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Hydrogeological Characterization Report

Issaquah, Washington

Prepared for

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1. INTRODUCTION

Geosyntec Consultants (Geosyntec) has prepared this report for the City of Issaquah (City) to document results of drilling and sampling activities completed in 2016 in the vicinity of City water supply Wells 4, 5, and 6 (Site). The water supply wells provide drinking water for the City of Issaquah.

The objectives of the field investigation were to: 1) develop an understanding of the distribution of perfluorooctanesulfonic acid (PFOS) in groundwater near City Well 4; and 2) establish a conceptual model of how PFOS entered and is transported in the upper aquifer that is pumped by City Well 4. PFOS and perfluorooctanoic acid (PFOA) are two isomers of a larger class of compounds known as perfluorinated compounds (PFCs) or perfluoroalkyl acids (PFAAs). An overview of PFAAs is provided in our earlier Phase 1 investigation report (Geosyntec, 2016a). The term PFCs will be used herein to describe this group of compounds[1].

On May 25th, 2016 the Environmental Protection Agency (EPA) released a drinking water health advisory for PFOS which lowered the advisory level for PFOS from 0.2 micrograms per liter (µg/L) to 0.07 µg/L, and for PFOA from 0.4 µg/L also to 0.07 µg/L (EPA, 2016a, b). EPA also recommended that when these two compounds occur together in a drinking water source that the sum of the PFOS and PFOA concentrations be compared to 0.07 µg/L. In other words, the drinking water health advisory level applies to both PFOS and PFOA independently and summed together.

The investigation included:

- The installation of seven groundwater monitoring wells: MW01, MW02, MW03, MW04, MW05, MW06, and MW07 (Figure 1);
- Groundwater quality sampling at the seven new wells and several existing wells in the vicinity of the City's water supply wells;
- Completion of a video log in an existing City test well near Well 5;
- Continuous monitoring of groundwater levels in six wells;

[1] The term "PFCs" is also used to describe compounds associated with ozone depletion.

- Sampling of soil at Eastside Fire and Rescue; and
- Surface water sampling in Issaquah Creek.

A draft work plan was prepared and submitted to the City on 17 May 2016 (Work Plan) describing the well installation and groundwater monitoring activities; however, through the course of the investigation the field program was modified based on the first round of sampling data. Drilling, sampling, and monitoring procedures were generally completed as described in the Work Plan.

2. DRILLING AND MONITORING WELL INSTALLATION

Monitoring well boreholes were drilled using track-mounted Sonic™ drilling rigs operated by Holt Services, Inc. (Edgewood, WA), and Cascade Environmental Services (Woodinville, WA). The monitoring wells were installed in two phases, MW01 through MW05 were completed in May 2016, and MW06 and MW07 were completed in October 2016. Continuous sample cores were obtained during drilling to characterize subsurface materials, conduct field screening, and identify zones for depth-discrete grab water samples. Borehole depths ranged from 80 feet below ground surface (bgs) to 110 feet bgs, as summarized in Table 1. Borehole logs, including field screening results and sample depths, are included in Appendix B.

2.1 Geology

The surficial geology in the vicinity of the City of Issaquah is shown in map form on Figure 2. The surficial materials are predominantly glacial sediments, but there is an outcrop of bedrock in the southwest portion of the City at the intersection of Sunset Way and Newport way.

Cross-sections that show our interpretation of the geology based on the borehole drilling are presented on Figures 2A and 2B. Subsurface materials encountered during this investigation generally consisted of:

- Brown sand or sandy silt to approximately 20 feet bgs, underlain by a grey to grey-green sandy silt from approximately 20 to 40 feet bgs. These two units are interpreted to be shallow alluvium (Qa) underlain by ice contact deposits (Qvi).

- A loose, grey sand was encountered from approximately 40 feet bgs to 60 or 70 feet bgs (ice contact deposits [Qvi]). This sand unit was difficult to drill through due to heaving sand conditions. The heaving sand unit was underlain by a grey sandy silt with occasional wood fragments approximately 10 to 20 feet in thickness (60 to 70 feet bgs to 70 to 80 feet bgs). Some organic material (wood fragments) and one small section of peat were encountered near the base of the ice contact deposits.
- Brown to grey brown sand to silty sand interpreted to be advance outwash sediments (Qva) were typically encountered at 70 to 80 feet bgs up to the maximum depth explored of 100 feet bgs. At MW02, the brown gravelly sand (Qva) is thinner than the other boreholes and advance outwash sediments were not encountered at MW01, west of MW02.
- These materials correspond to geologic units in the area, which are outlined in the Work Plan (Geosyntec, 2016b), and consist of the following formations (from shallowest to deepest):
    - Shallow alluvium (Qa);
    - Ice Contact Deposits (Qvi);
    - Advance Outwash (Qva);
    - Older glacial deposits (Qpff); and Olympian Sediment (Qob).

These units have an apparent northward hydrostratigraphic slope of about 1.4% (Figure 2A). Coarser grained sand and gravel generally was present to the south and finer sand and silt to the north, consistent with deposition in a deltaic (fining down-slope) type setting. The advance outwash (Qva) sediments intersected in MW02, MW03, MW04, MW05, MW06, and MW07 were each consistent with geology described in other City wells. These glacial advance outwash sediments were thinner at MW02. Glacial advance outwash sediments were not observed at MW01. This suggests that the advance outwash pinches out in the vicinity of MW02.

2.2 Discrete-Depth Groundwater Sampling

Groundwater samples were obtained from the boreholes during drilling to evaluate PFC concentrations at first encountered groundwater and at additional selected depths for vertical profiling. The sample results were collected in an open borehole and were not intended to substitute for results from a constructed monitoring well.

Sampling depths and results of the discrete-depth samples are discussed in more detail in Appendix A.

2.3 Monitoring Well Installation

A monitoring well was constructed in each borehole drilled at a depth interval determined in the field. Monitoring wells are constructed of 2" polyvinyl chloride (PVC) well casing with 0.010" slotted PVC well screens. A prepack well screen and above ground monument were used at MW02 due to heaving sand and artesian (flowing) conditions.

Borehole and monitoring well construction logs are included as Appendix B. The City completed a survey of the monitoring well locations and elevations on 10 June and 12 November 2016. Monitoring well construction details and survey data are summarized in Table 1.

3. GROUNDWATER ELEVATION MONITORING

Self-contained pressure transducers (Van Essen Divers or Divers) were initially installed in five monitoring wells (MW01 through MW05) and City of Issaquah Well COI-TW-3. The transducers in MW01 and MW02 were then moved to MW06 and MW07. In addition to the Divers, a pressure transducer that records barometric pressure (Baro-Diver) was installed at MW02 on the underside of the well monument cover. The Baro-Diver is used to compensate the groundwater pressure recorded by the Divers for changes in barometric pressure.

Manual groundwater measurements in the monitoring wells were measured prior to installation of the transducers and ranged from 55 feet above mean sea level (amsl) to 65 feet amsl (Table 2). The general direction of groundwater flow is from southeast to northwest.

The Divers began recording data on 2 June 2016. Diver operation was verified against field measurements by suspending cable length and manual depth-to-groundwater measurements compared to recorded groundwater pressures. Groundwater pressures recorded by the Divers were corrected for barometric pressure and converted to groundwater elevations using manual depth-to-water measurements and the surveyed top of casing elevations at each well.

The Diver data collected for the 2 June through the 17 October 2016 are presented as a time-series in Figure 4. The Figure shows the general seasonal trend of groundwater levels between June and October 2016. Groundwater levels generally decline about 2 to 4 feet during the course of the summer and rise again in September. The large changes in groundwater level shown at MW02 and MW03 in June and July are from testing at City Well 4. Data are recorded at 15 minute intervals in the transducer, but Figure 4 presents the average daily groundwater level for clarity. There is a high frequency water level fluctuation observed within the course of a day at MW02, MW03, MW04, and MW05. The fluctuations correspond to pumping operations at Sammamish Plateau Sewer and Water District (SPSWD) Wells 7 and 8, which are completed in the same aquifer. The fluctuation is not observed in the groundwater elevation record for MW01, which is screened above the advance outwash aquifer. The fluctuation is largest in MW04, causing changes up to one foot in groundwater elevation during the course of a day.

4. GROUNDWATER QUALITY MONITORING

Groundwater sampling was completed at monitoring and production wells (Figure 1), as follows:

- Darigold well (ABY249) was sampled on 4 May 2016;
- SPSWD wells 7.3, VT-2.1, VT-2.2, VT-2.3 were sampled on 10 May 2016;
- City of Issaquah wells COI6-TMW1s (formerly COI-MW1) and COI-TW-3 were sampled on 17 May 2016; and City Well 5 was sampled on 6, 13, and 27 July 2016, and
- New City of Issaquah monitoring wells MW01, MW02, MW03, MW04, and MW05 were sampled on 7 June 2016. Monitoring wells MW03, MW04, MW05 were sampled weekly from 21 June through 27 July 2016.
- Monitoring wells MW01 through MW07 were sampled on 17 October 2016.

Groundwater monitoring was completed using EPA protocols, including low flow purging and sampling of the new wells as outlined in the Work Plan (Geosyntec, 2016b). Sample preservation and handling procedures were developed with the laboratory to prevent cross-contamination with potential PFC-containing materials (i.e. Teflon), as described in the quality assurance project plan attached to the Work

Plan (Geosyntec, 2016b), and as outlined in Table 1 of the Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (State of Western Australia, 2016).

The SPSWD and City of Issaquah monitoring wells were purged and sampled using a peristaltic pump and disposable tubing. Approximately three well volumes were purged from each well prior to sampling. The Darigold well is a water supply well and was pumping during sampling, so a grab groundwater sample was obtained from a sample port at the well head after flushing for two minutes. Low-flow purging of the new groundwater monitoring wells was completed using a peristaltic pump and disposable tubing along with a Horiba water quality instrument to collect stabilization parameters. Following stabilization, groundwater samples were obtained for analytical testing of:

- PFCs using EPA Method 537;
- Cations (calcium, chloride, magnesium, potassium, and sodium) by EPA Method 200.7;
- Anions (sulfate and nitrate) by EPA Method 300;
- Alkalinity by standard method (SM) 2320B;
- pH by SM 4500-HB;
- Specific conductance by SM 2510B; and
- Benzene, toluene, ethylbenzene, total xylenes (BTEX), and methyl tert-butyl ether (MTBE) by EPA Method 524.2.

Prior to sampling, depth to groundwater was measured using an electronic depth to water meter.

Analytical laboratory reports are included in Appendix C along with Data Quality Review Memos. Results of the data quality review indicate that the analytical data are acceptable for their intended use.

In addition, SPSWD Wells 7, 8, 9 were sampled for PFCs by SPSWD on 15 and 20 June, and 26 July 2016 and analyzed by Eurofins Laboratory in Monrovia CA. These results are included in Table 3 and on Figure 5.

5. GROUNDWATER SAMPLING ANALYTICAL RESULTS

Analytical results for BTEX and cations/anions results are summarized in Table 3, and PFC results for groundwater are summarized in Table 4.

5.1 Perfluorinated Compounds (PFCs) Results

PFCs, including PFOS, have been detected in thirteen wells (Table 2) in the Lower Issaquah Valley, including City Wells 4 and 5, SPSWD Wells 7, 8, and 7.3, COI6-TMW1s (COI-MW1), the Darigold Well, MW01, MW03, MW04, MW05, MW06, and MW07. PFOS Results are summarized as follows:

- PFOS was detected above the EPA advisory level of 0.07 µg/L in MW03 (0.46 µg/L), MW05 (0.39 µg/L), MW06 (2.2 µg/L), and City Well 4.
- PFOS was detected below the EPA advisory level at COI-MW1, Darigold, City Well 5, and MW07.
- PFOS concentrations below the EPA advisory level were detected by SPSWD in Well 7 (0.019J and 0.015 µg/L) and Well 8 (0.029) µg/L.
- PFOS was not detected in MW01, MW02, and MW04.
- PFOA was detected at concentrations above the EPA advisory level at MW06 (0.08 µg/L). PFOA was detected at concentrations below the EPA advisory level (between 0.003 to 0.03 µg/L) at MW01, MW03, MW04, MW05, and MW07.

Additional PFCs (i.e. other isomers of the larger class of compounds) were detected in City Wells 4 and 5, MW03, MW05, and MW06. These other perfluorinated compounds do not have associated EPA advisory levels.

The distribution and sampling history of PFOS in the various monitoring wells is shown in a map format on Figure 5. Note, this figure shows both PFOS and PFOA (where detected).

5.2 Anions/Cations Ratios

The distribution of anions/cations at MW03, MW04, MW05, and MW06 are similar to each other indicating similar groundwater chemistry (i.e. same aquifer or recharge source). Slightly different cation compositions are observed at MW01, MW02, and

MW07. Water quality parameters are plotted in Figures 6 and 7 to evaluate their relative concentrations.

6. OBSERVATION WELL 5 VIDEO SURVEY

PFOS is present in City Well 5 at a concentration of 0.03 µg/L. Well 5 is completed in a deeper aquifer at 240 to 412 feet bgs. The deeper aquifer is separated from the advance outwash aquifer by approximately 100 feet of silt.

A video survey of an older observation well adjacent to City well 5 (Well 5OBS) was completed to assess the integrity of the well and determine whether it could be a conduit for PFCs to move from the shallow aquifer to the deep aquifer. Well 5OBS was drilled in the early 1980s as a test well for the City's deep production well. Well 5OBS was not completed with a well screen, but has a slotted casing from approximately 330 to 450 feet below ground surface.

The video survey of well 5OBS did not show signs of leakage, cracks, or breaks in the well casing. A cement plug was encountered at approximately 307 feet bgs that prevented the video camera from advancing into the completion interval. The purpose, extent, and date of installation of the plug are unknown. A photo-log showing some of the joints and welds in well 5OBS is provided in Appendix D.

7. SOIL SAMPLING

Based on the initial groundwater sampling results, we interpreted a south-trending distribution of PFOS in groundwater from City Well 4, toward MW05. Based on groundwater flow directions, a potential source location included the Eastside Fire and Rescue (EF&R) property, located at 175 Newport Way NW. This location site appears to be along a groundwater flow path that intersects both MW05 and City Well 4, and is located within the 10-year time of travel delineated in the City's Wellhead Protection Plan.

The City of Issaquah initially contacted EF&R in July and requested permission to collect soil samples, which was granted. On 22 July 2016, a Geosyntec technician collected three soil samples at the site. On 27 July 2016, Geosyntec and the City of Issaquah met with EF&R to discuss groundwater results in the monitoring wells. On 05 August 2016, Geosyntec and the City of Issaquah met with EF&R again to discuss historical fire training and fire response activity.

The purpose of the sampling at 175 Newport Way NW to determine the potential presence or absence of PFCs in soil at the property. The sampling effort was not intended to characterize the history, magnitude, distribution, or extent of PFCs on the site.

Three soil samples were obtained on 22 July 2016 from three locations (STTA01, STTA02, and STSP01) in a gravel area on the western portion of the property (Figure 8). The soil samples were collected using hand methods (shovel and hand-auger) at depths ranging from 27 to 46.5 inches bgs. The shovel and hand auger were decontaminated between sample locations. Subsurface materials consisted of a surface gravel layer from approximately 7 to 14 inches thick, a dark grey silt at STTA01 and STTA02, and a light brown sandy silt at location STSP01. Soil samples were placed directly into laboratory supplied containers, placed into a cooler with ice and shipped to Eurofins Eaton Analytical Labs in Lancaster PA for testing of PFCs by EPA Method 537. On 19 August 2016, Geosyntec received soil sample analytical results and initiated internal data validation.

Soil sample results for 175 Newport Way NW are summarized on Table 5. PFCs, including PFOS, were detected in all three soil samples, as follows.

- PFOS was detected in all three soil samples, and concentrations ranged from 23 to 1,300 nanograms per gram (or 0.023 to 1.3 mg/kg).
- PFOA was detected in two of the three soil samples at concentrations ranging from 5 to 11 ng/g (or 0.005 to 0.011 mg/kg). These two samples were from the area at the east end of the property.

8. SURFACE WATER SAMPLING

Two surface water samples were obtained from Issaquah Creek on 27 September 2016. Samples were collected at locations upstream of the fish hatchery (SW-A) and downstream of City Wells 4 and 5 (SW-B). The sample locations are shown on Figure 9. The samples were submitted for analytical testing of PFCs by EPA Method 537.

PFCs were not detected in the surface water samples. Analytical results are summarized in Table 4.

9. SUMMARY AND CONCLUSIONS

The sub-surface geology encountered in the boreholes consists of interbedded recent alluvial deposits underlain by and interbedded with glacial sediments that generally dip northward. The surficial geology in the area also consists of predominantly glacial sediments, but there is an outcrop of bedrock at the intersection of Sunset Way and Newport way. The glacial sediments terminate against this bedrock and represent the western edge of the aquifer system in this part of the valley. The bedrock contact extends northward along Newport way and appears as a "hook-shaped" feature on the map that wraps around the western portion of the property at 175 Newport Way NW.

Groundwater is typically found 20 to 30 feet below ground surface and groundwater flow is to the north, down valley towards Lake Sammamish. Silt interbeds are present in the upper 80 feet of the glacial sediments, but do not appear to be sufficiently thick nor continuous across the area to form aquitards that would limit vertical groundwater flow or connectivity through the upper aquifer.

PFOS is present in groundwater above the EPA advisory limit in City Well 4 and monitoring wells MW03, MW05, and MW06 (Figure 5). PFOS is not present at monitoring wells MW01, MW02, and MW04, and is present just above the detection limit at MW07. PFOS concentrations increase significantly in an upgradient direction from MW03 to MW06. The highest concentrations detected in this study were present in MW06 at 2.2 µg/L (a factor of 30 times higher than the EPA advisory limit).

The extent of PFOS at concentrations greater than 0.1 µg/L in the shallow aquifer appears to be a narrow and north-south oriented plume, as defined by detections in monitoring wells MW03, MW05, and MW06, and the absence of PFCs in MW01, MW02, MW04, and MW07. The north-south trending plume aligns parallel and west of Issaquah Creek. As shown on Figure 10, PFOS concentrations increase markedly between MW05 and MW06, which is located about 500 feet downgradient of 175 Newport Way NW, where PFOS was detected in soil. Historic use of firefighting foams at the 175 Newport Way NW, the presence of PFOS in soil, and the high PFOS detection at MW06 located just downgradient of this property, indicates this property is a source of PFCs to groundwater that should be investigated further.

The property at 175 Newport Way NW is also located north of an eastward jutting outcrop of bedrock (a "hook-shaped" feature on the map that wraps around the western portion of the property). The configuration of the bedrock may help to concentrate infiltration and focus the flow of infiltration on the property toward MW06. Although there was a trace detection of PFOS at MW07, located upgradient of the property, it is highly unlikely that a PFOS plume capable of producing a high concentration at MW06 could exist between MW07 and the bedrock outcrop. As such, we conclude that the 175 Newport Way NW property is the primary source of PFOS contributing the plume that intersects the City's Well 4.

The concentration of a contaminant at any given point within a contaminant plume varies over time and can increase or decrease because of contaminant transport processes, the history at the source area, and the concentration of contamination at the source area. It is likely that the source at 175 Newport Way NW has reached a steady state condition, and, if no source removal actions are undertaken, concentrations at MW06 would remain high until the source area was diluted of its residual PFOS. The high concentrations of PFOS at MW06, relative to the downgradient monitoring wells, suggest that PFOS concentrations will likely increase at the City's Well 4 before they decrease. Additional modeling of contaminant transport would be necessary to quantitatively predict future PFOS concentrations at City Well 4, but they are unlikely to reach the high levels observed at MW06.

Trace levels of PFOS were detected at SP7-3, SP-7, SP-8 wells, and City Well 5 (completed in the deep aquifer), indicating that deeper transport pathways are present. The specific transport pathways for PFOS to these locations are not known and this investigation did not characterize the deeper aquifer nor potential groundwater flowpaths to these wells.

Use of fire-fighting foams at the 2002 I-90 Tanker Fire west of City Well 4, originally suspected as a source of PFOS, was eliminated as a PFOS source to City Well 4. PFOS was not detected at MW01, located directly adjacent to the fire and staging area for fire response. The water quality data and water-level responses are also different at MW01 compared to other wells. The presence of PFOS at other wells upgradient of City Well 4 also eliminates this event as a source.

10. RECOMMENDATIONS

Based on these results, Geosyntec offers the following recommendations:

1. Conduct a more detailed soil and groundwater investigation at the 175 Newport Way NW property to determine the extent and distribution of PFCs on that property. The investigation should include sampling of current firefighting foams on site and, if possible, any material flushed from fire-fighting equipment and stored on-site.

2. Continue monitoring the recently installed monitoring wells (MW01-MW07) for water-levels and PFCs to evaluate seasonal trends in water levels and water quality.

3. The City's treatment system at Well 4 is currently functioning well, but we recommend that City evaluate operating procedures and determine whether adjustments to the current pumping schedule at Well 4 are warranted. This analysis should be coordinated with SPSWD so that an overall pumping strategy for the aquifer system is established. This would entail groundwater flow modeling that could also be used to evaluate contaminant transport. A simple well interference analysis that focuses solely on well pumping rates and hydraulic gradients could also be sufficient.

4. Once the 175 Newport Way NW source area has been better characterized and potential approaches to source removal have been evaluated, groundwater transport modeling may be useful to evaluate the longer term fate and transport of PFOS into the aquifer system.

11. REFERENCES

Geosyntec Consultants, 2016a. Phase 1 Hydrogeological Characterization. Issaquah, Washington, 4 March 2016.

Geosyntec Consultants, 2016b. Draft Hydrogeological Characterization Work Plan. Issaquah, Washington.

State of Western Australia, 2016. Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Contaminated Sites Guidelines, February 2016.

U.S. Environmental Protection Agency, 2016a. Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS), EPA Document Number: 822-R-16-004, May 2016.

U.S. Environmental Protection Agency, 2016b. Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA), EPA Document Number: 822-R-16-005, May 2016.

TABLES

Table 1
Monitoring Well Construction
City of Issaquah Hydrogeologic Assessment

Well Name	Date Installed	Well Diameter (in)	Boring Depth (ft)	Completed Depth (ft)	Ground Elevation (ft amsl)	Top of Casing Elevation (ft amsl)	Top of Screen Depth (ft bgs)	Bottom of Screen Depth (ft bgs)	Top of Screen Elevation (ft amsl)	Bottom of Screen Elevation (ft amsl)
MW01	5/26/2016	2	100	38	58.4	58.4	28	38	30.4	20.4
MW02	6/2/2016	2	100	90	59.7	62.8	70	90	-10.3	-30.3
MW03	5/24/2016	2	100	98	63.2	62.9	78	98	-14.8	-34.8
MW04	5/27/2016	2	90	90	73.3	73.1	70	90	3.3	-16.7
MW05	5/23/2016	2	90	90	72.1	71.9	70	90	2.1	-18.0
MW06	10/6/2016	2	100	100	86.5	86.3	80	100	6.3	-13.7
MW07	10/10/2016	2	110	110	90.7	90.3	100	110	-9.7	-19.7

Notes:
in = inches; ft = feet; ft amsl = feet above mean sea level; ft bgs = feet below ground surface

Table 2
Groundwater Level Measurements
City of Issaquah Hydrogeologic Assessment

Well Owner/ Property	Well Name	Measurement Date	Event	Measuring Point	TOC Elevation (ft amsl)	Depth to Water (ft)	Groundwater Elevation (ft amsl)
COI	**MW-1**	5/17/2016	Baseline sampling	TOC1	81.9	13.4	68.5
COI	**TW-3**	5/17/2016	Baseline sampling	TOC1	81.8	14.3	67.6
SPWSD	**VT-2.1**	5/10/2016	Baseline sampling	TOC1	59.4	8.2	51.2
SPWSD	**VT-2.2**	5/10/2016	Baseline sampling	TOC1	61.8	3.8	58.0
SPWSD	**VT-2.3**	5/10/2016	Baseline sampling	TOC1	62.0	3.0	59.0
SPWSD	**Well 7-3**	5/10/2016	Baseline sampling	Metal rim1	72.1	9.5	62.6
COI	**MW01**	6/7/2016	Post-installation	TOC	58.4	3.5	54.9
COI	**MW02**	6/7/2016	Post-installation	TOC	62.8	1.8	61.0
COI	**MW03**	6/7/2016	Post-installation	TOC	62.9	1.0	61.9
COI	**MW04**	6/7/2016	Post-installation	TOC	73.1	10.0	63.1
COI	**MW05**	6/7/2016	Post-installation	TOC	71.9	7.8	64.1
COI	**MW01**	10/17/2016	Sampling	TOC	58.4	3.2	55.2
COI	**MW02**	10/17/2016	Sampling	TOC	62.8	2.4	60.4
COI	**MW03**	10/17/2016	Sampling	TOC	62.9	4.1	58.9
COI	**MW04**	10/17/2016	Sampling	TOC	73.1	7.8	65.3
COI	**MW05**	10/17/2016	Sampling	TOC	71.9	6.8	65.2
COI	**MW06**	10/17/2016	Sampling	TOC	86.3	17.4	66.0
COI	**MW07**	10/17/2016	Sampling	TOC	90.3	18.4	72.0

Notes:

TOC - Top of casing

ft amsl - feet above mean sea level

[1] Calculated values, well was not surveyed.

