13 February 2018 Reference No. 1776943-004-L-Rev1-2100

Ms. Michelle Unger, Deputy Site Manager
Teck Metals Limited, Pine Point Mine
601 Knighton Road
Kimberley, BC
V1A 1C7

TECK METALS LIMITED
PINE POINT TAILINGS IMPOUNDMENT AREA OPERATION, MAINTENANCE, AND SURVEILLANCE MANUAL

Dear Ms. Unger,

The attached ***Operation, Maintenance, and Surveillance Manual*** for the Pine Point Tailings Impoundment Area has been prepared by Golder Associates Ltd. for Teck Metals Limited.

In preparing this document Golder has incorporated changes received from Teck Metals Limited on 8 February 2018. This includes information provided by SRK Consulting (Canda) Inc. which has been incorporated within Section 3.5.2 of the attached manual.

Following issue of this ***Operation, Maintenance, and Surveillance Manual*** by Golder Associates Ltd., Teck Metals Limited is responsible for subsequent updates and revisions.

We trust the information in his document meets your requirements. If you have any questions relating to the information contained in this document please do not hesitate to contact us.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Martyn Willan, M.Sc.
Geotechnical Specialist

ORIGINAL SIGNED

Bjorn Weeks, Ph.D., P.Eng.
Principal, Senior Geo-Environmental Engineer

MBW/BW/cr

Attachment 1: Pine Point Tailings Impoundment Area Operation, Maintenance, and Surveillance Manual
Reference No. PP-OMS-001.V002

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Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

The single most important factor in the prevention of incidents is a positive attitude towards safety. Before any task commences, make it a habit to assess the hazards so they can be mitigated and/or controlled. It only takes one at-risk behaviour to result in a serious incident.

Any employee who is asked to participate in an unfamiliar work process must inform his/her supervisor of such before proceeding. Necessary training will then be provided.

OPERATION, MAINTENANCE AND SURVEILLANCE MANUAL FOR PINE POINT TAILINGS IMPOUNDMENT AREA

The review protocol for the Operation, Maintenance and Surveillance (OMS) Manual is shown in Table A-1.

Table A-1: Operation, Maintenance and Surveillance Manual Review Protocol

	Name	Company	Position	Signature	Date
Prepared by	Björn Weeks	Golder Associates Ltd.	Engineer of Record	ORIGINAL SIGNED	13-FEB-18
Approved by	Michelle Unger	Teck Resources Limited	Deputy Site Manager		
Approved by	Kathleen Willman	Teck Resources Limited	Manager Engineering and Remediation		

RECORD OF REVISIONS

The OMS Manual should be reviewed on an annual basis and following any significant changes at the site to assess the validity of the content under the prevailing conditions at the time of the review. Revisions to the manual should be undertaken within a reasonable timeframe (within six months) of changes, should updates to the content be required. The version history of the OMS Manual is shown in Table A-2. The last revision of the OMS Manual supersedes all previous versions.

The single most important factor in the prevention of incidents is a positive attitude towards safety. Before any task commences, make it a habit to assess the hazards so they can be mitigated and/or controlled. It only takes one at-risk behaviour to result in a serious incident.

Any employee who is asked to participate in an unfamiliar work process must inform his/her supervisor of such before proceeding. Necessary training will then be provided.

Table A-2: Operation, Maintenance and Surveillance Manual Revision Summary

Revision Number	Details of Revision	Date of Issue	Comment
2018 Version 2	Updated Document by Golder	9 February 2018	■ Updated Site Manager ■ Updated based on revised water license (MV2017L2-0007) ■ Updated to include 2014 DSR (SRK 2016) ■ Updated to include revised MAC Guidelines (MAC 2017) ■ Updated Contingency manual in Appendix C ■ Water Treatment Management Plan for Upset Conditions included with Water treatment Manual in Appendix E ■ Updates to Section 3.5.2 (From SRK)
2017 Version 1	Updated Document by Golder	22 February 2017	■ Update of consequence class for north and west dykes from low to significant ■ Freeboard calculation updated to include up rush ■ Climate information from 2009 to 2016 updated ■ Formatted to comply with Teck Guideline (Teck 2014)
2009 Version 0	Updated Document by Golder	19 March 2009	

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1.0 ROLES AND RESPONSIBILITIES

1.1 Formally Assigned

The roles and responsibilities of personnel formally assigned roles in the operation, maintenance, and surveillance of the Pine Point Tailings Impoundment Area (TIA) are defined in Table 1-1.

Table 1-1: Individuals Responsible

Role	Name	Company	Responsibilities	Phone #
Site Manager	Stephen Parris	Teck Resources Limited	complete routine and event-driven/special inspections as outline by surveillance	Office: 250-427-8438 Mobile: 250-427-6012
Alternative Contact	Michelle Unger	Teck Resources Limited	contact in the event that site manager cannot be reached	Office: 250-427-8422 Mobile: 250-432-5264
Local Consultant	Clell Crook	Maskwa Engineering Limited	assist with routine and event-driven/special maintenance as outlined by maintenance	Office: 867-874-2207 Mobile: 867-874-4401
Manager, Engineering and Remediation	Kathleen Willman	Teck Resources Limited	be available for consultation	Office: 250-427-8401 Mobile: 250-432-9563
Engineer of Record (EoR)	Björn Weeks	Golder Associates Ltd.	be available for consultation, complete annual dam safety inspection and submittal, participate in dam safety reviews and risk assessments	Office: 604-297-4647 Mobile: 604-679-9079

During 2018 the EoR role will formally transition from Dr. Björn Weeks, P.Eng., to Dr. Ben Wickland, P.Eng. As part of this transition both Björn and Ben will be actively involved in the management of the Pine Point TIA.

1.2 Organization Chart

An organization chart identifying the individuals indicated in Table 1-1 and their chain of command is presented in Plate 1. Key internal staff (Teck) and external advisors are included.

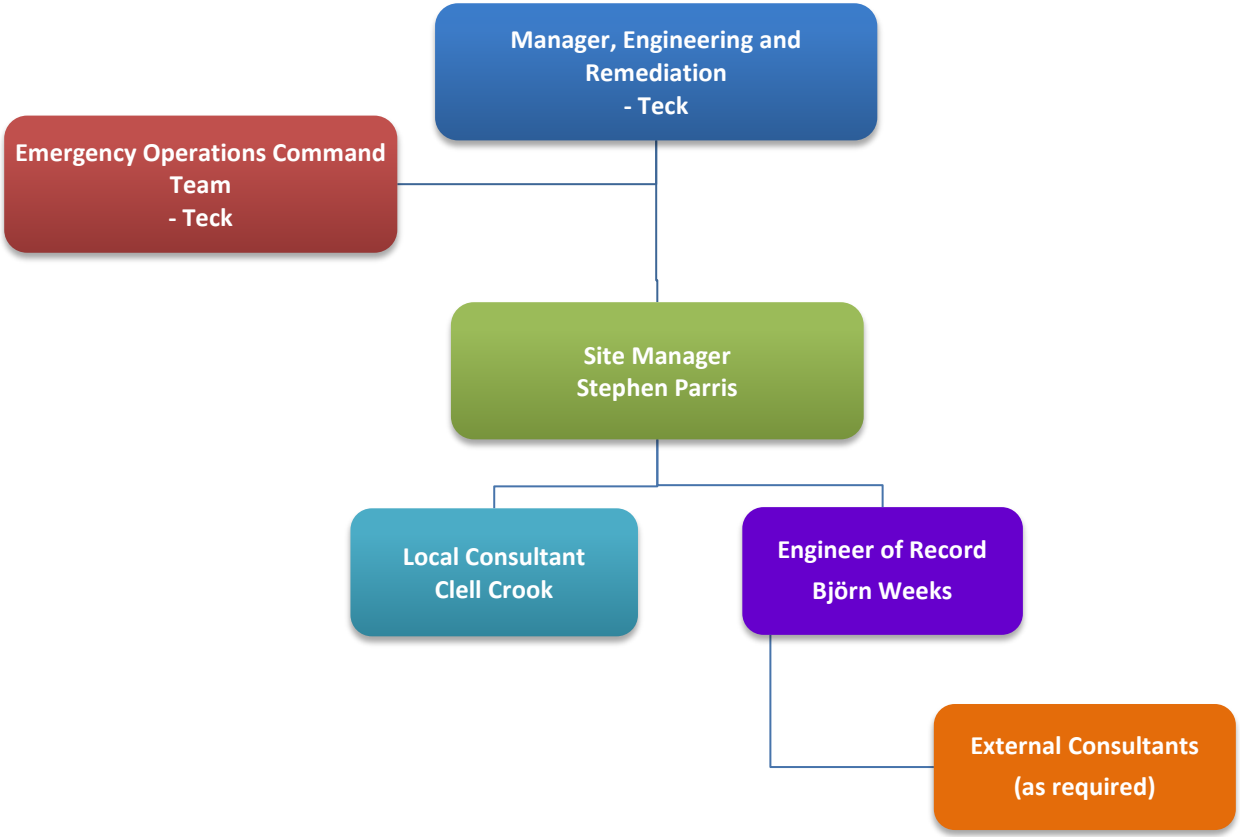

Plate 1: Pine Point TIA Chain of Command

1.3 Responsibilities and Requirements for Competency and Training

Summarizes the minimum knowledge, competency, and training requirements for personnel involved in the operation, maintenance, and surveillance of the Pine Point TIA.

Table 1-2: Required Proficiencies and Training

Roles	Minimum Knowledge and Competency Requirements	Training
Site manager	■ awareness of the responsibilities related to the dykes, their safety, and applicable regulations ■ an understanding of the significance of hazard and risk ■ detailed understanding of Emergency Preparedness and Response Plan (EPRP) in relation to the Pine Point TIA ■ detailed understanding of regulatory requirements for various regulatory bodies in relation to Dam Safety Inspections (DSIs) and Dam Safety Reviews (DSRs)	■ OMS Manual ■ EPRP ■ existing DSI reports ■ existing DSR reports
Caretaker/Local Consultant	■ detailed understanding of dam safety regulatory responsibilities ■ detailed understanding of Pine Point TIA operations, maintenance, and surveillance procedures in relation to OMS Manual ■ detailed understanding of EPRP in relation to the Pine Point TIA ■ understanding of dam design principles and construction techniques ■ understanding of abnormal and non-compliance conditions and protocol	■ OMS Manual ■ EPRP
Engineer of Record	■ experience commensurate with the consequence classification and complexity of the facility ■ registration as Professional Engineer in the Northwest Territories ■ detailed understanding of dam safety regulatory responsibilities ■ detailed understanding of design, construction history, as well as applicable standards, criteria, and guidelines	■ OMS Manual ■ EPRP
Teck employees	■ understanding of contents of the OMS Manual ■ knowledge of specific risks as they apply to work areas in and around the pond	■ OMS Manual
Contractors	■ knowledge of specific risks as they apply to work areas in and around the pond	
External consultants	■ experience with specific role relevant to the Pine Point TIA	■ OMS Manual ■ EPRP

OMS = Operation, Maintenance, and Surveillance; EPRP = Emergency Preparedness and Response Plan; DSI = dam safety inspection; DSR = Dam Safety Review; TIA = tailings impoundment area.

1.4 Responsibilities for Managing Change

There are no procedures in place for making changes to the design or operating plans since Pine Point TIA is closed and non-operational.

The OMS Manual and all associated documents shall be kept current with appropriate practices and procedures and, at minimum, be reviewed annually by the required personnel (Table A-1). The site manager will be responsible for ensuring that any changes imposed on the facility or within management are reflected in the OMS Manual, approved, and distributed accordingly.

2.0 FACILITY DESCRIPTION

2.1 Facility Overview

The TIA covers an area approximately 2.5 by 2.8 km in plan, or roughly 700 hectares, and contains approximately 60 million tonnes of zinc-lead tailings. The Pine Point site location is shown in Figure 1. A sketch and plan showing the layout of the TIA are presented in Figure 2. The mine ceased operations in 1988 and the mill buildings and tailings conveyor (trestle) were subsequently dismantled and removed. The only remaining mining installation at the site is the closed TIA.

The TIA is located to the north of the former Pine Point mill site on terrain that slopes gently downward towards the northwest. As a result of this topography the earthfill perimeter dyke system, which retains the tailings and any ponded water, extends fully along the north and west sides of the disposal area, but is required along only a portion of the south and east sides. The facility is described in more detail in Section 2.5, and its construction history is summarized in Section 2.8.

2.1.1 Water and Infrastructure Elevation Benchmarks

A summary of the elevations and benchmarks at the Pine Point TIA are presented in Table 2-1 and Plate 2. These elevations are adopted for determining water management operations at the site.

Table 2-1: Water and Infrastructure Elevations

Levels	Elevation (m)	Comment
Dyke Crest	203.5	Minimum crest elevation on the dyke.
Top of Spillway	202.5	Top and bottom of the concrete wall spillway at the outlet of the polishing pond.
Base of Spillway	199.2	
Culvert Invert Level in Main Pond	200.0	Culvert levels on the Main and Polishing Pond sides of the culvert.
Culvert Invert Level in Polishing Pond	199.9	
Alert Water Level	201.6	The site manager should be informed immediately, and water treatment should start as early as practicable. A site inspection should take place one week after the initial alert level was observation.
Maximum Operating Water Level	201.8	The maximum operating pond elevation. Actions to reduce the water level within the pond should commence as a matter of urgency.

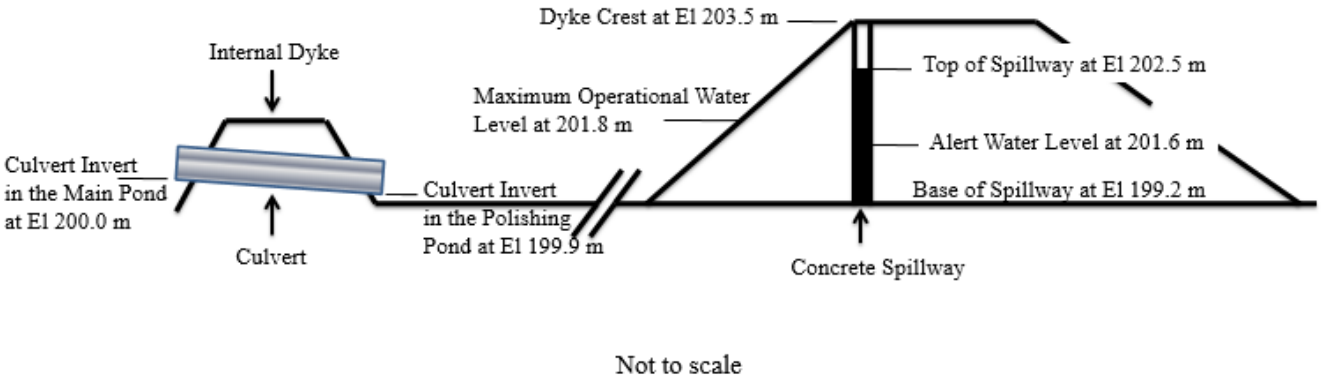

Plate 2: Water and Infrastructure Elevations

2.2 Regulatory Requirements

The Type B Water Licence (MV2017L2-0007) issued to Teck Metals for the Pine Point site by the Mackenzie Valley Land and Water Board (MVLWB 2017) is valid from 25 October 2017 to 24 October 2027. A copy of this licence is presented in Appendix D.

Additional codes and guidelines applicable to the Pine Point TIA are listed below:

- Canadian Dam Association (CDA) Dam Safety Guidelines (CDA 2013).
- Application of Dam Safety Guidelines to Mining Dams bulletins (CDA 2014).
- Mining Association of Canada Guidelines (MAC 2011 and MAC 2017).

2.3 Site Reference Data

2.3.1 Grid System and Maps

Pine Point uses UTM NAD 83 Zone 11 map grid. Figure 1 shows the site location map in UTM coordinate system.

2.3.2 Weather

Measurements of temperature, precipitation, snow on the ground, and wind are available from weather stations in the vicinity of Pine Point (Table 2-2). Measurements of temperature and precipitation are also available at Pine Point sporadically from 1953 to 1954 and 1965, and then on a more consistent basis during mining operations from 1975 to 1988. Lake evaporation estimates are sporadically available for Yellowknife (1966 to 1996) and Fort Smith (1966 to 2003), as well as on a continual basis for Pocket Lake from 1994 to 2007 (DIAND 2007).

Table 2-2: Regional Weather Stations

Name[a]	Environment Canada Station Number	Latitude	Longitude	Elevation[c] (m)	Approximate Distance from Site (km)	Period of Record Used
Pine Point	2203101	60.87° N	114.37° W	224	0	1953 to 1954, 1965, 1975 to 1988
Hay River	2202400	60.84° N	115.78° W	165	75	1953 to 2016
Fort Resolution	2202000	61.18° N	113.69° W	160	50	1953 to 2016
Fort Smith	2202196	60.00° N	111.93° W	183	170	1953 to 2016
Pocket Lake[2(b)]	NA	62.50° N	114.38° W	NA	180	1994 to 2007
Yellowknife[2(c)]	2204100	62.47° N	114.45° W	206	180	1966 to 1996

Notes:

(a) See Figure 1 for the location of the stations. Pocket Lake is immediately east of Yellowknife.

(b) Pocket Lake and Yellowknife stations are used only to describe evaporation. Pocket Lake station is operated by the Department of Indian and Northern Development (DIAND 2007).

(c) Approximate elevation of site is 200.0 m.

NA = not available.

Climate measurements at Pine Point correlate well with measurements from the Hay River, Fort Resolution, and Fort Smith weather stations. These stations are affected by the same climatic patterns as Pine Point but have different absolute values due to the distance between sites. A summary of the correlations are presented in Table 2-3 for coinciding observations from different stations on a monthly basis. The square of the correlation coefficients (R^2 values) for temperature are approximately equal to 1. Correlations for rainfall, snowfall, and snow on the ground between Pine Point and the other stations are considered satisfactory for establishing long term data series trends.

Table 2-3: Squared Correlation between Regional Weather Stations

Variable	Squared Correlation between Pine Point and:		
	Hay River	Fort Resolution	Fort Smith
Monthly mean temperature	0.995	0.994	0.994
Monthly rainfall	0.761	0.671	0.581
Monthly snowfall	0.615	0.558	0.554
Monthly snow on the ground	0.494	0.790[a]	0.465

(a) Only three months of coinciding data were available to assess the correlation between stations.

Continuous, long-term time series for temperature and precipitation were estimated for Pine Point based on the data up to the end of 2016. These data have been used in the water balance and flood modelling to assist with surface water management of the facility. Data from Pine Point have been used, where available, with data gaps filled with adjusted regional weather station data. Data from Hay River were used preferentially, due to the higher correlation coefficient values with Pine Point. Where Hay River data were not available, data from Fort Resolution and Fort Smith, respectively, were used as secondary and tertiary data sources to complete the data series.

Data from nearby stations, used to fill data gaps, were adjusted based on the differences between coinciding data for Pine Point and the regional weather stations. A constant value was added to regional temperature data, while a weighting factor was applied to regional rainfall and snowfall data (Table 2-4). Precipitation values were also adjusted for "under-catch" factors, which account for:

- wind under-catch and evaporation based on the type of rain gauge used
- gauge-specific wetting losses for individual rain events
- snowfall based on ruler measurements for the period of record to minimize potential discontinuities associated with the introduction of the shielded Nipher snow gauge in the mid-1960s
- snow density corrections based on concurrent ruler and Nipher snow measurements
- quantification of trace snowfall events

Assessments of meteorological records in the Canadian north (Metcalfe et al. 1993) concluded that precipitation amounts are underestimated due to these under-catch factors. Adjustments for the correction of precipitation amounts were proposed by Mekis and Hogg (1999) and applied to northern weather stations. Table 2-4 lists the under-catch factors applied to the weather stations.

Table 2-4: Adjustments to Climate Data

Station	Constant Adjustment on Temperature	Rainfall		Snowfall	
		Weighing Factor	Under-Catch Factor	Weighing Factor	Under-Catch Factor
Pine Point	0.00	1.00	1.12	1.00	1.31
Hay River	+0.02	1.06	1.12	1.82	1.31
Fort Resolution	-0.78	0.80	1.10	0.94	1.13
Fort Smith	-0.12	1.03	1.30	1.30	1.03

Hay River station has the most complete record of snow on the ground. As such, these observations were used without adjustment to describe this climate variable at Pine Point. Linear interpolation between existing data was used to fill gaps in the record.

Hourly wind observations at Hay River were selected and assessed, as it is the closest of the regional weather stations.

The lake evaporation record was the most complete at Fort Smith, and consequently this station was used as the prime source of data for this climate variable at Pine Point. Gaps in the record were filled with data from Yellowknife station from 1966 to 1996 and from Pocket Lake from 1997 and 2007. A factor of 1.075 was applied to data from Fort Smith and of 0.93 to data from Yellowknife and Pocket Lake (these stations are within 10 km of each other). These factors were needed to account for the observed spatial variability between Fort Smith, Yellowknife and Pine Point.

2.3.3 Subsoil Characteristics

The TIA dykes are founded on glacial deposits. The site geology indicates the TIA dykes are underlain by very stiff silty clay with isolated pockets of gravel. Along parts of the dyke alignment, local pockets of peat were encountered. These were not removed in the initial construction phase, but were removed during subsequent dyke crest raises.

2.3.4 Instrumentation

There is no geotechnical instrumentation (piezometers, inclinometers or settlement gauges) in the dykes at the Pine Point TIA. The only monitoring device is a water level gauge at the culvert from the north dyke to the polishing pond.

2.3.5 Surface Water Sampling

A Type B Water Licence was issued by MVLWB to Teck for the Pine Point site (licence number MV2017L2-0007, Appendix D). The licence details a water sampling program (i.e., Surveillance Network Program) that must be implemented for the monitoring of water quality parameter concentrations in the TIA, discharges from the TIA, and at selected locations in the receiving aquatic environment. This sampling program is applicable to both the regulatory requirement of the water licence and the operation, maintenance and surveillance program for the TIA. Data are managed by Teck and submitted as part of the annual report by 31 March of every year to MVLWB.

2.4 Site Conditions

2.4.1 Topography

The TIA is located to the north of the former Pine Point mill site on terrain which slopes downward towards the northwest. The terrain slopes gently for about 13 km towards Great Slave Lake from an approximate elevation of 230 m at the former mill site to an approximate lake elevation of 160 m. Topographic maps (85B15 and 85B16) indicate that the region around the site can be characterized as low gradient terrain.

2.4.2 Geology

The site is situated in a region that lies between the Cordilleran Orogen to the west and the Precambrian Shield to the east and consists of sedimentary strata. Ordovician to Devonian sediments overlay Archean crystalline rocks and Proterozoic sediments (Giroux 2001). Surficial material is composed of a layer of glacial till, gravel, sand, and clay (Fulton 1989; Giroux 2001).

2.4.3 Vegetation and Wildlife

The vegetation in the region is typical of the Taiga Plains Ecozone (Great Slave Lake Plain), where the land cover is composed predominately of wetlands and bog-fen vegetation such as dwarf black spruce, Labrador tea, ericaceous shrubs, and mosses (EC 2005). Jack pine and willows were also observed in the region of the site (Giroux 2001).

Moose, black bear, and deer are rarely observed in the region. The site is south of caribou migration routes and northwest of wood buffalo habitats (Giroux 2001).

