EXHIBIT B
Consent Decree

Teck Washington Incorporated
Pend Oreille Mine Tailings Disposal Facilities Nos. 1 & 2
CLEANUP ACTION PLAN

1.0 INTRODUCTION

This Cleanup Action Plan (CAP) is Ecology's final decision document that sets cleanup standards and selects a cleanup action to meet those cleanup standards for Teck Washington's (Teck) Pend Oreille Mine Tailings Disposal Facility Nos. 1 and 2 in Metaline Falls, Washington. The Site, for the sole purpose of this CAP, is referred to as the Pend Oreille Mine Tailings Facilities Nos. 1 and 2, located approximately 2 miles north of Metaline Falls, Washington. The Pend Oreille Mine Tailings Disposal Facilities Nos. 1 and 2 are located within the Site. The cleanup action selected for the Site is based upon information contained in the Washington Department of Ecology's (Ecology) files, and information presented in the remedial investigation (RI) and feasibility study (FS) completed by Teck, which has been named by Ecology as a potentially liable person (PLP) for the Site.

Ecology is responsible for the cleanup action selection and the completion of the CAP. The selected cleanup action is intended to fulfill the requirements of the Model Toxics Control Act (MTCA) RCW 70.105D. More specifically, the objectives of this document are to satisfy the MTCA requirements set forth in WAC 173-340-380(1) and will include the following:

- A brief Site history description;
- A description of the nature and extent of Site contamination summarized from the remedial investigation (RI);
- Establishment of cleanup standards for each contaminated medium that are protective of human health and the environment;
- Presentation of proposed remedial alternatives summarized from the feasibility study (FS); and
- Ecology's selected cleanup action.

1.1 Site Location

The Site, defined as where hazardous substances have come to be located, includes Tailings Disposal Facilities Nos. 1 and 2 (TDF-1 and TDF-2) and contaminated groundwater. As shown in Figure 1, the Site is located east of the Pend Oreille River and is bounded to the south by State Route 31 and the Grandview Mine property, to the north and northeast by Colville National Forest, and to the east by private land.

The Town of Metaline Falls is located in northeast Washington approximately 13 miles south of the Canadian border and 15 miles west of the Idaho border. The Site is located north of town in southeast quarter of Section 21, Township 39 North, Range 43 East, Willamette Meridian (WM) in Pend Oreille County, Washington.

1.2 Applicability

This CAP is applicable only to TDF-1 and TDF-2 and associated contamination. It does not include the new tailings facility or potential contamination associated with the permitted mining operations. The remedial actions to be taken at this Site were developed to meet the threshold requirements and other requirements of WAC 173-340-360. Cleanup standards have been

developed and cleanup actions selected as an overall remediation process being conducted under Ecology oversight using MTCA authority. Ecology's decisions regarding these matters should not be considered as setting precedent for other sites.

1.3 Administrative Documentation

Documents used to develop this CAP and the decisions contained herein are contained in Ecology's files. The administrative record for this Site is on file and available for public review by appointment at Ecology's Eastern Regional Office, located at 4601 N. Monroe, Spokane, Washington 99205-1295. Documents that were made available for public comment are also available at the Metaline Falls Public Library (in the Cutter Theater Building). The following documents were used to develop the final cleanup action:

- Dames & Moore, 1997. Seep Water Analysis from Tailings Pond No.1. Letter Report to Cominco American, Spokane, Washington. Spokane, Washington.
- Dames & Moore, 1999. Focused Groundwater Assessment Tailings Storage Facility No. 3. Pend Oreille Mine Metaline Falls, Washington. Spokane, Washington.
- ENSR, 1999a. Analysis of Data of the Pend Oreille Tailings Impoundment #3 February 1999 Sampling Study. Letter to Mr. Keith Stoffel, Washington Department of Ecology. Fort Collins, Colorado.
- ENSR, 1999e. Geochemical Evaluation of Pend Oreille Mine Monitoring Wells. Report prepared for Cominco American Inc., Spokane, Washington. Redmond, Washington.
- ENSR, 2000. Final Environmental Impact Statement Pend Oreille Mine Project. Report prepared for Washington Department of Ecology, Spokane, Washington. Redmond, Washington.
- Golder Associates Inc., 2007. Draft Remedial Investigation/Feasibility Study Report for the Pend Oreille Mine Tailing Disposal Facilities TDF-1 and TDF-2. Redmond, Washington.
- Maxim Technologies, Inc 1998. MTCA/Dangerous Waste Characterization Preliminary Results No. 3 Tailings Impoundment. Letter to Dave Godlewski, Environmental Manager, Cominco American, Inc. Spokane, Washington. Spokane, Washington.
- URS Corporation, 2008. Pend Oreille Mine TDF-1 and TDF-2 Hydrogeology Date Review. Memorandum prepared for Teck Cominco American Incorporated.
- URS Corporation, 2009. Supplemental Monitoring Well Installation and Groundwater Monitoring Pend Oreille Mine TDF-1 and TDF-2. Report prepared for Teck American Incorporated.
- URS Corporation, 2010, Supplemental Remedial Investigation/Feasibility Study Pend Oreille Mine TDF-1 and TDF-2, Metaline Falls, WA.
- United States Environmental Protection Agency, Region 10, 2000, Pend Oreille Mine Preliminary Assessment, Metaline Falls, WA. Prepared by Ecology and Environment, Inc. for U.S. EPA Superfund Technical Assessment and Response Team (START).

1.4 Cleanup Process

Cleanup conducted under the MTCA process requires specific documents to be completed and submitted to Ecology. The CAP and Public Participation Plan are documents completed by

Ecology. These documents are used by Ecology to obtain more detailed information and determine the remedial actions to be conducted and the monitoring requirements prior to and following a cleanup action. These procedural tasks and resulting documents, along with the MTCA section that requires their completion, are listed below with a brief description of each task.

- Remedial Investigation and Feasibility Study - WAC 173-340-350
- Draft Cleanup Action Plan - WAC 173-340-380
- Engineering Design Report - WAC 173-340-400
- Construction Plans and Specifications - WAC 173-340-400
- Operation and Maintenance Plan(s) - WAC 173-340-400
- Cleanup Action Report - WAC 173-340-400
- Compliance Monitoring Plan - WAC 173-340-410
- Public Participation Plan - WAC 173-340-600

The Remedial Investigation and Feasibility Study (RI/FS) process documents the investigations and engineering evaluations conducted at the Site from the discovery phase to the final RI/FS. The investigations are designed to characterize the type and extent of contamination and the associated risks posed by the contamination to human health and the environment. The FS presents and evaluates different Site cleanup alternatives and proposes the preferred cleanup alternative. The Draft Remedial Investigation Report and Draft Feasibility Study were reviewed by Ecology, made available for public review and comment, and then finalized.

The CAP sets the cleanup levels and standards for the Site and selects the cleanup actions intended to achieve the cleanup levels. After opportunity for public comment and any revisions made following public comment, the CAP is finalized with an attached responsiveness summary and becomes the cleanup action plan (CAP).

The Engineering Design Report outlines the engineered system and design components of the CAP. Construction Plans and Specifications provide the technical drawings and specifications for design and implementation of the CAP.

The Operation and Maintenance (O&M) Plan(s) summarizes the requirements for inspection and maintenance as well as the regulatory and technical necessities to assure effective operations. The O&M Plan(s) outline the actions required to operate and maintain any equipment, structures, or other remedial facilities used in the cleanup action.

A Cleanup Action Report will be completed following implementation of the selected cleanup action. The report will detail the activities performed for the Site cleanup action and provide documentation of adherence to or variance from the CAP.

Compliance Monitoring Plans are designed to serve the following three purposes:

- Protection – Confirm that human health and the environment are being protected during construction and O&M tasks for the cleanup action at the Site.
- Performance – Confirm that the cleanup action has attained cleanup standards.

- Confirmational – Confirm the long-term effectiveness of the cleanup action after cleanup standards have been attained.

The Public Participation Plan is the framework to provide the public with information and give it the opportunity for participation in a site. This plan is tailored to the meet the public's needs and coordinate its effort in the MTCA process.

2.0 SITE HISTORY

The following paragraphs provide a brief summary of ownership, operational, and regulatory history of the Site. The information supplied herein was provided in the reports completed by Dames & Moore, Inc., ENSR, Golder Associates, Maxim Technologies, URS Corporation, and other reports provided to Ecology.

The information contained herein is not the result of a title search and is based upon information gathered from various sources. The Pend Oreille Mine was in operation from 1952 until mining production ceased in 1977. At the time of closure, the Bunker Hill Company owned the mine. Between the years 1977 to 1986, the Bunker Hill Company, Pintlar, and GRC Exploration continued to operate pumps to prevent mine flooding as well as perform exploration around the mine. From 1986 to 1988, the mine was allowed to flood. In 1988, Resource Finance Corporation entered into an option-purchase agreement with Pintlar and began to dewater the mine. The Resource Finance Corporation purchased the mine and mill along with 13,000 acres of contiguous mineral holdings in 1990. Cominco American Incorporated purchased the mine from Resource Finance Corporation in 1995. Cominco American and Teck Limited of Canada merged to form Teck Cominco Limited in July 2001. Teck Cominco Limited's operations in the United States are currently performed by Teck American Incorporated.

The Pend Oreille is an underground lead-zinc mine. After metals are extracted from processed ore, a fine material called tailings remains. Prior to Teck's ownership and until 1967, the Pend Oreille Mine tailings were directly discharged to the Pend Oreille River. After 1967, three tailings disposal facilities were used for tailings disposal from the Pend Oreille mine. Tailings from the process mill were transported via a pipe to a starter dam to the tailing disposal facility. Tailings Disposal Facility No. 1 (TDF-1) covers approximately 18 acres and was used from 1967 to 1974. Tailings Disposal Facility No. 2 (TDF-2) was used from 1974 to 1975 and covers approximately 9 acres. Tailings Disposal Facility No. 3 (TDF-3) was used from 1975 until mine closure in 1977. TDF-3 encompasses about 20 acres.

To prepare for the resumption of operations at the mine, Teck Cominco constructed a new tailings disposal facility over TDF-3. In constructing the new disposal facility, TDF-3 was covered with a geomembrane liner system that includes two, sixty mil high density polyethylene liners. The new facility's liner system essentially functions as a cover system for TDF-3. Teck began mining production in 2004. This CAP describes the planned cleanup action for TDF-1 and TDF-2.

