Red Dog Mine
Closure and Reclamation Plan

Supporting Document I
Monitoring Plans

Red Dog Mine
Closure and Reclamation Plan

Red Dog Mine, Waste Management, Reclamation and Closure Monitoring Plan (TAK, 2009)

Teck

Red Dog Mine
ISO 14001:2004 Certified

RED DOG MINE

Waste Management, Reclamation and Closure Monitoring Plan

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1. INTRODUCTION

Teck Alaska Incorporated (Teck) is submitting the *Red Dog Mine Waste Management, Reclamation and Closure Monitoring Plan* (Plan) to the Alaska Department of Environmental Conservation (ADEC) and the Alaska Department of Natural Resources (ADNR), as required by 18 AAC 60.210 (b)(3)(D) to support Waste Management Permit 0132-BA002 and as a supporting document to the *Red Dog Mine, Closure and Reclamation Plan* (SRK 2008).

The monitoring described in this Plan is adopted by the Waste Management Permit and the Reclamation Plan Approval and includes the following:

- Biomonitoring, including aquatic life and ambient water quality monitoring, in the Bons Creek and Red Dog drainages[1] (previously conducted under the Red Dog Mine National Pollutant Discharge Elimination System (NPDES) Permit AK-003865-2 and as part of the Bons Creek Monitoring Program under an agreement between Teck and ADEC);
- Permafrost and sub-permafrost groundwater monitoring (previously conducted under the Groundwater Supplemental Environmental Project [SEP]);
- Inspections of the Red Dog Fish Weir (previously conducted under the Red Dog Creek Fish Weir Construction and Maintenance SEP);
- Certificates of Approval to Operate a Dam NID ID#AK00201 (Main Dam), NID ID#AK00260 (Mine Water Diversion Dam) and NID ID#AK00200 (Bons Creek Fresh Water Dam) – includes piezometer and thermistor monitoring and physical stability inspections;
- Water quality and flow monitoring at locations throughout the mine site and maintenance of water/load balances (previously conducted on a voluntary basis);
- Monitoring of waste rock and tailings;
- Monitoring of solid waste landfills (previously conducted under landfill permits SWZA016-012 and SW3A010-13, which have been rescinded and the requirements included within the Waste Management Permit);
- Visual monitoring of waste management facilities; and
- Monitoring of reclamation activities, including cover performance and revegetation success.

Table 1-1 (Page 3) summarizes the details of the monitoring in this Plan. The key facilities at the Red Dog Mine that are included in the Plan are shown on Figure 1. It should be

[1] This Plan includes some monitoring locations that are not part of the Bons Creek and Red Dog Creek drainages or are outside the jurisdiction of the Waste Management Permit boundary. These locations have been included in this Plan for reference and program completeness.

noted that this Plan covers the Red Dog Mine only and excludes the DeLong Mountain Regional Transportation System (DMTS), which includes the road and port facilities.

Monitoring associated with the operations phase is described in Section 2. Section 3 addresses changes to the monitoring program required during the period of active mine closure, while Section 4 describes anticipated requirements for the post-closure period. Section 5 describes the Quality Assurance/Quality Control programs in place. Report contents are included in Section 6.

1.1 Project Description

Red Dog Mine is located in northwestern Alaska, approximately 82 miles north of Kotzebue, and 46 miles inland from the coast of the Chukchi Sea. The mine is located on the Middle Fork of Red Dog Creek in the DeLong Mountains of the western Brooks Range, on private land owned by NANA Regional Corporation, Inc. (NANA). Some of the support facilities are situated on both State and NANA lands. Red Dog Mine is a joint venture between NANA and Teck, whereby Teck is the mine operator and NANA is the land owner.

The operation consists of an open pit zinc/lead mine, mill and support facilities. Construction of the mill began in 1988, with the first ore delivered to the mill in November 1989. Conventional drill and blast mining methods are employed. The mineral processing facilities use conventional grinding and sulfide flotation methods to produce zinc and lead concentrates. The concentrates are shipped to markets in North America, Europe and Asia from the DeLong Mountain Regional Transportation System (DMTS) port facility located on the Chukchi Sea. The Port is accessed via the 52-mile DMTS haul road, owned by the Alaska Industrial Development and Export Authority.

The ore deposits are massive sulfide zinc-lead-silver deposits. The ore and host rocks contain high concentrations of sulfide minerals, and the majority of the waste rock is acid generating, potentially acid generating, or has potential for metal leaching. Water from the open pit and waste rock stockpiles is collected in the tailings impoundment. During the open water season (May to October), water from the tailings impoundment is treated and discharged to the Middle Fork of Red Dog Creek.

Table 1-1: Summary of Waste Management, Reclamation and Closure Monitoring During Operations

Monitoring Program Element	Location	Parameters	Plan Section	Monitoring Frequency	Reporting Frequency
Biomonitoring Program					
Bons Creek Program	Buddy Creek (below falls and Station 221), Bons Creek (Station 220 and above pond), Anxiety Creek, Evaingiknuk Creek, Lower and Upper Bons Creek, Bons Reservoir, Dudd Creek	See Table 2-1 for specific parameters at each location (includes ambient water quality Profile I, periphyton, aquatic invertebrates, fish presence and use, juvenile Dolly Varden tissue metals analysis)	2.1.2	Ranges from monthly to yearly	Annual
Mine Drainage Program	Wulik River, Ikalukrok Creek, Station 9, Station 160, Station 20, Station 10, Station 12, Rachel Creek, Connie Creek, Shelly Creek, Sulfur Creek, Station 150, Station 145 Middle Fork above clean water bypass, and Station 140 above outfall.	See Table 2-2 for specific parameters at each location (includes ambient water quality Profile I, fall aerial surveys for overwintering Dolly Varden in Wulik River and for adult chum salmon in Ikalukrok Creek, periphyton, aquatic invertebrates, fish presence and use, juvenile Dolly Varden tissue metals analysis)	2.1.3	Ranges from monthly to yearly	Annual
Permafrost and Sub-permafrost Groundwater Monitoring					
Permafrost and Subsurface Temperature	Thermistors T-95-004, T95-005, T95-007, T95-008, T95-009; T-96-010, T96-012, T96-012S, T96-013, T96-015, T96-021, T96-022, T96-023; T-97-028, T97-029, -T97-030; T-05-61	Ground temperature (see Table 2-3)	2.2.2	Quarterly	Annual
Groundwater Level	Piezometers P-08A, P-08B; P-96-010, P-96-013, P-96-015; P-97-012, P-97-020, P-97-028; P-99-007R; SPP-97-002	Water elevation around the tailings storage facility (see Table 2-4)	2.2.3	Quarterly	Annual
Mine Water Management					
Water Quality and Flow	Main Dam Seepage Pumpback, Bons Creek Total Flow, East/West Overburden Sump, Tailings Water, Reclaim Water, WTP1/Mill Influent from Reclaim, WTP1 Influent from Mine Water Collection, WTP2 Influent from Reclaim, WTP3 Influent from Main Waste Stockpile, WTP3 Influent from Mine Water Collection, WTP3 Effluent, Mine Water Collection Sump, Natural Gas Water	See Table 2-5 for specific parameters at each location (includes total monthly water volumes and water quality Profile II)	2.3.2	Continuous, monthly, or calculated	Quarterly
Water Balance	Mine site	Total annual water volumes	2.3.3	Calculated	Annual
Load Balance	Mine site	Annual chemical loadings	2.3.3	Calculated	Annual
Visual Monitoring	Diversion ditches, Red Dog Creek Diversion, Mine Water Collection System, pipelines and pipeline containment structures, Main Waste Stockpile seepage collection system, treated water discharge lines, Overburden Stockpile runoff collection system, Fresh Water Dam, Mine Water	Signs of damage or potential damage; escape of waste or leachate or any unauthorized waste disposal; damage to the structural integrity of a containment structure or diversion structure; evidence of death or stress to fish, wildlife, or	2.3.4	Weekly when flow is present	Quarterly

Monitoring Program Element	Location	Parameters	Plan Section	Monitoring Frequency	Reporting Frequency
	Diversion Dam	vegetation			
	Fish weir	Signs of damage or potential damage	2.3.4	2/year	Quarterly
Waste Rock Management					
Quantity of Waste Rock	Waste rock and construction stockpiles	Quantity of waste rock removed and placed in stockpiles or used for construction	2.4.2	Daily	Quarterly
Geochemical Monitoring	Blast holes	Categorize, segregate, and quantify waste rock based on analyses of percent zinc, lead, iron, and sulfide sulfur (calculated), rock type	2.4.3	As scheduled	Quarterly
Visual Monitoring	Waste rock stockpiles	Signs of damage or potential damage; escape of waste or leachate or any unauthorized waste disposal; damage to the structural integrity of a containment structure or diversion structure; evidence of death or stress to fish, wildlife, or vegetation; inspections to ensure geological properties are appropriate for designated location or use; inspections for waste rock dump fires or "hot spots"	2.4.4	Weekly	Quarterly
Tailings Management					
Quantity of Tailings	Tailings Storage Facility	Quantity of tailings produced and placed in Tailings Storage Facility	2.5.2	Daily	Quarterly
Geochemical Monitoring	Final tailings slurry	Analysis of percent iron, lead and zinc	2.5.3	Continuous	Quarterly
Visual Monitoring	Diversion ditches, Tailings Storage Facility, Main Dam	Signs of damage or potential damage, structural integrity of diversion ditches, evidence of death or stress to fish, wildlife or vegetation	2.5.4	Weekly	Quarterly
Inert Solid Waste Landfills					
Quantity of Solid Waste	Landfills	Volume of solid waste placed in landfills	2.6.2	1/year	Annual
Visual Monitoring	Landfills	Signs of damage or potential damage; fire or combustion of waste, random inspections of incoming loads, evidence of death or stress to fish, wildlife or vegetation	2.6.3	Monthly	Quarterly

