Sampling and Analysis Plan

Precision Cast Parts Area-Wide Soil Sampling and Analysis

May 25, 2016

Land Quality,
Northwest Region
Cleanup Program
700 NE Multnomah Street,
Suite 600
Portland, OR 97232-4100
Phone 503-229-5069
Fax: 503-229-6945
www.oregon.gov/DEQ

DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water

State of Oregon
Department of Environmental Quality

Last Updated: 05/25/2016
DEQ16-NWR-0019-SAP
Version 2.0

This Sampling and Analysis Plan was prepared by:

Oregon Department of Environmental Quality
700 NE Multnomah Street, Suite 600
Portland, OR 97232-4100
1-503-693-5700
www.oregon.gov/deq

Contact:
Ray Hoy
503-229-5069

Project Approvals

Prepared By: _____ Date: _____
Ray Hoy, DEQ Project Manager

Reviewed By _____ Date: _____
Scott Hoatson, DEQ Quality Assurance Officer

Reviewed By _____ Date: _____
Scott Manzano, Acting DEQ Northwest Region Cleanup Manager

Signed Copy on File at DEQ

This page intentionally left blank

1. Project Management

1.1. Distribution List

The following personnel will be emailed regarding all aspects of this SAP. Deviations from this SAP must be communicated in writing (e-mail is acceptable) to all individuals identified in Table 1-1. Final reports from the laboratory (TBA) will be emailed and mailed via Hart Crowser to the DEQ Laboratory and the NWR project manager.

Table 1-1 Distribution List

Name	Phone	Email
Ray Hoy, DEQ NWR Project Manager	503-229-5069	hoy.ray@deq.state.or.us
Scott Hoatson, DEQ QAO	503-693-5786	hoatson.scott@deq.state.or.us
Hart Crowser Subcontract Laboratory (TBA)		
Scott Manzano, DEQ NWR Cleanup Manager	503-229-6748	manzano.scott@deq.state.or.us
Dan Hafley, DEQ NWR Cleanup Lead Worker	503-229-5417	hafley.dan@deq.state.or.us
Rebecca Wells-Albers, DEQ NWR Cleanup Program Project Peer	503-229-5585	wells-albers.rebecca@deq.state.or.us
Paul Seidel, DEQ Toxicologist	503-229-5614	seidel.paul@deq.state.or.us
Keith Johnson, DEQ NWR Cleanup and Air Quality Liaison	503-229-6431	johnson.keith@deq.state.or.us
Rick Ernst, Hart Crowser Program Manager	971-327-9121	rick.ernst@hartcrowser.com
Phil Cordell, Hart Crowser Project Manager	503-620-7284	Phil.cordell@hartcrowser.com

To track the time and expenses spent on this project DEQ personnel must use the **Q-Time number**:44826

1.2. Problem Definition/Background

Overall project assessment and oversight, including field activities, and coordination with the laboratory will be the responsibility of the DEQ's contractor (Hart Crowser) with oversight from DEQ. Data assessment/evaluation will also be provided by the DEQ Quality Assurance Officer and/or Data Coordinator (LEAP) on DEQ project manager request.

DEQ is collecting surface soil samples using incremental sampling methodology (ISM) from areas at Precision Cast Parts (facility), located at 4600 SE Harney Drive, and from public properties adjacent/nearby to the facility in Southeast Portland (See Appendix A). The sampling is being performed to determine if industrial activities at the facility may have impacted on-site and off-site soil, by the release mechanism of air emissions. The need for additional sampling is based, in part, on elevated chromium (total) and nickel detected in site catchbasins, storm sewers (subsequently cleaned), and in a segment of Johnson Creek. To provide broader coverage of on- and off-site sampling areas, and incorporate the concept of an exposure area, and to obtain representative soil samples, incremental sampling methodology (ISM) will be utilized in sample collection. ISM incorporates spatial and soil particle size variability and allows for reliable and reproducible results, providing an unbiased estimate of contaminant concentrations in soil.

If detected, contaminant concentrations will be compared to risk-based screening values for protection of human health or the environment. Naturally-occurring background levels will also need to be considered in assessing sampling results (See Appendix B). If contaminants associated with facility emissions are detected exceeding screening and background levels, additional assessment may be necessary.

DEQ's contractor will collect ISM soil samples following established guidelines presented in the Interstate Technology & Regulatory Council (ITRC) guidance document, *Incremental Sampling Methodology*, dated February 2012[1]. ISM samples will be collected from a total of 16 decision units (DUs) located both at the facility and on adjacent properties to assess potential air releases.

In addition to ISM samples, 4 discrete grab samples consisting each of a 3-scoop composite will be collected from the Errol Heights Community Garden and the Johnson Creek Riparian area for a total of 8 discrete grab samples.

ISM samples and discrete grab samples will be submitted for laboratory analysis by an accredited laboratory for the following metals.

- Arsenic (As)
- Beryllium (Be)
- Cadmium
- Chromium (Cr)
- Hexavalent Chromium (Cr+6)
- Iron (Fe)
- Lead (Pb)
- Manganese (Mn)
- Cobalt (Co)
- Nickel (Ni)
- Selenium (Se)
- Titanium (Ti)
- Zinc (Zn)

DEQ will compare laboratory results for metals to risk-based concentrations (RBCs) and background concentrations for the Portland Basin, as presented in the following, in order to assess potential risk:

- *Oregon DEQ Risk-Based Concentration Table, Revision: November 1, 2015*[2]
- *Oregon DEQ Development of Oregon Background Metals Concentrations in Soil, March, 2013*[3]
- *See also Appendix B*

Data from this project may also be used to determine the area of distribution of the potential contaminant deposition from air emissions from the facility. Oregon Health Authority may also utilize some of the data generated from this project as part of an OHA Health Consultation.