Table 3
Summary Water Quality Analytical Results
City of Issaquah Hydrogeologic Assessment

Well Owner/ Property	Well Name	Sampling Date	Sample Name	Alkalinity	Calcium	Chloride	Magnesium	pH	Potassium	Sodium	Specific Conductance	Sulfate	Total Nitrate	Benzene	Ethyl Benzene	m,p-Xylenes	o-Xylene	Total Xylenes	Methyl-Tert-butyl ether	Toulene
				-	Ca	Cl	Mg	pH	K	Na	-	SO_4	NO_3	VOCs						
			Units	mg/L as CaCO3	mg/L	mg/L	mg/L	SU	mg/L	mg/L	µmhos/ cm	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
COI	COI-5	7/6/2016	COI-Well 5-20160716		34.0	5.30	4.60		3.70	28.0		43.0	< 0.440							
COI	COI-5	7/13/2016	COI-Well5-20160713		36.0	5.10	4.60		4.00	29.0		40.0	< 0.440 J							
COI	COI-50BS	7/6/2016	COI-Well 50BS-20160716		18.0	3.50	3.50		3.50	19.0		< 0.500	< 0.440							
COI	MW01	6/7/2016	COI-MW01-060716	100	16.0	2.70	6.80	7.9	2.20	22.0	220	3.00	1.30	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
COI	MW01	10/17/2016	COI-MW01-20161017		20.0	2.80	8.20		2.50	14.0		1.90	< 0.440 J							
COI	MW02	6/7/2016	COI-MW02-060716	75.0	13.0	2.30	7.30	8.1	1.60	10.0	170	6.40	< 0.440	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
COI	MW02	10/17/2016	COI-MW02-2016017		20.0	3.50	11.0		1.50	8.80		8.80	1.20							
COI	MW03	6/7/2016	COI-MW03-060716	130	28.0	3.40	13.0	7.7	2.00	11.0	290	11.0	< 0.440	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
COI	MW03	7/6/2016	COI-MW03-20160716		19.0	3.10	9.00		1.60	12.0		2.00	< 0.440							
COI	MW03	7/13/2016	COI-MW03-20160713		20.0	3.10	10.0		1.40	11.0		2.40	< 0.440							
COI	MW03	7/20/2016	COI-MW03-20160720		21.0	3.20	10.0		1.50	10.0		2.60	< 0.440							
COI	MW03	10/17/2016	COI-MW03-2016017		20.0	3.20	9.60		1.80	9.50		2.10	< 0.440							
COI	MW04	6/7/2016	COI-MW04-060716	61.0	14.0	3.00	5.10	7.2	1.20	7.30	150	4.70	2.60	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
COI	MW04	7/6/2016	COI-MW04-20160716		18.0	3.70	7.70		1.40	9.40		2.30	1.40							
COI	MW04	7/13/2016	COI-MW04-20160713		22.0	4.00	9.70		1.60	12.0		< 0.500	< 0.440							
COI	MW04	7/20/2016	COI-MW04-20160720		18.0	3.80	7.80		1.20	9.60		2.30	1.40							
COI	MW04	10/17/2016	COI-MW04-20161017		16.0	3.50	6.60		1.60	8.80		4.10	1.60							
COI	MW05	6/7/2016	COI-MW05-060716	58.0	15.0	3.30	5.90	6.6	1.20	7.40	160	8.40	4.60	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
COI	MW05	7/6/2016	COI-MW05-20160716		14.0	4.30	5.80		< 1.00	7.30		8.20	5.30							
COI	MW05	7/13/2016	COI-MW05-20160713		16.0	3.40	6.20		1.10	8.40		8.30	5.00							
COI	MW05	7/20/2016	COI-MW05-20160720		16.0	3.60	6.50		< 1.00	8.30		8.60	5.10							
COI	MW05	10/17/2016	COI-MW05-20161017		15.0	3.50	5.90		1.00	7.80		8.20	5.20							
COI	MW06	10/17/2016	COI-MW06-20161017		19.0	4.30	8.10		1.80	12.0		8.70	1.10							
COI	MW07	10/17/2016	COI-MW07-20161017		25.0	5.60	13.0		4.90	24.0		11.0	< 0.440							

Notes:

mg/L	milligrams per liter
µg/L	micrograms per liter
CaCO3	calcium carbonate
SU	standard units
µmhos/cm	micromhos per centimeter

Table 4
Summary of PFC Analytical Results Groundwater and Surface Water
City of Issaquah Hydrogeologic Assessment

Well Owner/Property	Well Name	Sampling Date	Sample Name	Perfluorobutanesulfonic acid	Perfluorodecanoic acid	Perfluorododecanoic acid	Perfluoroheptanoic acid	Perfluorohexanesulfonic acid	Perfluorohexanoic acid	Perfluorononanoic acid	**Perfluorooctanesulfonic acid**	**Perfluorooctanoic acid**	Perfluorotetradecanoic acid	Perfluorotridecanoic acid	Perfluoroundecanoic acid
				PFBS	**PFDA**	**PFDoA**	**PFHpA**	**PFHxS**	**PFHxA**	**PFNA**	**PFOS**	**PFOA**	**PFTA**	**PFTrDA**	**PFUnA**
			Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
City of Issaquah	COI6-TMW1s	5/17/2016	COI-MW1-051716	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300	0.003	< 0.00300	< 0.00300	< 0.00300	< 0.00300
City of Issaquah	COI-TW3	5/17/2016	COI-TW3-051716	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300	< 0.00300
Darigold	ABY249	5/4/2016	Darigold-ABY249-050416	0.0032	< 0.00250	< 0.00250	< 0.00250	0.009	< 0.00250	< 0.00250	0.006	< 0.00250	< 0.00250	< 0.00250	< 0.00250
Darigold	ABY249	5/4/2016	Darigold-ABY249-050416-DUP	0.0032	< 0.00250	< 0.00250	< 0.00250	0.009	< 0.00250	< 0.00250	0.007	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW01	6/7/2016	COI-MW01-060716	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	0.0068	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW01	10/17/2016	COI-MW01-20161017	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW02	6/7/2016	COI-MW02-060716	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW02	10/17/2016	COI-MW02-2016017	0.0080	< 0.00250	< 0.00250	< 0.00250	0.005	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	6/7/2016	COI-MW03-060716	0.0920	< 0.00250	< 0.00250	0.029	0.280	0.065	0.0510	**0.440**	**0.0290**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	6/7/2016	COI-MW03-060716-DUP	0.0940	< 0.00250	< 0.00250	0.029	0.300	0.067	0.0510	**0.460**	**0.0300**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	6/21/2016	COI-MW03-20160621	0.0620	< 0.00250	< 0.00250	0.014	0.170	0.033	0.0160	**0.260**	**0.0200**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	6/21/2016	COI-MW03-20160621-DUP	0.0590	< 0.00250	< 0.00250	0.015	0.170	0.033	0.0180	**0.260**	**0.0190**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	6/28/2016	COI-MW03-20160628	0.0490	< 0.00250	< 0.00250	0.014	0.110	0.031	0.0160	**0.170**	**0.0120**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	6/28/2016	COI-MW03-20160628-DUP	0.0470	< 0.00250	< 0.00250	0.011	0.097	0.026	0.0130	**0.150**	**0.0120**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	7/6/2016	COI-MW03-20160716	0.0250	< 0.00250	< 0.00250	0.0063	0.062	0.015	0.0061	0.100	0.00510 J	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	7/6/2016	COI-MW03-20160716-Dup	0.0260	< 0.00250 J	< 0.00250	0.0062	0.062	0.014	0.0056	0.100	0.00710 J	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	7/13/2016	COI-MW03-20160713	0.0310	< 0.00250	< 0.00250	0.0071	0.075	0.016	0.0063	**0.088**	**0.0060**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	7/13/2016	COI-MW03-20160713 DUP	0.0290	< 0.00250	< 0.00250	0.0064	0.070	0.014	0.0055	**0.100**	**0.0053**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	7/20/2016	COI-MW03-20160720	0.0320	< 0.00250	< 0.00250	0.0071	0.080	0.017	0.0063	**0.098**	**0.0062**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	7/20/2016	COI-MW03-20160720-DUP	0.0330	< 0.00250	< 0.00250	0.0073	0.074	0.017	0.0071	**0.100**	**0.0063**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	7/28/2016	COI-MW03-20160728	0.0710	< 0.00250	< 0.00250	0.017	0.170	0.039	0.0250	**0.360**	**0.0160**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	7/28/2016	COI-MW03-20160728-DUP	0.0720	< 0.00250	< 0.00250	0.015	0.160	0.035	0.0220	**0.330**	**0.0150**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	10/17/2016	COI-MW03-2016017	0.0320	< 0.00250	< 0.00250	0.0071	0.067	0.018	0.0055	**0.088**	**0.0059**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW03	10/17/2016	COI-MW03-20161017-DUP	0.0330	< 0.00250	< 0.00250	0.0069	0.070	0.018	0.0056	**0.099**	**0.0061**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW04	6/7/2016	COI-MW04-060716	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	0.003	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW04	6/21/2016	COI-MW04-20160621	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW04	6/28/2016	COI-MW04-20160628	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW04	7/6/2016	COI-MW04-20160716	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW04	7/13/2016	COI-MW04-20160713	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW04	7/20/2016	COI-MW04-20160720	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW04	7/27/2016	COI-MW04-20160727	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	0.0039	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW04	10/17/2016	COI-MW04-20161017	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	0.003	< 0.00250	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW05	6/7/2016	COI-MW05-060716	0.0570	< 0.00250	< 0.00250	0.018	0.160	0.040	0.0086	**0.390**	**0.017**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW05	6/21/2016	COI-MW05-20160621	0.0540	< 0.00250	< 0.00250	0.019	0.170	0.042	0.0080	**0.490**	**0.013**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW05	6/28/2016	COI-MW05-20160628	0.0700	< 0.00250	< 0.00250	0.027	0.180	0.056	0.0100	**0.500**	**0.017**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW05	7/6/2016	COI-MW05-20160716	0.056	< 0.00250	< 0.00250	0.017	0.1700	0.039	0.0075	**0.4800**	**0.011**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW05	7/13/2016	COI-MW05-20160713	0.0580	< 0.00250	< 0.00250	0.0250	0.210	0.0540	0.0120	**0.440**	**0.018**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW05	7/20/2016	COI-MW05-20160720	0.052	< 0.00250	< 0.00250	0.019	0.180	0.040	0.0093	**0.510**	**0.013**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW05	7/28/2016	COI-MW05-20160728	0.066	< 0.00250	< 0.00250	0.023	0.18	0.049	0.0087	**0.5100**	**0.018**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW05	10/17/2016	COI-MW05-20161017	0.061	< 0.00250	< 0.00250	0.021	0.17	0.048	0.0079	**0.4**	**0.015**	< 0.00250	< 0.00250	< 0.00250
City of Issaquah	MW06	10/17/2016	COI-MW06-20161017	0.096	0.0029	< 0.00250	0.073	0.49	0.22	0.053	**2.2**	**0.08**	< 0.00250	< 0.00250	0.016
City of Issaquah	MW07	10/17/2016	COI-MW07-20161017	< 0.00250	< 0.00250	< 0.00250	< 0.00250	0.0049	< 0.00250	< 0.00250	0.0049	0.003	< 0.00250	< 0.00250	< 0.00250

Table 4
Summary of PFC Analytical Results Groundwater and Surface Water
City of Issaquah Hydrogeologic Assessment

Well Owner/Property	Well Name	Sampling Date	Sample Name	Perfluorobutanesulfonic acid PFBS	Perfluorodecanoic acid PFDA	Perfluorododecanoic acid PFDoA	Perfluoroheptanoic acid PFHpA	Perfluorohexanesulfonic acid PFHxS	Perfluorohexanoic acid PFHxA	Perfluorononanoic acid PFNA	**Perfluorooctanesulfonic acid PFOS**	**Perfluorooctanoic acid PFOA**	Perfluorotetradecanoic acid PFTA	Perfluorotridecanoic acid PFTrDA	Perfluoroundecanoic acid PFUnA
Sammamish Plateau Water Sewer District	SPWSD-VT2.1	5/10/2016	SPWSD-VT2.1-051016	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
Sammamish Plateau Water Sewer District	SPWSD-VT2.2	5/10/2016	SPWSD-VT2.2-051016	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
Sammamish Plateau Water Sewer District	SPWSD-VT2.3	5/10/2016	SPWSD-VT2.3-051016	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
Sammamish Plateau Water Sewer District	SPWSD-Well7	6/15/2016	S-06	< 0.0900	NA	NA	< 0.0100	0.0140 J	NA	< 0.0200	0.0190 J	< 0.0200	NA	NA	NA
Sammamish Plateau Water Sewer District	SPWSD-Well7	7/26/2016	Well 7 (201607270134)	0.0043	< 0.00250	< 0.00250	< 0.00250	0.012	0.0026	0.0028	0.015	< 0.00250	< 0.00250	< 0.00250	< 0.00250
Sammamish Plateau Water Sewer District	SPWSD-Well7.3	5/10/2016	SPWSD-Well7.3-051016	0.0054	< 0.00250	< 0.00250	< 0.00250	0.019	< 0.00250	0.0034	0.019	< 0.00250	< 0.00250	< 0.00250	< 0.00250
Sammamish Plateau Water Sewer District	SPWSD-Well8	7/26/2016	Well 8 - Sample 1 (201607270135)	0.0047	< 0.00250	< 0.00250	< 0.00250	0.019	< 0.00250	0.0056	0.026	< 0.00250	< 0.00250	< 0.00250	< 0.00250
Sammamish Plateau Water Sewer District	SPWSD-Well8	7/26/2016	Well 8 - Sample 2 (201607270137)	0.005	< 0.00250	< 0.00250	< 0.00250	0.020	< 0.00250	0.006	0.029	< 0.00250	< 0.00250	< 0.00250	< 0.00250
Sammamish Plateau Water Sewer District	SPWSD-Well9	6/20/2016	S-13	< 0.0900	NA	NA	< 0.0100	< 0.0300	NA	< 0.0200	< 0.0400	< 0.0200	NA	NA	NA
Surface water samples, Issaquah Creek	COI-SW-A	9/27/2016	COI-SW-A-092716	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250
Surface water samples, Issaquah Creek	COI-SW-B	9/27/2016	COI-SW-B-092716	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250

Notes:

Shaded - Value detected above laboratory reporting limit.

Bold - Bold text indicates the results for groundwater are above the corresponding US EPA Provisional Health Advisory Levels of 0.07 ug/L for PFOS and 0.07 ug/L for PFOA or 0.07 for combined PFOS and PFOA concentrations in groundwater (May 2016).

COI City of Issaquah
* City monitoring well COI-MW1 is renamed to COI6-TMW1s to differentiate from new monitoring well MW01.
** Sample analyzed by EPA Method 537 at Anatek Labs Inc, Moscow, ID.
µg/L micrograms per liter
< Value is less than the laboratory reporting limit shown
J Estimated value
NA Not analyzed
Samples analyzed by EPA Method 537 at Eurofins Eaton Analytical Laboratory in Monrovia, CA, unless otherwise noted.
COI-MW-20160716 sample names: the date was incorrectly noted in the field name, the samples were collected on 07/06/16 as indicated by the sample date.

Analytical results were reviewed and validated (Stage 2A) in accordance with guidelines provided in the EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002). Full validation memoranda and analytical laboratory reports are provided as attachments to this technical memorandum.

Sammamish Plateau Sewer and Water District (SPSWD) Wells 7, 8, 9 were sampled by SPSWD on the dates shown; these results are included for reference only. These results were not validated by the COI.

Table 5
Summary of PFCs Analytical Results at 175 Newport Way NW
City of Issaquah Hydrogeologic Assessment

Property	Sample Name	Date Sampled	Soil Sample Depth (inches bgs)	Perfluorobutanesulfonic acid PFBS	Perfluorodecanoic acid PFDA	Perfluorododecanoic acid PFDoA	Perfluoroheptanoic acid PFHpA	Perfluorohexanesulfonic acid PFHxS	Perfluorohexanoic acid PFHxA	Perfluorononanoic acid PFNA	**Perfluorooctanesulfonic acid PFOS**	**Perfluorooctanoic acid PFOA**	Perfluorotetradecanoic acid PFTA	Perfluorotridecanoic acid PFTrDA	Perfluoroundecanoic acid PFUnA
			Units	**ng/g**	**ng/g**	**ng/g**	**ng/g**	**ng/g**	**ng/g**	**ng/g**	**ng/g**	**ng/g**	**ng/g**	**ng/g**	**ng/g**
175 Newport Way NW	COI-STSP01-20160722	2016-07-22	26.5-27	< 1.90	1.2	< 0.960	< 0.720	< 1.90	0.58	0.77	23	< 0.720	< 0.960	< 1.40	1.0
175 Newport Way NW	COI-STTA01-20160722	2016-07-22	26.5-27	8.9	< 0.540	< 1.10	5.1	80	30	9.7	1,300	11	< 1.10	< 1.60	2.8
175 Newport Way NW	COI-STTA02-20160722	2016-07-22	46-46.5	4.5	3.9	< 1.10	2.1	25	15	33	180	4.3	< 1.10	2.7	36 J
175 Newport Way NW	COI-STTA02-20160722-Dup	2016-07-22	46-46.5	5.4	4.5	< 1.20	2.4	29	19	43	250	5.2	< 1.20	3	63 J

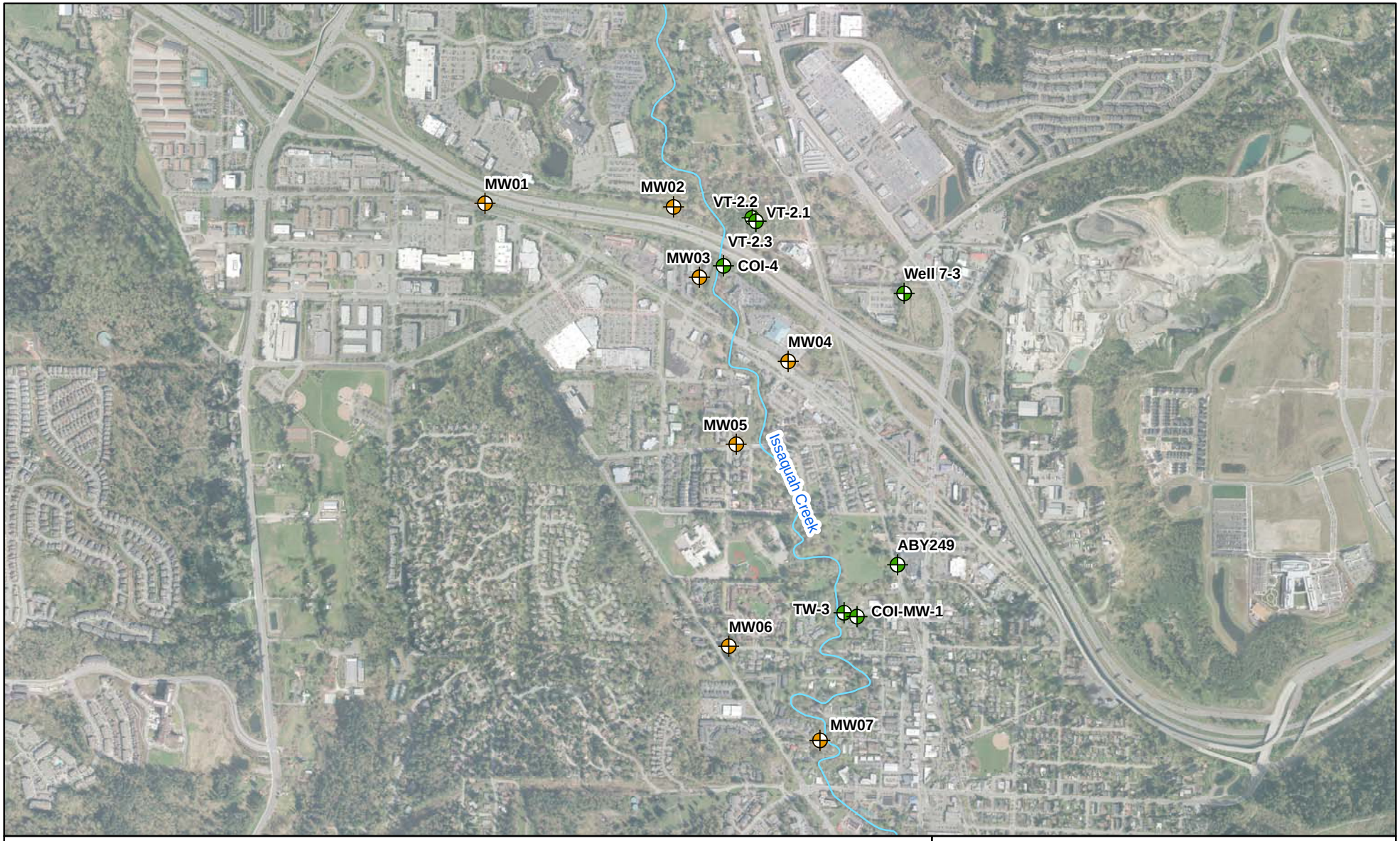
Notes:

Shaded - Value detected above laboratory reporting limit.
mg/kg milligrams per kilogram
ng/g nanogram per gram
< Value is less than the laboratory reporting limit shown
J Estimated value
bgs below ground surface

Samples analyzed by EPA Method 537 at Eurofins Eaton Analytical Laboratory in Monrovia, CA, unless otherwise noted.

Analytical results were reviewed and validated (Stage 2A) in accordance with guidelines provided in the EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002). Full validation memoranda and analytical laboratory reports are provided as attachments to this technical memorandum.

FIGURES



Legend

- Existing Well
- Newly Installed Monitoring Well

Notes

1. Aerial image from 2012.

N

0 0.5 Miles

Monitoring Well Locations

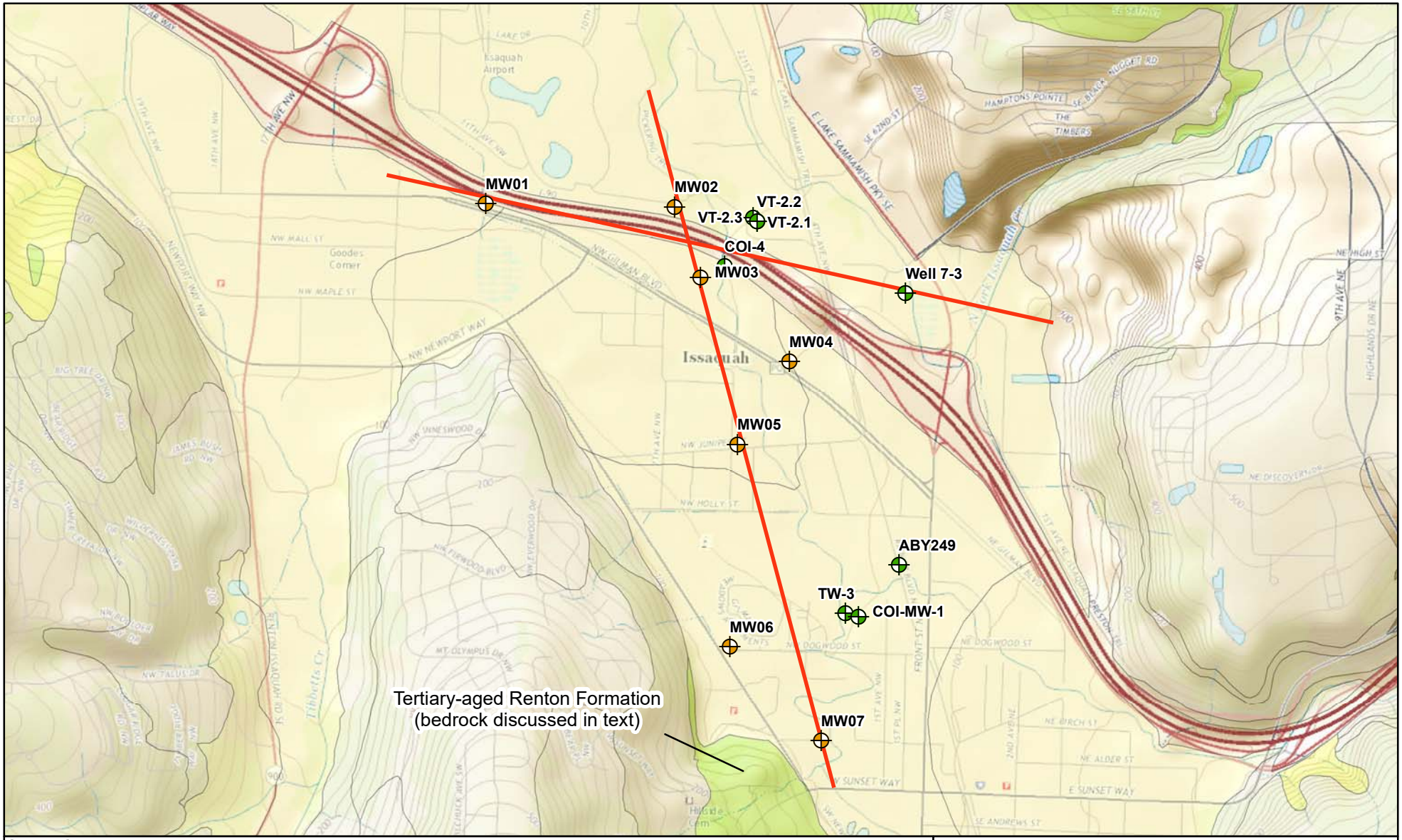
Issaquah, Washington

Geosyntec consultants

Seattle, Washington | November 2016

Figure 1

S:\GIS\PNG0714 - Issaquah\Projects\WellInstallation_TechMemo\Fig01_MonitoringWells.mxd 8/11/2016 10:47:20 AM



Legend

Quaternary Rocks and Deposits

- Quaternary alluvium
- Quaternary mass-wasting deposits
- Pleistocene continental glacial drift
- Pleistocene glacial and nonglacial deposits

