Remedial Investigation and Feasibility Study Work Plan Addendum

26 September 2013

Glacier Northwest, Inc. – Reichhold, Inc. Site

5900 West Marginal Way SW
Seattle, Washington 98106

Table of Contents

Table of Contents (cont'd)

List of Tables

List of Figures

Section 1: Introduction

This Remedial Investigation and Feasibility Study Work Plan Addendum (Addendum) was prepared by the Washington State Department of Ecology (Ecology) to support remedial investigation / feasibility study (RI/FS) activities for the site located at 5900 West Marginal Way SW, Seattle, Washington (the "site").

The original RI/FS Work Plan for the site was prepared by Ecology in August 2012 (August 2012 Work Plan) (Ecology 2012a) after receipt of the Companies Revised RI/FS Work Plan in May 2012. The August 2012 Work Plan and this Addendum were prepared in accordance with Washington Administrative Code (WAC) 173-340-350 and Agreed Order No. DE 6000 (Agreed Order) between Glacier Northwest, Inc. (Glacier) and Reichhold, Inc. (Reichhold) (together, "The Companies") and Ecology.

This Addendum includes revisions to portions of the August 2012 Work Plan. The August 2012 Work Plan is considered by Ecology to be the primary document for RI/FS activities at the site and is to be used in conjunction with this Addendum. Approved modifications to the August 2012 Work Plan include only those specifically described in this Addendum (i.e., the August 2012 Work Plan takes precedence unless specifically modified by the Addendum).

1.1 Background

The revisions to the August 2012 Work Plan presented herein are the product of a series of meetings, correspondence, and information exchanges between Ecology and The Companies (i.e., the "Work Out" process). The Work Out process was initiated following Dispute Resolution under the Agreed Order to resolve differences between Ecology's and The Companies' proposed RI/FS Work Plans, and their perspective regarding the conceptual site model and scope of work necessary to complete the RI.

The Companies submitted a *Revised Final Remedial Investigation and Feasibility Study Work Plan* (May 2012 Work Plan) (ERM 2012a) for the site in May 2012 following a series of meetings with Ecology to discuss Ecology's concerns with their previous version of the Work Plan. The May 2012 Work Plan was not approved by Ecology (except for the sediment sampling portion) because Ecology's comments for previous drafts of the Work Plan were not fully addressed. Ecology's August 2012 Work Plan included most of the tasks in ERM's May 2012 Work Plan, but the overall scope (primarily related to sample locations and analyses) was modified to address Ecology's remaining concerns for the site.

The Companies objected to a number of issues proposed in the August 2012 Work Plan. The Companies then initiated Dispute Resolution under the Agreed Order but subsequently terminated Dispute Resolution and agreed to initiate the Work Out process in an attempt to reach agreement on the issues in dispute. The Work Out process was initiated in December 2012 as an alternative to the elevated dispute resolution process described in the Agreed Order, and is completed with issuance of this Addendum.

During the Work Out process, Ecology and The Companies discussed the scope of work remaining to complete the RI for the site including collection of data to characterize impacts to

environmental media and finalizing the site conceptual model to support the evaluation of cleanup alternatives for the site. Although The Companies objected to a number of issues proposed in the August 2012 Work Plan, a portion of the required work was performed by The Companies in fall 2012 (see Section 4.1) prior to the start of the Work Out process and during the Work Out process, and the results of the work were discussed during the Work Out process.

Based on the results of the Work Out process, The Companies submitted a *Draft Addendum to Final Remedial Investigation and Feasibility Study Work Plan* (ERM 2013) to Ecology on August 8, 2013. Ecology prepared this Addendum following a review of The Companies' Draft Addendum.

During the Work Out process, the scope of the RI was modified to focus primarily on the identification of contaminant sources, with full characterization (lateral and vertical extent) of known impacts assigned a lower priority. If the data collected during the RI under this Work Plan is insufficient to characterize the site, Ecology expects The Companies to perform additional investigation activities necessary to complete the FS.

This Addendum amends the August 2012 Work Plan. The following sections describe the revisions to the August 2012 Work Plan.

Section 2: Project Schedule and Other Requirements

The schedule for completion of RI/FS tasks and submittal of RI/FS reports, monthly progress reports, and other deliverables is the same as that established for the Agreed Order and presented in the August 2012 Work Plan, except for changes specifically outlined in this Addendum or the Final Work Plan Addendum approval letter.

Other Ecology requirements for the work performed under the August 2012 Work Plan and this Addendum include the following:

- Analytical data that is being used to identify archived soil samples for follow-up laboratory analyses (discussed in Section 4.5) shall be submitted to Ecology no later than 3 business days prior to the expiration of sample holding times. The data submittal will also include recommendations for specific archived samples to be submitted for laboratory analysis. Follow-up analyses may include any of the analytical tests being performed at the site. Because holding times differ for each analytical test, data for analyses with shorter holding times (e.g., hexavalent chromium) may need to be submitted to Ecology prior to data validation.

- Ecology (or their representative) may be present onsite for any of the field activities included in the 2012 Work Plan and this Addendum.

- The Companies must notify Ecology at least 14 days prior to performing field activities at the site. Notification is required for each unique work task. Soil borings, top-of-riverbanks borings, well installations, groundwater sampling events, groundwater elevation monitoring events, etc. are each considered to be unique tasks requiring a 14-day notification prior to performing the work.

- Top-of-Riverbank borings (discussed in Section 4.4) shall not be performed without Ecology or their representative present onsite unless Ecology or their representatives are not available and the 14-day notification was provided. An onsite meeting between Ecology (and/or their representative), The Companies, and The Companies' drilling contractor shall occur prior to the performance of any intrusive (i.e., borings or well installations) work at the site. The purpose of the onsite meeting is to confirm the locations for the planned top-of-riverbank borings, upland soil borings, and monitoring wells.

- Any changes to the sampling locations identified during the onsite meeting, regardless of the reason for the change (refusal conditions, utility clearances, etc.), must be reported to Ecology and the changes shall not be implemented without Ecology approval unless Ecology or their representatives are not available and the 14-day notification was provided.

- Per the Agreed Order and the August 2012 Work Plan, The Companies must submit preliminary analytical data, or validated data if available, to Ecology within 60 days of field sampling. The 60-day requirement pertains to each separate batch of samples submitted for laboratory analysis and shall be based on the submittal date to the

laboratory as shown on the chain-of-custody (i.e., data for each sample will be reported to Ecology within 60 days of submittal to the laboratory, not 60 days following completion of all sampling). The 60-day requirement will be modified, as described in Section 4.5.1, for analyses with short hold times (e.g., hexavalent chromium) or long standard laboratory turn-around times (e.g., dioxins/furans).

- Ecology expects The Companies to use alternate methods to clear utilities at locations where previous methods (i.e., vacuum truck) have been inadequate. Alternative methods for utility clearance are described in ERM's Standard Operating Procedure (SOP) for subsurface clearance.

- Any new or revised SOP documents must be submitted to Ecology for review and approval prior to performing field activities.

- The Companies shall submit copies of field boring logs to Ecology within 1 week of installing the boring.

- Deviations from the Work Plan and Work Plan Addendum will be summarized in the monthly progress reports submitted to Ecology by The Companies.

Section 3: Preliminary Conceptual Site Model

Additional information is needed to complete the conceptual site model (CSM). A preliminary CSM was presented in Section 3 of the August 2012 Work Plan, and the CSM was discussed during the Work Out process. The RI activities presented in this Addendum and the August 2012 Work Plan are intended to address and evaluate the identified data gaps in the CSM including contaminant sources, contaminant fate and transport, exposure pathways, and potential receptors. A complete CSM will be presented in the RI Report. Ecology expects the CSM to address the issues discussed during the Work Out process. These include, but are not necessarily limited to, the following:

- Evaluation of potential preferential exposure pathways based on historical and current site features (i.e., ditches and impoundments)
- Evaluation of the relationship between impacts to environmental media (soil and groundwater) in upland site areas and sediment in the adjacent embayment and Lower Duwamish Waterway (LDW)
- Evaluation of the relationship between the upper and lower saturated zones and embayment sediments
- Discussion of historical dredging activities in the embayment and dock areas at the site
- Development of a CSM that is fully consistent with the historical, geologic, and chemical data available for the site.