Monitoring Program Element	Location	Parameters	Plan Section	Monitoring Frequency	Reporting Frequency
Mining and Milling Activities					
Mining and Milling Quantities	Mine site	Quantity of ore produced, waste rock removed and tailings produced	2.7	Daily	Quarterly
Reclamation					
Areas Disturbed / Reclaimed	Areas disturbed and reclaimed throughout mine site	Size of areas disturbed and reclaimed	2.8.2	As scheduled	Annual
Reclamation Research	Reclamation test plots and reclaimed areas	Various monitoring to assess effectiveness of reclamation research	2.8.3	As scheduled	Annual
Reclamation Monitoring	Reclaimed areas	Soil properties, plant density and survival, Plant cover and taxonomic richness, plant vigor	2.8.4	As scheduled	Annual
Dust					
Risk Management Plan (RMP)	Mine site	As specified in the RMP	2.9	RMP	
Wildlife					
Wildlife	Mine site	Wildlife interactions and casualties	2.10	Weekly	Quarterly

Notes: 1. Water flows, water quality and visual monitoring for seepage required only during periods of flowing water

1.2 Environmental Management

The Red Dog Mine achieved an environmental milestone in 2004 when it received ISO 14001 certification for its Environmental Management System (EMS). With this accomplishment, Red Dog Mine joined an elite group of US mines with certified EMS programs. The development and implementation of the EMS was a multi-million-dollar effort that took more than three years and 25,000 hours to complete. This certification means the mine's environmental management system supports environmental protection, prevents pollution and fosters improvements in environmental performance. The mine undergoes annual certification audits. Certification has been maintained since it was originally obtained in 2004, when an independent third-party audit was successfully completed in conformance with ISO 14001:2004.

Since 2000, more than $68 million has been invested to improve and enhance Red Dog Mine's environmental performance. This includes investing in new equipment and technology and conducting over 300 studies to improve performance.

Teck actively complies with 110 permits, regulations, agreements and environmental plans that contain more than 6,000 individual stipulations, involving over 27,000 tasks that must be met on a daily, weekly, monthly, quarterly, and annual basis. These tasks include a variety of environmental monitoring requirements.

To facilitate management of these tasks, Teck developed and operates a web-based information system that tracks daily compliance tasks that must be completed to meet all of the regulatory and permit requirements. The system also tracks environmental and safety incidents and all required corrective and preventive actions, and provides environmental training materials, records, and information on overall environmental performance. This tool is essential in ensuring that the monitoring included in this Plan is conducted as required, according to the stipulations in permits, regulations, plans, and company site-specific operating procedures.

In addition to the web-based information system, Teck maintains an environmental data management database. The database stores environmental data, such as water quality data, and includes a system for managing environmental samples, including scheduling and preparation of Chain of Custody forms. The database also tracks the receipt of data from external laboratories to ensure that all requested analyses are received, as well as compliance with permit and regulatory standards.

2. OPERATIONS MONITORING

2.1 Biomonitoring Program

Biomonitoring was initiated in the Red Dog Creek area in 1990 with fish tissue sampling and was expanded to the Bons Creek area in 1994. In 1996 invertebrate and periphyton sampling was added. The programs include a combination of aquatic life and water quality monitoring. The programs were updated by the Alaska Department of Fish & Game (ADF&G), in consultation with Teck, in 2007 and are incorporated into this Plan and adopted by the Waste Management Permit.

2.1.1 Key Elements of the Monitoring Program

The key elements of the Biomonitoring Program consist of the following:

- Aquatic life and ambient water quality monitoring within the Bons Creek drainage and Evaingiknuk Creek[5] (referred to as the Bons Creek Biomonitoring Program); and
- Aquatic life and ambient water quality monitoring within the Red Dog Creek drainage, Ikalukrok Creek and Wulik River (referred to as the Mine Drainage Biomonitoring Program).
- Flow measurements at selected sites in the Mine Drainage Program

The sampling locations are shown on Figure 2 and Figure 3 for the Bons Creek and Mine Drainage programs, respectively. The details of the monitoring program are provided in the following sections.

2.1.2 Bons Creek Biomonitoring Program

An aquatic biomonitoring program was implemented in 2004 within the Bons Creek drainage. This included intensive assessment from 2004 through 2006 to establish the current “baseline” conditions. The baseline assessment included collection and analysis of fish tissues, evaluations of fish distributions and population estimates, invertebrate and periphyton sampling in Bons Creek, Bons Reservoir and Buddy Creek. The program, previously conducted under an agreement between Teck and ADEC, has been incorporated into this Plan and is carried out annually.

The locations included in the Bons Creek biomonitoring program are shown in Table 2-1 and Figure 2. Table 2-1 also includes a description of the locations and the type of monitoring conducted at each location. Water quality profiles are located in Section 2.11.

Table 2-1: Monitoring Locations in the Bons Creek Biomonitoring Program

Location	Location Description	Sampling Period[1]	Sampling Frequency	Monitoring
Buddy Creek	Below falls	Open water	1/year	Periphyton[2]
			1/year	Aquatic invertebrates[3]
			1/year	Fish presence and use
			2/month	Water Quality Profile I
			1/year	Juvenile Dolly Varden metals in tissue[6]
Buddy 221	Buddy Creek, above road	Open water	1/year	Periphyton[2]
			1/year	Aquatic invertebrates[3]
			2/month	Water Quality Profile I
Bons 220	Bons Creek, below pond[4]	Open water	1/year	Periphyton[2]
			1/year	Aquatic invertebrates[3]
			2/month	Water Quality Profile I
Bons Above Pond	Above pond[4]	Open water	1/year	Periphyton[2]
			1/year	Aquatic invertebrates[3]
Anxiety Creek[5]	Below DMTS road	Open water	1/year	Fish presence and use
			1/year	Juvenile Dolly Varden metals in tissue[6]
Evaingiknuk Creek[5]	East of DMTS road	Open water	1/year	Fish presence and use
Lower Bons Creek	Below overburden seepage collection system	Open water	2/month	Water Quality Profile I
Upper Bons Creek	Above haul road	Open water	2/month	Water Quality Profile I
Bons Reservoir	Above reservoir spillway	Open water	2/month	Water Quality Profile I
			1/year	Juvenile Arctic grayling metals in tissue[6]
			1/year	Arctic grayling population estimate
Dudd Creek[5]	Above mouth	Open water	2/month	Water Quality Profile I

Notes:
1. Sampling conducted when flow is present
2. Periphyton as Chlorophyll-a concentrations in July
3. Aquatic invertebrates monitored for taxonomic richness, abundance, and density in July
4. The “pond” is the fresh water reservoir, referred to as Bons Pond, in the Bons Creek drainage
5. Monitoring location is outside the jurisdiction of the waste management permit boundary, but has been included here for reference and program completeness
6. Metals analyzed in fish tissue Zn, Pb, Se, Hg, and Cd

2.1.3 Mine Drainage Biomonitoring Program

Biomonitoring has been carried out in Red Dog Creek since 1990 with fish tissue sampling, followed in 1994 with invertebrate and Periphyton sampling. The program is

designed to monitor and evaluate changes that may occur as a result of activities associated with the wastewater discharge from the mine. A Bioassessment Program required to be conducted annually under the Red Dog Mine NPDES permit AK-003865-2, has been incorporated into this Plan.

The locations included in the Red Dog Creek biomonitoring program are shown in Table 2-2 and Figure 3. Table 2-2 also includes a description of the locations and the type of monitoring conducted at each location. Water quality profiles are located in Section 2.11.

The accompanying ambient water quality monitoring and stream gauge flow monitoring for some of the stations (Stations 12, 151, and 160) listed in this Plan are currently conducted under the Red Dog Mine NPDES permit AK-003865-2. Should the ambient monitoring at these stations and accompanying stream gauge flow monitoring currently conducted under the NPDES permit be removed from future NPDES permits, appropriate ambient monitoring shall be continued under this Plan to support the biomonitoring program.

Table 2-2: Monitoring Locations in the Red Dog Creek Biomonitoring Program

Location	Description	Sampling Frequency[1]	Parameters
Wulik River[6]	Kivalina Lagoon upstream to about 10 km upstream of the mouth of Ikalukrok Creek (where the canyon starts)	1/year	Fall aerial surveys for over-wintering Dolly Varden
Ikalukrok Creek[6]	Lower Ikalukrok Creek to mouth of Dudd Creek	1/year	Fall aerial surveys for adult chum salmon
Rachel Creek	Tributary to Red Dog Creek	1/month	Water Quality Profile I
Connie Creek	Tributary to Red Dog Creek	1/month	Water Quality Profile I
Shelly Creek	Tributary to Red Dog Creek	1/month	Water Quality Profile I
Sulfur Creek	Tributary to Red Dog Creek	1/month	Water Quality Profile I
Station 9[6]	Ikalukrok Creek upstream of confluence with Red Dog Creek	1/year	Periphyton[2]
		1/year	Aquatic invertebrates[3]
		1/year	Fish presence and use
		2/month	Water Quality Profile I
Station 160[4, 6]	Lower Ikalukrok Creek	1/year	Periphyton[2]
		1/year	Aquatic invertebrates[3]
		1/year	Fish presence and use
Station 20	Middle Fork Red Dog Creek upstream of the confluence with North Fork Red Dog Creek	1/year	Periphyton[2]
		1/year	Aquatic invertebrates[3]
Station 10[5, 6]	Mouth of Red Dog Creek	1/year	Periphyton[2]
		1/year	Aquatic invertebrates[3]
		1/year	Fish presence and use
		1/year	Juvenile Dolly Varden metals in tissue[7]

Location	Description	Sampling Frequency[1]	Parameters
Station 12[4]	North Fork Red Dog Creek	1/year	Periphyton[2]
		1/year	Aquatic invertebrates[3]
		1/year	Fish presence and use
		1/year	Record of spawning activity
		Periodic	Capture/mark Arctic grayling

Notes:
1. Samples taken when flow is present
2. Periphyton as Chlorophyll-a concentrations
3. Aquatic invertebrates monitored for taxonomic richness, abundance, and density
4. Ambient water quality is monitored at Stations 12 and 160 under Red Dog Mine NPDES permit AK-003865-2
5. Ambient water quality and stream gauge flow to support aquatic life monitoring for Station 10 is obtained from Station 151 under Red Dog Mine NPDES permit AK-003865-2
6. Monitoring location is outside the jurisdiction of the waste management permit boundary, but has been included here for reference and program completeness
7. Metals analyzed in fish tissue Zn, Pb, Se, Hg, and Cd

2.2 Permafrost and Sub-permafrost Groundwater Monitoring

Groundwater monitoring is performed as part of the Groundwater Supplemental Environmental Project (SEP) for the Red Dog Mine. Activities associated with the Groundwater SEP are outlined in Appendix B of the Consent Decree between Cominco Alaska Incorporated (now Teck) and the United States Environmental Protection Agency (EPA), entered on November 25, 1997 (U.S. v. Cominco Alaska Incorporated, Civil Action A97-267CV).