Tertiary Rocks

- Tertiary continental sedimentary rocks

- Existing Well
- Newly Installed Monitoring Well
- Cross Section

Notes

1. USGS topographic map from ESRI.
2. Geologic map from USGS, 2012.

0 0.5 Miles

Geologic Map

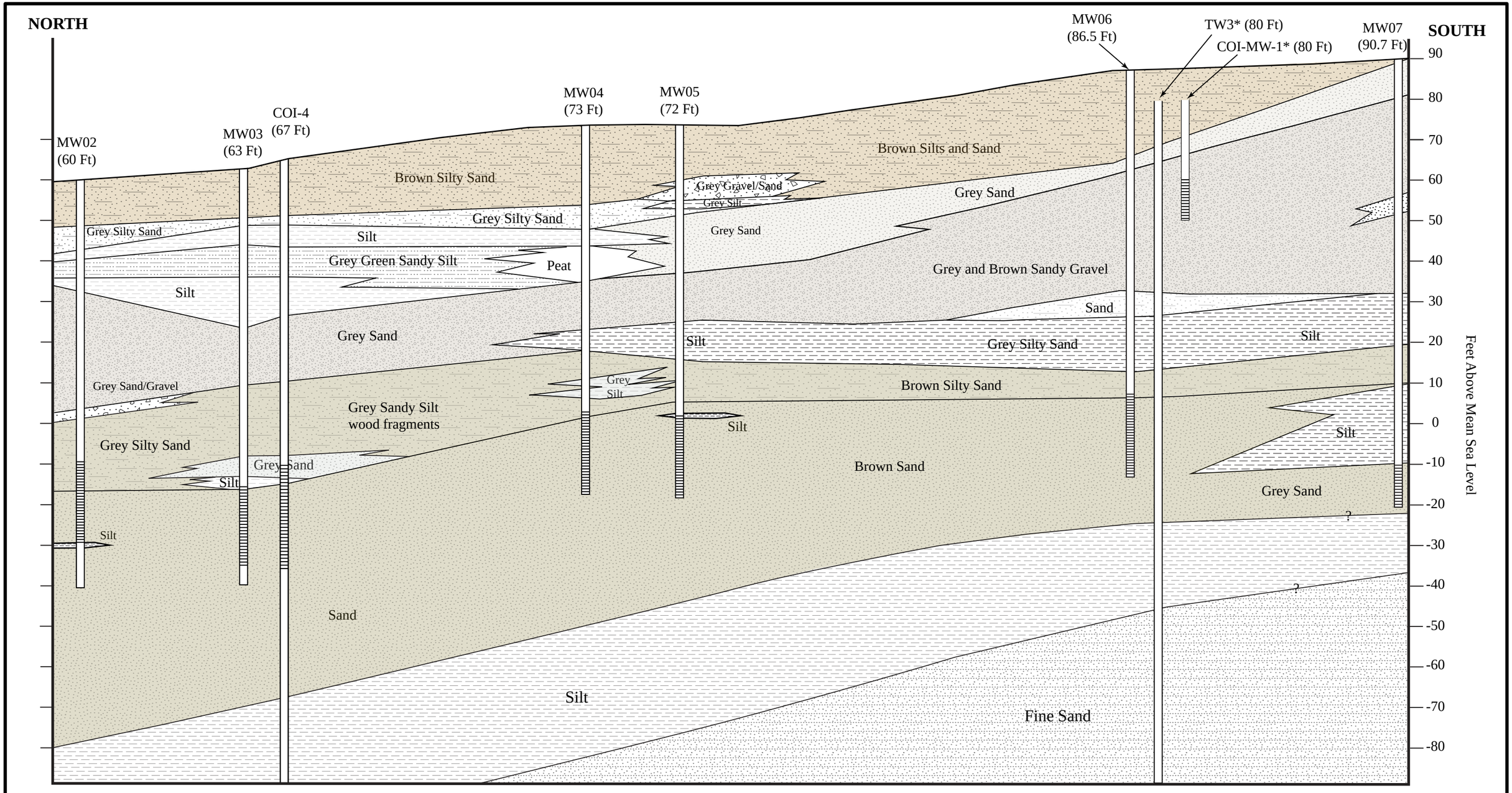
Issaquah, Washington

Geosyntec consultants

Seattle, Washington | November 2016

Figure 2

P:\GIS\PNG0714 - Issaquah\Projects\COI_Report\Fig02_GeologicMap.mxd 11/21/2016 11:38:24 AM



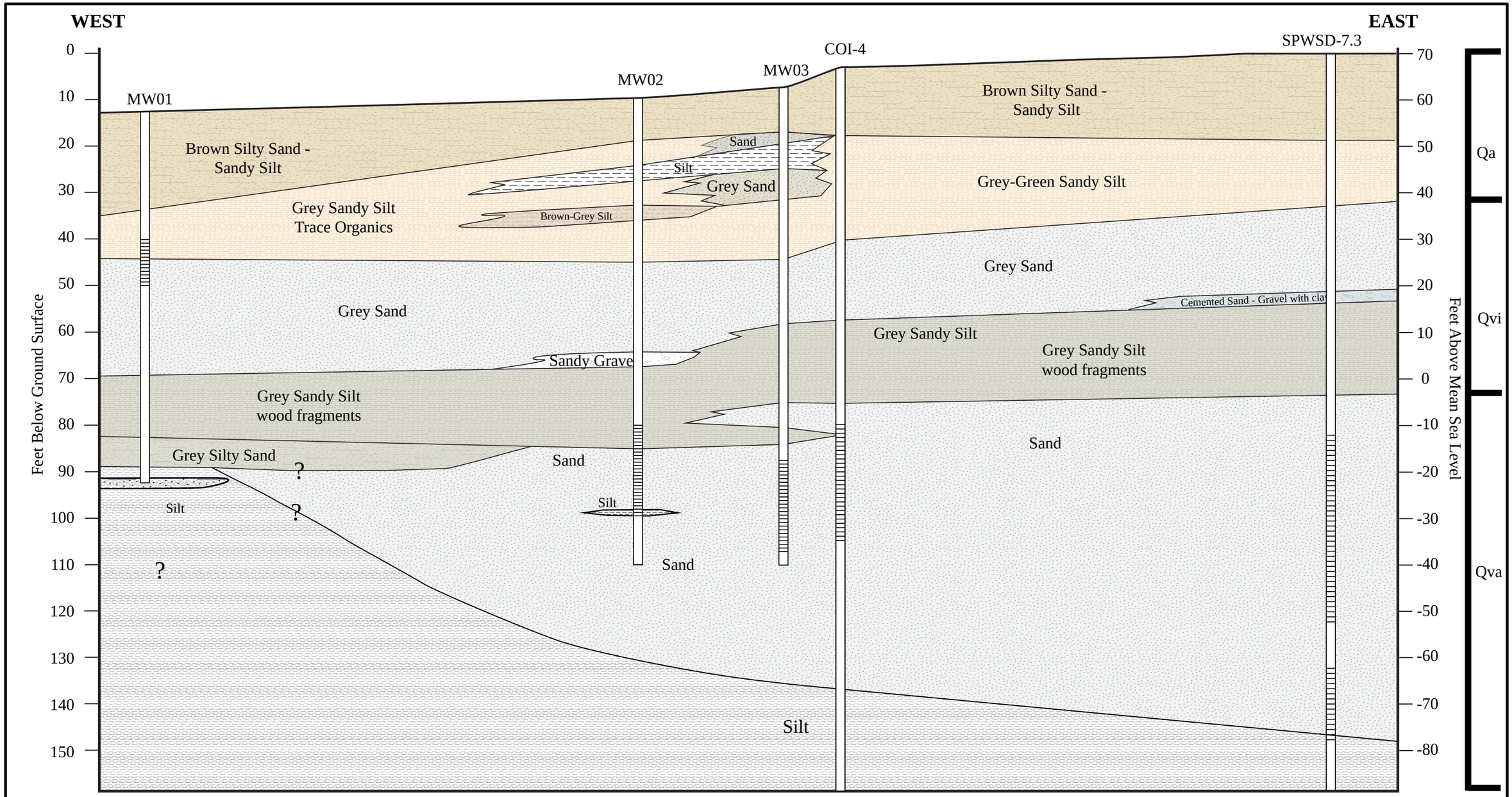
Notes:
Qa - Quaternary Alluvium
Qvi - Quaternary Ice Contact Deposits
Qva - Quaternary Advance Outwash Deposits
20x Vertical Exaggeration
*Wells Projected into line of section
(XX Ft) - Ground Elevation of Well

Interpreted North-South Cross Section
City of Issaquah

Geosyntec consultants

Seattle, WA | November 2016

Figure 2A



20 Feet
10
0

0 500 1,000 Feet

Note: 20x Vertical Exaggeration

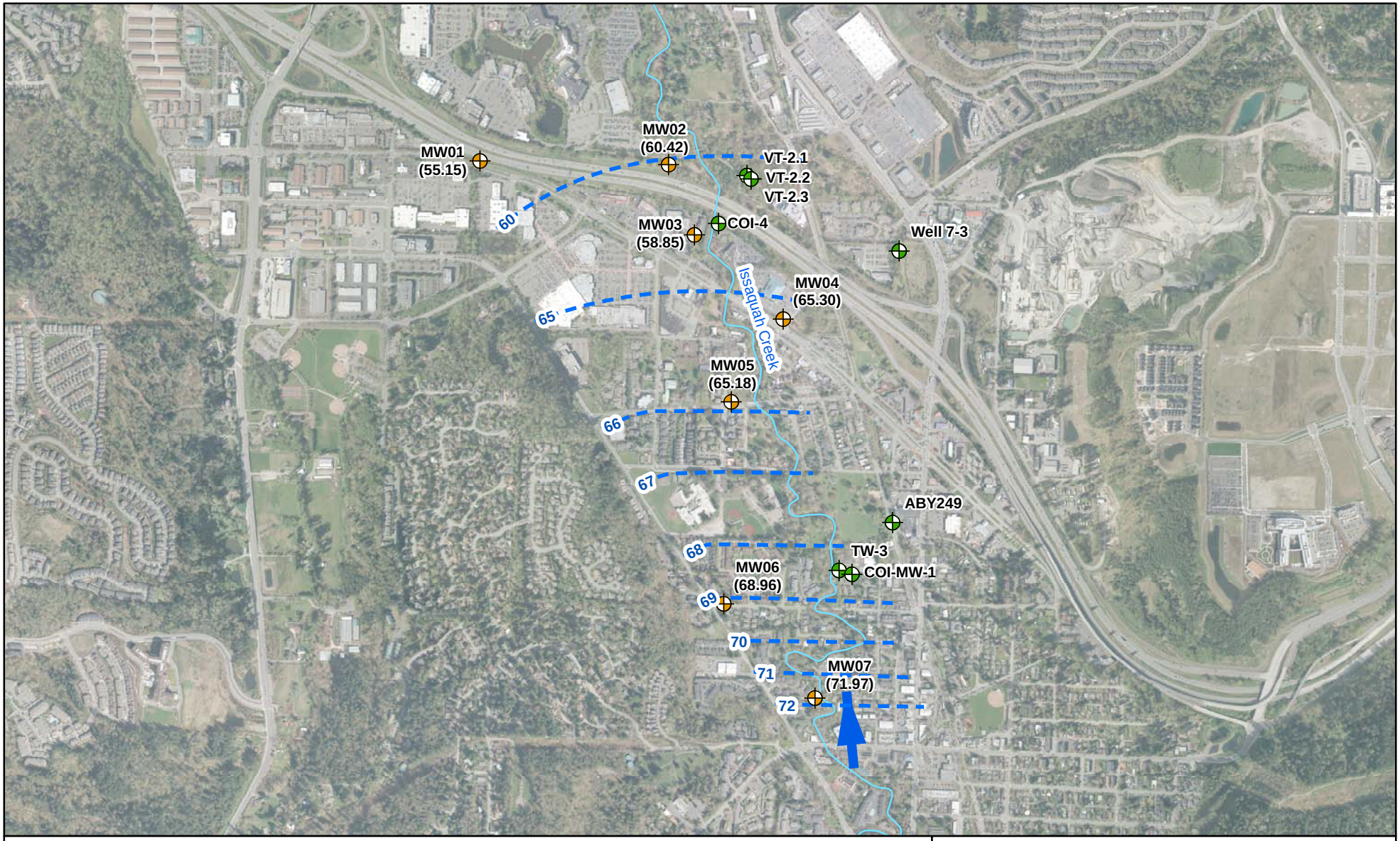
Notes:
Qa - Quaternary Alluvium
Qvi - Quaternary Ice Contact Deposits
Qva - Quaternary Advance Outwash Deposits
20x Vertical Exaggeration
*Wells Projected into line of section

Interpreted West-East Cross Section
City of Issaquah

Geosyntec consultants

Seattle, WA | June 2016

Figure 2B



Legend

- Existing Well
- Newly Installed Monitoring Well
- Groundwater Elevation
- Estimated Groundwater Flow Direction

(54.88) - Groundwater Elevation (hand measured in October 2016).

Notes

1. Aerial image from 2012.
2. Groundwater Elevations in feet above mean sea level.

N

0 0.5 Miles

Groundwater Elevations, October 2016

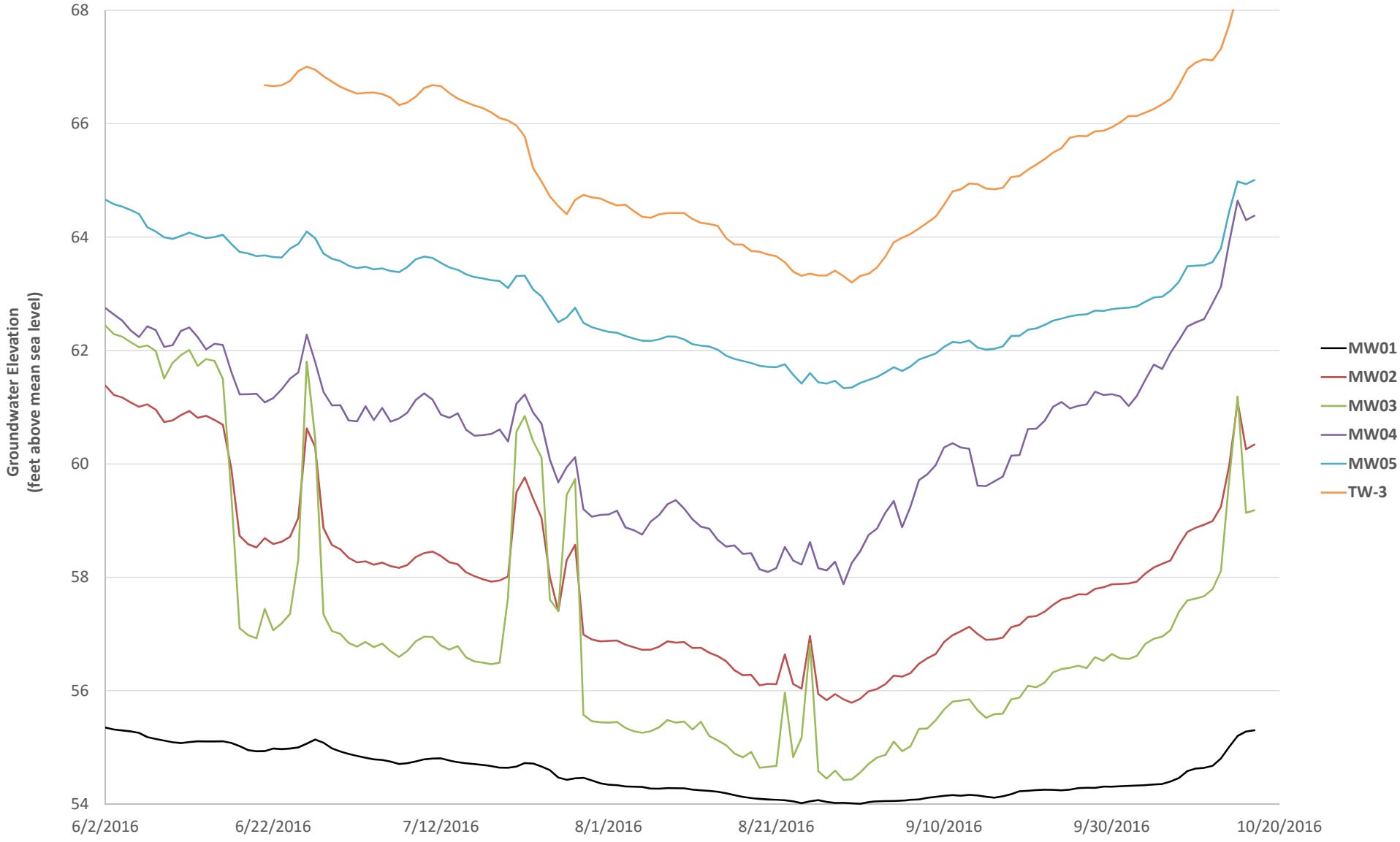
Issaquah, Washington

Geosyntec consultants

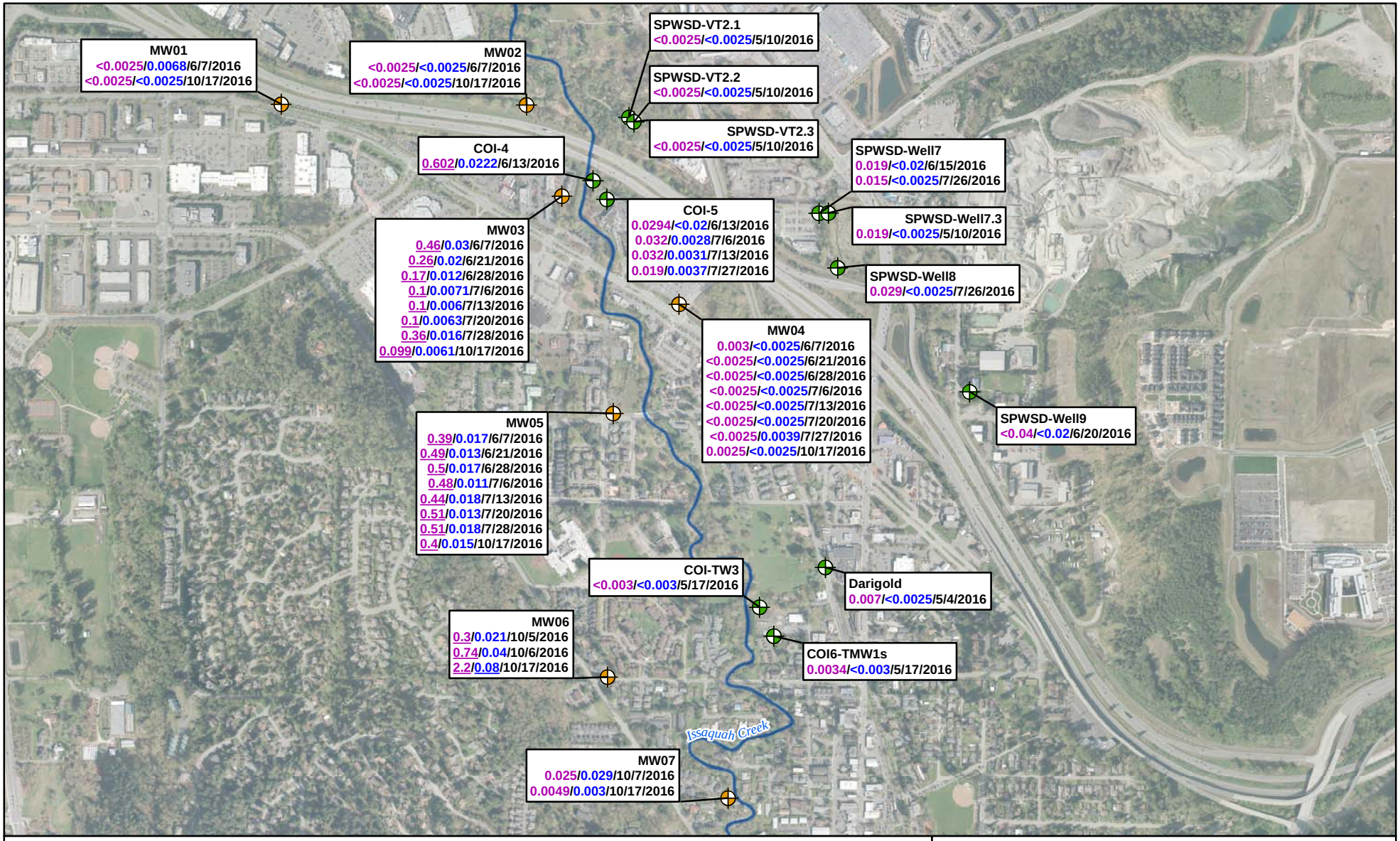
Seattle, Washington | November 2016

Figure 3

\\SantaBarbara-01\Data\GIS\PNG0714 - Issaquah\Projects\COI_Report\Fig03_GW_Levels.mxd 11/18/2016 3:22:15 PM



Geosyntec consultants	November 2016	**Figure 4** **Average Daily Groundwater Elevations, June 2-October 17, 2016** City of Issaquah, Issaquah, WA
	PNG0714	



Legend

- Monitoring Wells
- Newly Installed Monitoring Well; MW06; MW07
- Issaquah Creek

Location
PFOS/PFOA/Sample Date

Notes
1. Aerial image from 2012.
2. Results presented as a µg/L.
3. Underlined results exceed 0.07µg/L

N

0 1,500 Feet

PFOS and PFOA Results

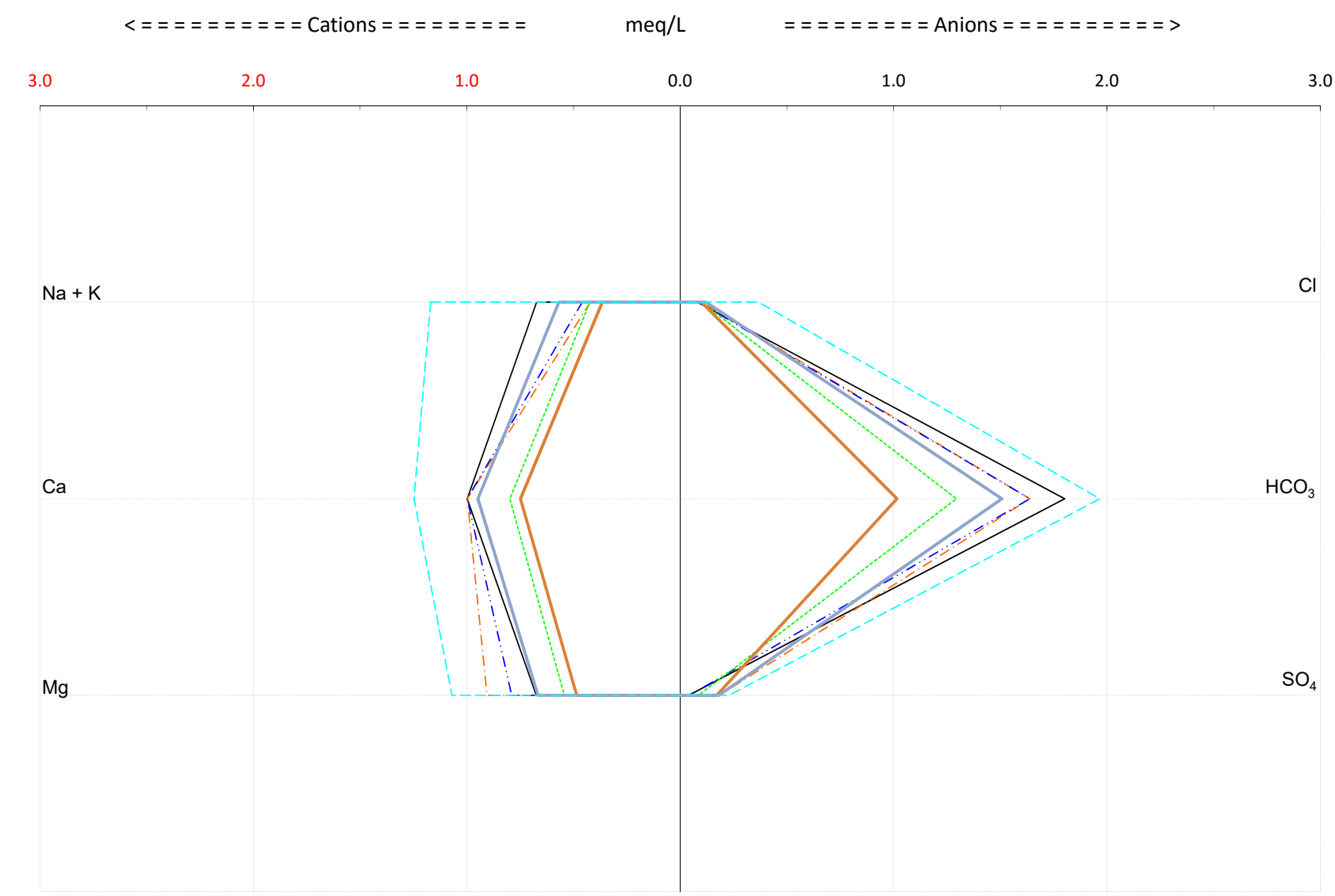
Issaquah, Washington

Geosyntec consultants

Seattle, Washington | November 2016

Figure 5

S:\GIS\PNG0714 - Issaquah\Projects\COI_Report\Fig05_PFOS-PFOA_Results.mxd 11/15/2016 STM 11:49:22 AM