1.3. Project/Task Description

Project Management: Oregon DEQ Northwest Region Cleanup Program
700 NE Multnomah Street, Suite 600
Portland, OR 97232-4100

[1] http://www.itrcweb.org/ism-1/Executive_Summary.html
[2] Oregon DEQ Risk-Based Concentrations Table, Revision: November 1, 2015: http://www.deq.state.or.us/lq/pubs/docs/RBDMTable.pdf
[3] Oregon DEQ Development of Oregon Background Metals Concentrations in Soil, March, 2013: http://www.deq.state.or.us/lq/pubs/docs/cu/FSbackgroundmetals.pdf

Sampling Organization: Hart Crowser
6420 SW Macadam Avenue, Suite 100,
Portland, OR 97239-3517

Analytical Organization: To Be Determined

1.4. Quality Objectives and Criteria

DEQ's contractor will conduct all sampling activities performed under this work plan in accordance with DEQ's *EPA PA/SI Investigations Quality Assurance Project Plan* dated August 14, 2012 (DEQ05-LQ-0069-QAPP) and the *Interstate Technology Regulatory Council Incremental Sampling Methodology Guidance*, dated February, 2012. The laboratory will analyze the samples and report results following EPA methods and standard laboratory procedures. The laboratory will follow their standard analytical QA/QC procedures that are accredited under the National Environmental Laboratory Accreditation Program (NELAP) and QA/QC criteria that meets or exceed the PA/SI QAPP unless otherwise stated in Table 2-4.

DEQ's contractor will collect ISM soil samples at each decision unit and submit them for laboratory analysis for the contaminants listed above. The laboratory will dry, sieve, grind, and process the ISM sample in accordance with ITRC sample preparation protocol and their standard operating procedure for processing ISM samples[1]. The laboratory will need to grind samples using a grinder made from materials that will not contaminate the target analytes (e.g. tungsten carbide, zirconia, corundum, ceramic, etc.; other containing material may be acceptable if the lab can demonstrate that target analytes are not introduced during the grinding process).

The laboratory will report analyte concentrations down to their method detection limit (MDL). Because values below the quantitation limit (QL) are less precise, there will be greater uncertainty associated with values below the QL and above the MDL. The quantitation limits[4] are shown in Table 1-2.

Table 1-2 Laboratory Quantitation Limits

Analyte	Cas No.	Method	QL	units
ARSENIC	7440-38-2	6020A	**1.0**	mg/Kg-dry wt
BERYLLIUM	7440-41-7	6020A	**0.2**	mg/Kg-dry wt
CADMIUM	7440-43-9	6020A	**0.1**	mg/Kg-dry wt
CHROMIUM	7440-47-3	6020A	**1.0**	mg/Kg-dry wt
COBALT	7440-48-4	6020A	**0.1**	mg/Kg-dry wt
HEXAVALENT CHROMIUM	18540-29-9	7199	**0.2**	mg/Kg-dry wt
IRON	7439-89-6	6020A	**1.0**	mg/Kg-dry wt
LEAD	7439-92-1	6020A	**0.1**	mg/Kg-dry wt
MANGANESE	7439-96-5	6020A	**1.0**	mg/Kg-dry wt
NICKEL	7440-02-0	6020A	**1.0**	mg/Kg-dry wt
SELENIUM	7782-49-2	6020A	**1.0**	mg/Kg-dry wt

[4] Quantitation limits may be raised if there is a need for dilutions.

TITANIUM	7440-32-6	6020A	**1.0**	mg/Kg-dry wt
ZINC	7440-66-6	6020A	**4.0**	mg/Kg-dry wt

1.5. Documentation and Records

Incremental sample locations are presented on the attached sampling maps for each decision unit and will be surveyed in the field using a global positioning system (GPS) and onsite measurements/observations (See Appendices A). Photographs will be taken of the sample area and any other site-related observations, including likely exposure areas (play areas, gardens, etc). Field documents will be maintained by the Hart Crowser Project Manager.

Samples collected from the field will be shipped to the analytical laboratory with the "Chain of Custody" form (Appendix C). Final analytical reports generated by the laboratory will follow their standard laboratory practices. All analytical results will be provided to DEQ as electronic data deliverables (EDDs). Electronic versions of the reports will be e-mailed to the DEQ project manager and the DEQ LEAP Data Coordinator in a Portable Document Format (PDF) and in standard DEQ-defined MS Excel format. An original hard copy of the report with the supporting QC documentation will be kept on file at the DEQ Laboratory. Policies and procedures for the maintenance of analytical records are described in the LEAP Quality Manual (DEQ91-LAB-0006-LQM). Copies of the report will be available upon request.

Property access agreements will be obtained and maintained by the DEQ Project Manager.

2. Data Generation and Acquisition

2.1. Sampling

Soil Sample Collection (Incremental Sampling Methodology)

Sampling design, collection, methods, and handling will be managed by DEQ and DEQ's contractor. Hart Crowser will ensure that all samples are collected in the appropriate sample containers, preserved as identified in the reference methods, transported to the analytical organization within the established holding times, with proper documentation and sample transport conditions. The analytical laboratory assumes no responsibility for the quality of data resulting from samples that were collected, shipped, or stored under inappropriate conditions.

Decision units and increment sample locations are presented in Appendix A and were designated based on locations of potential air emission deposition and public areas in the proximity to the property where human contact with contamination might occur. A brief description of each decision unit is presented below.

Errol Heights Community Garden (EHCG)
The Errol Heights Community Garden is owned by the City of Portland and is located at 4841 SE Tenino Court, north of the facility. The community garden is approximately 0.40 acres, and consists of open

space (lacking structures), grass-covered land to the south and west, and an actively-used community vegetable/fruit garden to the north and east.

