COMPLIANCE MONITORING PLAN

TAILING DISPOSAL FACILITIES 1 & 2
CLEANUP ACTION PLAN IMPLEMENTATION
PEND OREILLE MINE

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1.0 INTRODUCTION

This Compliance Monitoring Plan (CMP) has been prepared for the Pend Oreille Mine Tailings Disposal Facilities Nos. 1 and 2 (TDF-1 and TDF-2) at the Teck Washington Incorporated (TWI) Pend Oreille Mine (POM) in Metaline Falls, Washington (the Site). The Site includes TDF-1 and TDF-2 and groundwater and surface water in the vicinity of TDF-1 and TDF-2.

In 2011 and 2012, a low permeability cover system was constructed at TDF-1 and TDF-2 in accordance with a Washington Department of Ecology (Ecology) approved Cleanup Action Plan (CAP). These actions fulfilled the requirements of the Model Toxics Control Act (MTCA) RCW 70.105D, as implemented under Chapter 173-340 of the Washington Administrative Code (WAC) and were undertaken by TWI in accordance with a Consent Decree between TWI and Ecology. Future activities associated with the TDF-1 and TDF-2 Cleanup Action include maintenance of a restrictive covenant (deed restriction), long-term compliance monitoring, and operations and maintenance (O&M) of the remedy components to ensure long-term protectiveness of human health and the environment.

The remedial actions selected in the CAP, which were made available for public review and comment, included constructing a low permeability cover over TDF-1 and TDF-2, improving and modifying TDF-1 and TDF-2 drainage systems, making grade improvements to the embankment slopes for long-term stability, implementing institutional controls, and performing long-term groundwater and surface water compliance monitoring and O&M (Ecology 2010 and 2011). In addition to this CMP, other relevant Site documents include the Remedial Investigation/Feasibility Study (RI/FS) (Golder 2006 and URS 2010), Consent Degree (including the CAP, Restrictive Covenant and other Exhibits) (Ecology 2011), Construction Plans and Specifications (URS 2011a), Engineering Design Report (URS 2011b), O&M Manual (URS 2013a) and Construction Completion Report (URS 2013b).

1.1 PURPOSE AND SCOPE

This document complies with MTCA requirements for compliance monitoring contained in WAC 173-340-410 and should be used in conjunction of with the O&M Manual, which provides additional information on inspections and other O&M activities for TDF-1 and TDF-2. The CMP focuses primarily on groundwater and surface water performance monitoring requirements, defined in WAC 173-340-410 as monitoring that confirms that the cleanup action "has attained cleanup standards and, if appropriate, remediation levels or other performance standards such as construction quality control measures or monitoring necessary to demonstrate compliance with a permit or, where a permit exemption applies, the substantive requirements of other laws." Protection monitoring, which confirms that human health and the environmental are adequately protected during construction and the operation and maintenance of the cleanup action plan, is addressed through a Safety and Health Plan. The Safety and Health Plan is included in this CMP as **Appendix A**.

Conformational monitoring that confirms the long-term effectiveness of the cleanup action following attainment of cleanup standards, remediation levels, or other performance standards is not applicable to the CMP at this time since tailing will remain at the Site beneath the protective cover. The remedial actions specified in the CAP use a containment approach whereby hazardous substances in the tailings (metals) are to remain beneath a protective cover indefinitely. Ecology will verify that the remedies selected and implemented for the Site remain protective of human health and the environment by conducting periodic reviews pursuant to WAC 173-340-420.

1.2 SUMMARY OF TDF-1 AND TDF-2 CLEANUP ACTION

The Ecology-selected cleanup action for the Site is a containment remedy utilizing a low permeability cover system to disrupt the direct contact pathway for human and ecological receptors and minimize infiltration of surface water within the tailings impoundments. Institutional controls and long-term performance monitoring and O&M are required since hazardous substances in the tailings will remain beneath the cover at the Site indefinitely.

Construction of the remedial actions described in the CAP was performed by Clearcreek Contractors (Clearcreek) with construction management and engineering support provided by URS. The construction was completed in two phases. Phase 1 was performed during early August 2011 to mid-November 2011 and consisted of improving and modifying the grading and drainage systems on TDF-1 and the areas between TDF-1 and TDF-2, constructing a low permeability cover on TDF-1, and grading the embankment of TDF-1 for long-term slope stability. Phase 2 was performed by Clearcreek from mid-May 2012 through mid-October 2012, and consisted of improving and modifying the grading and drainage system on TDF-2 and constructing the low permeability cover on TDF-2. The substantial completion milestone, which signifies completion of the construction activities, was achieved on October 11, 2012.

Remedial and administrative activities that comprise the Cleanup Action at the Site include the following components:

- Construction of the cover system
- Slope stabilization
- Site grading
- Stormwater treatment and controls
- Site revegetation
- Institutional controls
- Long-term performance monitoring and O&M

Future work associated with execution of the CAP includes long-term performance monitoring and long-term O&M of the institutional controls.

1.3 SITE DESCRIPTION

The Site, defined as where hazardous substances have come to be located, includes TDF-1 and TDF-2 and groundwater and surface water that has or may become contaminated from the tailings at TDF-1 and TDF-2. The Site is located at POM in Pend Oreille County in the northeastern corner of Washington State. The POM is an underground zinc and lead mine and mill operated by TWI. POM is located at a latitude and longitude of 48°53'54.12" N and -117°21'36.00" W respectively, approximately 11 miles south of the Canadian border and 15 miles west of the Idaho State line. The nearest town is Metaline Falls, which is approximately two miles south of the Site. The Pend Oreille River is located approximately 700 feet west of TDF-1 (**Figure 1**).

The POM property is bounded by the Pend Oreille River (the River) to the west, State Route 31 and the Grandview Mine to the south, Colville National Forest to the north, and private property to the east. The topography is generally mountainous and elevations in the region range from 6,800 feet above mean sea level (MSL) to 1,990 feet MSL at the River adjacent to the Site. The Site is located in a coniferous forest within the Okanogan Highlands of the Selkirk Mountain Range.

TDF-1 is located on a terrace approximately 700 feet east and 200 feet above the River at an elevation of approximately 2,250 feet MSL. A wetland (Wetland A) covers approximately two acres along the eastern edge of TDF-1. TDF-1 covers approximately 11.1 acres and has a maximum tailing thickness of approximately 68 feet.

TDF-2 is located approximately 700 feet east and southeast of TDF-1. TDF-2 is located on a terrace above TDF-1. TDF-2 covers approximately 6.6 acres and is at an elevation of approximately 2,335 feet MSL.

1.4 CONTAMINANTS OF CONCERN

Contaminants of concern (COC) are those hazardous substances that were identified in the RI/FS in tailings, groundwater, or surface water at concentrations above applicable MTCA Cleanup Levels.

1.4.1 Soil/Tailings

The following COCs associated with the tailings will be monitored in the performance monitoring program: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), selenium (Se), and zinc (Zn). Soils adjacent to and in contact with the

tailings were not found to be affected by the tailings at concentrations exceeding cleanup levels for the various COCs (Ecology 2010). Since the cover system, which includes a biobarrier meets cleanup levels, compliance monitoring for soil is not required. In the event of an erosional event, monitoring may be required, but will be addressed as part of O&M.

1.4.2 Groundwater

The most beneficial use of Site groundwater is as a current and future drinking water source. Exposure through ingestion and other domestic uses is the main groundwater pathway. Iron and manganese are the primary indicator substances for groundwater because site groundwater monitoring data has shown iron and manganese groundwater levels have exceeded MTCA Method B cleanup levels (Ecology 2010). Other potential groundwater COCs include: arsenic, cadmium, copper, lead, selenium, and zinc. Groundwater samples will be analyzed for total metals including arsenic, cadmium, chromium (total), copper, iron, lead, manganese, selenium, and zinc.

1.4.3 Surface Water

Potential COCs for surface water are the same as groundwater COCs and include: arsenic, cadmium, chromium (total), copper, iron, lead, manganese, selenium, and zinc. Surface water samples will be analyzed for dissolved metal constituents.

1.5 COMPLIANCE MONITORING REQUIREMENTS

This CMP is intended to meet the requirements of the MTCA Cleanup Regulations, the CAP, Consent Decree, and other applicable Ecology regulatory guidance documents. As defined by MTCA (WAC 173-340-410), compliance monitoring is divided into three categories including protection monitoring, performance monitoring, and confirmational monitoring. This CMP is specific to performance monitoring and protection monitoring as it relates to future performance monitoring and O&M at the Site. Protection monitoring was also conducted during implementation of the CAP in accordance with a Site-specific health and safety plan that was provided to Ecology prior to the start of construction activities in 2011.

Continued monitoring of the cover system integrity (vegetation, geotextile and drainage layer), embankment slope stability and function of the stormwater controls is required as part of the O&M Manual. Periodic inspections have been established for the cover system as part of the O&M Manual. Long-term groundwater and surface water performance monitoring will be conducted pursuant to this CMP to confirm that the cover remedy remains protective of human health and the environment over the long-term.