Results of Phase I and II of the SEP were used to develop a detailed understanding of permafrost and groundwater conditions in the vicinity of the tailings impoundment, and were the basis for the development of the *Long-Term Permafrost and Groundwater Monitoring Plan for the Tailing Impoundment* (WMCI, 2001a), approved by EPA on January 11, 2002. This plan was implemented under Phase III of the SEP.

In transferring responsibility for this program from the federal government to ADEC, Teck incorporates the Permafrost and Sub-permafrost Groundwater SEP into the Red Dog Mine Waste Management, Reclamation and Closure Monitoring Plan. This Plan and SEP are adopted through the ADEC Waste Management Permit.

2.2.1 Key Elements of the Monitoring Program

The Permafrost and Sub-permafrost Groundwater Monitoring Program will consist of the following:

- Quarterly monitoring of key background and dam area thermistors to assess trends in temperature changes in the permafrost;

- Quarterly monitoring of key background and dam area piezometers to assess water levels and gradients;
- An annual data report; and
- A detailed assessment of subsurface trends and conditions every five years, including an evaluation of the requirement to update the thermal and numerical flow model developed as part of the SEP.

Groundwater monitoring shall continue for thirty years after the cessation of mining and/or milling operations unless it can be shown that with at least 10 years of data from the monitoring program and other relevant data that there is no reasonable potential that waters from the impoundment are being, or could be, discharged into groundwater connected with waters of the United States, other than as allowed by permit.

The locations of the thermistors and piezometers monitored are shown in Figure 4. The monitoring objectives of each thermistor and piezometer are detailed in the following sections.

2.2.2 Permafrost and Subsurface Temperature Monitoring

Thermal modeling of the tailings impoundment performed during Phase II of the SEP indicated that both long-term climatic changes and thermal impacts from the waters in the impoundment have an effect on observed subsurface temperatures. Long-term monitoring of subsurface temperatures is focused on collecting data sufficient to allow a continuing assessment of subsurface temperatures. Table 2-3 lists the thermistors used to monitor long-term permafrost and subsurface temperatures. Locations are shown on Figure 4.

Table 2-3: Summary of Thermistor Monitoring

Thermistor	Data Objective	Sampling Frequency
Red Dog Creek		
T-96-015	Monitors background permafrost temperatures down-gradient of dam within Red Dog Creek Alluvium	1/quarter
Dam Area		
T-95-004	Monitors background permafrost temperatures in dam area	1/quarter
T-05-061	T-05-061 will be monitored concurrently with T-95-004 until instrumentation or site access inhibits the use of T-95-004. At such time T-05-061 will become the primary thermistor for monitoring permafrost conditions in the vicinity of the west abutment of the dam.	1/quarter
T-95-005	Monitors background permafrost temperatures in dam area	1/quarter
T-96-010	Monitors permafrost temperatures in seepage dam area	1/quarter
T-97-028	Monitors subsurface temperatures within zone where permafrost is absent	1/quarter
T-97-029	Monitors permafrost temperatures along toe of dam	1/quarter
T-97-030	Monitors subsurface temperatures within zone where permafrost is absent	1/quarter
Tailings Impoundment		
T-95-007	Monitors background permafrost temperatures near tailings impoundment	1/quarter

Thermistor	Data Objective	Sampling Frequency
T-95-009	T-95-009 will be monitored concurrently with T-95-007 until increases in the tailings pond level inhibit the use of T-95-007. At such time, T-95-009 will become the primary thermistor for monitoring permafrost conditions in the vicinity of the tailings pond.	1/quarter
Overburden Stockpile		
T-95-008	Monitors subsurface temperatures within overburden stockpile	1/quarter
T-96-013	Monitors subsurface temperatures within overburden stockpile	1/quarter
T-96-021	Monitors subsurface temperatures within overburden stockpile	1/quarter
T-96-022	Monitors subsurface temperatures within overburden stockpile	1/quarter
T-96-023	Monitors subsurface temperatures within overburden stockpile	1/quarter
Bons Creek		
T-96-012	Monitors background permafrost temperatures along Bons Creek	1/quarter
T-96-012S	Monitors shallow subsurface temperatures along Bons Creek	1/quarter

2.2.3 Sub-permafrost Groundwater Level Monitoring

Data and analyses developed as part of SEP have demonstrated with relative certainty that virtually all shallow flow originating from the tailings impoundment is collected within the dam seepage collection system, and that no vertical flow is occurring between the impoundment and the sub-permafrost system. Because the SEP analysis did not indicate that any seepage pathways existed from the tailings impoundment, groundwater monitoring is not based on seepage pathways, but rather on assessing any changes over time from observed conditions. The focus of monitoring of the groundwater system is therefore based on monitoring water level changes over time as a means to assess potential changes from current conditions. Table 2-4 shows the piezometers used to measure long-term groundwater levels. Locations are shown on Figure 4.

Table 2-4: Summary of Quarterly Piezometer Monitoring

Piezometer	Data Objective	Sampling Frequency
Red Dog Creek		
P-96-015	Monitors sub-permafrost water levels along Red Dog Creek	1/quarter
Dam Area		
P-08A	Monitors shallow water levels within dam drain area	1/quarter
P-08B	Monitors shallow water levels within dam drain area	1/quarter
P-96-010	Monitors sub-permafrost groundwater within dam area	1/quarter
P-97-020	Monitors sub-permafrost groundwater in area where permafrost is absent	1/quarter
P-97-028	Monitors shallow water levels down-gradient of dam toe	1/quarter
SPP-97-002	Monitors shallow water levels in seepage dam area	1/quarter
P-99-007R	Monitors sub-permafrost water levels near tailings impoundment	1/quarter
Overburden Stockpile		
P-96-013	Monitors sub-permafrost water levels in Overburden Stockpile area	1/quarter
Bons Creek		
P-97-012	Monitors sub-permafrost water levels along Bons Creek	1/quarter

2.3 Mine Water Management

A schematic of the water flows throughout the mine site is provided in Figure 4. Mining-impacted water throughout the mine site is collected from waste stockpiles, mining areas, and seepage collection systems and stored in the tailings impoundment. Water from the tailings impoundment is reclaimed and either used in the milling process, with prior treatment in Water Treatment Plant 1 (WTP1) if needed, or treated in Water Treatment Plant 2 (WTP2) and subsequently discharged to Middle Fork Red Dog Creek at Outfall 001. Discharge to Red Dog Creek occurs when there is free-flow of water in Main Stem Red Dog Creek.

A number of diversion ditches have been constructed at the mine site to divert water that has not been impacted by mining activities. The Red Dog Creek Diversion is located to the east of the Main Waste Stockpile and is the largest diversion ditch onsite. It diverts water through mining areas and back into Red Dog Creek. Water in the area to the east of the Main Waste Stockpile that has been impacted by mining is collected in the Mine Water Collection Sump, and eventually pumped to the tailings impoundment.

A portion of the runoff and seepage from the Main Waste Stockpile is collected and treated in Water Treatment Plant 3 (WTP3). A portion of the water from the Mine Water Collection Sump may also be treated in WTP3. Effluent from WTP3 reports to the tailings impoundment. The purpose of WTP3 is to reduce the TDS loading in the impoundment.

Water within the tailings impoundment catchment that is not diverted drains into the impoundment. A pumpback system collects runoff from the south side of the Overburden Stockpile and pumps it to the impoundment. Seepage from the Main Dam (on the north end of the tailings impoundment) is collected and pumped back to the tailings impoundment.

Freshwater used for potable water, reagent mixing, cooling and other purposes is obtained from the Bons Creek Reservoir, located within the Bons Creek drainage. Other inputs to the impoundment include water from natural gas exploration activities, direct precipitation on the pond, water treatment sludge, and tailings. The key outflows from the impoundment include seepage, which is pumped back to the impoundment, evaporation, and water that is treated and discharged at Outfall 001.

Teck maintains a large number of flow and water quality sampling sites throughout the mine site to effectively monitor the management of water. In addition, water and load balances have been created and are maintained to model the flows and chemical loads throughout the mine site. Monitoring conducted under the Water Management program is described in the following sections.

2.3.1 Key Elements of the Monitoring Program

The key elements of the Mine Water Management Program consist of the following:

- Flow monitoring at locations throughout the mine site;
- Monitoring of water quality at locations throughout the mine site;
- Water and load balances to model flows and associated chemical loadings;
- Weekly visual monitoring of water management facilities; and
- Inspections of fish weir twice per year by a qualified individual.

The water management sampling locations are shown on Figure 4 and the details of the monitoring program are provided in the following sections.