Decision unit EHCG-DU-1 is the non-developed area of the property, outside of the boundaries of the gardening area, and is bound by SE Tenino Court to the west, SE Tenino Court to the south and east, and the community garden to the north (see Appendix A-1). The location of the decision unit is between the facility and the community garden, and is not actively managed except for seasonal mowing. The gardening area itself will have four discrete soil grab samples taken from the raised garden beds. These garden soil beds may not be representative of "natural" soil conditions and may contain import of compost or other soil amendments. The decision unit will be useful in determining potential impacts to the area near the community gardening and the discrete samples will provide information if the gardens themselves have metal levels above natural background conditions.

Errol Heights City Park, Natural Area (EHCP)
The Errol Heights City Park and Natural Area is owned by the City of Portland and is located at SE 52nd and Tenino Street, north of the facility. The natural area is approximately 13 acres, and consists of vegetation, Erroll Creek/wetlands, and walking paths. The property is bound by SE Tenino Court and SE Tenino Drive to the north, SE 45 Avenue to the west, SE Harney Drive to the south, and SE 52nd Avenue to the east. Private residences border the property on the northeast, east, and southeast side. Purdy's Pit Stop and Franz Bakery Outlet Store border the property on the southwest corner.

Decision unit EHCP-DU-1 is located in the south west portion of the property, immediately south of the community garden, and is predominantly flat with a mix of substrate (ie. grass, low lying vegetation, shrubs, etc.) mildly covered with trees (see Appendix A-2a). Decision unit EHCP-DU-2 (see Appendix A-2b). is located on north east portion of the natural area, outside of the wetlands and thick vegetation. These decision units were selected based on the absence of wetlands and thick vegetation and available soil media for sampling.

Precision Cast Parts (PCC)
The two decision units, PCC-DU-1 and PCC-DU-2, are located on-site, north of the facility manufacturing buildings and south of SE Harney Drive and the Precision Cast Parts parking area (see Appendix A-3). Both lie immediately adjacent to where manufacturing activities and air releases would occur. These unpaved areas are steep and have been recently cut back due to thick blackberry vegetation. These decision units were selected based on their accessibility and their location to potential industrial emissions at the facility.

Clackamas County Natural Area (CC)
The Clackamas County Natural Area is owned by the City of Portland, which is bound by SE Harney Drive and residential property to the north, SE 55th Avenue and residential property to the east, Precision Cast Parts (facility) to the west, and SE Johnson Creek and general industrial property to the south. The natural area is comprised of a wetland and dense vegetation. The decision units CC-DU-1 and CC-DU-2 were selected based on the absence of wetlands and thick vegetation (see Appendix A-4).

Springwater Corridor (SWC)between SE 45th Place and SE 55th Avenue
The Springwater Corridor is owned by the City of Milwauke, with the selected decision units located east of SE 45th Place, south of SE Johnson Creek Boulevard, north of Johnson Creek, and west of SE 55th Avenue (see Appendix A-5 through A-7). The decision units along the Springwater Corridor are predominantly flat and grass-covered, and are all situated adjacent to the asphalt trail and south of SE Johnson Creek Boulevard. These decision units (SWC-DU-1, SWC-DU-2 and SWC-DU-3 were selected

based on their location immediately south and southwest of the facility, in one of the primary down-wind locations relative to the PCC facility

Johnson Creek (JC)

This decision unit, JC-DU-1, is located to the northwest of the facility at the intersection of SE 44th Avenue and SE Umatilla Street. This natural area borders Johnson Creek and was selected based on the direction of wind moving toward the northwest (see Appendix A-8).

Hazeltine Park (HZP)

This decision unit, HZP-DU-1, is located to the northeast of the facility at the intersection of SE Flavel Drive and SE Nehalum Street. This city park is located in the residential area and was selected based on the direction of wind moving toward the northeast (see Appendix A-9).

Lane Middle School (LMS)

This decision unit, LMS-DU-1, is located to the northeast of the facility at the intersection of SE Ogden Street and SE 60th Avenue. This public school was selected to determine if air deposition is occurring in the northeast direction from the facility (see Appendix A-10).

Meriwether Lewis School (MLS)

This decision unit, MLS-DU-1, is located to the northwest of the facility at the intersection of SE Glenwood Street and SE 45th Avenue. This public school was selected to determine if air deposition is occurring in the northwest direction from the facility (see Appendix A-11).

Ardenwald Elementary School (AES)

This decision unit, AES-DU-1, is located to the southwest of the facility at the intersection of SE Roswell Street and SE 36th Avenue. This public school was selected to determine if air deposition is occurring in the southwest direction from the facility (see Appendix A-12).

Seth Lewelling Elementary School (SLES)

This decision unit, SLES-DU-1, is located to the southeast of the facility at the intersection of SE Logus Road and SE 51st Avenue. This public school was selected to determine if air deposition is occurring in the southeast direction from the facility (see Appendix A-13).

Soil Sampling Protocol (ISM)

One ISM soil sample will be collected from each of the 16, 2-dimensional decision units at the site. Two additional replicate samples will be collected from EHCG-DU-1, PCC-DU-1, SLES-DU-1. (Appendices A-1, A-3, and A-13).

Fifty gridded increments of surface soil (0-5 cm below the ground surface) totaling approximately 2000 grams[5] will be collected from each decision unit using a CRREL Multi Increment® Sampling Tool (CMIST) core sampler. Each increment will be approximately 40 g and consist of a 3 cm core 5-cm in length. Each increment will be placed in a labeled 1-gallon sealable plastic bag, with an estimated fill volume of one-third to one-half. The increments will not include the turf layer present in the top portion of the surface soil. The turf layer at each increment location will be peeled back with a sharpened, flat-bladed shovel or removed from each core using a soil knife.