3.0 PHYSICAL SETTING

The Pend Oreille Mine Tailings Disposal Facilities Nos. 1 and 2 (TDF-1 and TDF-2) are located approximately 2 miles north of Metaline Falls, Washington in Sections 10 and 15, Township 39 North, Range 43 East, Willamette Meridian (WM). Topographic map coverage of the Site and vicinity is provided by the Boundary Dam, Washington Quadrangle, U.S. Geological Survey, 7.5 minute series dated 1967 and photorevised in 1986. TDF-1 rests at elevations ranging from 2,200 to 2,280 feet above sea level while TDF-2 is situated about 2,320 to 2,400 feet above sea level using the National Geodetic Vertical Datum (NGVD) of 1929. The Site generally slopes to the west toward the Pend Oreille River at about a 30 percent fall. The topography steepens as it nears the river with the land surface terminating at a 50 foot precipice to the Pend Oreille River.

3.1 Regional Geology

The Site lies within the Metaline Lead-Zinc District, which encompasses about 75 square miles (Dings and Whitebread 1965). The Metaline District is characterized by sediments deposited in a carbonate reef environment. The oldest rocks were deposited during the Cambrian Period. The deposition in the shallow marine environment continued through the Ordovician Period into the Silurian/Devonian Period. This deposition resulted in sequences of limestone, dolomite, and shale. Toward the end of the marine deposition, depositional evidence such as the Ledbetter Slate suggests a transition from a shallow environment to deep marine sedimentation. A large quantity of breccias observed within the carbonate rocks as well as turbidite beds within the Ledbetter Slate suggests a tectonically active basin margin that was rapidly deepening (Morton 1992).

As a result of the major mountain building episode during the Cretaceous Period, the Metaline area rocks were folded, faulted, and intruded by igneous dikes, stocks, and sills. During the Tertiary Period, faulting occurred within the Metaline District, which resulted in the formation of the graben or land depression that characterizes the Metaline District. Several northeast trending low-angle thrust faults indicate compression of the sedimentary carbonates prior to graben formation.

During the Quaternary Period, continental glacial ice began to shape the landscape. Glaciofluvial and glaciolacustrine sediments covered the Metaline area. Erosion has shaped the current landscape of incised highlands and glacial valleys. Glacial lake bed sediments are the most dominant glacial sediment in the Metaline area and range in thickness from 200 to 500 feet (Dings and Whitebread 1965).

3.1.1 Site Geology

Test pits, borings and monitoring wells were installed near and through TDF-1 and TDF-2. The maximum tailings depth in TDF-1 of 68 feet was encountered in boring PP-D. Based on the borings, TDF-1 thickness varies from about 68 feet near PP-D to less than 5 feet along the southern edge (Figure 2). The TDF-1 tailings appear thickest near the northern most edge of the facility above the dam. In TDF-2 the tailings are thickest near monitoring well MW-202 with a thickness of about 55 feet. This monitoring well is located near the northwestern edge.

The native soil consists of sandy silt to silty sand, or clay with gravel. The gravel is mostly coarse, rounded to well-rounded and unsorted in the upper profile. The glaciofluvial deposit is underlain by a black, hard, thinly bedded slate known as the Ledbetter Slate.

3.2 Regional Hydrogeology

Groundwater occurs in the alluvial and unconsolidated glacial sediments as well as the underlying bedrock. In the Metaline Falls area, the unconfined alluvial aquifer is underlain by the laterally continuous Ledbetter Slate, which separates the alluvial aquifer from the deeper bedrock aquifer located within the Metaline Limestone. The unconsolidated glacial and alluvial deposits provide the majority of the domestic production in the area. The thickness of the glaciofluvial and glaciolacustrine sediments is dependent on the bedrock topography and is generally thickest near major streams and thins away from the valleys. Based on review of well logs on file with Ecology, domestic and commercial wells in the Metaline Falls area that are completed in bedrock have been found to yield between 30 to 250 gallons per minute and at depths between 50 and 300 feet.

3.2.1 Site Hydrogeology

The aquifer that flows beneath the Site is an unconfined water bearing zone that occurs within sandy silt to silty sand and clay with gravel. In 1990**,** five piezometers were installed within the tailings of TDF-1. These monitoring points provide water elevation information on the water occurrence within the tailings. The piezometers indicate the continued presence of water in the tailings. As part of Phase I of the RI, three monitoring wells were installed in TDF-2 and are identified as MW-201, MW-202, and MW-203. Only monitoring wells MW-201 and MW-203 encountered groundwater and MW-201 was the solitary well completed below the tailings. The piezometers and monitoring wells were used to develop a general understanding of groundwater movement within and below the tailing facilities.

As part of Phase II of the RI, three additional wells were drilled downgradient TDF-1 in an effort to describe groundwater conditions within the alluvial aquifer downgradient of the tailings facilities. Additionally, monitoring wells installed to monitor the current tailings facility (TDF-3) performance are used to assess upgradient groundwater conditions of the two closed tailings facilities.

The groundwater flow direction downgradient of the closed facilities is generally west-northwest. The flow direction can vary slightly based on seasonal flow characteristics. A horizontal hydraulic gradient of 0.008 feet/foot was estimated underneath TDF-2 from data collected from upgradient monitoring well MW-2 to MW-201. The gradient steepens from TDF-2 to TDF-1 with a horizontal hydraulic gradient of 0.11 feet/foot was estimated between MW-201 to MW-303 (Figure 3).

A limited pumping test was performed at monitoring well MW-201 to determine the aquifer's hydraulic properties. The pumping test utilized a submersible pump to withdraw the water and a pressure transducer with data logger to record the change in groundwater elevations within MW-201. The pumping test yielded a hydraulic conductivity range estimate of 4×10^{-2} to 1.5×10^{-1}

centimeters per second. Groundwater discharges to creeks in the tailings area and the creeks in turn feed into the Pend Oreille River.

3.3 Surface Water

The Pend Oreille River is located about 500 feet west of the Site boundary. Two creeks flow from the Site into the river and are identified as Creek #1 and Creek # 2 (Figure 4). Creek #1 is located north of the tailings facilities and flows northwest to the river. Creek #2 is the result of water diversion ditches along the north and south perimeter of TDF-1 combined with water from the decant structure. Creek #2 flows northwest into the Pend Oreille River.

The Pend Oreille River, one of the major sub-basins of the Columbia River, drains headwater basins in Montana and Idaho and flows through the northeast corner of Washington. The Pend Oreille River joins the Columbia River in southern British Columbia. The Pend Oreille River watershed is comprised of nineteen sub-basins and drains an area of about 25,200 square miles. The Site is located within the Sullivan sub-basin, the largest sub-basin in the watershed, draining 142 square miles.

4.0 REMEDIAL INVESTIGATION

The first phase of the tailings facility characterization began in July 2005. A total of seventeen exploration pits were excavated on TDF-1 and TDF-2. Twelve were completed in TDF-1 with the remaining five in TDF-2. Along with the test pits, two soil borings and three monitoring wells were completed. The characterization included completion of the following:

- Collected tailings material samples from seventeen test pits at discrete intervals from surface, three-foot, six-foot, and 10-12-foot interval depths.
- Composited the samples from each of the seventeen test pits at the discrete intervals discussed above into one sample from each pit and submitted the 17 samples for total metals and toxicity characteristic leaching procedure (TCLP) chemical analysis.
- Collected tailings material samples from the uppermost 2-4 inches, 6-12-inch, and 12-24 inch interval depths. Submitted 51 samples of tailings material for agronomic properties analysis.
- Completed hydraulic testing of monitoring wells and piezometers using pumping tests and slug tests.
- Collected groundwater samples from two new monitoring wells since one monitoring well was dry and the five existing piezometers.
- Collected surface water samples from seeps below TDF-2 and culvert discharges.
- Collected surface water samples from Creek #1 and Creek #2.
- Collected sediment samples from creek bottom.
- Collected 28 samples from various species of vegetation and submitted for chemical analysis.
- Conducted slope stability analysis of TDF-1.
- Conducted wildlife survey.

The preliminary characterization indicated that the tailings exceed human health and ecological screening criteria for select metals. Groundwater within TDF-1 and TDF-2 as represented by samples from the five piezometers and MW-202 are affected by metals from the tailings. The samples describe water quality conditions within the tailings. Toxicity characteristic leaching procedure (TCLP) analysis indicated a majority of tailings samples did not exceed dangerous waste criteria for metals. One composite sample from test pit TP-8 exceeded the dangerous waste criteria of 5 milligrams per liter (ppm) for lead with a concentration of 5.44 ppm. The split sample indicated the sample was below the 5 ppm criteria with a result of 2.81 ppm. A duplicate sample concentration exceeded the criteria with a value of 6.06 ppm.

Additional remedial investigation activities were performed in 2008 and 2009 in order to characterize downgradient groundwater impacts and provide geotechnical information to develop engineering design considerations. The field program included:

- Installation of three additional monitoring wells.
- Collection of groundwater samples from existing wells and the new wells.
- Collection of seep samples from below TDF-2.
- Excavate test pits to evaluate geotechnical stability.
- Conduct land survey of monitoring wells.

With installation of the new monitoring wells, the groundwater regime could be more adequately evaluated. The three new wells indicated that downgradient groundwater well samples exceed protection of surface water criteria for metals for human health and aquatic criteria. Seep samples exceeded groundwater screening cleanup levels for metals.

Tailings samples were collected during the earlier characterization phase of the project and were analyzed for total metals. Samples were submitted for total metals analysis of arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, selenium, silver, and zinc; chloride and sulfate; and alkalinity.
The results suggested the tailings metal concentrations were above Method B for select metals including arsenic, cadmium, copper, mercury and/or lead. Table 1 presents the Method B soil cleanup development for the tailings material.

Groundwater beneath and downgradient of the tailings facilities has been affected in limited areas by the tailings disposal. Using the most stringent cleanup level which is surface water criteria as a screening level, groundwater metals concentrations exceeded the screening criteria. Of the elevated metals in groundwater downgradient of the tailings facilities, copper, iron, manganese, and zinc are the only metals that continuously exceed a MTCA cleanup level established for protection of surface water. Table 2 presents the Method B groundwater cleanup development.

5.0 CLEANUP STANDARDS

The cleanup standard development process is used to determine which hazardous substances or indicator substances contribute to an overall threat to human health and the environment at a site. Once these indicator substances are identified, an evaluation is made to determine at what

concentration these substances are considered to be protective of human health and the environment. A point of compliance is then established on the Site, which is a point or points where these cleanup levels must be attained (WAC 173-340-200). Cleanup standards include both cleanup levels and points of compliance for those cleanup levels.

