EPA Comments and Responses on Draft In Situ Stabilization and Solidification Laboratory Pilot Study Work Plan (dated October 31, 2022) and Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan (dated February 16, 2023) Gasco Sediments Site

EPA Response dated March 14, 2023

This is U.S. Environmental Protection Agency's (EPA's) conditional approval of the revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan (TSWP). The revised TSWP was prepared by Anchor QEA, LLC (Anchor QEA) on behalf of NW Natural. The TSWP is a deliverable prepared for NW Natural under the Administrative Settlement Agreement and Order on Consent, CERCLA Docket No. 10-2009-0255, executed between EPA and NW Natural. EPA's conditional approval applies to the four proposed in-water sediment core locations and sample depths as presented in the revised TSWP. EPA understands core collection is scheduled to start on March 19, 2023. Approval of the revised TSWP is also conditioned on NW Natural adequately addressing EPA's responses as described below and does not apply to leachability testing as it relates to the Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan Addendum (TWSP addendum) dated March 13, 2023 which is currently under EPA and Oregon Department of Environmental Quality (DEQ) review. The TSWP addendum contains a proposed modification to the Phase IV leachability testing.

EPA Comments on the Revised TSWP

Since the TSWP addendum is currently under agency review, the following EPA responses are focused on all aspects of the TSWP except Phase IV leachability testing. EPA may provide additional comments on the Phase IV leachability testing section of the TSWP based on its review of the TWSP addendum. Unless otherwise noted, NW Natural's responses to EPA's comments on the draft TSWP and updates to the revised TSWP are acceptable. However, clarification and supplemental information is provided below for the following comments: General Comments 3a, 7, 9, 10; Specific Comments 5, 9, 11, 14a; and To Be Considered Comment 3.

EPA General Comment 3a (January 18, 2023)

Considerations for Sample Location Selection: Sampling of sediment containing higher concentrations of benzene and chlorinated volatile organic compounds should be considered in order to evaluate long-term leachability of these contaminants from treated sediments and potentially inform design of a cap, if needed. Sediment known to contain higher concentrations of metals which are expected to be impacted by changes in pH should also be sampled to evaluate construction-related impacts to surface water and porewater quality.

NW Natural Response (February 16, 2023)

NW Natural agrees that collection of the information EPA identifies in this comment is among the objectives for the treatability study. The Work Plan has been revised to provide further rationale for sample locations relative to the various considerations identified in the comment.

EPA Response (March 14, 2023)

The response is acceptable; however, item 2.a.iv in Section 2.1 states that: "Anchor QEA confirmed that metals sediment concentrations at the four proposed sample locations and depth intervals are generally representative of the central tendency of metals concentrations within the ISS treatment area." For completeness, revise the text or include a table to provide the range of metals sediment concentrations at each of the four proposed sediment sample locations along with the central tendency statistics within the ISS treatment area.

EPA General Comment 7 (January 18, 2023)

Grout Blend Design: The grout blend designs tested as part of the ISSLPS should consider amendments and/or additives (e.g., organophilic clays, activated carbon, etc.) to evaluate the potential to further improve reduction of contaminant leachability.

NW Natural Response (February 16, 2023)

Additives such as organophilic clay (OC) and activated carbon (AC) were considered in developing the proposed testing approach but were excluded because prior experience indicated they would be unlikely to significantly reduce leaching. For the Gowanus Canal site ISS design, 15 different ISS mixes were tested and included multiple percentages of OC. All tested mixes had similar naphthalene leaching results. As stated by Grubb et al. 2020: "[T]he most expensive reagent OC was eliminated from further consideration after the bench scale study showed the nominal enhancement did not justify the significant additional cost." Similarly, during ISS treatability testing for the Quanta site with PAH-rich dense nonaqueous phase liquid (DNAPL) in sediment, OC and powdered AC were tested as additives in ISS mix formulas, and neither were found to reduce leaching for volatile organic compounds (VOCs) or PAHs (Ramboll et al. 2019). The ineffectiveness of sorptive amendments in reducing leachability is because leaching from nonaqueous phase liquid (NAPL)-impacted sediments is ultimately controlled by the effective solubilities of the NAPL constituents.