2.0 CLEANUP STANDARDS

The MTCA cleanup regulation (WAC 173-340) requires that cleanup standards be established for Sites. The two components of the cleanup standards are (1) cleanup levels, and (2) point of compliance (POC).

2.1 CLEANUP LEVELS

Cleanup levels for the Site, which were selected by Ecology in the CAP (Ecology 2010), are summarized in **Table 1**. Table 1 also provides the basis of each of the cleanup levels for soil, groundwater, and surface water.

Cleanup levels for the affected media are further discussed below.

2.1.1 Soil

As reported in the CAP, concentrations of COCs in soil above the soil cleanup levels are limited to the tailings directly beneath TDF-1 and TDF-2. No additional soil conformational testing will be conducted at the Site. It is recognized that COCs will remain in the tailings below the cover system indefinitely. Soil cleanup levels beyond the limit of the tailings have already been met based on information collected in the RI/FS (Golder 2006, URS 2010, Ecology 2010). Institutional controls and long-term monitoring will ensure protection of human health and the environment from tailings beneath the protective cover.

2.1.2 Groundwater

The applicable groundwater cleanup levels for the Site are MTCA Method B. Groundwater cleanup levels set under Method B must be at least as stringent as the criteria in WAC 173-340-720(4)(b), which includes the following:

- Concentrations established under applicable state and federal laws, including the requirements in WAC 173-340-720(3)(b)(ii).
- For protection of surface water beneficial uses.
- For hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws, those concentrations which protect human health as determined by the equations presented in WAC 173-340-720(3)(iii)(A) and (B).

Table 5 in the CAP presented the Method B cleanup levels for groundwater. These groundwater cleanup levels are summarized in **Table 1** of this CMP. Groundwater at the Site discharges to creeks that flow to the Pend Oreille River, resulting in groundwater cleanup levels that must be set to be protective of drinking water and surface water.

Long-term groundwater performance monitoring will be conducted at the Site in accordance with Section 3. Groundwater samples will be analyzed for total As, Cd, Cr, Cu, Fe, Pb, Mn, Zn, and Se and the results will be compared to the applicable MTCA Method B cleanup levels in **Table 1** to determine compliance with groundwater cleanup levels. It should be noted that surface water

cleanup levels are based on dissolved concentrations of metals, except for Se, which is based on a total Se concentration. The difference between a dissolved and total sample, is that the dissolved sample is filtered through a 0.45 micron filter and a total metals sample is unfiltered. Groundwater samples for total metals and dissolved metals that are filtered in the field will be preserved with nitric acid in laboratory provided containers to a pH of less than 2 standard units. Groundwater and surface water samples for dissolved metals that are not filtered in the field and that will be filtered in the laboratory will not be preserved with nitric acid or other acids.

2.1.3 Surface Water

In evaluating surface water cleanup levels for metals, the criterion of hardness plays an important role in setting final cleanup levels for Cd, Cu, Pb, and Zn that were established in the CAP. The cleanup levels established in the CAP for As, Cr, Fe, Mn, and Se are not hardness dependent. For the purposes of water quality, hardness is defined as total calcium carbonate.

Generic Method B cleanup levels for hardness dependent metals, which are based on chronic aquatic toxicity criteria, are derived using an assumed hardness of 100 milligrams per liter (mg/L). Hardness values greater than 100 mg/L will result in a Method B cleanup level greater than the generic cleanup level, while hardness values less than 100 mg/L will result in a Method B cleanup level less than the generic cleanup level.

For this Site, Ecology used a Site-specific hardness value of 343 mg/L, which is based on water quality data from the RI/FS (Ecology 2010). Since, the Site-specific Method B cleanup levels established in the CAP are based on Site-specific hardness values, the cleanup levels established in the CAP will not be further compensated for hardness on a sample by sample basis.

However, in the event that it is later determined that the hardness value of 343 mg/L is not reasonably representative of Site conditions, and the more representative hardness values make a material effect on compliance with the Method B cleanup levels, then TWI will notify Ecology and new hardness dependent Method B cleanup levels may be developed. Changes to the hardness dependent cleanup levels, if determined to be necessary by Ecology, will be addressed through the five year review process, unless Ecology and TWI mutually agree to other arrangements.

2.2 POINTS OF COMPLIANCE

Conditional points of compliance have been established for soil, groundwater, and surface water at the Site at the outer boundary of TDF-1 and TDF-2, as represented by the monitoring locations in **Section 3.2** below.

3.0 COMPLIANCE MONITORING PROGRAM

TWI will conduct long-term compliance monitoring to demonstrate that the remedial actions and established institutional controls remain protective of human health and the environment. Compliance monitoring will be performed beginning the first quarter of 2013 in accordance with the CMP through 2017. TWI and Ecology will reevaluate the performance monitoring program after 5 years of monitoring and adjustments may be made to the program based on a review of the previous data, as appropriate. Change(s) to the monitoring program (e.g., monitoring frequency, monitored parameters) will require written approval from Ecology.

3.1 MONITORING OBJECTIVES

The goal of compliance monitoring is to assess the effectiveness of the TDF-1 and TDF-2 tailings cover and drainage system at meeting Site cleanup levels and performance objectives. Specific monitoring objectives include:

- Measure and document groundwater elevation data over time
- Measure and document groundwater and surface water COC concentrations over time
- Provide periodic reports to demonstrate compliance with Site cleanup levels.

A Sampling and Analysis Plan (SAP) is presented in **Appendix B**. The SAP is intended to promote:

- Consistent field procedures;
- Collection of representative samples;
- Proper calibration of field equipment to obtain accurate field measurements;
- Minimization of cross-contamination and the introduction of artificial contaminants;
- Accurate documentation of field observations, sampling procedures, and decontamination procedures;
- Consistent laboratory analytical procedures; and
- Collection of data that are accurate and defensible, and are of adequate technical quality to meet the data quality objectives for the Site.

3.2 MONITORING WELL AND SURFACE WATER MONITORING NETWORK

The compliance monitoring network consists of four existing groundwater monitoring wells (MW-7, MW-301, MW-302, MW-303) and one surface water sampling location at the drainage

pipe outfall at the headwaters of Creek 2. The compliance monitor network is identified in **Table 2** and sampling locations are shown on **Figure 2**. Groundwater samples will be collected for chemical analysis from these monitoring points during each monitoring event. The compliance monitoring network includes the following:

- Monitoring wells MW-301, MW-302, and MW-303 will serve as the downgradient sample points between TDF-1 and the Pend Oreille River;
- Monitoring well MW-7 south of TDF-1 and TDF-2 will serve as the upgradient sample point;
- TDF-1 Outfall includes discharges of water from Wetland A, seeps, and TDF-1 stormwater to Creek 2 and will serve as the surface water sampling point. This monitoring point is also currently sampled as a requirement of POM's Construction Stormwater Permit.

3.3 MONITORING FREQUENCY

Water samples will be collected from the groundwater and surface water monitoring network on a quarterly basis beginning the 1st Quarter of 2013 for a period of two years (end of 2014). Semi-annual monitoring (twice per year) will be in effect during the 3rd year of conformational monitoring (2015). A one-time per year (annual) monitoring frequency will be conducted for monitoring years four and five (end of 2017). Due to possible snow in winter months, it may not be practical to access all locations, especially well MW-302 and the TDF-1 drainage pipe at the toe of TDF-1 **(Figure 2).** If access is not practical during a monitoring event to all monitoring locations, TWI will attempt to reschedule the monitoring event at a time when access to all locations is practical. If access is still problematic, then TWI will proceed with sampling the other locations and will document the access limitations that prevented sampling at certain locations.

As part of the first five year review, Ecology and TWI will evaluate the groundwater and surface water monitoring data and make adjustments to the monitoring program going forward. If groundwater and surface water cleanup levels have been achieved and levels are stable, the sampling frequency or parameters may be reduced upon Ecology's written approval.

3.4 MONITORING EVENTS

Each groundwater monitoring event will include measuring and documenting groundwater elevations, and sampling of specific monitoring wells (MW-7, MW-301, MW-302, and MW-303) and a surface water location (TDF-1 Outfall) to assess groundwater and surface water quality.

3.4.1 Groundwater Elevations

The compliance monitoring program will include measurement of the depth to water and total well depth prior to sampling each of the designated wells. The depth-to-water measurements will be compared to historic elevation data to assess if groundwater flow direction is generally consistent with historic interpretations of groundwater flow patterns.

3.4.2 Sample Collection

Low-flow sampling techniques will be used to collect groundwater samples from the monitoring wells. During purging and prior to sampling, field water quality parameters will be measured to determine when water removed from a well is representative of in-situ groundwater conditions. The field parameters to be measured include temperature, pH, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. Once water quality parameters are measured, groundwater samples will be transferred to laboratory prepared and preserved (if necessary) sample containers.

Surface water samples will be collected using a decontaminated, dedicated surface water sampling tool. Surface water samples for dissolved As, Cd, Cu, Fe, Mn, Pb, and Zn will be filtered (when necessary) using new 0.45 micron disposable filters prior to transfer to pre-preserved laboratory sample containers or filtered using a 0.45 micron filter at the laboratory. Surface water samples for Se and groundwater samples for all COCs (As, Cd, Cr, Cu, Fe, Mn, Pb, Se, and Zn) will not be filtered to provide a "total" metal concentration. Specific applicable procedures for these activities are described in the SAP (**Appendix B**).