2.4.4 Temperature

The long-term monthly temperature range adopted for the site is presented in Table 2-5. July and January are the warmest and coldest months, with mean temperatures of 16.2°C and -23.4°C respectively. Mean monthly temperatures below 0°C are consistently observed from October to April.

Table 2-5: Monthly Temperature Means, Minimums and Maximums

Month	Monthly Minimum (°C)	Monthly Mean (°C)	Monthly Maximum (°C)
January	-28.1	-23.4	-18.7
February	-25.5	-20.0	-14.3
March	-20.3	-14.2	-7.9
April	-8.4	-2.8	3.0
May	0.9	6.4	11.9
June	7.4	13.1	18.7
July	10.9	16.2	21.4
August	8.8	14.0	19.1
September	3.3	7.9	12.5
October	-4.2	-0.4	3.3
November	-16.7	-12.7	-8.6
December	-24.4	-19.9	-15.4
Annual	-28.1	-2.9	21.4

Note: Values derived from site data from 1953 to 2016, with data gaps filled with data from regional weather stations (Hay River, Fort Resolution, and Fort Smith).

2.4.5 Precipitation and Snow on the Ground

The monthly precipitation and snow on the ground averages are presented in Table 2-6. The total average amount of precipitation calculated for the site is 565.0 mm, of which 59% is snowfall (333.2 mm as equivalent rainfall) and 41% is rainfall (231.8 mm). The total average effective precipitation is 461.7 mm, once snow cover loss, due to sublimation and wind redistribution, is accounted for. The snow cover loss at Pine Point (103.3 mm as equivalent rainfall) is estimated to be approximately 31% of the total average snowfall (333.2 mm), which is within the range observed in the Canadian northern regions

(Marsh et al. 1994; Pomeroy et al. 1997). The maximum amount of snow on the ground occurs in March and is estimated to be 477.0 mm (as snow). Snowfalls are consistently expected from October to April, and are present in smaller amounts in May, June, and September.

Table 2-6: Monthly Precipitation and Snow on the Ground Averages

Month	Rainfall (mm)	Snowfall (Water Equivalent, mm)[a]		Total Precipitation (mm)[b]		Snow on the Ground (mm)[c]
		Exclusive of Snow Loss[b]	Inclusive of Snow Loss[b]	Exclusive of Snow Loss[b]	Inclusive of Snow Loss[b]	
January	0.2	47.2	32.6	47.4	32.8	401.0
February	0.1	38.7	26.7	38.8	26.8	472.0
March	0.2	37.4	25.8	37.7	26.1	477.0
April	4.1	23.9	16.5	28.0	20.6	213.0
May	21.5	7.6	5.2	29.1	26.7	9.0
June	32.0	0.2	0.1	32.2	32.2	0.0
July	55.4	0.0	0.0	55.4	55.4	0.0
August	59.3	0.0	0.0	59.3	59.3	0.0
September	43.8	4.1	2.8	47.9	46.6	1.0
October	13.7	43.6	30.1	57.3	43.8	33.0
November	0.9	79.2	54.6	80.1	55.5	171.0
December	0.7	51.3	35.4	51.9	36.0	297.0
Annual[d, e]	231.8	333.2	229.9	565.0	461.7	477.0

(a) The water equivalent of snow assumed based on a relative density of 10% for snowfall.

(b) Snow loss accounts for the depletion of snowfall due to sublimation and snow redistribution.

(c) Snow on the ground observations at Hay River available from 1955 to 2016. The values in the table reflect the amount of snow on the ground at the end of the month (as mm of snow).

(d) The annual value for rainfall, snowfall, and total precipitation are the cumulative for of all the months. The annual value for snow on the ground is the maximum monthly mean.

(e) Annual values do not sum exactly due to rounding.

2.4.6 Wind

The average yearly maximum hourly wind in all principal directions, from 1953 to 2016, is presented in Table 2-7. Hourly wind observations at Hay River were used in the assessment of possible wave heights within the TIA, as this was the station closest to Pine Point with the required data.

Table 2-7: Average Yearly Maximum Hourly Wind in All Principal Directions

Direction [(a)]	Wind Speed [(b)] (km/h)
North	42.0
Northeast	37.7
East	37.0
Southeast	36.1
South	39.8
Southwest	38.2
West	44.7
Northwest	50.6

(a) The wind direction indicates the direction from which the wind is blowing.

(b) Values based on data from Hay River from 1953 to 2016.

2.4.7 Evaporation

The average total annual lake evaporation is estimated to be 524 mm. Evaporation occurs from May to September, and the estimated average lake evaporation for these months is presented in Table 2-8. The evaporation values are based on data from 1966 to 2007, and were derived for Pine Point based on data from the surrounding regional weather stations.

Table 2-8: Estimated Average Monthly Lake Evaporation

Month	Monthly Evaporation (mm)	Percentage of Total Evaporation (%)
May	110	21
June	132	25
July	132	25
August	100	19
September	50	10
Total	524	100

Note: Values derived from climate parameters measured at regional weather stations (Fort Smith, Yellowknife, and Pocket Lake).

2.4.8 Permafrost

Pine Point falls within the discontinuous sporadic permafrost zone (Johnston 1981; Heginbottom 1989). Permafrost exists where the ground is at or below 0°C for at least two years continuously. Discontinuous permafrost results when permafrost is present only in certain areas and covers less than 90% of the ground area. Less than 50% coverage of permafrost is called discontinuous sporadic permafrost (NRCC 1988). Site-specific data on the presence or extent of permafrost within the TIA or under the dykes are not available.

2.4.9 Seismicity

According to the 2010 National Building Code of Canada seismic hazard calculator (NRC 2011), peak ground acceleration (PGA) for the Pine Point site is:

- 0.019 g for the 1-in-1,000-year event (5% probability of exceedance in 50 years)
- 0.036 g for the 1-in-2,475-year event (2% probability of exceedance in 50 years)

Seismic hazard in the region of Pine Point mine is ranked as low (NRC 2008).

It is understood that major Precambrian faults run along the East Arm of Great Slave Lake and controlled the distribution of ore bodies which facilitated the discovery of lead-zinc deposits at Pine Point. These lines of weakness in the bedrock, where karstification, dolomitization, and mineralization occurred, are called the Precambrian McDonald–Great Slave Lake fault system (Hannigan 2008).

2.5 Facility Components

2.5.1 Access Roads

The Pine Point property is approximately 800 km north of Edmonton, Alberta, and approximately 10 km south of Great Slave Lake. Access to the site from Hay River is via a 90 km paved road, which is on Crown land. The old haul roads on site mostly remain serviceable and are accessible using light vehicles, skidoos, tractors, and other all-terrain vehicles (Giroux 2001).

2.5.2 Tailings Impoundment Area

The TIA covers an area approximately 2.5 by 2.8 km in plan, or roughly 700 hectares, and contains about 60 million tonnes of zinc-lead tailings. A sketch and plan showing the layout of the TIA are presented in Figure 2.

The TIA is located to the north of the former Pine Point mill site on terrain that slopes gently downward towards the northwest. As a result of this topography the earthfill perimeter dyke system, which retains the tailings and any ponded water, extends fully along the north and west sides of the disposal area, but is required along only a portion of the south and east sides.

The main pond, where surface water runoff accumulates at present, covers the north end of the TIA and its extent varies depending on water elevation.

2.5.3 Dykes

The total length of the dyke system is approximately 8.5 km with a maximum height of approximately 15 m at the northwest corner. The south dyke varies in height from 0 m at the southeast corner of the TIA to 4 m at the southwest corner. The west dyke connects to the south dyke and has a maximum height at the northwest corner of the TIA of 15 m. The north dyke extends from the west dyke to the east dyke, and includes the perimeter dyke enclosing the polishing pond. The north dyke varies from 15 m in height at the connection with the west dyke to 1.0 m in height at the northeast corner of the TIA.

The 1.0 m dyke height continues on the east dyke until the natural ground surface rises above the dyke crest elevation. The east dyke is approximately 200 m long.

Ponded water is typically present on the north side of the TIA, with the pond in contact with the north dyke. Typical sections of the west and north dykes are shown in Figures 3 and 4 respectively. The dam classifications of the dykes are summarized in Section 2.7.1.

A culvert, through the north dyke, connects the main pond and the polishing pond, which is located on the north side of the impoundment. The culvert is fitted with a gate valve which can be used to control the flow from the main pond to the polishing pond.

2.5.4 Polishing Pond

The polishing pond is enclosed by the north dyke and an internal dyke within the TIA, and is used to treat contact water prior to release to the environment. The water exits the facility, after treatment, via a spillway. The spillway consists of a concrete culvert with an internal concrete wall, which acts as a weir to control the elevation at which water exits the facility. Syphons are also situated in the spillway to facilitate the removal of treated water from the polishing pond but are not typically active at other times.

2.6 Regulatory Compliance Points

The Pine Point mine is permitted under Type B Water Licence MV2017L2-0007, a copy of which is presented in Appendix D, which was issued to Teck by MVLWB (2017). As a requirement of Water Licence MV2017L2-0007:

- An annual report must be submitted by March 31 of each year. The annual report must include all of the data and information required by the Surveillance Network Program described in the water licence (Section 4.0).
- A geotechnical inspection report must be submitted 90 days after the date of the site inspection visit.

The CDA (2013) Dam Safety Guidelines recommends that a Dam Safety Review (DSR) be conducted once every 10 years for embankments/dykes with a “Significant” dam classification, such as the west and north TIA dykes (Section 2.7.1). The last DSR was conducted in 2014 and included the south, west, and north dykes (SRK 2016).

The next DSR for these dykes should therefore be scheduled for 2024.

2.7 Basis of Design and Design Criteria

2.7.1 Dam Consequence Classification

The TIA is considered to be in the Closure–Active Care phase of mine life (Golder 2016), based on regular monitoring of the dykes and regular treatment and release of water from the facility. The design criteria for the dam therefore follow the CDA (2013) dam classification (Table 2-9).

Table 2-9: Dam Classification in Terms of Consequences of Failure

Dam Class	Population at Risk[a]	Incremental Losses		
		Loss of Life [b]	Environmental and Cultural Values	Infrastructure and Economics
Low	none	0	minimal short term loss; no long term loss	low economic losses; area contains limited infrastructure or service
Significant	temporary only	unspecified	no significant loss or deterioration of fish or wildlife habitat; loss of marginal habitat only; restoration or compensation in kind highly possible	losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes
High	permanent	10 or fewer	significant loss or deterioration of important fish or wildlife habitat; restoration or compensation in kind highly possible	high economic losses affecting infrastructure, public transport, and commercial facilities
Very High	permanent	100 or fewer	significant loss or deterioration of critical fish or wildlife habitat; restoration or compensation in kind possible but impractical	very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances)
Extreme	permanent	more than 100	major loss of critical fish or wildlife habitat; restoration or compensation in kind impossible	extreme losses affecting critical infrastructure or services (e.g., hospital, major industrial complex, major storage facilities for dangerous substances)

Source: CDA (2013), Table 2-1

(a) Definition for population at risk:

None – There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure.

Temporary – People are only temporarily in the dam-breach inundation zone (e.g., seasonal cottage use, passing through on transportation routes, participating in recreational activities).

Permanent – The population at risk is ordinarily located in the dam-breach inundation zone (e.g., as permanent residents); three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out).

(b) Implications for loss of life:

Unspecified – The appropriate level of safety required a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season.

Should the TIA move to the Closure–Passive Care phase, in which the system is considered stable with no water treatment or management of the pond, such that water may be passively released from the system, the design criteria for the dam should be revised based on recommendations by CDA (2014) and Teck (2014).

The dykes at the site are classified as Low to Significant based on the CDA (2013) guidelines. Only the north dyke retains water at any time. The south and west dykes retain only tailings, while the east dyke does not retain water or tailings (it is required only for freeboard). The criteria for classification are evaluated as follows:

- **Population at risk**—None. There is no known permanent population at risk downstream of the site.
- **Loss of life**—There is no possibility of loss of life other than through unforeseeable misadventure.
- **Environmental and cultural values**—A dyke failure would impact the local environment. There is a possibility of minimal short-term loss or deterioration of wildlife habitat as a result of a failure of the south and east dykes. Failure of the north or west dykes present a higher risk due to the impoundment of water, but failure would not lead to a significant loss or deterioration of important wildlife habitat or areas of cultural significance; restoration or compensation for impacts is considered highly possible.
- **Infrastructure and economics**—None. There is no development or infrastructure downstream of the TIA.

Table 2-10: Dam Failure Consequence Classification for the Tailings Impoundment Area Dykes

Dam	Dam Class	Population at Risk	Consequences of Failure		
			Loss of Life	Environment and Cultural Values	Infrastructure and Economics
North Dyke	Significant	none	low to none	low to significant	low to none
East Dyke	Low	none	low to none	low	low to none
West Dyke	Significant	none	low to none	low to significant	low to none
South Dyke	Low	none	low to none	low	low to none

Note: The class assigned to a dam is the highest rank determined among the four attributes (i.e., population at risk, loss of life, environmental and cultural values, and infrastructure and economics).

2.7.2 Design Criteria

The design criteria related to floods and seismic and static stability based on the CDA (2013) guidelines are summarized in Table 2-11:

Table 2-11: Minimum Design Criteria for Pine Point Dykes

Dykes	Dam Class	Annual Exceedance Probability – Floods	Annual Exceedance Probability – Earthquakes	Factors of Safety			
				Static		Pseudo-static	Post-earthquake
				Long Term	Full or Partial Drawdown		
North and west	Significant	between 1/100 and 1/1,000	between 1/100 and 1/1,000	1.5	1.2 to 1.3	1.0	1.2 to 1.3
South and east	Low	1/100	1/100	1.5	1.2 to 1.3	1.0	1.2 to 1.3

Note: Design criteria based on CDA 2013.

CDA (2013) provides two calculations for freeboard; the most critical of the two cases sets the minimum freeboard to be adopted:

- no overtopping by 95% of the waves caused by the most critical wind with a return period of 1,000 years with the pond at its maximum normal operating elevation
- no overtopping by 95% of the waves caused by the most critical wind with a return period of 10 years (for Significant consequence structures), with the pond at the maximum level during the passage of the inflow design flood (IDF)

2.7.3 Flood Design

2.7.3.1 Original Design Intent

The original design documents for the dykes are not available.

2.7.3.2 Existing Conditions and Current Design Status

2.7.3.2.1 Storage Capacity of the Tailings Impoundment Area

The storage capacity of the TIA was derived from a topographic survey conducted in November 2008 (Maskwa 2008a). The topographic survey did not include the northeast corner and as such the derived storage capacity represents a conservative estimate, due to underestimation of the impoundment area. Table 2-12 provides the derived storage capacity as a function of water elevation within the TIA.

The ponding volume in Table 2-12 starts at elevation 200.0 m, which corresponds to the upstream, main pond side of the culvert connecting the main pond to the polishing pond (Maskwa 2008b). The ponding volume stops at elevation 203.5 m which corresponds to the minimum elevation of the north dyke.

Table 2-12: Storage Capacity of the Tailings Impoundment Area

Water Elevation (m)	Pond Volume (m^3)
200.0	0
200.1	24,801
200.2	51,504
200.3	80,109
200.4	110,617
200.5	143,028
200.6	177,341
200.7	213,766
200.8	252,512
200.9	293,580
201.0	336,969
201.1	383,021
201.2	432,078
201.3	484,138
201.4	539,203
201.5	597,271
201.6	658,344
201.7	722,711
201.8	790,660
201.9	862,193
202.0	937,308
202.1	1,016,129
202.2	1,098,777
202.3	1,185,251
202.4	1,275,554
202.5	1,369,683
202.6	1,467,639
202.7	1,569,705
202.8	1,676,162
202.9	1,787,010
203.0	1,902,249
203.1	2,022,129
203.2	2,146,897
203.3	2,276,554
203.4	2,411,099
203.5	2,550,328

2.7.3.2.2 Flood Capacity

This section assesses the capacity of the TIA to operate under the following three scenarios:

- extreme daily rainfall occurring when infiltration is possible due to unfrozen/unsaturated soil conditions (likely from June to October)
- extreme daily rainfall occurring when infiltration is negligible due to frozen/saturated soil conditions (possible from April to May)
- extreme annual total precipitation

Events of extreme annual total precipitation and daily rainfall were estimated based on a frequency analysis using the derived precipitation data for Pine Point from 1953 to 2016. The resulting events for representative return periods are given in Table 2-13.

Table 2-13: Extreme Precipitation Events

Return Period (years)	Extreme Daily Rainfall (mm)	Extreme Annual Total Precipitation (mm)[(a)]
2	31	458
10	53	610
50	74	707
100	84	742
200	94	775
500	107	815
1,000[(b)]	**117**	**844**

(a) The amounts of cumulative snowfall and total precipitation account for the depletion of snowfall due to sublimation and snow redistribution.

(b) Design criteria, inflow design flood.

2.7.3.2.2.1 Extreme Annual Daily Rainfall

Flood routing analyses were completed using the Puls method (Watt et al. 1989), to confirm that the TIA can contain the 1-in-100-year and 1-in-1,000-year flood events. These flood events correspond to the lower and upper bound IDF range recommended by CDA (2013) for dams with Significant consequence classifications. (Table 2-11). Flood routing analyses were completed for the 1-in-100-year and 1-in-1,000-year flood events for both unfrozen/unsaturated and frozen/saturated soil conditions.

The following assumptions were used in the flood routing analyses:

- The water elevation in the TIA at the start of the storm is 201.6 m, which corresponds to the maximum observed water level in the TIA before treatment from 1998 to 2016 (Table 6-2).

- The lowest elevation of the internal dyke separating the main pond in the TIA and the polishing pond is assumed to be 202.5 m.
- The polishing pond spillway is assumed to be a broad-crested weir with a width of 2.44 m (Maskwa 2007) and an elevation of 202.5 m.

The results of the flood routing analyses indicate that the water level in the TIA would reach:

- 202.1 m during a 1-in-100-year storm assuming unfrozen/unsaturated soil conditions
- 202.6 m during a 1-in-100-year storm assuming frozen/saturated soil conditions
- 202.4 m during a 1-in-1,000-year storm assuming unfrozen/unsaturated soil conditions
- 202.8 m during a 1-in-1,000-year storm assuming frozen/saturated soil conditions

The predicted water levels are all below the dyke crest elevation of 203.5 m, which indicates that the flood events recommended by CDA (2013), for dams with Significant consequence classifications (Table 2-11), can be contained when the pre-storm water level in the TIA is equal to or lower than 201.6 m.

The flood routing analyses predicted that the polishing pond would discharge into the environment if the soil was frozen/saturated during a 1-in-100-year and 1-in-1,000-year storm, with water levels above the spillway elevation (202.5 m) but below the dyke crest (203.5). This is considered an acceptable management practice during storm events to prevent overtopping of the dyke.

A “YES” in Table 2-14 and Table 2-15 indicate when discharge is likely to occur during storm events with different return periods, for both unfrozen/unsaturated and frozen/saturated ground conditions, based on the pre-storm water level within the TIA.

A “NO” in Table 2-14 and Table 2-15 implies that no discharge through the TIA spillway is expected. A “YES” indicates that discharge through the TIA spillway is expected.

The estimated amount of runoff from unfrozen/unsaturated ground conditions was calculated using the Soil Conservation Service runoff equation and curve numbers (Rawls et al. 1993). A curve number of 81 was selected for unfrozen/unsaturated ground conditions. This was based on the assumption that the catchment consists of 7 km^2 of bare soil (tailings) and 2 km^2 of grassland (area adjacent to tailings). For the frozen/saturated ground scenario, no curve number was selected as infiltration is not assumed to occur in this scenario.

Table 2-14: Tailings Impoundment Area Discharge as a Function of Rainfall Events and Pond Elevations (unfrozen/unsaturated ground)

Return Period (years)	Effective Daily Rainfall (mm)	Rainfall Volume (m^3)	Exceedance of the Spillway Invert Level (202.5 m) Given a Rainfall Event and a Water Elevation (m) in the TIA at the Start of the Event of:										
			200.0	200.9	201.0	201.2	201.5	201.6	201.7	201.9	202.1	202.3	202.5
2	5	40,975	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES
10	17	151,423	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES
50	32	287,237	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
100	39	353,517	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
200	47	424,462	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES
500	58	525,418	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES
1,000[(a)]	**67**	**607,238**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**	**YES**

(a) Design criteria.

Notes: A "NO' implies that no discharge through the TIA spillway is expected. A "YES" indicates that discharge through the TIA spillway is expected.

TIA = tailings impoundment area.

Table 2-15: Tailings Impoundment Area Discharge as a Function of Rainfall Events and Pond Elevations (frozen/saturated ground)

Return Period (years)	Effective Daily Rainfall (mm)	Rainfall Volume (m^3)	Exceedance of the Spillway Invert Level (202.5 m) Given a Rainfall Event and a Water Elevation (m) in the TIA at the Start of the Event of:										
			200.0	200.9	201.0	201.2	201.5	201.6	201.7	201.9	202.1	202.3	202.5
2	31	277,369	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
10	53	477,792	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES
50	74	668,774	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES
100	84	753,904	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
200	94	841,633	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES
500	107	962,201	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES
1,000[(a)]	**117**	**1,057,237**	**NO**	**NO**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**

(a) Design criteria.

Notes: A "NO' implies that no discharge through the TIA spillway is expected. A "YES" indicates that discharge through the TIA spillway is expected.

TIA = tailings impoundment area.

The results indicate that discharge is not expected to occur for storms with return periods of up to the 1-in-1,000-years if the water elevation at the start of the storm is:

- Lower or equal to 200.9 m for both unfrozen/unsaturated and frozen/saturated ground conditions.
- At the previously observed maximum TIA water level before treatment (201.6 m) if the ground is unfrozen/unsaturated. Discharge from the TIA is likely to occur if the water level before the storm is at the previously observed maximum water level (201.6 m) and the soil is frozen/saturated.

2.7.3.2.2.2 Extreme Annual Total Precipitation

A flood capacity analysis of the TIA was completed for extreme annual total precipitation events. Table 2-16 indicates the estimated volume of water that the TIA will need to store during extreme annual total precipitation events.

The flood capacity analysis was based on the following:

- The extreme total annual precipitation in Table 2-13.
- The total losses (evaporation, evapotranspiration, and infiltration) are based on the relationship derived in Section 3.5.3 between total precipitation (i.e., rainfall plus snowfall) and total losses. The relationship indicates that ninety-five percent of the total precipitation is lost from the TIA due to total losses.
- A watershed area of approximately 9 km^2.
- The elevation-volume storage capacity relationship of the TIA, Table 2-12, which is based on the November 2008 topographic survey (Maskwa 2008a). The survey did not include the northeast corner of the TIA, and therefore the storage capacity represents a conservative estimate due to underestimation of the impoundment area.

Table 2-16: Flood Capacity Analysis for Extreme Annual Total Precipitation Events

Return Period (years)	Total Annual Precipitation (mm)	Total Annual Losses[(b)] (mm)	Net Annual Precipitation[(c)] (mm)	Net Annual Precipitation Volume[(d)] (m^3)
2	458	437	21	185,902
10	610	582	28	247,599
50	707	675	32	286,971
100	742	709	33	301,178
200	775	740	35	314,573
500	815	778	37	330,809
1,000[(a)]	**844**	**806**	**38**	**342,580**

(a) Design criteria.