In addition, NW Natural had extended conversations with a manufacturer of sodium persulfate and eliminated this additive from consideration based on the manufacturer's recommendation given the Project Area conditions.

EPA Response (March 14, 2023)

The response is acceptable; however, depending on the results of the bench-scale treatability study and field pilot, the need for amended caps will be evaluated in future stages of design. Revise the text to acknowledge this, as appropriate.

EPA General Comment 9 (January 18, 2023)

Pilot Study Schedule: NW Natural should consider the following concerning the pilot study schedule:

a. EPA understands that NW Natural plan is to implement a field pilot study during the 2023 work window. The feasibility of a 2023 field pilot should be explained given that all laboratory testing results will not be available by Fall 2023.

b. The proposed reporting schedule indicates that the ISSLPS may not be completed until after the Interim Design (EPA assumes that the "Interim Design" is equivalent to the "50% Design"). EPA believes it is critical for NW Natural to complete the ISSLPS and report all testing results, including a recommended final grout blend design, in the Interim Design.

NW Natural Response (February 16, 2023)

Section 4 of the Work Plan was revised to clarify how the treatability study results will be incorporated into forthcoming remedial design deliverables. Specifically, different treatability study elements will be completed sequentially over more than a year. This schedule, however, does not affect the Project Area remedial design process already underway. That is because the treatability study data are not needed to determine if ISS will be effective. The data will be used to ensure the means and methods for ISS technology used in the Project Area are optimally designed for site-specific conditions. For that reason, a separate Revised Basis of Design Report and Preliminary Design will be resubmitted as soon as possible. Due to the significant level of remedial design evaluations performed to support submittal of the Combined Sediment Remedy Basis of Design and Preliminary Design Report (Anchor QEA 2021) and subsequent evaluations of the revised ISS and Full Dredge Design presented to EPA, DEQ, and the Technical Coordination Team in 2022, the Preliminary Design is expected to be at the 50 percent design level. The results of the treatability study and subsequent proposed ISS field pilot study (see Section 7 of the Work Plan), as well as responses to comments from EPA on the Preliminary Design and any necessary remedial design revisions, will be incorporated into the subsequent Interim Design. Any feedback received from EPA and DEQ on the Interim Design will be addressed and incorporated into the Final Design. This approach enables efficient forward progress on design while facilitating completion of the field pilot study during the 2023 in-water work window and ensuring the necessary data and responses to EPA and DEQ comments are incorporated into the relevant phases of design.

A new Section 7 has been added to the Work Plan to describe the specific treatability study results that will be used to inform the field pilot study proposed during the summer 2023 in-water work window. NW Natural confirms that all Work Plan and the future proposed field pilot study results will be reported in the Interim Design.

EPA Response (March 14, 2023)

Considering the significant change in remedial technology selection, EPA believes that comments on the Final Design are possible and NW Natural should be prepared to address the comments in some manner.

EPA General Comment 10 (January 18, 2023)

Remedy Monitoring: EPA reiterates General Comment 5 on the PAR as it is also relevant to the ISSLPS WP: "The PAR suggests that the "Full Dredge and ISS Design" alternative would not require capping and would have reduced monitoring requirements compared to capping. The laboratory pilot study treatability testing results should be used to inform the need for capping subsequent to ISS implementation. Monitoring of the in-river remedy will still be required for the ISS remedy and these capping and monitoring requirements should be evaluated during future design stages."

NW Natural Response (February 16, 2023)

NW Natural agrees that the treatability study results will be used to determine the diffusive flux from the treated layer and to design the appropriate materials overlying the cover or treated layer to address this potential chemical migration pathway.

EPA Response (March 14, 2023)

NW Natural's response and the revised TSWP use the term cover while EPA's comment was specific to capping. Based on the results of the treatability study and subsequent design evaluations of contaminant flux EPA will determine the need for a cap or cover. Distinguishing between a cap and a cover has

implications regarding long-term performance monitoring that are important to clarify. Revise the TSWP to acknowledge that a cap may be needed to address contaminant flux.

