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January 18, 2023

Bob Wyatt
NW Natural
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via electronic delivery (email)

Re: DEQ Comments on the In-Situ Stabilization and Solidification Laboratory Pilot Study Work Plan
Former Gasco Manufactured Gas Plant Operable Unit
Portland, Oregon
ECSI# 84
ECSI# 183

Dear Mr. Wyatt:

The Oregon Department of Environmental Quality (DEQ) reviewed the October 31, 2022 *In Situ Stabilization and Solidification Laboratory Pilot Study Work Plan*[1] (LPS WP) submitted by Anchor QEA, LLC on behalf of NW Natural. The LPS WP was prepared under the *Administrative Settlement Agreement and Order on Consent for Removal Action*[2], U.S. Environmental Protection Agency Region 10 (EPA), CERCLA Docket No. 10-2009-0255 (ASAOC). The LPS WP proposes an in-situ stabilization and solidification (ISS) laboratory pilot study (LPS), including associated field sampling and laboratory methodologies, for the Gasco Sediments Site Shallow, Intermediate, and Riverbank Regions (i.e., nearshore) and the Gasco Operable Unit (OU) uplands. Since the LPS WP proposes sampling and testing of upland soils to inform the design of an upland ISS barrier wall, it should be submitted to EPA and DEQ under the ASAOC and upland cleanup agreements[3,4,5], respectively. It is appropriate and necessary that DEQ maintain oversight of Gasco OU upland remediation and source control decision making, consistent with the ASAOC, our upland cleanup agreements with NW Natural, and the Memorandum of Understanding for Portland Harbor Superfund Site (MOU)[6].

Consistent with the MOU, DEQ has transmitted review comments on the LPS WP scope of work relevant to the Gasco Sediments Site separately to EPA. Since EPA is the lead agency for the Gasco Sediments Site, we understand that our comments will be incorporated into EPA's comments provided to NW Natural. DEQ requires that the LPS WP be revised to address our comments provided below.

[1] Anchor QEA, LLC. 2022. In Situ Stabilization and Solidification Laboratory Pilot Study Work Plan, Gasco Sediments Cleanup Action. Prepared on behalf of NW Natural. October 31.
[2] EPA. 2009. Administrative Settlement Agreement and Order on Consent for Removal Action, U.S. Environmental Protection Agency Region 10, CERCLA Docket No. 10-2009-0255. September 9
[3] DEQ. 1994. Voluntary Agreement for Remedial Investigation/Feasibility Study. DEQ No. WMCVC-NWR-94-13. August 8.
[4] DEQ. 2006. First Addendum to Voluntary Agreement for Remedial Investigation/Feasibility Study. DEQ No. WMCVC-NWR-94-13. July 19.
[5] DEQ. 2016. Second Addendum to Voluntary Agreement for Remedial Investigation/Feasibility Study. DEQ No. WMCVC-NWR-94-13. October 11.
[6] 2001. Memorandum of Understanding for Portland Harbor Superfund Site.

General Comments

1) DEQ clarifies that deliverables that include work conducted under the ASAOC and upland cleanup agreements are subject to approval by EPA and DEQ, respectively, and should be prepared and submitted to both agencies consistent with the requirements of applicable cleanup agreements. We consider joint agency review of the LPS WP as a "test case" for coordinating joint reviews of future design deliverables (assuming both EPA and DEQ approve the in-water and upland elements of the "Full Dredge and ISS" Design alternative and new source control alternative, respectively). If joint agency review and approval of the LPS WP is not possible, then DEQ will require that the LPS WP and all future deliverables related to the in-water and upland elements of the "Full Dredge and ISS" Design alternative and new source control alternative be submitted to EPA and DEQ separately.

2) Revise the LPS WP to clarify that the LPS WP, including appendices, have been prepared in accordance with the ASAOC and the Voluntary Agreement for Remedial Investigation/Feasibility Study (DEQ No. WMCVC-NWR-94-13), as amended.

3) Portions of the LPS WP describe the ISS barrier wall as a component of the in-water remedy. These statements or implications are incorrect. Revise the LPS WP to clarify that the ISS barrier wall is an element of a proposed new source control alternative, subject to DEQ approval and oversight. In addition, revise descriptions of the ISS barrier wall location to clarify that it is located in the Gasco OU uplands.

4) Revise the LPS WP to consider how various ISS grout additives may affect the geochemistry of the soil and groundwater, and how those geochemical changes would affect mobilization of contamination. The LPS WP should acknowledge that the water used during leachability tests may not be representative of the groundwater at the site and discuss how actual field conditions may differ from laboratory scale conditions. For example, the groundwater (and associated contamination) that would interact with the ISS-treated soils will be anoxic and highly reducing relative to the water used in the leachability tests. These reducing conditions have the potential to change contaminant transport or long-term leachability (e.g., for metals like arsenic and manganese).

