APPENDIX C

FIELD EXPLORATION METHODS

G-Logics performed subsurface soil, shallow groundwater, and soil-vapor sampling during the assessment conducted on the subject property. The sampling activities were conducted in general accordance with Ecology's guidelines and regulations.

Underground Utility Clearance

Before conducting the subsurface exploration, G-Logics contacted a service that notifies public utilities of proposed subsurface investigations. Additionally, on-site private utilities were located by a private locating company to identify on-site utilities as well as specific areas of concern. Consequently, the below-grade utility locations were identified by marking their inferred location on the ground surface. This information was used to aid in identifying sampling locations. Additionally, at a number of boring locations, the first 4 to 5 feet of soils were removed using air-knife methods.

Quality Assurance Quality Control

Quality Assurance/Quality Control (QA/QC) for the presented scope of work included generally accepted procedures for sample collection, storage, tracking, and documentation. All sampling equipment was washed with a detergent wash and tap water rinse before the collection of the samples. All samples were labeled with a sample number, date, time, and sampler name, and were stored in an ice chest containing frozen "blue ice". Appropriate chain-of-custody documentation was completed.

Direct Push Soil Sampling

A probe subcontractor (ESN Northwest, Olympia, WA) performed the probe drilling at this site. The direct-push probe used for this work consisted of a 2-inch Macrocore sampler, in lengths of five feet. Continuous soil samples were obtained by driving/pushing this sampler, containing an acrylic liner, to the sampling depth. After reaching the required depth, the sampler was retrieved and opened. The collected soils contained within the acrylic liner were removed and placed into laboratory-provided glass jars. Samples were collected from the soil core using an Easy Draw Syringe and Powerstop Handle. The soil plug was then

extruded into a laboratory-supplied 40 ml VOA Vial containing methanol preservative. New liners were used for each sampling attempt.

Collected soil samples were evaluated for evidence of contamination by visible discoloration of the soil sample or VOCs detected by the PID. A portion of each soil sample was placed into a plastic zip-lock bag, and the vapors were drawn through the PID for qualitative screening of VOCs. The vapor readings were documented on the attached boring logs. A new plastic bag was used each time a sample was screened.

The soils were then observed and categorized for grain-size, color, moisture, odor, staining, sheen, and any other indications of contamination. This information was recorded on field boring logs (attached). Samples were collected where indications of contamination were observed or from where contamination would likely be present (i.e. at the groundwater interface).

Upon completion of each soil boring, a monitoring well (groundwater or soil-vapor) was installed (see attached boring logs). All soil cuttings were collected and placed into a waste drum for proper disposal (determined by analytical results).

Collected samples were labeled with a sample number, date, time, and sampler's name and stored in an ice chest containing frozen “blue ice”. Chain-of-custody procedures were followed to document sample handling.

Groundwater Monitoring Well Construction, Direct-Push Methods

Soil borings completed as groundwater monitoring wells were constructed in the following manner:

- To construct the well, 4” steal probe casing was driven to the desire depth for the well to be completed.
- The well casing materials consisted of 2-inch, inside diameter, flush-threaded, schedule 40 PVC pipe. Well screen intervals were constructed with 10–foot lengths of well screen, as shown on the boring logs.
- The screened interval of the well casing was perforated with 0.010-inch factory-cut slots.
- The annular seal of the well consisted of bentonite chip.
- All PVC casing materials were factory-cleaned before installation.

- The bottom of the well casing was sealed with a threaded cap. Blank (non-slotted) riser casing was used to extend the well from the top of the screened interval to ground surface. The length of the screened interval is identified on the boring logs.
- Well construction was accomplished by lowering the well casing into the open probe casing. The probe casing was then withdrawn from the boring and the resulting annular space around the blank riser was backfilled with sand and granulated bentonite to the depth shown on the boring logs.
- The well casing was sealed at the ground surface with a watertight expansion cap.
- A tamper-resistant steel cover was set over the well, flush to the ground surface. The cover was grouted in place with concrete.
- A reference point was marked on the top of the PVC well casing for consistent groundwater depth measurements.
- An Ecology well identification tag was placed inside the well box.

Well Development

After monitoring well construction and prior to purging the wells for sampling, the wells were developed. Over pumping, or removing water from the well at a rapid rate, was the devolvement technique used. An in-well GeoTech "Geosquirt 12DVC Purge Pump" was lowered to near the bottom of the well screen, and connected to a 12-volt power source. A swab/surge development technique also was also used. This movement was created by both lifting and lowering the pump, and by periodically turning the pump off and allowing the suspended water column to rapidly flow back down into the well. Well development continued until the initially turbid water turned nearly clear.