EPA Specific Comment 5 (January 18, 2023)

Section 1.2 ISS Description, last paragraph, page 4: The text states that: "ISS has been effectively used for decades at hundreds of sites around the country, many of which are manufactured gas plant sites like Gasco." Revise the text to clarify if these applications have been mostly associated with upland remedial actions.

NW Natural Response (February 16, 2023)

The referenced sentence has been revised consistent with the comment, and references to specific sites where ISS has been implemented have been added.

EPA Response (March 14, 2023)

Some of the referenced sites do not have associated citations and footnote 4 is missing from the text. Revise the list of sites to include citations (if available) and footnotes as appropriate. Note that EPA cannot verify the information for sites where the Design Team performed the work, but a published report or literature is unavailable.

EPA Specific Comment 9 (January 18, 2023)

Section 1.3.2 Leachability Testing Objectives and Evaluation Criteria, second paragraph, page 5: Revise the text to clarify how NW Natural intends to verify that DNAPL in the ISS treated materials will be immobile. Also include citations for studies to support this assumption.

NW Natural Response (February 16, 2023)

Consistent with the empirical testing results from the Gowanus Canal site, free-phase DNAPL is not expected to remain in ISS-treated samples (Olean et al. 2016). If free-phase DNAPL is not observed, it will be concluded that DNAPL is immobile. This information has been added to Sections 1.3.2 and 3.5.

EPA Response (March 14, 2023)

The response and associated TSWP revisions are acceptable. Similar to Olean et al. (2016), observations of potential stabilized NAPL in cylinders subjected to UCS testing should also be documented.

EPA Specific Comment 11 (January 18, 2023)

Section 3.2 Initial Characterization of Untreated Samples, second paragraph, pages 9: The untreated samples should be analyzed for contaminants with ROD Table 17 groundwater and riverbank soil/sediment CULs. Total organic carbon should also be analyzed as organic content can have significant influence on pozzolanic action of cementitious admixtures. Revise the text to include these analyses.

NW Natural Response (February 16, 2023)

Note that the analyte lists for untreated bulk sediment and soil samples are addressed separately in this response.

Bulk untreated sediment samples: The objective of performing chemical analyses on the bulk untreated sediment samples is to provide a baseline chemical characterization for reference while interpreting the Phase III and IV untreated and treated sediment leachability testing results. In turn, the objective of performing chemical analysis on the Phase III leachates is to document and rank the reduction of COC

leachability for various grout dosages. The objective of the Phase IV leachate testing is to quantify the COC mass flux and COC equilibrium concentrations in the pore space of the treated and untreated sediments to support chemical isolation evaluations, if determined to be needed through the ISS TS. NW Natural and EPA spent considerable effort negotiating a sediment chemical isolation evaluation approach that was ultimately approved in the *Final Pre-Remedial Basis of Design Technical Evaluations Work Plan* (TEWP; Anchor QEA 2019a). NW Natural's response to EPA General Comment 4 of the TEWP, as detailed in TEWP Appendix A-2, states, "Porewater concentrations will be used to evaluate cap compliance with ROD Table 17 groundwater cleanup levels during both remedial design capping demonstrations and long-term cap performance monitoring. ROD Table 17 riverbank soil/sediment cleanup levels will not be used for assessing cap performance during remedial design or long-term cap performance monitoring" [emphasis added]. Consistent with this previous agreement and the identified use of the Work Plan sediment leachability test results, the ROD Table 17 riverbank soil/sediment CULs are an inappropriate comparative endpoint for the untreated sediments and the Phase III and IV untreated and treated sediment leachability testing results, so analyzing for these contaminants will not support remedial design. Therefore, NW Natural has revised the Work Plan to include analysis of bulk untreated sediment analyses for all COCs containing a ROD Table 17 groundwater CUL, except for aliphatic hydrocarbons C10-C12. This analyte will not be included in Phase III and Phase IV leaching testing because Anchor QEA has not identified an analytical laboratory that is able to achieve the ROD Table 17 groundwater CUL of 2.4 micrograms per liter (µg/L). These samples will also be analyzed for permeability, grain size, bulk density, TOC, total solids, moisture content, Atterberg Limits, and porosity.