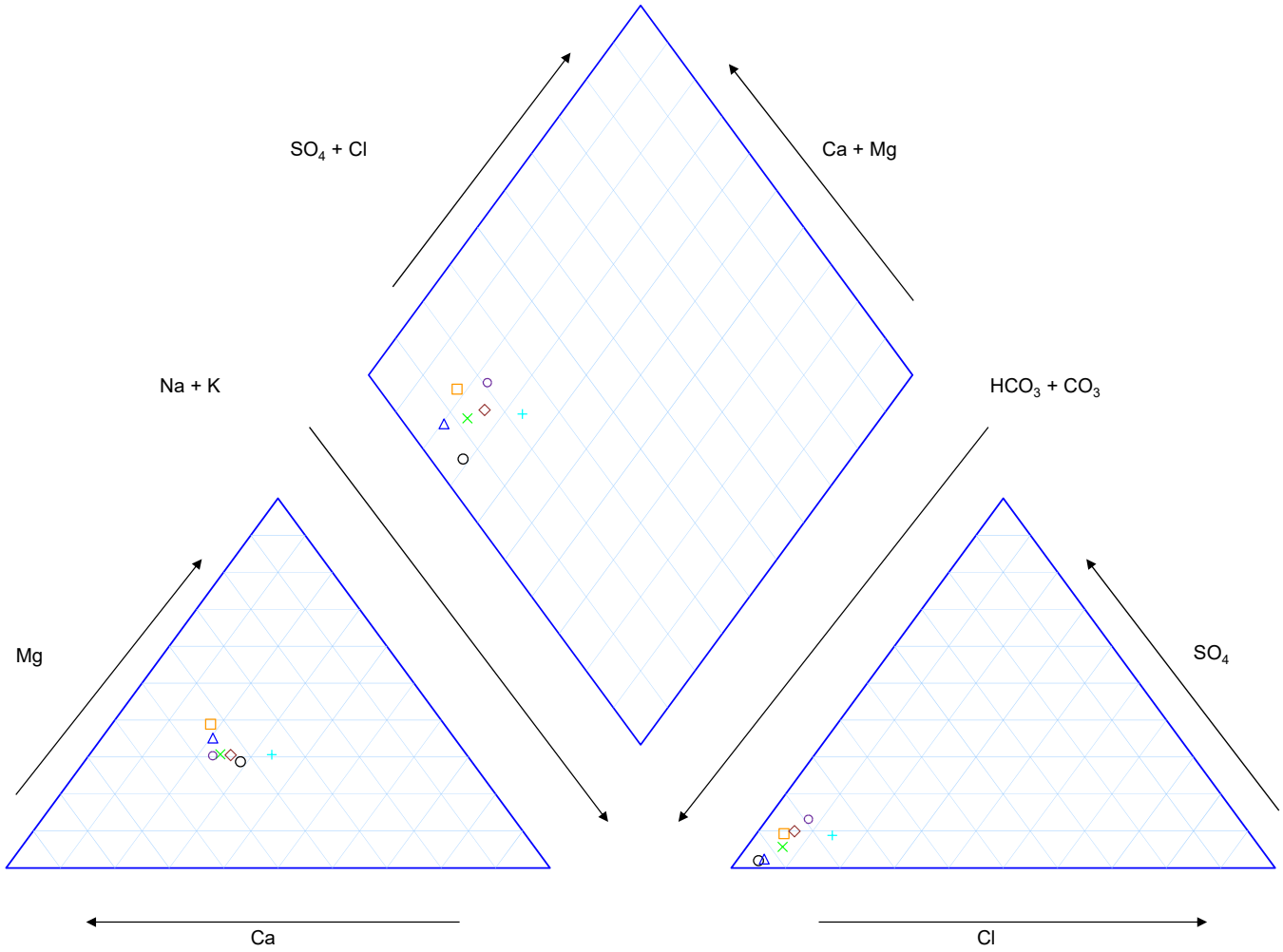


Geosyntec consultants

November 2016

PNG0714

Figure 6
Water Quality: Stiff Diagram
City of Issaquah, Issaquah, WA



○ MW01 □ MW02 △ MW03 × MW04

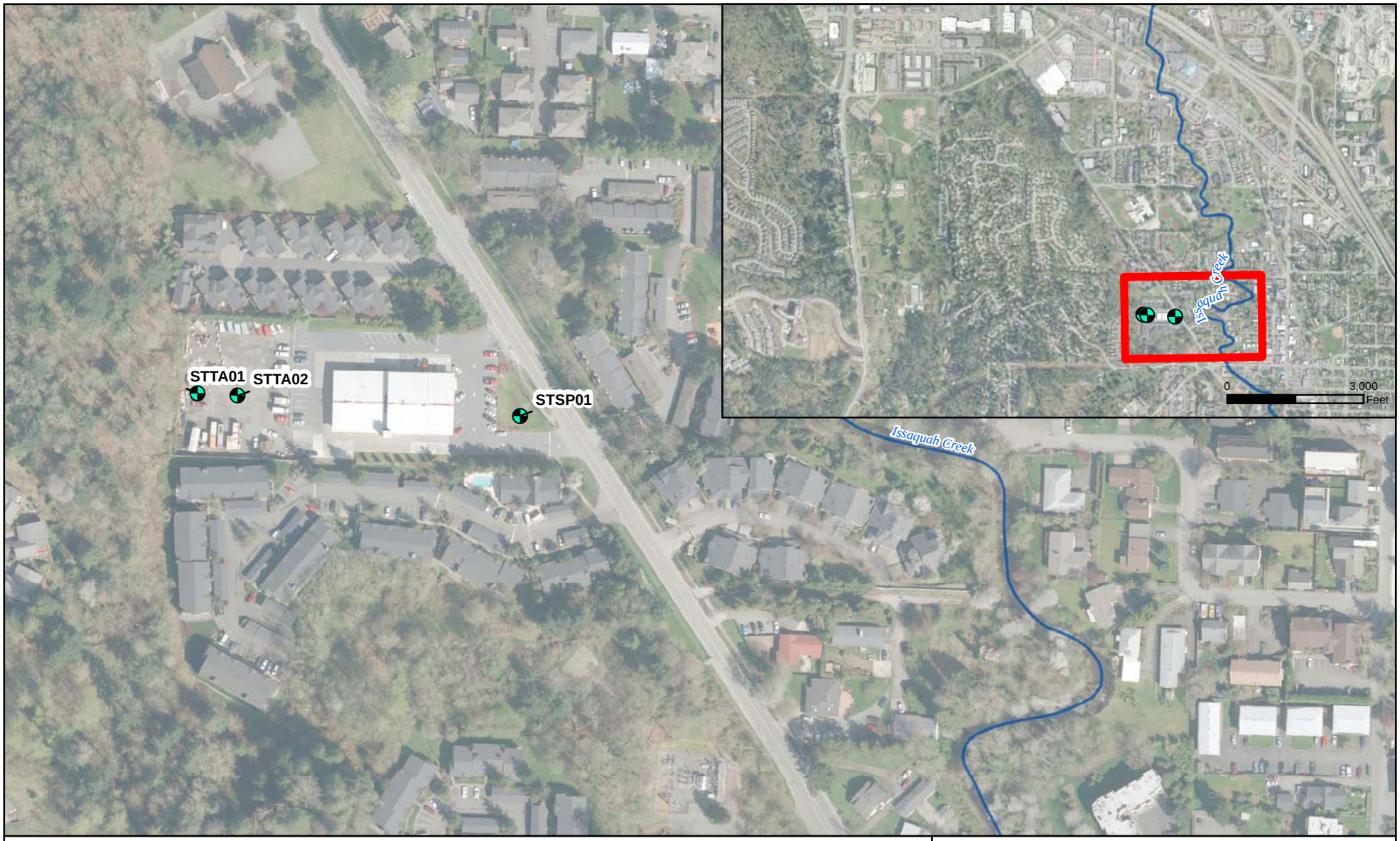
○ MW05 ◇ MW06 + MW07

Geosyntec consultants

November 2016

PNG0714

Figure 7
Water Quality: Trilinear Plot
City of Issaquah, Issaquah, WA



Legend

- Soil Sample
- Issaquah Creek

Notes

1. Aerial image from 2012.

0 200 Feet

Soil Sample Locations at 175 Newport Way NW

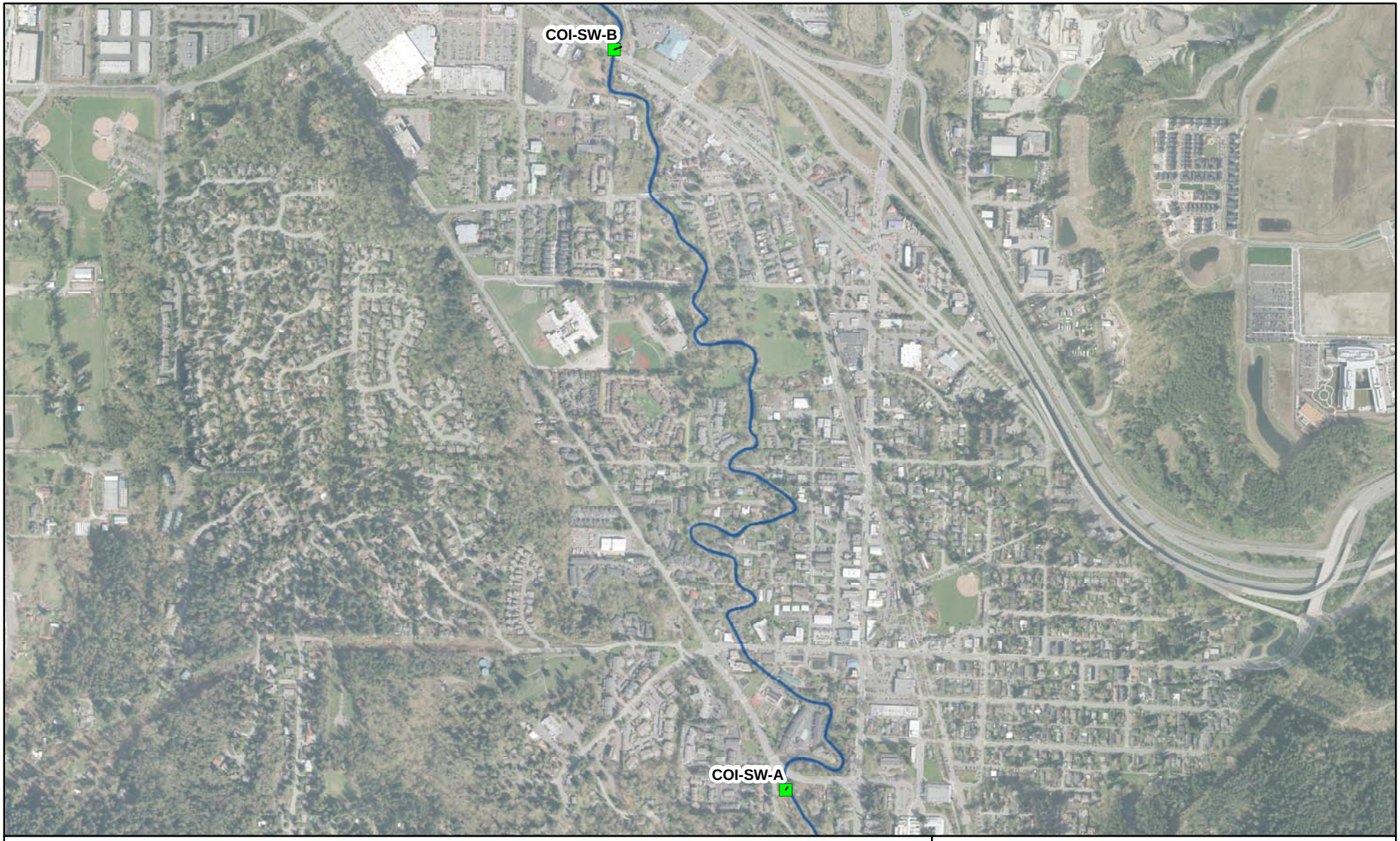
Issaquah, Washington

Geosyntec consultants

Seattle, Washington | September 2016

Figure 8

S:\GIS\PNG0714 - Issaquah\Projects\WellInstallation_TechMemo\Fig08_SoilSamples.mxd 9/13/2016 SRF 9:39:54 AM



Legend

- Surface Water Sample Location
- Issaquah Creek

Notes
1. Aerial image from 2012.

0 1,000 Feet

Surface Water Sample Locations

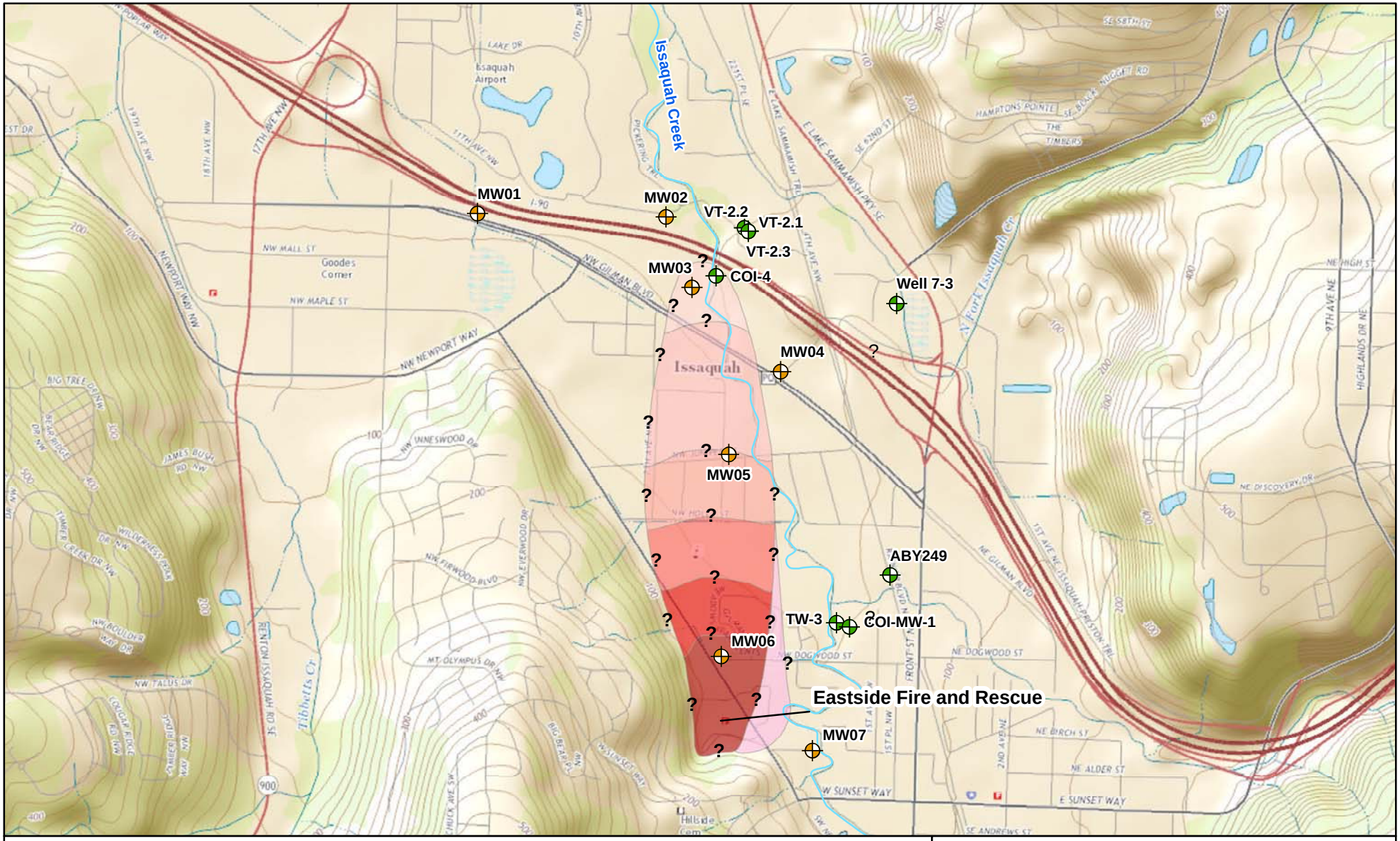
Issaquah, Washington

Geosyntec consultants

Seattle, Washington | November 2016

Figure 9

S:\GIS\PNG0714 - Issaquah\Projects\COI_Report\Fig09_SWSamples.mxd 11/15/2016 SRF 1:45:03 PM



Legend

- Existing Well
- Newly Installed Monitoring Well
- Interpreted extent of PFOS concentrations in groundwater, Diffusion
- Interpreted extent of PFOS concentrations in groundwater < 0.1 ug/L
- Interpreted extent of PFOS concentrations in groundwater > 0.1 ug/L
- Interpreted extent of PFOS concentrations in groundwater > 0.5 ug/L
- Interpreted extent of PFOS concentrations in groundwater > 1.0 ug/L
- Interpreted extent of PFOS concentrations in groundwater > 1.5 ug/L
- Interpreted extent of PFOS concentrations in groundwater > 2.0 ug/L

Notes

1. USGS topographic map supplied by ESRI.
2. Question marks indicate data gaps.

Interpreted Extent of PFOS in Groundwater

Issaquah, Washington

Geosyntec consultants

Seattle, Washington | November 2016

Figure 10

S:\GIS\PNG0714 - Issaquah\Projects\COI_Report\Fig10_PlumeExtent.mxd 11/17/2016 1:59:46 PM

APPENDIX A
DISCRETE DEPTH GROUNDWATER SAMPLING DURING DRILLING

1. DISCRETE DEPTH GROUNDWATER SAMPLING DURING DRILLING

Discrete-depth groundwater samples were obtained during drilling as described in the Work Plan (Geosyntec, 2016). The methodology for sampling during drilling was as follows:

- MW01 - samples were obtained using disposable bailers for the shallow and deep samples. A second discrete-depth groundwater sample was obtained at MW01 at the total borehole depth of 80 feet bgs. Approximately one casing volume of water was purged prior to collecting the deeper groundwater sample because water was added during drilling (due to heaving sand conditions).

- MW02, MW04, and MW05 - a peristaltic pump and new, disposable low-density polyethylene (LDPE) tubing were used to purge the borehole and sample first encountered groundwater.

- MW03 was purged and sampled at first encountered groundwater using a peristaltic pump and new, disposable LDPE tubing. A second sample was collected at approximately 40 to 50 feet bgs, and three casing volumes of water were purged prior to sampling because water was added during drilling (due to heaving sand conditions). A stainless steel Monsoon® pump and disposable LDPE tubing were used for the purging and sampling at the deeper depth. An equipment blank was collected from the Monsoon® pump and tubing before purging.

- MW06 and MW07 a peristaltic pump and new, disposable LDPE tubing were used to purge the borehole and sample first encountered groundwater. Groundwater samples were also obtained at MW06 at depths of 34.5 to 39.5 and 51 to 56, feet bgs, and at MW07 at 35 to 40 and 65 to 70 feet bgs.

Groundwater samples were placed directly into laboratory supplied-containers, placed into a cooler with ice, and submitted for analytical testing on a standard turn-around time. Each cooler was shipped to the laboratory with a trip blank. Thirteen groundwater samples, five trip blanks, and one equipment blank were analyzed by Eurofins Eaton Analytical Laboratory in Monrovia, CA for PFCs using Environmental Protection Agency (EPA) Method 537.

1.1 Discrete-Depth Analytical Results

PFCs were detected in nine groundwater samples from MW02, MW03, MW04, MW05, MW06, and MW07 as follows:

- MW01: PFCs were not detected (<0.0025 micrograms per liter [µg/L]) in either the shallow (10 to 20 feet bgs) or deep (55 to 65 feet bgs) samples.

- MW02: PFOS and PFOA were not detected (<0.0025 µg/L) in the sample from 40 to 50 feet bgs, although perflourobutanesulfonic acid (PFBS), perfluorohexanesulfonic acid (PFHxS), and perfluorohexanoic acid (PFHxA) were detected.

- MW03: PFOS was detected at 0.01 and 0.11 µg/L and PFOA at 0.0046 and 0.0075 µg/L in the samples from 10 to 20 and 40 to 50 feet bgs, respectively. Other PFCs detected in both groundwater samples included PFBS, PBHpA, PFHxS, PFHxA, and PFNA. The PFOS concentration in the deeper sample was an order of magnitude higher than the shallow sample.

- MW04: PFOS was detected at a concentration of 0.003 µg/L, and PFOA was not detected (<0.0025 µg/L). PFBS and PFHxS were also detected in the sample from MW04.

- MW05: PFOS and PFOA were detected at 0.013 µg/L at 0.022 µg/L, respectively. Other PFCs detected in MW05 included PFBS, PBHpA, PFHxS, PFHxA, and PFNA.

- MW06: PFOS was detected at 0.30 µg/L, 0.50 µg/L, 0.74 µg/L and PFOA was detected 0.021 µg/L, 0.036 µg/L, 0.040 µg/L (with increasing depth, shallow to deepest). Other PFCs detected in MW06 included PFBS, PBHpA, PFHxS, PFHxA, PFNA, and Perfluoroundecanoic acid (PFUnA).

- MW07: PFOS and PFOA were detected in the shallowest sample at 0.025 and 0.029 µg/L. PFOS was detected at 0.004 and 0.018 µg/L at the next two depths sampled. Other PFCs detected in MW07 included PFBS, PBHpA, PFHxS, and PFHxA.

The EPA provisional health advisory level for PFOS and PFOA, individually or summed together, is 0.07 µg/L. The PFOS concentration (0.11 µg/L) in one sample from MW03 (40 to 50 feet bgs) and the three samples at MW06 (ranging from 0.3 to 0.74 µg/L) were greater than the EPA provisional health advisory level. PFOS concentrations were below the EPA level at MW02, MW03 (10 to 20 feet bgs), MW04, MW05, and MW07. PFOA was detected below the EPA level at MW03 (2 samples), MW05, and MW07 (1 sample).

Analytical results are summarized in Table A-1. Analytical laboratory reports are included in Attachment B along with a Data Quality Review Memo. Results of the data quality review indicate that analytical data are acceptable.

Table A-1
Summary of Discrete Depth Sample PFCs Analytical Results
City of Issaquah Hydrogeologic Assessment

Well Owner/ Property	Well Name	Sampling Date	Sample Name	Perfluorobutanesulfonic acid	Perfluorodecanoic acid	Perfluorododecanoic acid	Perfluoroheptanoic acid	Perfluorohexanesulfonic acid	Perfluorohexanoic acid	Perfluorononanoic acid	**Perfluorooctanesulfonic acid**	**Perfluorooctanoic acid**	Perfluorotetradecanoic acid	Perfluorotridecanoic acid	Perfluoroundecanoic acid
				PFBS	**PFDA**	**PFDoA**	**PFHpA**	**PFHxS**	**PFHxA**	**PFNA**	**PFOS**	**PFOA**	**PFTA**	**PFTrDA**	**PFUnA**
			Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Discrete Depth Sampling Results															
COI	MW01	5/26/2016	MW01_30to40_20160526	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
COI	MW01	5/26/2016	MW01_55to65_20160526	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
COI	MW02	5/31/2016	MW02_40 to 50_20160531	0.0073	<0.0025	<0.0025	<0.0025	0.0077	0.0051	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
COI	MW03	5/24/2016	MW03_10 to 20_20160524	0.019	<0.0025	<0.0025	0.0051	0.031	0.012	0.0027	0.01	0.0046	<0.0025	<0.0025	<0.0025
COI	MW03	5/23/2016	MW03_40 to 50_20160524	0.036	<0.0025	<0.0025	0.0086	0.08	0.021	0.0091	**0.11**	**0.0075**	<0.0025	<0.0025	<0.0025
COI	MW04	5/27/2016	MW04_29to39_20160527	0.0051	<0.0025	<0.0025	<0.0025	0.0084 U	<0.0025	<0.0025	0.0028 U	<0.0025	<0.0025	<0.0025	<0.0025
COI	MW05	5/23/2016	MW05_10 to 20_20160523	0.03	<0.0025	<0.0025	0.016	0.039	0.036	0.0084 U	0.013	0.022	<0.0025	<0.0025	<0.0025
COI	MW06	10/5/2016	COI-MW06-20161005-19.5-24.	0.03	< 0.00250	< 0.00250	0.026	0.14	0.061	0.0069	**0.3**	**0.021**	< 0.00250	< 0.00250	< 0.00250
COI	MW06	10/6/2016	COI-MW06-20161006-34.5-39.	0.052	< 0.00250	< 0.00250	0.044	0.24	0.1	0.021	**0.5**	**0.036**	< 0.00250	< 0.00250	0.0062
COI	MW06	10/6/2016	COI-MW06-20161006-51-56	0.073	< 0.00250	< 0.00250	0.05	0.3	0.13	0.022	**0.74**	**0.040**	< 0.00250	< 0.00250	0.019
COI	MW07	10/7/2016	COI-MW07-20161007-20-25	0.0044	< 0.00250	< 0.00250	0.0076	0.0094	0.011	< 0.00250	0.03	0.029	< 0.00250	< 0.00250	< 0.00250
COI	MW07	10/7/2016	COI-MW07-20161007-35-40	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	< 0.00250	0.0	< 0.00250	< 0.00250	< 0.00250	< 0.00250
COI	MW07	10/7/2016	COI-MW07-20161007-65-70	< 0.00250	< 0.00250	< 0.00250	< 0.00250	0.004	< 0.00250	< 0.00250	0.0	< 0.00250	< 0.00250	< 0.00250	< 0.00250

Notes:

Shaded - Value detected above laboratory reporting limit.

Bold - Values are above the corresponding US EPA Provisional Health Advisory Levels of 0.07 ug/L for PFOS and 0.07 ug/L for PFOA or 0.07 for combined PFOS and PFOA concentrations.

APPENDIX B
BOREHOLE AND MONITORING WELL CONSTRUCTION LOGS

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

PROJECT Phase 2 Hydrogeologic Investigation
PROJECT LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

KEY SHEET - CLASSIFICATIONS AND SYMBOLS

GS FORM: KEY 09/99

EMPIRICAL CORRELATIONS WITH STANDARD PENETRATION RESISTANCE N VALUES *

	N VALUE * (BLOWS/FT)	CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (TONS/SQ FT)
FINE GRAINED SOILS	0 - 2	VERY SOFT	<0.25
	3 - 4	SOFT	0.25 - 0.50
	5 - 8	FIRM	0.50 - 1.00
	9 - 15	STIFF	1.00 - 2.00
	16 - 30	VERY STIFF	2.00 - 4.00
	31 - 50	HARD	>4.00
	>50	VERY HARD	

	N VALUE * (BLOWS/FT)	RELATIVE DENSITY
COARSE GRAINED SOILS	0 - 4	VERY LOOSE
	5 - 10	LOOSE
	11 - 30	MEDIUM DENSE
	31 - 50	DENSE
	>50	VERY DENSE

* ASTM D 1586; NUMBER OF BLOWS OF 140 POUND HAMMER FALLING 30 INCHES TO DRIVE A 2 IN. O.D., 1.4 IN. I.D. SAMPLER ONE FOOT.