The locations of the increments will be pre-determined based on a random sampling approach per grid within each decision unit, described below. This method is described in the ITRC ISM Guidance document referenced above.

[5] Weights may vary based on sample composition.

Each decision unit will be divided into a grid pattern, consisting of 50 grid cells that are approximately equal in area. The grids were created using a series of avenue scripts for ArcGIS created by Bill Huber of *Quantitative Decisions (http:www.quantdec.com)*. The scripts partition all polygons into equal area parts. A random increment point was identified within a grid cell. The random points within each grid were created using the AutoCAD LISP utility program by NovaPDF (novapdf.com).

DEQ's contractor will use a Trimble GeoExplorer 6000 series GeoXH handheld GPS to locate the borings. The unit is capable of real time accuracy of 0.1 to 3 feet. Each increment location within the decision unit will be flagged prior to sample collection and the decision unit will be photographed to show all increment locations within the decision unit.

Rocks and/or gravel will not be removed from the sample core. If refusal is encountered during coring, the sample location will be moved to a point as close as possible to the original sample location within the increment grid.

Six field replicates, consisting of 50 increments per decision unit, will be collected during the sampling event. The collection of replicate samples allows for the calculation of a relative standard deviation (RSD). Two replicates will be collected from one decision unit located at the PCC facility (PCC-DU-1), two replicates will be collected from the Errol Heights Community Garden (EHCD-DU-1) and two replicates will be collected from the Seth Lewelling Elementary School (SLES-DU-1).

Replicate samples will be collected as independent random samples from each of the three DUs where replicates are being collected. Hart Crowser will generate a random increment point, one per grid cell of the decision unit as previously described above. In this manner, increment location identification will be performed three times in total for each of the replicated DUs, once for the original sample, and once for each of the two replicates. Hart Crowser will locate these randomly selected locations in the field for sampling. The replicate increment locations are not shown in this SAP, but will be shown in the sampling report prepared for the project. The replicate samples will be placed in the same type of sample container (sealable gallon size bag) and analyzed for the same parameters as the original sample.

Sampling equipment will be decontaminated after sample collection from each decision unit and not between each increment. Decontamination will be performed in accordance with the following procedure:

a. Brush equipment with a wire brush, if necessary, to remove large particulate matter.
b. Rinse equipment with Alconox and distilled water.

Soil Sampling Protocol (Discrete Grab Samples)

Discrete grab soil samples will be collected with a new plastic trowel or spoon. There will be 3 scoops collected from the identified sampling area which will go into one discrete composite. The soil will be placed into a 6-ounce jar, labeled with a sample tag identifying the property sampling unit and location (depth) number. For samples collected at depth (6 inches), a clean shovel will be used and rinsed between locations. All soil samples will be placed into a cooler and transported using DEQ chain-of-custody procedures for delivery to the contract laboratory. Discrete soils must be dried, sieved and ground prior to analysis similar to the ISM laboratory processing (use the entire sample). The laboratory will analyze the samples for the analysis and using the method presented in Table 2-3.

As all soil samples will be collected from the soil surface, investigative derived waste will consist of disposable equipment (rubber gloves, soiled paper towels), and miscellaneous trash. These items will be disposed of in an appropriate manner (landfilling) by DEQ's contractor.

Examples of the locations and media to be sampled are presented in Table 2-1.

List of Field Items:

- Chain of Custody
- GPS unit
- Camera
- Paper towels
- Alconox® or similar cleansing agent
- Distilled water
- 5-gallon bucket
- 1-gallon sealable plastic bags (at least 20).
- Sample coolers
- Ice
- Shovel
- Plastic Scoop/Trowel
- Sample jars (6-ounce)
- Wire brush (for decontamination)
- CRREL Multi Increment® Sampling Tool (CMIST)
- Sample labels
- Sharpie pens

Table 2-1: Summary of the example locations, sampling names, and media

Example Naming Scheme	Description	Sample media
SWC-DU-1	Springwater Corridor, ISM Surface Soil Sample, Decision Unit 1, 0-5 cm depth	Soil
SWC-DU-1 - rep 1.0-N	Springwater Corridor, ISM Surface Soil Sample, North Replicate, Decision Unit 1, 0-5 cm depth	Soil
CC-DU-1	Clackamas County Natural Area, ISM Surface Soil Sample, Decision Unit 1, 0-5 cm depth	Soil
EHCG-DU-1-rep 1.0-N	Errol Heights Community Garden, ISM Surface Soil Sample, Decision Unit 1, 0-5 cm depth	Soil
EHCP-DU-1	Errol Heights City Park, Natural Area, ISM Surface Soil Sample, Decision Unit 1, 0-5 cm depth	Soil
PCC-DU-1	Precision Cast Parts, ISM Surface Soil Sample, Decision Unit 1, 0-5 cm depth	Soil
EHCP-Discrete-1	Errol Heights Community Garden, Discrete Surface Soil Sample, 0-5 cm depth	Soil
JC-Discrete-1	Johnson Creek, Discrete Surface Soil	Soil

	Sample, 0-5 cm depth	
SLES-DU-1-rep. 1.0-N	Seth Lewelling Elementary School, , 0-5 cm depth	Soil

2.2. Sampling Methods, Sample Handling, and Custody

Soil samples submitted for laboratory analysis will be collected using the protocols previously discussed. Each increment will be placed into a sealable, 1-gallon plastic bag, and labeled with a sample tag identifying the decision unit, sample time, and sample date. All soil samples will be placed into a cooler and transported using DEQ chain-of-custody procedures for delivery to the laboratory. The laboratory will prepare the samples following their ISM protocols and submit a copy of their ISM procedure to the DEQ project manager prior to project initiation. The laboratory will analyze the samples using the methods presented in Table 2-3.