3.4.3 Analytical Parameters

The following analytical parameters will be monitored during each sampling event:

- **Groundwater**:
    - Total As, Cd, Cr, Cu, Fe, Mn, Pb, Se, and Zn
- **Surface Water:**
    - Dissolved As, Cd, Cr, Cu, Fe, Mn, Pb, Zn
    - Total Se
    - Total Suspended Solids

Additionally, each groundwater and surface water sample will be monitored for temperature, specific conductivity, ORP, dissolved oxygen, and pH by field measurements at the time the samples are collected. Analysis of surface water samples for hardness is not required by Ecology

since baseline samples have been tested for hardness and surface water samples have been adjusted for a site-specific hardness value of 343 milligrams per liter (mg/L).

Table B-1 in the SAP **(Appendix B)** lists the analytical parameters, methods, holding times, minimum detection limits (MDLs) and reported detection limits (RDLs), and laboratory quality control criteria. All water samples will be analyzed by an Ecology-accredited laboratory using the methods specified in **Table B-1 (Appendix B)**.

3.4.4 Quality Control/Quality Assurance

Quality control (QC) and quality assurance (QA) processes employed during compliance monitoring will involve collection of field quality control samples, calibration of field equipment, analysis of internal laboratory QC samples, and external data quality review of the laboratory analytical results. The types and numbers of field QC samples and QA reviews are described in the SAP (**Appendix B**).

3.4.5 Safety and Health Plans

TWI will be responsible for the health and safety of their workers during implementation of the O&M and compliance monitoring programs.

Before the start of work, the field sampling individual(s) and project coordinator will review the project-specific Safety and Health Plan (**Appendix A**) and CMP, and will perform a hazard assessment to ensure that all appropriate front-end safety planning is in place. Upon arrival for a sampling event, the sampler(s) will hold a safety kickoff (or tailgate safety) meeting and review Site-specific safety concerns and requirements and document the meeting discussion in the field activity logs.

The Safety and Health Plan provided in **Appendix A** is intended to provide a framework to ensure that safety and health of the workers are appropriately considered prior to performing the work. This Safety and Health Plan may be supplemented with other TWI safety and health documents, policies, and procedures that are specific to POM. The Saftey and Health plans are evergreen documents that should be periodically updated. The Safety and Health Plan will be reviewed prior to the start of compliance monitoring or other O&M activities associated with TDF-1 and TDF-2, and will be updated to comply with new safety initiatives promulgated by TWI and changes based on federal and state regulations. Future updates to the Safety and Health Plans will be made by TWI, and will not require modification of the Consent Decree or subsequent re-approval by Ecology.

The cover system for the Site has been design to prevent ecological and human contact with the tailings. Administrative controls have been instituted for the facility to help protect human and ecological receptors. Signage will be been placed strategically around the Site restricting access and informing humans of the possible hazards. A restrictive covenant has also been filed with

Ecology and Pend Oreille County (URS 2013b). The covenant restricts the activities which can be performed at the Site. Restricted activities include removal of groundwater with the exception of environmental monitoring. The covenant serves to protect the controls implemented during the CAP and helps ensure the long-term performance of the engineered systems.

4.0 REPORTING

Groundwater and surface water sampling results associated with this CMP will be compiled into summary reports which will be submitted to Ecology on a quarterly basis during quarterly monitoring, semi-annual basis for semi-annual monitoring, and annual basis for annual monitoring. Reports will be submitted within 60 days of the end of each quarter, as follows:

- First Quarter – May 31
- Second Quarter – August 30
- Third Quarter – November 30
- Fourth Quarter – February 28

Semi-annual and annual reports will be submitted within 60 days after the end of the quarter when the sampling event was conducted, unless other written arrangements have been agreed to by TWI and Ecology.

In addition to the reports, the water level and analytical data will be submitted online in a format compatible with Ecology's Environmental Information Management (EIM) System.

At a minimum, the summary reports will include the following:

- Changes, if any, to the compliance monitor well network;
- Tabulated water level measurements, elevations, and analytical results for the sampling events;
- Hydrographs showing water level measurements over time for each piezometer and groundwater monitoring well in the CMP network;
- Field sampling records; and
- Laboratory analytical reports.

5.0 PLAN AMENDMENT

Changes in Site conditions may require modification of the CMP. Except for changes to the Safety and Health Plan (**Appendix A**), proposed modifications will be submitted to Ecology for approval prior to implementation. CMP modifications may include changes to the frequency or dates of scheduled sampling events, analytical methods, or the compliance monitoring network. If required by operating facility requirements, O&M necessity, accidental damage, or for other reasons, proposed modifications to the monitoring well network may include replacement, relocation, or physical removal (plugging and abandonment) of one or more wells. These types of changes will require written authorization from Ecology, but not modification of the Consent Decree.

6.0 REFERENCES

Ecology, 2010. "Draft Cleanup Action Plan, Pend Oreille Mine Tailings Disposal Facilities Nos. 1 &2, Metaline Falls, Washington". March.

Ecology, 2011a. "Responsiveness Summary for Pend Oreille Mine, Draft Cleanup Action Plan, Consent Decree, and State Environmental Policy Act (SEPA), Teck Washington Incorporated, Metaline Falls, Washington", April.

Ecology, 2011b. "Consent Decree No. 11-2-0083, State of Washington Department of Ecology v. Teck Washington Incorporated". July.

Golder Associates, Inc., 2006. "Draft Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailings Disposal Facilities TDF-1 and TDF-2. 10 and 17 October.

URS Corporation, 2010. "Report: Supplemental Remedial Investigation/Feasibility Study, Pend Oreille Mine TDF-1 and TDF-2, Metaline Falls, Washington", June 3.

URS 2011a. "Tailings Disposal Facilities 1 & 2 Cleanup Action Plan, Technical Specifications and Contract Drawings, Vol. 2 of 2", June.

URS, 2011b. "Final Engineering Design Report, Tailings Disposal Facilities Nos. 1 and 2 Cleanup Action Plan", July 22.

URS, 2013a. "Operations and Maintenance Manual, Rev. 0, TDF-1 and TDF-2, Metaline Falls, Washington", January 13.

URS, 2013b. "Construction Completion Report, Tailing Disposal Facilities 1 & 2, Cleanup Action Plan, Pend Oreille Mine, Metaline Falls, Washington". March.

TABLES

TABLE 1 - SUMMARY OF CLEANUP LEVELS
PEND OREILLE MINE TDF 1 AND TDF-2 COMPLIANCE MONITORING PLAN

Analyte	Soil Cleanup Level		Groundwater Cleanup Level		Surface Water Cleanup Level	
	(mg/kg)	Basis	(µg/L)	Basis	(µg/L)	Basis
Arsenic	9	Background	5	Background	5	Background
Cadmium	1	Background	0.58	Clean Water Act, Section 304	0.58	Clean Water Act, Section 304, Aquatic Criteria
Chromium (total)	N/A	No soil cleanup level is specified in the Cleanup Action Plan (see Table 1, CAP)	100	MTCA Method B, Maximum Contaminant Level	100	MTCA Method B, Maximum Contaminant Level
Copper	22	Background	25.7	Clean Water Act, Section 304	25.7	Clean Water Act, Section 304, Aquatic Criteria
Iron	56,000	Soil, Method B, Non-carcinogen, Standard Formula Value, Direct Contact (ingestion only), unrestricted land use	300	Clean Water Act, Section 304	300	Clean Water Act, Section 304, Human Health Criteria
Lead	50	Terrestrial	9.34	Water Qualtity Standards for Surface Waters of the State of Washington - WAC 173-201A	9.34	Clean Water Act, Section 304, Aquatic Criteria
Manganese	11,000	Soil, Method B, Non-carcinogen, Standard Formula Value, Direct Contact (ingestion only), unrestricted land use	50	Surface Water ARAR - Human Health - Fresh Water - Clean Water Act, Section 304	50	Clean Water Act, Section 304, Human Health Criteria
Selenium	0.8	Background	5	Water Qualtity Standards for Surface Waters of the State of Washington - WAC 173-201A	5	Water Qualtity Standards for Surface Waters of the State of Washington - WAC 173-201A
Zinc	86	Terrestrial	297	Water Qualtity Standards for Surface Waters of the State of Washington - WAC 173-201A	297	National Toxics Rule

Notes:

1) µg/L = micrograms per liter

2) mg/kg = milligrams per kilogram

3) Groundwater and surface water cleanup levels are based on hardness value of 343 milligrams per liter

4) Analytical data should be adjusted for Hardness in accordance with WAC 173-201A-240

5) Source: Cleanup Action Plan (Ecology 2010)

TABLE 2 - COMPLIANCE MONITORING NETWORK AND SAMPLING FREQUENCY
PEND OREILLE MINE TDF 1 AND TDF-2 COMPLIANCE MONITORING PLAN