2.3.2 Flow and Water Quality Monitoring

The site currently maintains a number of flow meters that record volumes of each of the main flows in and out of the tailings pond. The water quality associated with the flows into and out of the tailings pond is also monitored. This information is subsequently used in the water and load balances.

The locations monitored and the period and frequency of monitoring are summarized in Table 2-5 and shown in Figure 4. Water quality profiles are located in Section 2.11.

Table 2-5: Mine Water Management Stations

Location	Description	Sampling Frequency[1]	Parameters	Flow[1]
Main Dam Seepage Pumpback	Main (tailings) Dam seepage water to tailings pond	1/month	Water Quality Profile II	Total Monthly Gallons
Bons Creek Total Flow	Total withdrawal from Bons Creek reservoir	Water quality not required (flow used in Mill water balance)		Total Monthly Gallons
East Overburden Sump	Runoff from Overburden Stockpile	1/month	Water Quality Profile II[6]	Total Monthly Gallons
West Overburden Sump	Runoff from Overburden Stockpile	1/month	Water Quality Profile II[6]	Total Monthly Gallons
Tailings Water	Tailings supernatant discharged to the pond	1/month	Water Quality Profile II	Calculated[2]
Reclaim Water	Tailings pond water	1/month	Water Quality Profile II	N/A[3]
WTP1/Mill Influent from Reclaim[4]	Reclaim water from tailings pond to WTP1	Water quality equivalent to Reclaim Water location		Total Monthly Gallons
WTP1 Influent from Mine Water Collection	WTP1 influent from the Mine Water Collection Sump	Water quality equivalent to Mine Water Collection Sump location		Total Monthly Gallons
WTP2 Influent from Reclaim	Reclaim water from tailings pond to WTP2	Water quality equivalent to Reclaim Water location		Total Monthly Gallons
WTP3 Influent from Main Waste Stockpile	Influent to WTP3 from the Main Waste Stockpile (collection of former MWD flows)	1/month	Water Quality Profile II	Total Monthly Gallons
WTP3 Influent from Mine Water Collection	Influent to WTP3 from the Mine Water Collection Sump	Water quality equivalent to Mine Water Collection Sump location		Total Monthly Gallons

Location	Description	Sampling Frequency[1]	Parameters	Flow[1]
WTP3 Effluent	Treated effluent from WTP3	1/month	Water Quality Profile II	Calculated[5]
Mine Water Collection Sump	All mine related waters collected and pumped to the tailings pond	1/month	Water Quality Profile II	Total Monthly Gallons
Natural Gas Water	Water produced from Natural Gas Wells	1/month	Water Quality Profile II	Total Monthly Gallons

Notes:
1. Sample taken when flow is present
2. Tailings water volumes calculated from Mill water balance
3. Reclaim water volumes are accounted for under WTP1 Influent from Reclaim and WTP2 Influent from Reclaim
4. Reclaim water may or may not be treated in WTP1 prior to use in the Mill
5. WTP3 Effluent = WTP3 Influent from Mine Water Collection + WTP3 Influent from Main Waste Stockpile
6. In addition to Water Quality Profile II, samples from this location will also be analyzed for WAD cyanide.

2.3.3 Water and Load Balances

A water balance model of the site is maintained by Teck. A summary of the key results of the water balance will be presented in the Annual Report. The loads associated with the flows shown in Table 2-5 will be calculated once per year and presented in the Annual Report.

2.3.4 Visual Monitoring

Visual monitoring of the following mine water management facilities will be conducted weekly when flow is present:

- Diversion ditches;
- Red Dog Creek Diversion;
- Mine Water Collection System;
- Pipelines and pipeline containment structures;
- Main Waste Stockpile drainage collection system;
- Treated water discharge lines;
- Overburden Stockpile runoff collection system; and
- This Plan incorporates all monitoring required by the Operations and Maintenance Manual for the Fresh Water Dam (URS 2005b), which is a requirement of the Certificate to Operate a Dam NID ID#AK00200 and by the Operations and Maintenance Manual for the Mine Water Diversion Dam (URS 2005c), which is a requirement of the Certificate to Operate a Dam NID ID#AK00260.

  Note: A copy of all reporting required by the Certificates to Operate a Dam NID ID#AK00200 and NID ID#AK00260 will be provided to ADEC in addition to ADNR.

The following conditions will be monitored where applicable:

- Signs of damage or potential damage to facilities from settlement, ponding, leakage, thermal instability, frost action, or erosion at the facilities;
- Escape of waste or any unauthorized waste disposal;
- Deposition of precipitants;
- Damage to the structural integrity of a containment structure, or diversion structure; and
- Evidence of death or stress to fish, wildlife, or vegetation that might be caused by the facility.

The fish weir will be inspected twice per year by a qualified individual.

2.4 Waste Rock Management

The *Plan of Operations for Waste Rock Management* (SRK 2007a) calls for deposition of waste rock in the existing Main Waste Stockpile, as well as the Main Pit once mining activities have ceased at the Main Pit and development of the Aqqaluk Pit begins. In addition, waste rock material meeting the appropriate criteria will be used as cover and dam construction material.

2.4.1 Key Elements of Monitoring Program

The Waste Rock Management program consists of the following:

- Monitoring of quantities and locations of waste rock placement;
- Geochemical monitoring of waste rock to ensure proper segregation of materials; and
- Weekly visual monitoring of facilities.

Details of the monitoring program are provided in the following sections. The locations of the pits and Main Waste Stockpile are shown on Figure 1.

2.4.2 Quantity of Waste Rock

Waste production quantities are monitored daily using reported truck loads hauled from a blasted pit shot. The locations of waste rock placement and the quantities of waste rock placed at each location will be reported quarterly.

2.4.3 Geochemical Monitoring

The *Plan of Operations for Waste Rock Management* outlines criteria and methods for segregating waste rock from the Aqqaluk Pit for placement above or below the final water table in the Main Pit Stockpile. In addition, it includes criteria for segregating waste rock for use as dam or cover construction material. The segregation is based on the rock type and blast hole assays, including percent zinc, lead and iron, as shown in Table 2-6. Blast

hole assays are conducted in-house at the Red Dog Assay Lab. Results of geochemical monitoring of waste rock will be used to categorize, segregate types, determine quantities, and reported quarterly.

Table 2-6: Waste Rock Segregation Criteria

Intended Use/Disposal Location	Allowable Rock Types	Analytical Criteria[1]
Dam Construction	Siksikpuk Shale	Single blast hole assays not to exceed: 1% Zinc; or 1% Lead; or 3.5% Iron Average blast hole assays not to exceed: 0.5% Zinc; or 0.5% Lead; or 2.5% Iron
Cover Material	Kivalina Shale Okpikruak Shale	As above except Single blast hole assays not to exceed: Zinc = 0.2% Average blast hole assays not to exceed: Zinc = 0.1%
Most Reactive Waste Rock (where possible placed below the minimum water level, otherwise placed above the maximum water level in the backfilled Main Pit)	All Mineralized rock units, particularly the Ikalukrok Formation	>6% sulphide Sulfur[2]
Other Waste Rock (for placement in unsaturated portions of the waste rock stockpiles)	All other units	Unclassified

Notes:
1. Analytical criteria are only to be applied to the allowable rock type (i.e. rock type has precedence)
2. Sulfur from sulfide minerals = (%Zn*0.5160) + (%Pb*0.1547) + (%Fe*1.1482)

2.4.4 Visual Monitoring

Visual monitoring of the un-reclaimed waste rock stockpiles will be conducted weekly. The following conditions will be monitored:

- Damage or potential damage to the waste rock stockpiles from settlement, ponding, thermal instability, frost action, or erosion;
- Escape of waste or any unauthorized waste disposal;
- Damage to the structural integrity of a containment structure, or diversion structure;
- Evidence of death or stress to fish, wildlife, or vegetation that might be caused by the waste rock stockpiles; and

- Active waste rock deposition areas will be inspected to confirm that the geological properties of the rock are appropriate for the designated storage location or end use.
- Waste rock dumps will be inspected for waste rock fires or “hot spots”.

2.5 Tailings Management

The *Plan of Operations for Tailings and Water Management* (SRK 2007b) describes the procedures for management of tailings at the Red Dog Mine. The current plan involves disposal of tailings in the existing Tailings Storage Facility.

2.5.1 Key Elements of the Monitoring Program

Key elements of the Tailings Monitoring program include:

- Calculation of quantity of tailings produced and placed;
- Geochemical monitoring of final tailings stream; and
- Weekly visual monitoring of tailings management facilities.

The Tailings Storage Facility is shown on Figure 1. Details of the monitoring program are provided in the following sections.

2.5.2 Quantity of Tailings

Tailings production rates are estimated from the mill production records, and summarized on a monthly basis.

2.5.3 Geochemical Monitoring

Monitoring of the tailings solids will be conducted to determine variability in the geochemical composition of the tailings solids over time. Tailings geochemistry is expected to be relatively uniform in comparison to waste rock, due to the methods that are used to stockpile and blend the ore.

The monitoring program will be implemented with the issuance of the Waste Management Permit. An online analyzer calculates the percent iron, lead and zinc in the final tailings slurry. The monthly average values of these analyses will be reported quarterly.

2.5.4 Visual Monitoring

Visual monitoring of the Tailings Storage Facility (TSF) will be conducted weekly as follows:

- Visual monitoring of diversion ditches when flow is present;
- Inspections of the TSF for evidence of death or stress to fish, wildlife, or vegetation that might be caused by the facility

- This Plan incorporates all monitoring, including visual monitoring, required by the Operations and Maintenance Manual for the Red Dog Tailings Dam[2] (URS 2005a), which is a requirement of the Certificate to Operate a Dam NID ID#AK00201.