Bulk untreated soil samples: The objective of performing chemical analyses on the untreated soil samples is to provide a baseline chemical characterization for reference while interpreting the Phase III and IV untreated and treated soil leachability testing results. In turn, the objective of performing chemical analysis on the Phase III leachates is to document and rank the reduction of COC leachability for various grout dosages. The objective of the Phase IV leachate testing is to determine whether and to what extent diffusion from the riverbank ISS deep treatment barrier wall into the river via a potential chemical migration pathway under the ISS treated sediments may occur and whether this pathway may present a risk at the point of exposure in the river. The migration pathway associated with this exposure would include potential diffusion into groundwater from the river side face of the barrier wall. During the long-term remedy, groundwater extraction on the upland side of the wall will maintain a hydraulic gradient toward the upland through the wall. Advection through the wall will be minimal but will reduce the diffusive mass loss from the river side of the wall. Diffusion toward the river from the wall will only occur if concentrations on the river side of the wall are lower. However, COC concentrations on the river side of the wall will be similar. Therefore, the primary risk pathway on the river side of the wall beneath the ISS sediment zone will be advection through the full extent of untreated sediments under the in-water ISS treatment layer, with subsequent discharge along the channelward edge of the ISS footprint near the navigation channel. Groundwater advection on the river side of the wall will occur due to discharge of Deep Lower Alluvium groundwater, which occurs deeper than the extent of upland groundwater hydraulic control, and below the bottom elevation of the wall. The groundwater risk pathway on the river side of the wall will be evaluated by modeling during the remedial design. Diffusive mass flux from the wall will likely be negligible, but potential contribution will be evaluated. In any case, the appropriate comparative endpoint for this potential risk pathway is the ROD Table 17 groundwater CULs. Consistent with the untreated sediment baseline characterization, the ROD Table 17 riverbank soil/sediment CULs are an inappropriate comparative endpoint for both the untreated soils and the Phase III and IV untreated and treated soil leachability testing results, so analyzing for these contaminants will not support remedial design. Therefore, NW Natural has revised the Work Plan to include analysis of bulk untreated soil

analyses for the identical list as the bulk sediment samples, as well as sulfate and chloride in accordance with DEQ Specific Comment 5. Sulfite will not be analyzed as requested in DEQ Specific Comment 5. It is highly unlikely to be detected at any level that could affect ISS cure properties and will not provide useful data. In addition, laboratory analysis of sulfite has a very short hold time of 24 hours, which is infeasible given the time the sampling, processing, and shipping timeframes.

EPA Response (March 14, 2023)

C10-C12 aliphatic hydrocarbons should be analyzed using a lab that can achieve reasonably low detection limits close to the CUL of 2.6 µg/L. Additionally, sediment samples should also be analyzed for sulfate and chloride because of potential impacts to meeting ISS objectives and long-term permanence of the remedy.

EPA Specific Comment 14a (January 18, 2023)

Section 3.5.1 Leachability Testing Design, page 11: Chemical analysis of the leachate generated in both Phase I and Phase II leachability testing should include all contaminants with ROD Table 17 groundwater and riverbank soil/sediment CULs. EPA recognizes that some of these contaminants are not driving the design at the Gasco Project Area; however, at this stage of the ISSLPS all contaminants with ROD Table 17 groundwater and riverbank soil/sediment CULs should be analyzed for leachability testing in addition to the currently proposed analysis of PAHs, volatile organic compounds (VOCs), and arsenic.

NW Natural Response (February 16, 2023)

See response to EPA Specific Comment 11 regarding the rationale for why the ROD Table 17 riverbank soil/sediment CULs are not applicable to the Phase III and IV leachate testing. NW Natural agrees that the ROD Table 17 groundwater CULs are applicable. The objective of the Phase III leachate testing is to evaluate the reductions in leachability between the untreated and treated sediments and soils. The greatest reduction in leachability will be associated with the chemicals that are the most mobile and contain the highest concentrations. The Design Team reviewed the full list of COCs containing a ROD Table 17 groundwater CUL and determined that the following subset of COCs includes a broad range of analytes for which leachability reduction is anticipated to be critically dependent on grout dose and therefore will be used for both the untreated and treated sediment and soil Phase III leachability testing: SVOCs (including PAHs), VOCs, arsenic, and cyanide. The leachate will also be analyzed for TOC, DOC, pH, ORP and specific conductivity.

