemical Site OU1 Remedy Long-Term Monitoring Plan (continued)
Source: Anchor Qea 2021, Appendix I Long-Term Monitoring Plan, Table 3

Activity	Media	Sampling Summary	Schedule	Analyses
Surface Water Monitoring	Water	• 6 locations within Purvis Creek, LCP Ditch, and Eastern Creek (from remedial investigation) • 1 reference location in Troup Creek • Samples will be collected during both ebb and flood tide conditions • Avoid sampling for at least 48 hours after severe weather event (high winds or precipitation)	• Years 1, 3, and 5 following remedy completion	Total mercury, PCBs, and lead (filtered and unfiltered); total suspended solids
Fish and Shellfish Monitoring	Tissue – Human Receptors	• Two finfish species – Spotted seatrout (predator) – Southern kingfish (bottom feeder) • Three composite samples of each species collected from two locations within Turtle Creek and OU1 for a total of 6 samples per species	• Years 3 and 5 following remedy completion	Mercury, Aroclor 1268, lipids, wet weight
	Tissue – Ecological Receptors	• Fish and shellfish with small home range – Mummichog and fiddler crab • Fiddler crab: Three composite samples from 7 locations for a total of 24 samples • Mummichog: Three composite samples from 7 locations for a total of 21 samples	• Pre-construction baseline sampling • Years 3 and 5 following remedy completion	Mercury, Aroclor 1268

The LTM is planned for the first five years following completion of the remedy. Reports of the monitoring will be prepared and submitted to EPA and EPD at one-, three- and five-years after construction is completed. Reports will include summaries of field activities, observations and results, and all data generated by monitoring efforts; data validation reports and laboratory data reports; interpretations of data and results; photographs documenting the work conducted; and recommendations for any modifications to the monitoring program.

Section 5 of the LTM places caveats on the length of the program and discusses the possibility that remedial action objectives (RAOs) may not be accomplished for all aspects of the remedy. The noted potential limitations and their implications are presented below.

- "If results indicate that the RAOs have been met, then the monitoring program will be discontinued. Discontinuation of monitoring may occur earlier for some media or fish species than others, depending on attainment…[and]… if downward trends in tissue concentrations of mercury and Aroclor 1268 are delayed longer than anticipated.

- "While immediate reductions in mercury and Aroclor 1268 concentrations in the thin layer cover and dredge areas are anticipated as a result of remedial action, the response in fish and shellfish tissue may take several years.

- "As noted in the ROD (USEPA 2015), "Due to the potential for post-remedial residual contamination or the inability to control all significant sources of contamination to the water body, reaching sediment or biota levels resulting in unlimited exposure and unrestricted use may take many years if not a few decades. However, it is expected that contamination in biota within the LCP Chemicals marsh will be substantially reduced after several years post-remediation.

- "Also as noted for surface water, achievement of the water quality standard for mercury and total PCBs for protection of human health by consumption of organisms (i.e., 0.025 µg/L total mercury and 0.000064 µg/L for total PCBs) may not be feasible. As stated in the ROD (USEPA 2015), "Once the remedial action has been implemented and remedy effectiveness monitored for a number of years (including surface water quality), the EPA will evaluate whether a waiver under CERCLA Section 121(d)(4)(C) of these chemical-specific standards is warranted at this Site."

Details of the Long-Term Monitoring Plan

The three key elements of the monitoring program (Thin Layer Cover and Disturbed Areas, Water Quality, and Fish and Shellfish) are detailed as follows.

Thin Layer Cover and Disturbed Area Monitoring

Objectives for Covered Areas:

- Determine if contaminant levels in sediments meet or are trending towards established clean-up levels for Mercury, PCBs (as one specific PCB - Aroclor 1268), lead, and polycyclic aromatic hydrocarbons (PAHs).
- Confirm recovery and stability of marsh plants (minimum of 80% coverage) in remediated areas.
- Confirm that marsh plant species remain consistent with restoration targets.
- Confirm that benthic communities are reestablished, and invertebrate numerical abundance and diversity are improving.