5) DEQ offers the following comments regarding the proposed selection criteria for the grout mix design for soils:

    a) The LPS WP sets a minimum unconfined compressive strength (UCS) performance target of 50 pounds per square inch (psi). DEQ agrees that 50 psi represents a reasonable and appropriate minimum performance target for UCS. We recommend that the LPS WP also set a maximum UCS performance target (e.g., 150 psi) to ensure that the selected mix design can accommodate various known and unknown future use scenarios.

    b) The LPS WP sets a permeability performance target of less than 10^{-6} centimeters per second (cm/s). DEQ agrees that this represents a reasonable and appropriate performance target.

    c) The LPS does not propose leachability testing for upland soils. DEQ requires leachability testing for upland soils. DEQ is comfortable moving forward without numerical leachability goals, but notes that leaching (or diffusive flux) of contamination from the ISS-treated soils will need to be assessed to ensure that the ISS barrier wall is able to maintain long-term control of contamination to the Willamette River. The grout mix design that provides the greatest reduction in leachability

(that also achieves the other performance targets and is constructable) should be selected for full scale application.

d) The LPS WP identifies limiting the overall volume increase (swell) during construction as a selection criterion. DEQ considers this objective secondary to achieving the strength, permeability, and leachability reduction goals.

e) In addition to the performance targets discussed in the LPS WP, selection of a grout mix design for the ISS barrier wall should consider other criteria applicable to full-scale ISS implementability. Revise the LPS WP to provide additional discussion of parameters that represent technology-specific or site-specific implementation limitations or challenges, such as ability of grout to flow through injector heads of an auger, application of ISS in limited access areas (beneath dock walkways, dolphin walkways, vegetation, utilities etc.), the effect of study parameters (including UCS, swell, etc.) on the use, maintenance, or function of upland infrastructure near the shoreline, and the ability to vary grout mixes through soils with different physical and chemical characteristics.

6) The number and location of proposed soil sampling locations are inadequate. The Gasco OU soil and groundwater along portions of the shoreline are contaminated with high concentrations of total cyanide, naphthalene, benzene and other volatile organic compounds (VOCs), chlorinated VOCs (cVOCs), and metals. As shown on Table 2-1 of the ITRC Guidance for the *Development of Performance Specifications for Solidification/Stabilization*[7], ISS may not effectively control leaching of VOC contaminated media. The proposed boring adjacent to PW-2L will be informative for evaluating leachability of cVOCs. Further, application of ISS may mobilize high concentrations of metals to groundwater during construction as a result of pH changes. Revise the LPS WP to explain the rationale for selecting soil sample locations and depth intervals for testing, and how that rationale considers areas known to contain higher concentrations of these contaminants in order to evaluate short-term releases of these contaminants during construction and their long-term leachability from treated soils. In addition, revise the LPS WP to include the following:

   a) DEQ requires another soil boring another located near the MW-21 monitoring well cluster (or an acceptable alternative location with significantly elevated benzene and naphthalene concentrations).

   b) DEQ requires an additional soil boring location close to PW-10L, which is near the shoreline and the US Moorings property boundary.

   c) DEQ requires that soil samples representative of the fill, upper silt unit, Upper Alluvium, and Lower Alluvium be collected from each soil boring location to evaluate the heterogeneities (hydraulic conductivity, soil types and grain size differences) within each of these hydrogeological units. Multiple samples from these hydrogeologic units within each boring may be appropriate to test a range of grain sizes and contamination characteristics.

7) Several sections of the LPS WP limit consideration of PTW-NAPL to DNAPL that is observed to ooze from sediments. This limitation does not apply to upland soils. DEQ requires that soil cores log all manufactured gas plant (MGP) residuals. These materials are identified on Interim Feasibility

[7] Interstate Technology and Regulatory Council (ITRC). 2011. Development of Performance Specifications for Solidification/Stabilization. July.

Study[8] Table 4-1. Furthermore, one of DEQ's core objectives of the LPS is to understand long-term leachability of contaminants from ISS-treated soil. While DNAPL represents a source of potentially mobile and highly concentrated contamination, other MGP residuals also represent sources of highly concentrated contamination with the potential to contribute to long-term leaching. Assessing LPS sample locations for all MGP residuals will reduce uncertainty about the long-term reliability and protectiveness of ISS.