	Year and Quarter[1,2]																			
	2013				2014				2015				2016				2017			
Sample Location	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Down Gradient Monitoring Wells																				
MW-301	·	·	·	·	·	·	·	·	·		·		·		·				·	
MW-302	·	·	·	·	·	·	·	·	·		·		·		·				·	
MW-303	·	·	·	·	·	·	·	·	·		·		·		·				·	
Upgradient Monitoring Wells																				
MW-7	·	·	·	·	·	·	·	·	·		·		·		·				·	
Surface Water																				
TDF-1 Outfall	·	·	·	·	·	·	·	·	·		·		·		·				·	

Notes

[1] Quarter sampled and sampling frequency subject to change with written concurrance of Ecology

[2] Quarter 1: 1/1 - 3/31; Quarter 2: 4/1 - 6/30; Quarter 3: 7/1 - 9/30; Quarter 4: 10/1 - 12/31

FIGURES

0 300 600 1200
FEET

FIGURE 1
Facility Map
Compliance Monitoring Plan
Teck Washington Incorported
Pend Oreille Mine
Metaline Falls, Washington

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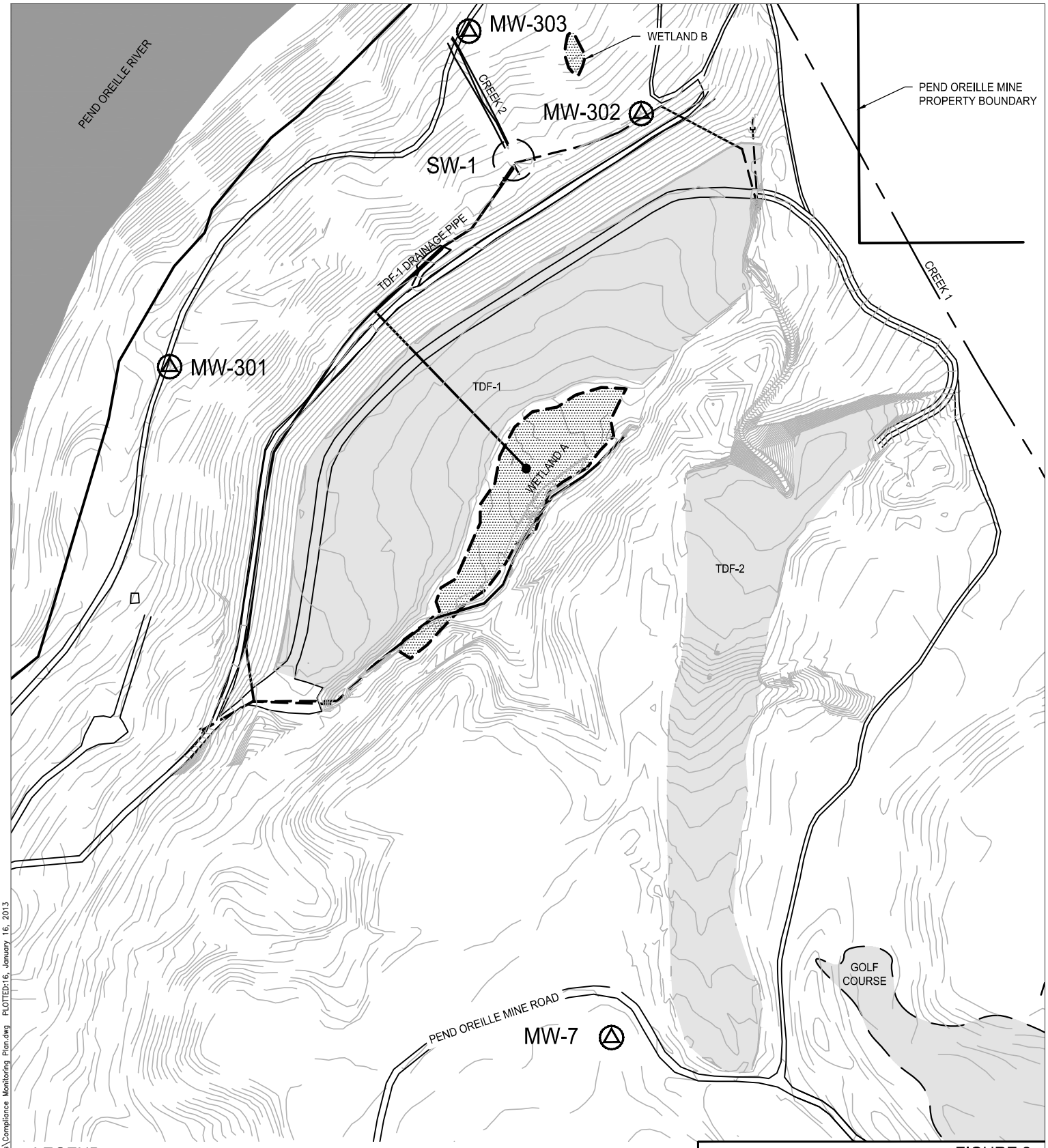
FILE NAME: P:\36310085 POM TDF 1 and 2 CAP\CAD\Figures\Compliance Monitoring Plan.dwg PLOTTED:16, January 16, 2013



LEGEND

- MW-301 GROUND WATER MONITORING WELL & NUMBER
- SW-1 SURFACE WATER MONITORING LOCATION & NUMBER (OUTLET OF TDF-1 DRAINAGE PIPE)

0 150 300 600
FEET

FIGURE 2
Compliance Monitoring Network
Compliance Monitoring Plan
Teck Washington Incorported
Pend Oreille Mine
Metaline Falls, Washington

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APPENDIX A
SAFETY AND HEALTH PLAN

This safety and health plan (Plan) is intended to comply with the protection monitoring requirements of WAC 173-340-410(a) and is an appendix to the Compliance Monitoring Plan for the TDF-1 and TDF-2 Cleanup Action Implementation Project at Pend Oreille Mine (POM), Pend Oreille County, Washington**.** This Plan was prepared by URS Corporation for the exclusive use of Teck Washington Incorporated (TWI). This Plan does not replace or otherwise alter existing health and safety policies and procedures at POM, but rather is intended to provide a framework to help ensure that performance monitoring and O&M activities are conducted in a safe manner. At its sole discretion TWI may elect to document safety and health measures through other documents and management systems that are comparable to this Plan. A cover system is now installed over the tailings on TDF-1 and TDF-2 so there is a low likelihood that workers would be exposed to the hazardous substances in the tailings. In the event that the work has a likelihood of exposing workers to the tailings (e.g., excavation), then TWI must ensure such workers have received appropriate training for working with hazardous substances, and the workers must take appropriate safeguards to minimize exposure to the tailings. Prior to implementing performance monitoring or O&M activities at TDF-1 and TDF-2, workers are required to complete the following steps:

Step 1: Scope of Work: Describe the overall scope and major definable features of work and the personnel involved.

Step 2: Emergency Contacts and Facilities: Provide all applicable emergency contacts and emergency facility information for project-related activities in Section 2.

Step 3: Applicable Teck Safety Management Standards: The worker should verify that applicable TWI safety procedures are considered prior to performing the Work.

Step 4: Job Safety Analysis: Use the Job Safety Analysis to identify specific hazards and control methods associated with each major definable feature of work. Hazards include those that could cause physical harm (e.g., fall hazards, excavation hazards, live electrical hazards) or those that require special consideration during the planning stages of the project due to regulatory and/or client constraints (i.e., potential exposure to airborne hazards that require respiratory protection, confined space entries, use of nuclear density gauges, hazardous material shipping/handling, etc.).

Step 5: Finalize the Safe Work Plan: The completed document must be approved by the Project Coordinator and TWO's Health, Safety and Environment (HSE) Representative, HSE Manager, or authorized H&S professional (CIH or CSP). If the work activities covered under this Plan pose a high risk (e.g., working at heights, excavation, demolition, confined space entry, work over water or drilling), the completed document must be approved by the TWI HSE Manager.

Step 6: Review Hazards And Control Measures Prior To Actual Field Work: Prior to conducting any field work, the project team should review the final Safe Work Plan as part of the initial site safety briefing. Additionally, the field team supervisor and all team members should participate in the completion of the Daily Tailgate Meeting Form prior to each day's work.

Project Name: TDF-1 & TDF-2 O&M and Compliance Monitoring

HSE Representative: _____ Project Coordinator _____

Scope of Work	
Scope of Work and Major Tasks	
Job Location (Provide as much detail as possible)	
Employees assigned	
Subcontractors and their scope of work	
Minimum Required Personal Protective Equipment	• Hard hat • Safety glasses with side shields • Safety toed boots/shoes • ANSI Class 2 high visibility apparel for work near roads or heavy equipment (Class 3 apparel is required for work at night or during periods of poor visibility) • Gloves specific for the task • Refer to JSA for additional PPE requirements for specific tasks Note: Downgrading/upgrading of the above mentioned PPE must be approved by the HSE manager or designee.
Required Training	
Dates of the work	

Emergency Contacts and Facilities			
Fire			
Police			
Medical			
EMERGENCY Nearest **Hospital**	Name:	Phone Number:	
Address & Directions to Nearest **Hospital** (Map Attached? ☐ YES ☐ NO)	Address:	Directions:	
NON-EMERGENCY Nearest **Occupational Health Clinic**	Name:	Phone Number:	
Address & Directions to Nearest **Occupational Health Clinic** (Map Attached? ☐ YES ☐ NO)	Address:	Directions:	
Responsible Personnel			
Project Coordinator	Name	Office Phone #	Cell Phone #
Health, Safety, and Environment Representative	Name	Office Phone #	Cell Phone #
HSE Manager	Name	Office Phone #	Cell Phone #
Subcontractor(s)	Name	Office Phone #	Cell Phone #
Subcontractor(s)	Name	Office Phone #	Cell Phone #
Emergency Response Personnel	Name	Office Phone #	Cell Phone #

he following safety management considerations generally apply to all field projects. Review the requirements of each SMS and determine appropriate steps to ensure project compliance with the requirements.