The following is an overview of the laboratory ISM processing protocol:

A) The laboratory technician will empty the entire contents of the sample onto a paper sheet and allow the sample to air dry at ambient temperature.

B) The sample will then be broken up with a spatula or wooden tongue depressor and sieved using a No. 10 (2 millimeter) sieve.

C) The sample will then be placed on an inert, flat surface at an even depth. Approximately 30 random subsamples, approximately 3 grams each, will be collected from evenly distributed locations using a random sampling approach to make up a 90g – 100g subsample. The subsamples will be collected using a sampling tool capable of collecting the entire distribution of grain sizes present in the sample. Repeat the process in replicate for each decision unit (followed by step D) and the ground subsample is provided to Precision Cast parts for comparison analysis. Precision Cast parts may select the Hart Crowser contracted lab for the analysis or may send the sample to another laboratory at their discretion.

D) The approximate 90g -100g subsample is to be ground to approximately < 200 mesh (~75 micron). The ground sample is then spread out and subsampled for final digestion/analysis.

E) For each analysis, the lab will take approximately 10 random subsamples, approximately 0.1 grams each, will be collected from evenly distributed locations using a random sampling approach to make up a 1g subsample for digestion (adjusted to 2.5g for Method 3060A/7199).

A summary of the sampling containers, preservation requirements, and holding times is presented in Table 2-2.

Table 2-2: Summary of ISM and discrete sampling preservation and holding time

Sample Type	Container	Preservation	Holding Time
Soil ISM	1-gallon sealable plastic bag	None Required (metals except Cr^{+6})	Metals:180 days
Soil ISM	1-gallon sealable plastic bag	Cool <6° C (Cr^{+6}),	30 days
Soil Grab (discrete)	4-oz jar	None Required (metals except Cr^{+6})	180 days
Soil Grab (discrete)	4-oz jar	Cool <6° C (Cr^{+6})	30 days

2.3. Analytical Parameters, Methods, and Quality Control

A summary of the requested analytical parameters and methods is provided in Table 2-3. Standard certified laboratory contractor and subcontractor to be determined. Laboratory standard operating procedures will be followed during the analyses of the samples, including analytical quality control measures and equipment inspection/maintenance.

Table 2-3: Summary of analytical parameters and methods

Sample Type	Analytical Parameters	Reference Method
Soil ISM, Soil Discrete Grab	Total Metals – As, Be, Cd, Co, Cr, Fe, Pb, Mn, Ni, Se, Ti, Zn	EPA 6020A (ICPMS)
	Hexavalent Chromium (Cr +6)	Cr (+6) 3060A/7199

All parameters will be reported on a dry weight basis.

Table 2-4 Quality Control

Quality Control	Frequency	Control Limits
Ground Sand Blank	3 initially to establish background levels of potential trace contaminants in sand	Goal is to < QL but it is expected that there may be trace levels of common contaminants (e.g. Fe, Zn)
	1 per 10 samples	Below QL or established background levels.
Method Blank	1 per digestion batch	Below ½ QL
Laboratory Control Sample or SRM	1 per digestion batch	80% - 120% (LCS) or within SRM stated limits
Lab Duplicate (replicate subsample)	1 per digestion batch	<25% RPD for samples > 5x QL or Absolute difference ≤ MRL for average concentrations ≤ 5 x MRL
Matrix Spike	1 per digestion batch	70% – 130%

2.4. Data Management

Analytical data generated by the laboratory will be sent via the Hart Crowser manager to the DEQ project manager and the DEQ LEAP data coordinator in a portable document format (pdf) and as an electronic data deliverable (EDD) in standard DEQ defined MS Excel format. The DEQ laboratory will maintain hard copies of the analytical reports, including all analytical QC measurements. Unless otherwise arranged, data generated by this project will be moved to the DEQ laboratory online database following release to the DEQ project manager. Data in this database is publically available. Until the online database is available, the information is available upon request.

3. Assessment and Oversight

Overall project assessment and oversight, including field activities, and coordination with the laboratory will be the responsibility of the DEQ's contractor, with oversight from DEQ. Data assessment/evaluation will also be provided by the DEQ quality assurance officer and/or data coordinator (LEAP) upon DEQ project manager request. Any analytical anomalies or delays encountered during laboratory operations must be communicated to the DEQ project manager and the DEQ LEAP in writing (e-mail is acceptable). The DEQ project manager and the DEQ LEAP data coordinator will also be notified in writing of any data quality limitations that may be the result of laboratory operations.

4. Data Validation and Usability

The laboratory will provide standard data review, verification, and validation on all analytical data generated by this project. The extent of the data review, verification, and validation is limited to the analytical processes only. However, in the best judgment of the DEQ QAO, any data that may be inaccurate, misleading, or otherwise fails the DEQ quality standards due to field or sampling activities will be identified in the final analytical report. Moreover, this data will be appropriately qualified when transferred to Element™. The LEAP Data Coordinator will assign data quality levels (DQL) in accordance to DEQ guidance document *Data Validation and Qualification* (DEQ09-LAB-0006-QAG). Generally, only DQLs of A, or B will be acceptable for this project unless the basis for the data acceptability is approved and documented by the DEQ project manager. All data verification, validation, and assessment activities for project purposes are the responsibility of the DEQ project manager and the DEQ LEAP data coordinator.