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

MAJOR DIVISIONS			SYMBOLS	DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50% OF MATERIAL COARSER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50% OF COARSE FRACTION RETAINED ON NO.4 SIEVE	CLEAN GRAVELS — LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES — APPRECIABLE AMOUNT OF FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS — MORE THAN 50% OF COARSE FRACTION PASSING NO.4 SIEVE	CLEAN SANDS — LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES — APPRECIABLE AMOUNT OF FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS — MORE THAN 50% OF MATERIAL FINER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT

NOTE: DUAL SYMBOLS USED FOR BORDERLINE CLASSIFICATIONS

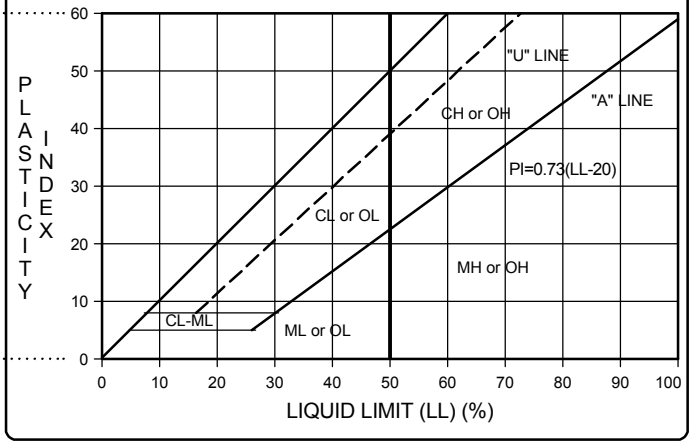
PARTICLE SIZE IDENTIFICATION

BOULDERS	>300 mm
COBBLES	75 - 300 mm
GRAVEL: COARSE	19.0 - 75 mm
GRAVEL: FINE	4.75 - 19 mm
SAND: COARSE	2.00 - 4.75 mm
SAND: MEDIUM	0.425 - 2.00 mm
SAND: FINE	0.075 - 0.425 mm
SILT	0.075 - 0.002 mm
CLAY	<0.002 mm

WELL GRADED - HAVING WIDE RANGE OF GRAIN SIZES AND APPRECIABLE AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES

POORLY GRADED - PREDOMINANTLY ONE GRAIN SIZE, OR HAVING A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING

PLASTICITY CHART



OTHER MATERIAL SYMBOLS

- Siltstone
- Sandstone
- Siltstone/Claystone
- Claystone
- Shale
- Siltstone/Sandstone
- Conglomerate
- Granitic
- Sand
- Silt
- Silty Sand
- Alluvium
- Artificial Fill
- Debris Fill
- Asphalt
- Cement

WELL SYMBOLS

- HYDRATED GRANULAR BENTONITE
- BENTONITE CEMENT GROUT
- FILTER PACK
- CONCRETE
- NATIVE/ SLOUGH
- CENTRAL-IZER

SAMPLER AND OTHER SYMBOLS

- GRAB SAMPLE
- SPLIT SPOON
- STANDARD PENETRATION TEST (SPT)
- SHELBY TUBE
- CALIFORNIA SAMPLER

- Water Level at Time Drilling, or as Shown
- Static Water Level
- MSL: Mean Sea Level
- MC: Moisture Content
- DD: Dry Density
- SA: Sieve Analysis
- PI: Plasticity Index
- LL: Liquid Limit
- c: Cohesion
- K: Hydraulic Conductivity
- Phi: Friction Angle

KEY-PORTLAND PNG0714 ISSAQUAH.GPJ EED DEFAULT GINT LIBRARY.GLB 6/13/16

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

PROJECT Phase 2 Hydrogeologic Investigation
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	9 - 15	STIFF	1.00 - 2.00
	16 - 30	VERY STIFF	2.00 - 4.00
	31 - 50	HARD	>4.00
	>50	VERY HARD	

	N VALUE * (BLOWS/FT)	RELATIVE DENSITY
COARSE GRAINED SOILS	0 - 4	VERY LOOSE
	5 - 10	LOOSE
	11 - 30	MEDIUM DENSE
	31 - 50	DENSE
	>50	VERY DENSE

* ASTM D 1586; NUMBER OF BLOWS OF 140 POUND HAMMER FALLING 30 INCHES TO DRIVE A 2 IN. O.D., 1.4 IN. I.D. SAMPLER ONE FOOT.

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

MAJOR DIVISIONS			SYMBOLS	DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50% OF MATERIAL COARSER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50% OF COARSE FRACTION RETAINED ON NO.4 SIEVE	CLEAN GRAVELS — LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES — APPRECIABLE AMOUNT OF FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS — MORE THAN 50% OF COARSE FRACTION PASSING NO.4 SIEVE	CLEAN SANDS — LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES — APPRECIABLE AMOUNT OF FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS — MORE THAN 50% OF MATERIAL FINER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT

NOTE: DUAL SYMBOLS USED FOR BORDERLINE CLASSIFICATIONS

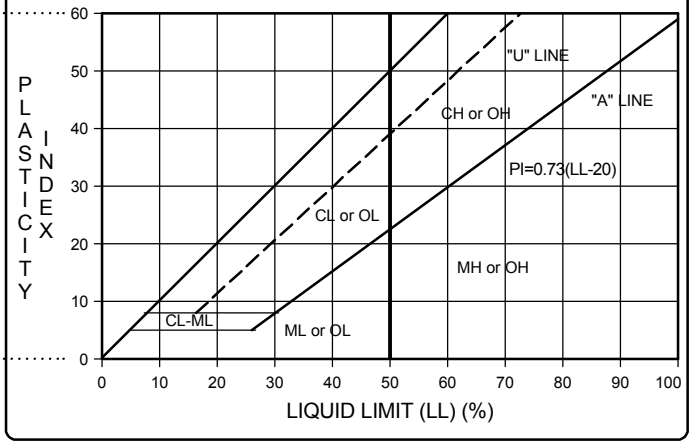
PARTICLE SIZE IDENTIFICATION

BOULDERS	>300 mm
COBBLES	75 - 300 mm
GRAVEL: COARSE	19.0 - 75 mm
GRAVEL: FINE	4.75 - 19 mm
SAND: COARSE	2.00 - 4.75 mm
SAND: MEDIUM	0.425 - 2.00 mm
SAND: FINE	0.075 - 0.425 mm
SILT	0.075 - 0.002 mm
CLAY	<0.002 mm

WELL GRADED - HAVING WIDE RANGE OF GRAIN SIZES AND APPRECIABLE AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES

POORLY GRADED - PREDOMINANTLY ONE GRAIN SIZE, OR HAVING A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING

PLASTICITY CHART



OTHER MATERIAL SYMBOLS

- Siltstone
- Sandstone
- Siltstone/Claystone
- Claystone
- Shale
- Siltstone/Sandstone
- Conglomerate
- Granitic
- Sand
- Silt
- Silty Sand
- Alluvium
- Artificial Fill
- Debris Fill
- Asphalt
- Cement

WELL SYMBOLS

- HYDRATED GRANULAR BENTONITE
- BENTONITE CEMENT GROUT
- FILTER PACK
- CONCRETE
- NATIVE/ SLOUGH
- CENTRAL-IZER

SAMPLER AND OTHER SYMBOLS

- GRAB SAMPLE
- SPLIT SPOON
- STANDARD PENETRATION TEST (SPT)
- SHELBY TUBE
- CALIFORNIA SAMPLER

- Water Level at Time Drilling, or as Shown
- Static Water Level
- MSL: Mean Sea Level
- MC: Moisture Content
- DD: Dry Density
- SA: Sieve Analysis
- PI: Plasticity Index
- LL: Liquid Limit
- c: Cohesion
- K: Hydraulic Conductivity
- Phi: Friction Angle

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Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW01 **SHEET** 1 OF 3
START DATE 5/26/2016 **Elevation** 58.36 FT. MSL
FINISH DATE 5/26/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
0	Grass, topsoil			Surface completion: 8" Morris monument	58					TOPSOIL	
	Brown (7.5YR 4/3), loose, dry, silty SAND; well graded, some rounded gravel								0.1	SM	
5					55						
					50				0.1		
10				2" sch 40 PVC well casing				40			
					45						
15											
	Brown (7.5YR 4/3), medium dense, moist to dry, sandy SILT; some gray mottling, trace fine gravel			Halliburton Hole-plug, 3/8" bentonite chips	40					SM-ML	
20	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT							35		SM-ML	
					35						
	6" fine sand										
25									0.1		
	trace organics/wood fragments										no oxidation noted
					30						
30	Gray (Gley 2 4/5B dark bluish gray), loose, wet, fine to medium SAND; well sorted, poorly graded, trace rounded gravel			2" sch 40 PVC 0.01" slotted well screen				100		SM	First encountered groundwater: 29'
					25	MW01_30to40_20160526@1215					DTW: 18' Screen: 30-40'
35											

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 201387.690
EASTING 1338963.340
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: park bench. Well Tag ID: BJX-185

COORDINATE SYSTEM:

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BOREHOLE LOG

BORING MW01 **SHEET** 2 OF 3
START DATE 5/26/2016 **Elevation** 58.36 FT. MSL
FINISH DATE 5/26/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
			20						10' of sand heave
40	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT						0.2	SM-ML	
	trace organics/wood fragments	Halliburton Hole-plug, 3/8" bentonite chips	15			100			
45	firm to stiff								
			10				0.4		
	organic odor								
50	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT; trace organics and wood fragments					90		SM-ML	
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to medium silty SAND							SM	no oxidation noted
			5						
	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT; trace organics and wood fragments							SM-ML	
55							0.3		
			0						
60				MW01_55to65_20160526 @1600		100			DTW: 13' Screen: 55-65'
			-5						
65									15' of sand heave
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to medium silty SAND; well sorted		-10				0.3	SM	
70									

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 201387.690
EASTING 1338963.340
ANGLE Vertical
BEARING ------
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REMARKS: Site: park bench. Well Tag ID: BJX-185

COORDINATE SYSTEM:

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BOREHOLE LOG

BORING MW01 **SHEET** 3 OF 3
START DATE 5/26/2016 **Elevation** 58.36 FT. MSL
FINISH DATE 5/26/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to medium SAND; trace gravel, well sorted							90		SW	
	Gray (Gley 2 4/5B dark bluish gray), firm, moist, SILT; non-plastic				-15				0.4	ML	
75	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to medium silty SAND; well sorted									SM	
					-20						
80	End of boring, install monitoring well.							100			

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 201387.690
EASTING 1338963.340
ANGLE Vertical
BEARING ------
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REMARKS: Site: park bench. Well Tag ID: BJX-185

COORDINATE SYSTEM:
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BOREHOLE LOG

BORING MW02 **SHEET** 1 OF 3
START DATE 5/31/2016 **Elevation** 59.70 FT. MSL
FINISH DATE 6/2/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
0	Topsoil	Above ground completion (+3.5 feet), steel monument, 3 bollards installed around monument	55					TOPSOIL	
	Brown (10YR 6/6 brownish yellow), medium stiff, dry, sandy SILT; trace oxidation							SM-ML	
	becomes moist								
5	Brown (10YR 6/6 brownish yellow), medium dense, wet, silty fine SAND; well graded, poorly sorted, some oxidation							SM	
	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT; trace wood fragments		50			70		SM-ML	
10									
	3" lens of gray, loose, wet, medium sand		45						
15	Gray (Gley 2 4/5B dark bluish gray), stiff, dry, SILT; slightly mottled							ML	
	Gray (Gley 2 4/5B dark bluish gray), firm, moist, sandy SILT							SM-ML	
	3" lens of gray, loose, wet, medium sand		40			100			
20	becomes wet	2" sch 40 PVC well casing							
	Gray green (Gley 1 4/5G dark greenish gray), stiff, dry, SILT							ML	
25	Gray (Gley 2 4/5B dark bluish gray), firm, moist, sandy SILT		35					SM-ML	
	trace wood fragments								
30			30						
35			25						

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 201354.260
EASTING 1340787.500
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Pickering Trail. Well Tag ID: BJX-187

COORDINATE SYSTEM:

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BOREHOLE LOG

BORING MW02 **SHEET** 2 OF 3
START DATE 5/31/2016 **Elevation** 59.70 FT. MSL
FINISH DATE 6/2/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
40	becomes wet	Halliburton Hole-plug, 3/8" bentonite chips	20			100			First encountered groundwater: 39'
	becomes moist								
	becomes wet								
45	Gray, medium dense, wet, SAND		15					SM	
	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT			MW02_40to50_20160531 @1730				SM-ML	DTW: 2.0' Screen: 40-50'
	becomes moist								
	6" lens gray, medium dense, sand								
50	becomes moist to dry, trace wood fragments		10			100			
	becomes wet								End of drilling 05/31/2016; continue on 06/01/2016
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to medium sandy GRAVEL; poorly sorted, well graded, trace organics and mottling							GM	
55	Gray (Gley 2 4/5B dark bluish gray), firm to soft, wet, sandy SILT; trace wood fragments		5					SM-ML	
60			0			100			
65			-5						
	2-6" lens wet, fine to medium sand								
	Gray (Gley 2 4/5B dark bluish gray), loose, dry,		-10					SW	
70									

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 201354.260
EASTING 1340787.500
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Pickering Trail. Well Tag ID: BJX-187

COORDINATE SYSTEM:

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BOREHOLE LOG

BORING MW02 **SHEET** 3 OF 3
START DATE 5/31/2016 **Elevation** 59.70 FT. MSL
FINISH DATE 6/2/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	medium to coarse SAND; well graded, poorly sorted, some gravel					100			
	Brown (10YR 5/1 gray), loose, dry, medium to coarse SAND; well graded, poorly sorted, some gravel	pre-pack screen						SW	
75			-15						
	6" lens gray, firm, silt								
	Gray (Gley 2 4/5B dark bluish gray), loose, dry, medium to coarse SAND; well graded, poorly sorted, some gravel							SW	
80			-20			100			
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, medium to coarse SAND; poorly graded, no fines, trace coarse gravels							SW	
	6" lens firm, wet, silt								
85			-25						
	Gray (Gley 2 4/5B dark bluish gray), firm, moist, SILT							ML	
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to coarse SAND; well graded							SW	
90			-30			100			10-15' of sand heave
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, silty fine SAND; poorly graded, well sorted							SM-ML	
		Slough							
95			-35						
100	End of boring, install monitoring well.		-40						

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 201354.260
EASTING 1340787.500
ANGLE Vertical
BEARING ------
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REMARKS: Site: Pickering Trail. Well Tag ID: BJX-187

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GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW03 **SHEET** 1 OF 3
START DATE 5/24/2016 **Elevation** 63.16 FT. MSL
FINISH DATE 5/25/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
0	Brown (2.5YR 5/2 weak red), firm, dry, sandy SILT	Surface completion: 8" Morris monument	60				0.2	SM-ML	
5	Brown (7.5YR 4/6 strong brown) with trace red oxidation, loose, wet, fine to medium SAND; trace silt						0.2	SM	
	Brown (7.5YR 4/6 strong brown) with trace red oxidation, very stiff, moist, SILT							ML	
	Brown (2.5YR 5/2 weak red) with some gray mottles, medium dense, moist, sandy SILT; some oxidation		55					SM-ML	
10	Brown (2.5YR 5/2 weak red), loose, wet, medium to fine SAND; some oxidation, well graded, poorly sorted					90	0.2	SM	
	Gray (Gley 2 5/5BG greenish gray), firm, moist, silty SAND; poorly graded, well sorted, trace organics							SM-ML	
	Gray (Gley 2 5/5BG greenish gray), medium dense, wet, silty SAND		50					SM	
15	Gray (Gley 2 5/5BG greenish gray), very stiff, wet, SILT			MW03_10to20_20160524@1545			0.2	ML	DTW: 8.27' Screen: 10-20'
	Gray (Gley 2 4/10B dark bluish gray), medium dense, wet, fine to medium SAND; poorly sorted, well graded		45					SW	
20	Gray (Gley 2 4/5BG dark greenish gray), medium dense, wet, fine to coarse SAND; poorly sorted, well graded					90	0.2	SW	
	Gray (Gley 2 4/5BG dark greenish gray), loose, wet, gravelly coarse SAND; no fines						0.1	SP	
	Gray (Gley 2 4/5BG dark greenish gray), very stiff, wet, SILT; slightly plastic, trace fine sand		40				0.2	ML	
25		2" sch 40 PVC well casing							
			35				0.1		
30						100			Driller using water to drill, heaving conditions
			30						
35									

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 200673.280
EASTING 1341038.950
ANGLE Vertical
BEARING ------
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REMARKS: Site: Dental lab. Well Tag ID: BJX-184

COORDINATE SYSTEM:

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BOREHOLE LOG

BORING MW03 **SHEET** 2 OF 3
START DATE 5/24/2016 **Elevation** 63.16 FT. MSL
FINISH DATE 5/25/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
40	Gray (Gley 2 4/5BG dark greenish gray), loose, wet, fine to coarse SAND; with gravel interbeds				25					SM	
	Gray (Gley 2 4/5BG dark greenish gray), loose, wet, gravelly fine to coarse SAND; fine to coarse gravel			Halliburton Hole-plug, 3/8" bentonite chips (12-50lb bags)				100		SP	
45					20	MW03_40to50_20160524 @1730					DTW: 0.0' Screen: 40-50'
	Gray (Gley 2 4/5BG dark greenish gray), stiff, wet, sandy SILT; trace organics				15			100		ML	
50								100			possible heave
					10				0		
55											
					5				0		
60								100			
					0						
65	Gray (Gley 2 4/5B dark bluish gray), dense, wet, silty fine to coarse SAND; trace organics, well graded, poorly sorted				-5					SM	
70											

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 200673.280
EASTING 1341038.950
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Dental lab. Well Tag ID: BJX-184

COORDINATE SYSTEM:

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BOREHOLE LOG

BORING MW03 **SHEET** 3 OF 3
START DATE 5/24/2016 **Elevation** 63.16 FT. MSL
FINISH DATE 5/25/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT					100		ML	
	trace oxidation at contact						0.6	SP	
	Brown (10YR 4/3), loose, gravelly SAND; fine to coarse, rounded gravel, well sorted, poorly graded (Advanced Outwash)		-10						
75							0.5		
	medium to coarse		-15						
80		2" sch 40 PVC 0.01" slotted well screen				100			
			-20						
85									
			-25						
90						100			10' sand heave
			-30						
95	Gray (Gley 2 5/5B bluish gray), fine to coarse SAND							SP	flowing well, water level fluctuating at ground
	fine to medium		-35						
100	End of boring, install monitoring well	Slough bottom				90			

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 200673.280
EASTING 1341038.950
ANGLE Vertical
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REMARKS: Site: Dental lab. Well Tag ID: BJX-184

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GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW04 **SHEET** 1 OF 3
START DATE 5/27/2016 **Elevation** 73.30 FT. MSL
FINISH DATE 5/31/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
0	Grass, topsoil	Surface completion: 8" Morris monument	70					TOPSOIL	
	Brown, medium stiff, dry, sandy SILT; some rounded gravel							ML	
5			65				0.2		
	Gray, medium dense, dry, medium to fine SAND; poorly graded, trace gravel					60		SM	
10	Gray with some brown, medium dense, dry, silty SAND; poorly graded, trace gravel						0	SM	
	Brown, firm, wet, SILT; oxidation		60					ML	
15									
	Gray (Gley 2 4/5BG dark greenish gray), medium dense, moist, fine silty SAND; poorly graded, trace gravel, oxidation at 16.5-17.0							SM	
20	Gray (Gley 2 4/5BG dark greenish gray), medium dense, fine silty SAND; poorly graded	2" sch 40 PVC well casing	55			70		SM	
	Gray (Gley 2 4/5BG dark greenish gray), firm, moist, SILT							ML	
25	Gray (Gley 2 4/5BG dark greenish gray), firm, dry, SILT; some oxidation		50					ML	
	Black, dry, PEAT; some wood pieces, blocky structure							PT	
30			45			100			
	6" gray, firm, wet, silt			MW04_29to39_20160527 @1245					DTW: 11' Screen: 29-39' First encountered groundwater:
	Gray (Gley 2 4/5BG dark greenish gray), loose,		40					GM	
35									

CONTRACTOR Holt Services **NORTHING** 199858.780
EQUIPMENT Terra Sonic, track **EASTING** 1341896.090
DRILL MTHD Sonic **ANGLE** Vertical
DIAMETER 8" **BEARING** ------
LOGGER J Dahl **REVIEWER** C Bartlett **PRINTED** 07/08/16

REMARKS: Site: Post office. Well Tag ID: BJX-186. Complete drilling on 05/27/2016, casing remained in the borehole 05/28-05/30, constructed monitoring well 05/31/2016.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

BORING LOG W/WELL SONIC (PORTLAND) PNG0714 ISSAQUAH.GPJ EED DEFAULT GINT LIBRARY.GLB 7/8/16

Geosyntec consultants

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Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW04 **SHEET** 2 OF 3
START DATE 5/27/2016 **Elevation** 73.30 FT. MSL
FINISH DATE 5/31/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
40	wet, sandy GRAVEL; well graded, poorly sorted, subrounded gravel	Halliburton Hole-plug, 3/8" bentonite chips (12-50lb bags)	35			100			33'
	6" gray, firm, wet, silt								
45	Gray (Gley 2 4/5BG dark greenish gray), firm, wet, SILT; trace organics, trace wood fragments		30					ML	
	Gray (Gley 2 4/5BG dark greenish gray), loose, wet, sandy GRAVEL; well graded, trace cobbles							GM	
50	Gray (Gley 2 4/5BG dark greenish gray), loose, wet, fine to coarse SAND; poorly sorted, well graded		25			100		SM	
55	6" gray, firm, wet, silt		20						
	Gray (Gley 2 4/5BG dark greenish gray), firm, wet, SILT; some organics							ML	
60	Gray (Gley 2 4/5BG dark greenish gray), medium dense, wet, fine to medium SAND; well sorted, trace silt		15			100		SM	
	Gray (Gley 2 4/5BG dark greenish gray), firm, wet, sandy SILT		10					SM-ML	
65	Gray (Gley 2 4/5BG dark greenish gray), medium SAND; well sorted							SM	
	Gray (Gley 2 4/5BG dark greenish gray), firm, wet, sandy SILT		5					SM-ML	
70									

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 199858.780
EASTING 1341896.090
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Post office. Well Tag ID: BJX-186. Complete drilling on 05/27/2016, casing remained in the borehole 05/28-05/30, constructed monitoring well 05/31/2016.

COORDINATE SYSTEM:

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BOREHOLE LOG

BORING MW04 **SHEET** 3 OF 3
START DATE 5/27/2016 **Elevation** 73.30 FT. MSL
FINISH DATE 5/31/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
75	Brown, medium dense, fine to coarse SAND; well graded, some rounded gravel (Advanced Outwash)			2" sch 40 PVC 0.01" slotted well screen	0			100		SW	
					-5						
80	Brown, medium dense, wet, gravelly fine to coarse SAND							100		SP	
					-10						
85											
					-15						
90	End of boring, install monitoring well							100			

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 199858.780
EASTING 1341896.090
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Post office. Well Tag ID: BJX-186. Complete drilling on 05/27/2016, casing remained in the borehole 05/28-05/30, constructed monitoring well 05/31/2016.