WORK ACTIVITY CHECKLIST					
Determine the applicability of these items to your project/activity	**Yes**	**In Plan**	**Determine the applicability of these activities to your project**	**Yes**	**In Plan**
Groundwater or Surface Water Sampling	**Yes**	**Yes**	Erosion and Sediment Control Activities	**Yes**	**Yes**
Water Level Measurement (Piezometers)	**Yes**	**Yes**	Site Inspections	**Yes**	**Yes**
Work in vicinity of embankments	**Yes**	**Yes**	Health, Safety, and Environment Training	**Yes**	**Yes**
New Employee HSE Orientation	**Yes**	**Yes**	Incident Reporting and Notifications	**Yes**	**Yes**
Significant Incident Investigation	**Yes**	**Yes**	Injury and Claims Management	**Yes**	**Yes**
Excavation or Potential Exposure to Tailings	**Yes**	**Yes**	Managing HSE Related Risks	**Yes**	**Yes**
Management of Change (New activity by worker)	**Yes**	**Yes**	Vehicle Useage	**Yes**	**Yes**
Power Tools	**Yes**	**Yes**	Mechanical Equipment	**Yes**	**Yes**
Other:			Other:		

HAZARD IDENTIFICATION CHECKLIST					
Determine the applicability of these items to your project/activity	**Yes**	**In Plan**	**Determine the applicability of these activities to your project**	**Yes**	**In Plan**
New task by individual	**Yes**	**Yes**	Biological hazards	**Yes**	**Yes**
New miner (less than 1 year experience at POM)	**Yes**	**Yes**	Chemical exposure	**Yes**	**Yes**
Work in vicinity of embankements	**Yes**	**Yes**	Dust, airborne particulate	**Yes**	**Yes**
Trips, slips, falls	**Yes**	**Yes**	Heavy lifting	**Yes**	**Yes**
Heavy equipment/vehicles	**Yes**	**Yes**	Cold	**Yes**	**Yes**
Work at Elevated Heights	**Yes**	**Yes**	Lightning	**Yes**	**Yes**
Heat exhaustion/heat stoke	**Yes**	**Yes**	Heavy Rain	**Yes**	**Yes**
Potential Exposure to Tailings	**Yes**	**Yes**	Others		
Power tools/electrical equipment	**Yes**	**Yes**	Others		

JOB SAFETY ANALYSIS

For those major tasks identified in the Scope of Work, complete the Job Safety Analysis below. Use additional sheets, as necessary.

DATE: ☐ **NEW** ☐ **REVISED**	**PAGE** **of**
WORK ACTIVITY (Description):	

DEVELOPMENT TEAM	POSITION/TITLE	REVIEWED BY	POSITION/TITLE

JOB STEPS[1]	POTENTIAL HAZARDS[2]	HAZARD CONTROL PROCEDURES[3]

JOB STEPS[1]	POTENTIAL HAZARDS[2]	HAZARD CONTROL PROCEDURES[3]

Person drafting this Safety & Health Plan:	Name	Signature	Title	Date
Project Coordinator Approval:	Name	Signature	Title	Date
Health, Safety, and Environment Approval *	Name	Signature	Title	Date

** Note: Approval must be by the designated Health, Safety and Environment (HSE) Representative, the HSE Manager, or any TWI designated Certified Industrial Hygienist (CIH) or Certified Safety Professional (CSP). If the work activities covered under this Safety and Health pose a high risk (e.g., working at heights, excavation, demolition, confined space entry, work over water, or drilling), the completed document must be approved by a HSE Manager.*

Plans are only valid for one year from the date of approval, unless otherwise noted.

1 Each Job or Operation consists of a set of steps. Be sure to list all the steps in the sequence that they are performed. Specify the equipment or other details to set the basis for the associated hazards in Column 2.

2 A hazard is a potential danger. What can go wrong? How can someone get hurt?

3 Aligning with the first two columns, describe what actions or procedures are necessary to eliminate or minimize the hazards. Be clear, concise and specific. Use objective, observable and quantified terms. Avoid subjective general statements such as, "be careful" or "use as appropriate".

APPENDIX B
SAMPLING AND ANALYSIS PLAN

APPENDIX B OF COMPLIANCE MONITORING PLAN
SAMPLING & ANALYSIS PLAN

TAILING DISPOSAL FACILITIES 1 & 2
CLEANUP ACTION PLAN IMPLEMENTATION
PEND OREILLE MINE

Prepared by

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March 6, 2013

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1.0 SAMPLING OBJECTIVES AND LOCATION

This Sampling & Analysis Plan (SAP) presents standards and protocols for groundwater and surface water performance monitoring associated with the Pend Oreille Mine (POM) Tailings Disposal Facilities No. 1 (TDF-1) and No. 2 (TDF-2) Cleanup Action Plan (CAP). The SAP is a companion document to the Compliance Monitoring Plan (CMP) for the TDF-1 and TDF-2 Site.

Four groundwater monitoring wells and one surface monitoring location will be periodically sampled in accordance with the CMP. The Compliance Monitoring Locations are shown on **Figure 2 of the CMP**, and include the following:

- Three existing downgradient groundwater monitoring wells (MW-301, MW-302, and MW-303);
- One existing upgradient groundwater monitoring well (MW-7); and
- One surface water sampling location (TDF-1 outfall at Creek 2).

2.0 ANALYTE LIST

Text Table 1 below presents the groundwater and surface water sampling analyte list:

Text Table 1
Groundwater and Surface Water Analyte List

Analyte	Method	Groundwater	Surface Water
Arsenic	EPA 200.8	Total	Dissolved
Cadmium	EPA 200.8	Total	Dissolved
Chrome	EPA 200.7	Total	Total
Copper	EPA 200.8	Total	Dissolved
Iron	EPA 200.7	Total	Dissolved
Lead	EPA 200.8	Total	Dissolved
Manganese	EPA 200.7	Total	Dissolved
Selenium	EPA 200.8	Total	Total
Zinc	EPA 200.7	Total	Dissolved
Total Suspended Solids	SM 2540D	NA	N/A

1) Total Suspended Solids and hardness to be sampled for surface water only.
2) Dissolved metal samples shall be filtered with a 0.45 micron filter.
3) Total metal samples shall be unfiltered.
4) NA = Not applicable

3.0 DATA QUALITY OBJECTIVES AND PROCEDURES

Data Quality Objectives or DQOs for the analytical data generated under this SAP are qualitative and/or quantitative statements of the precision (a measure of the random error), bias (a measure of systematic error), representativeness, completeness, and comparability necessary for the data to serve the objectives of the project. The quality of laboratory data will be evaluated based on

the relative precision, bias, representativeness, completeness, and comparability of the data generated by each type of analysis.

3.1 PRECISION

Precision is the degree of reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a pair of measurements compared to their average value, expressed as relative percent difference (RPD). Precision may be affected by the natural variation of the matrix or contamination within that matrix, as well as by errors made in field and/or laboratory duplicates. RPD is defined by the difference of the percent recovery (%R) of a spike and a spike duplicate as follows:

$$\%RPD_i = \frac{2|O_i - D_i|}{(O_i + D_i)} \times 100\%$$

where:

$\%RPD_i$= Relative percent difference for compound *i*
O_i = Value of compound *i* in original sample
D_i = Value of compound *i* in duplicate sample

3.2 ACCURACY

Accuracy is a measure of how well the analytical result reflects the actual concentration of a chemical in the medium and, therefore, is a measure of the bias in a measurement system. An error may be introduced by sampling process, sample handling, laboratory sample preparation, and analytical process. Sampling accuracy will be assessed by evaluating the results of one field blank.

Laboratory accuracy will be evaluated by comparing the analytical difference of measurements to reference values, and will be expressed as %R. %R is defined as the fractional difference of the spike quantity and the quantified amount as follows:

$$\%R_i = (Y_i \div X_i) \times 100\%$$

where:

%Ri = percent recovery for compound *i*
Y_i = measured analyte concentration in sample *i* (measured - original sample concentration)
X_i = known analyte concentration in sample *i*

3.3 REPRESENTATIVENESS

Representativeness is a function of the sampling design; therefore, it requires a slightly more subjective evaluation that includes evaluating the adequacy of the number of samples collected given specific site conditions and approved sampling procedures. The sample locations have

been selected in consultation with Ecology to yield chemical data representativeness of the project site.