Additionally, the Phase IV leachability testing data will be used to demonstrate that the full list of COCs containing ROD Table 17 groundwater CULs are protective of any measured chemical migration from the ISS treatment layer, so this full list will be analyzed via aqueous samples collected from the water bath. In addition, the full list will be analyzed via an extraction of COCs that have sorbed to the PDMS liners. Metals and cyanide that will only be analyzed in the water bath because these chemicals are not sorbed by the liners. Aliphatic hydrocarbons C10-C12 will not be analyzed in either the water bath or liner because the analytical laboratories are unable to achieve the ROD Table 17 groundwater CUL of 2.4 µg/L (see response to EPA Specific Comment 11). In addition, the water baths will be analyzed for TOC, DOC, pH, ORP, and specific conductivity. It is important to note that high-resolution methods will be required to attempt to achieve the significantly low DDx (0.001 µg/L), DDD (0.000031 µg/L), DDE (0.000018 µg/L), and DDT (0.000022 µg/L) CULs during the Phase IV leachability testing. The laboratories will need to report down to the estimated detection limits (EDLs), which cannot be predetermined because they are calculated at the instrument at the time of analysis for each non-detected result. Any matrix

interferences encountered during the testing will increase EDLs and could lead to non-detectable concentrations above the CULs.

EPA Response (March 14, 2023)
EPA will provide a response to this comment after reviewing the TWSP addendum for proposed revision to Phase IV leachability testing.

EPA To Be Considered Comment 3 (January 18, 2023)

Sample Size: The ISSLPS Work Plan should provide more justification for the proposed number of samples to be tested in each phase of testing. For example, the ISSLPS Work Plan provides only one sampling location per soil sample type ("One sampling location and depth interval was selected from each WBZ [water bearing zone]"—i.e., the Fill WBZ, upper alluvium, and lower alluvium) and only two sampling locations for each of two in-water sediment sample depths. NW Natural should confirm that the number and type of samples will be sufficient to select the most representative grout blend design.

NW Natural Response (February 16, 2023)
Sediment and soil sample locations were selected to be representative of Project Area and upland site conditions (see response to EPA General Comment 3 and EPA TBC Comment 2). However, at the request of DEQ (DEQ General Comment 6), two additional sampling locations (collocated with existing MW-21-165 and PW-10L) were added to the top of riverbank barrier wall soil sampling scope. One composite sample representative of the full soil boring depth will be collected at each soil boring location. This is intended to represent conditions during barrier wall installation using the revised DeWind OnePass technology. This technology homogenizes the soil to the full depth of the deep ISS treatment barrier wall. Additional detail regarding this revised design concept is provided below and will be further detailed in NW Natural's future submittal to DEQ for the Revised Source Control Addendum.

The design concept for the ISS treatment barrier wall has been updated based on further preliminary design evaluations and detailed discussions with equipment vendors. As described in the *Source Control Addendum Report* (Anchor QEA 2022a), the original barrier wall design concept was to extend two rows of top of riverbank ISS columns to the depths required to form a continuous wall of overlapping columns with the directly adjacent riverbank ISS columns. The overlaps in the double row were intended to ensure that there would be no gaps left in the wall due to column deviations. This design concept is depicted in Figures 4-2 through 4-3e of the *Source Control Addendum Report*.

The maximum depth of the barrier wall will be as much as 155 feet below existing ground surface. After consultation with equipment vendors and review of this auger technology at other sites, including those constructed by members of the Design Team, NW Natural had concerns about the feasibility of this process to such depths and the difficulty of maintaining continuity between columns that might deviate from vertical. DEQ comments on the *Source Control Addendum Report* (see Comment 7a; DEQ 2022) identified similar implementability concerns associated with the previous ISS auger technology design concept to the significantly deep target depths. These concerns led to the identification of an upland field pilot test to field verify that this technology could achieve the design objectives to the target depths.