Note: A copy of all reporting required by the Certificate to Operate a Dam NID ID#AK00201 will be provided to ADEC in addition to ADNR.

2.6 Inert Solid Waste Landfills

Currently, there are two inert solid waste landfills located at the Red Dog Mine, as shown on Figure 5:

- Main Waste Stockpile Landfill, located within the Main Waste Stockpile; and
- Old Mine Landfill, located east of the Tailings Storage Facility, next to the incinerator.

The landfills are operated as outlined in the Standard Operating Procedures (SOP's) *Landfill, Main Waste Stockpile SOP* (ID #447) and *Landfill, Old Mine SOP* (ID #505).

2.6.1 Key Elements of Monitoring Program

The key elements of the solid waste landfill monitoring program include:

- Calculation of volumes of solid waste placed;
- Monthly visual inspections and random inspections of incoming loads; and
- Submission of updated site development and use plans annually.

Details of the monitoring program are provided in the following sections.

2.6.2 Quantity of Solid Waste

Estimates of disposal volumes based on fill volume will be conducted and summarized in the Annual Report.

2.6.3 Visual monitoring

Visual monitoring of the landfills includes the following which will be summarized and reported quarterly:

- Monthly visual inspections consistent with the Standard Operating Procedures.
- Inspections for evidence of fire or combustion in the waste;
- Random inspections of incoming loads to the Main Waste Stockpile consistent with the current landfill permits; and
- Inspections for evidence of death or stress to fish, wildlife, or vegetation that might be caused by the facility.

[2] This dam is also referred to as the Main Dam.

2.7 Mining and Milling Activities

Quantities of ore removed and processed and waste rock and tailings generated are tracked in mine production and milling records, and summarized on a monthly basis. Quantities will be reported quarterly.

2.8 Reclamation

Two key mine closure methods proposed in the *Red Dog Mine, Closure and Reclamation Plan* have been and continue to be tested on site under various programs. These include the covers to be placed on various mine waste materials, and revegetation of the covered materials and other disturbed land. Progressive reclamation of some parts of the site will be possible while the mine is still in production, which will include both cover placement and revegetation.

A summary schedule that includes anticipated dates for progressive reclamation, tailings and water management activities is provided in the *Red Dog Mine Closure and Reclamation Plan* (SRK 2008), *Figure 5.1.1*. In many cases, the precise scheduling of activities will depend on factors that are not fully predictable. The schedule therefore shows early and late dates for many activities. The following sections describe the monitoring planned for progressive reclamation projects.

2.8.1 Key Elements of Monitoring Program

The key elements of the Reclamation Monitoring program include:

- Reporting of areas disturbed and reclaimed;
- Research of reclamation methods; and
- Monitoring of reclamation activities.

2.8.2 Areas Disturbed and Reclaimed

The size and locations of areas disturbed and reclaimed are recorded and will be summarized annually. Areas projected for disturbance or reclamation during the next calendar year will be reported annually. Each Annual Report will include a discussion of the reclamation actions in sufficient detail describing reclamation at each location and how it was accomplished. The description of each reclamation project will also include a table of equipment hours, labor hours, and material quantities for the reclaimed areas for use in financial responsibility estimates.

2.8.3 Reclamation Research

Reclamation research will continue throughout the life of the operation. Examples include Oxide Stockpile cover instrumentation, ARD test pits, seed mixes, transplanting, innovative fertilizers, native species establishment and native seed collection and

propagation. Information on reclamation research conducted during the year and reclamation research planned for the upcoming calendar year will be summarized and reported annually. Any reclamation research data or reports generated will be provided upon request.

2.8.4 Reclamation Monitoring

The following sections describe the general approach to monitoring existing revegetation sites and future revegetation undertaken as progressive reclamation projects.

Monitoring Vegetation Success

The success of reclaimed and revegetated areas will be evaluated by measuring a number of parameters that are indicators of overall productivity and habitat quality. The measurements are intended to identify which species are the most effective at establishing in disturbed areas; what factors may be contributing to enhanced or marginal growth; and what kind of recovery can be expected on the various mine disturbances over the long term. This information is needed so that corrective action can be taken in those areas where performance is poor, and to develop performance criteria that can be used to assess the success of revegetation efforts in meeting mine closure objectives.

Soil Properties

To assess the physical and chemical characteristics of reclaimed soils, samples will be collected at 2 to 10 centimeter depth for analysis. Parameters measured will include particle size, percent organic matter, carbon and sulfur, electrical conductivity (EC), cation exchange capacity (CEC), total and exchangeable nitrogen and phosphorous, and exchangeable potassium, sodium, calcium, and magnesium. Levels of micronutrient metals, including copper, zinc, iron, manganese, and boron also will be measured.

Plant Density and Survival

Plant density and survival will be measured only for transplanted species and to assess percent germination and survival in test plots. Density will be measured in one square-meter plots, or within belt transects, depending on the size of the assessment area.

Plant Cover and Taxonomic Richness

For most areas, plant cover will be measured along transects using the point-intercept method: plant species are recorded intersecting points at 0.5–1.0 meter intervals delineated along a 50 m or 100 m transect (100 points per transect). The length of the transect will depend on the size of the assessment area.

In some instances, cover may be measured using a point frame. This method is similar to the point intercept method except that the sample points are measured within a quadrat (usually 1 square-meter or 0.25 m^2) rather than along a transect.

Plant Vigor

This assessment tool was used as part of the North Latitude Revegetation and Seed Project study the Alaska Plant Materials Center (APMC) initiated in 1987 (Wright, 1990). Plant vigor was subjectively ranked from 1–9, using the following criteria: plant tissue color, height, flower and/or seed production, and on overall health. This ranking system may also be used for assessing the vigor of species in revegetated areas, although a more systematic ranking system is recommended to ensure consistency in assessments and data collection among observers.

Monitoring Schedule

Soil characteristics will be measured during the first year of seeding (or transplanting) and then every 3 to 5 years, depending on the vegetation response following treatment. Soil development occurs very slowly in an Arctic environment due to the low temperatures and short growing season. Thus, monitoring soil characteristics more frequently is unlikely to reveal any measurable differences between sampling events.

The frequency of evaluating vegetation response will depend on the objectives of the revegetation effort. For test plots, assessments would probably be conducted annually for the first three years to document germination, survival and vigor, and vegetation cover. For mine development units, vegetation will be measured for the first two growing seasons following treatment, with additional monitoring occurring on the same schedule as described for the soils analysis. In some cases (*e.g.* experimental studies), more frequent monitoring may be required in order to satisfy specific research objectives. Monitoring will no longer be conducted after an area fulfills the performance standards developed for that unit.

2.9 Dust Monitoring

Recognizing that similar efforts to manage dust concerns were underway within a variety of programs, a decision was made to include the mine facility within the scope of the development of an area wide fugitive dust Risk Management Plan (RMP). Therefore, any

monitoring identified in the forthcoming RMP and associated implementation plans, within the physical boundaries of the waste management permit, will be incorporated into this Plan.

2.10 Wildlife Monitoring

Teck has procedures in place for reporting wildlife interactions, issuing wildlife alerts and controlling potential animal attractants. Monitoring of wildlife is conducted as part of the weekly visual monitoring of facilities. Wildlife casualties will be reported to ADEC, the appropriate state and federal agencies, and the Red Dog Subsistence Committee (if applicable).

2.11 Water Quality Profiles

Table 2-7 lists the analytical parameters included in the water quality profiles referenced in Sections 2.1 and 2.3.

Table 2-7: Water Quality Profiles

Monitoring Profile	Parameters
Profile I *Ambient surface water quality monitored as part of the Biomonitoring Program*	Aluminium[1] Calcium[1] Cadmium[1] Chloride[1] Iron[1] Potassium[1] Magnesium[1] Sodium[1] Lead[1] Selenium[1] Zinc[1] Alkalinity Total Dissolved Solids (TDS) Total Suspended Solids (TSS) Sulfate (SO_4) pH Temperature Conductivity
Profile II *Water quality monitored as part of the Mine Water Management Program*	Aluminum[2] Calcium[2] Cadmium[2] Copper[2] Chloride[2] Iron[2] Potassium[2] Magnesium[2] Manganese[2] Sodium[2] Lead[2] Zinc[2] Ammonia Nitrogen (NH_3-N) Acidity Total Dissolved Solids (TDS) Sulfate (SO_4) pH Temperature Conductivity

Notes: 1. Total recoverable metals
2. Dissolved metals

3. CLOSURE MONITORING

The period of intensive mine closure activity, after all mining and processing has ceased, is expected to last approximately two years. The Mine Reclamation and Closure plan indicates that the closure phase is likely to occur more than twenty years from now, at approximately 2031. Progressive reclamation of some disturbed land can be undertaken while production continues and this will be done wherever reclamation would not hinder planned or potential future operations.

Project-specific closure monitoring programs will be designed and implemented for each reclamation task. The implementation of closure activities and the discontinuation of mining will bring about changes to the Plan, as follows:

- Some additional localized surface water monitoring for specific closure projects, such as sedimentation monitoring;
- Discontinuation of tailings and waste rock monitoring;
- Modifications to flow and water quality monitoring and water and load balances according to changes associated with closure[3]; and
- Implementation of performance monitoring programs for specific closure measures.

4. POST CLOSURE MONITORING

The “post closure” phase of the project begins immediately after the period of intensive closure activities. The current indications are that the post closure phase would start about the year 2033. This period has no definite endpoint, but can be considered as three general phases with respect to the required monitoring: 1) 5 years after closure; 2) 5-30 years after closure; and 3) more than 30 years after closure. It is anticipated that many aspects of the existing monitoring will continue, with the possible modifications provided below:

5 Years After Closure

- Reduction in monitoring of physical stability of dams where risk of failure is reduced following closure;
- Addition of water quality monitoring of pit water once pits are flooded;
- Reduction of visual monitoring of closed waste management facilities and elimination of monitoring of decommissioned structures (e.g. tailings pipeline); and
- Closure performance monitoring, based on annual assessments.