(b) Total Annual Losses includes evaporation, evapotranspiration and infiltration.

(c) Net Annual Precipitation is Total Annual Precipitation minus Total Annual Losses.

(d) Net Annual Precipitation Volume is Net Annual Precipitation multiplied by a watershed area of 9 km^2.

When the net precipitation volumes in Table 2-16 are compared with the storage capacity of the TIA (Table 2-12), the results indicate that the TIA has sufficient capacity to store extreme annual total precipitation events with a return period as high as 1,000 years.

2.7.3.2.3 Freeboard

CDA (2013) recommends that the height of the freeboard be sufficiently high enough to prevent overtopping by 95% of the waves caused by the most critical wind in the following two scenarios:

- Scenario 1: Wind return period of 1,000 years with the pond at its maximum normal operating elevation.
- Scenario 2: Wind return period of 10 years (for Significant consequence structures), with the pond at the maximum level during the passage of the IDF.

The total wave uprush (wind setup plus wave run-up) on the upstream face of the dykes is a function of wind speed and fetch length (i.e., the length of water over which a given wind blows) as formulated by USACE (2006). The hourly wind speeds for the relevant return period were determined through frequency analysis using the wind data from the Hay River station from 1953 to 2016 and are presented in Table 2-17.

Table 2-17: Extreme Hourly Wind Events

Return Period (years)	Wind Directions[a] and Wind Speed (km/h)							
	North	Northeast	East	Southeast	South	Southwest	West	Northwest
2	39.9	37.9	37.1	35.5	39.3	37.8	44.8	51.0
10[b]	**55.4**	**45.0**	**44.0**	**44.7**	**47.4**	**47.2**	**51.5**	**61.1**
50	70.6	48.2	47.5	51.5	53.2	53.2	55.4	66.7
100	77.7	49.1	48.4	54.3	55.5	55.1	56.7	68.6
200	85.1	49.8	49.2	56.9	57.6	56.9	57.9	70.3
500	95.5	50.5	50.1	60.3	60.4	58.9	59.4	72.3
1,000[c]	**104.0**	**50.9**	**50.5**	**62.8**	**62.5**	**60.1**	**60.4**	**73.6**

(a) The wind direction indicates the direction from which the wind is blowing.

(b) Design Criteria for Scenario 2.

(c) Design Criteria for Scenario 1.

Winds blowing from the north and northwest direction would generate wave movement away from the dikes and were therefore not considered in the assessment of uprush. Wave uprush was estimated for all other directions. The combination of the wind speed and fetch length that resulted in the highest wave uprush is generated by winds blowing from the east.

The input parameters for the two scenarios mentioned above and for an east wind direction were as follows:

- Scenario 1:
  - an operational pond elevation of 201.6 m, which corresponds to the maximum observed TIA pond level before treatment from 1998 to 2016 (Table 6-2)
  - fetch length of 1,700 m for the east wind (50.5 km/h)
- Scenario 2:
  - maximum water level at the passage of the IDF of 202.8 m, which is based on the results of the flood routing for the 1-in-1,000-year flood event when there are frozen/saturated ground conditions (Section 2.7.3.2.2) and the pond was already at a maximum operational level of 201.6
  - fetch lengths of 2,000 m for the southwest wind (44.0 km/h)

The estimated wave uprush heights and corresponding elevations are provided in Table 2-18.

Table 2-18: Wave Uprush Heights and Elevations

Scenario	Wind Return Period (years)	Pond Elevation (m)	East Wind	
			Wave Uprush Height (m)	Wave Uprush Elevation (m)
1	1,000	201.6[(a)]	0.53	202.13
2	10	202.8[(b)]	0.52	203.32

(a) 201.6 is the maximum observed TIA pond level before treatment from 1994 to 2016.

(b) 202.8 m is the maximum pond elevation during the 1-in-1,000-year flood event, assuming frozen/saturated ground conditions and the TIA pond at 201.6 m at the beginning of the storm.

TIA = tailings impoundment area.

Based on the results of the assessment, the following levels have been set:

- an alert level of 201.6 m
- a maximum operational pond level of 201.8 m

The alert level is the elevation at which the site manager should be informed immediately, and water treatment should start as early as practicable. A site inspection should take place one week after the initial alert level observation. The maximum operational pond level the maximum level at which the pond level is in compliance with all CDA guidelines for the provision of freeboard to prevent overtopping. At this level, the pond should be able to sustain the 1-in-1,000-year flood event when there are frozen/saturated ground conditions as well as a 1 in 10 year wind without overtopping. At higher levels, there would be a risk of overtopping of the dyke under this combination of circumstances. Once the pond level reaches the maximum operation level actions to reduce the water level within the pond should commence immediately.

2.7.4 Seismic and Static Stability

2.7.4.1 Foundation Conditions

There is no known documentation of site investigation that may have been conducted prior to construction of the dykes. Conditions have been inferred from the site geology, which indicates the TIA dykes are underlain by very stiff silty clay with isolated pockets of gravel. Soil units under the clay and gravel are unknown. Along parts of the dyke alignment, local pockets of peat were encountered during construction. These were not removed in the initial construction phase, but were removed during subsequent dyke crest raises.

2.7.4.2 Embankment Fill Materials

The initial perimeter dyke was developed with silt-clay and without a downstream gravel blanket. The clay material for the dyke construction was obtained from borrow pits to the west of the TIA (these pits are now flooded). The sand and gravel needed for the dyke extensions were obtained from borrow pits to the southwest or east of the TIA.

The available information suggests that:

- The north and west dykes were developed with a clay zone on the pond side to act as a low permeability zone, and a downstream shell was built with sand and gravel to maintain a low phreatic surface through the dykes. Dyke raises for the north and west dykes were constructed using downstream construction methods and included a downstream gravel toe zone which was overlain at the top of the dyke section by a 1 to 2 m thick layer of local silt or silty clay. Typical sections of the west and north dyke are shown in Figures 3 and 4 respectively.
- A very limited clay zone was developed on the pond side of the south dyke, with the bulk of the dyke developed with sand and gravel. The south dyke was not designed or built to retain water, only tailings.
- The east dyke was not developed with a clay upstream or pond side low permeable zone.

2.7.4.3 Original Design Intent

Original design documents for the dykes are not available.

2.7.4.4 Existing Conditions and Current Design Status

The 1981 stability review indicated that:

- The north dyke had a global static stability Factor of Safety of 1.8 because of the existing toe berm. The dyke was noted to have a Factor of Safety of 1.4 for a shallow slumping failure of the upper surface of the downstream slope, but this was not deemed to represent a critical surface, provided any slumping of the slope was repaired.
- The west dyke had a global static stability Factor of Safety of 1.4 with no toe berm. The subsequent dyke raise included a toe berm which raised the static Factor of Safety to 1.5.

The 1981 stability review did not calculate a seismic Factor of Safety against failure for the dykes as the 1980 Building Code specified a very low seismic risk for the site. As part of the 2010 DSR (SRK 2010), an independent slope stability analysis was completed for the north and west dykes under pseudo-static conditions. This analyse used a horizontal PGA of 0.059 g, based on the 2005 National Building Code seismic hazard calculator (NRC 2005) for the 1-in-2,475-year event.

The National Building Code was updated following the 2010 DSR, and the 2010 National Building Code seismic hazard calculator (NRC 2011) indicates a PGA for this site of 0.019 g for the 1-in-1,000-year event (5% probability of exceedance in 50 years), and 0.036 g for the 1-in-2,475-year event (2% probability of exceedance in 50 years).

A stability review was completed as part of the 2014 Dam Safety Review (DSR) (SRK 2016). This analysis used a horizontal peak ground acceleration (PGA) of 0.019 g, based on the 2010 National Building Code seismic hazard calculator (NRC 2011) for the 1-in-1,000-year event.

Complete stability analysis were carried out for the North and West Dykes. The analysis indicated factors of safety of between 1.4 and 1.5 for the North Dyke and 1.3 and 1.6 for the West Dyke under seismic loading condition (a minimum factor of safety of 1.0 is recommend by CDA 2013 for seismic loading conditions).

The selected seismic event meets the requirements for a facility in the Closure-Active Care phase of mine life, as defined by CDA (2014). Should the TIA move to the Closure-Passive Care phase, the stability of the facility should be assessed for the 1-in-2,475 year event (2% probability of exceedance in 50 years) as detailed in CDA (2014).

All static factors of safety were in excess of the 1.5 recommend by CDA (2013).

2.7.5 Geometry

2.7.5.1 Original Design Intent

Original design documents for the dykes are not available.

2.7.5.2 Existing Conditions and Current Design Status

The geometry of the dykes is summarized in Table 2-19. Typical sections of the west dyke and north dyke are shown in Figures 3 and 4 respectively.

Table 2-19: Tailings Impoundment Area Current Dyke Geometry

Dyke	Downstream Slopes	Upstream Slopes	Crest Width (m)	Embankment Height (m)
North	2 horizontal to 1 vertical	2 horizontal to 1 vertical	4 to 5	1 to 15
West	2 horizontal to 1 vertical	steeper than 2 horizontal to 1 vertical, but are now buried or supported by tailings	4 to 5	4 to 15
South	2 horizontal to 1 vertical	1.5 horizontal to 1 vertical	generally 3.5 m wide with several narrower sections	0 to 4
East	unknown	unknown	unknown	up to 1

2.7.6 Dam Breach and Inundation Study

No dam breach and inundation study has been completed for the Pine Point TIA.

2.7.7 Design Criteria Summary

Table 2-20 summarizes the design criteria for the TIA.

Table 2-20: Tailings Impoundment Area Closure–Active Care and Design Criteria

Design Feature	Criteria	Source	Original Assessment	Updated Assessment	Meets Criteria	Comments
Dam safety inspection	required to be completed annually	CDA (2013, 2014)	NA	in progress	Y	
Dam Safety Review	required to be completed every 10 years	CDA (2013, 2014)	NA	SRK 2016	Y	
Emergency Preparedness and Response Plan	NA	CDA (2013, 2014)	NA	in progress	Y	
OMS Manual	NA	CDA (2013, 2014)	NA	OMS Manual (2018)	Y	
Freeboard	two calculations for freeboard with the more critical of the two cases setting the minimum freeboard	CDA (2013, 2014)	NA	OMS Manual (2017)	Y	
Inflow design flood	between 1/100 and 1/1,000 year return period	CDA (2013, 2014)	NA	OMS Manual (2017)	Y	
Earthquake design ground motion	between 1/100 and 1/1,000 year return period	CDA (2013, 2014)	NA	SRK 2016	Y	PGA for 1-in-1,000-year event of 0.019 g used
Factory of Safety	long term static – 1.5	CDA (2013, 2014)	NA	SRK 2016	Y	post-earthquake condition not analysed
	pseudo-static – 1.0	CDA (2013, 2014)	NA	SRK 2016	Y	
	post-earthquake – 1.2	CDA (2013, 2014)	NA	required	out of date	

OMS = operation, maintenance and surveillance; PGA = peak horizontal ground acceleration; NA = not available; NBCC = National Building Code of Canada.

2.8 Construction History

Mine construction started in 1962 and mining operations in 1964. The initial perimeter dyke was developed with silt-clay and without a downstream gravel blanket. The clay material for the dyke construction was obtained from borrow pits to the west of the TIA (these pits are now flooded). The sand and gravel needed for dyke raising were obtained from borrow pits to the southwest or east of the TIA. The tailings dykes were raised and extended in several stages during the life of the mine as required to contain the increasing volume of mill tailings. The last three crest level increases to the dykes were as follows:

- **1976**—The crest of the north dyke was raised to elevation 203.5 m above mean sea level or some 2.1 m above the previous crest. Also, the dyke was extended eastward to the northeast corner of the pond. Construction of a segment of the east dyke was also carried out.
- **1981**—During the summer of 1981, the west and south dykes were raised and the south dyke extended eastwards.
- **1987**—The height of the perimeter dykes was again raised in July and August 1987 to provide additional tailings storage. Fill was added to the south, west, and a portion of the north dyke at this time. The increase in height of the dyke was generally 1 m or less.

2.9 Training Requirements

Teck site inspectors are required to have completed the following training courses:

- Inspection & Maintenance of Dams, Dam Safety Guidelines, Province of British Columbia Waste Management Branch, Version 2, March 2011.

2.10 Documentation and Document Control

Teck has set up procedures for the retention of information. Once a document has been revised, the version number is updated, at which time the revised procedure is flagged as necessary training to all applicable employees.

Historical reports on the Pine Point TIA and reports from external consultants conducting work on the Pine Point TIA are kept by Teck at its administrative office and electronically on its server in Kimberley, BC, as follows.

Teck Resources Limited
601 Knighton Road
Kimberley, BC
Canada
V1A 3E1

3.0 OPERATIONS

3.1 Objectives

The objective of this section is to define operating standards and procedures in accordance with design criteria, regulatory requirements, company policies, and best operating practices.

3.2 Tailings Transport and Deposition

Pine Point is a closed site, and there is no ongoing tailings transport and deposition.

3.3 Equipment Operating Instructions

Pine Point is a closed site, and equipment operations at Pine Point only relate to water management at the TIA. Refer to Section 3.5 for surface water management operating instructions.

3.4 Dam and Impoundment Raising

Pine Point is a closed site, and no raises to the dam are undertaken or planned at this time.

3.5 Surface Water Management and Water Balance

3.5.1 Water Release

The following operational practices should be applied to the TIA:

- The polishing pond should be operated as instructed in the Water Treatment Manual (Teck 2017) and Water Treatment Management Plan for Upset Conditions (SRK 2018), a copy of which is provided in Appendix E. when water treatment is implemented. The applicability of this document should be reviewed on a regular basis and updated if required. The release of treated water must be controlled to maximize retention time in the polishing pond, which will allow the reaction of constituents such as zinc in the water with the lime solution employed in the treatment process.
- Water treatment should proceed until no water can be conveyed through the culvert between the main and polishing ponds by gravity flow, which would occur when water elevation reaches elevation 200.0 m.
- Visits to site for general inspections (Section 4.3.1) should be made at least three times per year during the open water period, namely during spring (April to May), summer (June to August), and fall (September to October) to determine compliance with the alert level (201.6 m) and maximum operational water level (201.8 m).

- A general inspection should also be undertaken after extreme weather events as noted by the monitoring program (Section 4.3.8). If water elevation is observed at or above the alert level (201.6 m) during any visit, the site manager should be informed immediately and water treatment should start as early as practicable. Another inspection should be scheduled one week later. If water elevation is observed below 201.6 m, water treatment should be initiated in July, per standard operating practice.
- Instructions provided in the Contingency Manual (Appendix C) should be followed in the event of the discharge of untreated water.

A flow chart diagram summarizing the operational and climate monitoring practices for water releases, and a diagram of infrastructure elevation benchmarks is attached in Appendix A.

3.5.2 Water Treatment

Water Treatment Manual (Teck 2017) and Water Treatment Management Plan for Upset Conditions (SRK 2018) must be consulted for details of operational practices for water treatment. Only a brief description of these practices is given in this section.

Water treatment on site consists of a lime solution, prepared in a slurry tank, which is fed with a peristaltic pump to the water flowing in the culvert connecting the main pond to the polishing pond. The amount of lime used is estimated from the historical records of treated water discharge and the water elevation in the TIA. Historical consumption of lime indicates that an average amount of 0.17 kg of lime should be used for every 1 m^3 of released water.

During the water treatment period, the following tasks are undertaken daily:

- Activate power to the treatment facility.
- Prepare the lime solution in the slurry tank by mixing lime and water to achieve a slurry density of 17% solids.
- Generate a water flow in the polishing pond by opening the culvert.
- Feed the lime solution to the water in the culvert by activating the peristaltic pump.
- Adjust the pump speed to achieve a desired pH in the water of 9.3 (Teck 2017).
- If the pH at station 35-1b exceeds 9.3, specific actions should be implemented as detailed in Water Treatment Management Plan for Upset Conditions (SRK 2018).
- At the end of the day, stop the flow (i.e., close the culvert and spillway gate) and turn off the power to the treatment facility.

The constituents in the water, such as zinc, precipitate out to form solids that settle to the bottom of the polishing pond under low velocity (high retention time). These solids form a sludge which is dredged periodically to preserve the capacity, and therefore the retention time, of the polishing pond. The dredged material is removed from the polishing pond and placed within the TIA footprint.

The revised water licence (MV2017L2-0007, Appendix D) requires that pH in the discharge from SNP station 35-1b is maintained between 6.5 and 9.5. Teck is considering a number of additional engineering controls for ongoing compliance with this. Teck will implement the most suitable of these controls in time for the summer 2018 treatment campaign. Further control measures may be identified and implemented depending on the confidence in the preferred solution. The Water Treatment Management Plan for Upset Conditions (SRK 2018), included as Appendix E, describes the engineering solutions under consideration as well as providing the following:

- A description, including detailed rationale, of the monitoring endpoints (Action Levels) for each parameter monitored in the SNP.
- Mitigation measures for decreasing pH at SNP station 35-1b if it exceeds effluent quality criteria.
- A description of response actions to be carried out if the Action Levels are exceeded.

3.5.3 Water Balance

The water balance for the TIA describes the yearly amount of water released from the facility as the sum of rainfall and snowfall, minus sublimation and snow redistribution, evaporation and evapotranspiration, and infiltration. An annual water balance was performed for the TIA (

Table 3-1), from 1993 to 2017, to estimate total losses from evaporation, evapotranspiration, and infiltration. The following assumptions were considered in the water balance:

- Rainfall and snowfall are based on derived precipitations for Pine Point from 1993 to 2016.
- Sublimation and snow redistribution reduces snowfall values by 31%.
- Infiltration occurs over the whole watershed area, which includes the TIA.
- The effects of evaporation, evapotranspiration and infiltration are combined into a single term called total losses.
- Evaporation only occurs in the main pond, which constitutes only a small percentage of the total watershed area of the TIA. Evapotranspiration affects the remaining area of the watershed (i.e., land area). Estimation of the respective amount of evapotranspiration and infiltration cannot be supported with direct observations, however, a previous study concluded that evapotranspiration is greater than precipitation at the location of Pine Point mine (Golder 1996).

The documented volume of water released (Table 6-2) was converted into an equivalent water depth for use in this water balance. This was calculated by dividing the documented volume of water released by the watershed area of the TIA (approximately 9 km^2). The equivalent water depth is termed Net Water Released in Table 3-1.

Table 3-1: Water Balance in the Main Pond

Year	Rainfall (mm)	Snowfall [(a)] (mm)	Total Losses [(b)] (mm)	Net Water Released (mm)
1993/4	158	201	314	45
1994/5	108	253	278	83
1995/6	168	115	252	31
1996/7	344	142	468	18
1997/8	275	145	401	19
1998/9	336	184	498	22
1999/0	201	118	310	9
2000/1	252	249	463	38
2001/2	392	282	634	40
2002/3	223	213	409	27
2003/4	174	244	396	22
2004/5	226	274	491	9
2005/6	283	201	457	27
2006/7	272	332	590	14
2007/8	198	380	562	16
2008/9	364	463	801	26
2009/10	220	427	620	27
2010/11	325	354	658	21
2011/12	168	508	649	27
2012/13	223	673	869	27
2013/14	195	321	491	25
2014/15	250	295	537	8
2015/16	354	342	660	36
2015/2017	214	357	49	522

(a) The snowfall amounts in the table are adjusted to account for sublimation and snow redistribution.

(b) Total losses consist of the effects of evaporation, evapotranspiration and infiltration.

The water balance results (Table 3-1) indicate that water had been released every year since 1993, and that there is a strong linear relationship between the values of total precipitation (i.e., rainfall plus snowfall) and total losses (Plate 3). The square of the correlation coefficient (R^2 value, or the coefficient of determination) for these two variables is 0.987 (Plate 3). This relationship indicates that 95% of total precipitation is removed from the basin as total losses. Consequently, the water released from the TIA constitutes approximately 5% of the total precipitation.

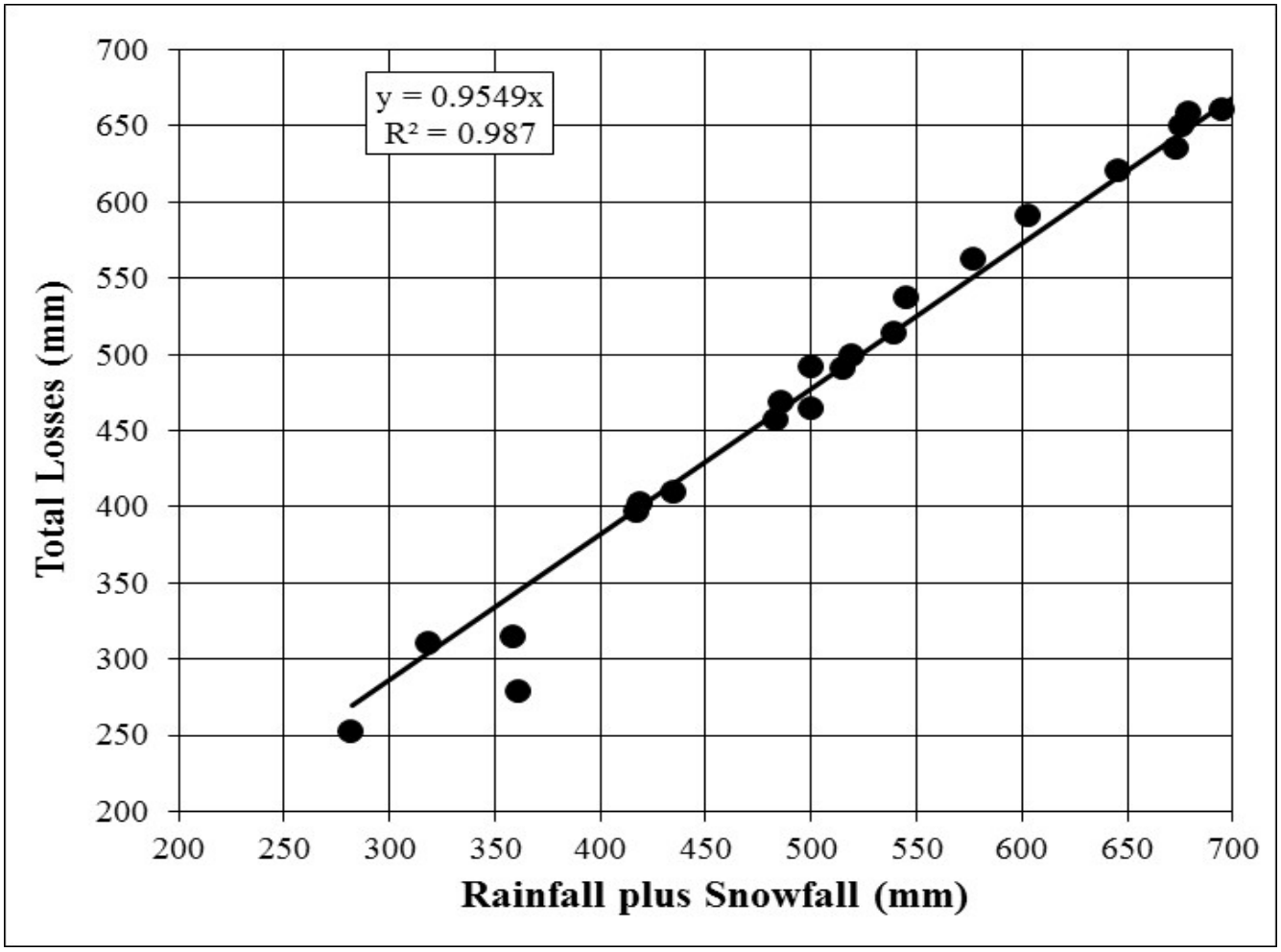

Plate 3: Relation between Total Losses and Total Precipitation (rainfall plus snowfall)

3.6 Environmental Protection

Refer to section 3.5.1 and 3.5.2 for surface water release and treatment operating instructions.