MTCA provides three main methods for establishing cleanup levels at a site. These are Method A, B, and C. Method A provides cleanup levels for routine cleanup actions for sites with relatively few hazardous substances. Methods B and C cleanup concentrations are calculated from applicable or relevant and appropriate requirements (ARARs) and from using the formulas provided in WAC 173-340-720 through WAC 173-340-760. Method B is the universal method for establishing cleanup levels and is applicable to all sites. Method C is a conditional method for use at sites subject to limited uses. Table 3 presents the ARARS.

Following establishment of cleanup levels, media having concentrations above cleanup levels must be addressed using one or more technologies selected as part of the remedy. Criteria for remedy selection are outlined in WAC 173-340-360.

Tailings, groundwater, and surface water are the contaminated media at the Site. Elevated metals are the hazardous substances that have been identified in this media. The metal contamination is a direct result of the tailings' metal content and probable erosion of tailings into surface waters.

Human health and terrestrial ecological conditions are evaluated in order to establish cleanup standards. Three exposure pathways have been considered in establishing cleanup standards for this Site. These pathways are direct contact with the tailings and the protection of groundwater, and protection of surface water. Even though the Site is located in an area that allows for a mixture of uses, Ecology has determined that the most reasonable exposure scenarios for human health and ecological receptors are ingestion and direct contact with the tailings, ingestion of contaminated drinking water and dermal contact with groundwater and surface water.

Groundwater cleanup standards are set according to WAC 173-340-720. As stated previously, the highest beneficial use of Site groundwater is as a current and future drinking water source. Ecology has determined that the reasonable maximum exposure expected is through ingestion of drinking water and other domestic uses (WAC 173-340-720 (1) (a)). A Method B cleanup standard will be used for establishing cleanup levels in soil and groundwater at the Site.

5.1 Terrestrial Ecological Evaluation

A site is required under WAC 173-340-7490 to perform a terrestrial ecological evaluation (TEE) to determine whether a release of hazardous substances to soil may pose a threat to ecological receptors. A site may be excluded from a TEE if any of the following conditions are met:

- All contaminated soil is or will be located below the point of compliance;
- All contaminated soil is or will be covered by physical barriers such as buildings or pavement;
- The site meets certain requirements related to the nature of on-site and surrounding undeveloped land; or

- Concentrations of hazardous substances in soil do not exceed natural background levels.

This Site does not meet any of the exclusionary criteria nor does it qualify for a simplified evaluation. A site-specific TEE was conducted at the Site. While the mining operations are considered an industrial use, the proximity of unrestricted land use required the terrestrial ecological evaluation to consider the Site as an unrestricted land use site. The Site is surrounded by forest lands and wetlands have been identified on-site.
Therefore, plants and animals are considered as receptors.

5.2 Indicator Substances

Indicator substances as defined by WAC 173-340-200 are a subset of hazardous substances present at a site selected under WAC 173-340-708 for monitoring and analysis during any phase of remedial action for the purpose of characterizing a site or establishing cleanup requirements for a site.

Metals have been identified as chemicals of concern at the Site. Indicator substances are selected from the list of chemicals of concern. The criteria found in WAC 173-340-708 (2) are used to screen the list of chemicals Following the selection of indicator substances, cleanup levels are developed for the list of substances that are used to calculate the total site risk. Protection of groundwater and surface water are considered in conjunction with exposure scenarios. For non-carcinogenic substances, the summation of risk for each toxic endpoint of all media must not exceed a hazard index of one. For establishing cleanup levels of carcinogenic substances, the total cancer risk from all chemicals in the affected media must not be greater than one in one hundred thousand or $1x10^{-5}$.

5.2.1 Soil/Tailings Indicator Substances

Tailings are a by-product of the milling and recovery of metals from ore. The most likely pathway for exposure to the tailings is through direct contact and ingestion. As stated above the current land use is industrial, however the proximity of unrestricted land use requires a full evaluation of the ecological receptors. The terrestrial ecological evaluation provided conservative or lower cleanup levels for plant or animal exposures. The reasonable maximum exposure scenario at the Site for humans is an industrial setting. However, industrial cleanup levels were not developed for protection of human health since like with the ecological evaluation, potential future land use of the Site may be unrestricted. Protection of groundwater and surface water is also a consideration. Arsenic, cadmium, copper, lead, mercury, and zinc are indicator substances for soil. Soil indicator substance screening results are presented as Table 4

Metals contamination at this Site is associated with the tailings. Soils adjacent to and in contact with the tailings do not appear to be affected by the tailings to the point of exceeding cleanup levels.

5.2.2 Groundwater Indicator Substances

Groundwater downgradient of TDF-1 and TDF-2 has been impacted by metals. 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 indicator substances for groundwater. Groundwater indicator substance screening results are presented as Table 5.

5.2.3 Surface Water Indicator Substances

Surface water samples collected on-site from metal culverts, seeps, diversion ditches, and creeks indicate surface water quality criteria has been exceeded for metals. The highest beneficial use and reasonable maximum expected exposure for surface water shall guide the cleanup level establishment. Groundwater cleanup levels will be protective of surface water.

5.3 Cleanup Standard Development

The indicator substance screening produced six soil and two groundwater contaminants that will be carried forward for cleanup standard development. The soil cleanup levels will be set to be protective of ecological receptors. In the case of arsenic, the most restrictive cleanup level was the Method B concentration which is below the background concentration, and therefore, the background concentration is used. Cadmium, copper, and selenium cleanup levels were also set at background since the most stringent criteria of protecting groundwater was below background. The background metal concentrations published in Washington State Publication 94-115 were used to establish background. Groundwater cleanup levels will be set to be protective of human health via ingestion and other domestic uses as well as protection of surface water.

5.3.1 Soil Cleanup Levels

Soil cleanup concentrations set under Method B shall be at least as stringent as the criteria in WAC 173-340-740(3)(b), which includes the following:

- Concentrations established under applicable state and federal laws.
- No significant adverse effects on the protection and propagation of terrestrial ecological receptors established using the procedures specified in WAC 173-340-7490 through 173-340-7494.
- 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 173-340-740(3)(iii)(A) and (B).

Soil cleanup levels were developed for six metals identified as indicator substances. The indicator substances are arsenic, cadmium, copper, lead, mercury, and zinc. The arsenic cleanup level was adjusted since the Method B cleanup level of 0.67 mg/kg is below the background concentration of 9 mg/kg. The cadmium and copper cleanup levels are set to be protective of groundwater using protection of surface water criteria. As in the case of arsenic the calculated cleanup level of 0.08 mg/kg for cadmium and 11.4 mg/kg for copper was below the background metal concentrations in soil. The cleanup level for cadmium and copper are 1 mg/kg and 22 mg/kg, respectively. The remaining soil cleanup levels were established using the terrestrial ecological evaluation table values.

The lead level was set at 50 mg/kg and the zinc concentration at 86 mg/kg for protection of plants. Soil biota is protected with a mercury level established at 0.1 mg/kg.

A point of compliance (WAC 173-340-200) is the point or points where cleanup levels established in accordance with WAC 173-340-720 through 173-340-760 shall be attained. Once those cleanup levels have been attained at that point, a site is no longer considered a threat to human health and the environment. If a conditional point of compliance is established, institutional controls must remain in place to prevent exposure where hazardous substances remain on-site above cleanup levels.

The standard soil point of compliance for cleanup levels established to be protective of human health via direct contact is upper fifteen feet of the soil profile. Where hazardous substances remain on-site as part of the cleanup action, institutional controls will be required. Since the soil cleanup levels were established for protection of terrestrial receptors, a conditional point of compliance may be used with institutional controls. The conditional point of compliance may be set at the biologically active zone, which is assumed to extend to six feet below ground surface. The department may approve a site-specific depth based on a demonstration that an alternative is appropriate for the site.

5.3.2 Groundwater Cleanup Levels

Groundwater cleanup levels set under Method B for groundwater 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 presents the Method B cleanup levels for groundwater. 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. In evaluating surface water cleanup levels for metals, the criterion of hardness plays an important role in setting final cleanup levels. For the purposes of water quality, hardness is defined as total calcium carbonate. Method B surface water standards are derived using an assumed hardness of 100 milligrams per liter. When a site's hardness values are higher than the assumed hardness of 100 milligrams per liter (ppm), the resulting cleanup levels will be increased and conversely decreased if hardness values are less than the 100 ppm. Site surface water sample results indicated hardness concentrations were above the assumed 100 ppm value for Method B calculation. An arithmetic average of surface water results was used to determine surface water cleanup levels. The average value used in calculating cleanup levels was 343 milligrams per liter.

During the cleanup analysis, empirical evidence based on surface water samples revealed surface water had not been affected by metals previously selected as indicator substances. The absence

of the indicator substances in surface water samples indicated the surface water adjacent to and downgradient of the tailings facilities had not been affected by metals above surface water standards developed for the Site. A review of groundwater cleanup levels for those same indicator substances showed that groundwater sample concentrations were below the most stringent, applicable groundwater criteria. Therefore, the metals cadmium, copper, and selenium were not retained as groundwater indicator substances for the Site.

For iron, the most stringent of these concentrations is 300 micrograms per liter (µg/L) from Section 304 of the Clean Water Act for a chronic exposure to human health. The Method B Site cleanup level for manganese is 2,240 µg/L.

A point of compliance (WAC 173-340-200) is the point or points where cleanup levels established in accordance with WAC 173-340-720 through 173-340-760 shall be attained. Once those cleanup levels have been attained at that point, a site is no longer considered a threat to human health and the environment. If a conditional point of compliance is established (see below), institutional controls must remain in place to prevent exposure where hazardous substances remain on-site above cleanup levels.

Under MTCA, the standard groundwater point of compliance is throughout a site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the Site (WAC 173-340-720(8)(b)).

Where hazardous substances remain on-site as part of the cleanup action, a conditional point of compliance, which shall be as close as practicable to the source of hazardous substances not to exceed the property boundary, may be used. If a conditional point of compliance is used, the proponent shall demonstrate that all practicable methods of treatment are utilized in the cleanup action (WAC 173-340-720(8)(c)). A conditional point of compliance has been selected for use at the Site, as explained in Section 7.1 below.

5.4 Overall Site Risk

Arsenic is the only carcinogen identified as Site indicator substances for soil and groundwater. Since the arsenic cleanup level is set at background, it will not be used in calculating overall site risk. The hazard quotient calculations for soil and groundwater are presented in Tables 6 and 7, respectively. The Site hazard index is less than one. This is derived from a combination of risk associated with the six indicator metals in soil and two indicator substances in groundwater. The hazard quotient calculations are presented as Table 8. The effects from non-carcinogenic substances were used to determine the hazard index by summation of the hazard quotients from soil and groundwater. The highest calculated hazard index is 0.027 is derived from the combination of mercury in soil and manganese in groundwater with the toxic endpoint of neurotoxicity.