Water Level Measurements in Wells

Water level measurements were referenced to the top of the well casing. The static water level was measured in each monitoring well using a conductivity type, water level probe (Keck Model 1213, Flat Tape Water Level Meter). The conductivity probe on the water level meter was lowered into the well until the instrument detected water. The tape on the probe was used to obtain a depth-to-water measurement, from the reference point, to within 0.01 feet.

Monitoring Well Sampling, Peristaltic Pump Method

A G-Logics employee sampled groundwater wells in accordance with the following protocol:

- The height of the water column within the well was calculated by subtracting the depth to water from the total depth of the well. The volume of this water column was calculated using the relationship $V=3.14r^2h$. Where V is the volume of water in cubic feet, r is the radius of the well in feet and h is the height of the water column in feet.
- Based on these calculations, 3 to 5 volumes of water were removed from the well casing prior to collection of samples.
- All purge water was collected and placed into waste drums for proper disposal (determined by analytical results).
- The contract laboratory prepared the sample containers to conform to EPA-recommended preservation techniques for the analytes of concern.
- Groundwater samples were collected with a peristaltic pump. Sample containers were open only as long as necessary to collect the samples.
- Sample bottles were labeled with a sample number, date, time, and G-Logics employee's name and were stored in an ice chest containing frozen “blue ice”. Chain-of-custody procedures were followed to document sample handling.
- Dedicated tubing was used at each sampling location.

Soil-Vapor Monitoring Well Construction, Direct-Push Methods

Soil borings completed as soil-vapor monitoring wells were constructed in the following manner:

- To construct the well, 2” steal probe casing was driven to the desire depth for the well to be completed.
- The well casing materials consisted of 1-inch, inside diameter, flush-threaded, schedule 80 PVC pipe. Well screen intervals were constructed with 2.5–foot lengths of well screen, as shown on the boring logs.
- The screened interval of the well casing was perforated with 0.010-inch factory-cut slots.
- The annular seal of the well consisted of bentonite chip.
- All PVC casing materials were factory-cleaned before installation.

- The bottom of the well casing was sealed with a threaded cap. Blank (non-slotted) riser casing was used to extend the well from the top of the screened interval to ground surface. The length of the screened interval is identified on the boring logs.
- Well construction was accomplished by lowering the well casing into the open probe casing. The probe casing was then withdrawn from the boring and the resulting annular space around the blank riser was backfilled with sand and granulated bentonite to the depth shown on the boring logs.
- The well casing was sealed at the ground surface with a watertight vapor extraction plug (an expansion cap fitted with an airtight, quick connect coupling).
- A tamper-resistant steel cover was set over the well, flush to the ground surface. The cover was grouted in place with concrete.
- An Ecology well identification tag was placed inside the well box.
- Each soil-vapor monitoring point was screened above the groundwater capillary zone, as recommended in the Washington State Department of Ecology (Ecology) draft guidance document, *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action*, dated October 2009 (Vapor Intrusion Guidance, screening levels updated 2015).

Soil-Vapor Sampling

Soil-vapor monitoring points were sampled in accordance with the following protocol:

- A well plug fitted with a quick-connect barbed fitting was connected to the top of the casing of the soil-vapor monitoring point.
- Tubing was connected from the barb fitting to a peristaltic pump which was used to draw soil vapor from the well. Approximately three well volumes of soil vapor were purged from the monitoring point using the peristaltic pump.
- After purging was complete, a six-liter Summa canister fitted with a 70-minute flow regulator was connected to the monitoring point with Tedlar-lined tubing.
- A shut-in test was then completed to confirm connections were air-tight, tested between the monitoring point and Summa canister. A three-way valve (attached to the sampling assembly) was opened to apply vacuum pressure using a hand pump. Vacuum pressure was monitored at the hand pump and the Summa canister to confirm air-tight fittings.
- The three-way valve port for the hand pump was then closed. A rag soaked with isopropyl alcohol was then loosely wrapped around the monitoring point

casing. The rag was left for the duration of the sampling as a leak detection tracer in order to confirm the sample was representative.

- Once leak testing and setup is complete, the Summa canister valve is fully opened. Each Summa canister was then filled for approximately 70 minutes. Samples were noted with Summa canister serial numbers, beginning and ending canister pressure readings, location, purge duration, date, and time.
- The collected vapor samples were submitted to an analytical laboratory for volatile organic compound analysis using Method TO-15. Chain-of-custody procedures were followed to document sample handling.