COORDINATE SYSTEM:

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BOREHOLE LOG

BORING MW05 **SHEET** 1 OF 3
START DATE 5/23/2016 **Elevation** 72.05 FT. MSL
FINISH DATE 5/23/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
0	Grass and Topsoil	Surface completion: 8" Morris monument	70				0	TOPSOIL	easy drilling
	FILL (Light brown, loose, moist, silty sandy GRAVEL; round coarse gravel)							FILL	
	Dark gray, medium dense, moist, silty GRAVEL/gravelly SILT; trace fine sand, subangular gravel, trace rounded gravel						0	ML-GM	
5	Dark and light gray mottled (Gley 1 3/5GY very dark greenish gray), medium dense, moist, silty fine SAND						0	SM	
	Gray (Gley 1 3/N very dark gray) fine SAND interbed with trace firewood pieces		65					SP	
	Dark and light gray mottled (Gley 1 3/5GY very dark greenish gray), medium dense, moist, silty fine SAND						0	SM	
10	Very dark gray (Gley 1 3/N), loose, moist, coarse SAND with some fine gravels grades to gravelly SAND, wet, well graded, round coarse gravels					100	0	SP	First groundwater: 10', rising
	Dark gray (Gley 1 2.5/5GY greenish black), moist, SILT with some clay; slight plasticity, fine sand interbeds (<1")		60	MW05_10to20_20160523@1150			0	ML	DTW: 7.7' Screen: 10-20'
	Brown (10YR 4/2 dark grayish brown), loose, medium SAND; poorly graded, trace coarse angular sand and fine subangular gravels		55				0	SP	
20	Dark gray, medium dense, wet, sandy GRAVEL	2" sch 40 PVC well casing				100		GM	5' heave
	Medium brown (10YR 5/2 grayish brown), medium dense, wet, sandy GRAVEL; rounded/subrounded gravels, coarse sand, trace silt, well sorted gravels of volcanics, quartzite, basalt, and granodiorite		50				0	GM	
25									
			45				0		
	medium to fine SAND, trace rounded gravel							SM	
30	Medium brown (10YR 5/2 grayish brown), medium dense, wet, sandy GRAVEL; round/subround gravels, coarse sand, trace silt, well sorted gravels of volcanics, quartzite, basalt, and granodiorite							GM	Continued heave
	Dark gray, medium dense, wet, silty SAND to dark gray, medium stiff, wet, sandy SILT (Gley 1 4/N)		40					SM-ML	
35							0.1		

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 199057.680
EASTING 1341394.920
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Salmon Run Park. Well Tag ID: BJX-183

COORDINATE SYSTEM:
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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BOREHOLE LOG

BORING MW05 **SHEET** 2 OF 3
START DATE 5/23/2016 **Elevation** 72.05 FT. MSL
FINISH DATE 5/23/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Brown (10YR 4/3), medium dense, wet, fine to medium SAND; trace fine rounded gravels							SP	
	Medium brown/orange oxidation, medium dense, wet, coarse sandy GRAVEL; fine rounded gravel, trace coarse rounded gravel		35					GP	
	Medium brown/orange (7.5YR 4/6 strong brown), medium dense, wet, fine SAND; trace fine rounded gravel						0.1	SP	
40	Medium brown/orange (10YR 4/3 brown), loose, wet, gravelly SAND/sandy GRAVEL; coarse sand, coarse rounded well graded gravel	Halliburton Hole-plug, 3/8" bentonite chips (14-50lb bags)				100		GP	
			30				0.2		
	Dark gray (Gley 2 4/5B dark bluish gray), medium stiff, wet, sandy SILT; trace wood fragments, slight sulfur odor							SM-ML	
45							0		
			25						
50							0		
	Dark gray (Gley 2 4/5B dark bluish gray), medium stiff, wet, sandy SILT; trace organics					75		ML	
							0.1		
	Brown (10YR 4/3), medium dense, wet, fine to medium SAND; trace gravel		20					SM	
	Dark gray (Gley 2 4/5B dark bluish gray), medium stiff, wet, sandy SILT							SM-ML	
55	Brown (10YR 4/3), medium dense, wet, silty SAND; well graded, poorly sorted, trace gravel						0.1	SM	
			15						
							0		
60						100			
	Brown (2.5Y 3/2 very dark grayish brown), wet, fine to medium SAND; trace gravel, poorly graded, well sorted		10					SM	
	Brown, medium dense, wet, silty SAND; oxidation at contact						0	SM	
65							0		
	Brown (10YR 5/4 yellowish brown), stiff, wet, sandy SILT, some wood fragments							SM-ML	
			5						
	Brown (10YR 5/4 yellowish brown), medium dense, wet, silty coarse rounded GRAVELS							GP	
								SM-ML	
	Gray (Gley 2 4/5B dark bluish gray), soft, wet, sandy SILT						0	GM	
70									

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 199057.680
EASTING 1341394.920
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Salmon Run Park. Well Tag ID: BJX-183

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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Geosyntec consultants

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Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW05 **SHEET** 3 OF 3
START DATE 5/23/2016 **Elevation** 72.05 FT. MSL
FINISH DATE 5/23/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Brown (10YR 4/4 dark yellowish brown), medium dense, wet, silty sandy GRAVEL; well graded, poorly sorted							75		SW	
	Brown (10YR 4/3), loose, wet, gravelly SAND; trace cobbles, no fines, well sorted, poorly graded, rounded (Advance Outwash)			2" sch 40 PVC 0.01" slotted well screen	0						
75					-5						
80	Brown (10YR 4/3), loose, wet, gravelly SAND; well graded, poorly sorted, no fines, rounded gravels				-10				0	SW	
85	Brown (10YR 4/3), medium dense, wet, fine to medium SAND; trace gravels, rounded, well sorted, poorly graded, no fines				-15				0	SW	
90	End of boring, installed monitoring well										

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 199057.680
EASTING 1341394.920
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Salmon Run Park. Well Tag ID: BJX-183

COORDINATE SYSTEM:

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GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW06 **SHEET** 1 OF 3
START DATE 10/5/2016 **Elevation** FT. MSL
FINISH DATE 10/6/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	SAMPLE NAME	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	FILL (Barkdust, geotextile at 0.5')	Surface completion: 8" Morris monument, 2'x2' concrete pad		100	0.3	FILL	
	FILL (Medium brown, loose, dry, silty SAND; topsoil)					FILL	
5	Light olive brown (2.5Y 5/3), loose, dry, fine SAND; trace silt	Halliburton Hole-Plug, 3/8" bentonite chips (4-50lb bags)		10		SM	
					0.0		Very soft drilling, compressing samples, poor recovery
				75			
10	Medium gray brown, soft, moist, SILT; some fine sand, trace clay (slightly plastic)			50		ML	
					0.1		
	Dark bluish gray (2 gley 4/5 PB), soft, moist, medium gravelly SILT; less sand, more water, mottled gray and brown, trace clay, slightly plastic, oxidized at lower contact			100		ML	
15				100			
					0.1		
	Light brown gray, loose, moist, fine SAND; large wood piece at 19-19.5' (fresh), slight sulfur odor, trace silt, grading to coarse sand with depth				0.3	SM	
20				100	1.0		
	Medium brown, loose, wet, fine GRAVEL; some fine to coarse sand, trace silt, poorly sorted, occasional coarse subrounded gravel, grades to coarse gravel with depth		CO1-MW06 -20161005 -19.5-24.5 @1530		0.1	GM	DTW: 20' Screen: 19.5-24.5'
					0.0		
25				100			
	Brown (7.5YR 4/4), loose, wet, sandy coarse GRAVEL; poorly sorted subrounded to subangular, trace silt				0.2	GW	
30	Dark yellow brown (10YR 4/6), loose, wet, GRAVEL; some cobbles, coarse sand to coarse subangular to subrounded gravel, trace fine sand	2" sch 40 PVC well casing		100	0.0	GW	Hit metal at 30', move over 2'
					0.2		Second hole on 10/06/2016, metal at 32.5?
					0.3		
35							

CONTRACTOR Cascade Drilling **NORTHING**
EQUIPMENT Geoprobe 8140LS, track **EASTING**
DRILL MTHD Sonic **ANGLE** Vertical
DIAMETER 6" **BEARING** ------
LOGGER C Bartlett **REVIEWER** C Bartlett **PRINTED** 11/07/16

REMARKS: Site: Dogwood/Newport. Well Tag ID: BJH-349

COORDINATE SYSTEM:
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GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW06 **SHEET** 2 OF 3
START DATE 10/5/2016 **Elevation** FT. MSL
FINISH DATE 10/6/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
								100	0.4	GW	
						CO1-MW06 -20161006 -34.5-39.5 @1015					DTW: 30' Screen: 34.5-39.5'
										GP-GM	
	- color change to dark brown (7.5YR 3/3), increased silt								0.1		
40								100			
									0.1		
										GW	
45	Dark brown, loose, wet, sandy GRAVEL; trace fine sand, trace subrounded cobbles							100	0.0		
	Brown (7.5YR 4/3), loose, wet, silty sandy GRAVEL									GP	
	Dark brown, loose, wet, sandy GRAVEL; trace fine sand, trace subrounded cobbles								0.0	GW	
									0.0		
50	Dark brown, loose, wet, coarse subrounded to subangular SAND; some fine gravel, occasional subangular cobble							100		SW	
									0.0		
						CO1-MW06 -20161006 -51-56 @1235					DTW: 29' Screen: 51-56'
55									0.0		
	Brown, loose, gravelly SAND									SP	
	Dark brown, loose, wet, cobbly subangular GRAVEL; trace silt, trace fine sand								0.0	GP-GM	
	Dark grayish brown (10YR 4/2), loose, wet, fine to medium SAND; trace fine gravel (no silt)									SP	
									0.0		
60				Halliburton Quik-Grout (4-50lb bags, 140 gal of water)				100			10' heave
									0.0		
65	Dark bluish gray (2 Gley 4/1 5PB), medium stiff, moist, fine sandy SILT; occasional fine rounded gravel								0.0	ML	
									0.0		
70											

CONTRACTOR Cascade Drilling **NORTHING**
EQUIPMENT Geoprobe 8140LS, track **EASTING**
DRILL MTHD Sonic **ANGLE** Vertical
DIAMETER 6" **BEARING** ------
LOGGER C Bartlett **REVIEWER** C Bartlett **PRINTED** 11/07/16

REMARKS: Site: Dogwood/Newport. Well Tag ID: BJH-349

COORDINATE SYSTEM:
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BOREHOLE LOG

BORING MW06 **SHEET** 3 OF 3
START DATE 10/5/2016 **Elevation** FT. MSL
FINISH DATE 10/6/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
					100	0.0		
75	- increased fine sand, becomes finely interbedded, fine sand and silt					0.0		
		Halliburton Hole-Plug, 3/8" bentonite chips (1-50lb bag)				0.0		
80	Brown (10YR 4/3), loose, wet, SAND; well sorted, trace fine subrounded gravel, trace silt				75	0.0	SP	
						0.0		Heave, flush out with water
85					100	0.0		
						0.0		
90		2" sch 40 PVC 0.01" slotted well screen with 10/20 silica sand filter pack (8-50lb bags)			100	0.0		Using water to drill
95	Gray (1 Gley N4), loose, wet, silty very fine to fine SAND					0.0	SM	
	Gray, soft, wet, very fine sandy SILT					0.0	SM-ML	Sample compressed
100	End of boring, install monitoring well				75			

CONTRACTOR Cascade Drilling **NORTHING**
EQUIPMENT Geoprobe 8140LS, track **EASTING**
DRILL MTHD Sonic **ANGLE** Vertical
DIAMETER 6" **BEARING** ------
LOGGER C Bartlett **REVIEWER** C Bartlett **PRINTED** 11/07/16

REMARKS: Site: Dogwood/Newport. Well Tag ID: BJH-349

COORDINATE SYSTEM:
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BOREHOLE LOG

BORING MW07 **SHEET** 1 OF 4
START DATE 10/7/2016 **Elevation** FT. MSL
FINISH DATE 10/10/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
0	FILL (Light brown gray, loose, dry, fine SAND)	Surface completion: 8" Morris monument, 2'x2' concrete pad					FILL	
3	Yellowish brown (10YR 5/4), medium stiff, dry, SILT	Halliburton Hole-Plug, 3/8" bentonite chips (3-50lb bags)			75	0	ML	
5					100			
10	Light brown gray, loose, dry, sandy coarse GRAVEL; subrounded to subangular, some subrounded cobbles					0	GP	
15	- increased silt (<10%)							
20	- large boulder		CO1-MW07 -20161007 -20-25 @1450		80 100		GM	Hard drilling DTW: 26' Screen: 20-25'
23	Yellow brown (10YR 5/4), medium dense, moist, sandy coarse GRAVEL; subrounded, trace silt, some cobbles							
25		2" sch 40 PVC well casing						
30								Hole caved-in 30-32' washed out
32	Olive brown (2.5Y 4/3), loose, wet, fine to coarse SAND; some coarse subangular gravel						SW	
35								

CONTRACTOR Cascade Drilling **NORTHING**
EQUIPMENT Geoprobe 8140LS, track **EASTING**
DRILL MTHD Sonic **ANGLE** Vertical
DIAMETER 6" **BEARING** ------
LOGGER C Bartlett **REVIEWER** C Bartlett **PRINTED** 11/07/16

REMARKS: Site: Alder Court. Well Tag ID: BJH-348

COORDINATE SYSTEM:

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BOREHOLE LOG

BORING MW07 **SHEET** 2 OF 4
START DATE 10/7/2016 **Elevation** FT. MSL
FINISH DATE 10/10/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Brown, loose, wet, silty fine to coarse subrounded GRAVEL to fine to coarse sandy GRAVEL, with silt, occasional cobble					CO1-MW07 -20161007 -35-40 @1535		75		GM	DTW: 22' Screen: 35-40'
40											
45											
50											
	Light olive brown (2.5Y 5/2), loose, wet, sandy GRAVEL; with silt			Halliburton Quik-Grout (4-50lb bags, 30 gal of water)						GM	
	Brown, loose, wet, silty fine to coarse subrounded GRAVEL to fine to coarse sandy GRAVEL, with silt, occasional cobble									GM	7' of heave, very soft, pushing out, poor recovery (depths recovered uncertain)
55											
	Olive brown, very soft, wet, SILT									ML	change to flapper bit
60	Dark gray, soft, wet, clayey SILT; low to medium plasticity							25		ML	
	Dark gray (N4), medium stiff, moist, SILT; low plasticity, trace very fine to fine sand									ML	very soft, fighting heave at 60', good recovery
65											
						C01-MW07 -20161007 -65-70 @1800					DTW: 52' Screen: 65-70'
70											

CONTRACTOR Cascade Drilling **NORTHING**
EQUIPMENT Geoprobe 8140LS, track **EASTING**
DRILL MTHD Sonic **ANGLE** Vertical
DIAMETER 6" **BEARING** ------
LOGGER C Bartlett **REVIEWER** C Bartlett **PRINTED** 11/07/16

REMARKS: Site: Alder Court. Well Tag ID: BJH-348

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW07 **SHEET** 3 OF 4
START DATE 10/7/2016 **Elevation** FT. MSL
FINISH DATE 10/10/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Dark gray, loose, wet, silty very fine to medium SAND; some finely interbedded silt							100		SM	
75								100			
80	Dark gray, medium stiff, moist, sandy SILT; trace clay							80		ML	End of day (10/07/16) Begin next day (10/08/16)
								100			
85											
90								100			
95				Halliburton Hole-Plug, 3/8" bentonite chips (1-50lb bag)							
	Dark gray, loose, moist, fine to medium SAND; trace fine gravel and silt									SM	
100								75			
105											

CONTRACTOR Cascade Drilling **NORTHING**
EQUIPMENT Geoprobe 8140LS, track **EASTING**
DRILL MTHD Sonic **ANGLE** Vertical
DIAMETER 6" **BEARING** ------
LOGGER C Bartlett **REVIEWER** C Bartlett **PRINTED** 11/07/16

REMARKS: Site: Alder Court. Well Tag ID: BJH-348

COORDINATE SYSTEM:
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

BORING LOG W/WELL SONIC (PORTLAND) PNG0714 ISSAQUAH.GPJ EED DEFAULT GINT LIBRARY.GLB 11/7/16

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW07 **SHEET** 4 OF 4
START DATE 10/7/2016 **Elevation** FT. MSL
FINISH DATE 10/10/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
110	End of boring, install monitoring well			2" sch 40 PVC 0.01" slotted well screen with 10/20 silica sand filter pack (4.5-50lb bags)				100			

CONTRACTOR Cascade Drilling
EQUIPMENT Geoprobe 8140LS, track
DRILL MTHD Sonic
DIAMETER 6"
LOGGER C Bartlett **REVIEWER** C Bartlett

NORTHING
EASTING
ANGLE Vertical
BEARING ------
PRINTED 11/07/16

REMARKS: Site: Alder Court. Well Tag ID: BJH-348

COORDINATE SYSTEM:
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

BORING LOG W/WELL SONIC (PORTLAND) PNG0714 ISSAQUAH.GPJ EED DEFAULT GINT LIBRARY.GLB 11/7/16

APPENDIX C
ANALYTICAL DATA QUALITY REVIEW MEMOS, ANALYTICAL LABORATORY REPORTS

Geosyntec consultants

180A Market Place Boulevard
Knoxville, TN 37922
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Memorandum

Date: 16 June 2016

To: Bob Anderson
Cindy Bartlett
Samantha Fox

From: Mary Tyler

CC: J. Caprio

Subject: Stage 2A Data Validation - Level II Data Deliverables – Eurofins Eaton Analytical Report Numbers 577272 Revised, 588864, 589670 and 591042

SITE: PNG0703

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of eight water samples, one field duplicate sample and four trip blank, collected February 19, 2016, May 4, 2016, May 10, 2016 and May 17, 2016, as part of the project PNG0703 sampling event. The analyses were performed at Eurofins Eaton Analytical, Monrovia, California. The samples were prepared and analyzed by the following analytical test:

- Perfluorinated alkyl acids (PFAAs) by EPA Method 537

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data are usable for meeting project objectives.

The organic data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002), as well as by the pertinent method referenced by the data package and technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID
201602240087	Well 4-021916
201602240088	Trip Blank - 021916
201605050734	Darigold-ABY249-050416
201605050735	Trip Blank - 050416
201605060067	Darigold-ABY249-050416-DUP
201605110272	SPWSD-VT2.1-051016
201605110273	SPWSD-VT2.2-051016

Laboratory ID	Client ID
201605110274	SPWSD-VT2.3-051016
201605110275	SPWSD-Well7.3-051016
201605110276	trip Blank - 051016
201605180426	COI-TW3-051716
201605180427	COI-MW1-051716
201605180428	TRIP BLANK-051716

The samples were received at the laboratory within the criteria of 0-6ºC. No sample preservation issues were noted by the laboratory.

The laboratory noted that the samples reported in report 577272 were received partially frozen. This did not result in qualification of the data.

The chain of custody (COC) in report 577272 was not relinquished by the sampler.

Report 577272 was revised; the narrative indicated that the original reported perfluorooctane-sulfonic acid (PFOS) result was mis-integrated; it did not include the branched isomers. The data for PFOS were re-integrated and revised results were reported in the revised laboratory report.

1.0 PERFLUORINATED ALKYL ACIDS

The samples were analyzed for PFAAs per EPA Method 537. The following compounds were reported:

- Perfluorobutanesulfonic acid, PFBS
- Perfluorodecanoic acid, PFDA
- Perfluorododecanoic acid, PFDoA
- Perfluoroheptanoic acid, PFHpA
- Perfluorohexanesulfonic acid, PFHxS
- Perfluorohexanoic acid, PFHxA
- Perfluorononanoic acid, PFNA
- Perfluorooctanesulfonic acid, PFOS
- Perfluorooctanoic acid, PFOA
- Perfluorotetradecanoic acid, PFTA
- Perfluorotridecanoic acid, PFTrDA
- Perfluoroundecanoic acid, PFUnA.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Trip Blank
- ✓ Equipment Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The PFAA data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

1.2 Holding Time

The holding times for the PFAA analysis of a water sample are 14 days from collection to extraction and 28 days from extraction to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Five method blanks were reported (batches 894999, 909576, 909665, 910527 and 911819). The PFAAs were not detected in the method blanks above the method reporting limits (MRLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Five LCS/LCS duplicate (LCSD) pairs were reported. The recovery and relative percent difference (RPD) results were within the method specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Equipment Blank

Equipment blanks were not collected with the sample sets.

1.8 Trip Blank

Four trip blanks, Trip Blank - 021916, Trip Blank – 050416, trip Blank – 051016 and TRIP BLANK-051716, accompanied the sample shipments. The PFAAs were not detected in the trip blanks above the MRLs.

1.9 Field Duplicate

One field duplicate sample, Darigold-ABY249-050416-DUP, was collected with the sample sets. Acceptable precision (RPD $\leq$30% for concentrations greater than two times the MRLs, RPD $\leq$50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, Darigold-ABY249-050416.

1.10 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

1.11 Electronic Data Deliverables (EDD) Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

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* * * * *

ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

Geosyntec consultants

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Memorandum

Date:	30 August 2016
To:	Bob Anderson
	Cindy Bartlett
From:	Mary Tyler
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level 2 Data Deliverable – Eurofins Eaton Analytical Report Number 596940**

SITE: PNG0714

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of three water samples, one field duplicate sample and one trip blank, collected June 21, 2016, as part of the project PNG0714 sampling event. The analyses were performed at Eurofins Eaton Analytical, Monrovia, California. The samples were prepared and analyzed by the following analytical test:

- Perfluorinated alkyl acids (PFAAs) by EPA Method 537

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data are usable for meeting project objectives.

The organic data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002), as well as by the pertinent method referenced by the data package and technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID
201606220760	COI-MW03-20160621

Laboratory ID	Client ID
201606220761	COI-MW03-20160621-DUP
201606220762	COI-MW04-20160621

Laboratory ID	Client ID
201606220763	COI-MW05-20160621
201606220764	Trip Blank - 20160621

The samples were received at the laboratory within the criteria of 0-6ºC. No sample preservation issues were noted by the laboratory.

1.0 PERFLUORINATED ALKYL ACIDS

The samples were analyzed for PFAAs per EPA Method 537. The following compounds were reported:

- Perfluorobutanesulfonic acid, PFBS
- Perfluorodecanoic acid, PFDA
- Perfluorododecanoic acid, PFDoA
- Perfluoroheptanoic acid, PFHpA
- Perfluorohexanesulfonic acid, PFHxS
- Perfluorohexanoic acid, PFHxA
- Perfluorononanoic acid, PFNA
- Perfluorooctanesulfonic acid, PFOS
- Perfluorooctanoic acid, PFOA
- Perfluorotetradecanoic acid, PFTA
- Perfluorotridecanoic acid, PFTrDA
- Perfluoroundecanoic acid, PFUnA.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

✓ Overall Assessment
✓ Holding Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogates
✓ Trip Blank
✓ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

1.1 Overall Assessment

The PFAA data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

1.2 Holding Time

The holding times for the PFAA analysis of a water sample are 14 days from collection to extraction and 28 days from extraction to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Three method blanks were reported (batches 918879, 918805 and 920999). The PFAAs were not detected in the method blanks above the method-specified one third (1/3) of the method reporting limits (MRLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Three LCS/LCS duplicate (LCSD) pairs were reported. The recovery and relative percent difference (RPD) results were within the method specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

One trip blank, Trip Blank - 20160621, accompanied the sample shipment. The PFAAs were not detected in the trip blank above the MRLs.

1.8 Field Duplicate

A field duplicate sample, COI-MW03-20160621-DUP, was collected with the sample set. Acceptable precision (RPD ≤30% for concentrations greater than two times the MRLs, RPD ≤50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, COI-MW03-20160621.

1.9 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level IV report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level IV report and the EDD.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

Geosyntec consultants

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Memorandum

Date: 30 August 2016

To: Bob Anderson
Cindy Bartlett

From: Mary Tyler

CC: J. Caprio

Subject: Stage 2A Data Validation - Level 2 Data Deliverable – Eurofins Eaton Analytical Report Number 597948

SITE: PNG0714

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of three water samples, one field duplicate sample and one trip blank, collected June 28, 2016, as part of the project PNG0714 sampling event. The analyses were performed at Eurofins Eaton Analytical, Monrovia, California. The samples were prepared and analyzed by the following analytical test:

- Perfluorinated alkyl acids (PFAAs) by EPA Method 537

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data are usable for meeting project objectives.

The organic data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002), as well as by the pertinent method referenced by the data package and technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID
201606300054	COI-MW04-20160628

Laboratory ID	Client ID
201606300055	COI-MW05-20160628

Laboratory ID	Client ID
201606300056	COI-MW03-20160628
201606300057	COI-MW03-20160628-DUP

Laboratory ID	Client ID
201606300058	Trip Blank-20160628

The samples were received at the laboratory within the criteria of 0-6ºC. No sample preservation issues were noted by the laboratory.

1.0 PERFLUORINATED ALKYL ACIDS

The samples were analyzed for PFAAs per EPA Method 537. The following compounds were reported:

- Perfluorobutanesulfonic acid, PFBS
- Perfluorodecanoic acid, PFDA
- Perfluorododecanoic acid, PFDoA
- Perfluoroheptanoic acid, PFHpA
- Perfluorohexanesulfonic acid, PFHxS
- Perfluorohexanoic acid, PFHxA
- Perfluorononanoic acid, PFNA
- Perfluorooctanesulfonic acid, PFOS
- Perfluorooctanoic acid, PFOA
- Perfluorotetradecanoic acid, PFTA
- Perfluorotridecanoic acid, PFTrDA
- Perfluoroundecanoic acid, PFUnA.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

✓ Overall Assessment
✓ Holding Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogates
✓ Trip Blank
✓ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

1.1 Overall Assessment

The PFAA data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

1.2 Holding Time

The holding times for the PFAA analysis of a water sample are 14 days from collection to extraction and 28 days from extraction to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported (batch 920999). The PFAAs were not detected in the method blank above the method-specified one third (1/3) of the method reporting limits (MRLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). A batch MS/MSD pair was reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS/LCS duplicate (LCSD) pair was reported. The recovery and relative percent difference (RPD) results were within the method specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

One trip blank, Trip Blank-20160628, accompanied the sample shipment. The PFAAs were not detected in the trip blanks above the MRLs.

1.8 Field Duplicate

A field duplicate sample, COI-MW03-20160628-DUP, was collected with the sample set. Acceptable precision (RPD ≤30% for concentrations greater than two times the MRLs, RPD ≤50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, COI-MW03-20160628.

1.9 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level IV report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level IV report and the EDD.

---

* * * * *

ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

Geosyntec consultants

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Memorandum

Date:	30 August 2016
To:	Bob Anderson
	Cindy Bartlett
From:	Mary Tyler
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverables – Eurofins Eaton Analytical Report Numbers 598922 and 600700**

SITE: PNG0714

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of nine water samples, two field duplicate samples and two trip blanks, collected July 6, 2016 and July 13, 2016, as part of the project PNG0714 sampling event. The analyses were performed at Eurofins Eaton Analytical, Monrovia, California. The samples were prepared and analyzed by the following analytical tests:

- Perfluorinated alkyl acids (PFAAs) by EPA Method 537
- Selected Metals (Calcium, Magnesium, Potassium, and Sodium) by EPA Method 200.7
- Anions by EPA Method 300.0

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data as qualified are usable for meeting project objectives. Qualified data should be used within the limitations of the qualification.

The data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002), the US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, August 2014 (USEPA-540-

R-013-001), as well as by the pertinent methods referenced by the data package and technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Sample ID
201607070539	COI-MW04-20160716
201607070555	COI-Well 5-20160716
201607070556	COI-Well 50BS-20160716
201607070557	COI-MW05-20160716
201607070558	COI-MW03-20160716
201607070559	COI-MW03-20160716-Dup
201607070560	Trip Blank - 20160716
201607160575	COI-Well5-20160713

Laboratory ID	Sample ID
201607160577	COI-MW04-20160713
201607160578	COI-MW05-20160713
201607160579	COI-MW03-20160713
201607160580	COI-MW03-20160713 DUP
201607160581	TRIP BLANK-20160713

The samples were received at the laboratory within the criteria of 0-6ºC. No sample preservation issues were noted by the laboratory.