6.0 REMEDIAL ALTERNATIVES

The first draft of the feasibility study proposed six remedial alternatives. The revised FS identified and carried forward three of the six alternatives for site remediation. These alternatives were originally numbered as Alternatives 2, 3, and 4. Alternative 2 includes institutional

controls, groundwater monitoring, and sediment capture. The remaining two alternatives include these elements along with slope improvements and accelerating the vegetative growth on the tailings facilities.

The revised FS alternatives were developed by Teck to better comply with MTCA including other applicable or relevant and appropriate requirements (ARARs), and to provide protection of human health and the environment. These alternatives are presented below as they were presented in the revised FS.

6.1 Alternative 2 – Institutional Controls, Creek #2 Sediment Capture and Monitoring

Alternative 2 would eliminate potential Site risks by preventing future residential land use on the tailings facilities and prevent Creek #2 sediment migration toward the Pend Oreille River, but would not reduce risks associated with TDF-1 slope stability. Alternative 2 includes the following major components:

1. Deed restrictions to prevent future residential land use;
2. Construct TDF-1 access road;
3. Short-term monitoring during remedial implementation;
4. Refurbish existing TDF-1 surface water diversion systems;
5. Construct a surface water spillway from the surface of TDF-1 to the improved surface water diversion systems;
6. Construct a sedimentation basin for Creek #2; and
7. Periodic inspection monitoring, dredging, and maintenance of the sedimentation basin and TDF-1 dam.

6.2 Alternative 3 – TDF-1 Slope Improvement (2H:1V) with Rock Buttressing and Accelerate Vegetation on TDF-1 and TDF-2

Alternative 3 would include the same deed restrictions and remedial actions included in Alternative 2. Under this alternative the potential risks from erosion or global stability of TDF-1 would be reduced by reducing TDF-1 dam face to a 2H:1V slope and stabilizing the dam face with an armored and vegetated surface. TDF-1 and TDF-2 surfaces would have soil amendments and nutrients added to accelerate vegetation growth/establishment. Cover material available from a suitable cover material source will be used as vegetative soils. Long-term maintenance of TDF-1 dam for Alternative 3 is anticipated to be significantly reduced compared to Alternative 2.

Alternative 3 includes the following major components:

1. Implement institutional controls, conduct monitoring, refurbish TDF-1 surface water diversion systems, and construct Creek #2 sedimentation basin as described in Alternative 2;
2. Reduce slope of TDF-1 dam face to 2H:1V and add additional rock buttress;
3. Grade the consolidated tailings and excavated area for even slope and good stormwater drainage toward the TDF-1 decant tower and new spillway;

4. Place a 0.5-foot thick cap consisting of a mixture of soil (a suitable source) and armor rock (from mine waste rock pile - appropriately sized) over the re-sloped TDF-1 dam face;
5. Regrade and vegetate stormwater drainage toward the TDF-1 decant tower and new spillway;
6. Re-vegetation of TDF-1 tailings surface with tilled amendments and nutrients (upper six inches) and hydroseeding, but excluding TDF-1 wetland and wetland perimeter soils;
7. Accelerate vegetation on TDF-1 with surface applied amendments to the TDF-1 wetland perimeter soils;
8. Re-vegetate TDF-2 with tilled amendments and nutrients (upper six-inches) followed by hydroseeding; and
9. Annual groundwater monitoring and periodic inspection and maintenance of the sedimentation basin, TDF-1 dam face slope and TDF-1 and TDF-2 vegetation.

6.3 Alternative 4 –TDF-1 Slope Improvement (2H:1V) with rock buttressing, TDF-2 Partial Soil Cap and Accelerate Vegetation on TDF-1 and TDF-2

Alternative 4 is the same as Alternative 3, except that the southern potentially phytotoxic portion of TDF-2 would be capped with six-inches of soils and six-inches of vegetative soils with appropriate amendments and nutrients to sustain vegetation. Alternative 4 would include the same deed restrictions and remedial actions included in Alternative 2 and 3. Alternative 4 includes the following major components:

1. Implement institutional controls, conduct monitoring, refurbish TDF-1 surface water diversion systems, and construct Creek #2 sedimentation basin as described in Alternative;
2. Reduce slope of TDF-1 dam face to 2H:1V and add additional rock buttress;
3. Grade the consolidated tailings and excavated area for even slope and good stormwater drainage toward the TDF-1 decant tower and new spillway;
4. Place a 0.5-foot thick cap consisting of a mixture of soil over the re-sloped TDF-1 dam face;
5. Vegetate TDF-1 dam face with tilled soil amendments and nutrients followed by hydroseeding;
6. Re-vegetation of TDF-1 tailings surface with tilled amendments and nutrients (upper six inches) and hydroseeding, but excluding TDF-1 wetland and wetland perimeter soils;
7. Accelerate vegetation on TDF-1 with surface applied amendments to the TDF-1 wetland perimeter soils;
8. Cap south portion of TDF-2 that is potentially phytotoxic with six-inches of soil cap and six-inches of growth soil;
9. Vegetate entire TDF-2 surface (including the southern capped portion) with tilled amendments and nutrients (upper six-inches) followed by seeding; and
10. Periodic inspection monitoring and maintenance of the sedimentation basin, TDF-1 slopes and TDF-2 vegetation and soil caps.

6.4 Cleanup Action Evaluation Criteria

The criteria used to evaluate cleanup actions are presented in WAC 173-340-360. All cleanup actions must meet the following four threshold requirements.

- Protect human health and the environment
- Comply with cleanup standards set forth in WAC 173-340-700 through 760
- Comply with applicable state and federal laws
- Provide for compliance monitoring

Other requirements for cleanup actions that meet threshold criteria include the following:

- Use permanent solutions to the maximum extent practicable
- Provide for reasonable restoration time frame
- Consider public concerns raised during the public comment period on CAP

WAC 173-340-360(3)(b) describes the specific requirements and procedures for determining whether a cleanup action uses permanent solutions to the maximum extent practicable. A permanent solution is defined as one where cleanup levels can be met without further action being required at a site, other than the disposal of residue from the treatment of hazardous substances. To determine whether a cleanup action uses permanent solutions to the maximum extent practicable, a disproportionate cost analysis is conducted. This analysis compares the costs and benefits of the cleanup action alternatives and involves the consideration of several factors, including:

- Protectiveness;
- Permanent reduction of toxicity, mobility and volume;
- Cost;
- Long-term effectiveness;
- Short-term effectiveness
- Implementability; and
- Consideration of public concerns.

The comparison of benefits and costs may be quantitative, but will often be qualitative and require the use of best professional judgment.

WAC 173-340-360(4) describes the specific requirements and procedures for determining whether a cleanup action provides for a reasonable restoration time frame.

6.4.1 Soil Cleanup Action Requirements

The soil cleanup action requirements under WAC 173-340-360(2)(d) do not apply at this Site.

6.4.2 Groundwater Cleanup Action Requirements

At sites with contaminated groundwater, WAC 173-340-360(2)(c) requires that the cleanup action meet certain additional requirements. For non-permanent groundwater cleanup actions, the regulation requires that the following two requirements be met:

1. Treatment or removal of the source of the release shall be conducted for liquid wastes, areas of high contamination, areas of highly mobile contaminants, or substances that can't be reliably contained; and
2. Groundwater containment (such as barriers) or control (such as pumping) shall be implemented to the maximum extent practicable.

6.4.3 Cleanup Action Expectations

WAC 173-340-370 sets forth the following expectations for the development of cleanup action alternatives and the selection of cleanup actions. These expectations represent the types of cleanup actions Ecology considers likely results of the remedy selection process; however, Ecology recognizes that there may be some sites where cleanup actions conforming to these expectations are not appropriate.

- Treatment technologies will be emphasized at sites with liquid wastes, areas with high concentrations of hazardous substances, or with highly mobile and/or highly treatable contaminants;
- To minimize the need for long-term management of contaminated materials, hazardous substances will be destroyed, detoxified, and/or removed to concentrations below cleanup levels throughout sites with small volumes of hazardous substances;
- Engineering controls, such as containment, may need to be used at sites with large volumes of materials with relatively low levels of hazardous substances where treatment is impracticable;
- To minimize the potential for migration of hazardous substances, active measures will be taken to prevent precipitation and runoff from coming into contact with contaminated soils or waste materials;
- When hazardous substances remain on-site at concentrations which exceed cleanup levels, they will be consolidated to the maximum extent practicable where needed to minimize the potential for direct contact and migration of hazardous substances;
- For sites adjacent to surface water, active measures will be taken to prevent/minimize releases to that water; dilution will not be the sole method for demonstrating compliance;
- Natural attenuation of hazardous substances may be appropriate at sites under certain specified conditions (see WAC 173-340-370(7)); and
- Cleanup actions will not result in a significantly greater overall threat to human health and the environment than other alternatives.

6.5 Evaluation of Proposed Remedial Alternatives

The remedial alternatives proposed in the feasibility study were evaluated according to the criteria set forth in WAC 173-340-360 and discussed in the prior section of this report. The three

alternatives meet the threshold requirements to varying degrees. The alternatives will be listed with high, moderate or low ranking for protectiveness of human health and the environment.

The alternatives do not completely meet the threshold criteria described in WAC 173-340-360(2)(a). Alternatives three and four limit direct exposure to the tailings, provide for stable slopes, and require institutional controls. However, the alternatives do not fully provide for protection of human health or ecological receptors. Each alternative does include compliance monitoring.

The second criteria used to evaluate alternatives is "Other Requirements" under WAC 173-340-360(2)(b), which includes requirements that remedies use permanent solutions to the maximum extent practicable, provide for a reasonable restoration time frame, and reflect the consideration of public concerns. The most practical permanent solution is the baseline alternative against which cleanup alternative are compared. None of the alternatives presented are considered a permanent solution. Therefore, the alternative that provides the greatest degree of permanence shall be the baseline alternative For the purpose of evaluation, Ecology considers the public concern for each alternative to be equivalent and will rely on actual public input to gauge public concern. Table 9 presents the results of the MTCA criteria evaluation.