Because a complete and accurate CSM is critical for the evaluation and selection of an appropriate and effective cleanup remedy for the site, future phases of investigation may be necessary. Ecology expects cleanup alternatives to be developed following the preparation of a complete and conclusive CSM. The Companies and Ecology will evaluate the available site information and address key data gaps when they are identified (both during the RI and FS development). When adequate site characterization information has been developed, The Companies (with Ecology oversight) will evaluate a range of remedial technologies, process options, and remedial alternatives to address the site in accordance with MTCA including WAC 173-340-350 and WAC 173-340-360.

Section 4: RI Tasks

This section presents a summary of work that has been performed recently at the site by The Companies, and a description of the revisions to the August 2012 Work Plan for the remaining tasks. The following sections include:

- A summary of RI activities that have been performed by The Companies since 2009, including some tasks which were included in the August 2012 Work Plan
- A summary of shallow and deep soil borings and analyses
- A summary of top-of-riverbank sample locations and analyses
- A description of the requirements for selection and analysis of archived soil samples
- A summary of shallow-zone and deep-zone monitoring wells to be installed
- A summary of the groundwater monitoring program (chemical analyses, water elevation monitoring, and tidal studies) to be implemented during the RI and FS process
- A summary of remaining stormwater sampling activities (stormwater solids and storm water outfall sampling)
- A summary of remaining sediment sampling activities.

4.1 Summary of 2012 Work Plan RI Activities Performed

Some of the RI activities that were included in the August 2012 Work Plan have been performed, to some degree, by The Companies. The activities described below (other than the sediment sampling) were not performed under an Ecology-approved Work Plan, but some of the work performed met some of the requirements of the August 2012 Work Plan.

Data related to these activities has been provided to Ecology, but formal reports have not been submitted to Ecology for these activities (other than noted below). Ecology expects The Companies to include discussion and evaluation of these activities and data in the RI report. The activities previously performed include, but are not necessarily limited to, the following:

- Installation of 11 new monitoring wells (MW-28S, MW-29S, MW- 30S, MW-31S, MW-32S, MW-32D, MW-33S, MW-34S, MW-35S, MW-36S, and MW-14D).
- Completion of independent groundwater sampling events (wells and analytes for these monitoring events differed from the 2012 Work Plan in some cases).
- Completion of quarterly groundwater level measurements and generation of groundwater gradient/flow direction maps for shallow and deeper aquifers.

- A ground penetrating radar (GPR) survey was conducted at the site on 20 September 2012 to identify historical ditch locations. The results of the survey were documented in the *Ground Penetrating Radar Results Memorandum, Glacier Northwest, Inc. – Reichhold, Inc. Site, Seattle Washington* dated 29 November 2012 and transmitted to Ecology via email on 30 November 2012 (ERM 2012d).

- Installation of 32 shallow soil borings [GP-26 through GP-34, GP-36 through GP-39, GP-41 (surface sample), GP-44 through GP-48 (GP-47 and GP-48 are surface samples), GP-50, GP-53, GP-55 through GP-59, and GP-61 through GP-66]. Some of these borings were installed at locations similar to those specified in the August 2012 Work Plan, but sampling intervals and analyses performed varied from the August 2012 Work Plan for some locations.

- Geological logging and collection and laboratory analysis of soil samples from soil borings and well installation borings.

- Completion of four stormwater sampling events from the National Pollutant Discharge Elimination System sampling point in the stormwater ditch (STW-01). The stormwater analytical results were transmitted to Ecology as the data were validated and were included in December 2012 and June 2013 progress reports.

- Collection of five stormwater solids samples (CB-01, SWD-01, SWD- 02, TANK-01, and duplicate from TANK-01) from the stormwater conveyance system. The stormwater solids analytical results were transmitted to Ecology in the December 2012 progress report on 15 January 2013.

- A total of 20 surface and 89 subsurface sediment samples were collected during the May/June 2012 sediment sampling event under the Ecology Review and Approval of the Sediment Sampling at 5900 West Marginal Way SW-REVISED letter dated 21 May 2012 (Ecology 2012c) and the RI/FS Sediment Sampling Work Plan and Sampling and Analysis Plan dated May 2012 (ERM 2012b, c). Of this total, 20 surface and 45 subsurface sediment samples were initially submitted for laboratory analysis.

- The Companies submitted 17 additional subsurface sediment samples on May 8, 2013 for laboratory analysis to more fully characterize the vertical and lateral extent of the constituents of potential concern in subsurface sediment (no additional surface sediment samples were analyzed). A summary of the sediment analytical results and the archive sediment analysis plan are presented in the Sediment Results Summary Memorandum dated June 12, 2013 transmitted to Ecology via email on June 12, 2013. Data for the archived sample analyses have not yet been provided to Ecology and are expected to be transmitted this fall based on The Companies' progress reports. These data are to be discussed in the RI Report.

4.2 Remaining RI Activities

The following subsections describe the remaining RI activities for each media of concern. The remaining RI activities are also summarized in the attached tables and figures as follows:

- Table 1 provides a summary of shallow soil borings, deep soil borings, top-of-riverbank borings, and stormwater solids samples including depth intervals and laboratory analyses. Table 1 replaces Tables 1 and 2 in the August 2012 Work Plan.

- Table 2 provides a summary of shallow and deep monitoring wells to be included in the sampling program, including analytical testing, and construction details for new wells. Table 2 replaces Table 3 in the August 2012 Work Plan.

- Tables 3 and 4 provide updated Quality Assurance/Quality Control (QA/QC) requirements (Table 3) and sample container, preservative, and holding time parameters (Table 4). Table 3 replaces Table 4 in the August 2012 Work Plan, and Table 4 replaces Table 5.

- Figure 1 provides an overview of historical sampling locations (test pits, borings, and wells), historical site features, and the remaining RI sample boring and well locations. Figure 1 replaces Figures 2 and 4 in the August 2012 Work Plan.

- Figure 2 depicts the locations of the new soil borings and monitoring wells on an aerial photo background. Figure 2 replaces Figure 7 in the August 2012 Work Plan.

- Figure 3 shows the locations of existing and new monitoring wells and indicates which wells are to be included in the semi-annual monitoring events and quarterly water level elevation monitoring.

4.3 Upland Soil Borings

Soil borings will be advanced at 26 upland locations, eight of which will be completed as groundwater monitoring wells, as shown on Figures 1 and 2. Soil samples will be collected from the lithologic units and depths described in Section 4.3.3 below and listed in Table 1.

4.3.1 Shallow Soil Borings and Wells

Fifteen shallow borings will be advanced in upland areas (refer to Figures 1 and 2). Shallow borings will be terminated in the upper portion of the aquitard to investigate soil in the shallow fill, dredge fill, and aquitard material in the areas of the former aboveground tank farm, former Whetlerite building, former Mineralized Cell operational area, former drainage ditches, and former drain field and impoundment area.

Two of the shallow borings will be completed as shallow-zone monitoring wells MW-43S and MW-45S. Well construction details are provided in Table 2.

4.3.2 Deep Soil Borings and Wells

Eleven soil borings will be advanced to a depth of up to 25 feet below ground surface (bgs) to investigate soil in the aquitard and deep aquifer in the former Mineralized Cell operational area, along the southern property boundary, and in the area of former drainage ditches. Deep soil boring locations are shown on Figures 1 and 2.

Six of these borings (MW-20D, MW-31D, MW-35D, MW-38D, MW-43D, and MW-45D) will be completed as deep-zone groundwater monitoring wells. Well construction details are provided in Table 2.

4.3.3 Soil Sampling Intervals

Soil samples will be collected from each interval described below at each soil boring location for laboratory analyses and/or archival. Soil samples for initial laboratory analysis are listed in Table 1. Possible analysis of archived soil samples is discussed in Section 4.5.

Soil sampling intervals are as follows:

Shallow Borings

- Shallow Fill: A soil sample will be collected from the upper portion of the shallow soil horizon (i.e., shallow fill layer), typically 1 to 3 feet bgs. Where recent gravel fill is present (southern portion of the property), the sample is to be collected below the recent gravel fill.

- Dredge Fill: A soil sample will be collected from the uppermost 2 feet of the dredge fill layer, typically 3 to 5 feet bgs but will vary with location. The target interval for this sample is the uppermost 2 to 3 feet of the historical (1930s to 1960s) ground surface (prior to placement of fill in the late 1960s through present day).

- Top of Aquitard: A sample will be collected from the contact between the dredged fill and the aquitard and will include approximately 6 inches from each lithologic unit in the sample (i.e., the sample interval will be centered on the contact between the dredge fill and silt aquitard). If the silt layer is not encountered, the sample will be collected from the expected silt layer depth based on previous nearby borings (anticipated to be 9 to 12 feet bgs at most locations). In addition, if the silt layer is not encountered, an additional soil sample will be collected from the bottom of the boring (approximately 13 to 15 feet bgs) for archival.