3.7 Safety and Security

The site currently does not have access restriction. It is a remote site, which historically has had little unauthorized access.

3.8 Change Management

The site manager will be responsible for ensuring that any changes at the facility or within management is reflected in the OMS Manual and subsequently reviewed, approved, and distributed accordingly.

3.9 Documentation

The OMS Manual and all associated documents shall be kept current with appropriate practices and procedures and at minimum, reviewed annually by the required personnel (Table A-1).

3.10 Reporting

Records of yearly water releases, lime consumption for water treatment, and water elevations in the main pond at the start and end of the treatment phase are to be kept.

4.0 SURVEILLANCE

4.1 Objectives

A surveillance program is implemented to assess the current performance of a facility relative to its intended design parameters.

The objective of the surveillance program is to provide confirmation of the adequate performance of the facility, including containment, stability, and operational function by observing, measuring, and recording data relative to potential failure modes.

4.2 Surveillance Parameters

4.2.1 Potential Physical Stability Failure Modes

The following represent the different failure modes applicable to the physical stability of the Pine Point TIA:

- overtopping
- instability
- piping

4.2.2 Visual Parameters

Table 4-1 outlines the different failure modes applicable to the Pine Point TIA and visual observations which may indicate potential failure.

Table 4-1: Failure Modes and Identification

Failure Mode	Conditions to Identify Potential Failure Mode
Overtopping	■ water elevation ■ meteorological event
Instability	■ cracking ■ settlement ■ bulging ■ seepage ■ erosion ■ seismic event
Piping	■ seepage ■ wet spots downstream of dam toe ■ sinkholes, depressions

4.2.3 Instrumentation Installation Details

There is no geotechnical instrumentation (piezometers, inclinometers or settlement gauges) in the dykes at the Pine Point mine.

A water level gauge is present at the culvert from the north dyke to the polishing pond, for the monitoring of pond water levels.

4.2.4 Instrumentation Parameters and Thresholds

Details of the operation benchmark and warning elevations for the water level gauge, present at the culvert from the north dyke to the polishing pond, are presented in Section2.1.1.

4.2.5 Sampling and Testing Location Details

The Type B Water Licence issued by MVLWB to Teck for the Pine Point site (licence number MV2017L2-0007) details a water sampling program (i.e., Surveillance Network Program) that must be implemented (Annex A of the Water License). Reference should be made to the Water Licence for the details of sampling and testing locations.

4.2.6 Sampling and Testing Parameters and Thresholds

The Type B Water Licence issued by MVLWB to Teck for the Pine Point site (licence number MV2017L2-0007) details a water sampling program (i.e., Surveillance Network Program) that must be implemented (Annex A of the Water License). Reference should be made to the Water Licence for the details of sampling and testing locations.

4.3 Surveillance Procedures

4.3.1 Defined Frequency, Schedule, and Procedures

A program of regular periodic surveillance is required to ensure that the TIA is performing adequately and that any problems are detected so that the necessary corrective actions can be implemented in a timely manner. Site inspections will be conducted as per the following frequencies:

- General inspections of the TIA are to occur each spring after the freshet (April to May), summer (June to August), and prior to spring freeze-up in the fall (September to October).
- Geotechnical inspections of the dykes are to be arranged each summer; and following any extreme weather or seismic events (i.e., extreme wind, rainfall or earthquakes).
- DSRs are to be conducted every 10 years.
- Water quality is to be monitored as per the Type B Water license (MV2017L2-0007), Appendix D.

The general inspections are the responsibility of any personal visiting the site. The general inspection in spring (April to May) is to be scheduled no later than two weeks after a period of two weeks with air temperatures above 0°C, and no later than 31 May of each year, ideally prior to or during the spring freshet period. The site is also to be inspected during the summer, and prior to start of the winter period to gauge the water management needs.

The geotechnical inspections are the responsibility of the geotechnical specialist, and a geotechnical inspection is to be conducted at least once a year.

An independent DSR should be undertaken by an external consultant or third party.

The site manager is responsible for the implementation of all visits conduced on site.

4.3.2 Visual Monitoring

General inspection forms are attached in Appendix B. The general inspections involve a brief assessment of the TIA and should cover the tasks noted below:

- observation of compliance with the main pond alert level (201.6 m) and maximum operational pond level (201.8 m)
- general characterization of the dyke crests
- observation of any evidence of significant slope instability, sloughing or slides
- observation and recording of deterioration and damage to the access roads to confirm yearly site access; deterioration or damage to the access roads include:
  - any indications of instability (e.g., potholes, slumping, or cracks) in the road or the supporting fills below the road
  - any accumulations of debris or other materials on the road or paths

If seepage is observed through the dykes, the seepage should be inspected. If the seepage flow is “clear,” small local collection ditches and/or retention pools should be developed to allow monitoring of the flows to the existing surface water management system. If the seepage flow is “cloudy,” the geotechnical specialist or EoR should be informed and a site visit arranged. In addition, measures should be started to develop and construct a gravel filter zone in the area of the seepage to minimize the loss of dyke material. These water management actions would be built on the downstream side of the dykes at the site of the seepages.

The geotechnical inspections of the dyke should provide an assessment of both the upstream and downstream faces of the TIA dykes. The tasks for the upstream slope inspection entail observations of:

- any water ponding against the face
- any indication of cracking on the face
- any distortion or displacement of the face

The tasks for the downstream slope inspection include observing the following:

- any indication of cracking of the dam fill
- any areas of local subsidence of the dam fill
- any areas of water ponding
- any areas of accumulation of fines or other unsuitable materials
- any areas of vegetation growth

4.3.3 Survey and Bathymetry

A topographic survey of the tailings facility at the location of the main pond will be made every 10 years or if observations during previous site visits indicate significant changes in the topography of the TIA. The survey will be used to recalibrate the water storage capacity of the main pond and include a check on the north dyke crest elevations.

The last survey of the Pine Point TIA was completed in November 2008 (Maskwa 2008a). No bathymetry has been completed for the TIA.

4.3.4 Instrumentation Measurements

The water level at the gauge will be recorded during each site inspection and as per standard procedure during the water treatment period (SRK 2018). The most accurate water elevations would be obtained when no flow is conveyed through the culvert or spillways. It is therefore preferable that the culvert gate valve be shut when a water level is recorded.

4.3.5 Sampling and Testing

The Type B Water Licence issued by MVLWB to Teck for the Pine Point site (licence number MV2017L2-0007, Appendix D) is valid from 25 October 2017 to 24 October 2027. The licence details a water sampling program (i.e., Surveillance Network Program) that must be implemented for the monitoring of water quality parameter concentrations in the TIA, discharges from the TIA and at select locations in the receiving aquatic environment. This sampling program is applicable to both the regulatory requirement of the water licence and the operation, maintenance and surveillance program for the TIA.

Sample collection, preservation, and analyses should be conducted in accordance with methods prescribed in the most up to date edition of *Standard Methods for the Examination of Water and Wastewater* (APHA 2017), or equivalent. The site manager is responsible for selecting an approved laboratory where the samples will be analyzed. The site manager is also responsible for reviewing the quality assurance and quality control (QA/QC) plan for the laboratory and planning for a QA/QC procedure (i.e., collecting split and blank samples) within the sampling program for Pine Point. The sampling program, laboratory selection, and QA/QC must be accepted by an analyst from MVLWB.

The water management/treatment operator is responsible of conducting the water sampling program. As a support to that program, this person must also undertake the following tasks:

- record the daily and annual volume of water discharged from the polishing pond to the aquatic environment
- record the water level in the main pond three times a year in conjunction with the water samples performed in the TIA (spring, summer, and fall)

4.3.6 Weather Stations

Reference should be made to Table 2-2 (Section 2.3.2) for a list of weather stations near Pine Point.

Observations of air temperature, rainfall and snowfall are available publicly for Hay River. These observations can be obtained from Environment Canada (https://www.canada.ca/en/services/environment/weather.html). Hourly and daily temperature as well as daily precipitation records are available for download in Excel compatible files (i.e., CSV files). The data should be compiled and processed by the site manager or an assigned member of their staff. The processing should include applying the rainfall and snowfall weighting and under-catch factors that are identified in Table 2-4 to the data from Hay River to determine precipitation at Pine Point. All the downloaded data should be summarized each year by the site manager or designate to determine the cumulative or total precipitation on a yearly basis at the TIA. The information will assist in determining trends to assist with the oversight of the water management system. At present, these data are reviewed annually and reported as part of the annual DSI.

In anticipation of extreme events, the site manager should subscribe to the Weather Network weather alert service (http://www.theweathernetwork.com/) or similar, and check the Environment Canada website for public weather alerts (http://weather.gc.ca/warnings/index_e.html) on a regular basis.

Rainfall data at Hay River should be collected from Environment Canada following any heavy rainfall warning issued between April and September. Environment Canada defines heavy rainfall as 7 mm per hour or more.

If total rainfall during any five days exceeds 50 mm, which is equivalent to a 10-year daily rainfall event (Table 2-13), an inspection should be scheduled as soon as practical. This procedure is included in the flow chart diagram showing operational and climate monitoring practices for water releases in Appendix A.

4.3.7 Triggers for Change of Operations

The Pine Point TIA is not in operation.

Ongoing surveillance is intended to detect any unusual conditions that could signify potential issues with the site, as described in Section 4.2 of this document. If any unusual conditions are observed, the site manger must be informed immediately. Depending on the nature and severity of the condition observed, the EoR may be contacted or the EPRP may be initiated. The decision to execute the EPRP shall only be made once an incident exists (i.e., possible failure or failure of a dyke) and there is a serious risk to facilities and/or downstream stakeholders.

4.3.8 Event-Driven Procedures

In addition to the routine and periodic inspections, special inspections may be required during (if possible) and after unusual or significant seismic or climatic events. Significant climatic events include heavy rainfall and spring freshet floods.

Teck staff should carry out the special inspections after significant events, and the EoR should be notified. If there are any concerns with areas of the dyke, then the site manager would arrange to bring in the EoR for further inspections and review.

4.3.9 Data Collection, Analysis, and Documentation

Inspection reports and water quality results are maintained by Teck at its administrative office, and electronically on its server, in Kimberley, BC.

4.3.10 Periodic Inspections and Review

4.3.10.1 Annual Dam Safety Inspection

A comprehensive review of the Pine Point TIA and its management should be undertaken annually by the EoR or designate. This review shall be submitted to MVLWB within 90 days of the date on which the inspection takes place. The inspection shall consist of a geotechnical assessment of the conditions of the dykes, spillways, and would typically be conducted following the freshet period.

Starting with the 2018 review report all future reports will be produced to meet the 90 day timescale. This will include the reporting of all data available up to 30 days following the inspection. Reporting will exclude the routine inspection carried out in fall each year (and include the routine inspection conducted in the fall of the previous year). Inspection reports are stored by Teck at its administrative office, and electronically on its server, in Kimberley, BC.

4.3.10.2 Dam Safety Review

The Canadian Dam Association Dam Safety Guidelines (CDA 2013) recommends that a DSR be conducted once every 10 years for embankments/dykes with a ‘Significant’ dam classification, such as the west and north TIA dykes. The last DSR was conducted in 2014 (SRK 2016). The next DSR for these dykes is therefore scheduled for 2024.

All dam safety review reports are stored by Teck at its administrative office, and electronically on its server, in Kimberley, BC.

5.0 MAINTENANCE

5.1 Objectives

Facility maintenance is important to the safe operation of the TIA and the effective management of the ponded water. It is the responsibility of the site manager to ensure that the TIA is properly maintained.

The objectives of the maintenance program are to:

- identify and describe critical parts of the facility
- address routine, predictive/preventative, and event-driven maintenance
- address operating and surveillance observations for all components of the facility

5.2 Inventory of Components Requiring Maintenance

The following components of the Pine Point TIA may require maintenance over the facility's lifetime:

- access
- dykes
- culverts
- spillways

5.3 Maintenance Schedule and Triggers

The TIA should be subject to a regular maintenance program.

The site manager for Pine Point should have sufficient personnel or access to a contractor in close proximity to the site to perform necessary repairs to the TIA infrastructure. These repairs would be planned tasks to address issues identified during the regular inspections (Section 4.3.1) or inspections due to extreme weather or reported sudden change in TIA conditions.

Contractors in Hay River who have experience with earthworks and who could be contacted are:

- Carter Industries Ltd., 40 Studney Drive, phone: 867-874-6574
- Rowe's Construction, 25 Studney Drive, phone: 867-874-3243

5.4 Maintenance Parameters

There are no maintenance parameters.

5.5 Routine and Preventative Maintenance

5.5.1 Access

The access road to the site of the TIA is on Crown land; however, any observed road deterioration or damage during site visits should be recorded. If it is noted that it is necessary to carry out a maintenance program, this will require coordination with MVLWB to confirm access to the TIA site. The maintenance program may normally include regrading of the gravel site access roads as needed. It is not anticipated that extensive work would be required.

5.5.2 Dykes

Maintenance work required on the dyke structures to control seepage and erosion should be carried out as needed and comprise the following activities:

- Regrade dyke crests and replace granular road surfacing material to maintain crest design profiles.
- Replace and regrade fill materials lost on the downstream face and road surface (such as may be eroded by rainfall runoff).
- Replace and regrade fill materials lost on the pond side slope and regrade the adjacent road.

  Ongoing removal of vegetation is required to protect dyke integrity, in particular to prevent the growth of larger trees and the damage to the dykes that could occur in the event of treefall. Any tree on the dykes with a trunk diameter greater than 100 mm should be cut within 50 mm of the ground surface. Any vegetation on the north and west dykes with a trunk/stem diameter larger than 20 mm should be cut to within 50 mm of the ground surface. If herbicide is to be used to control vegetation, all trees with a diameter greater than 20 mm are to be cut off within 50 mm of the ground surface prior to herbicide application.

5.5.3 Culvert

The conveying capacity of the culvert connecting the main pond to the polishing pond must be maintained. The culvert should be kept clean of any blockages from soil material or vegetation. The valve should also be maintained in an operable condition.

5.5.4 Spillway

In order to maintain the efficiency of the spillway, the following activities should be undertaken:

- The conveying capacity of the spillway must be maintained. The spillway should be kept clean of any blockages from soil material or vegetation.
- A reserve of clay should be on site to fill the clay plug at the spillway, if needed, to minimize seepage.

5.6 Event-Driven Maintenance

After a special inspection due to an event-driven inspection, event-driven maintenance may be required. The maintenance should be completed as soon as possible.

5.7 Documentation

Maintenance records and summaries are maintained by Teck at its administrative office and electronically on its server in Kimberley, BC.

6.0 REPORTING AND COMMUNICATION

6.1 Communications

Contacts for the Pine Point operation are listed in Table 6-1.

Table 6-1: Pine Point Contacts

Name	Contact Number
Stephen Parris (site manager)	Office: 250-427-8438 Mobile: 250-427-6012
Michelle Unger (alternate)	Office: 250-427-8422 Mobile: 250-432-5264

6.2 Operations Reporting

Records of yearly water releases, lime consumption for water treatment, and water elevations in the main pond at the start and end of water releases are to be kept. The totals from 1994 to 2017 are provided in Table 6-2.

Table 6-2: Lime Consumption and Water Levels at the Tailings Impoundment Area

Year	Lime Consumption (tonnes)	Volume of Water Releases (m^3)	Water Level in the TIA at the Start of Water Releases (m)	Water Level in the TIA at the End of Water Releases (m)
1994	17.0	410,000	NA	NA
1995	65.0	748,000	NA	NA
1996	44.0	274,000	NA	NA
1997	NA	164,164	NA	NA
1998	NA	162,661	202.0	200.3
1999	NA	196,381	201.2	200.5
2000	NA	86,917	200.7	200.4
2001	95.0	336,648	201.6	200.3
2002	89.9	359,173	201.6	200.6
2003	66.5	237,494	201.3	200.3
2004	43.0	197,931	201.1	200.3
2005	23.0	86,457	200.8	200.4
2006	46.0	244,791	201.3	200.3
2007	29.0	122,374	201.0	200.3
2008	27.1	139,000	201.1	200.5
2009	50.5	240,000	201.4	200.4
2010	42.2	237,700	201.4	200.4
2011	25.8	190,000	201.2	200.4
2012	20.0	240,617	201.1	200.3

Year	Lime Consumption (tonnes)	Volume of Water Releases (m^3)	Water Level in the TIA at the Start of Water Releases (m)	Water Level in the TIA at the End of Water Releases (m)
2013	20.0	240,486	201.1	200.4
2014	20.0	226,954	201.1	200.3
2015	12.0	79,088	201.0	200.4
2016	28.0	320,124	201.4	200.4
2017	39.5	440,218	201.5	200.4

TIA = tailings impoundment area; NA = not available.

6.3 Surveillance Reporting

Surveillance reporting must be completed as follows:

- three times a year (spring, summer, and fall) for general inspections
- annually for the geotechnical DSI
- every 10 years for a DSR
- any time a special inspection due to extreme weather is carried out

A list of the general inspections from 1990 to 2017 are shown in Table 6-3.

Table 6-3: List of General Inspections

Year	Month
1990	May
1992	May
1994	June
1996	June
1998	June
2000	July
2002	July
2004	July
2005	July
2006	July
2007	July & October
2008	August
2009	May & October
2010	May, July & October

Year	Month
2011	May, July & October
2012	May, August & October
2013	May, July & October
2014	May, July & October
2015	May, July & October
2016	May, July & October
2017	May, July & October

It is the responsibility of:

- any personnel visiting the site to report (i.e., letter or electronic mail) to the site manager within a day any observed issues that require immediate maintenance or repair
- any personnel visiting the site to report (i.e., letter or electronic mail) to the site manager within one week any other observed issues that require maintenance or repair
- the geotechnical specialist to prepare a memorandum for each geotechnical inspection, describing the observation made during the visits on site
- the water management/treatment operator to prepare summary tables summarizing water volume discharged to the aquatic environment and transferred to the polishing pond from the TIA, water level in the TIA, volume of lime used, and water quality sampling results

Observations made during general and geotechnical inspections must be catalogued in field books. Photocopies of the used pages of the field books should be made for safekeeping. Copies of field notes or field books should be stored at the project office location when not in use.

As a requirement of the water licence (MVLWB 2017; Appendix D), an annual report must be submitted by 31 March of every year. The reports must include all of the data and information required by the Surveillance Network Program described in the water licence (Section 4.3). It is the responsibility of the site manager to prepare these annual reports, which would include the summary tables prepared by the water management/treatment operator. The Pine Point site manager is responsible to submit copies to MVLWB and any other agencies. The site manager would also prepare quarterly activity reports for Teck.

A comprehensive review of the Pine Point TIA and its management should be undertaken annually by the EoR or designate. This review shall be submitted to MVLWB within 90 days of the date on which the inspection takes place. The inspection shall consist of a geotechnical assessment of the conditions of the dykes, spillways, and would typically be conducted following the freshet period. Starting with the 2018 review report all future reports will be produced to meet the 90 day timescale. This will include the reporting of all data available up to 30 days following the inspection. Reporting will exclude the routine inspection carried out in fall each year (and include the routine inspection conducted in the fall of the previous year).

The site manager is also responsible for the preparation of the DSR report, which must be produced every 10 years. The content of the report should meet the requirements provided in the latest Dam Safety Guidelines published by the Canadian Dam Association, Currently CDA 2013.

Hard copies of all documents produced in the reporting process are to be stored at the project safe keeping location. All electronic documents are to be saved on a safe computer or network drive. All documents will be retained for a period of time defined in Teck 2014.

6.4 Maintenance Reporting

It is the responsibility of the water management/treatment operator to maintain and keep updated an electronic database cataloguing all quantitative data collected on site, including:

- water volume discharged to the aquatic environment from the polishing pond
- water level in the TIA
- quantity (in tonnes) of lime used
- water quality sampling results

The database should be saved on a network drive. All documents will be retained for the period of time defined in Teck 2014.

Maintenance records and summaries must be completed immediately after works are carried out and maintained on Teck's Kimberley, BC server.

6.5 Annual Operation, Maintenance and Surveillance Manual Review and Update

Revisions to the OMS Manual are made, as and when required, by re-issuing a complete section, table, or appendix so that the outdated section, table, or appendix can be removed and replaced. The official electronic copy of the OMS Manual is also updated at the same time and will be the primary reference document.

The version history of the OMS Manual is shown in Table 6-4. The last revision of the OMS Manual supersedes all previous versions.

Table 6-4: Operation, Maintenance and Surveillance Manual Revision Summary

Revision Number	Details of Revision	Date of Issue	Comment
2018 Version 2	Updated Document by Golder and SRK	9 February 2018	■ Updated Site Manager ■ Updated based on revised water license (MV2017L2-0007) ■ Updated to include 2014 DSR (SRK 2016) ■ Updated to include revised MAC Guidelines (MAC 2017) ■ Updated Contingency manual in Appendix C ■ Water Treatment Management Plan for Upset Conditions included with Water treatment Manual in Appendix E ■ Updates to Section 3.5.2
2017 Version 1	Updated Document by Golder	20 February 2017	■ Change of consequence class for north and west dykes from low to significant ■ Freeboard calculation updated to include up rush ■ Climate information from 2009 to 2016 updated ■ Formatted to comply with Teck Guideline (Teck 2014)
2009 Version 0	Updated Document by Golder	19 March 2009	

The personnel responsible for the review of the OMS Manual is shown in Table 6-5.