The chain of custody for the samples reported in laboratory report number 600700 indicated metals and anion analyses for trip blank TRIP BLANK-20160713. Metals and anions were not reported for this sample.

1.0 PERFLUORINATED ALKYL ACIDS

The samples were analyzed for PFAAs per EPA Method 537. The following compounds were reported:

- Perfluorobutanesulfonic acid, PFBS
- Perfluorodecanoic acid, PFDA
- Perfluorododecanoic acid, PFDoA
- Perfluoroheptanoic acid, PFHpA
- Perfluorohexanesulfonic acid, PFHxS
- Perfluorohexanoic acid, PFHxA
- Perfluorononanoic acid, PFNA
- Perfluorooctanesulfonic acid, PFOS
- Perfluorooctanoic acid, PFOA
- Perfluorotetradecanoic acid, PFTA
- Perfluorotridecanoic acid, PFTrDA
- Perfluoroundecanoic acid, PFUnA.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

✓ Overall Assessment
✓ Holding Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
⊗ Surrogates
✓ Trip Blank
⊗ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The PFAA data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

1.2 Holding Time

The holding times for the PFAA analysis of a water sample are 14 days from collection to extraction and 28 days from extraction to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Three method blanks were reported (batches 921762, 923973 and 923636). The PFAAs were not detected in the method blanks above the method-specified one third (1/3) of the method reporting limits (MRLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Three LCS/LCS duplicate (LCSD) pairs were reported. The recovery and relative percent difference (RPD) results were within the method specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses, with the following exception.

The recovery of 13C-PFDA in sample COI-MW03-20160716-Dup was low and outside the method specified acceptance criteria. Therefore, based on professional and technical judgment, the nondetect result of PFDA in sample COI-MW03-20160716-Dup was J qualified as estimated.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
COI-MW03-20160716-Dup	Perfluorodecanoic acid	0.0025	US7	0.0025	UJ	6

µg/L-micrograms per liter
U-not detected at or above the MRL
*Validation qualifiers are defined in Attachment 1 at the end of this report
** Reason codes are defined in Attachment 2 at the end of this report

1.7 Trip Blank

Two trip blanks, Trip Blank – 20160716 and TRIP BLANK-20160713, were collected with the sample sets. The PFAAs were not detected in the trip blanks above the MRLs.

1.8 Field Duplicate

Two field duplicate samples, COI-MW03-060716-DUP and COI-MW03-20160713 DUP, were collected with the sample sets. Acceptable precision (RPD ≤30% for concentrations greater than two times the MRLs, RPD ≤50% for concentrations within two times the MRLs) was demonstrated

between the field duplicates and the original samples, COI-MW03-060716 and COI-MW03-20160713, with the following exception.

The RPD for perfluorooctanoic acid was greater than 30% and the concentrations in the field duplicate pair were greater than two times the MRL. Therefore, the concentrations of perfluorooctanoic acid in the field duplicate pair were J qualified as estimated.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	RPD	Validation Result (µg/L)	Validation Qualifier	Reason Code
COI-MW03-20160716	Perfluorobutanesulfonic acid	0.025	NA	4	NA	NA	NA
COI-MW03-20160716-Dup	Perfluorobutanesulfonic acid	0.026	S7		NA	NA	NA
COI-MW03-20160716	Perfluoroheptanoic acid	0.0063	NA	2	NA	NA	NA
COI-MW03-20160716-Dup	Perfluoroheptanoic acid	0.0062	S7		NA	NA	NA
COI-MW03-20160716	Perfluorohexanesulfonic acid	0.062	NA	0	NA	NA	NA
COI-MW03-20160716-Dup	Perfluorohexanesulfonic acid	0.062	S7		NA	NA	NA
COI-MW03-20160716	Perfluorohexanoic acid	0.015	NA	7	NA	NA	NA
COI-MW03-20160716-Dup	Perfluorohexanoic acid	0.014	S7		NA	NA	NA
COI-MW03-20160716	Perfluorononanoic acid	0.0061	NA	9	NA	NA	NA
COI-MW03-20160716-Dup	Perfluorononanoic acid	0.0056	S7		NA	NA	NA
COI-MW03-20160716	Perfluorooctanesulfonic acid	0.10	NA	0	NA	NA	NA
COI-MW03-20160716-Dup	Perfluorooctanesulfonic acid	0.10	NA		NA	NA	NA
COI-MW03-20160716	Perfluorooctanoic acid	0.0051	NA	33	0.0051	J	7
COI-MW03-20160716-Dup	Perfluorooctanoic acid	0.0071	S7		0.0071	J	7
COI-MW03-20160716	The other PFAAs	ND	NA	0	NA	NA	NA
COI-MW03-20160716-Dup	The other PFAAs	ND	NA		NA	NA	NA
COI-MW03-20160713	Perfluorobutanesulfonic acid	0.031	NA	7	NA	NA	NA
COI-MW03-20160713 DUP	Perfluorobutanesulfonic acid	0.029	NA		NA	NA	NA

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	RPD	Validation Result (µg/L)	Validation Qualifier	Reason Code
COI-MW03-20160713	Perfluoroheptanoic acid	0.0071	NA	10	NA	NA	NA
COI-MW03-20160713 DUP	Perfluoroheptanoic acid	0.0064	NA		NA	NA	NA
COI-MW03-20160713	Perfluorohexanesulfonic acid	0.075	NA	7	NA	NA	NA
COI-MW03-20160713 DUP	Perfluorohexanesulfonic acid	0.070	NA		NA	NA	NA
COI-MW03-20160713	Perfluorohexanoic acid	0.016	NA	13	NA	NA	NA
COI-MW03-20160713 DUP	Perfluorohexanoic acid	0.014	NA		NA	NA	NA
COI-MW03-20160713	Perfluorononanoic acid	0.0063	NA	14	NA	NA	NA
COI-MW03-20160713 DUP	Perfluorononanoic acid	0.0055	NA		NA	NA	NA
COI-MW03-20160713	Perfluorooctanesulfonic acid	0.088	NA	13	NA	NA	NA
COI-MW03-20160713 DUP	Perfluorooctanesulfonic acid	0.10	NA		NA	NA	NA
COI-MW03-20160713 DUP	Perfluorooctanoic acid	0.0053	NA	12	NA	NA	NA
COI-MW03-20160713	Perfluorooctanoic acid	0.0060	NA		NA	NA	NA
COI-MW03-20160713 DUP	The other PFAAs	ND	NA	0	NA	NA	NA
COI-MW03-20160713	The other PFAAs	ND	NA		NA	NA	NA

µg/L-micrograms per liter
NA-not applicable
S7-laborartory flag indicating the surrogate recovery was below laboratory and method acceptance limits; unable to confirm matrix effect
ND-not detected at or above the MRL

1.9 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

1.10 Electronic Data Deliverables (EDD) Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

2.0 SELECTED METALS

The samples were analyzed for selected metals per EPA Method 200.7.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Trip Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

2.1 Overall Assessment

The metals data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

2.2 Holding Time

The holding time for the metals analysis of a water sample is 180 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four method blanks were reported (batches 921963, 922648, 924020 and 924992). The metals were not detected in the method blanks above the MRLs.

2.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

2.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four LCS/LCSD pairs were reported. The recovery and RPD results were within the method specified acceptance criteria.

2.6 Trip Blank

The trip blanks were not analyzed for metals.

2.7 Field Duplicate

Two field duplicate samples, COI-MW03-060716-DUP and COI-MW03-20160713 DUP, were collected with the sample sets. Acceptable precision (RPD $\leq$30% for concentrations greater than two times the MRLs, RPD $\leq$50% for concentrations within two times the MRLs) was demonstrated between the field duplicates and the original samples, COI-MW03-060716 and COI-MW03-20160713.

2.8 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

2.9 Electronic Data Deliverables Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

3.0 ANIONS

The samples were analyzed for anions by EPA method 300.0.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

✓ Overall Assessment
⊗ Holding Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Trip Blank
✓ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverables Review

3.1 Overall Assessment

The anion data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

3.2 Holding Time

The holding times for water samples are listed below.

Analysis	Holding Time
Nitrate as N, Nitrate as NO_3, and Nitrite as N and total nitrate, nitrate-N by calculation by EPA Method 300.0	48 hours from collection to analysis
Chloride and Sulfate by EPA Method 300.0	28 days from collection to analysis

The holding times were met for the sample analyses, with the following exception. Sample COI-Well5-20160713 was analyzed fifty-two hours after collection. Therefore, the nondetect results of nitrate and nitrite in this sample were UJ qualified as estimated less than the MRLs.

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier	Reason Code
COI-Well5-20160713	Nitrate (as N)	0.10	UH3	0.10	UJ	2
COI-Well5-20160713	Nitrate (as NO_3)	0.44	UH3	0.44	UJ	2
COI-Well5-20160713	Nitrite (as N)	0.050	UH3	0.050	UJ	2
COI-Well5-20160713	Nitrate and Nitrite (as N)	0.10	UH3	0.10	UJ	2

mg/L-milligrams per liter
U-not detected at or above the MRL
H3-laboratory flag indicating the sample was received and/or analysis requested past holding time

3.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four method blanks were reported (batches 921569, 921570, 923178 and 923179). The anions were not detected in the method blanks above the MRLs.

3.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Sample specific MS/MSD pairs were reported for the anions using sample COI-MW04-20160716. The recovery and RPD results were within the laboratory specified acceptance criteria.

Batch MS/MSD pairs were also reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

3.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four LCS/LCSD pairs were reported. The recovery and RPD results were within the method specified acceptance criteria.

3.6 Trip Blank

The trip blanks were not analyzed for metals.

3.7 Field Duplicate

Two field duplicate samples, COI-MW03-060716-DUP and COI-MW03-20160713 DUP, were collected with the sample sets. Acceptable precision (RPD ≤30% for concentrations greater than two times the MRLs, RPD ≤50% for concentrations within two times the MRLs) was demonstrated between the field duplicates and the original samples, COI-MW03-060716 and COI-MW03-20160713.

3.8 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

3.9 Electronic Data Deliverables Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

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* * * * *

ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

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Memorandum

Date:	07 September 2016
To:	Bob Anderson
	Cindy Bartlett
From:	Mary Tyler
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverables – Eurofins Eaton Analytical Report Number 601877**

SITE: PNG0714

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of three water samples, one field duplicate sample and one trip blank, collected July 20, 2016, as part of the project PNG0714 sampling event. The analyses were performed at Eurofins Eaton Analytical, Monrovia, California. The samples were prepared and analyzed by the following analytical tests:

- Perfluorinated alkyl acids (PFAAs) by EPA Method 537
- Selected Metals (Calcium, Magnesium, Potassium, and Sodium) by EPA Method 200.7
- Anions by EPA Method 300.0

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data are usable for meeting project objectives.

The data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002), the US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, August 2014 (USEPA-540-R-013-001), as well as by the pertinent methods referenced by the data package and technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Sample ID
201607220374	COI-MW04-20160720
201607220376	COI-MW05-20160720
201607220377	COI-MW03-20160720
201607220378	COI-MW03-20160720-DUP

Laboratory ID	Sample ID
201607220379	TRIP BLANK - 20160720

The samples were received at the laboratory within the criteria of 0-6ºC. No sample preservation issues were noted by the laboratory.

The following issues were noted with the chain of custody (COC); these did not result in qualification of the data.

- The COC indicated that the anion analyses were on hold; anions were reported for the samples.

- The COC indicated metals and anion analyses for trip blank TRIP BLANK-20160720. Metals and anions were not reported for this sample. In addition, no collection time was listed on the COC for the trip blank. The laboratory assigned a collection time of 0800.

1.0 PERFLUORINATED ALKYL ACIDS

The samples were analyzed for PFAAs per EPA Method 537. The following compounds were reported:

- Perfluorobutanesulfonic acid, PFBS
- Perfluorodecanoic acid, PFDA
- Perfluorododecanoic acid, PFDoA
- Perfluoroheptanoic acid, PFHpA
- Perfluorohexanesulfonic acid, PFHxS
- Perfluorohexanoic acid, PFHxA
- Perfluorononanoic acid, PFNA
- Perfluorooctanesulfonic acid, PFOS
- Perfluorooctanoic acid, PFOA
- Perfluorotetradecanoic acid, PFTA
- Perfluorotridecanoic acid, PFTrDA
- Perfluoroundecanoic acid, PFUnA.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues

were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Trip Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The PFAA data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

1.2 Holding Time

The holding times for the PFAA analysis of a water sample are 14 days from collection to extraction and 28 days from extraction to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two method blanks were reported (batches 925241 and 925697). The PFAAs were not detected in the method blanks above the method-specified one third (1/3) of the method reporting limits (MRLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are

batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two LCS/LCS duplicate (LCSD) pairs were reported. The recovery and relative percent difference (RPD) results were within the method specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

A trip blank, TRIP BLANK-20160720, was collected with the sample set. The PFAAs were not detected in the trip blank above the MRLs.

1.8 Field Duplicate

A field duplicate sample, COI-MW03-20160720-DUP, was collected with the sample set. Acceptable precision (RPD $\leq$30% for concentrations greater than two times the MRLs, RPD $\leq$50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, COI-MW03-20160720.

1.9 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II report and the EDD.

2.0 SELECTED METALS

The samples were analyzed for selected metals per EPA Method 200.7.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Trip Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

2.1 Overall Assessment

The metals data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

2.2 Holding Time

The holding time for the metals analysis of a water sample is 180 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two method blanks were reported (batches 925591 and 925849). The metals were not detected in the method blanks above the MRLs.

2.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

2.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two LCS/LCSD pairs were reported. The recovery and RPD results were within the method specified acceptance criteria.

2.6 Trip Blank

The trip blank was not analyzed for metals.

2.7 Field Duplicate

A field duplicate sample, COI-MW03-20160720-DUP, was collected with the sample set. Acceptable precision (RPD $\leq$30% for concentrations greater than two times the MRLs, RPD $\leq$50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, COI-MW03-20160720.

2.8 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

2.9 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II report and the EDD.

3.0 ANIONS

The samples were analyzed for anions by EPA method 300.0.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate

- ✓ Laboratory Control Sample
- ✓ Trip Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

3.1 Overall Assessment

The anion data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

3.2 Holding Time

The holding times for water samples are listed below. The holding times were met for the sample analyses. It was noted that the nitrate and nitrite analysis of sample COI-MW04-20160720 was performed 18 minutes outside the 48 hour holding time. Since it was analyzed within the hour of the 48 hours, no qualifications were applied to the data, based on professional and technical judgment.

Analysis	Holding Time
Nitrate as N, Nitrate as NO_3, and Nitrite as N and total nitrate, nitrate-N by calculation by EPA Method 300.0	48 hours from collection to analysis
Chloride and Sulfate by EPA Method 300.0	28 days from collection to analysis

3.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two method blanks were reported (batches 924873 and 924874). The anions were not detected in the method blanks above the MRLs.

3.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

3.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two LCS/LCSD pairs were reported. The recovery and RPD results were within the method specified acceptance criteria.

3.6 Trip Blank

The trip blank was not analyzed for anions.

3.7 Field Duplicate

A field duplicate sample, COI-MW03-20160720-DUP, was collected with the sample set. Acceptable precision (RPD $\leq$30% for concentrations greater than two times the MRLs, RPD $\leq$50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, COI-MW03-20160720.

3.8 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

3.9 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II report and the EDD.

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* * * * *

ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

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Memorandum

Date:	07 September 2016
To:	Bob Anderson
	Cindy Bartlett
From:	Mary Tyler
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level 2 Data Deliverable – Eurofins Lancaster Laboratories Analytical Report Number 601992**

SITE: PNG0714

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of three soil samples and one field duplicate sample, collected July 22, 2016, as part of the project PNG0714 sampling event. The analyses were performed at Eurofins Lancaster Laboratories, Lancaster, Pennsylvania. The samples were prepared and analyzed by the following analytical test:

- Perfluorinated alkyl acids (PFAAs) by EPA Method 537, revision 1.1 Mod

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data as qualified are usable for meeting project objectives. Qualified data should be used within the limitations of the qualifications.

The organic data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002), as well as by the pertinent method referenced by the data package and technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID
201607230255	COI-STTA01-20160722
201607230256	COI-STTA02-20160722
201607230257	COI-STTA02-20160722-DUP

Laboratory ID	Client ID
201607230258	COI-STSP01-20160722

The samples were received at the laboratory within the criteria of 0-6ºC. No sample preservation issues were noted by the laboratory.

1.0 PERFLUORINATED ALKYL ACIDS

The samples were analyzed for PFAAs per EPA Method 537, revision 1.1 Mod. The following compounds were reported:

- Perfluorobutanesulfonic acid, PFBS
- Perfluorodecanoic acid, PFDA
- Perfluorododecanoic acid, PFDoA
- Perfluoroheptanoic acid, PFHpA
- Perfluorohexanesulfonic acid, PFHxS
- Perfluorohexanoic acid, PFHxA
- Perfluorononanoic acid, PFNA
- Perfluorooctanesulfonic acid, PFOS
- Perfluorooctanoic acid, PFOA
- Perfluorotetradecanoic acid, PFTA
- Perfluorotridecanoic acid, PFTrDA
- Perfluoroundecanoic acid, PFUnA

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

✓ Overall Assessment
✓ Holding Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogates
✓ Trip Blank
⊗ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

1.1 Overall Assessment

The PFAA data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

1.2 Holding Time

The method lists the holding times for the PFAA analysis of a water sample. Additional information from the laboratory indicated that the holding times for soils are 28 days from collection to extraction and 28 days from extraction to analysis. The laboratory specified holding times were met for the soil sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported (batch 16210006). The PFAAs were not detected in the method blank above the limits of quantitation [LOQs, also called the reporting limits (RLs)].

1.4 Matrix Spike (MS)

A sample set specific MS was reported, using sample COI-STTA01-20160722. The recovery results were within the laboratory specified acceptance criteria, with the following exception.

The recovery of perfluorooctanesulfonic acid was high and outside the laboratory specified acceptance criteria. Due to the difference between the sample and spike concentrations and professional and technical judgment, no qualifications were applied to the data.

It was noted that the sample results for COI-STTA01-20160722 were reported on a dry weight basis and the MS results were reported on a wet weight basis. This did not result in qualification of the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS/LCS duplicate (LCSD) pair was reported. The recovery and relative percent difference (RPD) results were within the method specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

A trip blank did not accompany the sample shipment.

1.8 Field Duplicate

A field duplicate sample, COI-STTA02-20160722-DUP, was collected with the sample set. Acceptable precision (RPD ≤50%) was demonstrated between the field duplicate and the original sample, COI-STTA02-20160722, with the following exception.

The RPD for perfluoroundecanoic acid was greater than 50%. Therefore, based on professional and technical judgment, the concentrations of perfluoroundecanoic acid in the field duplicate pair were J qualified as estimated.

Sample ID	Compound	Laboratory Concentration (ng/g)	Laboratory Flag	RPD	Validation Concentration (ng/g)	Validation Qualification*	Reason Code**
COI-STTA02-20160722	PFBS	4.5	NA	18	NA	NA	NA
COI-STTA02-20160722-DUP	PFBS	5.4	NA		NA	NA	NA
COI-STTA02-20160722	PFDA	3.9	NA	14	NA	NA	NA
COI-STTA02-20160722-DUP	PFDA	4.5	NA		NA	NA	NA
COI-STTA02-20160722	PFHpA	2.1	NA	13	NA	NA	NA
COI-STTA02-	PFHpA	2.4	NA		NA	NA	NA

Sample ID	Compound	Laboratory Concentration (ng/g)	Laboratory Flag	RPD	Validation Concentration (ng/g)	Validation Qualification*	Reason Code**
20160722-DUP							
COI-STTA02-20160722	PFHxS	25	NA	15	NA	NA	NA
COI-STTA02-20160722-DUP	PFHxS	29	NA		NA	NA	NA
COI-STTA02-20160722	PFHxA	15	NA	24	NA	NA	NA
COI-STTA02-20160722-DUP	PFHxA	19	NA		NA	NA	NA
COI-STTA02-20160722	PFNA	33	NA	26	NA	NA	NA
COI-STTA02-20160722-DUP	PFNA	43	NA		NA	NA	NA
COI-STTA02-20160722	PFOS	180	NA	33	NA	NA	NA
COI-STTA02-20160722-DUP	PFOS	250	NA		NA	NA	NA
COI-STTA02-20160722	PFOA	4.3	NA	19	NA	NA	NA
COI-STTA02-20160722-DUP	PFOA	5.2	NA		NA	NA	NA
COI-STTA02-20160722	PFTrDA	2.7	NA	11	NA	NA	NA
COI-STTA02-20160722-DUP	PFTrDA	3	NA		NA	NA	NA
COI-STTA02-20160722	PFUnA	36	NA	55	36	J	7
COI-STTA02-20160722-DUP	PFUnA	63	NA		63	J	7

Sample ID	Compound	Laboratory Concentration (ng/g)	Laboratory Flag	RPD	Validation Concentration (ng/g)	Validation Qualification*	Reason Code**
COI-STTA02-20160722	The other PFAAs	ND	NA	0	NA	NA	NA
COI-STTA02-20160722-DUP	The other PFAAs	ND	NA		NA	NA	NA

ng/g -nanograms per gram
NA-not applicable
ND-not detected
* Validation qualifiers are defined in Attachment 1 at the end of this report
**Reason codes are defined in Attachment 2 at the end of this report

1.9 Sensitivity

The samples were reported to the LOQs. No elevated nondetect results were reported for the samples. It was noted that the nondetect results for sample COI-STSP01-20160722 were reported as ND (<); the nondetect results in the other samples were reported as ND. Based on information from the laboratory, this was due to the data entered in the laboratory information system (LIMS) by the analyst; this did not result in qualifications of the data.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level IV report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level IV report and the EDD.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

Geosyntec consultants

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Memorandum

Date: 03 September 2016

To: Bob Anderson
Cindy Bartlett

From: Mary Tyler

CC: J. Caprio

Subject: Stage 2A Data Validation - Level 2 Data Deliverable – Eurofins Eaton Analytical Report Number 602965

SITE: PNG0714

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of four water samples, one field duplicate sample and one trip blank, collected July 27-28, 2016, as part of the project PNG0714 sampling event. The analyses were performed at Eurofins Eaton Analytical, Monrovia, California. The samples were prepared and analyzed by the following analytical test:

- Perfluorinated alkyl acids (PFAAs) by EPA Method 537

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data are usable for meeting project objectives.

The organic data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002), as well as by the pertinent method referenced by the data package and technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID
201607290381	COI-MW04-20160727

Laboratory ID	Client ID
201607290382	COI-Well5-20160727

Laboratory ID	Client ID
201607290383	Trip Blank - 20160727
201607290389	COI-MW03-20160728
201607290390	COI-MW03-20160728-DUP

Laboratory ID	Client ID
201607290391	COI-MW05-20160728

The samples were received at the laboratory within the criteria of 0-6ºC. No sample preservation issues were noted by the laboratory.

The following issues were noted with the chain of custody (COC) form; no qualifications were applied to the data:

- Analyses and matrices were noted for samples COI-MW04-20160727 and COI-MW05-20160728 on the COC. PFAAs were reported the other water samples listed on the COC.

- There was no time of collection listed for the trip blank on the COC; the laboratory assigned a collection time of 0800.

1.0 PERFLUORINATED ALKYL ACIDS

The samples were analyzed for PFAAs per EPA Method 537. The following compounds were reported:

- Perfluorobutanesulfonic acid, PFBS
- Perfluorodecanoic acid, PFDA
- Perfluorododecanoic acid, PFDoA
- Perfluoroheptanoic acid, PFHpA
- Perfluorohexanesulfonic acid, PFHxS
- Perfluorohexanoic acid, PFHxA
- Perfluorononanoic acid, PFNA
- Perfluorooctanesulfonic acid, PFOS
- Perfluorooctanoic acid, PFOA
- Perfluorotetradecanoic acid, PFTA
- Perfluorotridecanoic acid, PFTrDA
- Perfluoroundecanoic acid, PFUnA

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Trip Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

1.1 Overall Assessment

The PFAA data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

1.2 Holding Time

The holding times for the PFAA analysis of a water sample are 14 days from collection to extraction and 28 days from extraction to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two method blanks were reported (batches 926352 and 926827). The PFAAs were not detected in the method blanks above the method-specified one third (1/3) of the method reporting limits (MRLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two LCS/LCS duplicate (LCSD) pairs were reported. The recovery and relative percent difference (RPD) results were within the method specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

One trip blank, Trip Blank - 20160727, accompanied the sample shipment. The PFAAs were not detected in the trip blank above the MRLs.

1.8 Field Duplicate

A field duplicate sample, COI-MW03-20160728-DUP, was collected with the sample set. Acceptable precision (RPD $\leq$30% for concentrations greater than two times the MRLs, RPD $\leq$50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, COI-MW03-20160728.

1.9 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level IV report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level IV report and the EDD.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

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Memorandum

Date: 24 June 2016

To: Bob Anderson
Cindy Bartlett
Samantha Fox

From: Mary Tyler

CC: J. Caprio

Subject: Stage 2A Data Validation - Level II Data Deliverables – Eurofins Eaton Analytical Report Numbers 592302, 592671, 593456, and 594492

SITE: PNG0714

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of twelve water samples, one field duplicate sample, one equipment blank, and four trip blanks, collected May 23 – June 7, 2016, as part of the project PNG0714 sampling event. The analyses were performed at Eurofins Eaton Analytical, Monrovia, California. The samples were prepared and analyzed by the following analytical tests:

- Perfluorinated alkyl acids (PFAAs) by EPA Method 537
- Selected Volatile Organic Compounds (VOCs) [Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) and methyl tert butyl ether (MTBE)] by EPA Method 524.2
- Selected Metals (Calcium, Magnesium, Potassium, and Sodium) by EPA Method 200.7
- Anion by EPA Method 300.0
- Alkalinity by Standard Method 2320B
- Specific Conductance by Standard Method 2510B
- pH by Standard Method 4500-HB

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data are usable for meeting project objectives.