Deep Borings

Deep boring soil sampling intervals include the three shallow sampling intervals described above, as well as deeper soil sampling intervals to characterize soil within the aquitard and deeper aquifer soil as follows:

- Middle of Aquitard: A soil sample will be collected from the approximate middle of the silt aquitard. If the aquitard is not encountered in a deep boring, the sample is to be

collected at a depth approximately 3 feet below the top-of-silt depth in other nearby borings (or 15 feet bgs if nearby boring logs are inconclusive).

- Deeper Aquifer Soil: A soil sample will be collected from the uppermost 2 to 3 feet of the lower sand unit beneath the silt aquitard. If the aquitard is not encountered, the sample is to be collected at a depth approximately 8 feet below the top-of-silt depth in other nearby borings (or 20 feet bgs if nearby boring logs are inconclusive).

In addition to the soil sample intervals described above, soil samples shall be collected if field observations (staining, odor, field screening parameters, etc.) indicate a potential for contaminant impacts at depth intervals which differ from those described above. The Companies shall notify Ecology within 24 hours of collecting soil samples based on field observations. These samples, if any, may be submitted for initial analysis and/or archived with Ecology approval on a case-by-case basis [initial analyses and possible archive sample analyses (see Section 4.5) may differ for each sample]. The Companies will propose analytes for initial analysis within one week of sample collection for review and approval by Ecology.

4.3.4 Soil Sample Analytes

Soil samples will be analyzed initially for the analytes presented in Table 1 and as summarized below. Additional analyses may be performed for archived samples (see Section 4.5). The QA/QC samples to be collected as well as the sampling containers, preservations and holding times are summarized in Table 3 and 4, respectively. In addition, the August 2012 Work Plan presents the laboratory detection limits and practical quantitation limits for the project.

Initial soil sample analyses for each sample (refer to Table 1) may include the following:

- Metals including arsenic, chromium, copper and zinc (49 samples) at the locations listed in Table 1.

- Semivolatile organic compounds (SVOCs) including phenols and hexachlorobenzene (25 samples) or full EPA 8270 analysis (17 samples), depending on location (refer to Table 1).

- Dioxins/furans (10 samples) at the locations listed in Table 1.

- Hexavalent chromium (23 samples) at the locations listed in Table 1.

Although analysis of volatile organic compounds (VOCs) in soil is not being requested by Ecology in this Addendum, Ecology expects soil samples to be collected for possible VOC analysis if field observations indicate the presence of volatile contaminants at any boring location and depth interval.

4.4 Riverbank Soil Sampling

Riverbank soil samples will be collected from seven locations shown on Figures 1 and 2. The samples will be analyzed or archived for the analytes presented in Table 1. Details of the sampling and analyses are presented below:

- Riverbank soil sampling will be performed at seven locations to characterize riverbank soil.

- Six top-of-riverbank soil borings (TB-01 through TB-06) will be completed in the same manner as the soil borings previously described, and soil samples will be collected at the same intervals as the upland soil sampling intervals (refer to Section 4.3.3), including shallow fill, dredge fill, and top-of-aquitard or the equivalent depth interval as described in Section 4.3.3.

- One riverbank soil sample (TB-07) on the embankment near the northern boundary of the Port of Seattle Terminal 115 property (see Figures 1 and 2) will be collected to evaluate the nature of fill placed during construction of Terminal 115 and subsequent deposition. The soil sample will be collected from the top 1 foot of soil; deeper intervals (as described in Section 4.3.3) will be collected as conditions allow (depending on bank armoring material and drill rig accessibility). If any deeper samples are collected at TB-07, The Companies will notify Ecology within 24 hours and The Companies and Ecology will discuss potential analyses to be performed.

4.5 Criteria for Analysis of Archived Soil Samples

Select archived soil samples will be analyzed if necessary to meet the objectives of the RI or to meaningfully understand the nature and extent of contamination at the site. Consideration of archived samples for analysis will be based on the initial results for soil samples collected from upland and top-of-riverbank soil borings following the criteria described in Section 4.5.2.

After the soil sample volume required for the initial analyses has been collected at each sampling location and interval, the remaining soil from the sample interval, if any, will be collected in one 8-ounce glass jar for laboratory archive. An 8-ounce sample for possible archive analysis will also be collected at sample intervals where no initial analyses are being performed. The remaining soil volume from initial sample analyses (i.e. that which is not used by the laboratory) will also be archived (frozen) by the analytical laboratory in addition to the 8-ounce jar described above.

4.5.1 Data Submittal and Archive Sample Analysis Plan

Upon receipt of the analytical data from the laboratories, the data will be validated for quality assurance and usability prior to making decisions on analyses of archived samples (except hexavalent chromium as described below). The validated data will be provided to Ecology as it becomes available, but not later than 60 days following submittal of the sample to the analytical laboratory as described in Section 2 (with the exception of dioxins/furans as described below).

Within 30 days after providing Ecology with the validated data, The Companies will present to Ecology in a memorandum or similar transmittal the recommendation for analyses of archived

samples. Within 45 days, Ecology and the Companies will discuss The Companies' recommendations and reach agreement on the selection of archived analyses.

Holding times for samples provided by The Companies are listed in Table 4. For analyses with short hold times (i.e., hold times that are less than the sum of the total allocated time listed above; approximately 3 months), or extended standard laboratory turn-around times (i.e., greater than 3 weeks), the schedule for data submittal and archive analysis recommendations to Ecology will be modified as follows:

- Ecology understands that the standard hold time for some analyses [e.g., SVOCs and polychlorinated biphenyls (PCBs)] of 30 days or less may be extended by freezing the samples. Freezing samples for this purpose is acceptable to Ecology.

- For analyses with short hold times (i.e., hexavalent chromium), data will be submitted to Ecology within 1 day of receipt from the analytical laboratory with preliminary recommendations for archive sample analyses. Ecology understands that data for analyses with shorter holding times will likely not be validated prior to submittal to Ecology and thus, will be considered draft; however, the data is considered suitable for purposes of selecting archived samples for analyses.

- Total chromium data may be used to estimate hexavalent chromium concentrations, with Ecology approval, if the holding time has expired for archived samples identified for follow-up analysis (i.e., if analysis of an archived sample from a nearby boring is recommended and its hold time has expired).

  To utilize this alternative approach, an evaluation of the ratio between total and hexavalent chromium at the site using recent and historical data will be performed by The Companies, including evaluation of potential variation in the ratio(s) at different areas of the site. Results of the evaluation will be submitted to Ecology and, if the results are acceptable to Ecology, archive samples may be analyzed for total chromium and the corresponding hexavalent chromium concentrations estimated using the established ratio(s) for the site.

- For analyses with extended standard laboratory turn-around times (e.g., dioxins/furans), validated data shall be submitted to Ecology not later than 45 days following receipt of laboratory data. The Companies expect a standard turn-around time of approximately 60 days for dioxins/furans.

4.5.2 Archive Sample Analysis Criteria

The following factors will be considered when determining whether an archived sample should be analyzed for a given constituent:

- Evaluation of concentrations of constituents in vertically adjacent soil samples in the same boring (above and below) in addition to those of horizontally adjacent soil borings. Concentrations will be evaluated relative to Ecology's current draft screening levels for LDW sites, or other MTCA cleanup levels or ARARs, if a draft LDW cleanup level is not available for the constituent.

- Trends of constituents present in the same lithological units (e.g., dredge fill) across the site (i.e., the overall distribution of the constituent at the site).

- Ability to delineate the concentration of the archived sample based on concentrations of existing data in the vicinity of the archived sample (horizontally and vertically).

- Whether the data will provide a meaningful understanding of site conditions or the nature and extent of constituents.

4.6 Groundwater Sampling

This section provides a summary of groundwater monitoring activities including:

- Installation of new shallow-zone and deep-zone groundwater monitoring wells

- Semi-annual sampling and laboratory analysis of groundwater for select monitoring wells

- Quarterly groundwater elevation monitoring

- Tidal study.

4.6.1 Planned Monitoring Well Installations

Eight new monitoring wells will be installed at the locations shown on Figures 1, 2, and 3.

- Six deep monitoring wells (MW-20D, MW-31D, MW-35D, MW-38D, MW-43D, and MW-45D) will be installed at the site. The deep wells are to be screened in the upper portion of the lower sand unit beneath the aquitard.