3.4 COMPARABILITY

Comparability is a qualitative parameter that indicates the confidence with which one data set can be compared to another. Comparability will be promoted by using approved sampling plans, standardizing analytical and field procedures, and reporting data in uniform units. Data will be grouped and evaluated according to sampling media and laboratory analytical methods.

3.5 COMPLETENESS

For each analytical method, completeness will be determined by calculating the ratio of non-rejected data points to the number of data points requested for analyses. Data will be at least 90 percent complete. Completeness will be assessed through a cursory check of 100 percent of the analytical results.

3.6 LABORATORY ANALYTICAL PROTOCOLS

Laboratory qualifications, analytical methods, target detection limits, calibration procedures and frequency, and criteria for laboratory QC samples are specified in this section. The analytical methods specified are based on current information on site conditions and are selected to meet DQOs. In time, new considerations may need to be addressed and additional guidelines may be provided to maximize the quality and efficiency of the laboratory procedures.

U.S. Environmental Protection Agency (EPA) approved methods will be used for all chemical analyses. Any omission in this plan of relevant requirements, tasks, and other items found in the referenced methods does not constitute a waiver of the omitted requirement, task, or item. The laboratory manager and analysts are expected to be cognizant of all relevant aspects of the referenced methods to the extent necessary to provide accurate, precise, and defensible data.

Numerical DQOs for precision and bias will be assessed based on the current laboratory control limits for the respective constituent. Laboratory quality control (QC) samples are used to assess if analytical results are within quality control limits and documented. The types of QC samples the laboratory will employ depend on the particular analytical methodology that will be used to analyze the samples. Each analytical method has required QC that must meet laboratory developed acceptance limits in order for the data to be considered valid.

In addition, as part of the laboratory's annual accreditation program, performance evaluation samples and method detection limit studies are conducted to evaluate the laboratory's capability of performing the method accurately and precisely. Specific types of QC samples and corresponding control or acceptance limits for each analyte with respect to the particular analytical methodology are defined by the contracted laboratory’s quality assurance control manual and the respective U.S. Environmental Protection Agency (EPA) or State of Washington (Ecology) DQO for laboratory procedures. Matrix spikes (MS), matrix spike duplicates (MSD), and laboratory control samples shall be performed on project samples with each analytical batch; or as necessary to meet DQO and laboratory method standards.

These control limits were statistically calculated for each analytical method and matrix in accordance with EPA publication SW-846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (January 2008). Matrix spike and laboratory control sample recoveries associated with analyses of the samples are reviewed by the laboratory to assess whether the recoveries indicate an out-of-control situation and to determine if corrective action is necessary. The laboratory will document the findings of their QC review and the corrective actions performed in the case narrative for the analytical reports.

Representative samples will also be ensured through following proper protocols for sample handling (storage, preservation, packaging, custody, and transportation), sample documentation, and laboratory sample handling and documentation procedures.

Comparability of the data will be ensured by selecting standard EPA analytical methodologies for sample analysis. Data will be reported from the laboratory to TWI both electronically and in paper copy form. Data quality will be assessed in terms of precision, bias, representativeness, completeness and comparability using current laboratory-developed criteria, method criteria, and guidance as discussed above.

Data reduction is the process of converting raw data to final results. Laboratory analytical data reduction, review and reporting will be conducted by the laboratory in accordance with their standard operating procedures (SOPs) discussed in their published Quality Assurance Manual (QAM). Data deliverables will include the project sample results and QC results in electronic format and standard paper report format. The data will be submitted to TWI electronically and in paper form for data quality assessment and database formatting.

3.7 FIELD SAMPLE QC PROTOCOLS

Quality control procedures provide the means of evaluating and controlling the precision and bias of the analytical results. Careful adherence to established procedures for sample collection, preservation, and storage will minimize errors due to sampling and sample instability. All analytical samples shall have associated field QC samples collected and analyzed. Field duplicates and equipment blanks or trip blanks will be established at a frequency of one QC sample per sampling event, or once every 10 samples, whichever is greater. All field QC samples will be analyzed independently for the same analytes as the associated sample(s) and will be used as an indicator of potential errors in sampling techniques.

Table B-1 (attached) presents analytical test methods, duplicate, matrix, and blank spike limits, and minimum laboratory detection limits.

4.0 SAMPLING PROCEDURES

4.1 SAMPLING EQUIPMENT

The following equipment is required for groundwater and surface water sampling at the site.

- Key to well locks
- Tool Box (bolt cutters, screwdrivers, ½-inch Allen wrench, 9/16 ratchet, hammer)
- Plastic Sheeting
- Peristaltic pump or polyethylene bailers
- 12-volt battery
- Groundwater sample filters
- Tubing (clean)
- Nitrile and/or latex gloves
- Water level indicator
- Tube cutting tool
- Calibrated Water Quality Meter - pH, conductivity, temperature, turbidity, dissolved oxygen, oxygen reduction potential
- Stop watch
- Graduated cylinder
- Purge containers (5-gallon buckets)
- Sample bottles and materials (labels, preservative, plastic baggies, coolers, ice)
- Bubble wrap and/or other packaging material
- 0.45 µm filters
- Filtration apparatus, vacuum or pressure
- Decontamination equipment (potable water, deionized water, tubs, brushes, detergent)
- Logbook, sampling forms, COCs, pens, sharpies, calculator
- Cell Phone

4.2 GROUNDWATER SAMPLING

All sampling procedures and data shall be recorded in a field logbook. Additionally, all sampling data should be recorded on a unique monitor well purging/sampling form.

The following information shall be recorded prior to each time a well is purged and sampled:

- Weather conditions (precipitation, wind and temperature);
- Condition of each well;
- Depth to water before and after purging; Flow rate, total volume purged and well bore volume calculation;
- Sounded total depth of the monitor well; and
- Field parameters, such as pH, temperature, specific conductance, dissolved oxygen and turbidity collected while purging.

Before groundwater sampling begins, wells shall be inspected for signs of tampering or other damage. Signs of tampering or well damage (e.g., casing is damaged, lock or cap is missing) should be recorded in the field logbook and reported to the Project Coordinator.

Before the start of sampling activities, plastic sheeting shall be placed on the ground surrounding the well and/or sampling surface. Plastic sheeting shall be used to provide a clean working area

around the well monument and prevent soil from contacting sampling equipment. Standing water, if present, needs to be removed from the monument prior to venting and purging.

4.2.1 Groundwater Level Measurement

Prior to each time a well is sampled, and prior to installing other equipment into the well casing, water level measurements shall be performed to determine the depth to groundwater. The measuring tape shall be decontaminated between wells in accordance with the procedures described in Section 6. Conditions (e.g., precipitation) that may affect water levels should be recorded in the field log. The field log shall also include the previous water-level measurement for each well to evaluate if the current water level is consistent.

The groundwater level shall be measured to the nearest 0.0l foot using an electric water-level indicator. Two or more sequential measurements shall be taken at each well until measurements agree to within + or – 0.01 foot. The probe and attached tape shall be thoroughly washed with a solution of phosphate-free, laboratory-grade detergent (Liquinox or equivalent) and potable water, and rinsed with distilled water before use in each well. Waste handling procedures are provided in **Section 7.0**. The water-level indicator will be constructed of chemically inert materials to prevent equipment damage and cross-contamination between wells. Water levels shall be measured from the notch or permanent mark located at the top of the well casing and recorded on the well sampling form. If well casings are not notched or marked, measurements shall be taken from the north edge of the top of the well casing, and a notch or mark shall be made.

After sampling is complete, the total depth of the well shall be measured by slowly inserting the probe to the bottom of the well until resistance is felt. Insert the probe slowly to minimize disturbance of any sediment that may have accumulated in the well. Well total depth shall be recorded in the field logbook and on the groundwater sampling form. The water level depth shall then be subtracted from the total depth of the well to determine the height of the water column present in the well casing. The measured total depth of the well should be compared to well construction details to ascertain the thickness of accumulated sediment, if any. All water level and total depth measuring devices shall be routinely checked with a steel tape measure to ensure accurate measurements.

4.2.2 Low-Flow Purging Procedure

A low-flow, minimal draw down technique shall be used for monitoring well purging and sampling. This procedure induces laminar (non-turbulent) flow and is designed to ensure that samples collected from the wells are representative of groundwater. The low-flow rates minimize disturbance in the screened aquifer, resulting in: (1) minimal production of artificial turbidity and oxidation; (2) minimal mixing of chemically distinct zones; and (3) collection of representative samples while minimizing purge volume.

Low-flow purging typically consists of pumping water from the sampled well at a flow rate of approximately 0.1 to 0.5 liters per minute (L/min). However, the flow rate is dependent upon site-specific conditions. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min.

Following water-level measurement (**Section 4.2.1**), the well tubing will be positioned adjacent to, or slightly above the midpoint of, the screened interval. Care shall be taken to gently insert the tubing to minimize disturbance of any sediment that may have accumulated in the well. Equipment shall not be allowed to free-fall into a well.