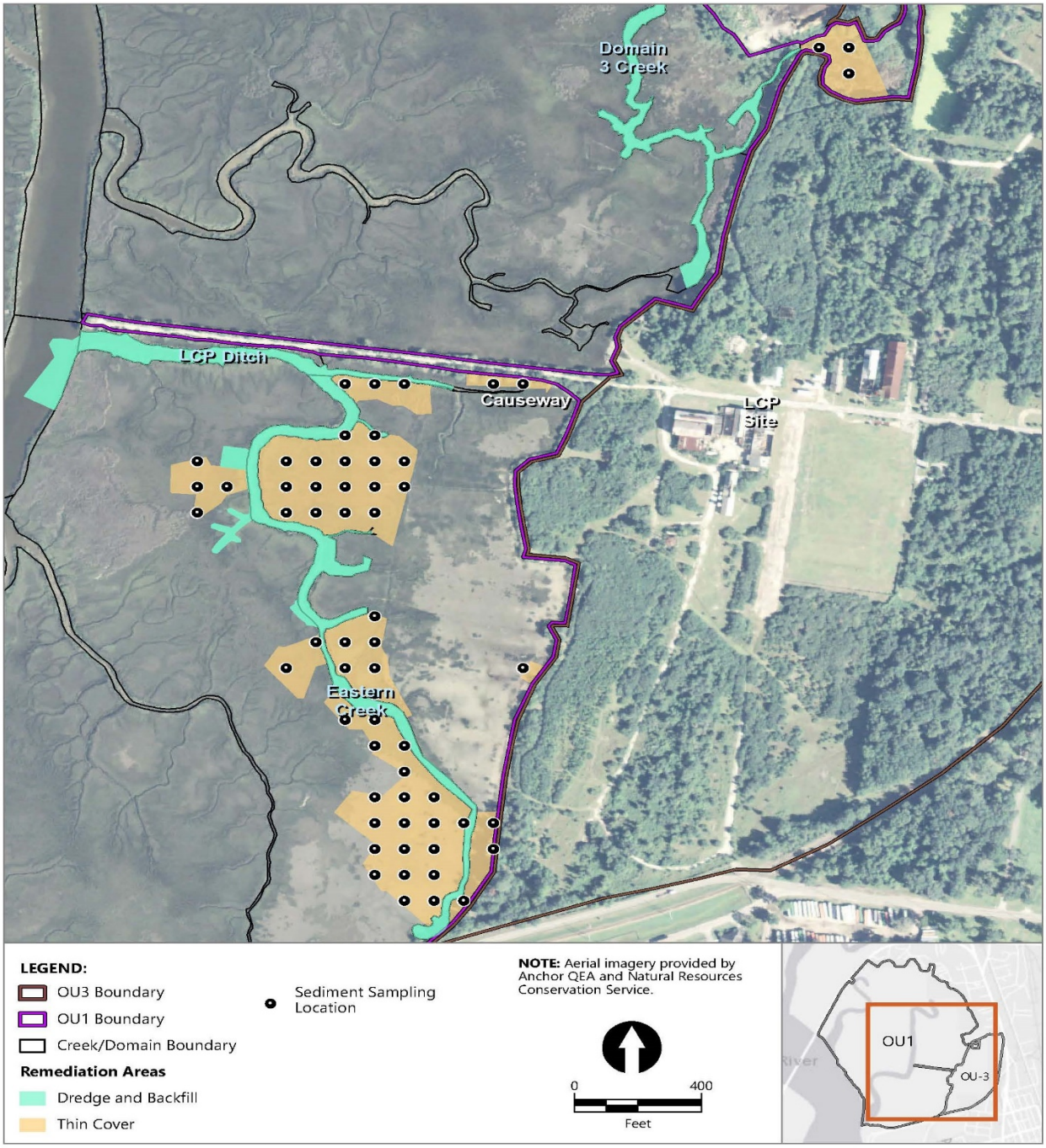
Objectives for Other Disturbed Areas:

- Confirm recovery and stability of marsh plants (minimum of 80% coverage) in remediated areas.
- Confirm marsh plant species remain consistent with restoration targets.

Cover and Sediment Sampling and Analysis:

- Three rounds of sampling/analysis (at one-, three-, and five-years after construction is completed).
- Five sediment cores collected per acre (total 60 cores over the 12-acre cover area, as shown in the figure from the LTM that is reproduced on the following page).
- Cores will extend to a depth beyond 12 inches and photographed.