8) Consistent with recommendations provided in Section 2.3 of the ITRC Guidance for the Development of Performance Specifications for Solidification/Stabilization, the grout mix designs tested as part of the LPS should include reagents and additives to evaluate the potential to further improve reduction of contaminant leachability. DEQ requires that bentonite clay, organophilic clay, oxidants (persulfate)[9], and activated carbon be tested. Different grout mix additives/reagents may offer advantages across different WBZs or GSAs with different characteristics and natures of contamination (i.e., cVOC impacted areas, DNAPL and other MGP residual-impacted areas, areas with high concentrations of benzene, naphthalene, and metals).

Specific Comments

1) **Section 1.1, Background**. Revise the third sentence the third paragraph to state, "An alternative source control approach, consisting of an integrated deep ISS barrier wall, groundwater interceptor trench, and network of monitoring wells, has been proposed to DEQ." Refer to DEQ Comments[10] on the Source Control Addendum[11].

2) **Section 1.1, Background**. The fourth paragraph states that the Full Dredge and ISS Design alternative "eliminates contaminant transport via advective flux, and ensures there will be no recontamination of the Project Area from the Gasco OU uplands…" Revise this paragraph to clarify that the objective of DEQ's source control program at the Gasco OU uplands is to prevent recontamination of the Gasco Sediments Site. The existing groundwater source control measure for the Alluvium WBZ (the hydraulic control and containment [HC&C] system) is currently achieving source control objectives. The planned groundwater interceptor trenches and/or horizontal wells in the Fill WBZ are expected to achieve source control objectives. NW Natural submitted a Source Control Addendum to DEQ on November 10, 2022 that includes a new source control alternative consisting of an ISS barrier wall, groundwater interceptor trench, and a network of monitoring wells. DEQ provided comments on the Source Control Addendum on December 23, 2022.

3) **Section 1.3.2, Leachability Testing Objectives and Evaluation Criteria**. The first paragraph states that after treatment, "there will be no pathway for advective flux through the treated areas." While DEQ agrees that the hydraulic conductivity of the treated soils will be very low, some amount of advective flux through ISS barrier wall will occur. As shown on Figure 3-1 of the ITRC Guidance for the Development of Performance Specifications for Solidification/Stabilization, there are several factors that may play a role in the long-term physical and environmental performance of cement-based materials that may result in some advective flux through the treated soils. DEQ does not believe

[8]Anchor QEA, LLC. 2018. Draft Interim Feasibility Study. Gasco OU. Prepared for NW Natural. November 18 (final content received January 11, 2019).
[9] J. Bergman, H. Nord, P. Elander, S. Moeini, J. Molin, and B. Smith. 2022. Combined Remedies Evaluation to Treat Residual Contamination at a Former MGP Site. Presented by Jonny Bergman (RGS Nordic/Sweden), Battelle -Twelfth International Conference on the Remediation of Chlorinated and Recalcitrant Compounds proceedings, Palm Springs, California. May 25.
[10] DEQ. 2022. Letter to Bob Wyatt (NW Natural). Regarding: DEQ Comments on the Source Control Addendum Report, Former Gasco Manufactured Gas Plant Operable Unit, Portland, Oregon, ECSI #84, ECSI #183. December 22.
[11] Anchor QEA, LLC. 2022. Source Control Addendum Report, NW Natural Gasco Site, ECSI No. 84. Prepared for NW Natural. November 10.

these factors are likely to result in failure but may warrant further consideration to ensure that the ISS barrier wall is able to maintain long-term control of contamination to the Willamette River.

4) **Section 2.2, Soil Sample Locations and Depth**. Delete the first sentence of the first paragraph. DEQ is the lead agency responsible for overseeing Gasco OU upland remediation and source control.

5) **Section 2.2, Soil Sample Locations and Depth**. This section poorly explains the rationale for the proposed soil sampling locations and depths. Revise the LPS WP to include a matrix that relates each sample location and depth to each LPS objective and variable(s) being evaluated. At a minimum, the variables evaluated as part of the LPS scope should include, but not be limited to: grain size, hydraulic conductivity, moisture content, presence and type of MGP residual (including DNAPL), concentration of VOCs and SVOCs (e.g., benzene, naphthalene, TCE, etc.), concentration of site-specific COCs that may be affected by the grout mix design (e.g., total petroleum hydrocarbons (TPH), cyanide, pH dependent metals [arsenic, aluminum, iron, manganese, etc.]), constituents that affect leachate composition (e.g., total and dissolved organic carbon), and presence of constituents that may affect grout setting/curing or long-term performance[12] (e.g., sulfate, sulfite, chlorides).