Purging shall proceed by pumping groundwater from the well at a rate of approximately 0.1 to 0.5 L/min. The flow rate shall be measured by filling a graduated cylinder and measuring the flow rate using a stopwatch. During purging, the water level in the well shall be monitored to ensure that the water level is not receding and allowing water to cascade down the sides of the well screen. Cascading can aerate the groundwater, possibly affecting its chemical characteristics. Purge water shall be allowed to flow onto the ground down gradient of the monitoring well.

During purging, specific conductance, temperature, pH, dissolved oxygen, Oxidation/Reduction Potential (ORP) and turbidity of the produced water shall be measured every three to five minutes using a multi-parameter water quality meter and flow-through cell. The water-quality meter shall be calibrated at the start of each field day, prior to sampling and in accordance with the manufacturer's instructions. All water-quality measurements made during purging shall be recorded on a groundwater sampling form. When water-quality readings have stabilized over three measurements, purging may cease and samples may be collected. Stabilization is reached when three successive readings are within ±0.1 for pH, ±3 percent for conductivity and ± 10 percent for dissolved oxygen and turbidity. If one or more of the readings have not stabilized within one hour, samples shall be collected and the unstable readings shall be noted on the sampling form.

Wells will be purged using a peristaltic pump and dedicated polyethylene tubing. The low-flow sampling technique described above shall be used. If a well goes dry during purging, the well will be allowed to recharge before collecting the sample. This condition shall be noted in the field logbook and sampling forms.

4.2.3 Alternative Well Sampling Procedures

An alternative to low-flow purging is to remove at least three well volumes from the well before it is sampled. Groundwater elevation measurement procedures are provided in **Section 4.2.1**. One well volume can be calculated using the following equation:

$$V = H \times F$$

Where,

V = one well volume
H = the difference between the depth of well and depth to water (ft)
F = factor for volume of one foot section of casing (gallons) from below.

Text Table 2 summarizes the volume of water in one foot of casing for well diameters ranging from 1.5 to 6 inches.

Text Table 2
Volume of Water in One-Foot Section of Well Casing

Diameter of Casing (inches)	F Factor (gallons)
1.5	0.09
2	0.16
3	0.37
4	0.65
6	1.47

F can also be calculated from the formula:

$$F = \pi(D/2)2 \times 7.48 \text{ gal/ft}3$$

Where,

D = the inside diameter of the well casing (inches) and pi is approximated by 3.14.

Wells with yields too low to produce three well volumes before the well goes dry shall be purged to dryness and sampled following water level recovery. This condition shall be noted in the field logbook and well sampling forms.

Purge water temperature, pH, specific conductance, DO, ORP, and turbidity shall be measured and recorded on the well sampling form after removing each well volume during purging. Detailed information concerning disposal of investigative derived wastes is presented in **Section 7.0**.

4.2.4 Groundwater Sample Collection

Sampling can be initiated after water-quality parameters have stabilized in accordance with **Section 4.2.2** or a total of three well volumes have been purged. Before collecting groundwater samples, the sampler shall don clean, phthalate-free protective gloves. In-line water-quality measurement devices should be disconnected or bypassed during sample collection. Sampling flow rate may remain at the established purge rate or may be adjusted slightly to minimize aeration, bubble formation or turbulent filling of sample bottles. Typically, flow rates less than 0.5 L/min are appropriate.

The same device will be used for sampling as was used for purging. Required sample containers, preservation methods, volumes and holding times are provided in **Table B-2 (attached)**. Sampling equipment shall be decontaminated in accordance with **Section 6.0**, following completion of sampling activities.

Upon completion of sampling, the wells shall be capped and locked. Well caps shall be loosely fixed to the well so that the water level in the well equilibrates with atmospheric pressure. Allowing the well to equilibrate with the atmosphere will provide a more accurate static water level measurement.

4.2.5 Filtration

Surface water samples to be analyzed for dissolved metals require filtering. Filtering may be performed in the field or the laboratory. The filter must be decontaminated prior to use between uses (see Section 6). Filters may be of either the pressure-type or vacuum-type. A barrel filter such as the "Geotech" filter works with a bicycle pump, which is used to build up positive pressure in the chamber containing the sample. The sample is then forced through the filter paper (minimum size of 0.45 µm) into a jar placed underneath. The barrel itself is filled directly via the hose of the sampling pump.

The vacuum filter consists of two chambers. The upper chamber contains the sample and a filter (minimum size of 0.45 µm) divides the chambers. A Gillian type pump or hand pump, air is withdrawn from the lower chamber, creating a vacuum, which causes the sample to move through the filter into the lower chamber where it is drained into a sample jar. Preservation, if necessary, should be done after filtering.

4.3 SURFACE WATER SAMPLING

Surface water samples shall be collected at the site. Direct grab samples shall be collected from the start of Creek 2 near the TDF No 1 outfall. All sampling procedures and data shall be recorded in the field logbook.

The sampler shall don new clean nitrile or latex gloves and place a closed collection container into the creek with the opening facing upstream. The sample collection container shall consist of a laboratory-provided, decontaminated, non-preserved plastic bottle. The lid of the collection container will then be removed under water, taking care not to disturb any sediment. Once the lid has been removed from the collection container, the bottle may be rinsed two times by the sample water. The collection container shall then be removed from the water and the sample water transferred to an appropriate laboratory-provided sample container. Samples to be analyzed for dissolved metals shall be filtered in the field or at the laboratory, as described in **Section 4.2.5**. Required sample containers, preservation methods, volumes and holding times are provided in **Table B-2 (attached)**.

After the surface water sample has been collected, the multi-parameter probe shall be placed into the water where the sample was collected and readings are to be recorded on the field sheet. If sediment disturbance occurs it shall be recorded in the field logbook and sample collection shall be delayed until the area clears and sediment is flushed downstream. If opening of the container underwater is not practical without disturbing the sediment, it shall be noted in the field book and the sample container lid shall be removed before submersion.

4.4 SAMPLE HANDLING

4.4.1 Sample Containers

All samples shall be collected into glass or plastic containers supplied by an analytical laboratory specific to the analytical method. Sample containers shall be stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Appropriate surface water and groundwater sample container information including preservation techniques, required volumes and holding times are provided in **Table B-2**.

4.4.2 Sample Hold Time

Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods utilized are specified in **Table B-2**. Holding times for samples collected from wells that purged dry will be counted from the first day of sample collection.

4.4.3 Sample Preservation

Sample preservation procedures are used to maintain the original character of analytes during storage and shipment. Before shipping sample bottles to the field, the contract laboratory shall add the required preservatives to the sample bottles that will be used for surface water and groundwater. The laboratory shall affix waterproof labels to the bottles, on which the type of analysis and the type and amount of preservative will be written. Samples not preserved in accordance with EPA Contract Laboratory Program (CLP) "National Functional Guidelines for Inorganic Data Review" (October 2004) requirements shall be resampled and analyzed.

All samples shall be placed in the appropriate sample containers and chilled (on ice or an ice-substitute in a cooler) immediately upon sample collection. The samples shall be submitted to an analytical laboratory accredited in the State of Washington for analysis. Samples shall be submitted under chain-of-custody protocol.

4.4.4 Filtration

Surface water samples that are analyzed for dissolved metals shall be filtered, as described in **Section 4.2.5.**

4.4.5 Storage Requirements

Samples shall be placed in secure, on-site storage, or remain in the possession of the sampling personnel until they are delivered to the laboratory. Immediately after collection, and during shipment to the analytical laboratory, samples shall be stored in coolers on ice or an ice-substitute at approximately 4°C. Either ice packaged in plastic storage bags or prepackaged ice substitute may be used to maintain the temperature in the shipping containers at approximately 4°C. Ice should be replenished as needed to ensure adequate cooling of samples during storage. Cubed ice shall be double-bagged.

4.4.6 Sample Identification

To provide a sample tracking mechanism, each sample collected shall be given a unique sample identification number using the numbering system described below. The sample identification number shall include the site name (POM), sample type (MW or C2), well number, and date.

Example 1: A primary groundwater sample collected from monitoring well number MW-303 on June 1, 2013 would be labeled **POM-MW303-060113**. POM = Site, MW-303 = Monitor Well and Well Number, 060113 = date.

Example 2: A primary surface sample collected from the drainage pipe on June 1, 2013 would be labeled **POM-SW01-060113**. POM = Site, SW01 = Surface Water Location, 060113 = date.

Field duplicate samples will not be designated in the primary sample number. Field duplicate samples shall be labeled using the following example:

Field Duplicate Example: A field duplicate groundwater sample collected from monitoring well number MW-303 on June 1, 2013 would be labeled **POM-MW303D-060113**. POM = Site, MW303 = Monitor Well, D = field duplicate designator, 060113 = date.

Sample labels, whether blank or preprinted, shall contain an abbreviated summary of the logbook entry for the sample. The following information should be included on sample container labels:

- Sample identification number
- Date and time of sampling
- Name of sampling personnel
- Type of sample preservatives
- Analyses to be performed

4.5 SAMPLE CUSTODY

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Documentation of the custody and condition of the samples is maintained in field and laboratory records.

The Project Coordinator or his/her designee shall maintain chain-of-custody records for all field samples while samples are in their possession and until relinquished to the analytical laboratory.

All sample containers shall be sealed in a manner that shall prevent and detect tampering if it occurs. In no case shall tape be used to seal sample containers.