6.5.1 Alternative 2

This alternative would place deed restrictions on the site to eliminate residential land use on the tailings facilities and limit potential exposures. A sedimentation basin for Creek #2 would be constructed to minimize off-site migration of tailings toward the Pend Oreille River. The current surface water diversion system will be refurbished to improve surface water handling. An operations and maintenance plan that includes periodic inspection monitoring, dredging, and maintenance of the sedimentation basin and TDF-1 dam will be developed. This alternative has been given a low degree of permanence since it does not comply with the ARARs by providing for slope stability or limiting direct exposure to the tailings with a cover system. A longer restoration time frame would be realized since no source removal will be conducted. Since the alternative involves standard construction techniques, the implementability of the alternative is known and can be completed. The long-term effectiveness of this alternative is low since it is not protective and does not utilize the critical components of protecting human health and the environment. The short-term risks will be risks associated with standard construction practices that can readily be addressed with proper safety precautions.

6.5.2 Alternative 3

Alternative 3 uses the options presented in Alternative 2 along with additional remedial action. This alternative has been given a moderate degree of permanence since the actions presented will provide limited protection for human health, but not for ecological receptors. The alternative involves standard construction techniques so the alternative can be easily implemented. The long-term effectiveness of this alternative is medium since source removal is not utilized and continued operations and maintenance will be required. The short-term risks will be risks associated with standard construction practices that can readily be addressed with proper safety precautions. A longer restoration time frame would be realized since no source removal will be conducted.

6.5.3 Alternative 4

This alternative is considered to provide the most permanent of the alternatives evaluated. The alternative provides the same remedial components as Alternative 3 with the addition a partial soil cap on TDF-2. The soil cap will provide additional soil over the phytotoxic portion of TDF-2 prior to seeding the area. A moderate degree of permanence was assigned to this alternative since it will provide limited human health protection, but does not protect the environment. The restoration time frame will be the same as alternative two. The alternative involves standard construction techniques so the alternative can be easily implemented. The long-term effectiveness of this alternative is medium since source removal is not utilized and continued operations and maintenance will be required. The short-term risks will be risks associated with standard construction practices that can readily be addressed with proper safety precautions.

7.0 SELECTED CLEANUP ACTION

The selected cleanup action is designed to meet the MTCA requirements and expectations. The cleanup action will be protective of human health and the environment. Ecology is selecting a variation of Alternative 4 presented in the revised FS. The selected cleanup action will protect terrestrial ecological receptors from tailings exposure. The containment remedy utilizing a cover system will reduce and control groundwater and surface water contamination. The selected cleanup action meets the threshold requirements and includes the following major components:

1. Refurbish TDF-1 surface water diversion systems and construct Creek #2 sedimentation basin as described in Alternatives 2 through 4;
2. Reduce slope of TDF-1 dam face to 2H:1V and add additional rock buttress to the slope base;
3. Reduce slope of TDF-2 dam face to a stable configuration to be described in the Engineering Design Report;
4. Place a 0.5-foot thick cap consisting of a mixture of soil and waste rock over the resloped dam faces;
5. Revegetate the resloped dam faces with tilled soil amendments and nutrients followed by hydroseeding;
6. Grade the consolidated TDF-1 tailings and excavated area for controlled slope and managed stormwater drainage toward the TDF-1 decant tower and new spillway;
7. Grade the consolidated TDF-2 tailings and excavated area for even slope and good stormwater drainage toward stormwater infiltration/conveyance systems to be described in the Engineering Design Report;
8. Compact the surface of tailings in TDF-1 (excluding the wetlands) and TDF-2 to achieve a permeability goal of 10-6 centimeters per second to minimize stormwater infiltration and protect groundwater;
9. Cover the compacted tailings surfaces with a drainage layer comprised of appropriately-sized aggregate. The drainage layer will be covered with a geotextile fabric. The drainage layer and overlying geotextile fabric will be designed to be a non-biologically active layer for purposes of establishing a conditional point of compliance for terrestrial ecological receptors;
10. Place a soil growth layer over the compacted tailings, drainage layer, and geotextile fabric;

11. Vegetate the surface of TDF-1 (excluding the wetlands) and TDF-2 with tilled soil amendments and nutrients followed by hydro-seeding;
12. Accelerate vegetation on TDF-1 with surface applied amendments to the TDF-1 wetland perimeter soils;
13. Implement institutional controls, including limiting access to TDF-1 and TDF-2 areas, maintenance of the cover system, groundwater use restrictions, and a financial assurance mechanism for continued monitoring, maintenance of institutional controls, and operation and maintenance of vegetative cover; and
14. Quarterly groundwater monitoring, periodic sediment basin operation and maintenance, regraded dam slope inspections, vegetation monitoring, TDF-1 and TDF cover system monitoring.

The modified Alternative 4 containment remedy will disrupt the direct contact pathway for human and ecological receptors. In addition, the selected remedy will limit continued contact of precipitation and runoff from the tailings. In typical containment remedies, a low-permeability cover is placed over the contaminant source material. Since the identified soil indicator substances are not observed in groundwater or surface water, a synthetic low-permeability cover is not necessary. In order to meet performance standards of the identified ARAR for limited purpose landfills (WAC 173-350), the tailings materials will be regraded and compacted establishing a low-permeability layer. The tailings will be compacted to achieve a reduced permeability with a goal of 1×10^{-6} centimeters per second. A drainage layer that will route stormwater off and away from the tailings will overlie the compacted tailings. A geotextile will be used to separate the drainage layer and the overlying soil layer. The soil layer should be able to support the appropriate vegetation. The cover system, as a whole, will provide at least one barrier layer (e.g. geotextile or granular drainage layer) to address the conditional point of compliance for ecological receptors. The compacted tailings will function as part of the overall cover ensuring containment for terrestrial ecological protection, reduced infiltration to groundwater, and long-term stability.

Groundwater contamination above cleanup levels is evident in the form of manganese only in the monitoring well downgradient of TDF-1, and in the form of iron concentrations only in one monitoring well beneath TDF-2. Given this limited distribution of contaminants, in conjunction with the source control measures to be implemented and the lack of current receptors, active groundwater treatment is not practicable. The highest beneficial use of Site groundwater is as a drinking water source. Site groundwater discharges to surface water and eventually to the Pend Oreille River. Groundwater cleanup levels were set to be protective of surface water, although no groundwater contaminated above cleanup levels currently reaches surface water, or is expected to reach surface water after remedy implementation.

The Draft Engineering Design Report will include a plan to further evaluate seismic and slope stability issues associated with the tailings facilities. In conjunction with the slope stability analysis, final grades for closure and stormwater routing will be determined. The conceptual cover system design will be finalized to ensure compliance with MTCA and the ARARs.

Groundwater monitoring wells will be sampled to assess the efficacy of the cover system. The wells will be sampled on a quarterly basis until such time as a less frequent schedule is

warranted. A compliance monitoring plan for the cleanup action will be required to confirm cleanup effectiveness.

7.1 Point of Compliance

A standard soil point of compliance is fifteen feet below ground surface. A conditional point of compliance may be set for a soil remedy developed to be protective of ecological receptors. For a site with institutional controls a conditional point of compliance may be set at the biologically active soil zone. The biologically active zone is assumed to extend to a depth of six feet. The department may approve a site-specific depth based on a demonstration that an alternative depth is appropriate for the site. The cover system design will provide a barrier layer (e.g. geotextile or granular drainage layer) to address the ecological conditional point of compliance

A conditional point of compliance for groundwater may be approved where it can be demonstrated that it is not practicable to meet cleanup levels throughout a site. In addition, if hazardous substances remain on-site as part of the cleanup action, a conditional point of compliance, which shall be as close as practicable to the source of hazardous substances not to exceed the property boundary, may be approved. Teck owns the property up to the Seattle City Light property approximately 200 feet from the Pend Oreille River at the river elevation of 1990 feet. Since it is not practicable to meet cleanup levels throughout the Site because the tailings facilities will remain in place, a conditional compliance is appropriate. Ecology will approve a conditional groundwater point of compliance for this cleanup action. If a conditional point of compliance is used, the proponent shall demonstrate that all practicable methods of treatment are to be utilized in the cleanup action (WAC 173-340-720(8)(c)). Groundwater treatment in the form of tailings cover system containment will be used at the Site. A conditional point of compliance will be used and established as close to the contamination as practicable. The monitoring wells downgradient of TDF-1 will function as the point of compliance wells.

7.2 Institutional Controls

Institutional controls are measures undertaken to limit or prohibit activities that may interfere with the cleanup action or result in the exposure to hazardous substances at a site. Institutional controls are required where cleanup actions result in residual concentrations of hazardous substances exceeding cleanup levels established for a site. These controls may not be used as a substitute for a cleanup that is technically possible. Since a cover system will be placed on the tailings facilities and a conditional point of compliance will be used, institutional controls are required.

Limited groundwater contamination occurs downgradient of TDF-1. Teck owns the property to within 100 feet of the Pend Oreille River and therefore controls land ownership overlying the groundwater contamination. A conditional point of compliance will be used, which requires placement of institutional controls. The institutional control requirements are set forth in WAC 173-340-440. The following institutional controls that prohibit and/or limit groundwater use within the groundwater contamination plume will be required, as incorporated into an environmental covenant to be filed with the office of the Pend Oreille County Auditor:

1. Teck shall maintain the cover system. Access to the closed tailings facilities will be limited.
2. No groundwater may be taken from the Site, except for purposes related to the Remedial Action, such as groundwater monitoring.
3. Teck shall provide a financial assurance mechanism to provide for the continued operation and maintenance of the cleanup action, which includes monitoring and maintaining institutional controls and operation and maintenance of the vegetative cover on TDF-1 and TDF-2. An operation and maintenance plan will be developed and approved by Ecology to meet these requirements.

7.3 Periodic Review

WAC 173-340-420 states that at sites where a cleanup action requires an institutional control, a periodic review shall be completed no less frequently than every five years after the initiation of a cleanup action. Since the waste materials remain on-site and institutional controls will be required, five-year reviews shall take place at this Site. Groundwater monitoring data shall be reviewed to continue to assess the effectiveness of the cover system. If groundwater or surface water data do not indicate that the cover system is adequately addressing groundwater contamination to concentrations below cleanup levels, then further remedial action may be considered.

8.0 EVALUATION OF THE CLEANUP ACTION USING MTCA CRITERIA

The selected remedy is evaluated using the MTCA criteria set forth in WAC 173-340-360, as follows:

8.1 Protection of Human Health and the Environment

Tailings and groundwater are the contaminated media and are the focus of the cleanup action at the Site. The exposure routes identified at the Site are direct contact, ingestion of groundwater, and protection of surface water. The cleanup action will reduce the risk from direct contact and provide for protection of surface water. Institutional controls restricting groundwater withdrawal and use will limit exposure via ingestion and dermal contact.