- The depth of the cover material in each core will be measured and recorded and each core will be divided into two parts (upper six inches and lower six inches)
- The core samples will be analyzed for mercury, Aroclor 1268, lead, PAHs, total organic carbon, and grain size distribution.



LCP Chemicals Site, Marsh Cover/Sediment Core-Sample Locations - OU1 Long-Term Monitoring
Source: Anchor Qea 2021, Appendix I Long-Term Monitoring Plan, Figure 3

Benthic Community Evaluations:

- Two rounds of sampling/analysis (at one- and five-years after construction completed)
- Five cover/sediment samples collected across the cover area.
- Samples analyzed for the number of taxa, taxonomic groups, and individuals to determine the density of individuals and diversity and equitability indices.
- Other parameters relevant to benthic community structure determined also (particle size, organic carbon content, habitat, elevation, and tidal position within the system)
- Numerical abundance and diversity (achieved by count and taxonomic identification of benthic invertebrates) will permit calculation of Index of Biological Integrity metrics.
- The numerical abundance and diversity of the benthic invertebrates in the fifth-year samples will be compared to the results from the first-year samples.
- Results will not be compared to any reference (or "background") locations because multiple factors besides contaminant concentrations impact benthic communities.

Vegetation Assessment (abundance and type of vegetation):

- Three rounds of observation/analysis (at one-, three-, and five-years after construction is completed).
- Five observation plots (to be established) per acre of cover area (total of 60 plots)
- Ten reference plots (to be established) in marsh but outside of the cover/disturbed areas
- Aerial photography by drone to evaluate overall vegetation recovery.
- Compare conditions at observation plots to reference plots.
- Changes in species type or abundance compared to performance standards.

Water Quality Monitoring

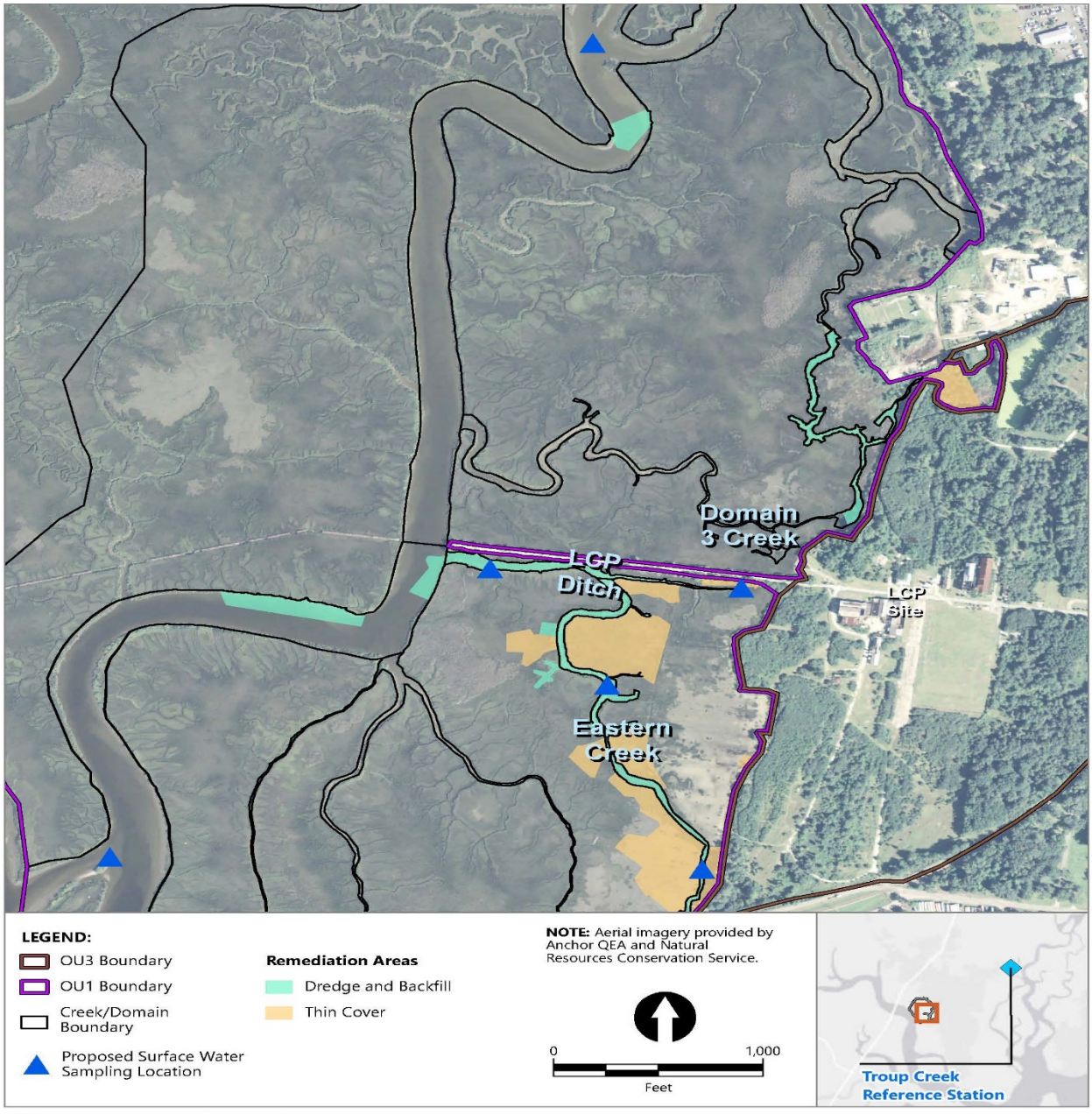
Concentrations of mercury, Aroclor 1268, and lead in surface water will be determined to measure progress toward meeting national and Georgia surface water quality standards for the protection of recreational users, high quantity finfish consumers, and ecological receptors.