5. Revision History

Version	Date	Changes	Editor
1.0	5/23/16	New Document	RH, PS, SH
2.0	5/25/2016	Added language into section 1.4 to discuss grinder material Removed mercury as a target analyte Changed numbering references for Clackamas County natural area to CC-DU-1 and CC-DU-2 Section 2.1 Sampling Protocol Updated sample sizes to Clarified field replicate collection process. Section 2.2. modified the overview of the lab ISM protocol extensively to include grinding and extra replicates for PCC Added a QC Table (2-4) Moved List of Field items to end of Sampling Section 2.1.	RH, PS, SH

6. APPENDICES

Appendix A: Site Location and Decision Unit Sampling Map

Appendix A-1: Errol Heights Community Garden Decision Unit Sampling Map (EHCG-DU-1)

Appendix A-2a: Errol Heights City Park (EHCP-DU-1)

Appendix A-2b: Errol Heights City Park (EHCP-DU-2)

Appendix A-3: Precision Cast Parts (PCC-DU-1, PCC-DU-2)

Appendix A-4: Clackamas County Natural Area (CC-DU-1, CC-DU-2)

Appendix A-5: Springwater Corridor (SWC-DU-1)

Appendix A-6: Springwater Corridor (SWC-DU-2)

Appendix A-7: Springwater Corridor (SWC-DU-3)

Appendix A-8: Johnson Creek (JC-DU-1)

Appendix A-9: Hazeltine Park (HZP-DU-1)

Appendix A-10: Lane Middle School (LMS-DU-1)

Appendix A-11: Meriwether Lewis School (MLS-DU-1)

Appendix A-12: Ardenwald Elementary School (AES-DU-1)

Appendix A-13: Seth Lewelling Elementary School (SLES-DU-1)

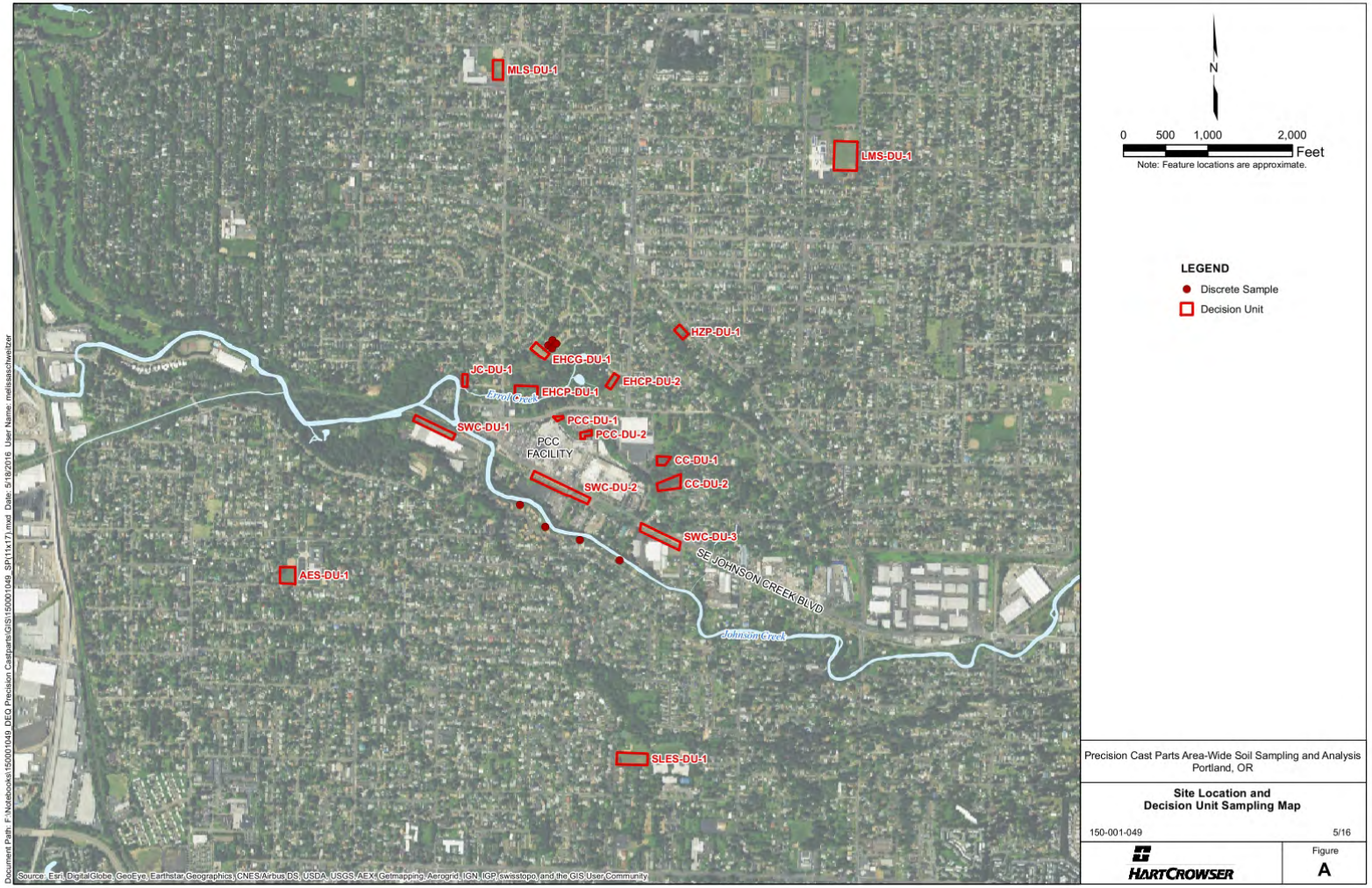
Appendix A-14: Errol Heights Discrete Samples

Appendix A-15: Johnson Creek Discrete Samples

Appendix B: DEQ Soil Screening Table

Appendix C: Chain of Custody

APPENDIX A: SITE LOCATION AND DECISION UNIT SAMPLING MAP



Appendix A-1: Errol Heights Community Garden Decision Unit Sampling Map (EHCG-DU-1)