Table 6-5: Operation, Maintenance and Surveillance Manual Review Protocol

Name	Company	Position
Björn Weeks	Golder Associates Ltd.	Engineer of Record
Stephen Parris	Teck Resources Limited	Site Manager
Kathleen Willman	Teck Resources Limited	Manager, Engineering and Remediation

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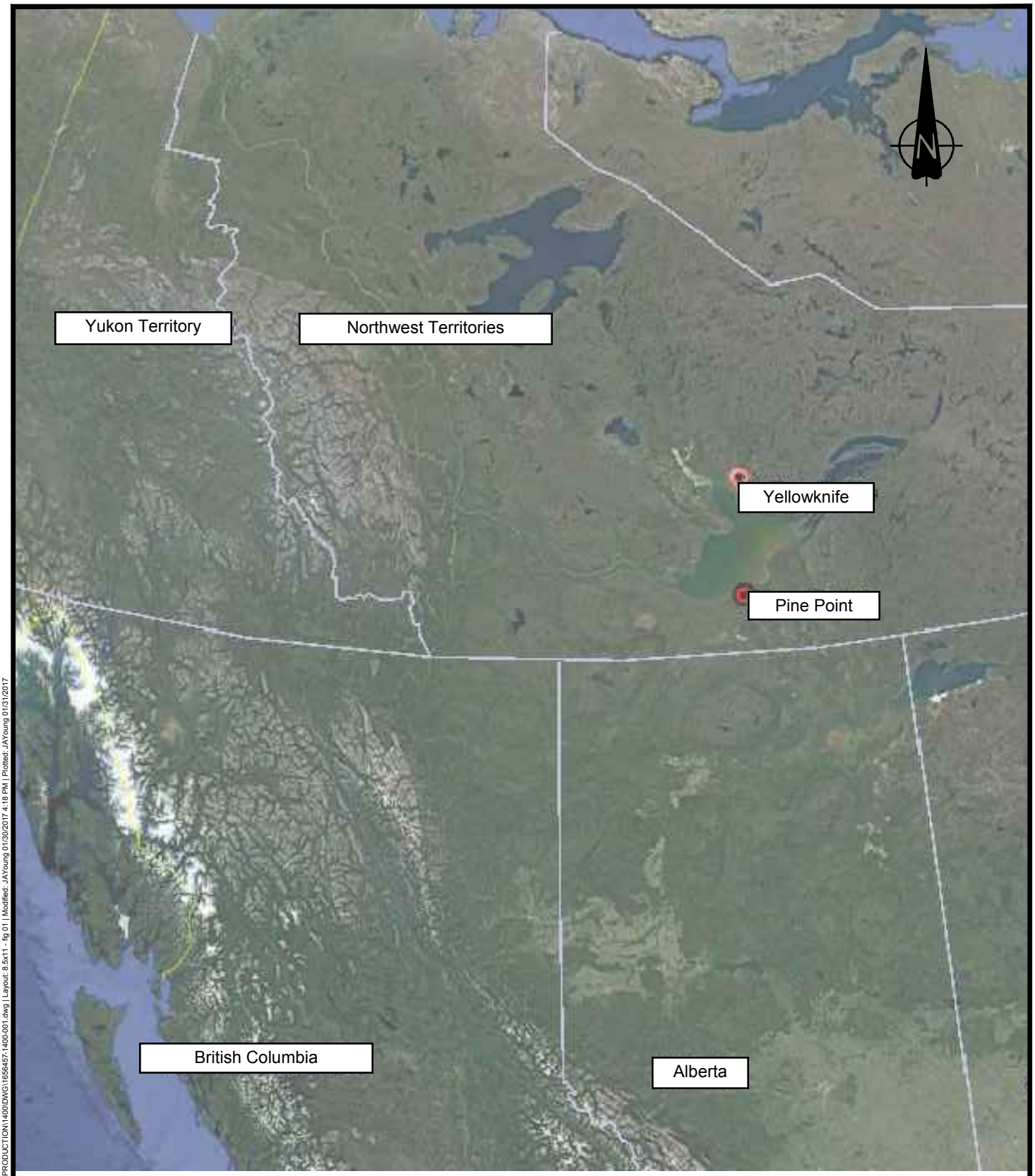


PROJECT

TECK
PINE POINT, NT

TITLE

GENERAL LOCATION OF PINE POINT MINE SITE

Golder Associates

PROJECT No.		1656451	FILE No.	1656457-1400-001
DESIGN	MS	2017-01-31	SCALE	NTS
CADD	JY	2017-01-31		
CHECK	MW	2017-02-20		
REVIEW	BW	2017-02-20		

FIGURE 1

REFERENCE

BASE PLAN PROVIDED BY TECK COMINCO
CAD FILE: PINE_POINT_01.MXD
DATED: OCTOBER 14, 2006

PROJECT
TECK
PINE POINT, NT

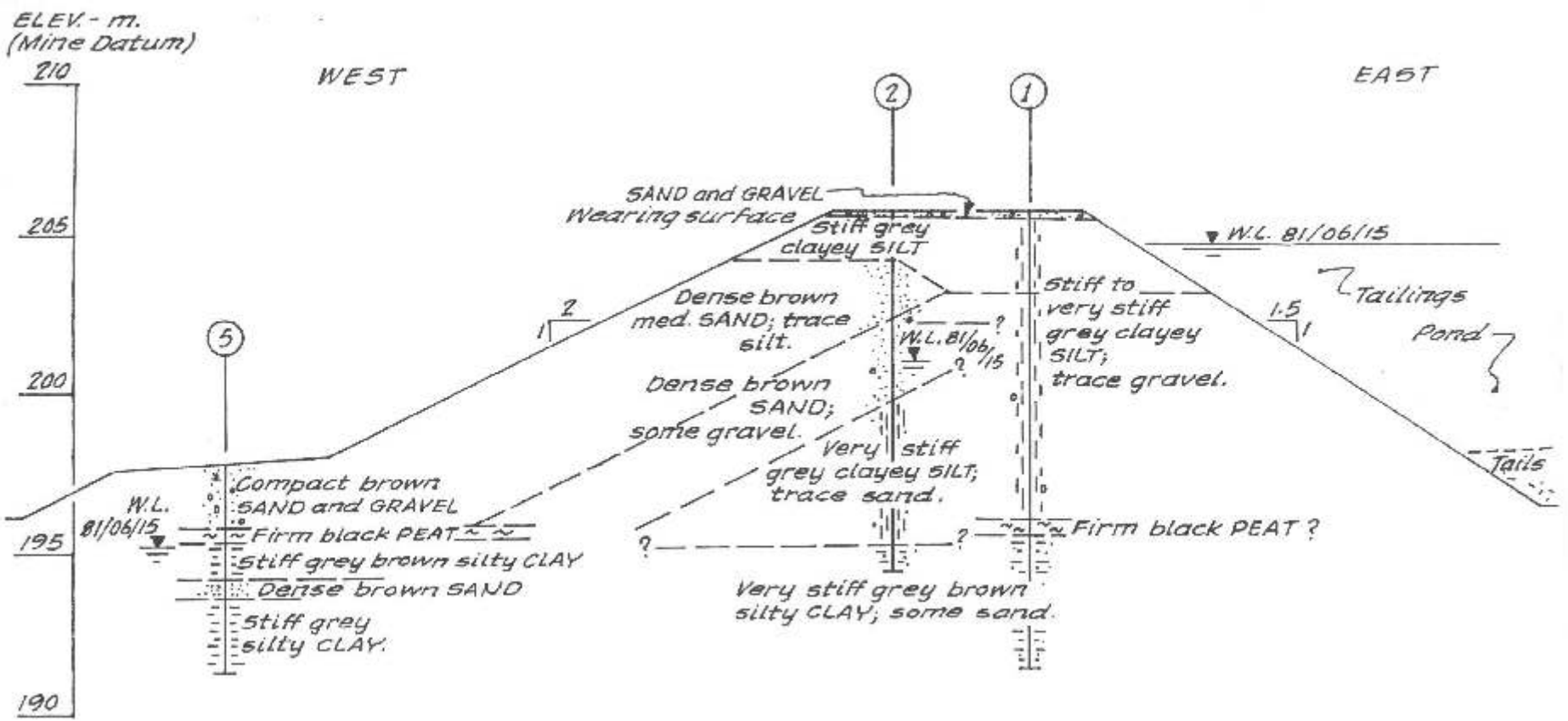
TITLE
TAILINGS IMPOUNDEMENT AREA

Golder Associates

PROJECT No.		1656457	FILE No.	1656457-1400-001
DESIGN	JH	30JAN09	SCALE AS SHOWN	REV.
CADD	GG	30JAN09	FIGURE 2	
CHECK	MW	20FEB17		
REVIEW	BW	20FEB17		

DRAWING DATE: 04-Feb-09 COREL FILE: N:\Bur-Graphics\Projects\20071413\07-1413-0068\Drafting\4000\FIGURE 2.cdr

DRAWING DATE: 04-Feb-09 COREL FILE: N:\Bur-Graphics\Projects\2007\1413\07-1413-0068\Drafting\4000\FIGURE 3_4.cdr



SCALE 1 : 200

LEGEND

(2) Location of Borehole

NOTE

1. Section partially inferred from construction records.
2. Black peat removed from under toe berm of west dyke south of Sta. 35+00.

PROJECT

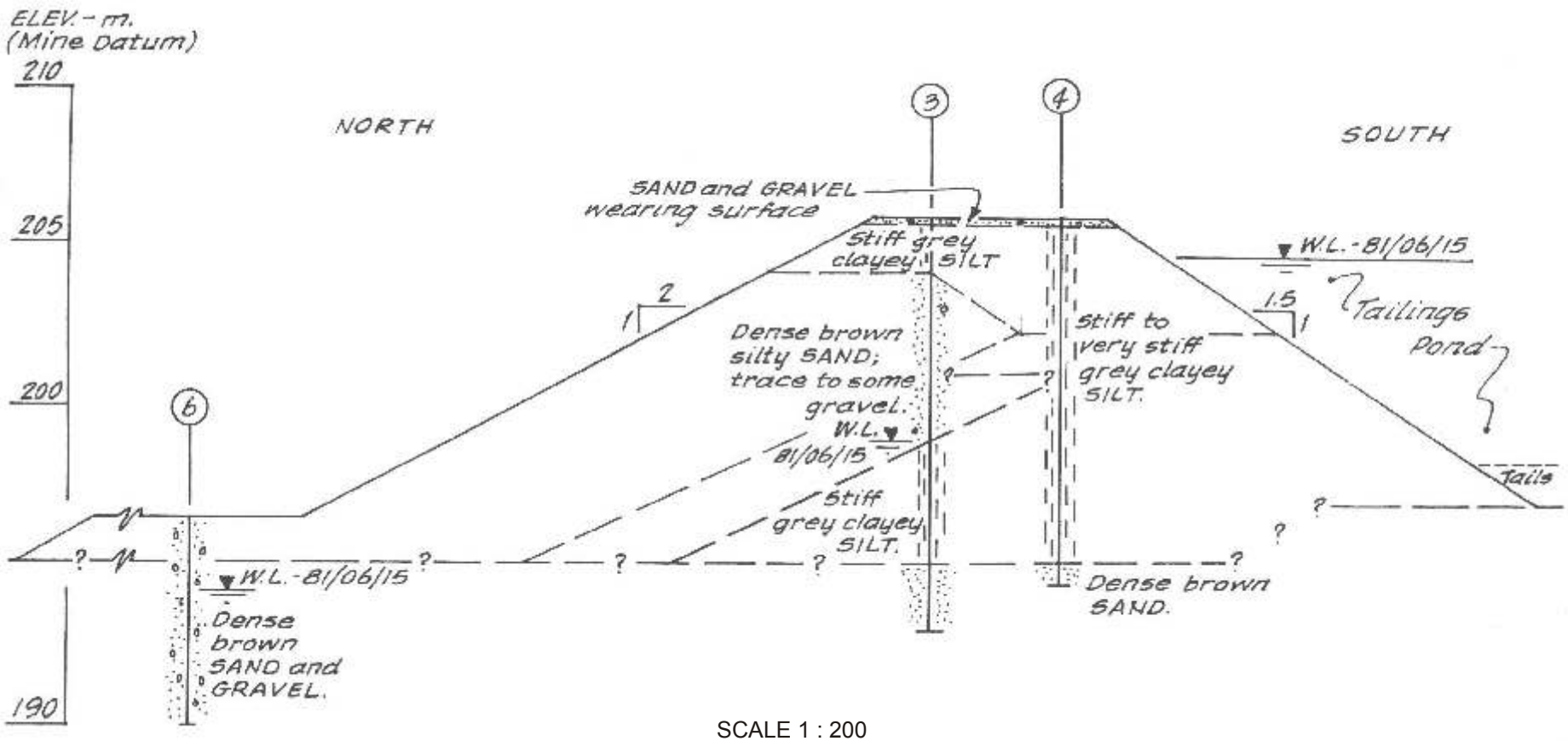
TECK
PINE POINT, NT

TITLE

TYPICAL SECTION
WEST DYKE

Golder Associates

PROJECT No.		1656457	FILE No.	1656457-1400-001
DESIGN	JH	07OCT08	SCALE	REV.
CADD	SS	07OCT08		
CHECK	JH	07OCT08	**FIGURE 3**	
REVIEW	BW	20FEB17		



SCALE 1 : 200

LEGEND

(6) Location of Borehole

NOTE

1. Section partially inferred from construction records.

PROJECT

TECK

PINE POINT, NT

TITLE

TYPICAL SECTION

NORTH DYKE

Golder Associates

PROJECT No.		1656457	FILE No.	1656457-1400-001
DESIGN	JH	07OCT08	SCALE	REV.
CADD	SS	07OCT08		
CHECK	JH	07OCT08		
REVIEW	BW	20FEB17		

FIGURE 4

APPENDIX A

Flowchart Diagram of Operational and Climate Monitoring Practices for Water Releases

Operational and Climate Monitoring Practices for Water Releases

Climate Monitoring

If air temperature is above 0 C for two weeks, then proceed to the spring general inspection within two weeks

Compilation of air temperature, rainfall and snowfall observations:
End of March for the period between October to March
Weekly from April to May
Biweekly from June to September

Weather Warnings:
If issued, then collect rainfall observations daily for five days

If total rainfall is higher than 50 mm, then conduct a general inspection.

General Inspections and Decisions

Spring General Inspection (Apr – May)

Summer General Inspection (Jun – Aug)

Fall General Inspection (Sep – Oct)

Geotechnical Inspection (Yearly)

General Inspection following extreme rainfall

General Inspection two weeks following a previous inspection

If water level is at or above alert level of 201.6 m

Inform Site Manager and initiate water treatment as early as practical

Water treatment starts no later than early July

Water treatment stops when water level approaches elevation 200.0 m

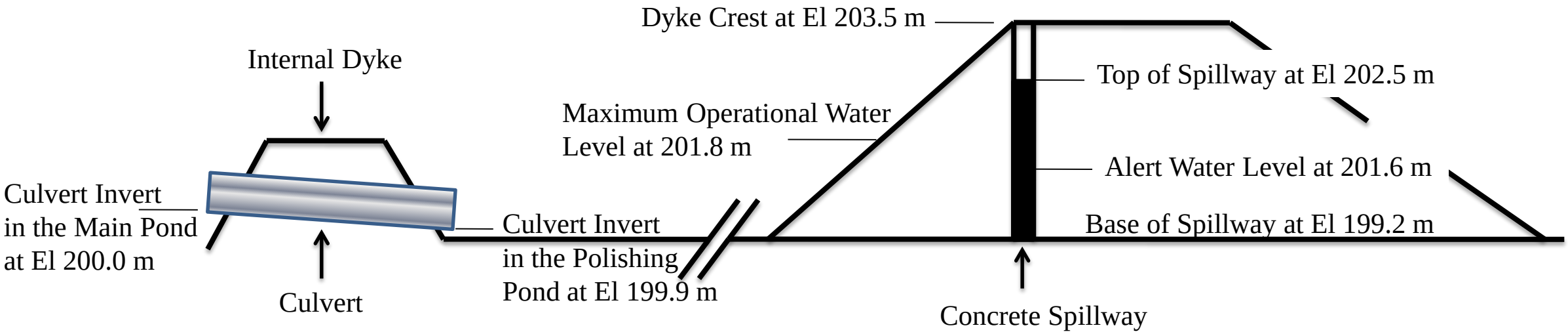
Water and Infrastructure Elevations

Water Levels:
Maximum Operational Water Level
201.8 m
Alert Water Level
201.6 m

Infrastructure Elevations:
Dyke Crest
203.5 m
Top of Spillway
202.5 m
Base of Spillway
199.2 m
Culvert Invert in the Main Pond
200.0 m
Culvert Invert in the Polishing Pond
199.9 m

Polishing Pond:
Operated as instructed in the Water Treatment Manual when treatment is implemented.

Water and Infrastructure Elevations



Not to scale

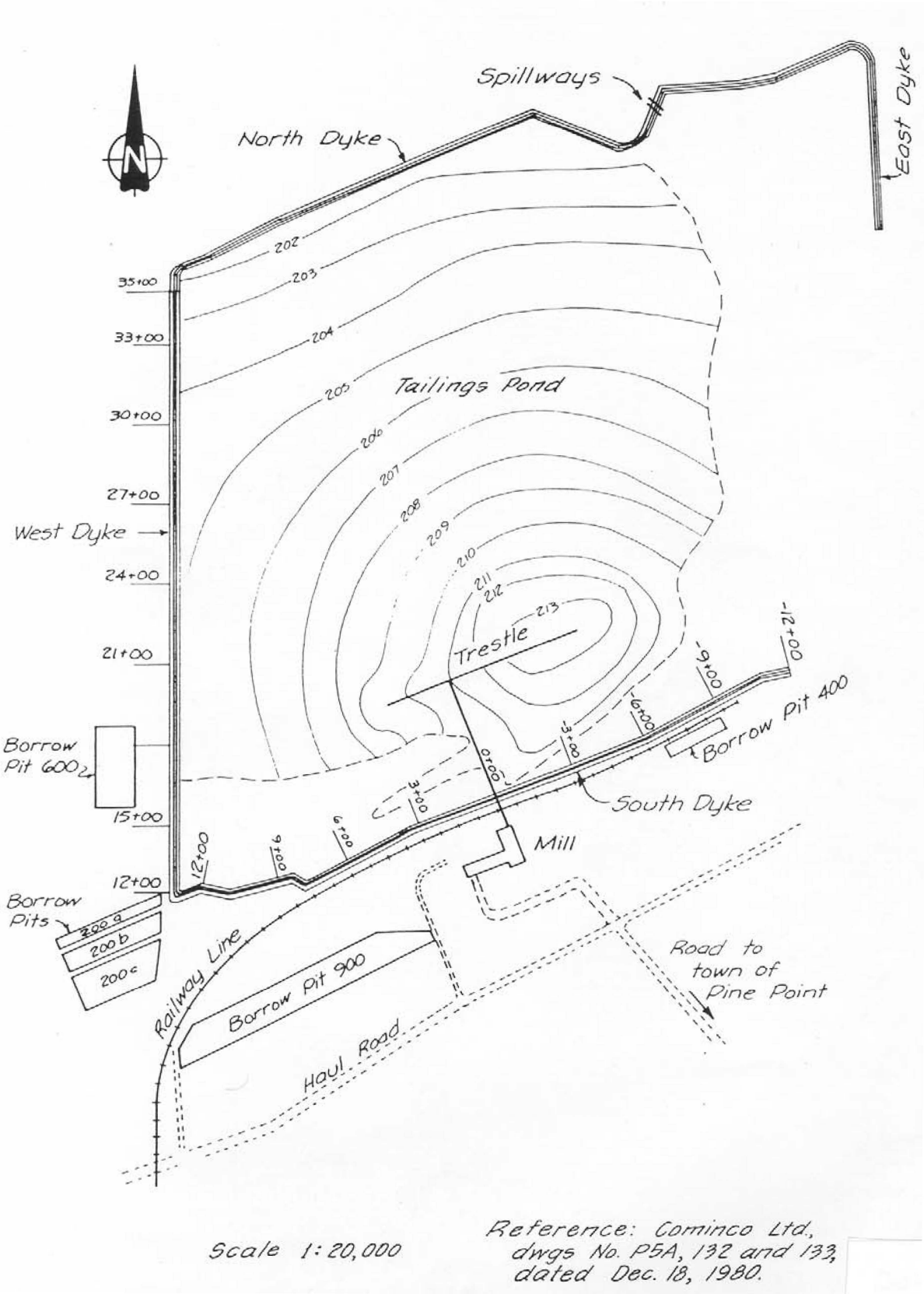
APPENDIX B

Inspection Form

Teck Cominco Metals Ltd
Tailings Impoundment Inspection Form
Pine Point Tailings Impoundment

Date:		Inspected By:
Weather:		
Tailings Pond Information:		
Pond Elevation:		Operating Limits:
Crest Elevation: -note for each area.		Freeboard: (Minimum 1m)
Dyke Inspection Check List (✓ = checked and no problems; x = not checked)		
Check: Upstream Slope of Dyke, Crest and Downstream Slope of Dyke		
South Dyke	**Checked**	**Comment**
Ponded Water		
Erosion		
Settlement/Depressions		
Cracks/Movement		
Debris: on upstream s e.		
Vegetation		
Other – (photos)		
Notes:		Water ponded on outside.
West Dyke		
Ponded Water		Water is or is not at dam.
Erosion		Downstream Slope.
Settlement/Depressions (on dam crest)		
Sinkholes		In front of dam
Cracks/Movement		
Debris		
Vegetation		
Other – (photos)		
Notes:		Seepage at north end.

North Dyke	Checked	Comment
Ponded Water		GPS Coordinates: - where on north side
Erosion		Upstream slope - Downstream slope -
Settlement/Depressions		
Sinkholes		Pond side
Cracks/Movement		Dam Crest
Debris		
Vegetation		
Main Pond Spillway		
Treatment Spillway		
Other – (photos)		
Notes:		
East Dyke		
Ponded Water		
Erosion		
Settlement/Depressions		
Sinkholes		
Cracks/Movement		
Debris		
Vegetation		
Other – (photos)		
Notes:		Water ponded at dyke -


Spillways
East Dyke
North Dyke
202
203
204
205
Tailings Pond
206
207
208
209
210
211
212
213
Trestle
35+00
33+00
30+00
27+00
West Dyke
24+00
21+00
15+00
12+00
-12+00
-9+00
-6+00
-3+00
0+00
3+00
6+00
9+00
12+00
Borrow Pit 600
Borrow Pit 400
South Dyke
Mill
Borrow Pits
200a
200b
200c
Railway Line
Borrow Pit 900
Haul Road
Road to town of Pine Point
Scale 1:20,000
Reference: Cominco Ltd., dwgs No. P5A, 132 and 133, dated Dec. 18, 1980.

Tailings Impoundment Inspection
Explanation of Details

Ponded Water:

Look for pools of water against the inside or outside slopes of the Dyke structure. The pooled water is a potential source of water to erode the dyke and therefore the presence of any water must be recorded. Ideally the GPS location should be noted in the comments area.

Another aspect of pooled water is that it may be a source of seepage water at the outside toe of the dyke therefore where pooled water is observed look for increased seepage at the toe. The presence of water at the dyke face can be an indication of increased water levels within the dyke which can decrease Dyke stability.

Erosion:

The presence of small rills, up to 0.3m deep, on the downstream face of the dyke are normal and of no concern. If the rills start eroding into channels greater than 0.3 m and are cutting into the crest more than 0.5 m then the rills must be filled to prevent further progress.

Erosion can also be caused by wave action on the pooled water. Erosion has been occurring on the inside slope of the North Dyke and will soon require placement of material to armor the dyke face. Erosion into the till core must be prevented therefore any excessive erosion must be reported. Ideally record the GPS location so the area can be found on future inspections.

Settlement/Depressions:

Settlement or depressions in the crest or slopes indicate groundwater erosion of the interior of the dyke. Look for any visible seepage at the toe of the dyke. This is a very serious problem and it must be investigated by a professional.

Ideally record the GPS location so the depression can be easily found.

Sinkholes:

Sinkholes are localized deep depressions and are another indication of interior erosion of the dyke. This is a very serious problem and it must be investigated by a professional.

Ideally record the GPS location so the depression can be easily found.

Cracks/Movement:

Cracks accompanied by movement are an indication of a dyke failure and material would probably be seen flowing from the toe of the dyke. This is a very serious situation which must be reported immediately and be investigated by a professional. Ideally record the GPS location so the area can be easily found.