The Consent Decree sets the goal of meeting federal and state water quality criteria for mercury and PCBs for the protection of aquatic life (unless there is an approved waiver). EPA acknowledges that it may be infeasible, however, to achieve the Georgia water quality criteria for protection of human health via fish consumption. These criteria are 0.025 micrograms per liter (µg/L) for total mercury and 0.000064 µg/L for total PCBs.

Surface Water Sampling/Analysis:

- Three rounds of sampling/analysis (at one-, three-, and five-years after construction is completed).
- Samples collected at six locations within Purvis Creek, LCP Ditch, and Eastern Creek (as shown in the figure from the LTM that is reproduced on the following page).

- A reference sample collected from Troup Creek, approximately 4.3 miles from the Site on the eastern side of the Brunswick Peninsula (representing similar urbanized conditions, used as a reference location during previous OU1 investigations).
- Mercury, PCBs, lead, and total suspended solids (filtered and unfiltered samples).
- Sampling density may be adjusted in later years based on the variability observed in the data from the first-year sampling.
- Samples collected during ebb tide conditions and during flood tide conditions.
- Sampling will be delayed for at least 48 hours following heavy rains or strong winds.



LCP Chemicals Site, Marsh Cover/Sediment Core-Sample Locations - OU1 Long-Term Monitoring
Source: Anchor Qea 2021, Appendix I Long-Term Monitoring Plan, Figure 3

Fish and Shellfish Monitoring

The fish and shellfish monitoring will measure progress toward goals for reducing concentrations of mercury and Aroclor 1268 in finfish to meet site-specific, target tissue concentrations and the national recommended water quality criterion and state criterion for mercury in fish tissue. Contaminant concentrations in prey items of wildlife and finfish will be monitored to confirm that they are declining. The performance standards for this monitoring are detailed in the following table (source: Anchor Qea 2021, Appendix I Long-Term Monitoring Plan, Section 4.2).

Objective	Media	RAO	Performance Standards
1, 2	Spotted seatrout edible tissue	RAO 3	Concentrations meeting or trending toward target tissue concentrations for human health (0.099 and 0.11 mg/kg for mercury and Aroclor 1286, respectively) and the national recommended and state criterion for human health (0.3 mg/kg for mercury)
1, 2	Southern kingfish edible tissue	RAO 3	Concentrations meeting or trending toward target tissue concentrations for human health (0.133 and 0.142 mg/kg for mercury and Aroclor 1286, respectively) and the national recommended and state criterion for human health (0.3 mg/kg for mercury)
2	Mummichog and fiddler crab tissue	RAOs 2 and 5	Concentrations declining compared to baseline data

Notes:
The site-specific target tissue concentrations are from Table 19 of the ROD (USEPA 2015).
As noted previously, the target tissue concentrations and national recommended and state criterion for mercury assume different consumption rates (i.e., high frequency and recreational, respectively).