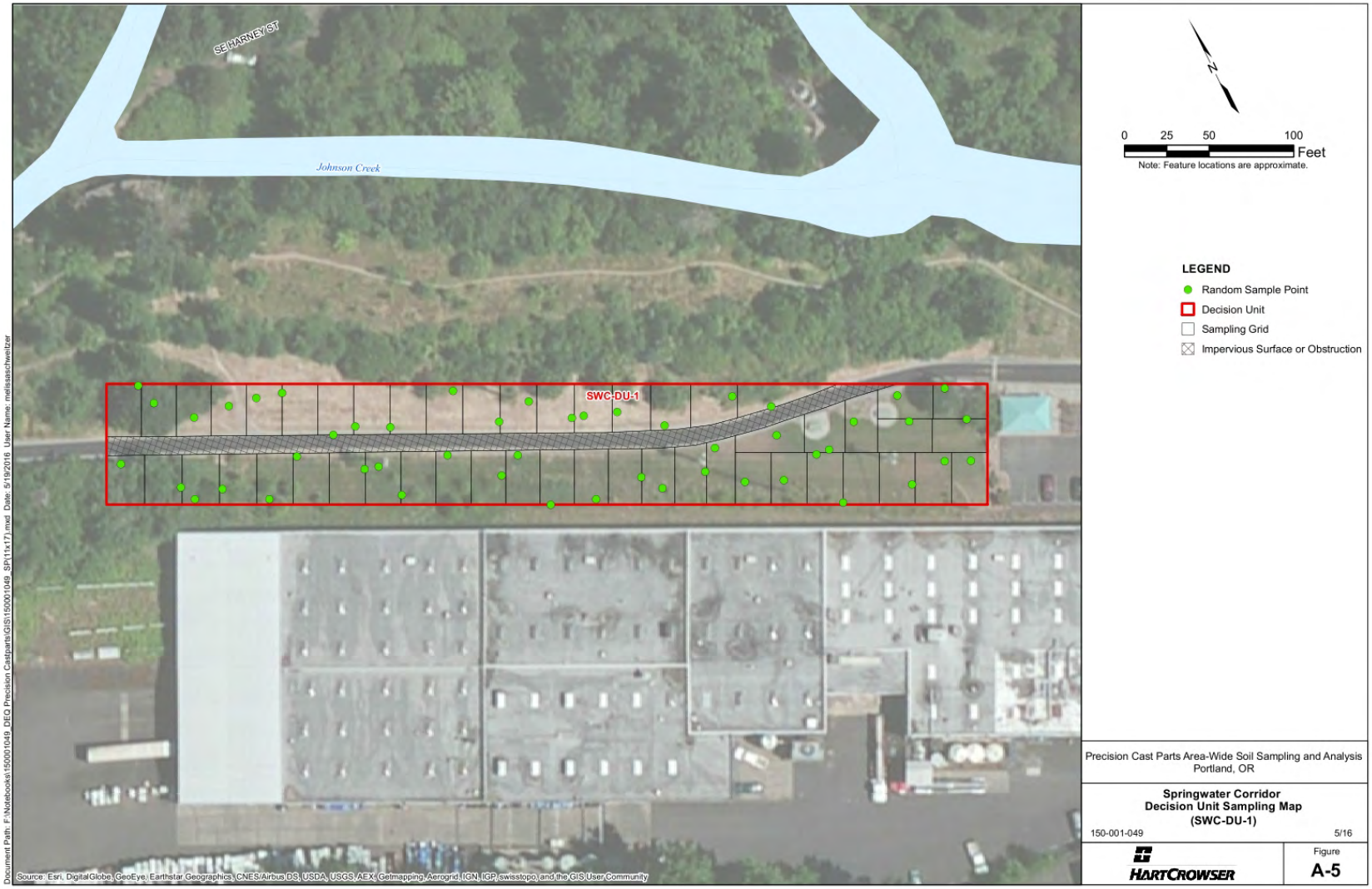
Appendix A-2a: Errol Heights City Park (EHCP-DU-1)

Appendix A-2b: Errol Heights City Park (EHCP-DU-2)

Appendix A-3: Precision Cast Parts (PCC-DU-1, PCC-DU-2)

Appendix A-4: Clackamas County Natural Area (CC-DU-1, CC-DU-2)

Appendix A-5: Springwater Corridor (SWC-DU-1)



Appendix A-6: Springwater Corridor (SWC-DU-2)

Appendix A-7: Springwater Corridor (SWC-DU-3)

Appendix A-8: Johnson Creek (JC-DU-1)

Appendix A-9: Hazeltine Park (HZP-DU-1)

Appendix A-10: Lane Middle School (LMS-DU-1)