Debris:

Accumulation of debris on the dyke can prevent inspection of the dyke and should be removed.

Vegetation:

Small vegetation on the slopes of the dykes is good to minimize surface erosion. Larger vegetation hinders inspections of the dyke and can damage the dyke if root systems penetrate the till core or large root systems are ripped out by the wind. Therefore any trees on the dyke slopes over 1" diameter should be removed.

Photos:

A log of photos should be maintained.
Locations of key photos should be noted so future photos are taken from the same spot of area looking at the same feature.

APPENDIX C

Contingency Plan, Pine Point Mine Tailings Impoundment Area

Pine Point Mine Tailings Impoundment Area

Contingency Manual

February 2018

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1.0 PURPOSE & OBJECTIVES

The purpose of this contingency manual is to minimize health hazards and adverse environmental effects caused by spills, as well as to comply with the Canadian Environmental Protection Act, *Environmental Emergency Regulations*.

This document outlines contingency measures and response strategies for spills of potentially hazardous substances in the Pine Point Tailings area, which may adversely affect the environment, and/or human health and safety. Rapid deployment of emergency personnel and equipment to a spill will both protect the health and safety of employees and public as well as minimize potential effects to the environment.

All Teck Resources Limited (Teck) employees and Contractors working at the Pine Point Mine Tailings Impoundment Area (TIA) should be familiar with this document. New employees and contractors will be introduced to the plan as part of their orientation. Personnel will understand the potentially hazardous situations that spills can create to the health and safety of workers and the environment. They will understand their responsibilities as workers to prevent, identify, report, and appropriately deal with a spill. This document will be available for viewing by all workers. The company will advise workers of revisions or changes to the plan.

The objectives of the manual are:

- To identify potentially hazardous materials located on site.
- To identify spill prevention measures.
- To identify and describe spill response and emergency response measures in the case of an incident.
- To establish a high order of preparedness in the event that a spill occurs.
- To ensure an orderly and timely decision-making, response and reporting process.

2.0 SITE DESCRIPTION

Figure 1 provides a general location map for Pine Point, Figure 2 depicts an area overview of the Tailings Pond area.

The mine operated from the early 1960's until the spring of 1988. Lead/zinc ore from the open pits was trucked to the plant site where it was treated to separate and recover the lead and zinc minerals into two concentrates. Recovery of the minerals was accomplished using a flotation process. The mineral concentrates were generally shipped by rail as they were produced. In the final years of operation stockpiles of concentrate were built to the east and west of the plant site. The tailings from the treatment plant were discharged into the tailings pond located north of the plant site. The processing plant was shut down permanently in the spring of 1988. After shutdown the stockpiles of concentrate were shipped until they were depleted. The site was prepared for abandonment by following the approved Abandonment & Restoration Plan.

The TIA is the only remaining area under lease where annual water treatment and discharge will occur until treatment is no longer required.

Figure 1: General Location Map

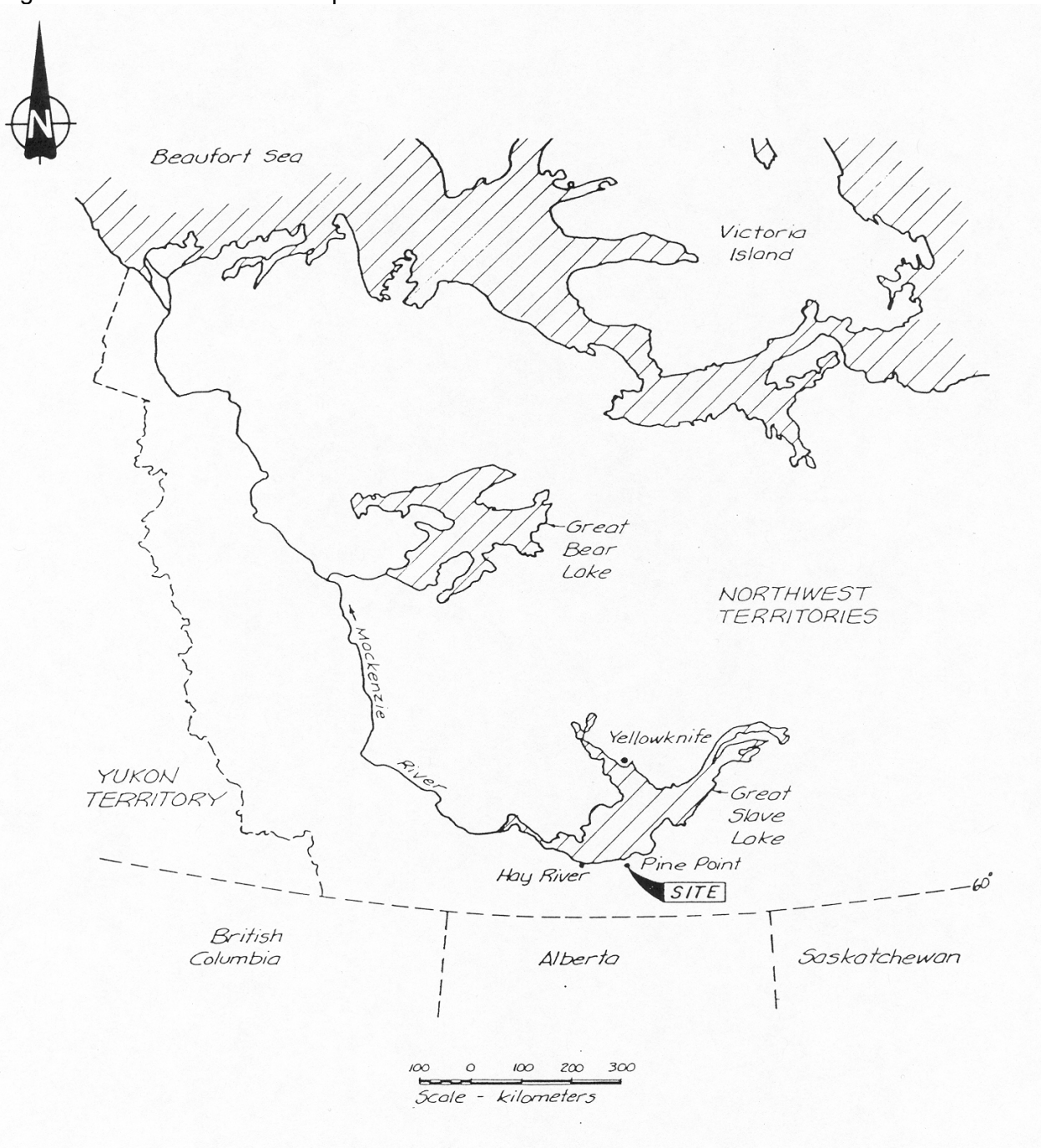
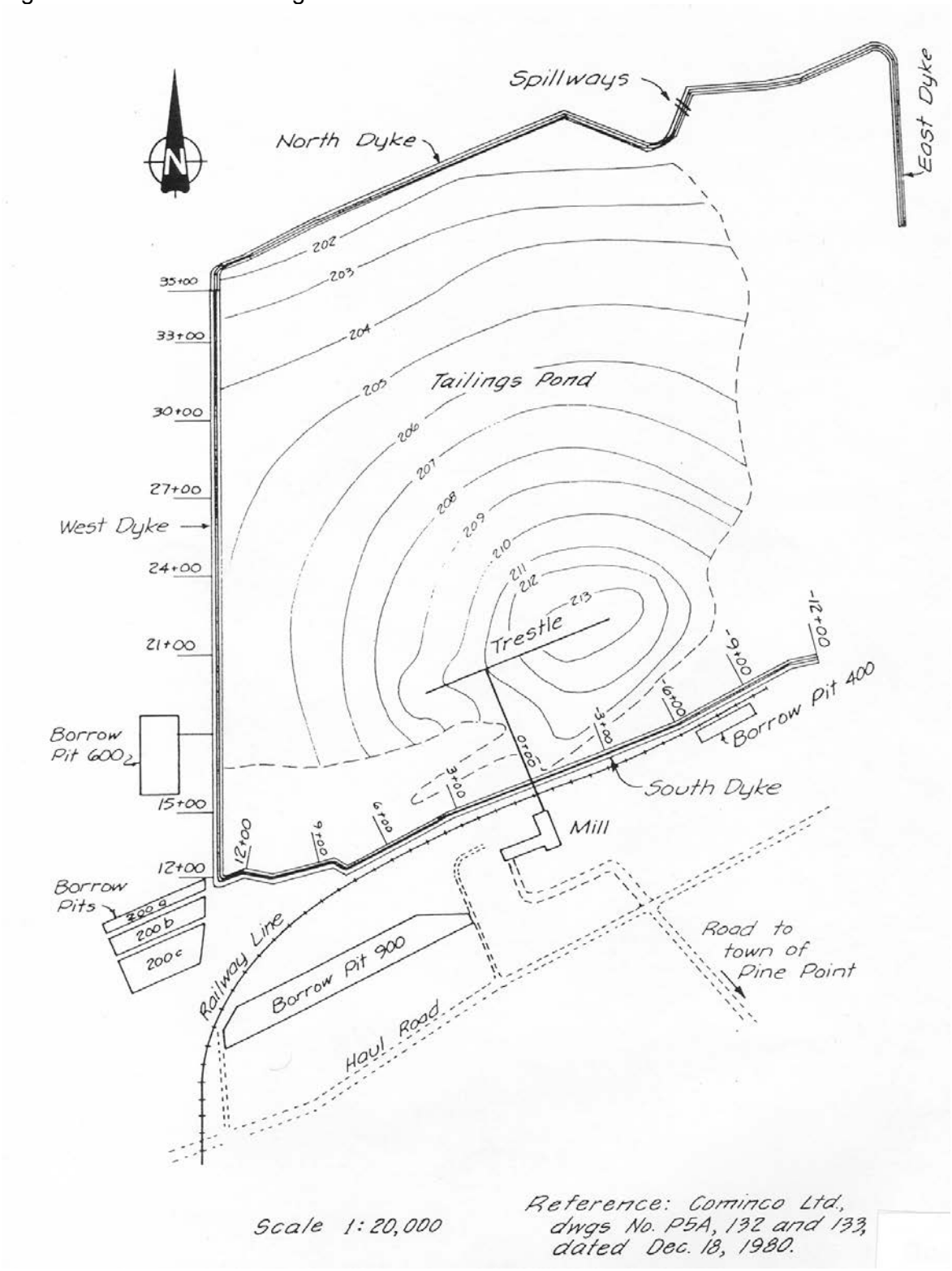


Figure 2: Overview of Tailings Pond Area



3.0 TECK RESOURCE LIMITED'S COMMITMENT TO THE ENVIRONMENT

Teck is committed to advancing environmental protection and providing safe working conditions for employees and contractors. The company recognizes the need to maintain and improve environmental quality on its property. The prevention of deleterious substances from operations entering and impacting the environment is imperative to the Company's long-term future in Canada.

Teck will take an active and aggressive role in minimizing the impact of its operations on the environment by utilizing appropriate technologies and effective management strategies. The company believes that it has a responsibility to develop resources productively and efficiently by applying technologies in a manner that is environmentally responsible.

4.0 GENERAL SPILL CONTINGENCY PLAN

4.1 RESPONSE ORGANIZATION

The mine remains permanently closed and therefore there are no personnel on-site except during the summer water treatment period. There are no Hazardous Materials on the site except during the water treatment period. The only possible spills, other than during the water treatment period, would be related to the TIA dykes. In the event of an incident the Site Manager is responsible for coordinating activities.

As the Incident Commander, the Site Manager is responsible for:

- Overall command and control of an incident.
- Establishing response objectives and strategies.
- Providing information to authorities regarding reportable incidents.
- Scheduling meetings to update the response plan.

During the water treatment period, there will be personnel on-site with Hazardous Materials, in relatively small volumes, under their control. In the event of a spill, the personnel would react immediately to a spill and contact the Site Manager.

4.2 REPORTABLE SPILLS

A spill in excess of the following thresholds is considered a spill under the N.W.T. Spill Contingency Planning and Reporting Regulations (N.W.T. Reg. 068-93), pursuant to the Environment Protection Act. In these regulations "Federal Regulations" means the amended Transportation of Dangerous Goods Regulations (International Harmonization Update, 2016) SOR/2016-95.

Table 1: Reportable Spill Quantity of Dangerous Goods

Substance Spilled	Severe Marine Pollutant	TDG Code	Reportable Quantity
Explosives of Class 1 as defined in section 3.9 of the Federal Regulations.		1	Any amount
Flammable gases, of Division 1 of Class 2 as defined in section 3.11 (a) of the Federal Regulations.	**Gasoline**	2.1	Any amount of gas from a container larger than 100L, or where the spill results from equipment failure, error or deliberate action or inaction.
Non-flammable gases of Division 2 of Class 2 as defined in section 3.11 (d) of the Federal Regulations.		2.2	Any amount of gas from a container larger than 100L, or where the spill results from equipment failure, error or deliberate action or inaction.
Poisonous gases of Division 3 of Class 2 as defined in section 3.11(b) of the Federal Regulations.		2.3	Any amount
Corrosive gases of Division 4 of Class 2 as defined in section 3.11 (c) of the Federal Regulations.		2.4	Any amount
Flammable liquids of Class 3 as defined in section 3.12 of the Federal Regulations.	**Diesel**	3	200L (Any amount if spilled into a watercourse)
Flammable solids of Class 4 as defined in section 3.15 of the Federal Regulations.		4	25 kg
Products or substances that are oxidizing substances of Division 1 of Class 5 as defined in sections 3.17(a) and 3.18(a) of the Federal Regulations.		5.1	50 kg or 50 L
Products or substances that are organic compounds that contain the bivalent "-0-0-"structure of Division 2 of Class 5 as defined in sections 3.17 (b) and 3.18 (b) of the Federal Regulations.		5.2	1 kg or 1L
Products or substances that are poisons of Division 1 of Class 6 as defined in sections 3.19 (a) to (e) and 3.20 (a) of the Federal Regulations.		6.1	5 kg or 5 L
Organisms that are infectious or that are reasonable believed to be infectious and the toxins of these organisms as defined in sections 3.19(f) and 3.20(b) of the Federal Regulations.		6.2	Any amount
Radioactive materials of Class 7 as defined by section 3.24 of the Federal Regulations.		7	Any discharge or a radiation level exceeding 10 mSv/h at the package surface and 200 mSv/h at 1 m from the package surface.
Products or substances of Class 8 as defined by section 3.24 of the Federal Regulations.		8	5 kg or 5 L
Miscellaneous products or substances of Division 1 of Class 9 as defined by sections 3.27 (1) and 2 (a) of the Federal Regulations.		9	50 kg or 50 L

TDG = Transportation of Dangerous Goods.

4.3 DISCOVERY AND RESPONSE TO SPILLS

The following provides a general response to any spill upon initial discovery. Refer to Appendices A and B for more specific information including spill response procedures and MSDS documents for the particular substances located at the mine site.

Appendix B – **Gasoline**

Appendix C – **Diesel**

FIRST PERSON TO OBSERVE THE SPILL:

Ensure personal and worker safety, if you cannot identify the spilled substance consider it dangerous.

If personnel are injured

- Call for medical help, attend to injured person, and administer first aid if safe to do so.

If Safe

- Stop all sources of ignition and stop or reduce the source flow of the spill.
- Shut off all valves.
- Shut off all electrical power.
- Initiate containment.
- Put down adsorbent pads and berm spill area, if possible.
- Do not enter confined spaces.
- Do not expose self to fire hazard.
- Complete the spill report form and report the spill.

If Unsafe

- Initiate evacuation (upgrade or upwind) – move to safe area.
- Notify Site Manager.
- Isolate area and deny entry until qualified response personnel arrive.
- Deny access to all unauthorized personnel.
- Complete the spill report form and report the spill.
- Update Site Manager on spill status.

4.4 TAILINGS DYKE FAILURE

Risk

The risks to the TIA dykes potentially include:

- Release untreated water if water levels exceed specific elevations, or
- Release water and tailings if one of the dykes were to be breached.

Due to the remote location of the TIA, the release of water and/or tailings are not a significant risk to human health or safety. There are no dwellings close to the area and only rarely are individuals present close enough to the dykes that a sudden release of tailings or water would represent a risk. Release of the tailings pond effluent and tailings would have minimal environmental impact in the short term and in the longer term mitigation strategies (such as relocating tailings back into the TIA and reconstructing the dykes could be implemented).

Prevention

The tailing dykes that partially surround the TIA are inspected three times a year in compliance with the Water License. These are completed in spring summer and fall. At a minimum of once every year, the summer inspection is conducted by a qualified geotechnical engineer.

The Operation, Maintenance and Surveillance (OMS) Manual recommends that the water level in the pond be maintained at or less than the maximum operational water level so that in the event of a high wind, waves on the pond will not overtop and erode the crest of the dykes.

To maintain the pond level at or below the maximum operational water level (201.8 m), the pond level is inspected during the spring, summer and fall inspections. If the water level is at or above the alert level of 201.6 m, the site manager is informed and the water is treated and released as early as practical. Water treatment stops when water level approaches elevation 200.0 m.

Accidental Release of Contents

Potential risks to the dykes could occur due to the following events:

1. **Event:** Erosion from wave action on the face of the dykes or from precipitation. If erosion were to become extreme, the potential to weaken the dyke to the point of failure is possible.
   Actions: Identification of this condition should be undertaken during one of the three annual inspections of the dam. If significant erosion is noted, or if a full or partial dyke breach were to be the result, the Site Manager must be contacted and informed of the situation. The Site Manager will then contact the geotechnical consultant to conduct a formal inspection of the dam and to make recommendations as to whether repairs to the dyke are required as well as specify the details of the repairs. Identified source materials for any repairs and a list of contractors are detailed in the OMS Manual. If any release of tailings were to have occurred, they would need to be moved back into the impoundment area upon completion of repairs.

2. **Event:** Water levels in the pond exceed the height of the spillway.

   Response: In the event that water treatment was not carried out, the pond level could be relatively high going into the fall season. It is possible that prior to the next season's normal treatment period, the elevation of the pond could exceed the elevation of the spillway invert and effluent from the pond be discharged in the spring during freshet. Upon discovery of this, the Site Manager must be contacted and a treatment program initiated so that the water level in the pond could be lowered to or below the maximum operational level as defined in the OMS Manual.

3. **Event:** An earthquake causes structural damage to the dam.

   Response: If there is an earthquake in excess of magnitude 5 within 100 kilometers, the Site Manager is notified by the federal government. The Site Manager will immediately contact a geotechnical engineer to undertake a dam inspection; and if this cannot be done in a timely fashion the Site Manager will have another person with geotechnical experience make an interim inspection of the facility. Recommendations from the geotechnical engineer would be acted upon and dyke repairs initiated. Identified source materials for any repairs and a list of contractors are detailed in the OMS Manual. Any tailings released would need to be returned to the impoundment after dyke repairs were completed. The Site Manager is responsible for coordinating repairs using identified material sources.

With any of the above accidental releases, the volumes and concentrations of zinc in the water discharged would exceed the permit limits. Therefore the spill line would need to be contacted and the spill reported.

4.5 COMMUNICATION: SPILL REPORTING

4.5.1 Teck Resources Limited's Reporting and Contact Information

Spills with quantities greater than those shown in section 4.2 must be immediately reported to the Site Manager. If the Site Manager is unavailable, contact Teck's designated alternate, as detailed in Table 2.

If the on-site person is unable to make direct contact with the Site Manager or designated alternate they shall report the incident to the N.W.T. 24 Hour Spill Report Line at 1-867-920-8130.

If possible contact the local Resource Management Officer, Olivia Villebrun, at 867-872-2558 and inform her of the situation.

Table 2: Contact Details for Site Manager and Alternate

Site Manager: Stephen Parris	
Office Tel.	250-427-8403
Cell	250-427-6012
Alternate #1: Michelle Unger	
Office Tel.	250-427-8422
Cell	250-432-5264

If the Site Manager deems that the spill has exceeded the reporting threshold for the spilled substance, Teck's Head Office in Vancouver and the appropriate government agencies will be notified. The government procedure is outlined in the following section, "External Notification".

4.5.2 External Notification

All spills of petroleum products or other hazardous materials exceeding the appropriate threshold must be reported. The Site Manager is responsible for all external reporting. Although several government agencies at the federal, territorial and municipal levels may ultimately be involved, only one government contact is required to be made by the Site Manager or his designate for mine site spills. Affected Agencies will be contacted at:

Northwest Territory 24 HOUR SPILL REPORT LINE

Telephone: 1-867-920-8130

This is a 24 Hour telephone number to Environment Canada. They will notify all other concerned agencies when necessary. The following information shall be conveyed to the affected agencies through the 24 Hour Spill Report Line. This information is to be documented on the "Spill Reporting Form" provided in Appendix A-1.

The reporting person must give as much of the following information as possible:

a) Date and time of spill.

b) Location of spill as follows:
Pine Point Tailings Area 100 km by road east of Hay River, 10 km south of Great Slave Lake.

c) Direction the spill is moving.

d) Name and phone number of a contact person close to the spill location.

e) Type of contaminant spilled and quantity spilled.

f) Cause of spill.

g) Whether spill is continuing or has stopped.

h) Description of existing containment.

i) Action taken to contain, recover, clean up and dispose of spilled contaminant.

j) Name, address and phone number of person reporting spill.

k) Name of owner or person in charge, management or control of contaminants at time of spill.

A list of typical spill response equipment is provided in Appendix A-2.

4.5.3 External Technical Advice - CANUTEC

The Canadian Transport Emergency Center (CANUTEC), a branch of Transport Canada, can also be contacted for 24-hour technical advice on Dangerous Goods, as needed. The CANUTEC – help line for dangerous goods is 1-888-226-8832 or 613-996-6666.

REFERENCES

Canutec. 2016. *Dangerous Goods Initial Emergency Response Guide 2016*. Minister of Supply and Services Canada 2016, Ottawa, Canada.

Government of Canada, Environment Canada. 1999. *Canadian Environmental Protection Act, (1999).*

Government of Canada, Environment Canada. 2003. *Environmental Emergency Regulations (2003).*

Government of Northwest Territories. *Spill Contingency Planning and Reporting Regulations N.W.T. Reg. 068-93*, *Environmental Protection Act (1988).*

APPENDIX A

A-1: Spill Reporting Form

A-2: List of Typical Spill Response Equipment

A-1: Spill Reporting Form

1) Date of Incident: _____ Time: _____

2) Location Details (nearest community, watercourse etc.): _____

3) Direction spill is moving: _____

4) Contact person close to spill location: Name: _____

Telephone: _____

5) Type of Contaminant spilled: (check) Oil ____Gasoline ____Diesel ____

Other (name) _____

And Quantity spilled: _____

6) Cause of Spill: _____

7) Is spill continuing or has it stopped: _____

8) Description of existing containment: _____

_____

9) Action taken to contain, recover, clean up and dispose of spilled contaminant: _____

_____

10) Contact information of person reporting the spill: Name: _____

Telephone: _____

11) Name of owner or person in charge, management or control of contaminants at time of spill:
Name: _____

Telephone: _____

12) Weather Conditions: Temperature _____ Wind Direction/Speed _____ Precipitation _____

13) Hazards to human life or health: _____

14) Expected Environmental Effects: _____

15) Nearest Surface Water with Approximate Distance to Spill: _____

_____

16) Potential to Enter Surface Water: _____

17) Fish Kill: Yes ___ No ___ Bird Kill: Yes ___ No ___

18) Fire Hazard: _____

19) Threat to drinking water: _____

20) General Comments: _____

21) How to prevent recurrence: _____

A-2: List of Typical Spill Response Equipment

- **Absorbents** (For Petroleum Hydrocarbon {Fuels, Lubricants, and Solvents} and Wastewater)
  - Booms
  - Sheets
  - Towels
  - Absorbent granules

- **Contaminated Soils Recovery Tools**
  - Shovels
  - Picks
  - Excavators
  - Loaders
  - Trucks

- **Liquid Recovery Tools**
  - Pumps
  - Containers
  - Vacuum / Eductor Truck

- **Fire Suppression Equipment**
  - Various, for different material types.