- Two shallow monitoring wells will be installed (MW-43S and MW-45S) adjacent to the corresponding deep wells. The shallow wells screen intervals shall span the saturated thickness of the upper saturated zone and account for annual variations in water elevation. To ensure that the bottom of the screen interval is at or below the bottom of the upper saturated zone, the bottom of the well casing will be installed at least 6 inches below the top of the silt layer for each well. The top of the well screen for each well will extend above the anticipated seasonal high groundwater elevation.

- The new monitoring well construction details are presented in Table 2 (note: construction details are subject to change, with Ecology approval, based on observed field conditions such as depth and thickness of aquitard).

4.6.2 Semiannual Groundwater Monitoring

Semi-annual groundwater sampling will be performed for new monitoring wells and for 24 existing monitoring wells (32 wells total including 21 shallow-zone and 11 deep-zone wells) as summarized in Table 2 and shown on Figure 3. Analyses performed for each well will be the same for each semi-annual event except as noted in Section 4.6.3.

Semi-annual groundwater monitoring will be conducted for 2 years (1 year during the RI and 1 year during the development of the RI Report and FS) in order to evaluate groundwater concentration trends during seasonal periods of high and low water table. Monitoring will be performed in September-October and March-April of each year. The first monitoring event will be September-October 2013.

Although Ecology agreed to semi-annual monitoring for this RI Work Plan in an effort to accelerate the overall schedule, both Ecology and The Companies acknowledge compliance monitoring following the remedial action will include quarterly sampling in accordance with WAC 173-340-410.

4.6.3 Groundwater Sample Analytes

Groundwater samples will be analyzed for the analytes presented in Table 2. The QA/QC samples to be collected as well as sampling containers, preservations and holding times are summarized in Table 3 and 4, respectively. In addition, laboratory detection limits and practical quantitation limits for the project are presented in the August 2012 Work Plan.

- Dioxins/furans will be analyzed in groundwater in 11 monitoring wells, summarized as follows:

    - Seven shallow wells (MW-2S, -17S, -26S, -33S, -35S. -43S, and -45S) and four deep wells (MW-2D, -3D, -35D, and -45D) (11 wells total) will be sampled for dioxins/ furans to develop understanding of the relationship between the shallow and deep aquifers. Dioxins/furans have low solubility, are relatively hydrophobic, and can be sensitive to bias from suspended solids in water samples. Dioxins/ furans groundwater samples will be collected utilizing no purge sampling methodology ("no purge method") to reduce a potential for sampling-induced turbidity. Because the existing site groundwater data set for dioxins/furans is limited, a comparison of the no-purge and post-purge methodologies based on site-specific data shall be performed. Samples for dioxin/furan analysis will be collected using both no-purge and post-purge methodologies for the first semi-annual sampling event at three wells (MW-2S, MW-2D, and MW-17S). Field measurement of turbidity shall be performed both before and after purging.

    - Methodology for collection of groundwater samples for dioxin/furan analysis for subsequent monitoring events may be modified based on the results of the comparison of the no-purge and post-purge methodologies, with Ecology approval.

    - Based on the dioxins/furans results for the first monitoring event, the wells included for sampling for dioxins/furans in subsequent monitoring events may be modified (increased or decreased) with approval from Ecology.

- PCBs will be monitored in groundwater during the first semi-annual monitoring event in MW-29S to evaluate potential PCB concentrations in groundwater relative to screening levels.

- If PCB concentrations in MW-29S are above the draft LDW screening level (or other MTCA cleanup levels or ARARs) for the first sampling event, MW-29S (and possibly additional wells) may be sampled for PCBs in subsequent events.

- PCBs may be added to the list of analytes at some wells based on the results of the top-of-riverbank soil sampling. If PCBs are identified in top-of-riverbank soil samples at concentrations above the draft LDW screening level (or other MTCA cleanup levels or ARARs), monitoring wells in proximity of the top-of-riverbank sample(s) may be analyzed for PCBs in groundwater.

- PCBs have low solubility, are highly hydrophobic, and are consequently extremely sensitive to bias from even very low levels of artificially-suspended solids in sample water. Thus, PCB groundwater samples will be collected utilizing no purge sampling methodology. Because PCB analysis of groundwater samples has not been previously performed at the site, a comparison of the no-purge and post-purge methodologies based on site-specific data shall be performed. Samples for PCB analysis will be collected using both no-purge and post-purge methodologies for the first semi-annual sampling event. Field measurement of turbidity shall be performed both before and after purging.

- Methodology for collection of groundwater samples for PCB analysis for subsequent monitoring events may be modified based on the results of the first event, with Ecology approval.

- SVOCs including phenols and hexachlorobenzene (18 wells) or full EPA 8270 analysis (eight wells) will be monitored in groundwater for all semi-annual events.

- Volatile organic compounds (VOCs) will be monitored in groundwater during the first semi-annual monitoring event in two wells (MW-17S and MW-34S) for the full EPA 8260 analyte list. Monitoring for VOCs for subsequent monitoring events may be considered based on the results of the first semi-annual event, with approval from Ecology.

- Total and dissolved metals including arsenic, chromium, copper, and zinc will be monitored in groundwater in 26 monitoring wells identified in Table 2 for all semi-annual events.

- Hexavalent chromium analyses will be performed in groundwater in 16 monitoring wells identified on Table 2 using the analytical method listed in Table 4.

- General chemistry and water quality parameters have been included for 20 monitoring wells for all monitoring events, as presented in Table 2.

4.6.4 Quarterly Groundwater Gradient Monitoring

Groundwater level measurements from all existing and new wells, including a measurement from the Glacier dock, will be collected using a water level indicator. Elevation monitoring is to include all functional wells at the site, not only those included in the semi-annual sampling events. Time of measurement will be recorded for each well for each water level measurement.

Water level measurements will be made during both high and low tide conditions for each quarterly event (i.e., two measurements, high and low tide, for each event). High and low tide water level measurements for each quarterly event will be made within the same tidal cycle, but not necessarily at the high-high and low-low of the cycle. Tidal stage data will be collected at the beginning and end of each measurement event (for both tidal extremes). The tidal data will be collected by measuring the depth to water in the Embayment from a control point on the existing Glacier dock.

For quarterly elevation monitoring events being performed during the same quarter as groundwater sampling (September-October and March-April of each year), the elevation measurements are to be taken within 1 week of the sampling event.

The water level data, including measurement times, will be tabulated and groundwater elevations will be calculated. Groundwater elevation contour maps will be prepared for each event for both saturated zones, and submitted to Ecology in the monthly progress reports.

4.6.5 Tidal Study

The Companies performed a tidal study at the site between July 19, 2013 and July 29, 2013 to supplement understanding of the relationship between the LDW and the deeper aquifer at the site.

An additional tidal study will be performed following installation of the new groundwater monitoring wells at the site. The tidal study shall include each shallow/deep well pair and concurrent monitoring of tidal conditions in the LDW adjacent to the site. The tidal monitoring study shall be performed using pressure transducers equipped with data loggers. The Companies will include a recommendation for the duration of the additional tidal study as part of their July 2013 tidal study results submittal to Ecology.

Data from both tidal studies will be used to:

- Calculate a vertical hydraulic gradient between the shallow and deep aquifers
- Evaluate tidal response across the aquitard in the existing shallow and deep well pairs in order to identify possible breaches in the aquitard
- Determine tidal-lag time observed in site monitoring wells for timing of groundwater sampling
- Update the CSM.

4.7 Stormwater Evaluation

The remaining RI stormwater evaluation activities to be completed include the collection of a stormwater solids sample from the 15-inch historical stormwater pipe and abandonment of the historical pipe.

4.7.1 Historical Stormwater Pipe Abandonment

During 2009, a field effort was completed to verify the drawing for the site, which shows a 15-inch-diameter concrete stormwater pipe with five catch basins in the southern portion of the site. The stormwater pipe tie-in was verified using an in-pipe camera survey and field trenching completed in 2009 (ERM 2009b). At that same time, a number of shallow excavations were completed in an effort to field-locate the five catch basins shown on historical site drawings, but none were located.

As recommended in the *Historical Stormwater Pipe Investigation Technical Memorandum* (ERM 2009b) submitted to Ecology, the historical stormwater pipe will be abandoned in-place in accordance with applicable City of Seattle codes. For planning purposes, it is expected the stormwater pipe will be exposed up-flow of the location where it ties into the 48-inch Seattle Public Utilities stormwater pipe near the southern entrance of the property.