Tissue samples will be analyzed for mercury and Aroclor 1268 (lipids will also be analyzed for finfish only). Fish length and individual sample or composite weight will be determined in the field and percent wet weight will be measured in the laboratory. Sex of fiddler crabs will be determined in the field so that males only are included in composite samples.

EPA acknowledged that reaching sediment or biota levels of mercury and PCBs that would allow unlimited exposure and unrestricted use may take many years if not a few decades to achieve. This is due to limitations of the remedy (residual contamination will remain in the estuarine environment after the remedial action is completed), and the impracticality of controlling all significant sources of contamination in the ecosystem. EPA expects that contamination in biota within the LCP site marsh, however, will be substantially reduced within several years.

The LTM notes that "In the Turtle River system, the fish consumption advisories for spotted seatrout and southern kingfish are, at most, one meal per week throughout the system (GADNR 2020a) due to mercury and/or PCBs, and this is unlikely to change to no restrictions following remediation."

Tissue Sampling for Human Health Exposure:

Tissue sampling/analysis for Human Health Exposure will focus on spotted seatrout and southern kingfish (whiting), which represent predator and bottom feeder fish. The LTM notes that spotted

seatrout and southern kingfish are reported to constitute 39.4% and 19.7%, respectively, of total catch of fish species in Georgia based on angling success. The fish sampling for human health exposure is shown in the following table (source: Anchor Qea 2021, Appendix I Long-Term Monitoring Plan, Section 4.3.1, Table 4), and summarized i n the bullets below.

Species	Number of Sampling Stations		Number of Samples	Total Number of Samples
	Zone D	Zone H/I		
Spotted seatrout	1	1	3 replicates per zone of 5 composited spotted seatrout per station	6
Southern Kingfish	1	1	3 replicates per zone of 5 composited southern kingfish per sampling station	6

- Sampling at three- and five-years after construction is completed.
- Spotted seatrout and southern kingfish will be sampled from Zones D, H, and I. Zone D is the middle of the Turtle River; Zones H and I are Purvis Creek and Gibson Creek.
- For each species, fish will be collected throughout the portions of Zone D and Zones H/I that are within the Site boundary.
- Each sample will consist of composites of five fish. The smallest fish in a composite sample will be at least 75% of the total length of the largest fish (in accordance with GADNR guidelines).
- Only the filet of each fish will be submitted for chemical analysis. The fish will be scaled, leaving the skin on, and then fileted. The filet will include the belly flap; however, the rib cage will be removed (in accordance with GADNR guidelines).

Tissue Sampling for Ecological Exposure:

For consideration of risk to wildlife and finfish, tissues from mummichog and fiddler crabs will be monitored. They are common prey for wildlife, have small home ranges, and are more likely to reflect changes in sediment concentration than fish or shellfish with larger home ranges. The tissue sampling for ecological exposure is shown in the following table (source: Anchor Qea 2021, Appendix I Long-Term Monitoring Plan, Section 4..3.2, Table 5), and summarized in the bullets on the following page.

Species	Number of Sampling Stations	Number of Samples	Total Number of Samples
Fish			
Mummichog	7	3 replicates of at least 5 composited mummichog per station	21
Shellfish			
Fiddler crab	7	3 replicates of at least 5 composited crabs (exclusively males) per station	21

Note:
The number of fish and crab per composite, the range of lengths, and total weight per composite will be specified in the FSP. The previous data, as summarized in Table 8-2 of the remedial investigation report (EPS and ENVIRON 2012) will be considered in making this determination.