- **Personal Safety Equipment**
  - Protective Clothing
  - Eye Protection
  - Breathing Apparatus

Note to Plan User:

This is by no means an exhaustive list of materials and tools that can be assembled and used for spill response.

More information on spill response equipment and equipment suppliers can be found on the Internet. Suppliers of this sort of equipment and material can also be found in Hay River, Fort Smith or Yellowknife and other communities in the Northwest Territories.

APPENDIX B

SPECIFIC SPILL INFORMATION AND RESPONSE FOR GASOLINE (MSDS INCLUDED)

Gasoline

CAS# 86290-81-5

Other Names: Gasoline of all grades.

Physical Traits: Clear or coloured liquid with a strong hydrocarbon odour.

Special Precautions:

- Combustible/flammable liquid.
- Moderately toxic by inhalation, avoid prolonged exposure to fumes.
- Harmful or fatal if swallowed.

Incompatible Materials:

- Incompatible or can react with strong oxidizers.

Personal Protective Equipment / Response Equipment

Impermeable protective gloves (i.e.) nitrile) should be worn during routine handling of gasoline. Respiratory protection is not normally required, however, if working in enclosed areas or at high temperatures, conditions may warrant NIOSH approved respiratory equipment. If splashing is likely a face shield and goggles should be worn. Standard work clothing is sufficient when handling gasoline, as long as fastidious cleanliness practices are employed.

Cleanup Procedures and Options:

- Keep unprotected personnel upwind of spill.
- Stop spill at the source, contain in smallest possible area.
- Protect waterways.

If on land and it is safe to do so:

1. Stop, or reduce discharge if safe to do so by plugging, righting, adjusting valves or other suitable method.
2. Contain spill by diking with earth, snow and ice or other barrier, possible trenching or creating a lined sump down gradient from the spill source.
3. Ensure that you have reported the spill.
4. Remove fuel from containment area with pumps, vacuum equipment and place in appropriate containers. Ensure equipment intrinsically safe (does not have a source of ignition/spark).
5. Absorb residual liquid on natural or synthetic absorbents (e.g. 3M products).
6. Remove contaminated soils in the spill site to an appropriate disposal site if spill located near water supply or stream/river course or for aesthetic reasons.
7. Dispose of contaminated fuel by recycling or incineration. In situ, incineration may be possible if permission granted from environmental and forestry officials contacted through the Emergency Spill Response Line.

If in water and if safe to do so:

1. Stop or reduce discharge if safe to do so by plugging, righting, adjusting valves, or other suitable method. This material floats on water and is harmful to aquatic life.
2. If possible, contain discharge by booming using commercial boom material, logs, or other material at hand.
3. If in rapidly flowing water, direct to quieter backwater using booms to deflect material.
4. Ensure that you have reported the spill.
5. Remove from water by skimming, using absorbents, and collect in suitable container (tanks, drums, plastic lined depression in ground or snow).

NOTE: IN THE EVENT MATERIAL IS SPILLED DURING VERY WARM WEATHER AND THERE IS DANGER OF FIRE DUE TO FUMES, DO NOT ATTEMPT TO CONTAIN PRODUCT ON WATER. ALLOW PRODUCT TO DISPERSE AND EVAPORATE.

6. Dispose absorbents by recycling or incineration if conditions are suitable and after consultation with environmental authorities and/or forestry officials contacted through the Emergency Spill Response Line.

If on snow and it is safe to do so:

1. Stop, or reduce discharge if safe to do so by plugging, righting, adjusting valves, or other suitable method.
2. Compact the snow around the perimeter of the spill area.
3. Construct and compact snow dams.
4. Locate the low point of the spill area, then clear channels in the snow to allow material not absorbed to flow into the low area.
5. Once collected in the low area, shovel the spilled material into containers or pick it up with mobile heavy equipment, then transport it to an approved disposal or recovery site.

Material Safety Data Sheet

http://www.mtsonline.net/msds/Default.asp

Trade Name: GASOLINE, UNLEADED **Manufacturer:** ESSO - IMPERIAL OIL

MSDS Code: 08522 **Type of Chemical:** GAS

Notes:
Material Safety Data Sheets

MSDS Number: 08522

1. PRODUCT INFORMATION

Product Identifier: UNLEADED GASOLINE
REGULAR UNLEADED
MIDGRADE UNLEADED
ESSO SUPER PREMIUM UNLEADED
PREMIUM UNLEADED
ESSO REGULAR UNLEADED
ESSO MIDGRADE UNLEADED
ESSO EXTRA MIDGRADE UNLEADED
ESSO PREMIUM UNLEADED
EXXON MIDGRADE UNLEADED
EXXON PREMIUM UNLEADED
INDOLENE GASOLINE
EXXON REGULAR UNLEADED
PREMIUM GASOLINE
ESSO EXTRA MIDGRADE GASOLINE
MIDGRADE GASOLINE
GASOLINE REGULAR UNLEADED
GASOLINE MIDGRADE UNLEADED MUL89 (DYED OR CLEAR)
GASOLINE REGULAR UNLEADED RUL87 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED PUL91 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED PUL92 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED SUL94
SUPERSUPREME 94 PREMIUM UNLEADED GASOLINE-MTBE
GASOLINE MIDGRADE UNLEADED MUL89 (P91/R87)
GASOLINE MIDGRADE UNLEADED MUL89 DCA (P92/R87)
REGULAR UNLEADED
MIDGRADE UNLEADED
ESSO SUPER PREMIUM UNLEADED
PREMIUM UNLEADED
ESSO REGULAR UNLEADED
ESSO MIDGRADE UNLEADED
ESSO EXTRA MIDGRADE UNLEADED
ESSO PREMIUM UNLEADED

EXXON MIDGRADE UNLEADED
EXXON PREMIUM UNLEADED
INDOLENE GASOLINE
EXXON REGULAR UNLEADED
PREMIUM GASOLINE
ESSO EXTRA MIDGRADE GASOLINE
MIDGRADE GASOLINE
GASOLINE REGULAR UNLEADED
GASOLINE MIDGRADE UNLEADED MUL89 (DYED OR CLEAR)
GASOLINE REGULAR UNLEADED RUL87 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED PUL91 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED PUL92 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED SUL94
SUPERSUPREME 94 PREMIUM UNLEADED GASOLINE-MTBE
GASOLINE MIDGRADE UNLEADED MUL89 (P91/R87)
GASOLINE MIDGRADE UNLEADED MUL89 DCA (P92/R87)

Application and Use:
Motor gasoline fuel, for use in internal combustion engines only

Product Description:

A mixture of aliphatic and aromatic hydrocarbons and additives.

REGULATORY CLASSIFICATION

WHMIS:
Class D, Division 2, Subdivision A: Very Toxic Material.
Class B, Division 2: Flammable Liquids.

CEPA: CANADIAN ENVIRONMENTAL PROTECTION ACT
All components of this product are either on the Domestic Substances List (DSL) or are exempt.

TDG INFORMATION (RAIL/ROAD):

Shipping Name: Gasoline
Class: 3
Packing Group: II
PIN Number: UN1203
Marine Pollutant:P

Please be aware that other regulations may apply.

TELEPHONE NUMBERS MANUFACTURER/SUPPLIER:

Emergency 24 hr. (519) 339-2145 IMPERIAL OIL
Technical Info. (800) 268-3183 Products Division
111 St Clair Avenue West
Toronto, Ontario
M5W 1K3

(416) 968-4441

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2. REGULATED COMPONENTS

The following components are defined in accordance with sub-paragraph 13(a) (i) to (iv) or paragraph 14(a) of the Hazardous Products Act:

NAME % CAS #

Gasoline >99 V/V 8006-61-9 LD50>18ml/kg,orl,rat
LD50> 5ml/kg,skn,rbt

Methyl T-Butyl Ether 0-15 V/V 1634-04-4 LD50:3.9g/Kg,ing,rat
LD50:>10g/Kg,skn,rbt
LC50:142Mg/L,inh,rat

---

3. TYPICAL PHYSICAL & CHEMICAL PROPERTIES

Physical State: Liquid
Specific gravity: not available
Viscosity: 0.80 cSt at 20 deg C
Vapour Density: 3.2
Boiling Point: 35 to 210 deg C
Evaporation rate: >10 (1= n-butylacetate)
Solubility in water: negligible
Freezing/Pour Point: -60 deg C less than
Odour Threshold: not available
Vapour Pressure: 76 kPa to 103 kPa at 38 deg C
Density: 0.73 g/cc at 15 deg C
Appearance/odour: Naturally occurring water white or pale yellow; may be dyed a variety of colours for tax or other purposes; petroleum odour.

---

4. HEALTH HAZARD INFORMATION

NATURE OF HAZARD

INHALATION:

High vapour concentrations are irritating to the eyes, nose, throat and lungs; may cause headaches and dizziness; may be anesthetic and may cause other central nervous system effects.
Avoid breathing vapours or mists.

EYE CONTACT:

Slightly irritating, but will not injure eye tissue.

SKIN CONTACT:

Low toxicity.
Frequent or prolonged contact may irritate the skin and cause a skin rash (dermatitis).

INGESTION:

Low toxicity.
Small amounts of this liquid drawn into the lungs from swallowing or vomiting may cause severe health effects (e.g. bronchopneumonia or pulmonary edema).

CHRONIC:

The International Agency for Research on Cancer (IARC) has evaluated gasoline and found it to be a possible human carcinogen.
Contains benzene. Human health studies (epidemiology) indicate that prolonged and/or repeated overexposures to benzene may cause damage to the blood producing system and serious blood disorders, including leukemia.
Animal tests suggest that prolonged and/or repeated overexposures to benzene may damage the embryo/fetus. The relationship of these animal studies to humans has not been fully established.
Contains n-hexane. Prolonged and/or repeated exposures may cause damage to the peripheral nervous system (e.g. fingers, feet, arms etc.).
Methyl Tertiary Butyl Ether (MTBE) was tested for carcinogenicity, neurotoxicity, chronic, reproductive and developmental toxicity. The NOEL for all endpoints evaluated in three animal species was 400 ppm or greater. An increase in kidney tumors/damage and liver tumors was observed in animals exposed to high concentrations of MTBE. Some embryo/fetal toxicity and birth defects were observed in the offspring of pregnant mice exposed to maternally toxic doses of MTBE, however the offspring of exposed pregnant rabbits were unaffected. The significance of the animal findings at high exposures are not believed to be directly related to potential human health hazards in the workplace.

ACUTE TOXICITY DATA:

Based on animal testing data from similar materials and products, the acute toxicity of this product is expected to be:
Oral : LD50 > 18 ml/kg (Rat)
Dermal : LD50 > 5 ml/kg (Rabbit)

OCCUPATIONAL EXPOSURE LIMIT:

Manufacturer Recommends:
For gasoline, 300 mg/m3.
For Methyl-tert-Butyl Ether, 25 ppm (90 mg/m3) 8-hour TWA and 75 ppm (270 mg/m3) 15-minute STEL.

ACGIH recommends:
For Gasoline, ACGIH recommends a TWA of 300 ppm (890 mg/m3) and

categorizes it as an animal carcinogen.
For n-Hexane (skin), 50 ppm (176 mg/m3).
For Benzene, ACGIH recommends a TWA of 0.5 ppm (1.6 mg/m3), (skin), and categorizes it as a confirmed human carcinogen.
For Methyl-tert-Butyl Ether, ACGIH recommends a TLV of 40 ppm (144 mg/m3) an categorizes it as an animal carcinogen.

Local regulated limits may vary.

---

5. FIRST AID MEASURES

INHALATION:

In emergency situations use proper respiratory protection to immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.

EYE CONTACT:

Flush eyes with large amounts of water until irritation subsides. If irritation persists, get medical attention.

SKIN CONTACT:

Flush with large amounts of water. Use soap if available.
Remove severely contaminated clothing (including shoes) and launder before reuse.
If irritation persists, seek medical attention.

INGESTION:

DO NOT induce vomiting since it is important that no amount of the material should enter the lungs (aspiration). Keep at rest. Get prompt medical attention.

---

6. PREVENTIVE AND CORRECTIVE MEASURES

PERSONAL PROTECTION:

The selection of personal protective equipment varies, depending upon conditions of use.
In open systems where contact is likely, wear safety goggles, chemical-resistant overalls, and chemically impervious gloves.
Where only incidental contact is likely, wear safety glasses with side shields. No other special precautions are necessary provided skin/eye contact is avoided.
Where concentrations in air may exceed the occupational exposure limits given in Section 4 and where engineering, work practices or other means

of exposure reduction are not adequate, approved respirators may be necessary to prevent overexposure by inhalation.

ENGINEERING CONTROLS:

The use of local exhaust ventilation is recommended to control emissions near the source. Laboratory samples should be handled in a fumehood. Provide mechanical ventilation of confined spaces.
Use explosion-proof ventilation equipment.

HANDLING, STORAGE AND SHIPPING:

Keep containers closed. Handle and open containers with care.
In keeping with good personal hygiene practices, wash hands thoroughly after handling the material.

Store and load at normal (up to 38 deg C) temperature and at atmospheric pressure.
Material will accumulate static charges which may cause a spark. Static charge build-up could become an ignition source. Use proper relaxation and grounding procedures.
For personnel entry into confined spaces (i.e. bulk storage tanks) a proper confined space entry procedure must be followed including ventilation and testing of tank atmosphere.
Empty containers may contain product residue. Do not pressurize cut, heat, or weld empty containers. Do not reuse empty containers without commercial cleaning or reconditioning.

LAND SPILL:

Eliminate source of ignition. Keep public away. Prevent additional discharge of material, if possible to do so without hazard.
Vapours or dust may be harmful or fatal. Warn occupants of downwind areas.
Prevent spills from entering sewers, watercourses or low areas. Contain spilled liquid with sand or earth. Do not use combustible materials such as sawdust.
Recover by pumping (use an explosion proof motor or hand pump), or by using a suitable absorbent.
Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately.
Take all additional action necessary to prevent and remedy the adverse effects of the spill.

WATER SPILL:

Eliminate all sources of ignition. Vapours or dust may be harmful or fatal. Warn occupants and shipping in downwind areas.
Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately.
Take all additional action necessary to prevent and remedy the adverse effects of the spill.

7. FIRE AND EXPLOSION HAZARD

Flashpoint and method: -40 deg C COC D92 less than/moins de

Autoignition: NA Flammable Limits: LEL: 1.4% UEL: 7.6%

GENERAL HAZARDS:

Extremely flammable; material will readily ignite at normal temperatures.
Flammable Liquid; may release vapours that form flammable mixtures at or above the flash point.
Toxic gases will form upon combustion.
Static Discharge; material may accumulate static charges which may cause a fire.

FIRE FIGHTING:

Use water spray to cool fire exposed surfaces and to protect personnel.
Shut off fuel to fire if possible to do so without hazard. If a leak or spill has not ignited use water spray to disperse the vapours.
Either allow fire to burn out under controlled conditions or extinguish with foam or dry chemical. Try to cover liquid spills with foam.
Respiratory and eye protection required for fire fighting personnel.
Avoid spraying water directly into storage containers due to danger of boilover.
A self-contained breathing apparatus (SCBA) should be used for all indoor fires and any significant outdoor fires. For small outdoor fires, which may easily be extinguished with a portable fire extinguisher, use of an SCBA may not be required.

HAZARDOUS COMBUSTION PRODUCTS:

Smoke, carbon monoxide, carbon dioxide under thermal decomposition.

8. REACTIVITY DATA

STABILITY:

This product is stable. Hazardous polymerization will not occur.

INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID:

Strong oxidizing agents

HAZARDOUS DECOMPOSITION:

none

9. NOTES

All components of this product are listed on the U.S. TSCA inventory.

10. PREPARATION

Prepared by: Lubricants & Specialties
IMPERIAL OIL
Products Division
111 St Clair Avenue West
Toronto, Ontario
M5W 1K3
(800) 268-3183

APPENDIX C

SPECIFIC SPILL INFORMATION AND RESPONSE FOR DIESEL (MSDS INCLUDED)

Diesel

CAS# 68334-30-5

Other Names: Diesel fuel, diesel oil, fuel oil.

Physical Traits: Clear colorless or dyed liquid.

Special Precautions:

- Combustible/flammable liquid.
- May contain PAHs that may be carcinogenic.
- Generally regarded as being of low toxicity unless exposure is repeated and/or prolonged.
- Skin and respiratory tract irritant.

Incompatible Materials:

- Strong acids
- Oxidizing agents
- Halogens

Personal Protective Equipment / Response Equipment

Level D

Coveralls (disposable); gloves and boots made from neoprene or butyl rubber; safety glasses or goggles; hardhat. Additional equipment at discretion of Incident Commander.

Cleanup Procedures and Options:

- Keep unprotected personnel upwind of spill.
- Stop spill at the source, contain in smallest possible area.
- Protect waterways.

If on land and it is safe to do so:

1. Stop or reduce discharge if safe to do so by plugging, righting, adjusting valves or other suitable method.
2. Contain spill by diking with earth, snow or ice or other barrier, possible trenching or creating a lined sump down gradient from the spill source.
3. Ensure that you have reported the spill.
4. Remove fuel from containment area with pumps, vacuum equipment and place in drums or empty storage tanks, “TIDY” tanks or bladders.
5. Absorb residual liquid on natural or synthetic absorbents (e.g. 3M products).
6. Remove contaminated soils in the spill to an appropriate disposal site if spill site is located near water supply or stream/river course or for aesthetic reasons.
7. Dispose of contaminated fuel by recycling or incineration. In site, incineration may be possible if permission granted from environmental and forestry officials.

If in water and if safe to do so:

1. Stop, or reduce discharge if safe to do so by plugging, righting, adjusting valves, or other suitable method. This material floats on water and is toxic to aquatic life in low concentrations.
2. If possible, contain discharge by booming using commercial boom material, logs or other material at hand.
3. If in rapidly flowing water, direct to quieter backwater using booms to deflect material.
4. Ensure that you have reported the spill.
5. Remove from water by skimming, using absorbents, and collect in suitable container (tanks, drums, plastic lined depression in ground or snow).
6. Dispose by recycling or incineration, if conditions are suitable and regulatory authorities grant permission.

If on snow and it is safe to do so:

1. Stop, or reduce discharge if safe to do so by plugging, righting, adjusting valves, or other suitable method.
2. Compact the snow around the perimeter of the spill area.
3. Construct and compact snow dams.
4. Locate the low point of the spill area, then clear channels in the snow to allow material not absorbed to flow into the low area.
5. Once collected in the low area, shovel the spilled material into containers or pick it up with mobile heavy equipment, then transport it to an approved disposal or recovery site.

Material Safety Data Sheet

Trade Name: DIESEL FUEL **Manufacturer:** ESSO - IMPERIAL OIL

MSDS Code: 00826 **Type of Chemical:** GAS

Notes:
1. PRODUCT INFORMATION

Product identifier: MIDDLE DISTILLATE
ESSO MARINE GAS OIL (DYED OR CLEAR)
ESSO RAILROAD DIESEL (DYED OR CLEAR)
HEATING OIL (DYED OR CLEAR)
DIESEL (DYED OR CLEAR)
DIESEL QUALITY FURNACE FUEL (DYED OR CLEAR)
DIESEL QUALITY HEATING OIL (DYED OR CLEAR)
ESSO DIESEL (DYED OR CLEAR)
ESSO DIESEL QUALITY COMMERCIAL FUEL (DYED OR CLEAR)
ESSO DIESEL QUALITY FURNACE FUEL
ESSO DIESEL QUALITY HEATING OIL
ESSO FURNACE FUEL (DYED OR CLEAR)
ESSO HEATING OIL (DYED OR CLEAR)
ESSO MARINE DIESEL FUEL (DYED OR CLEAR)
ESSO RAILROAD DIESEL FUEL #3 (DYED OR CLEAR)
ESSO TOBACCO CURING OIL
FUEL OIL 75
FUEL OIL 76
DIESEL MARINE (DYED OR CLEAR)
DIESEL MARINE GAS OIL (DYED OR CLEAR)
FURNACE (DYED OR CLEAR)
DIESEL MARINE – POUR DEPRESSED (DYED OR CLEAR)
NO.2 FUEL OIL
NAVAL FUEL OIL 3-GP – 11M (DYED)
ESSO DIESEL FUEL LS
DIESEL LOW SULPHUR (DYED OR CLEAR)
NO. 2 FUEL OIL FOR EXPORT
DIESEL FOR EXPORT (DYED OR CLEAR)
FURNACE TOBACCO CURING OIL
DIESEL NAVAL 3GP-11 (DYED OR CLEAR)
DIESEL NAVAL 3GP – 15 (DYED OR CLEAR)
DIESEL LOW SULPHUR RAIL (DYED OR CLEAR)
DIESEL LOW SULPHUR DYED EP
DIESEL RAIL (DYED OR CLEAR)
DIESEL RAIL #3 (DYED OR CLEAR)
DIESEL RAIL #3 (DYED OR CLEAR)
DIESEL LOW SULPHUR <032> (DYED OR CLEAR)
FURNACE URBAN (DYED OR CLEAR)
DIESEL (032) (DYED OR CLEAR)
DIESEL LOW SULPHUR (EXP DYED)
FURNACE FUEL <032> DYED

DIESEL LOW SULPHUR
MARINE GAS OIL

Application and use:
Multi-purpose fuel
Product description:
A complex mixture of aliphatic, olefinic, naphthenic and aromatic hydrocarbons.

REGULATORY CLASSIFICATION

WHMIS:
Class B, Division 3: Combustible Liquids
Class D, Division 2: Subdivision B: Toxic Material

CEPA: CANADIAN ENVIRONMENTAL PROTECTION ACT
All components of this product are either on the Domestic Substances List (DSL) or are exempt.

TDG INFORMATION(RAIL/ROAD):
Shipping Name: FUEL OIL
Class: 3
Packing Group: III
PIN Number: UN1202

Please be aware that other regulations may apply.

TELEPHONE NUMBERS MANUFACTURER / SUPPLIER:
EMERGENCY 24 HOUR: (519) 339-2145 IMPERIAL OIL
TECHNICAL INFO: (800) 268-3183 Products Division
111 St. Clair Avenue West
Toronto, Ontario
M5W 1K3
(416) 968-4441

2. REGULATED COMPONENTS

The following components are defined in accordance with sub-paragraph 13(a)(I) or (iv) or paragraph 14(a) of the Hazardous Products Act:
NAME % CAS #
Fuel Oil No. 2 >99.9 v/v 68476-30-2

3. TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Liquid
Specific gravity: 0.820 to 0.900 at 15 deg C
Viscosity: 1.30 cSt at 40 deg C
Vapour density: 4
Boiling point: 150 to 370 deg C
Evaporation rate: <1 (1=n-butylacetate)
Solubility in water: negligible
Freezing/pour point: -4 deg C –39 (range)
Odour Threshold: not available
Vapour Pressure: 4 kPa at 38 deg C
Appearance/odour: white or pale yellow liquid, petroleum odour.