A video camera survey will be completed on the network of pipes proposed for abandonment, including mapping of the pipe locations on the ground surface. Following completion of the video survey and mapping, the 15-inch pipe will be cut and the end capped at the connection. After capping, both exposed ends will be filled with concrete to eliminate the connection to the site.

Any appropriate permits identified by the City of Seattle will be obtained before completing the abandonment.

4.7.2 Stormwater Solids Sampling

During the historical stormwater pipe abandonment, one solids sample will be collected from within the 15-inch stormwater pipe (SWP-01) and will be analyzed for the analytes presented in Table 2.

For the current stormwater system, no additional stormwater solids sampling will be performed, as solids samples have already been collected from each stormwater conveyance path to the waterway.

4.7.3 Stormwater Sampling

Four stormwater sampling events have been completed to date over three seasons (i.e., fall and winter 2012 and spring 2013) from the current stormwater system.

Ecology is not requiring additional stormwater sampling at this time, but sampling of stormwater outfalls and seeps may be required in the future.

4.8 Sediment Sampling

No additional sediment sampling in the embayment is proposed as part of this Addendum. Based on the results of the 2012 sediment sampling and analysis, including archive sample data which has not yet been submitted to Ecology, additional sediment sampling may be required by Ecology in the future.

References

Ecology, 2010. Data Gaps Review by Ecology for Glacier Northwest, Inc./Reichhold, Inc. June 2010.

Ecology. 2012a. Final Remedial Investigation and Feasibility Study Work Plan. 31 August 2012.

Ecology. 2012b. Ecology Review and Approval of "Sediment Sampling at 5900 West Marginal Way SW- REVISED", outlined in the May 16, 2012 letter with attached Figure 1 and Table 1, and portions of Appendix B (REVISED FINAL, Remedial Investigation Sampling and Analysis Plan), for the Glacier Northwest, Inc./Reichhold, Inc. Site – Agreed Order DE6000. May 2012.

Environmental Resources Management (ERM). 2009a. Draft Summary of Existing Information and Data Gaps Report. October 2009.

ERM. 2009b. Historical Stormwater Pipe Investigation Technical Memorandum, Glacier Northwest, Inc.-Reichhold, Inc. Site, Seattle, Washington. November 2009.

ERM. 2012a. Revised Final Remedial Investigation and Feasibility Study Work Plan, Glacier Northwest, Inc. – Reichhold, Inc. Site, Seattle, Washington. May 2012.

ERM. 2012b. Sediment Sampling at 5900 West Marginal Way SW – REVISED. May 2012.

ERM. 2012c. Revised Final Remedial Investigation and Feasibility Study Work Plan Appendix B: Sampling and Analysis Plan. May 2012.

ERM. 2012d. Ground Penetrating Radar Results Memorandum, Glacier Northwest, Inc. – Reichhold, Inc. Site, Seattle, Washington. 29 November 2012.

ERM. 2013. Draft Addendum to Final Remedial Investigation and Feasibility Study Work Plan. August 2013.

Tables

Table 1: Summary of Chemical Analyses for Soil Samples (Initial Analyses Only) [a]

Boring / Well Number	Depth for Soil Investigation (see Table 2 for well screen intervals)	Units to be Sampled [b,c]	Phenols and Hexachloro-benzene	8270 Full Suite	Metals (As, Cr, Cu, Zn)	Hexavalent Chromium	Dioxins and Furans	PCBs	Total Organic Carbon and Grain Size
Shallow Soil Borings									
GP-35	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill		X			X		
		Top of Silt		X	X				
GP-40	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill		X			X		
		Top of Silt		X	X				
GP-43	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill	X				X		
		Top of Silt	X		X				
GP-49	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill		X	X		X		
		Top of Silt			X				
GP-52	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill	X		X				
		Top of Silt	X		X				
GP-54	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill	X		X				
		Top of Silt			X				
GP-60	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill		X	X	X			
		Top of Silt			X	X			
GP-67	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill	X				X		
		Top of Silt	X		X				
GP-68	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill		X	X	X			
		Top of Silt			X	X			
GP-70	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill		X	X	X	X		
		Top of Silt		X	X	X			
GP-72	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill	X		X				
		Top of Silt	X		X				

Table 1: Summary of Chemical Analyses for Soil Samples (Initial Analyses Only) [a]

Boring / Well Number	Depth for Soil Investigation (see Table 2 for well screen intervals)	Units to be Sampled [b,c]	Phenols and Hexachloro-benzene	8270 Full Suite	Metals (As, Cr, Cu, Zn)	Hexavalent Chromium	Dioxins and Furans	PCBs	Total Organic Carbon and Grain Size
Shallow Soil Borings, continued									
GP-73	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill	X				X		
		Top of Silt	X		X				
GP-75	6 inches into top of silt or to 20' if silt not present	Shallow Fill							
		Dredge Fill	X		X	X			
		Top of Silt			X	X			
Deep Soil Borings									
GP-42	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill	X						
		Top of Silt	X		X				
		Middle Silt							
		Lower Sand			X				
GP-51	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill	X						
		Top of Silt	X		X				
		Middle Silt							
		Lower Sand			X				
GP-69	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill	X		X	X			
		Top of Silt	X		X	X			
		Middle Silt							
		Lower Sand			X	X			
GP-71	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill		X			X		
		Top of Silt		X	X	X			
		Middle Silt							
		Lower Sand			X	X			
GP-74	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill		X	X		X		
		Top of Silt		X	X	X			
		Middle Silt							
		Lower Sand				X			

Table 1: Summary of Chemical Analyses for Soil Samples (Initial Analyses Only) [a]

Boring / Well Number	Depth for Soil Investigation (see Table 2 for well screen intervals)	Units to be Sampled [b,c]	Phenols and Hexachloro-benzene	8270 Full Suite	Metals (As, Cr, Cu, Zn)	Hexavalent Chromium	Dioxins and Furans	PCBs	Total Organic Carbon and Grain Size
Top-of-Riverbank Soil Boring Locations and Stormwater Solids									
TB-01	6 inches into top of silt or to 20' if silt not present	Shallow Fill	X		X				X
		Dredge Fill	X		X		X	X	X
		Top of Silt	X		X		X	X	X
TB-02	6 inches into top of silt or to 20' if silt not present	Shallow Fill	X		X				X
		Dredge Fill	X		X		X	X	X
		Top of Silt	X		X		X	X	X
TB-03	6 inches into top of silt or to 20' if silt not present	Shallow Fill	X		X				X
		Dredge Fill	X		X		X	X	X
		Top of Silt	X		X		X	X	X
TB-04	6 inches into top of silt or to 20' if silt not present	Shallow Fill	X		X				X
		Dredge Fill	X		X		X	X	X
		Top of Silt	X		X		X	X	X
TB-05	6 inches into top of silt or to 20' if silt not present	Shallow Fill	X		X				X
		Dredge Fill	X		X		X	X	X
		Top of Silt	X		X		X	X	X
TB-06	6 inches into top of silt or to 20' if silt not present	Shallow Fill	X		X				X
		Dredge Fill	X		X	X	X	X	X
		Top of Silt	X		X	X	X	X	X
TB-07[d]	Upper 1'	Shallow Soil	X		X		X	X	X
SWP-01	Solids in Pipe	Storm Water Solids	X		X		X	X	X
Monitoring Well Boring Locations (see Table 2 for screen intervals and groundwater sampling)									
MW-20D	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill	X		X				
		Top of Silt			X				
		Middle Silt							
		Lower Sand			X				
MW-31D	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill	X		X				
		Top of Silt	X		X	X			X
		Middle Silt							
		Lower Sand			X	X			X

Table 1: Summary of Chemical Analyses for Soil Samples (Initial Analyses Only) [a]

Boring / Well Number	Depth for Soil Investigation (see Table 2 for well screen intervals)	Units to be Sampled [b,c]	Phenols and Hexachloro-benzene	8270 Full Suite	Metals (As, Cr, Cu, Zn)	Hexavalent Chromium	Dioxins and Furans	PCBs	Total Organic Carbon and Grain Size
Monitoring Well Boring Locations, continued (see Table 2 for screen intervals and groundwater sampling)									
MW-35D	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill	X		X				
		Top of Silt	X		X	X			X
		Middle Silt							
		Lower Sand			X	X			X
MW-38D	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill		X	X	X	X		X
		Top of Silt		X	X	X			X
		Middle Silt							
		Lower Sand							
MW-43D (no soil samples for MW-43S) [e]	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill		X	X				
		Top of Silt		X	X				
		Middle Silt							
		Lower Sand			X				
MW-45D (no soil samples for MW-45S) [e]	2' into lower sand (below silt layer) or to 25' if silt not present	Shallow Fill							
		Dredge Fill	X		X				
		Top of Silt	X		X	X			X
		Middle Silt							
		Lower Sand			X	X			X

Notes:

(a) This table shows initial analyses only. Soil samples for possible follow-up analyses (archived) are to be collected at all locations from all specified units. Archived samples are to be frozen by the analytical laboratory(ies). After the soil sample volume required for the initial analyses has been collected, the remaining soil from the sample interval, if any, will be collected in one 8-ounce glass jar for laboratory archive. The remaining sample volumes from initial analyses are also to be archived. The procedure for identifying archived samples for possible analysis is presented in Section 4.5 of the main text.