[3] Water and load balances will continue to be maintained after mining operations cease

5 to 30 Years After Closure

- Reduction of monitoring of permafrost and sub-permafrost groundwater monitoring program;
- Further reduction of visual monitoring of closed waste management facilities; and
- Reduction in closure performance monitoring;

Beyond 30 Years After Closure

- Further reduction in monitoring of closed waste management facilities, closure performance monitoring and visual monitoring of closed facilities.

The long-term plan for the site requires a permanent staff presence to operate the water collection and treatment systems. The site staff would carry out most of the routine monitoring. Site staff would also undertake frequent monitoring of access roads, fuel and chemical storage areas, power infrastructure, water pipes, channels and sumps, tailings reservoir, tailings dams and spillways. Engineered structures with significant failure consequences, such as the dams and some water management infrastructure, would be inspected by a qualified engineer, as required, for as long as they remain active and present any significant risk.

Reclamation performance monitoring would commence immediately after the reclamation works have been completed. Basic performance objectives for the planned reclamation works have been stated in the *Red Dog Mine, Closure and Reclamation Plan* (SRK, 2008), but detailed performance standards have not yet been defined. As such, plans for the reclamation performance monitoring cannot be made yet. As information on the success of closure methods becomes available from monitoring progressive reclamation projects, over the next ten or more years, the design of closure projects will be refined and the monitoring requirements better understood. In particular, further details of closure and post closure monitoring need to be developed for the planned waste material covers (oxide stockpile, waste rock and tailings beaches) and revegetation of covers and other disturbances.

5. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

There are a number of different Quality Assurance/Quality Control programs for the various environmental monitoring activities described in this Plan, as described in the following sections. Most QA/QC plans may require updates as methods, methodologies, regulations, and guidance change. Therefore, the documents referenced below are subject to periodic revision.

5.1 Water Quality Monitoring

The Quality Assurance Project Plan associated with water quality monitoring at Red Dog Mine is entitled "*Quality Assurance Plan – for the Red Dog Mine Water Quality Monitoring Program, NPDES AK-003865-2"*.

5.2 Biomonitoring Program

Quality assurance procedures for the bioassessment program are described in Methods for Aquatic Life Monitoring to Satisfy Requirements under 1998 NPDES Permit, NPDES AK-003865-2, Red Dog Mine Site.

5.3 Groundwater Monitoring SEP

The Quality Assurance and Control Plan for the Groundwater Monitoring SEP is detailed in the *"Long-Term Permafrost and Groundwater Monitoring Plan for the Tailing Impoundment"*. The plan includes calibration checks and duplicate measurements.

5.4 Geochemical Monitoring

The Teck internal laboratory (Assay Lab) performs geochemical analyses in-house according to the "*Assay Laboratory Quality Assurance SOP"*.

6. REPORTING

The reporting required under the Waste Management Permit and Reclamation Plan Approval will be submitted as a combined report. The frequency of reporting is quarterly with a comprehensive Annual Report after the fourth quarter of each year. The Annual Report will cover the period from January 1 through December 31. Quarterly reports will be submitted within 60 days following the end of each calendar quarter with the Annual Report sent by March 1st. The contents of reports are detailed on the following page in Table 6-1. Supporting drawings will also be provided.

Table 6-1: Reporting Requirements

Item	Plan Section	Reporting Requirement	Quarterly	Annual	Five-Year
Biomonitoring Program					
Biomonitoring Program	2.1	An annual report on the biomonitoring conducted during the previous year, as described in Table 2-1 and Table 2-2		X	
Permafrost and Sub-permafrost Groundwater Monitoring					
Permafrost and Subsurface Temperature Monitoring	2.2.2	The temperature measurements from the thermistors identified in Table 2-3, including a summary of instrumentation problems and significant temperatures anomalies		X	
Sub-permafrost Groundwater Level Monitoring	2.2.3	The groundwater level measurements from the piezometers identified in Table 2-4, including a summary of instrumentation problems and significant groundwater levels changes.		X	
Five-Year Data Analysis Report	2.2.1	The long-term trends in subsurface temperatures and groundwater levels are assessed in relation to historical site conditions. The next five-year review is scheduled for 2012 and will cover the period from January 1, 2007 to December 31, 2011 and will be submitted in lieu of the 2011 annual report.			X
Mine Water Management					
Flow and Water Quality Monitoring	2.3.2	A summary of the metered flows and the results of the water quality monitoring identified in Table 2-5. The Annual Report will provide water quality data in a flexible electronic format and include graphs over time for all parameters.	X		
Water and Load Balances	2.3.3	A summary of the changes and key results of the site water balance. The Annual Report will provide the data in a flexible electronic format and contain water and load balance schematics similar to those in the *Red Dog Ming Closure and Reclamation Plan (Figures 2.3.2, 2.3.3 and 2.3.4)*.		X	
Visual Monitoring	2.3.4	A summary of the visual monitoring conducted during the reporting period	X		
		A summary of the fish weir inspections conducted during the reporting period	X		
Significant Activity		A summary of significant activities associated with the water management and water treatment	X		
Waste Rock Management					
Quantities	2.4.2	The amount and placement of waste rock	X		
Geochemical Monitoring	2.4.3	The results of the geochemical monitoring	X		
Visual Monitoring	2.4.4	A summary of the visual monitoring conducted	X		
Significant Activity		A summary of significant activities associated with the waste rock storage facilities	X		

Item	Plan Section	Reporting Requirement	Quarterly	Annual	Five-Year
Tailings Management					
Quantities	2.5.2	The amount of tailings produced and the location of discharge	X		
		The pond elevation for the reporting period	X		
Geochemical Monitoring	2.5.3	The results of the geochemical monitoring	X		
Visual Monitoring	2.5.4	A summary of the visual monitoring conducted during the reporting period	X		
Significant Activity		A summary of significant activities associated with the tailings facilities	X		
Inert Solid Waste Landfills					
Quantities	2.6.2	The amount and placement of solid waste		X	
Visual monitoring	2.6.3	A summary of visual monitoring conducted during the reporting period	X		
Significant Activity		A summary of significant activities associated with the landfill facilities	X		
Mining and Milling Activities					
Quantities	2.7	The amount of ore milled and mill production	X		
Significant Activity		A summary of significant activities associated with the Mill and Mine areas	X		
Reclamation					
Areas Disturbed and Reclaimed	2.8.2	The location and size of disturbed and reclaimed areas and a summary of reclamation activity		X	
Reclamation Research	2.8.3	A summary of research associated with the reclamation of the facility		X	
Reclamation Monitoring	2.8.4	A summary of the reclamation monitoring		X	
Significant Activity		A summary of significant activities associated with reclamation	X		
Financial Assurance					
Updates to financial assurance		A brief update on the adequacy of the existing financial assurance will be provided annually		X	
		A detailed assessment of the adequacy of financial assurance will be carried out every 5 years			X
Dust					
Risk Management Plan (RMP)	2.9	Summary of dust impact monitoring at the mine site and associated implementation plan		X	
Wildlife					
Wildlife interactions or casualties	2.10	Summary of wildlife interactions and casualties	X		

7. REFERENCES

SRK 2007a. *Plan of Operations for Waste Rock Management*. Prepared for Teck Cominco Alaska Incorporated, Anchorage AK. SRK Consulting Inc. September 2007.

SRK 2007b. *Plan of Operations for Tailings and Water Management*. Prepared for Teck Cominco Alaska Incorporated, Anchorage AK. SRK Consulting Inc. September 2007.

SRK 2008. *Red Dog Mine, Closure and Reclamation Plan (Draft)*. Prepared for Teck Cominco Alaska Incorporated, Anchorage, AK. SRK Consulting Inc.

URS 2005a. *Operations and Maintenance Manual – Revision 4 – Red Dog Tailings Dam, Red Dog Mine, Alaska*. Prepared for Teck Cominco Alaska Inc. by URS Corporation. August 2005.

URS 2005b. *Operations and Maintenance Manual, Rev. 2, Fresh Water Dam, NID ID#00200, Red Dog Mine, Alaska*. Prepared for Teck Cominco Alaska Inc. by URS Corporation. August 2005.

URS 2005c. *Operations and Maintenance Manual, Rev. 1, Mine Water Diversion Dam, NID ID#00260, Red Dog Mine, Alaska*. Prepared for Teck Cominco Alaska, Inc. by URS Corporation. August 2005.