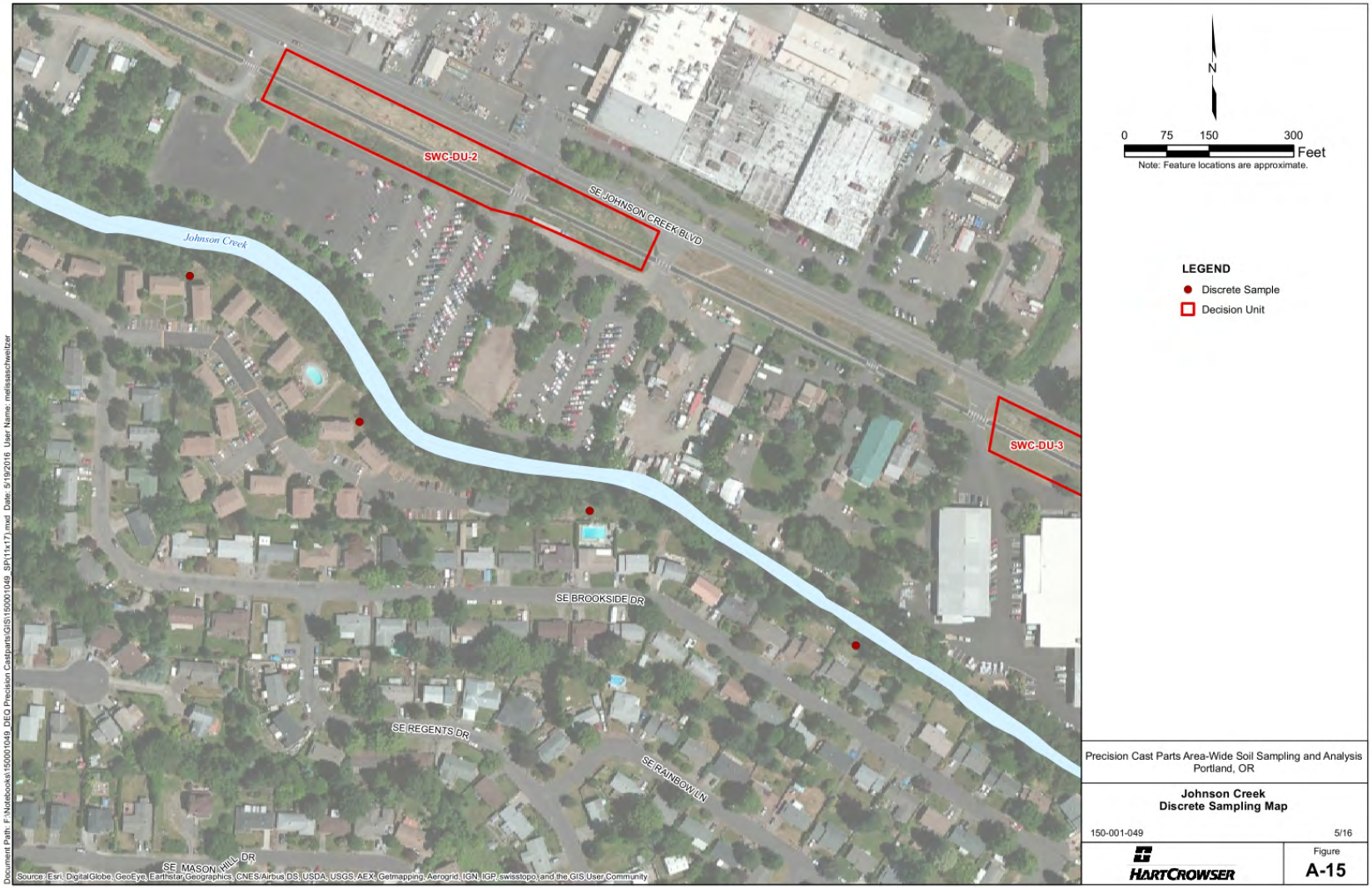
Appendix A-11: Meriwether School (MLS-DU-1)

Appendix A-12: Ardenwald Elementary School (AES-DU-1)

Appendix A-13: Seth Lewelling Elementary School (SLES-DU-1)

Appendix A-14: Errol Heights Discrete Samples

Appendix A-15: Johnson Creek Discrete Samples



APPENDIX B: DEQ SOIL SCREENING TABLE

Metal	DEQ Background[1]	Residential [2]	ATSDR Values [3]
Arsenic	8.8	0.43	15
Beryllium	2.0	160	100
Cadmium	0.63	78	5
Total Chromium [c]	76	120,000	75,000
Chromium +6	NA	0.3	45
Cobalt [a]	33 [b]	23	500
Iron	36,100	55,000	NA
Lead	79	400	NA
Manganese	1,800	1,800	2,500
Mercury	0.23	23	15
Nickel	47	1,500	1,000
Selenium	0.71	390	250
Titanium	10,827 [b]	140,000	NA
Zinc	180	23,000	15,000

All values presented in mg/kg

1- Source DEQ background metals fact sheet, http://www.deq.state.or.us/lq/pubs/docs/cu/FSbackgroundmetals.pdf

2 - Residental values are DEQ soil screening values, where available, or EPA regional screening values (RSLs) when no DEQ residential value is pub

DEQ Residential values assume the following:

· A person resides in the same residence 24 hours a day, 7 days a week, 350 days a year, for 26 years

· Adults incidentally ingest 100 mg of soil per day, children incidentally ingest 200 mg of soil per day

3 - Agency for Toxic Substances and Disease Registry (ATSDR) Screening Values. ATSDR values are environmental media evaluation guides (EMEG
or reference dose media evaluation guides (RMEGs).

a - Residential values for these metals are the US EPA Regional Screening Values (RSLs) for residential use

b - No background estimate for cobalt or titanium have been published by DEQ. Value shown is average of Willamette Valley soil from DEQ data

c - Background value is based on total chromium. Screening Values are based on trivalent chromium

NA - Not Available - No estimate of background soil concentration or screening values are available for these substances.

APPENDIX C: CHAIN OF CUSTODY FORM

Sample Custody Record

Samples Shipped to: _____

HARTCROWSER

Hart Crowser, Inc.
6420 SW Macadam Avenue, Suite 100
Portland, Oregon 97239-3517
Office 503.620.7284 (Fax 503.620.6918

JOB _____ LAB NUMBER _____
PROJECT NAME _____
HART CROWSER CONTACT _____
SAMPLED BY:

REQUESTED ANALYSIS

NO. OF CONTAINERS

OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINT NAME		PRINT NAME	
COMPANY		COMPANY	
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINT NAME		PRINT NAME	
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. _____ for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION
CUSTODY SEALS:
☐YES ☐NO ☐N/A
GOOD CONDITION
☐YES ☐NO
TEMPERATURE _____
SHIPMENT METHOD: ☐HAND
☐COURIER ☐OVERNIGHT

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐48 HOURS ☐STANDARD
☐72 HOURS OTHER _____