6) **Section 3.1, Sample Collection and Handling**. Revise the LPS WP to provide the target volume from each of the sample locations.

7) **Section 3.2, Initial Characterization of Untreated Samples**. Upland soils should be analyzed for ROD Table 17 COCs with groundwater CULs, any other COCs that exceed ROD Table 17 cleanup levels within the Gasco Sediments Site and/or upland shoreline across any media, as well as constituents that may require special consideration for the ISS technology (See specific comment #5). This comment also applies to Appendix A Section 5.1.1 and Appendix B.

8) **Section 3.2, Initial Characterization of Untreated Samples**. DEQ recommends the homogenization of the samples be completed at the laboratory on undisturbed samples collected from the field.

9) **Section 3.3, Grout Component Testing**. The LPS should be expanded to measure and evaluate TPH and VOCs in headspace (off-gassing), temperature, pH, and material phase separation (NAPL mobilization, formation of precipitates and/or other gels/supernatant during setting).

10) **Section 3.4, Strength and Permeability Testing**. The LPS should be revised to provide additional detail describing the method for determining when the assessing the effective solubility of the DNAPL is needed. It should be noted that in addition to DNAPL, supernatants/gels and leachates may be produced during the curing process. All of these observations should be recorded, along with material temperatures, pH, and off-gassing (refer to Specific Comment #9).

11) **Section 3.5.1, Leachability Testing Design**. Leachate generated from soil samples during each phase of leachability testing should also be analyzed for TPH, total cyanide, lead, zinc, and pH dependent metals (e.g., arsenic, aluminum, iron, manganese, etc.). This comment also applies to Appendix A Section 5.4 and Appendix B.

[12] As shown on Figure 3-1 and Table 4-1 of the ITRC Guidance for the Development of Performance Specifications for Solidification/Stabilization, environmental attack of these constituents on Portland cement blends may lead to aggressive degradation.

12) **Section 5, Reporting**. Revise this section to clarify that LPS data will be reported to EPA and DEQ (refer to General Comment #1). It is critical for NW Natural to complete the LPS and report all of the results, including recommended final grout mix designs, in the Intermediate Design.

13) **Table 2-2, Selected Soil Laboratory Pilot Study Locations and Depth Intervals**. Incorporate additional sampling required in our comments herein. Provide additional rationale that includes discussion of other MGP residuals expected at each boring location, general material types and approximate thickness of each hydrogeologic unit at each boring, approximate depth intervals with elevated benzene, naphthalene, and/or cVOC concentrations.

14) **Table 3-2, Strength and Permeability Testing Plan**. Please include representative grain size data and total organic carbon for the upland soil samples. Where applicable, include effective solubility ranges.

15) **Appendix A, Section 2, Project Management and Responsibilities**. Include the point of contact for the DEQ project manager.

16) **Appendix A, Section 3.1, PTW-NAPL Identification**. Revise this section or add a separate subsection that describes MGP residuals identification for upland soils.

17) **Appendix A, Section 3.3.3, Soil Logging and Processing Procedures.** Soil logging should include the presence and characteristics of subsurface debris.

18) **Appendix A, Section 4.4, Management of Investigation-Derived Waste**. IDW characterization should include total solids/percent dry weight, per Table 3-1 of the *Contaminated Material Management Plan*[13]. In addition, DEQ should be copied on the transmittal of the waste profile package to the selected disposal facility requesting acceptance of the waste for disposal.

19) **Appendix A, Section 5.2, Grout Component Testing**. Grout component testing should be conducted on more than one (1) soil sample location. Separate grout component testing should be conducted for soils collected from different hydrogeologic units (i.e., fill, upper silt unit, upper alluvium, and lower alluvium). Grout component testing should also assess additional reagents and admixtures (refer to General Comment #8).

20) **Appendix A, Section 5.3, Strength and Permeability Testing**. Grout dose rates for upland soil may need to include rates higher than 10%, depending on the results of the grout component testing. Grout strength and permeability testing should also assess additional reagents and admixtures (refer to General Comment #8).

21) **Appendix A, Attachment A, Field Forms**. Include field forms for soil logging and sample collection.

22) **Appendix B, Distribution List**. Include Wesley Thomas, Project Manager, Oregon Department of Environmental Quality.

23) **Appendix B, Figure B-1**. Include DEQ on the project organizational chart.

[13] Anchor QEA, LLC and Hahn and Associates, Inc. 2021. Contaminated Materials Management Plan. NW Natural Gasco Site. Prepared for NW Natural. November 19.

Please do not hesitate to contact me at (503) 229-6932 or Wesley.Thomas@deq.oregon.gov if you have any questions regarding this letter.

Sincerely,

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