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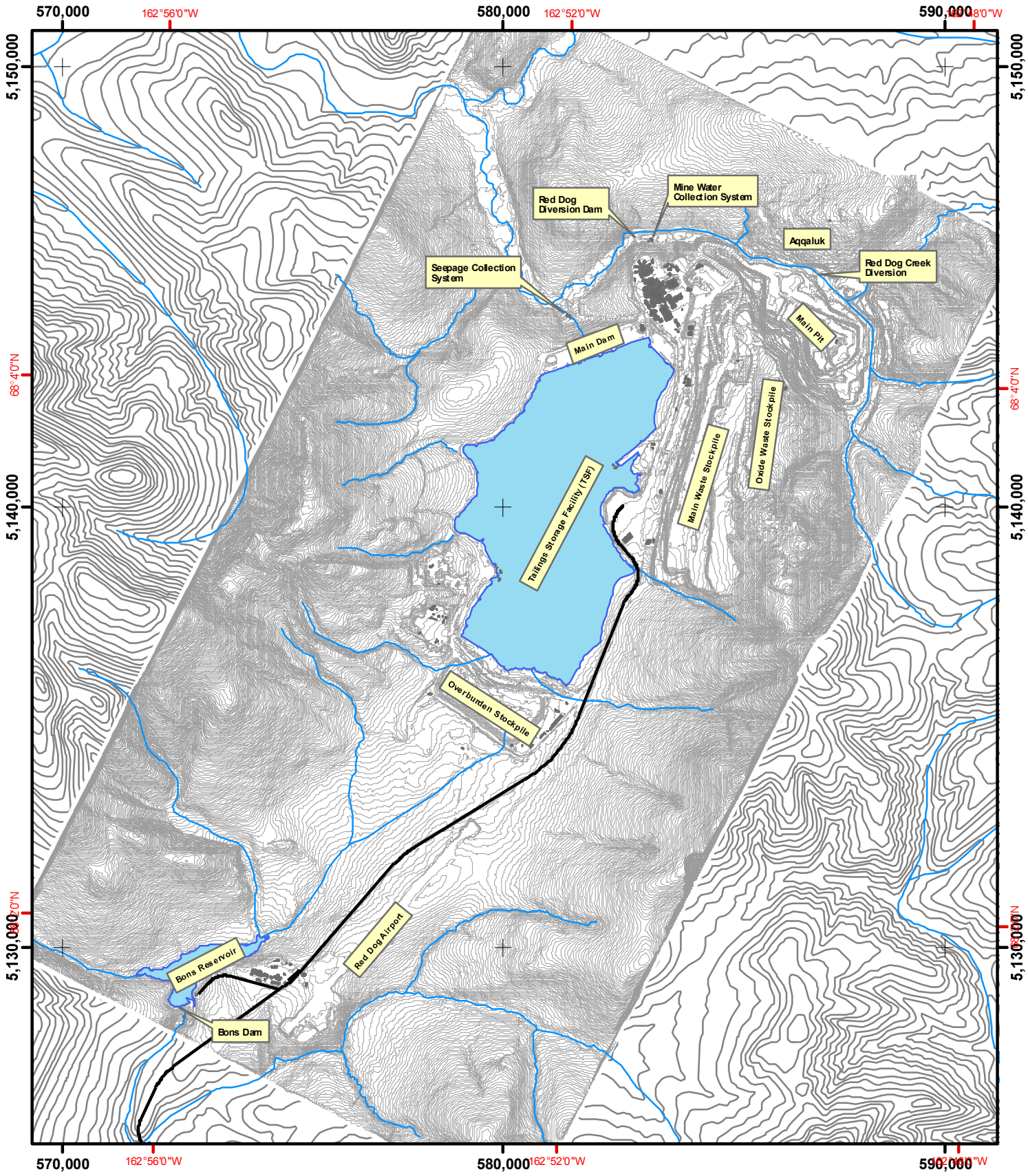
Wright, Stoney J. 1990. *Final Report on Data and Observations Obtained From the Red Dog Mine Evaluation and Demonstration Plots*. State of Alaska, Division of Agriculture, Plant Materials Center.