(b) Soil samples are to be collected for initial analysis or for archival at all locations and intervals listed above for each boring (intervals are described below and in text Section 4.3.3):

- Shallow Fill: Above the Dredge Fill unit, typically 1-3 feet below ground surface (bgs) but may vary by location. Where recent gravel fill is present, the sample shall be collected below the recent gravel.
- Dredge Fill: Samples are to be collected from the upper portion of the Dredge Fill unit. The top of the sample interval is expected to be 3-5 feet bgs depending on location. The objective for the Dredge Fill samples is to characterize soils that were within 2-3 feet of the historical ground surface (1930s to mid-1960s ground surface).
- Top of Silt: Samples to be collected from the contact between the Dredge Fill and Silt. The sample interval is to be centered on the contact and will include portions of both the Silt and Dredge Fill units. If the silt layer is not encountered in a shallow boring, the Top of Silt sample is to be collected at the expected silt layer depth based on nearby previous borings (typically 9-12 feet bgs) or 10-11 feet bgs if data for nearby borings in inconclusive. If the silt layer is not encountered, an additional sample (for archive) is to be collected from the bottom of the boring.
- Middle Silt: Sample is to be collected from the middle of the silt layer. If the silt layer is not encountered in a deep boring, the Middle Silt sample is to be collected at the expected depth based on nearby borings (approximately 3 feet below expected top-of-silt) or from approximately 15 feet bgs if data for nearby borings is inconclusive.
- Lower Sand: Sample is to be collected from the uppermost 2-3 feet of the lower sand unit beneath the silt layer. If the silt layer is not encountered in a deep boring, the Lower Sand sample is to be collected from the expected depth based on nearby borings (approximately 8 feet below the expected top-of-silt) or from approximately 20 feet bgs if data for nearby borings is inconclusive.

(c) Soil sample intervals for all units are to be no greater than 2 feet.

(d) Samples shall be collected from deeper intervals (dredge fill and top of silt as described in Section 4.3.3) as conditions allow (refer to Section 4.4) .

(e) Soil sampling at new paired well locations is to be performed for the deep well boring only.

Table 2: Summary of Chemical Analyses for Groundwater Samples [a,b]

Well Number [c]	Well Type	Screen Intervals (feet bgs) and Constuction Details (for new wells)	Phenols and Hexachloro-benzene	8270 Full Suite	Metals (As, Cr, Cu, Zn) (Total & Dissolved)	Hexavalent Chromium	Dioxins and Furans[d]	VOCs[d]	PCBs[d]	pH and Salinity
MW-1S	shallow	4.4 to 9.4	X		X	X				X[f]
MW-1D	deep	17.55 to 22.55	X		X	X				X[f]
MW-2S	shallow	5.05 to 10.05	X		X		X[e]			X[f]
MW-2D	deep	17.8 to 22.8		X	X		X[e]			X[f]
MW-3S	deep	5.9 to 10.9	X		X	X				X[f]
MW-3D	deep	20.2 to 25.2	X		X	X	X			X[f]
MW-4S	shallow	5 to 10		X	X	X				X
MW-5S	shallow	5 to 10	X		X	X				X
MW-12S	shallow	4.5 to 11.5		X		X				X
MW-13S	shallow	4.5 to 11.5	X							X
MW-14S	shallow	4 to 11	X		X	X				X[f]
MW-14D	deep	19 to 24			X					X[f]
MW-17S	shallow	4.5 to 11.5	X		X		X[e]	X		X
MW-18S	shallow	3 to 13	X							X
MW-19S	shallow	3 to 13	X		X					X
MW-20S	shallow	3 to 13			X					X[f]
MW-20D	**NEW deep**	5' screen interval; Top of screen to be 1-2' below the contact between the silt and lower sand. (20-25' if silt not present)			X					X[f]
MW-21S	shallow	3 to 13			X					X
MW-26S	shallow	5 to 15	X		X	X	X			X
MW-29S	shallow	3 to 9							X[e]	X
MW-30S	shallow	3 to 7				X				X
MW-31S	shallow	3 to 9		X	X	X				X[f]
MW-31D	**NEW deep**	5' screen interval; Top of screen to be 1-2' below the contact between the silt and lower sand. (20-25' if silt not present)		X	X	X				X[f]
MW-33S	shallow	4 to 11	X		X		X			X[f]
MW-34S	shallow	3.5 to 10.5	X			X		X		X
MW-35S	shallow	3 to 10	X		X	X	X			X[f]

Table 2: Summary of Chemical Analyses for Groundwater Samples [a,b]

Well Number [c]	Well Type	Screen Intervals (feet bgs) and Constuction Details (for new wells)	Phenols and Hexachloro-benzene	8270 Full Suite	Metals (As, Cr, Cu, Zn) (Total & Dissolved)	Hexavalent Chromium	Dioxins and Furans[d]	VOCs[d]	PCBs[d]	pH and Salinity
MW-35D	NEW deep	5' screen interval; Top of screen to be 1-2' below the contact between the silt and lower sand. (20-25' if silt not present)	X		X	X	X			X[f]
MW-38D	NEW deep	5' screen interval; Top of screen to be 1-2' below the contact between the silt and lower sand. (20-25' if silt not present)		X	X	X				X[f]
MW-43S	NEW shallow	Screen interval to span highest seasonal water table elevation. Bottom of well to be set 6" into top of silt layer (5-15' if silt not present)		X	X		X			X[f]
MW-43D	NEW deep	5' screen interval; Top of screen to be 1-2' below the contact between the silt and lower sand. (20-25' if silt not present)		X	X					X[f]
MW-45S	NEW shallow	Screen interval to span highest seasonal water table elevation. Bottom of well to be set 6" into top of silt layer (5-15' if silt not present)	X		X		X			X[f]
MW-45D	NEW deep	5' screen interval; Top of screen to be 1-2' below the contact between the silt and lower sand. (20-25' if silt not present)	X		X		X			X[f]

Notes:

(a) This table shows chemical analyses for contaminants of concern only.

(b) All chemical analyses are to be performed for four consecutive semi-annual monitoring events to be performed in September-October and March-April, unless otherwise noted (refer to Section 4.6.3).

(c) Not all site monitoring wells are included in the quarterly sampling program. However, all wells are to be included in the quarterly groundwater elevation monitoring events described in Section 4.6.4.

(d) Wells included for analysis of dioxins/furans, volatile organic compounds (VOCs), and polychlorinated biphenyls (PCBs) may be modified (with approval from Ecology) based on the results of the first semi-annual monitoirng event and top-of-riverbank soil sample results.

(e) Samples for dioxins/furans and PCBs will be collected using both non-purge and post-purge methodologies for the first monitoring event. Sampling methodology for subsequent events may be modified based on the results of the first event. Field measurement of turbidity is to be performed both before and after purging.

(f) New wells and select existing wells to be analyzed for the Water Quality Parameters/General Chemistry Analytes specified in Table 3 of Ecology's August 2012 Final RI/FS Work Plan for all monitoring events. Laboratory analysis of pH and salinity to be performed for all monitoring events at all wells.