- Sampling before remedial construction begins, and at three- and five-years after construction is completed.
- Seven fiddler crab and seven mummichog sampling locations.
- Sampling locations focus on areas where remedial activities will occur, including some that were sampled historically.
- Three composite samples collected at each sampling location. A minimum of five individuals will be included in each composite sample, however more than five individuals may be required to meet minimum tissue requirements for sample analysis.
- The smallest individual in a composite sample will be at least 75% of the total length of the largest individual (in accordance with GADNR guidelines).

Schedule

The LTM is expected to begin soon after EPA approves the plan and in accordance with the OU1 remedial action schedule presented in the 95% Basis of Design Report. That schedule targets mid-December 2021 for final agency approval/authorization to proceed; mid-June 2022 for starting remedial construction; and mid-December 2023 for construction completion.

Pre-construction baseline sampling for the mummichog and fiddler crab analysis will be conducted before remedial action begins. After construction is completed, the various media will be sampled at one-, three- and/or five-years after construction is completed. If design approval occurs as currently planned, and construction is completed in mid-September 2023, the first-year of the long-term monitoring activity will occur in the fourth quarter of 2024.

Comments on LTM

It is important to understand that the LTM is not the only monitoring associated with the OU1 remedial action. During remedy construction, additional sampling will be performed to ensure that the sediment dredging and covering, and thin-cover placement work, is done in accordance with the final design. Surface water and air will be monitored to ensure that construction activities do not disperse contaminants beyond work areas or otherwise adversely affect the environment.

A few comments about the LTM are offered below:

- It appears that all EPA and EPD requirements for post-remedial monitoring will be addressed adequately by the LTM, although additional effort will probably be required of Honeywell before the LTM can be finalized and approved. Based on my experience, Honeywell's technical consultant Anchor Qea has significant experience on similar sediment remediation projects and is widely recognized as a top-tier expert on these matters.

- In general, the media to be monitored, monitoring parameters, numbers of sampling locations, and frequencies are consistent with what I have seen in my experience with a few similar sediment remediation projects that I have consulted on (including sediment dredging/capping projects at contaminated estuaries and embayments in California in which Anchor Qea is providing technical services).

- I suspect that EPA may require some additional information, possibly adding more sampling of certain media, and possibly additional media to be sampled, to the LTM, based on recent conversations with EPA's Project Manager Pamela Scully.

- Ms. Scully has informed me that she believes details on Quality Assurance/Quality Control (QA/QC) procedures should be included in the LTM, and a more in-depth explanation of sampling and analyses methods (e.g., standard operating procedures) should also be incorporated into the LTM. The LTM at this stage states that such details would be contained in the overall project QA/QC and Field Sampling Plans.

- Although the LTM anticipates ceasing the program after the fifth-year monitoring activities, I believe it is highly likely that EPA and/or EPD will require monitoring for a longer time. The suggestion in the LTM that some monitoring could be curtailed sooner than the initial five years is probably unrealistic and over-optimistic. A five-year period may be too short to establish any trends in performance measures. For example, statistically-significant data on tissue-burdens of contaminants in aquatic species may not be generated by the few rounds of sampling now specified, or upward migration of contaminants into/through the thin-layer covers due to biological (organism-induced migration) or chemical actions may take longer than five years to become apparent.

- Five years also may be not long enough to gain confidence in the physical stability of the thin-layer covers and/or clean-sand backfill over certain dredged areas. For example, if there are no severe storms during the first five years after construction completion, monitoring would not provide any data that would support concluding that the covers will provide adequate long-term protection.

- Whether or not the LTM is revised to extend beyond five years, EPA's Five-Year Review process for Superfund sites with containment remedies means that additional sampling will be performed to support assessment of the on-going success of the containment remedy. It is logical to expect that such Five-year-Review related sampling and analysis would include at least some, if not all, of the LTM media and parameters.

Next Steps

EPA's technical team has been reviewing the entire Basis of Design Report, including the LTM. Their target date to provide Ms. Scully with comments is September 24. Although that target could slip a week or so, we should learn about any EPA concerns/comments relatively soon.
I will continue to be in contact with EPA on their comments as they are finalized, and will monitor progress on the overall remedial design as it is finalized and the LTM is approved.

I trust this memorandum provides GEC and the community with a good understanding of the status of LTM for the OU1 remedial action. Feel free to contact me if you have any questions or desire any additional information.