To minimize the identified risks by the Design Team and address the concerns expressed in the DEQ comment letter, the Design Team contacted DeWind OnePass Inc. to discuss their capabilities to construct a completely mixed soil-ISS barrier wall to the target depths. While other companies have similar equipment, only DeWind has developed equipment with the power and proven capacity to reach the target

depths. The basic concept is a gigantic chainsaw that cuts through the ground as it combines grout and other additives into a soil-mix blend. During the machine's progress, the vertical profile is completely homogenized and mixed into a semi-fluid state with a thickness of 3 feet. After the machine passes, the homogenized blend sets up and attains the required design parameters. Information about the equipment can be found on DeWind's website.1 Videos of the machine at work are available on YouTube, with one example at a depth of 145 feet deep.2 DeWind has been continuing to extend the power and depth range of its equipment. For this project, their current capacity of 145 feet below ground surface will achieve the target depths – the work platform can be degraded slightly to bring the design depth of 155 feet below existing grade within reach.

This technology has the obvious technical advantage that the massive treatment blade must pass through the entirety of the soil profile with no possibility of leaving "windows" of untreated soils behind. In addition, there is no open trench at any time since it is always full of mixed soil-cement. This homogenization is accounted for in the revised soil sampling method of compositing the entirety of the soil column to the bottom depth of the barrier wall at each of the proposed five upland locations, as described in Section 2.2 of the Work Plan.

The Design Team member Sevenson Environmental Services has used this technology on a series of environmental containment projects, including one at a depth of more than 100 feet:

- Glassboro South Jersey Gas Former MGP—Glassboro, New Jersey (2022): Soil-cement bentonite wall with dimensions 200 feet long by 87 feet deep by 3 feet wide
- Harrison MGP Site—Harrison, New Jersey (2021): Soil-bentonite wall with dimensions 2,200 feet long by 76 to 104 feet deep by 3 feet wide
- Former Koppers Wood Treating Facility—Carbondale, Illinois (2004): Groundwater collection trench with dimensions 931 feet long by 35 feet deep with installed 4-inch HDPE SDR-11
- Newport S. Landfill Superfund Site—Newport, Delaware (2002): Permeable reactive barrier-ZVI wall with dimensions 1,887 feet long by 25 feet deep

DeWind projects exceeding 100 feet include the following:

- Pittsburg Landfill—Antioch, California (2021): Soil-bentonite wall with dimensions 3,800 feet long by 90 to 145 feet deep by 3 feet wide
- K+S Potash—Bethune, Saskatchewan, Canada (2020): Soil-bentonite wall with dimensions 2,297 feet long by 68 to 96 feet deep by 3 feet wide with a test section to 135 feet deep
- Mosaic-New Wales Potash Facility—Mulberry, Florida (2019): Soil-bentonite wall with dimensions 5,200 feet long by 55 to 100 feet deep
- Cleveland-Cliffs, Hibbing Taconite Mine—Hibbing, Minnesota (2018): Soil-bentonite wall with dimensions 3,910 feet long by 50 to 100 feet deep

Another significant advantage of the proven track record of this technology is that it should not require a pilot scale project to prove its feasibility.

EPA Response (March 14, 2023)

The revised TSWP does not propose testing of material representative of riverbank soils. The riverbanks included within the Gasco Sediments Site vary between the Gasco property and the Siltronic property, as a result of placement of different fill materials over different time periods. While the Revised TSWP

proposes collection of upland soils that would include these fill materials, NW Natural has proposed compositing soils over the full depth of the proposed barrier wall, and not testing of discrete hydrogeologic units. The properties of riverbanks soil could differ enough from the proposed sediment samples and composited upland soil samples to warrant treatability testing to identify an appropriate grout mix design for that region. EPA recommends at least one treatability testing sample be collected from both the Gasco property riverbank and Siltronic property riverbank. Note that EPA understands DEQ plans to require NW Natural to collect and test upland fill soils separately from the composite samples.