Table 3

Laboratory and Field Quality Assurance/Quality Control
Glacier Northwest, Inc. - Reichhold, Inc. Site
5900 West Marginal Way SW
Seattle, Washington

Analysis Type	Field Quality Assurance					Laboratory Quality Control Elements							
	Rinsate Blank	Field Blanks	Field Duplicates	Temperature Blank	Trip Blank	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes	SRM[2]/LCS/ Blank Spike	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Grain size	NA	NA	NA	1 per cooler	1 per cooler containing volatile samples	Each batch[1]	NA	1 per 20 samples	NA	NA	NA	NA	NA
TSS	NA	NA	NA	1 per cooler	1 per cooler containing volatile samples	Each batch[1]	NA	1 per 20 samples	NA	1 per 20 samples	NA	1 per 20 samples	NA
TOC	NA	NA	NA	1 per cooler	1 per cooler containing volatile samples	Daily or Each Batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
$Cl/NO_3/ PO_4/ SO_4$	NA	NA	NA	1 per cooler	1 per cooler containing volatile samples	Daily or Each Batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Metals[3]	1 per 20 standard samples with a minimum of per sampling event	1 per 20 standard volatile samples with a minimum of per sampling event	1 per 10 standard samples with a minimum of per sampling event	1 per cooler	1 per cooler containing volatile samples	Daily	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA
Dioxins / Furans	1 per 20 standard samples with a minimum of per sampling event	1 per 20 standard volatile samples with a minimum of per sampling event	1 per 10 standard samples with a minimum of per sampling event	1 per cooler	1 per cooler containing volatile samples	As needed[4]	Every 10 hours	NA	NA[5]	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every Sample
PCB congeners	1 per 20 standard samples with a minimum of per sampling event	1 per 20 standard volatile samples with a minimum of per sampling event	1 per 10 standard samples with a minimum of per sampling event	1 per cooler	1 per cooler containing volatile samples	As needed[4]	Every 10 hours	NA	NA[5]	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every Sample
VOCs	1 per 20 standard samples with a minimum of per sampling event	1 per 20 standard volatile samples with a minimum of per sampling event	1 per 10 standard samples with a minimum of per sampling event	1 per cooler	1 per cooler containing volatile samples	As needed[4]	Every 10 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every Sample
SVOCs	1 per 20 standard samples with a minimum of per sampling event	1 per 20 standard volatile samples with a minimum of per sampling event	1 per 10 standard samples with a minimum of per sampling event	1 per cooler	1 per cooler containing volatile samples	As needed[4]	Every 10 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every Sample

Notes:

[1] Calibration and certification of drying ovens and weighing scales are conducted biannually.
[2] Puget Sound SRM will be analyzed for PCBs and dioxins. An LCS will be analyzed for all other analysis.
[3] Metals analysis quality control includes total and dissolved analyses.
[4] Initial calibrations are considered valid until the ongoing calibration no longer meets method specifications. At that point, a new calibration is performed.
[5] Isotope dilution required per method.

LCS = laboratory control sample
NA = not applicable
PCB = polychlorinated biphenyl
SRM = standard reference materials
SVOC = semivolatile organic compound
TOC = total organic carbon
TSS = total suspended solids
VOC = volatile organic compound

Table 3 was prepared by The Companies and submitted to Ecology on August 8, 2013

Table 4

Sample Collection Containers, Preservatives, and Holding Times
Glacier Northwest, Inc. - Reichhold, Inc. Site
5900 West Marginal Way SW
Seattle, Washington

		Upland Soil				Ground Water		
Analyte	**Method**	**Container**	**Preservative**	**Holding Time**	**Archive Holding Time[2]**	**Container**	**Preservative**	**Holding Time**
Total/Dissolved Metals	USEPA 6010/6020	4oz.WMG	Cool≤6°C	6 Months	2 years	500mL HDPE	HNO_3, Cool≤6°C	6 Months
Total/Dissolved Mercury	USEPA 7470A/7471A			28 Days	28 Days			
Hexavalent Chromium	USEPA 7196A			28 Days		500mL HDPE	Unpreserved	24 hours
Chloride	USEPA 300.0					500mL HDPE	Cool≤6°C	28 Days
Sulfate	USEPA 300.0							
Nitrate	USEPA 300.0							48 hours
Phosphate	SM 4500							
SVOCs/Phenols	USEPA 8270D	16oz.WMG	Cool≤6°C	14 Days	1 Year	2-500mL AG	Cool≤6°C	7 Days
PAHs	USEPA 8270-SIM	16oz.WMG				2-500mL AG		
Pentachlorophenol	USEPA 8041	16oz.WMG				2-500mL AG		
Dioxins/Furans	USEPA 1613B	250mL AWMG	Frozen	1 Year	1 Year	1 Liter AG	Cool≤4°C[1]	14 Days
PCB Aroclors	USEPA 8082B	8oz.WMG	Cool≤6°C	14 Days	1 Year	2-500mL AG	Cool≤6°C	7 Days
Total Organic Carbon	USEPA 9060	4oz.WMG	Cool≤4°C	14 Days	6 Months	250mL AG	H_2SO_4, Cool≤6°C	28 Days
Grain Size	PSEP	16oz. WMG	None	6 Months				
Total Suspended Solids	SM 2450D					1 Liter HDPE	Cool≤6°C	7 Days
Hardness	SM 2340B					500mL	HNO_3, Cool≤6°C	6 Months
Alkalinity	SM 2320B					1L Glass	Cool≤6°C	14 Days
VOCs / VOCs Total Solids	USEPA 8260C					2-40mLvial	HCl, Cool≤6°C	14 Days
Salinity	SM 2520					500mL HDPE	-	28 Days
pH	USEPA 9045					500mL	-	immediately

Notes:

[1] Sample-dependent preservative. If pH is greater than 9, add H_2SO_4. If residual chlorine is present, add sodium thiosulphate.

Grayed cells indicate that analyte will not be sampled for that matrix.

SVOCs include phenols, phthalates, and polycyclic aromatic hydrocarbons.

[2] Analysis Methods are based on EPA SW-846 for solid samples (e.g. soils, sediments, sludges) which specifies recommended hold times may be extended if reported analyte concentrations are not adversley affected from preservation and storage. Maximum hold times for archive soil samples frozen at -18°C are based on Ecology publication number 03-09-043, *Sediment Sampling and Analysis Plan Appendix (SAPA),* February 2008 and *Sediment Evaluation Framework for the Pacific Northwest, May 2009.*

AG = Amber Glass Boston Round Bottle
AWMG = Amber Wide Mouth Glass Jar
°C = Degrees Celsius
H_2SO_4 = Sulfuric acid
HCl = Hydrochloric acid
HDPE = High-density polyethylene
HNO_3 = Nitric acid
mL = Milliliters
NO_3 = Nitrate
oz = Ounce
PCB = Polychlorinated Biphenyls
SM = Standard Method
USEPA = United States Environmental Protection Agency
USEPA Method 1613B = Axys Method MLA-017
WMG = Wide Mouth Glass Jar

Table 4 was prepared by The Companies and submitted to Ecology on September 24, 2013.

Figures

37S	Proposed Shallow-Zone Monitoring Well
37D	Proposed Deep-Zone Monitoring Well
TB-01	Proposed Top-of-Riverbank Boring Location
GP-60	Proposed Shallow Soil Boring
GP-71	Proposed Deep Soil Boring
33S	Existing Shallow-Zone Monitoring Well
2D	Existing Deep-Zone Monitoring Well
GP-66	Previous Soil Boring
TP-8	Previous Test Pit

LEGEND:

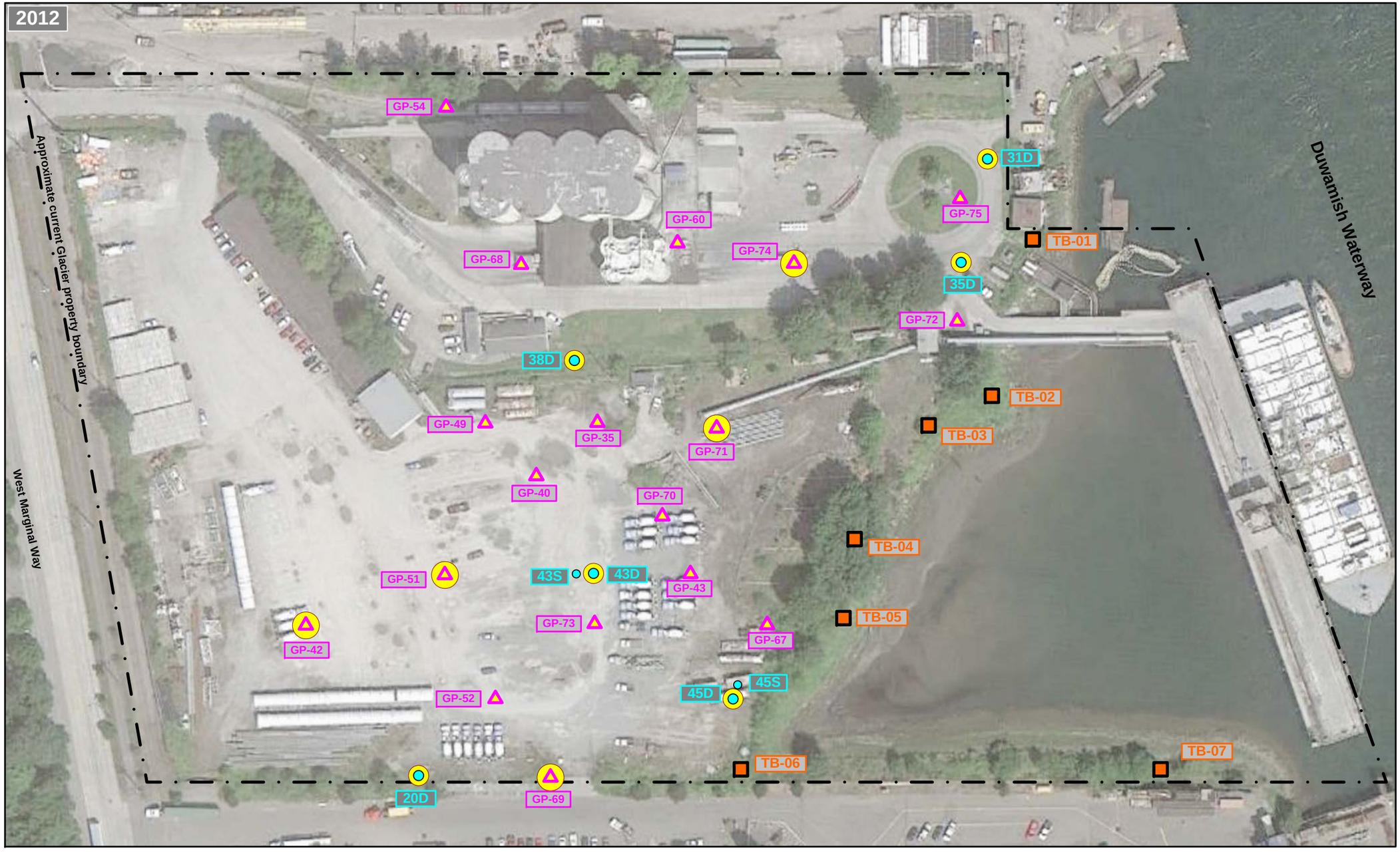
- 1936 / 1965 / 1972 — Historical top-of-bank shoreline locations based on aerial photographs (dates shown)
- Dock and mooring platform installed late 1960s
- Dock and pier installed late 1970s
- Former structures and features associated with former Army and Reichhold Chemical operations based on aerial photographs, 1959 site plan map, and Army Real Estate map.
- Former Reichhold impoundment basin (from 1956 aerial photograph) and disposal area and associated gravel-filled ditches (from 1956 aerial and Army Real Estate map).
- Former drainage ditches and other site drainage features from aerial photographs, 1959 Site Plan map, and Army Real Estate map.
- Former wood treatment area structures and features and other structures visible on 1936 aerial photograph.
- Approximate existing City of Seattle storm drain easement for storm drain pipe installed in late 1960s to early 1970s.

NOTE: All locations are approximate

The Lower Duwamish Waterway (LDW)
Glacier Northwest Inc – Reichhold Inc, Seattle WA

Historical Site Features and Sample Location Map

Figure 1



LEGEND:

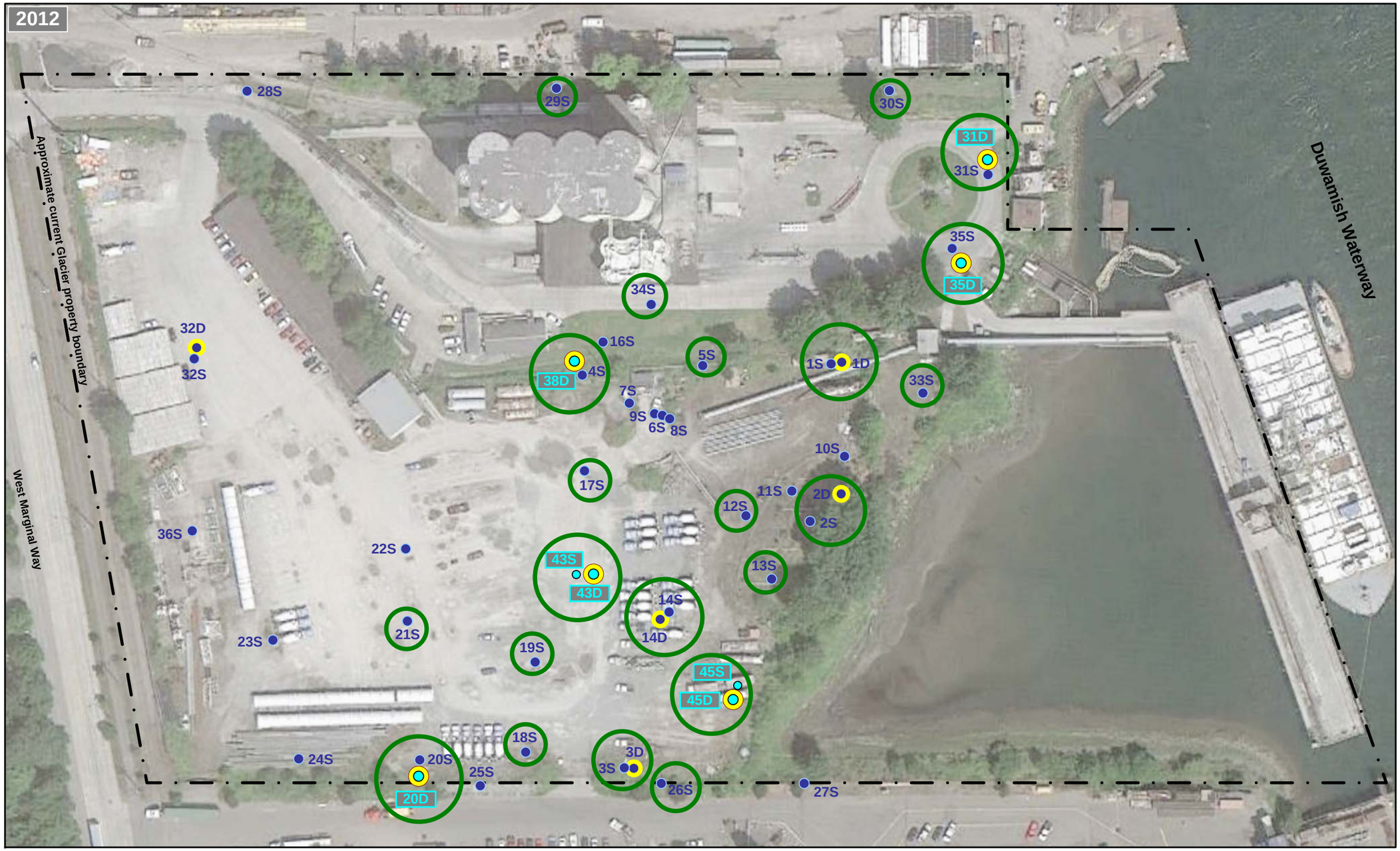
- 37S — Proposed Shallow-Zone Monitoring Well
- 37D — Proposed Deep-Zone Monitoring Well
- TB-01 — Proposed Top-of-Riverbank Boring Location
- GP-60 — Proposed Shallow Soil Boring
- GP-71 — Proposed Deep Soil Boring

NOTE: All locations are approximate

The Lower Duwamish Waterway (LDW)
Glacier Northwest Inc – Reichhold Inc, Seattle WA

New Soil Boring, Top-of-Bank Boring, and Monitoring Well Location Map

Figure 2



LEGEND:

33S Existing Shallow-Zone Monitoring Well

45S New Shallow-Zone Monitoring Well

2D Existing Deep-Zone Monitoring Well

35D New Deep-Zone Monitoring Well

Monitoring Wells Included in the Semi-Annual Monitoring Program (refer to Table 2 for specific analyses to be performed for each well)

NOTES:

1. **All locations are approximate**
2. **All wells are to be included in quarterly water level measurements, not only those being sampled.**

The Lower Duwamish Waterway (LDW)
Glacier Northwest Inc – Reichhold Inc, Seattle WA

Groundwater Monitoring Well Location and Sampling Map

Figure 3