FIGURES



Red Dog Mine
Solid Waste Monitoring Plan
Facility Map

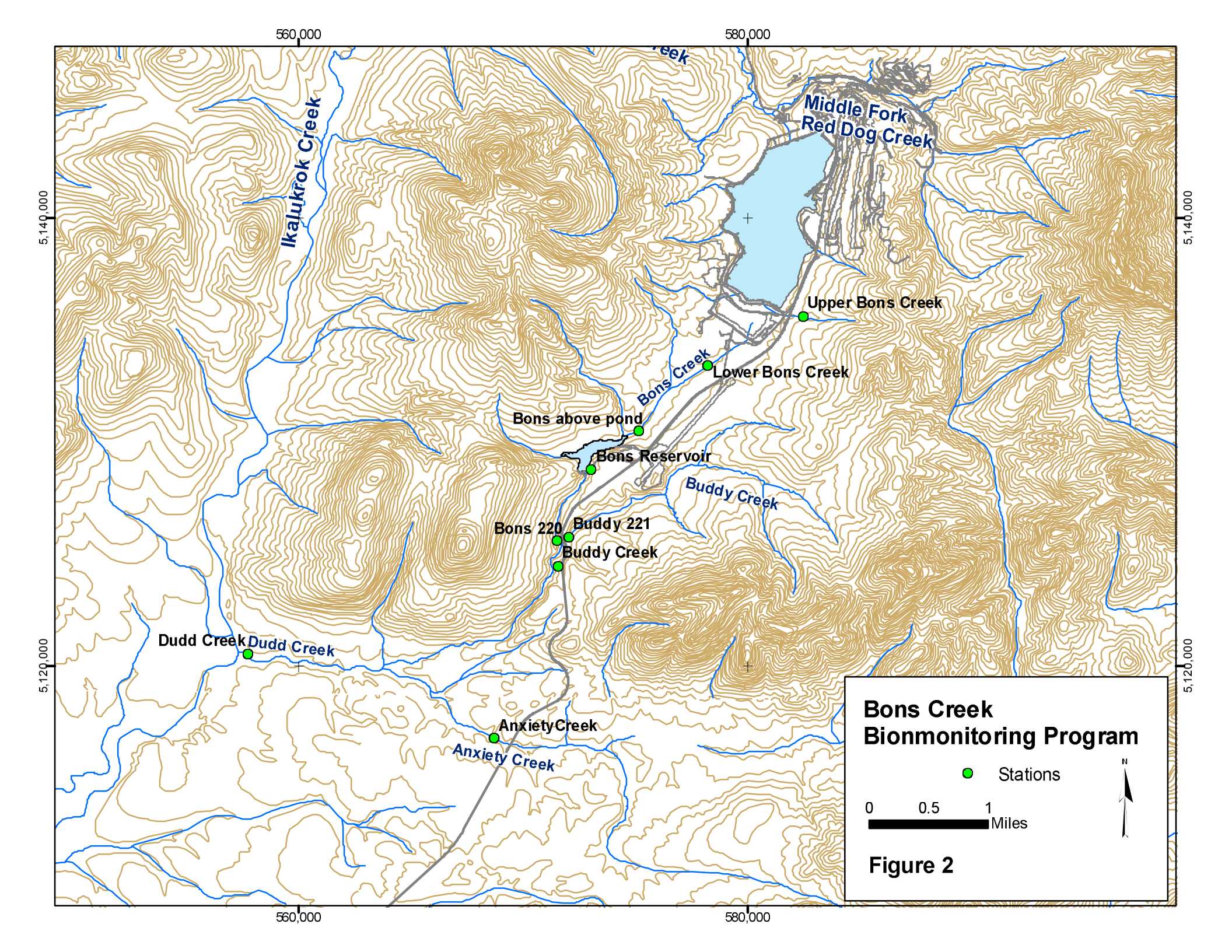
Teck

Figure 1

Date 10/08

0 1,000 2,000 4,000 Feet

N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Ikalukrok Creek
Middle Fork
Red Dog Creek
Upper Bons Creek
Bons Creek
Lower Bons Creek
Bons above pond
Bons Reservoir
Buddy Creek
Bons 220
Buddy 221
Buddy Creek
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AnxietyCreek
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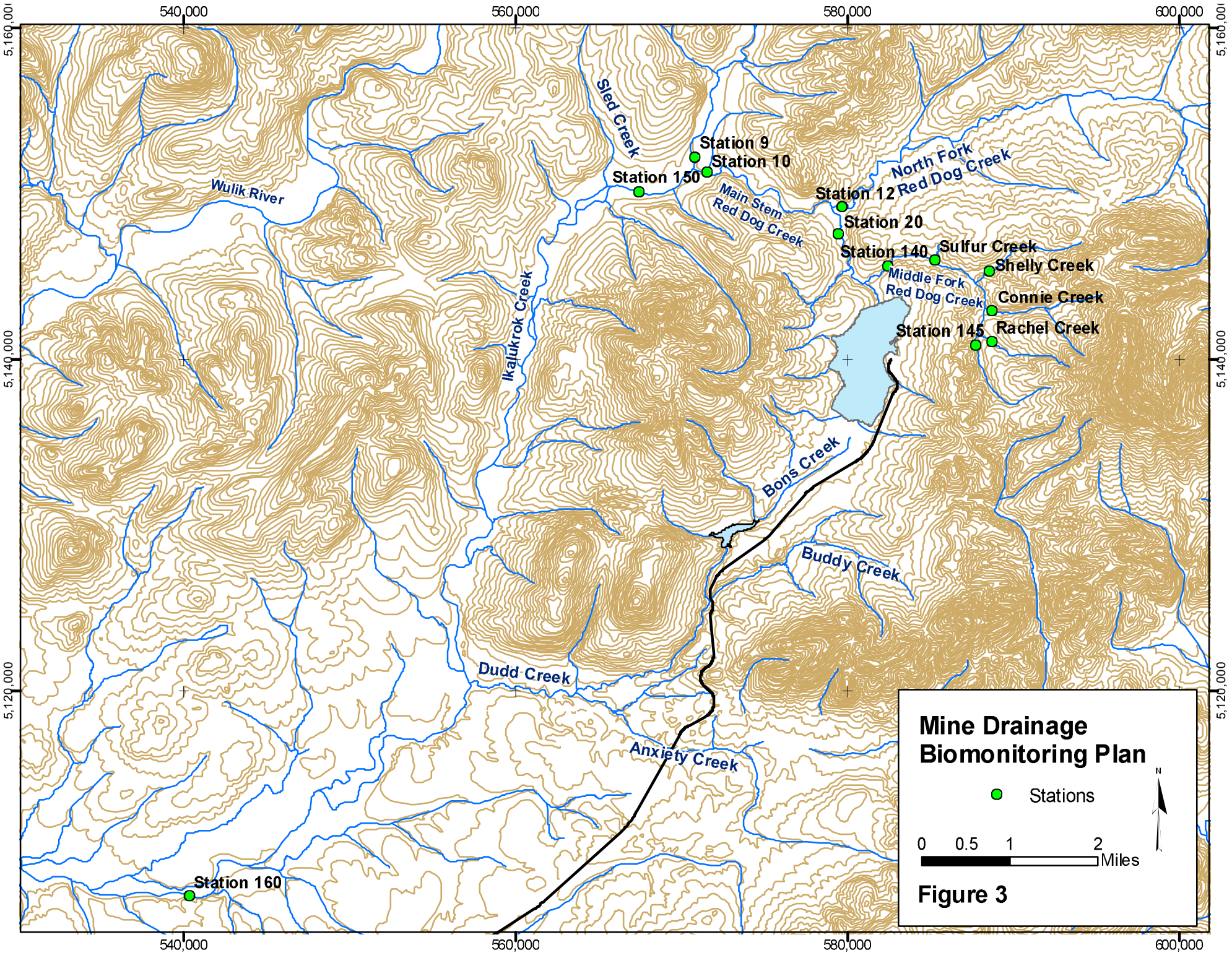
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600,000
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5,120,000
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Station 10
Station 150
Wulik River
Main Stem
Red Dog Creek
North Fork
Red Dog Creek
Station 12
Station 20
Station 140
Sulfur Creek
Shelly Creek
Middle Fork
Red Dog Creek
Connie Creek
Rachel Creek
Station 145
Ikalukrok Creek
Bons Creek
Buddy Creek
Dudd Creek
Anxiety Creek
Station 160
Mine Drainage
Biomonitoring Plan
Stations
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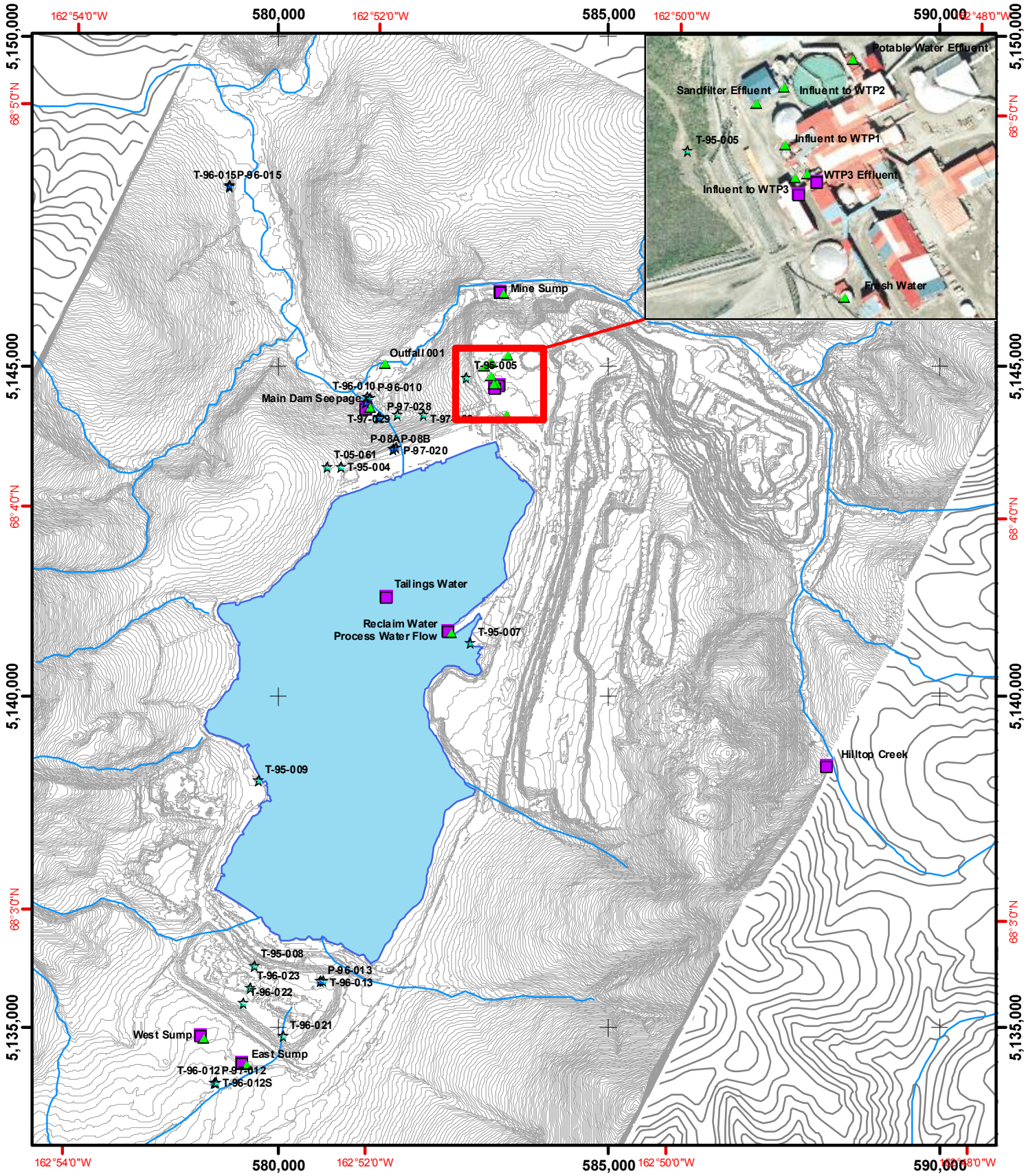
Miles
Figure 3



Legend

Water Flow Locations

- Water Flow Locations

Water Quality Locations

- Water Quality Locations

Groundwater Intrumentation locations

- Piezometer
- Thermistor

Teck

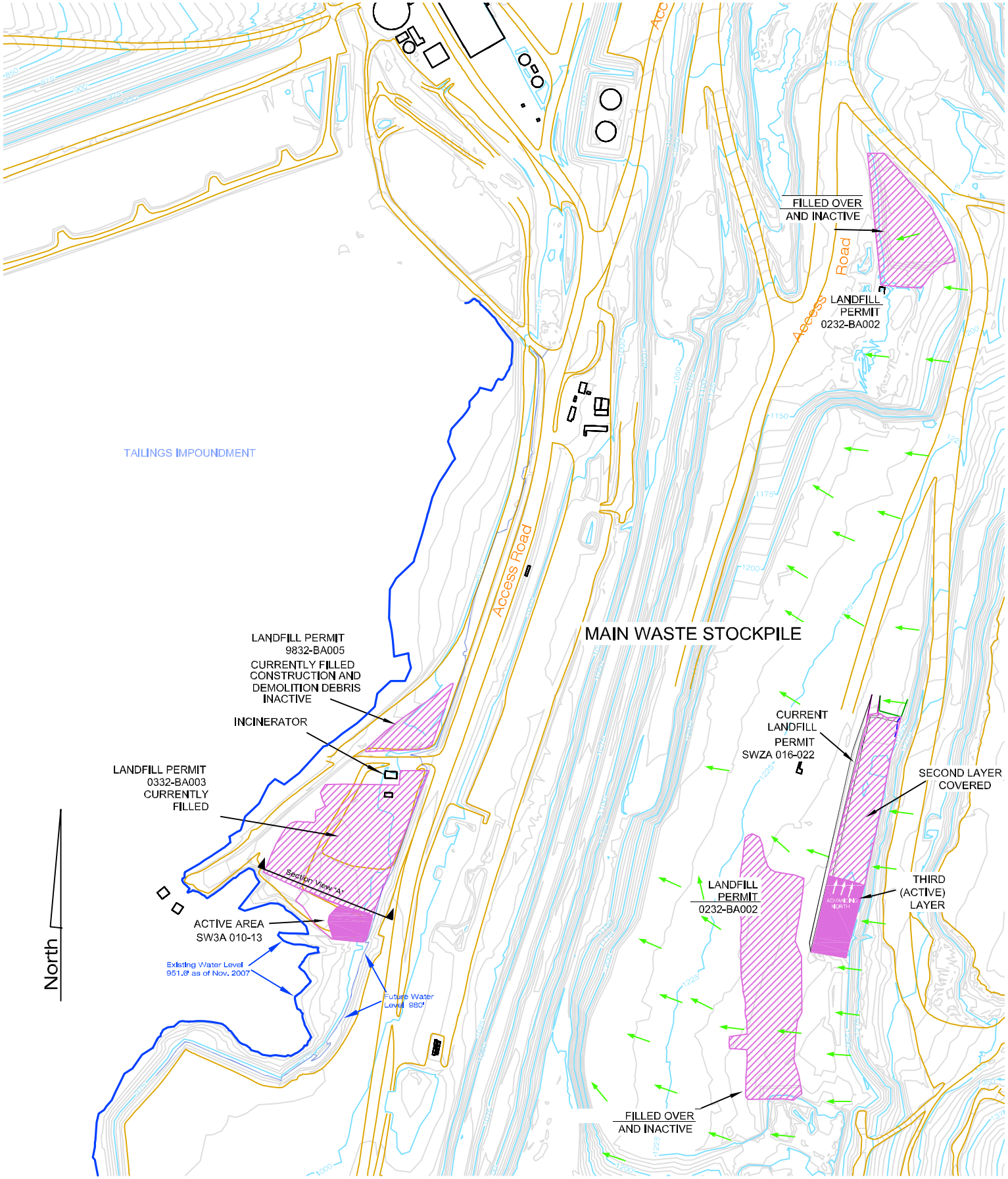
Red Dog Mine Water Flow, Quality and Groundwater Monitoring Locations

Figure 4

Date 10/08

0 500 1,000 2,000 Feet

N



Red Dog Mine
Mine Area Landfills
Operational Map 2008

Drawn By:	Drawing Date:
SOH	11-30-07
Checked By:	Check date:

Teck

Department	Reviewed By	Date
Mine Engineering		
Mine Operations		
Survey		
Geology		
Approved by:		

Revision:	Scale:	MWO or Job #:
6 1/15/09	1" = 500'	

Figure 5