8.2 Compliance with Cleanup Standards

Generation of contaminated groundwater will be reduced by the cover system. Institutional controls will be part of this cleanup action since the tailings facilities will remain in-place.

8.3 Compliance with Applicable State and Federal Laws

The cleanup action for this Site complies with applicable state and federal laws. The applicable state and federal laws for the implementation of the cleanup action are identified in Table 3. Local laws, which can be more stringent, will govern actions when they are applicable.

8.4 Compliance Monitoring

Compliance monitoring is a required component of the cleanup action. A compliance monitoring plan will be developed to address the required monitoring throughout the project. The plan will identify the point of compliance wells, analytical techniques and criteria, and sampling frequency.

Compliance monitoring is divided into three categories, which are protection, performance, and confirmational (WAC 173-340-410). Protection monitoring is designed to protect human health and the environment during construction and the operation and maintenance tasks for the cleanup action. Performance monitoring confirms that the cleanup action has attained cleanup and/or performance standards.
Confirmational monitoring confirms the long-term effectiveness of the cleanup action once cleanup standards have been achieved or other performance standards have been attained.

8.5 Use Permanent Solutions to the Maximum Extent Practicable

A permanent solution is one in which cleanup standards can be met without further action being required. A practicable permanent solution was not identified for the Site. A variation of Alternative 4 was selected by Ecology and provides a moderate to high degree of permanence and can be readily implemented.

8.5.1 Protection of Human Health and the Environment

The remedy selected for soil, groundwater, and surface water is considered protective of human health and the environment. The soil remedy is considered protective since it will eliminate the direct contact pathway for human and ecological receptors. The remedy will also limit the potential leaching of metals into groundwater and possible erosion of tailings into surface water. Institutional controls will prohibit the withdrawal and use of the contaminated groundwater at the Site. Achieving cleanup standards will be assessed as part of the periodic review process required under WAC 173-340-420. If groundwater standards downgradient are not achieved by the selected cleanup action, additional cleanup action may be required.

8.5.2 Long-Term Effectiveness

The long-term effectiveness of the remedy will be assessed as the containment remedy limits the generation of groundwater contamination. Maintenance of the cover system and the vegetation will be required to ensure the effectiveness of eliminating direct contact as well as groundwater contamination.

8.5.3 Short-Term Effectiveness

Risks associated with the cleanup action in the short term are the potential exposure of workers to the tailings during re-grading and cover system installation. Potential impacts to surface water will be controlled with best management stormwater control requirements. Institutional controls will prevent contact with contaminated groundwater. Worker health and safety will be addressed as part of the health and safety plan and will require compliance with the appropriate regulations and to satisfy the protection monitoring requirements.

8.5.4 Permanent Reduction of Toxicity, Mobility, and Volume

The containment remedy will reduce exposure potential and the generation of groundwater contamination, which in turn will be protective of surface water.

8.5.5 Implementability

The selected cleanup action can be readily implemented since it involves the use of conventional remediation technologies. It is anticipated that the conceptual design of Ecology's selected cleanup alternative may be modified for final implementation. The remedial design will more fully evaluate and describe how the selected cleanup action will be constructed, operated, and maintained.

8.5.6 Cost

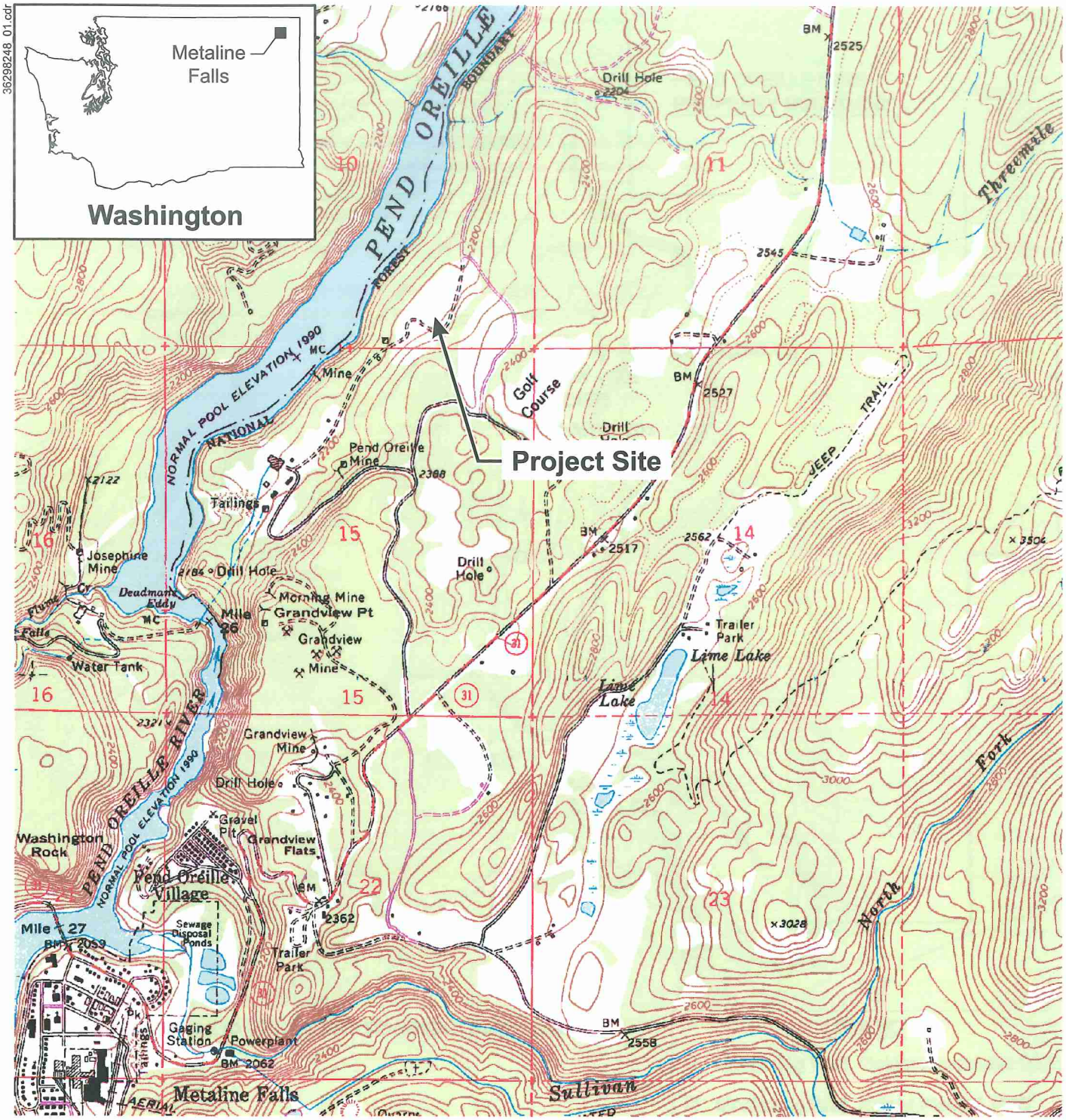
The cost provided in the FS for the selected alternative is estimated at about 2.5 million for capital costs. The projected annual operation and maintenance (O&M) costs for inspection and monitoring is $63,000.

8.6 Provide Reasonable Restoration Time Frame

The final cleanup action will provide source control measures by reducing infiltration and resulting in a reduction in groundwater contamination. Restoration at the conditional point of compliance, however, should occur once the cleanup action is fully implemented**.** Details of the monitoring program, including parameters and frequency, will be specified in the Compliance Monitoring Plan. Monitoring and periodic review will provide an assessment of the cleanup action.

8.7 Public Participation and Community Acceptance

A public comment period will be held to allow the public and parties affected by the cleanup action an opportunity to provide comment on this document. Public comments and concerns will be addressed in a responsiveness summary and incorporated as appropriate in the final cleanup action plan.



SOURCE: 7.5-minute USGS topographic quadrangles, Metaline Falls and Boundary Dam, Washington, 1986