The following minimum information concerning the sample shall be documented on the chain of custody.

- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Preservative used
- Analyses required
- Name of collector(s)
- Serial numbers of custody seals and transportation cases (if used)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories
- Bill of lading or transporter tracking number (if applicable)

Samples collected in the field shall be transported to the laboratory as expeditiously as possible. When a 4°C requirement for preserving the sample is indicated, the samples shall be packed in ice or chemical refrigerant to keep them cool during collection and transportation.

5.0 MONITORING INSTRUMENTATION, CALIBRATION AND QUALITY CONTROL

Instruments to be used during field activities that require calibration by field personnel are the multi-parameter water quality meter and the water level indicator.

5.1 Multi-Parameter Water Quality Meter

The water quality meter will be used to measure the water quality parameters (pH, specific conductance, turbidity, temperature, ORP and DO). The instrument shall be calibrated daily according to the manufacturer's instructions using stock liquid standards. Atmospheric oxygen shall be used to calibrate the DO element. If the measured calibration concentration is not within 5 percent of the standard concentration (or manufacturer's recommended tolerances), the meter shall be recalibrated according to the manufacturer's instructions. Alternatively, the manufacturer will be contacted for assistance. If these alternatives do not result in a properly calibrated meter, a replacement unit shall be obtained. Calibration data will be recorded in the field logbook. The meter calibration will be performed in accordance with manufacturer's instructions.

5.2 Water Level Indicator

A water level indicator shall be used to measure depth to groundwater and total depth of the well. The 9-volt battery will be replaced as needed. Periodically the water level indication should be checked against a steel tape for accuracy.

6.0 EQUIPMENT DECONTAMINATION

The objectives of equipment decontamination are to prevent the introduction of contaminants into samples from sampling equipment, the environment or other samples. This section outlines procedures that shall be followed to meet decontamination objectives.

Water sampling equipment shall be decontaminated between sample locations using the following procedure:

- Scrub equipment thoroughly with phosphate free detergent (Liquinox) and potable water to remove any particulate matter or surface film; a the submersible pump (if used) shall also be flushed with phosphate-free detergent and warm potable water;
- Rinse and/or flush with clean potable water;
- Triple rinse and/or flush with clean deionized water;
- Package and seal equipment in appropriate containers to prevent recontamination.

Non-dedicated sampling equipment that comes in contact with sampled water (such as water level indicators, sampling pump, hose assemblies, dippers, and filtration apparatus) shall be decontaminated before and after each use. New sample hose should be used for each monitoring well or dedicated hose left within the well casing between sampling events. Meter sensors that contact sample water shall be thoroughly rinsed with distilled water. The water level indicator probe and cable shall be decontaminated before use at each well by washing the probe and cable with a Liquinox detergent and potable water solution and then thoroughly rinsed with deionized water.

7.0 WASTE HANDLING

7.1 GENERAL WASTE HANDLING PROCEDURES

Waste may be classified as non-investigative or investigative-derived waste. Non-investigative waste such as litter shall be collected on an as-needed basis to maintain the site in a clean and orderly manner. This waste shall be containerized and transported to an onsite solid wate collection bin.

Investigation-derived waste (IDW) generated during the project shall be stored, handled, and disposed of according to this section. The IDW guidelines presented in this section were set forth in the EPA publication “Management of Investigation-Derived Wastes during Site Inspections” (1991).

According to EPA guidelines, the most important elements of managing IDW include:

- Leaving the site in no worse condition than what existed before the investigation
- Removing wastes that present an immediate threat to the human health or the environment

- Complying with federal and state Applicable or Relevant and Appropriate Requirements (ARARs) to the extent practicable
- Planning and coordination of IDW management
- Minimizing the quantity of generated wastes

IDW shall be segregated at the site according to matrix (solid or liquid,) and as to how it was derived. Each container shall be properly labeled with site identification, sampling point, depth, matrix, constituents of concern, and other pertinent information for handling.

7.2 EXPECTED TYPES OF IDW

The methods for handling and disposing of IDW generated at the site were developed under the assumption that it is unlikely that any IDW generated during this project will require special handling or disposal. The following types of IDW may be generated during this project.

7.2.1 Purge Water

During purging of monitoring wells, field personnel shall observe the produced water for visual and olfactory evidence of contamination. Use of low flow, minimal draw down sampling procedures greatly reduces the volume of water produced during monitoring well purging. Purge water will be allowed to flow to the ground down gradient of the monitoring well. The volume of purge water volume will be low and concentrations of potential contaminants in the groundwater are not expected to be a threat to human health or the environment.

7.2.2 Decontamination Solutions

Decontamination solutions will consist of a mixture of Liquinox nonphosphatic laboratory detergent and potable water. Liquinox is nontoxic, nonhazardous, and biodegradable. Approximately two gallons of Liquinox solution may be generated at each well from decontamination of sampling pumps and other reusable equipment. Decontamination water will be allowed to flow to the ground down gradient of each well after all samples from the location have been collected.

7.2.3 Personal Protective Equipment

The sampling tasks to be performed for this project will be performed in Level D personal protective equipment (PPE). The only PPE that will require disposal is expected to be used latex or nitrile gloves. All used PPE shall be bagged and disposed with other inert solid wastes.

7.2.4 Solid Wastes

Nonhazardous solid wastes (i.e., used paper towels, used gloves, used tubing) shall be placed into plastic refuse sacks and discarded into a solid waste collection bin.

8.0 REFERENCES

U.S. Environmental Protection Agency (EPA) 1991. “Guide to Management of Investigation-Derived Wastes”, EPA 9345.3-03FS.

EPA, 2004. “National Functional Guidelines for Inorganic Data Review”, EPA 540-R-04-004, October.

EPA 2008. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", Publication SW-846, January.

TABLES

TABLE B-1
ANALYTICAL PARAMETERS, CLEANUP LEVELS, AND LABORATORY QUALITY ASSURANCE/QUALITY CONTROL
PEND OREILLE MINE TDF-1 AND TDF-2 SAMPLING ANALYIS PLAN

Analyte	Method	CUL	Miniumum Detection Limit (MDL)	Reported Detection Limit (RDL)	Units	Surr.	DUP	Matrix Spike		Blank Spike	
						%R	RPD	%R	RPD	%R	RPD
Arsenic	EPA 200.8	5	0.25	1.0	ug/L	NA	20%	30%	20%	15%	NA
Cadmium	EPA 200.8	0.58	0.20	0.4	ug/L	NA	20%	30%	20%	15%	NA
Chromium (total)	EPA 200.7	100	0.27	0.4	ug/L	NA	20%	30%	20%	15%	NA
Copper	EPA 200.8	25.7	1.00	1.70	ug/L	NA	20%	30%	20%	15%	NA
Iron	EPA 200.7	300	19	60	ug/L	NA	20%	30%	20%	15%	NA
Lead	EPA 200.8	9.34	1.7	3.0	ug/L	NA	20%	30%	20%	15%	NA
Manganese	EPA 200.7	50	1.4	4.0	ug/L	NA	20%	30%	20%	15%	NA
Selenium	EPA 200.8	5	0.55	3	ug/L	NA	20%	30%	20%	15%	NA
Zinc	EPA 200.7	297	2.6	10	ug/L	NA	20%	30%	20%	15%	NA
Total Suspended Solids	SM 2540D	NA	NA	NA	mg/l	NA	NA	NA	NA	NA	NA

Notes:
mg/l - milligrams per liter
ug/L - micrograms per liter
NA - Not Applicable
%R - percent recovery
RPD - relative percent difference
CAS - Chemical Abstract System
CUL based on hardness value of 343 mg/L
CUL - Cleanup Level
MDLs and RDLs may vary based on laboratory. Teck to confirm that RDLs are below CULs for all constituents.

TABLE B-2
SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS
PEND OREILLE MINE TDF-1 AND TDF-2 SAMPLING ANALYIS PLAN

Analyte	Method	Container	Volume (milliliters)	Preservation [1]	Hold (Days)
Arsenic	EPA 200.8	Glass or Plastic	250	Add HNO3 to pH<2	180
Cadmium	EPA 200.8	Glass or Plastic	250	Add HNO3 to pH<2	180
Chromium (total)	EPA 200.8	Glass or Plastic	250	Add HNO3 to pH<3	180
Copper	EPA 200.8	Glass or Plastic	250	Add HNO3 to pH<2	180
Iron	EPA 200.7	Glass or Plastic	250	Add HNO3 to pH<2	180
Lead	EPA 200.8	Glass or Plastic	250	Add HNO3 to pH<2	180
Manganese	EPA 200.7	Glass or Plastic	250	Add HNO3 to pH<2	180
Selenium	EPA 200.8	Glass or Plastic	250	Add HNO3 to pH<2	180
Zinc	EPA 200.7	Glass or Plastic	250	Add HNO3 to pH<2	180
Total Hardness by Calculation	SM 2340B	Glass or Plastic	250	Add HNO3 to pH<2	180
Total Suspended Solids	SM 2540D	Glass or Plastic	1,000	4 °C	180

[1] Do not preserve sample with nitric acid if dissolved metal samples are filtered in the laboratory.