The organic data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002), as well as by the pertinent method referenced by the data package and technical and professional judgment.

The inorganic data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, August 2014 (USEPA-540-R-013-001), as well as by the pertinent method referenced by the data package and technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Sample ID
201605260223	MW05_10 to 20_20160523
201605260227	MW03_10 to 20_20160524
201605260228	TRIP BLANK_20160524
201605260229	MW03_40 to 50_20160524
201605280242	MW01_30 to 40_20160526
201605280243	MW01_Rinseate_20160526
201605280244	MW01_55 to 65_20160526
201605280245	MW04_29 to 39_20160527
201605280246	trip blank_20160527
201606020681	MW02_40to50_20160531

Laboratory ID	Sample ID
201606020682	Trip Blank_20160601
201606080558	COI-MW01-060716
201606080560	COI-MW02-060716
201606080561	COI-MW03-060716
201606080562	COI-MW03-060716-DUP
201606080563	COI-MW04-060716
201606080564	COI-MW05-060716
201606080568	Trip Blank-060716

The samples were received at the laboratory within the criteria of 0-6ºC. No sample preservation issues were noted by the laboratory.

The relinquished date and time were not listed on the chain of custody (COC) in report 592302.

1.0 PERFLUORINATED ALKYL ACIDS

The samples were analyzed for PFAAs per EPA Method 537. The following compounds were reported:

- Perfluorobutanesulfonic acid, PFBS
- Perfluorodecanoic acid, PFDA
- Perfluorododecanoic acid, PFDoA
- Perfluoroheptanoic acid, PFHpA

- Perfluorohexanesulfonic acid, PFHxS
- Perfluorohexanoic acid, PFHxA
- Perfluorononanoic acid, PFNA
- Perfluorooctanesulfonic acid, PFOS
- Perfluorooctanoic acid, PFOA
- Perfluorotetradecanoic acid, PFTA
- Perfluorotridecanoic acid, PFTrDA
- Perfluoroundecanoic acid, PFUnA.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

✓ Overall Assessment
✓ Holding Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogates
✓ Equipment Blank
⊗ Trip Blank
✓ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The PFAA data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

1.2 Holding Time

The holding times for the PFAA analysis of a water sample are 14 days from collection to extraction and 28 days from extraction to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Nine method blanks were reported (batches 914151, 914427, 915130, 915652, 915136, 916189, 916843, 916753, and 917227). The PFAAs were not detected in the method blanks above the method reporting limits (MRLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

It was noted that some MS/MSD recovery calculations appeared incorrect based on the data presented. The laboratory has not provided information explaining the inconsistencies. Since these are batch QC the reports were validated based on the pertinent associated QC samples and no qualifications were applied to the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Nine LCS/LCS duplicate (LCSD) pairs were reported. The recovery and relative percent difference (RPD) results were within the method specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses, with the following exception.

The recovery of 13C-PFDA in sample MW01_Rinseate_20160526 was high and outside the laboratory specified acceptance criteria. Since the remaining three surrogates were within laboratory limits, no qualifications were applied to the data based on professional judgment.

1.7 Equipment Blank

One equipment blank, MW01_Rinseate_20160526, was collected with the sample set. The PFAAs were not detected in the equipment blank above the MRLs.

1.8 Trip Blank

Four trip blanks, TRIP BLANK_20160524, trip blank_20160527, Trip Blank_20160601, and Trip Blank-060716, accompanied the sample shipments. The PFAAs were not detected in the trip blanks above the MRLs, with the following exceptions.

Perfluoroheptanoic acid (0.0099 µg/L), perfluorohexanesulfonic acid (0.023 µg/L), perfluorohexanoic acid (0.021 µg/L), perfluorononanoic acid (0.0085 µg/L), perfluorooctanesulfonic acid (0.059 µg/L), and perfluorooctanoic acid (0.011 µg/L) were detected at concentrations greater than the MRLs in trip blank_20160527. Since perfluoroheptanoic acid, perfluorohexanoic acid, perfluorononanoic acid, and perfluorooctanoic acid were not detected in the associated samples, no qualifications were applied to these compounds. However, the perfluorohexanesulfonic acid and perfluorooctanesulfonic acid concentrations greater than the MRLs and less than the trip blank contamination in the associated sample were U qualified as not detected at the reported concentrations.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
MW04_29 to 39_20160527	Perfluorohexanesulfonic acid	0.0084	NA	0.0084	U	3
MW04_29 to 39_20160527	Perfluorooctanesulfonic acid	0.0028	NA	0.0028	U	3

µg/L-micrograms per liter
NA-not applicable
*Validation qualifiers are defined in Attachment 1 at the end of this report
** Reason codes are defined in Attachment 2 at the end of this report

1.9 Field Duplicate

One field duplicate sample, COI-MW03-060716-DUP, was collected with the sample sets. Acceptable precision (RPD ≤30% for concentrations greater than two times the MRLs, RPD ≤50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, COI-MW03-060716.

1.10 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

1.11 Electronic Data Deliverables (EDD) Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

2.0 SELECTED VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per EPA Method 524.2.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

✓ Overall Assessment
⊗ Holding Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogates
✓ Trip Blank
✓ Equipment Blank
✓ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverables Review

2.1 Overall Assessment

The VOC data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

2.2 Holding Time

The holding time for the VOC analysis of a water sample is 14 days from collection to analysis. The holding times were met for the sample analyses, with the following exception.

Sample COI-MW03-060716-DUP was Q3 flagged by the laboratory indicating the sample was not properly preserved. The laboratory indicated the sample pH was greater than 2; therefore, the sample was considered unpreserved. The holding time for the VOC analysis of an unpreserved water sample is 7 days from collection to analysis. The sample was analyzed outside the holding time. Therefore, the nondetect results in sample COI-MW03-060716-DUP were UJ qualified as estimated less than the MRL based on professional judgment.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
COI-MW03-060716-DUP	Benzene	0.50	UQ3	0.50	UJ	2
COI-MW03-060716-DUP	Ethylbenzene	0.50	UQ3	0.50	UJ	2
COI-MW03-060716-DUP	m&p-Xylenes	0.50	UQ3	0.50	UJ	2
COI-MW03-060716-DUP	Methyl tert-Butyl Ether	0.50	UQ3	0.50	UJ	2
COI-MW03-060716-DUP	o-Xylene	0.50	UQ3	0.50	UJ	2
COI-MW03-060716-DUP	Toluene	0.50	UQ3	0.50	UJ	2
COI-MW03-060716-DUP	Xylenes, Total	0.50	UQ3	0.50	UJ	2

µg/L-micrograms per liter
U-not detected at or above the MRL
Q3-laboratory flag indicating sample was not properly preserved

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported (batch 917124). The VOCs were not detected in the method blank above the MRLs.

2.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were not reported.

2.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS/LCSD pair was reported. The recovery and RPD results were within the method specified acceptance criteria.

2.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.7 Equipment Blank

The equipment blank was not analyzed for VOCs.

2.8 Trip Blank

One trip blank, Trip Blank-060716, accompanied the sample shipments and was analyzed for VOCs. The VOCs were not detected in the trip blank above the MRLs.

2.9 Field Duplicate

One field duplicate sample, COI-MW03-060716-DUP, was collected with the sample sets. Acceptable precision (RPD $\leq$30%) was demonstrated between the field duplicate and the original sample, COI-MW03-060716. The RPDs were 0%.

2.10 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

2.11 Electronic Data Deliverables Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

3.0 SELECTED METALS

The samples were analyzed for selected metals per EPA Method 200.7.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

✓ Overall Assessment
✓ Holding Time

- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Equipment Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

3.1 Overall Assessment

The metals data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

3.2 Holding Time

The holding time for the metals analysis of a water sample is 180 days from collection to analysis. The holding times were met for the sample analyses.

3.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported (batch 916682). The metals were not detected in the method blank above the MRLs.

3.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

3.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS/LCSD pair was reported. The recovery and RPD results were within the method specified acceptance criteria.

3.6 Equipment Blank

The equipment blank was not analyzed for metals.

3.7 Field Duplicate

One field duplicate sample, COI-MW03-060716-DUP, was collected with the sample set. Acceptable precision (RPD ≤30%) was demonstrated between the field duplicate and the original sample, COI-MW03-060716.

3.8 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

3.9 Electronic Data Deliverables Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

4.0 WET CHEMISTRY PARAMETERS

The samples were analyzed for anions by EPA method 300.0, alkalinity by standard method 2320B, specific conductance by standard method 2510B, and pH by Standard Method 4500-HB.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Equipment Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

4.1 Overall Assessment

The wet chemistry data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

4.2 Holding Time

The holding times for water samples are listed below. The holding times were met for the sample analyses.

Analysis	Holding Time
Nitrate as N, Nitrate as NO^3, and Nitrite as N by EPA Method 300.0	48 hours from collection to analysis
Chloride and Sulfate by EPA Method 300.0	28 days from collection to analysis
Alkalinity by Standard Method 2320B	14 days from collection to analysis
Specific Conductivity by Standard Method 2510B	28 days from collection to analysis
pH by Standard Method 4500-HB	As soon as possible

pH does not have a specific holding time listed in method 4500-HB; the method indicates the samples should be analyzed as soon as possible after sample collection since pH changes occur within 15 minutes of sampling. Based on professional and technical judgment, as soon as possible should be within one day of receipt by the laboratory at most. Therefore, since the water pH analyses were performed within one day of laboratory receipt, no qualifications were applied to the water pH data.

4.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four method blanks were reported (batches 915726, 915736, 915950, and 915960). The wet chemistry parameters were not detected in the method blanks above the MRLs.

4.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Sample specific MS/MSD pairs were reported for

nitrate as N, nitrite as N, chloride, and sulfate using sample COI-MW02-060716. The recovery and RPD results were within the laboratory specified acceptance criteria.

Batch MS/MSD pairs were also reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

4.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Five LCS/LCSD pairs were reported. The recovery and RPD results were within the method specified acceptance criteria.

4.6 Laboratory Duplicate

Batch laboratory duplicates were reported for pH and specific conductivity. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

4.7 Equipment Blank

The equipment blank was not analyzed for metals.

4.8 Field Duplicate

One field duplicate sample, COI-MW03-060716-DUP, was collected with the sample sets. Acceptable precision (RPD $\leq$30%) was demonstrated between the field duplicate and the original sample, COI-MW03-060716.

4.9 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

4.10 Electronic Data Deliverables Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

Geosyntec consultants

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Memorandum

Date:	07 November 2016
To:	Bob Anderson
	Cindy Bartlett
From:	Mary Tyler
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverable – Eurofins Eaton Analytical Report Number 613606**

SITE: PNG0714

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of two water samples and one trip blank, collected September 27, 2016, as part of the project PNG0714 sampling event. The analyses were performed at Eurofins Eaton Analytical, Monrovia, California. The samples were prepared and analyzed by the following analytical test:

- Perfluorinated alkyl acids (PFAAs) by EPA Method 537

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data are usable for meeting project objectives.

The data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002), as well as by the pertinent method referenced by the data package and technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Sample ID
201609280826	COI-SW-A-092716

Laboratory ID	Sample ID
201609280851	COI-SW-B-092716

Laboratory ID	Sample ID
201609280852	TripBlank-092716

The samples were received at the laboratory within the criteria of 0-6ºC. No sample preservation issues were noted by the laboratory.

1.0 PERFLUORINATED ALKYL ACIDS

The samples were analyzed for PFAAs per EPA Method 537. The following compounds were reported:

- Perfluorobutanesulfonic acid, PFBS
- Perfluorodecanoic acid, PFDA
- Perfluorododecanoic acid, PFDoA
- Perfluoroheptanoic acid, PFHpA
- Perfluorohexanesulfonic acid, PFHxS
- Perfluorohexanoic acid, PFHxA
- Perfluorononanoic acid, PFNA
- Perfluorooctanesulfonic acid, PFOS
- Perfluorooctanoic acid, PFOA
- Perfluorotetradecanoic acid, PFTA
- Perfluorotridecanoic acid, PFTrDA
- Perfluoroundecanoic acid, PFUnA.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

✓ Overall Assessment
✓ Holding Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogates
✓ Trip Blank
✓ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

1.1 Overall Assessment

The PFAA data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

1.2 Holding Time

The holding times for the PFAA analysis of a water sample are 14 days from collection to extraction and 28 days from extraction to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported (batch 940060). The PFAAs were not detected in the method blank above the method-specified one third (1/3) of the method reporting limits (MRLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). One batch MS/MSD pair was reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS/LCS duplicate (LCSD) pair was reported. The recovery and relative percent difference (RPD) results were within the method specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

A trip blank, TripBlank-092716, was collected with the sample set. The PFAAs were not detected in the trip blank above the MRLs.

1.8 Field Duplicate

A field duplicate sample was not collected with the sample set.

1.9 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II report and the EDD.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

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Memorandum

Date:	03 November 2016
To:	Bob Anderson
	Cindy Bartlett
From:	Mary Tyler
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverable – Eurofins Eaton Analytical Report Number 617739**

SITE: PNG0714

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of seven water samples, one field duplicate sample and one trip blank, collected October 17, 2016, as part of the project PNG0714 sampling event. The analyses were performed at Eurofins Eaton Analytical, Monrovia, California. The samples were prepared and analyzed by the following analytical tests:

- Perfluorinated alkyl acids (PFAAs) by EPA Method 537
- Selected Metals (Calcium, Magnesium, Potassium and Sodium) by EPA Method 200.7
- Anions (Nitrate as N, Nitrate as NO_3, Nitrite as N and total Nitrate, Nitrate-N by Calculation) by EPA Method 300.0

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data as qualified are usable for meeting project objectives. Qualified data should be used within the limitations of the qualification.

The data were reviewed based on the information and/or guidance provided in the US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-014-002), the US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, August 2014 (USEPA-540-

R-013-001), as well as by the pertinent methods referenced by the data package and technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Sample ID
201610190441	COI-MW01-20161017
201610190442	COI-MW02-2016017
201610190443	COI-MW03-2016017
201610190444	COI-MW03-20161017-DUP
201610190445	COI-MW04-20161017

Laboratory ID	Sample ID
201610190446	COI-MW05-20161017
201610190447	COI-MW06-20161017
201610190448	COI-MW07-20161017
201610190449	TRIP BLANK-20161017

The samples were received at the laboratory within the criteria of 0-6ºC. No sample preservation issues were noted by the laboratory.

The following issue was noted with the chain of custody (COC); this did not result in qualification of the data.

- No collection time was listed on the COC for the trip blank. The laboratory assigned a collection time of 0800.

1.0 PERFLUORINATED ALKYL ACIDS

The samples were analyzed for PFAAs per EPA Method 537. The following compounds were reported:

- Perfluorobutanesulfonic acid, PFBS
- Perfluorodecanoic acid, PFDA
- Perfluorododecanoic acid, PFDoA
- Perfluoroheptanoic acid, PFHpA
- Perfluorohexanesulfonic acid, PFHxS
- Perfluorohexanoic acid, PFHxA
- Perfluorononanoic acid, PFNA
- Perfluorooctanesulfonic acid, PFOS
- Perfluorooctanoic acid, PFOA
- Perfluorotetradecanoic acid, PFTA
- Perfluorotridecanoic acid, PFTrDA
- Perfluoroundecanoic acid, PFUnA.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Trip Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

1.1 Overall Assessment

The PFAA data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

1.2 Holding Time

The holding times for the PFAA analysis of a water sample are 14 days from collection to extraction and 28 days from extraction to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two method blanks were reported (batches 944126 and 944831). The PFAAs were not detected in the method blanks above the method-specified one third (1/3) of the method reporting limits (MRLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two LCS/LCS duplicate (LCSD) pairs were reported. The recovery and relative percent difference (RPD) results were within the method specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

A trip blank, TRIP BLANK-20161017, was collected with the sample set. The PFAAs were not detected in the trip blank above the MRLs.

1.8 Field Duplicate

A field duplicate sample, COI-MW03-20161017-DUP, was collected with the sample set. Acceptable precision (RPD $\leq$30% for concentrations greater than two times the MRLs, RPD $\leq$50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, COI-MW03-20161017.

1.9 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II report and the EDD.

2.0 SELECTED METALS

The samples were analyzed for selected metals per EPA Method 200.7 (Calcium, magnesium, potassium and sodium).

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Trip Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The metals data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

2.2 Holding Time

The holding time for the metals analysis of a water sample is 180 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported (batch 943898); the method blank was analyzed twice, once in each analytical batch (batches 944503 and 945221). The metals were not detected in the method blank above the MRLs.

2.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Four sample set specific MS/MSD pairs were reported, using samples COI-MW01-20161017, COI-MW02-2016017, COI-MW05-20161017 and COI-MW06-20161017. The recovery and RPD results were within the laboratory specified acceptance criteria

2.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS/LCSD pair was reported; the LCS/LCSD pair analyzed twice, once in each analytical batch. The recovery and RPD results were within the method specified acceptance criteria.

2.6 Trip Blank

The trip blank was not analyzed for metals.

2.7 Field Duplicate

A field duplicate sample, COI-MW03-20161017-DUP, was collected with the sample set. Acceptable precision (RPD $\leq$30% for concentrations greater than two times the MRLs, RPD $\leq$50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, COI-MW03-20161017.

2.8 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

2.9 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II report and the EDD.

3.0 ANIONS

The samples were analyzed for anions by EPA method 300.0 (Nitrate as N, nitrate as NO_3, nitrite as N and total nitrate, nitrate-N by calculation).

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine the impact on data quality and usability.

✓ Overall Assessment
⊗ Holding Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Trip Blank
✓ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

3.1 Overall Assessment

The anion data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

3.2 Holding Time

The holding times for water samples are listed below.

Analysis	Holding Time
Nitrate as N, Nitrate as NO_3, Nitrite as N and Total Nitrate, Nitrate-N by calculation by EPA Method 300.0	48 hours from collection to analysis
Chloride and Sulfate by EPA Method 300.0	28 days from collection to analysis

The holding times were met for the sample analyses, with the following exceptions. The nitrate and nitrite analyses of sample COI-MW02-2016017 were performed 5 minutes outside the 48 hour holding time. Since this sample was analyzed within the hour after 48 hours from collection, no qualifications were applied to the data, based on professional and technical judgment. The nitrate and nitrite analyses of sample COI-MW01-20161017 were performed 5 hours outside the 48 hour holding time. Therefore, based on professional and technical judgment, the nondetect results of nitrate as N, nitrate as NO_3, nitrite as N and total nitrate, nitrate-N by calculation in sample COI-MW01-20161017 were UJ qualified as estimated less than the MRLs.

Sample ID	Analyte	Laboratory result (mg/L)	Laboratory Flag	Validation result (mg/L)	Validation Qualifier*	Reason Code**
COI-MW01-20161017	Nitrate (as N)	0.10	UH3	0.10	UJ	2
COI-MW01-20161017	Nitrate (as NO3)	0.44	UH3	0.44	UJ	2
COI-MW01-20161017	Nitrite (as N)	0.050	UH3	0.050	UJ	2
COI-MW01-20161017	Nitrate and Nitrite (as N)	0.10	UH3	0.10	UJ	2

mg/L-milligram per liter
U-not detected at the stated MRL
H3-laboratoary flag indicating that the sample was received and/or analysis requested past the holding time
* Validation qualifiers are defined in Attachment 1 at the end of this report
**Reason codes are defined in Attachment 2 at the end of this report

3.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four method blanks were reported (batches 943714, 943715, 943786 and 943891). The anions were not detected in the method blanks above the MRLs.

3.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

3.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four LCS/LCSD pairs were reported. The recovery and RPD results were within the method specified acceptance criteria.

3.6 Trip Blank

The trip blank was not analyzed for anions.

3.7 Field Duplicate

A field duplicate sample, COI-MW03-20161017-DUP, was collected with the sample set. Acceptable precision (RPD ≤30% for concentrations greater than two times the MRLs, RPD ≤50% for concentrations within two times the MRLs) was demonstrated between the field duplicate and the original sample, COI-MW03-20161017.

3.8 Sensitivity

The samples were reported to the MRLs. No elevated nondetect results were reported for the samples.

3.9 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II report and the EDD.

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* * * * *

ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

APPENDIX D
5OBS WELL VIDEO SURVEY
PHOTO-LOG

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Oregon DEQ Project Number: PNG0714

Subject Site: Issaquah Phase II Hydrologic Investigation – Well 5 obs

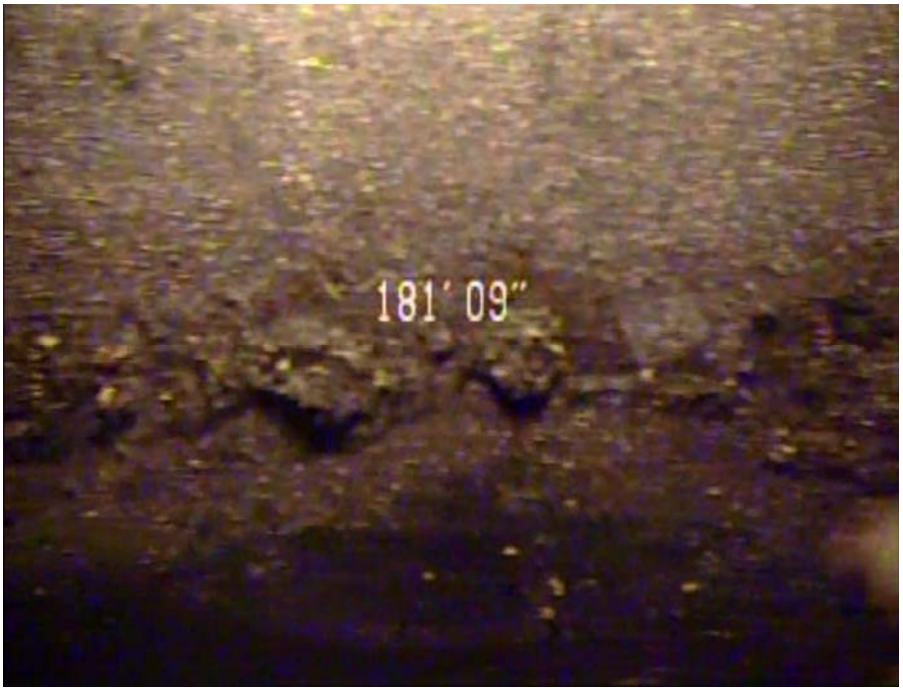
Photograph 1	
Date: N/A	
Direction: N/A	
Comments: 1st joint at 41'04". No visible deterioration of joint or welding nor intrusion of filter pack sand. Small amounts of iron bacteria present.	

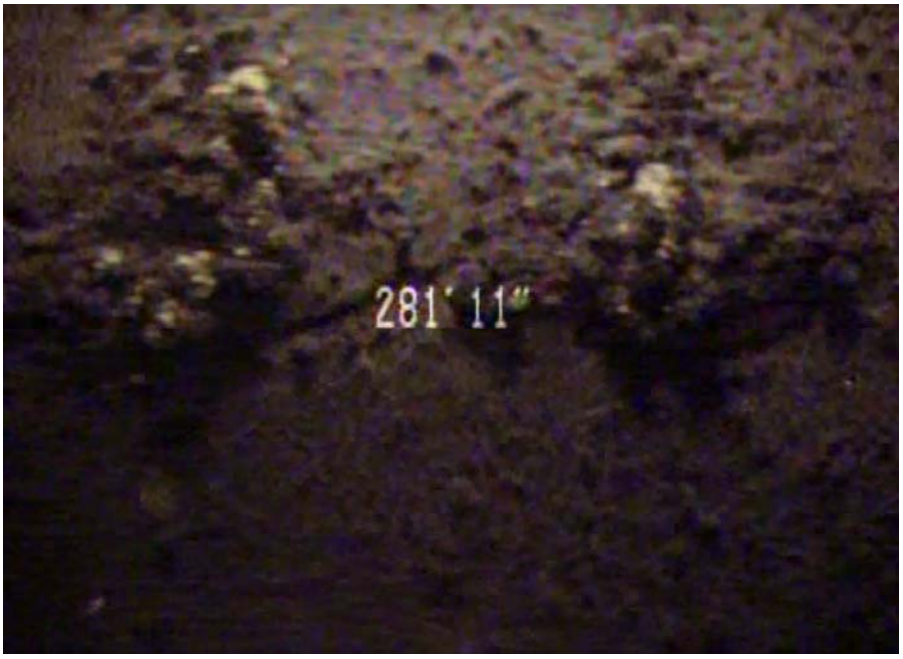
Photograph 2	
Date: N/A	
Direction: N/A	
Comments: 4th Joint at 101'05". No visible deterioration of joint or welding nor intrusion of filter pack sand. Small amounts of iron bacteria present.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Oregon DEQ Project Number: PNG0714

Subject Site: Issaquah Phase II Hydrologic Investigation – Well 5 obs

Photograph 3	
Date: N/A	
Direction: N/A	
Comments: 7th Joint at 181'09". No visible deterioration of joint or welding nor intrusion of filter pack sand. Small amounts of iron bacteria present.	

Photograph 4	
Date: N/A	
Direction: N/A	
Comments: 12th Joint at 281'11". No visible deterioration of joint or welding nor intrusion of filter pack sand. Small amounts of iron bacteria present.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Oregon DEQ Project Number: PNG0714

Subject Site: Issaquah Phase II Hydrologic Investigation – Well 5 obs

Photograph 5	
Date: N/A	
Direction: N/A	
Comments: Concrete plug at 304’10”. Location above well screen. No visible evidence of water seepage through/around concrete.	