0 0.5 1

Scale in Miles

Figure 1

Site Location Map

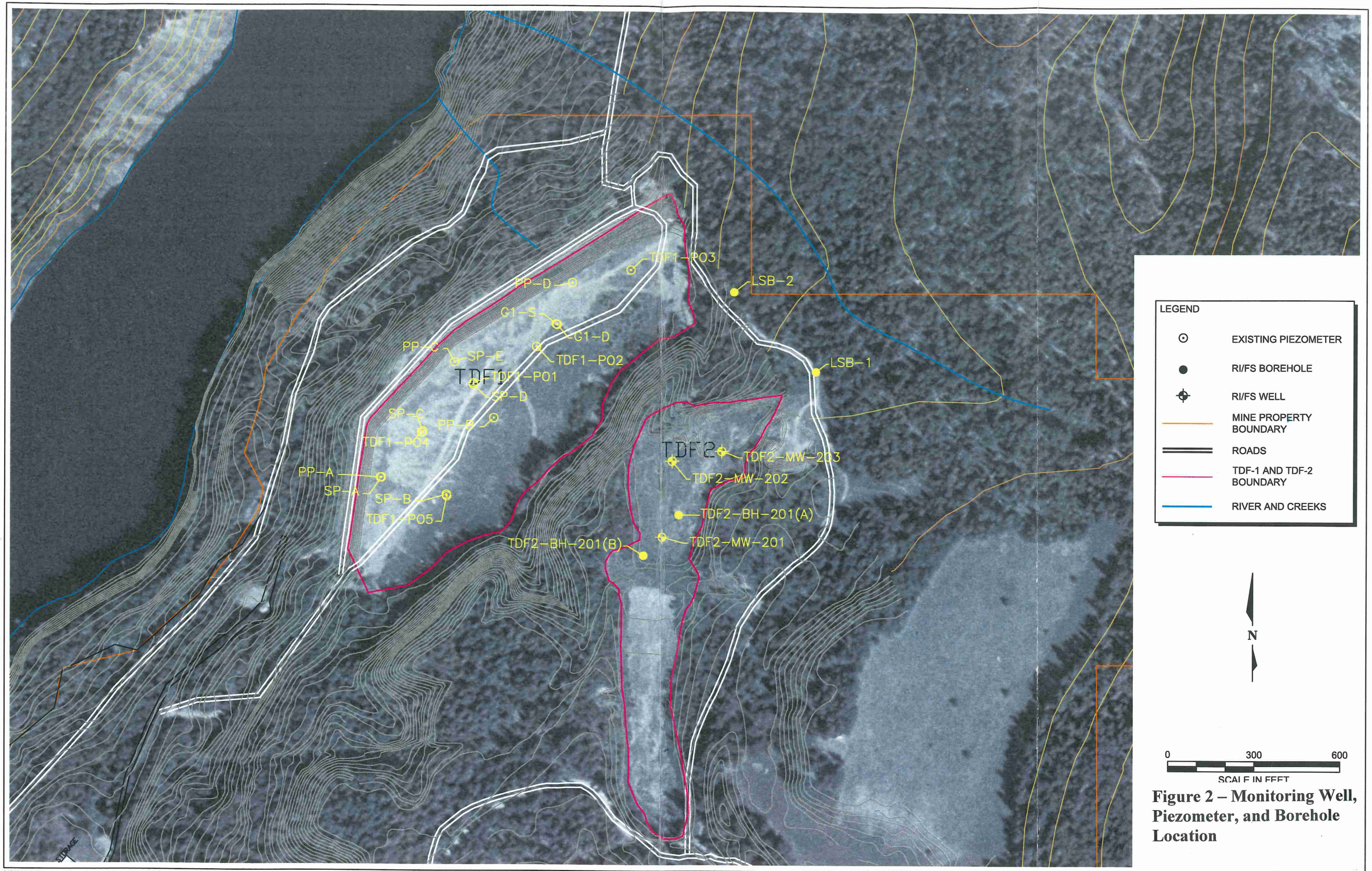


Figure 2 – Monitoring Well, Piezometer, and Borehole Location

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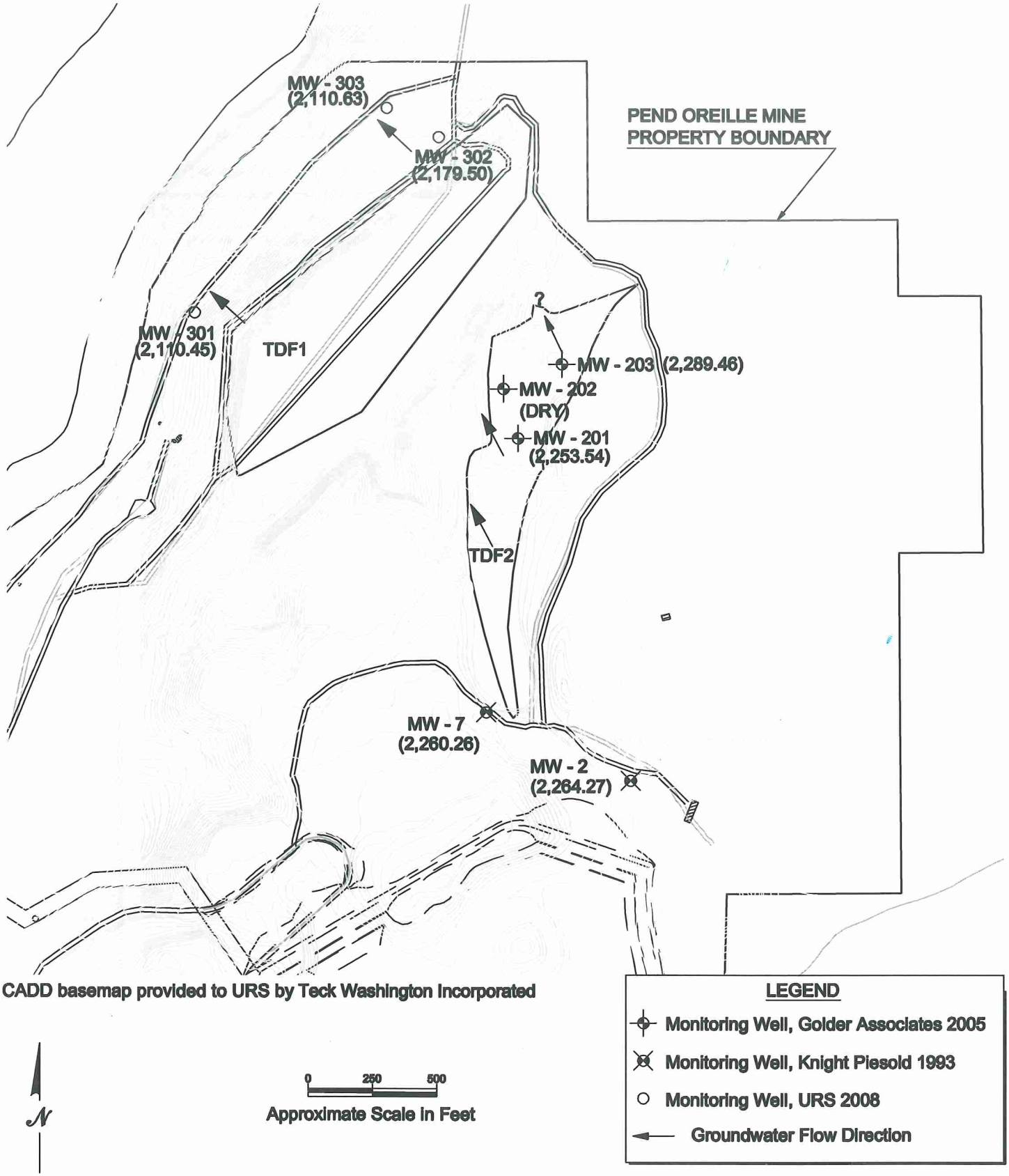
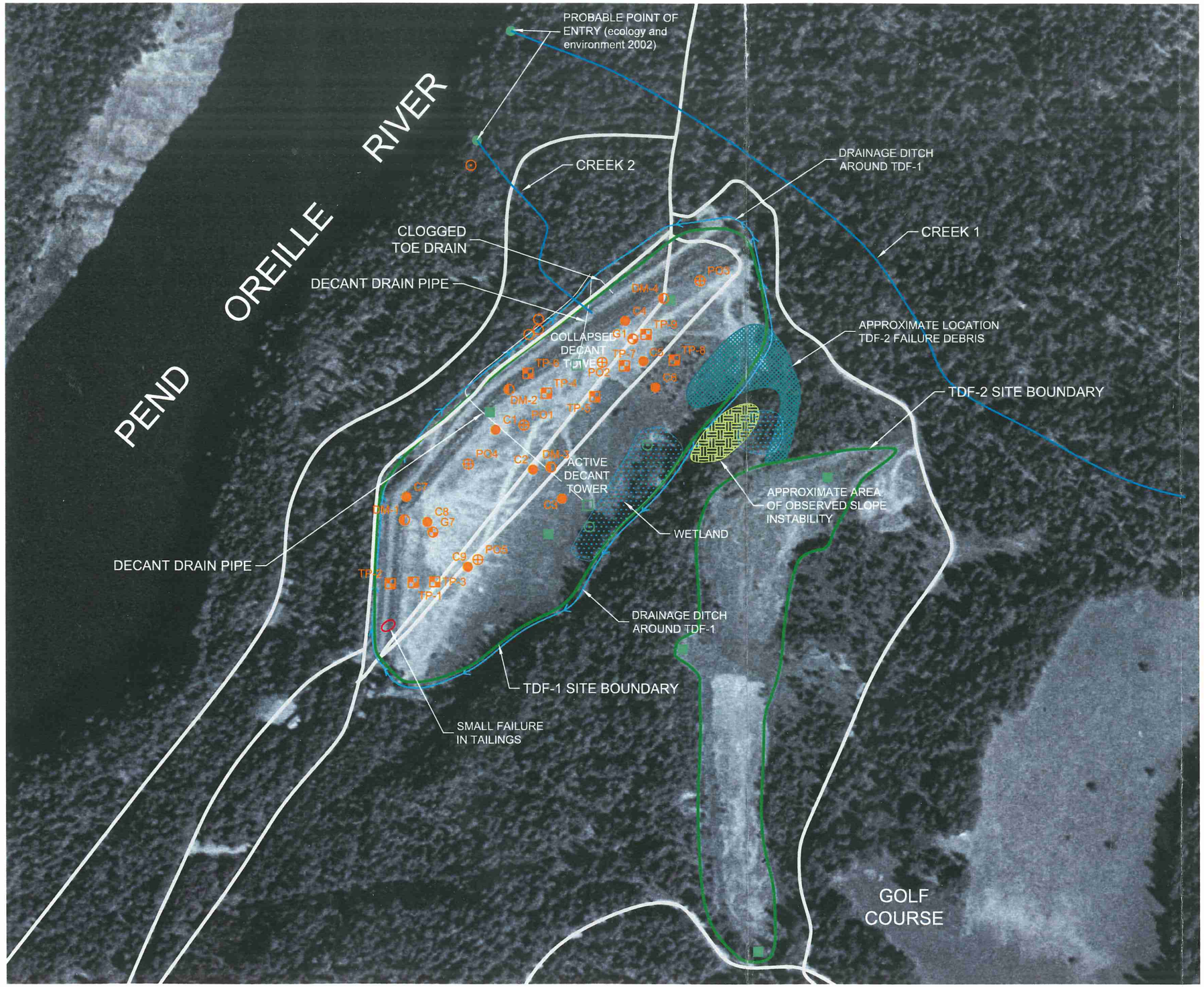


Figure 3

Groundwater Elevations and Monitoring Well Locations - TDF-1 and TDF-2

All locations are approximate

From URS Report



LEGEND

- PIEZOMETER BY U.S. DEPARTMENT OF INTERIORBUREAU OF MINES (1992)
- BORING BY DAMES & MOORE (1988)
- BORING BY GOLDER ASSOCIATES (1996)
- CONE PENETROMETER TEST BY GOLDER ASSOCIATES (1996)
- TEST PIT BY DAMES & MOORE (1997)
- SEDIMENT AND WATER SAMPLE BY Ecology and Environment (2002)
- SURFACE SOIL SAMPLE BY Ecology and Environment (2002)
- SURFACE WATER SAMPLE BY Ecology and Environment (2002)
- SURFACE WATER SAMPLE BY Dames and Moore (1997b)
- SEEP WATER SAMPLE BY Dames and Moore (1997b)
- TDF BOUNDARY
- SURFACE WATER DRAINAGE
- WETLANDS
- ROADS

N

0 300 600

SCALE IN FEET

Figure 4 – Creek #1 And Creek #2 Location

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From Golder Report

TABLE 1 DEVELOPMENT OF SOIL CLEANUP LEVELS - METHOD B
SOIL METHOD B CRITERIA FOR PEND OREILLE SITE

CONTAMINANT	Protection of Groundwater	Terrestrial	Method B	Background	Most Restrictive	Method B Cleanup Level	Basis
Arsenic	2.92 ppm	10 ppm	.67 ppm	9 ppm	0.67 ppm	9 ppm	Background
Cadmium	.08 ppm	4 ppm	80 ppm	1 ppm	0.08 ppm	1 ppm	Background
Copper	11.4 ppm	50 ppm	3,000 ppm	22 ppm	11.4 ppm	22 ppm	Background
Lead	1,868 ppm	50 ppm	NA	15 ppm	50 ppm	50 ppm	Terrestrial
Mercury	2.08 ppm	0.1 ppm	24 ppm	0.02 ppm	0.1 ppm	0.1 ppm	Terrestrial
Selenium	0.52 ppm	0.3 ppm	400 ppm	0.8	0.8 ppm	0.8 ppm	Background
Zinc	369.5 ppm	86 ppm	24,000 ppm	66 ppm	86 ppm	86 ppm	Terrestrial

TABLE 2 . DEVELOPMENT OF CLEANUP LEVELS - METHOD B

GROUNDWATER METHOD B CRITERIA FOR PEND OREILLE SITE (Includes protection of surface water) - [WAC 173-340-720(4)(b)]

	GROUNDWATER			SURFACE WATER											
	BLE GROUNDWATER A			SURFACE WATER ARARS											
				AQUATIC LIFE						HUMAN HEALTH					
CONTAMINA	Federal MCL	State MCL	MTCA METHOD B FORMULA	Ch. 173-201A		CWA Section 304		NTR (40 CFR 131)		CWA Section 304	NTR (40 CFR131)	MTCA METHOD B FORMULA	MOST STRINGENT CONCENTRATION, (ug/L)	NATURAL BACKGROUND	PQL	**METHOD B CLEANUP LEVEL, (ug/L)**	BASIS
				Acute	Chronic	Acute	Chronic	Acute	Chronic								
arsenic	10	10	0.058/CAR	360	190	340	150	360	190	0.018	0.018	0.098/CAR	0.018	5		**5**	Background
barium	2000	2000								1000							CWA-HH
cadmium	5	5	8/NCAR	14.06	2.56	6.66	0.58	13.5	2.5			20/NCAR	0.58			**0.58**	CWA-AC
chromium (tot	100	100		1505.8	488.5	1563.5	203.38	1505.8	488.5				100				MCL
copper	1300	1300	590/NCAR	54.35	32.54	42.9	25.7	54.35	32.44			2700/NCAR	25.7			**25.7**	CWA-AC
iron							1000			300			300				CWA-HH
lead	15	15		239.71	9.34	239.7	9.34	239.7	9.34				9.34	5		**9.34**	CWA-AC
manganese			2240/NCAR							50			50			**50**	CWA
mercury	2	2	4.8/NCAR	2.1	0.012	1.4	0.77	2.1	0.012		0.14		0.012			**0.1**	PQL
zinc			4800/NCAR	325.2	296.96	332.97	335.69	325.2	296.96	7400		17,000/NCAR	296.96			**296.96**	NTR

CAR - Carcinogenic
NCAR - Non-carcinogenic
CWA-HH - Clean Water Act Human Health
CWA-AC - Clean Water Act Aquatic Criteria
MCL - Maximum Cleanup Level
PQL - Practical Quantitation Limit
NTR - National Toxics Rule
Hardness Value of 343 was used in calculations.

TABLE 3

DRAFT CLEANUP ACTION PLAN
APPLICABLE RELAVENT AND APPROPRIATE REQUIREMENTS (ARARs)

ACTION	REFERENCE	COMMENT
Cleanup Construction		
	29 CFR 1910	Occupational Safety and Health Act
	Ch. 296-155 WAC	Safety Standards for Construction Work
	Ch.296-62 WAC	Occupational Health Standards - Hazardous Waste Operations and Emergency Response
	Ch. 43.21 RCW; 197-11 WAC	State Environmental Policy Act and Rules
	33 USC 1251	Clean Water Act
	Ch. 173-340 WAC	Model Toxics Control Act
	Ch. 173-160 WAC	Minimum Standards for Construction of Wells
	40 CFR 257	Classification of Solid Waste Disposal Facilities and Practices
	Ch. 173-350 WAC	Solid Waste Handling Standards
	42 USC 7401; 40 CFR 50	Clean Air Act; National Ambient Air Quality Standard
	Ch. 173-175	Dam Safety
Cleanup Standards		
	42 USC 300	Safe Drinking Water Act
	40 CFR 141	National Primary Drinking Water Standards
	40 CFR 142	National Secondary Drinking Water Standards
	70.105D RCW; Ch. 173-340 W	Hazardous Waste Cleanup; Model Toxics Control Act
	40 CFR 131	National Toxics Rule
	Ch 90.48 RCW; 173-201A WA	Water Poluution Control; Surface Water Quality Standard
	Ch. 246-290	Department of Health Standards for Public Water Supplies

TABLE 4. INDICATOR SUBSTANCE SCREENING - SOIL

CONTAMINANT	Frequency of Detection	Frequency of Exceedence	Maximum Concentration, mg/kg	MTCA Cleanup Level, mg/kg	BASIS	Screening Results
Total Metals						
Arsenic	1	0.31	34.8	9	**Background**	**Indicator**
Cadmium	**1**	0.99	58.5	**1**	**Background**	**Indicator**
Copper	**1**	0.29	323	**22**	**Background**	**Indicator**
Lead	**1**	1	11,800	**50**	**Terrestrial**	**Indicator**
Mercury	**1**	0.94	0.686	**0.1**	**Terrestrial**	**Indicator**
Selenium	0		<1	0.3	Terrestrial	<=5% detection frequency
Zinc	**1**	1	14,900	**86**	**Terrestrial**	**Indicator**

TABLE 5. INDICATOR SUBSTANCE SCREENING - GROUNDWATER

CONTAMINANT	Frequency of Detection	Frequency of Exceedance	Maximum Concentration, ug/L	MTCA Cleanup Level, ug/L	BASIS	Screening Results
Arsenic	0.23	0.04	8.99	5 ppb	BKGND	< 5% detection
Barium	1.00	0.00	177	1000 ppb	CWA-HH	< cleanup level
Cadmium	0.18	0.09	2.43	0.58 ppb	CWA-AC	Not in surface water
Chromium	0.27	0.03	1520	100 ppb	Method B, MCL	< 5% detection
Copper	0.27	0.09	42.6	25.7 ppb	CWA-AC	Not in surface water
Iron	**0.83**	**0.44**	**20,000**	**300 ppb**	**CWA-HH**	**Indicator**
Lead	0.24	0.04	13.8	9.34 ppb	WAC 173-201A	< 5% detection
Manganese	**0.80**	**0.13**	**4,400**	**50 ppb**	**CWA**	**Indicator**
Mercury	0.00	0.00	0.2	2 ppb	MCL	< 5% detection
Selenium	0.57	0.14	15.1	5 ppb	173-201A	Not in surface water
Zinc	0.6	0	142	297 ppb	173-201A	< cleanup level

TABLE 6. SOIL CLEANUP LEVELS ADJUSTMENT/CANCER RISK AND HAZARD QUOTIENTS CALCULATIONS

				HAZARD QUOTIENT									
INDICATOR SUBSTANCE	METHOD B CLEANUP LEVEL, ug/l	BASIS	CANCER RISK **	HEMOTOXICITY	HEPATOTOXICITY	NEPHROTOXICITY	NEUROTOXICITY	WEIGHT	MORTALITY	INCREASED	ALKALINE PHOSPHATASE	ACTIVITY	UNSPECIFIED	GASTROINTESTINAL
Total Metals														
Arsenic	**9**	Background												
Cadmium	4	Background												
Copper	50	Background												
Lead	50	Terrestrial												
Mercury	0.1	Terrestrial				0.0042	0.0042							
Zinc	86.0	Terrestrial		0.00360										
			0.00E+00											
				0.0036	0.000	0.0042	0.0042	0.000	0.000				0	0

TABLE 7. GROUND WATER CLEANUP LEVELS ADJUSTMENT/CANCER RISK AND HAZARD QUOTIENTS CALCULATIONS

						HAZARD QUOTIENT								
INDICATOR SUBSTANCE	METHOD B CLEANUP LEVEL, ug/l	BASIS	ADJUSTED METHOD B CLEANUP LEVEL, ug/L	PROPOSED CLEANUP LEVEL, ug/L	CANCER RISK **	HEMOTOXICITY	HEPATOTOXICITY	NEPHROTOXICITY	NEUROTOXICITY	WEIGHT	MORTALITY	INCREASED PHOSPHATE ALKALINITY	UNSPECIFIED	GASTROINTESTINAL ACTIVITY
Total Metals														
Iron	300	Clean Water Act		300										
Manganese	2,240	Method B		2,240					0.0227					
			Total Cancer Risk =		0.00E+00									
			Hazard Index =				0.000	0	0.0227	0.000	0.000			

TABLE 8. TOTAL SITE RISK AND HAZARD QUOTIENT CALCULATIONS

MEDIUM	CANCER RISK	HAZARD QUOTIENT								
		HEMOTOXICITY	HEPATOTOXICITY	NEPHROTOXICITY	NEUROTOXICITY	WEIGHT	MORTALITY	INCREASED ALKALINE PHOSPHATASE	UNSPECIFIED	GASTROINTESTINAL ACTIVITY
Soil (from Table 4)		0.0036		0.0042	0.0042					
Ground Water (from Table 5)		0.0067	0	0	0.0227	0	0	0		0.0059
Total Site Cancer Risk =	**0.00E+00**									
Total Hazard Quotient =		**0.0103**	**0.000**	**0.004**	**0.027**	**0.000**	**0.000**	**0.000**		**0.0059**

TABLE 9
MTCA EVALUATION

	PROTECTS HUMAN HEALTH	COMPLY WITH CLEANUP STANDARDS	COMPLY WITH ARARS	PROVIDE FOR COMPLIANCE MONITORING	USE PERMANENT SOLUTIONS	PROVIDE FOR REASONABLE RESTORATION TIME FRAME	CONSIDER PUBLIC CONCERNS
Alternative 1	Low	Low	Low	High	Low	Low	Medium
Alternative 2	Medium	Medium	Medium	High	Medium	Medium	Medium
Alternative 3	High	Medium	Medium	High	Medium	Medium	Medium
Ecology Alternative	High	High	High	High	High	Medium	Medium