4. HEALTH HAZARD INFORMATION

NATURE OF HAZARD

INHALATION:
Negligible hazard at normal temperatures (up to 38 deg C).
High vapour concentrations are irritating to the eyes, nose, throat and lungs.
May cause headaches and dizziness. May be anesthetic and may cause other central nervous system effects. Avoid breathing vapours or mists.

EYE CONTACT:
Slightly irritating, but will not injure eye tissue.

SKIN CONTACT:
Low toxicity, irritating.

INGESTION:
Low toxicity.
Small amounts of this liquid drawn into the lungs from swallowing or vomiting may cause severe health effects (e.g. bronchopneumonia or pulmonary edema)

CHRONIC:
Lifetime skin painting tests indicate that materials of similar composition have produced skin cancer in experimental animals. The relationship of these results to humans has not been fully established.

ACUTE TOXICITY DATA:
Based on animal testing data from similar materials and products, the acute toxicity of this product is expected to be:
ORAL: LD50 > 5000 mg/kg (RAT)
DERMAL: LD50 > 2000 mg/kg (RABBIT)
INHALATION: LC50 > 2500 mg/m3 (RAT)

OCCUPATIONAL EXPOSURE LIMIT:
Manufacturer recommends: 100 ppm based on composition
Local regulated limits may vary.

5. FIRST AID MEASURES

INHALATION:
In emergency situations use proper respiratory protection to immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.

EYE CONTACT:
Flush eyes with large amounts of water until irritation subsides. If irritation persists, get medical attention.

SKIN CONTACT:
Immediately flush with large amounts of water. Use soap if available. Remove contaminated clothing, including shoes, after flushing has begun. If irritation persists, seek medical attention.

INGESTION:
DO NOT induce vomiting since it is important that no amount of the material should enter the lungs (aspiration). Keep at rest. Get prompt medical attention.

6. PREVENTITIVE AND CORRECTIVE MEASURES

PERSONAL PROTECTION:
The selection of personal protective equipment varies, depending upon conditions of use. In open systems where contact is likely, wear safety goggles, chemical resistant overalls, and chemically impervious gloves.
Where concentrations in air may exceed the occupational exposure limits given in Section 4 and where engineering, work practices or other means of exposure reduction are not adequate, approved respirators may be necessary to prevent overexposure by inhalation.

ENGINEERING CONTROLS:
The use of local exhaust ventilation is recommended to control emissions near the source. Laboratory samples should be handled in a fumehood. Provide mechanical ventilation of confined spaces.

HANDLING, STORAGE AND SHIPPING:
Keep containers closed. Handle and open containers with care. Store in a cool, well ventilated place away from incompatible materials. In keeping with good personal hygiene practices, wash hands thoroughly after handling the material.
Do not handle or store near an open flame, sources of heat, or sources of ignition.
Material will accumulate static charges which may cause a spark. Static charge build-up could become an ignition source. Use proper relaxation and grounding procedures.
Empty containers may contain product residue. Do not pressurize, cut, heat, or weld empty containers. Do not reuse empty containers without commercial cleaning or reconditioning.

LAND SPILL:
Eliminate source of ignition. Keep public away. Prevent additional discharge of material, if possible to do so without hazard. Prevent spills from entering sewers, water courses or low areas. Contain spilled liquid with sand or earth. Do not use combustible materials such as sawdust. Recover by pumping (use an explosion proof motor or hand pump), or by using a suitable absorbent.
Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

WATER SPILL:
Remove from surface by skimming or with suitable absorbents, if allowed by local authorities and environmental agencies, sinking and / or suitable dispersants may be used in unconfined waters. Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

7. FIRE AND EXPLOSION HAZARD

Flashpoint and method: >40 deg C PMCT ASTM D93
Autoignition: NA Flammable Limits: LEL: 0.7% UEL: 6.5%

GENERAL HAZARDS:
Combustible liquid: may form combustible mixtures at or above the flash point.
Toxic gases will form upon combustion.
Static Discharge: material may accumulate static charges which may cause a fire.

FIRE FIGHTING:
Use water spray to cool fire exposed surfaces and to protect personnel.
Shut off fuel to fire.
Use foam, dry chemical or water spray to extinguish fire.

Respiratory and eye protection required for fire fighting personnel.
Avoid spraying water directly into storage containers due to danger f boilover.
A self contained breathing apparatus (SCBA) should be used for all indoor fires and any significant outdoor fires. For small outdoor fires, which may easily be extinguished with a portable fire extinguisher, use of an SCBA may not be required.

HAZARDOUS COMBUSTION PRODUCTS:
Smoke, carbon monoxide, carbon dioxide and traces of oxides of sulphur.

8. REACTIVITY DATA

STABILITY: This product is stable. Hazardous polymerization will not occur.

INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID: strong oxidizing agents.

HAZARDOUS DECOMPOSITION: None.

9. NOTES

All components of this product are listed on the US TSCA inventory.
Three year WHMIS review.
This MSDS has been revised in Section 3.

10. PREPARATION

Prepared by: Lubricants & Specialties
IMPERIAL OIL
Products Division
111 St. Clair Avenue West
Toronto, Ontario
M5W 1K3
(800) 268-3183

CAUTION:
The information contained herein relates only to this product or material and may not be valid when used in combination with any other product or material or in any process. If the product is not to be used for a purpose or under conditions which are normal or reasonably forseeable. This information cannot be relied upon as complete or applicable. For greater certainty. Uses other than those described in Section 1 must be reviewed with the supplier. The information herein is based on the information available at he indicated date of preparation. This MSDS is for the use of Imperial Oil customers and their employees and agents only. Any further distribution of this MSDS by Imperial Oil customers is prohibited without the written consent of Imperial Oil.

APPENDIX D

Mackenzie Valley Land and Water Board Type B Water Licence. Licence Number MV2017L2-0007

Mackenzie Valley Land and Water Board
7th Floor - 4922 48th Street
P.O. Box 2130
YELLOWKNIFE NT X1A 2P6
Phone (867) 669-0506
FAX (867) 873-6610

December 18, 2017 File: MV2017L2-0007

Ms. Michelle Unger
Manager, Environmental Compliance
Teck Metals Ltd.
Bag 2000
Kimberley BC V1A 3E1 Email: MICHELLE.UNGER@TECK.COM

Dear Ms. Unger:

Administrative update to Water Licence MV2017L2-0007 and Reasons for Decision – Approved Water Monitoring – Pine Point, NT

The Mackenzie Valley Land and Water Board (MVLWB/the Board) met on December 18, 2017 to review an administrative update to Section 5.2.10 of the Reasons for Decision document, which accompanies the issuance of Water Licence MV2017L2-0007. This update was requested by Teck Metals Ltd. on November 24, 2017.

The Board accepted the requested changes to the Reasons for Decision document. In addition, Annex B: Concordance Table of Items Requiring Submission of Water Licence MV2017L2-0007 has been updated to better align with the Licence conditions. The updated Licence and Reasons for Decision documents are attached below.

If you have any questions or concerns, please contact Kierney Leach at (867) 766-7470 or email kleach@mvlwb.com.

Yours sincerely,

Mavis Cli-Michaud
MVLWB, Chair

Copied to: Distribution List
Wendy Bidwell, GNWT-ENR, Water Resources Officer

Attached: Water Licence MV2017L2-0007
Reasons for Decision
General Procedures for the Administration of Licences in the Northwest Territories

Mackenzie Valley Land and Water Board
Water Licence

Pursuant to the *Mackenzie Valley Resource Management Act,* the *Waters Act,* and the Waters Regulations, the Mackenzie Valley Land and Water Board, hereinafter referred to as the Board, hereby grants to:

Teck Metals Inc.
(Licensee)

of Bag 2000, Kimberley, British Colombia V1A 3E1
(Mailing Address)

hereinafter called the Licensee, the right to alter, divert, or otherwise use water subject to the restrictions and conditions contained in the *Waters Act* and Regulations made thereunder and subject to and in accordance with the conditions specified in this Licence.

Licence Number:	MV2017L2-0007
Licence Type:	B
Water Management Area:	Northwest Territories 01
Location:	60°53'41.3"N and 114°25'30.7"W (Formerly known as Pine Point, NT)
Purpose:	To dispose of waste and associated uses
Description:	Mining and Milling
Quantity of Water **not to be exceeded**:	0 cubic metres (m^3)
Effective date of licence:	October 25, 2017
Expiry date of licence:	October 24, 2027

This Licence issued and recorded at Yellowknife includes and is subject to the annexed conditions.

Mackenzie Valley Land and Water Board

Chair **Witness**

Type B Water Licence MV2017L2-0007
Teck Metals Ltd. – Pine Point Tailings Impoundment Area
Water Monitoring and Management

Table of Contents

Part A: Scope and Definitions

1. Scope

a) This Licence entitles the Licensee to monitor and manage Water within the Tailings Impoundment Area, and dispose of Wastewater from the Main Pond at the former Pine Point Mine, Northwest Territories, as described in the Accepted Application.

b) This Licence is issued subject to the conditions contained herein with respect to the management of Water and the depositing of Waste of any type in any Waters or in any place under any conditions where such Waste or any other Waste that results from the deposit of such Waste may enter any Waters. Whenever new Regulations are made or existing Regulations are amended by the Commissioner in Executive Council under the Act, or other statutes imposing more stringent conditions relating to the quantity or type of Waste that may be so deposited or under which any such Waste may be so deposited this Licence shall be deemed, upon promulgation of such Regulations, to be automatically amended to conform with such Regulations.

c) Compliance with the term and conditions of this Licence does not relieve the Licensee from responsibility for compliance with the requirements of all applicable Federal, Territorial or municipal legislation.

d) The Licensee shall take every reasonable precaution to protect the environment.

e) In conducting its activities under this Licence, the Licensee shall make best efforts to consider and incorporate any scientific and Traditional Knowledge that is made available to the Licensee.

2. Definitions

Act - the *Waters Act*, S.N.W.T. 2014, c.18.

Accepted Application – the application and supporting documentation submitted August 22, 2017 and the additional information submitted during the regulatory process.

Action Level – a predetermined qualitative or quantitative trigger which, if exceeded, requires the Licensee to take appropriate actions including, but not limited to: further investigations, changes to operations, or enhanced mitigation measures and reporting.

Analyst - an Analyst designated by the Minister under subsection 65(1) of the Act.

Board - the Mackenzie Valley Land and Water Board established under subsection 99(1) of the *Mackenzie Valley Resource Management Act*;

Construction - any activities undertaken to construct or build any components of, or associated with, the undertaking.

Dam Safety Guidelines - the Canadian Dam Association's (CDA) *Dam Safety Guidelines*, 2007. The scope and applicability of the Dam Safety Guidelines referred to in this Licence is presented in Section 1 of the Dam Safety Guidelines.

Discharge - the direct or indirect release of any Water or Waste to the Receiving Environment.

Engagement Plan - a document, developed in accordance with the Board's June 2013 *Engagement and Consultation Policy* and the *Engagement Guidelines for Applicants and Holders of Water Licences and Land Use Permits* describes proposed engagement activities during the life of the undertaking.

Engineered Structures - any structure or facility related to Water Use or the deposit of Waste that is designed and approved by a Professional Engineer.

Freeboard - the vertical distance between the Water line and the effective containment crest on the upstream slope of a dam or dyke.

Groundwater - all Water below the ground surface.

Inspector - an Inspector designated by the Minister under subsection 65(1) of the Act.

Licensee – the holder of this Licence.

Main Pond – the pond located north of the Tailings as outlined in Attachment 7, Figure 7 of the Accepted Application.

Maximum Average Concentration - the discrete average of four consecutive analytical results, or if less than four, the analytical results collected during a batch decant and as submitted to the Board in accordance with the sampling and analysis requirements specified in the Surveillance Network Program.

Maximum Grab Concentration - a concentration of a parameter listed in the Licence that cannot exceeded in any one grab sample.

Minewater - Groundwater or any Water that is pumped or flows out of any underground working.

Minister - a duly appointed member of the Executive Council who is responsible for the *Waters Act* or the department responsible for administering that Act.

Modification - a change, other than an expansion, that does not alter the purpose or function of a structure.

Professional Engineer - a person who is registered with the Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists in accordance with the *Engineering and Geoscience Professions Act.* S.N.W.T. 2006, V.16, as a Professional Engineer, and whose principal field of specialization is appropriate to address the components of the undertaking at hand.

Receiving Environment - the aquatic environment that receives any Water or Waste released from the undertaking.

Reclamation - activities which facilitate the return of areas affected by the undertaking to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment,

human activities, and the surrounding environment.

Regulations - Regulations promulgated pursuant to section 63 of the Act.

Seepage - Water or Waste that drains through or escapes from any structure designed to contain, withhold, divert or retain Water or Waste.

Sewage - all Toilet Wastes and Greywater.

Spill Contingency Plan - a document, developed in accordance with Indian and Northern Affairs Canada's April 2007 *Guidelines for Spill Contingency Planning*, that describes the set of procedures to be implemented to minimize the effects of a spill.

Surveillance Network Program (SNP) - the totality of the sampling requirements detailed in Annex A of this Licence.

Traditional Knowledge - the cumulative collective body of knowledge, experience and values built up by a group of people through generations of living in close contact with nature. It builds upon the historic experiences of a people, and adapts to social, economic, environmental, spiritual and political change.

Tailings Impoundment Area - comprises the Tailings storage area and the Engineered Structures designed to contain Tailings as described in Teck's 2017 Operations and Maintenance Plan (Operations, Maintenance and Surveillance Manual for Pine Point Tailings Impoundment Area, 2017) and shown on Figure 2 (Pine Point Tailings Impoundment Area Site Plan) in the Accepted Application.

Tailings – the materials rejected from the mill after the recoverable valuable minerals have been extracted.

Unauthorized Discharge - a Discharge or spill of any Water or Waste not authorized under this Licence.

Waste – any Waste as defined in section 1 of the Act.

Wastewater - any Water that is generated by activities or originates on site and contains Waste and includes, but is not limited to, runoff, Seepage, or Minewater.

Water - any Water as defined in section 1 of the Act.

Part B: General Conditions

1. The Licensee shall ensure a copy of this Licence is maintained on site at all times.

2. All references to policies, guidelines, codes of practice, statutes, Regulations or other authorities shall be read as a reference to the most recent versions.

3. All information submitted to the Board, as required by this Licence, shall:
   a) Be in accordance with the Mackenzie Valley Land and Water Board's March 2012, *Document Submission Standards;* and
   b) Include a section within each submission which identifies where the pertinent requirements of the Licence are addressed.

4. The Licensee shall operate in accordance with approved plans referred to in this Licence, including such revisions as may be made pursuant to the conditions of this Licence and as approved by the Board. If any plan is not approved by the Board, the Licensee shall revise the plan as directed and resubmit it to the Board for approval.

5. The Licensee shall comply with the **Schedules** which are annexed to and forms part of this Licence, and any changes to the Schedules as may be made from time to time by the Board.

6. The Licensee shall comply with the **Surveillance Network Program**, which is annexed to and forms part of this Licence, and any changes to the Surveillance Network Program as may be made from time to time by the Board.

7. The Schedules, Surveillance Network Program, and any compliance dates specified in this Licence may be changed at the discretion of the Board. If any date for a submission falls on a weekend or holiday, the submission shall be made on the following business day.

8. The Licensee shall maintain, to the satisfaction of an Inspector, the signs necessary to identify the stations of the Surveillance Network Program.

9. Meters, devices, or other such methods used for measuring the volumes of Water used and Waste Discharged shall be installed, operated, and maintained by the Licensee to the satisfaction of an Inspector.

10. Within 60 days following issuance of this Licence, the Licensee shall post signs to identify the Surveillance Network Program stations. All signs shall be located and maintained to the satisfaction of an Inspector.

11. The Licensee shall act in accordance with the **Engagement Plan,** once approved by the Board. The Licensee shall annually review the approved Plan and make any necessary revisions to reflect changes in operations, or as directed by the Board. The revised Plan shall include a brief summary of the changes made, and shall be submitted to the Board, for approval, at least 60 days prior to any proposed changes to the requirements in the approved Plan.

12. Beginning March 31, 2018, and no later than every March 31 thereafter, the Licensee shall submit to the Board, an **Annual Water Licence Report**, which shall be in accordance with Schedule 1, item 1.

Part C: Conditions Applying to Security Requirements

1. The Licensee shall post and maintain a security deposit in accordance with Schedule 2, item 1.

2. Upon request of the Board, the Licensee shall submit a revised Reclamation liability estimate utilizing the current version of RECLAIM or another method acceptable to the Board.

3. The amount of the security deposit required by Part C, item 1 and Schedule 2 may be revised by the Board based on estimates of the current Reclamation liability referred to in Part C, item 2 or based on such other information as it may become available to the Board.

4. If the amount of the security deposit is revised by the Board as described under Part C, item 3, the Licensee shall post the revised amount with the Minister within 90 days of the Board giving notice of the revised amount.

Part D: Conditions Applying to Construction

1. The Licensee shall ensure that all structures intended to contain, withhold, divert, or retain Water or Wastes are designed, constructed, and maintained to prevent escape of Waste to the Receiving Environment.

2. The Licensee shall ensure that all Engineered Structures intended to contain, withhold, divert, or retain Water or Wastes and which meet the definition of a dam under the *Dam Safety Guidelines* are designed, constructed, and maintained to meet or exceed the *Dam Safety Guidelines.*

Part E: Conditions Applying to Modifications

1. The Licensee may, without written approval from the Board, carry out Modifications to the Engineered Structures provided that such Modifications are consistent with the terms of this License and the following requirements are met:

    a) The Licensee has notified the Board and an Inspector in writing of such proposed Modifications at least 60 days prior to beginning the Modifications;
    b) Such Modifications do not place the Licensee in contravention of either the License or the *Act*;
    c) The Board has not, during the 60 days following notification of the proposed Modifications, informed the Licensee that review of the proposal will require more than 60 days;
    d) An Inspector has authorized the proposed Modifications and provided a letter of notification to the Board; and
    e) The Board has not rejected the proposed Modifications.

2. Modifications for which all of the conditions referred to in Part E, Item 1 have not been met, may be carried out only with written approval from the Board.

3. The Licensee shall provide to the Board as-built plans and drawings of the Modifications referred to in this License within 90 days of completion of the Modifications.

Part F: Conditions Applying to Waste and Water Management

1. The Licensee shall manage Water and Waste with the objectives of minimizing impacts on the quantity and quality of Water in the Receiving Environment through the use of appropriate mitigation measures, monitoring, and follow-up actions.

Management Plans and Monitoring Programs

2. The Licensee shall act in accordance with the **Water Management Plan,** once approved by the Board. The Licensee shall annually review the approved Plan and make any necessary revisions to reflect changes in operations, technology, chemicals, or fuels, or as directed by the Board. The revised Plan shall include a brief summary of the changes made, and shall be submitted to the Board, for approval, at least 60 days prior to any proposed changes to the requirements in the approved Plan.

3. The Licensee shall act in accordance with the **Operations and Maintenance Plan** in the Accepted Application, and submit a revised Plan by February 1, 2018, for approval, which shall include the addition of the following information:
   a) A description, including detailed rationale, of the monitoring endpoints (Action Levels) for each parameter monitored in the Surveillance Network Program;
   b) Mitigation measures for decreasing pH at SNP station 35-1b when it exceeds effluent quality criteria, as specified in Part F, item 10;
   c) A description of response actions to be carried out if the Action Levels are exceeded; and
   d) Any other item as directed by the Board.

4. Once approved by the Board, the Licensee shall annually review the Operations and Maintenance Plan and make any necessary revisions to reflect changes in operations, or as directed by the Board. The revised Plan shall include a brief summary of the changes made, and shall be submitted to the Board, for approval, at least 60 days prior to any proposed changes to the requirements in the approved Plan.

Operations of Structures and Facilities

5. The Licensee shall maintain the Tailings Impoundment Area structures, and all other Waste storage facilities, to design specifications/engineering standards such that:
   a) The solids fraction of the Mill Tailings shall be permanently contained within the Tailings Impoundment Area;
   b) Seepage from the Tailings Impoundment Area is minimized;
   c) Any Seepage from the Tailings Impoundment Area that occurs and does not meet effluent quality criteria, as specified in Part F, item 10, shall be prevented from entering the Receiving Environment;
   d) A Freeboard limit of one meter is maintained at all times;
   e) The rate of Waste Discharge is controlled and measured at all times;
   f) Any constructed facilities that are eroded are repaired immediately; and
   g) Conditions for eventual closure and Reclamation of the Waste storage facilities are optimized.

Inspections of Structures and Facilities

6. The Licensee shall conduct daily inspections for erosion at Discharge points during periods of Discharge, or more frequently as directed by an Inspector. Records of these inspections shall be kept for review upon request of an Inspector.

7. The Licensee shall ensure that geotechnical inspections of the dams, dykes, culverts, spillways, and any other Engineered Structures are conducted annually, during the summer months, by a Professional Engineer and following any unforeseen extreme events (such as earthquakes, flooding, cracks, sinkhole formation, etc). The Licensee shall:
   a) Provide written notification to an Inspector a minimum of two weeks prior to inspections; and,
   b) Within 90 days of completing an inspection, the Licensee shall submit the Professional Engineer's full **Geotechnical Inspection Report** to the Board. The Report shall include a covering letter from the Licensee outlining an implementation plan to respond to any recommendations made by the Professional Engineer, including a rationale for any decisions that deviate from the Professional Engineer's recommendations.

8. The Licensee shall conduct inspections of the Tailings dams after spring freshet, once during the summer period, and again prior to spring freeze-up in the fall. Records of these inspections shall be kept for review upon request of an Inspector or the Board.

Effluent Quality Criteria (EQC)

9. The Licensee shall provide Water sampling results from Surveillance Network Program (SNP) station 35-1b to an Inspector no later than five days prior to the first annual Discharge of treated Wastewater to the Receiving Environment. Discharge shall not commence until authorized in writing by an Inspector.

10. Discharges from SNP station 35-1b shall have a pH between 6.5 and 9.5 and meet the following EQC:

Parameter	Maximum Average Concentration (in mg/L)	Maximum Grab Concentration (in mg/L)
Total Arsenic	0.50	1.00
Total Copper	0.15	0.30
Total Cyanide	0.10	0.20
Total Lead	0.20	0.40
Total Zinc	0.50	1.00
Ammonia as N	2.00	4.00
Total Suspended Solids	25.00	50.00

mg/L = milligrams per litre

11. If any of the EQC's as listed in Part F, item 10 are exceeded, the Licensee shall cease all Discharge to the Receiving Environment, shall immediately notify the Board and an Inspector, and shall take the necessary corrective action to mitigate the exceedance, as outlined in the approved Operations and Maintenance Plan referred to in Part F, items 3 and 4, to the satisfaction of an Inspector.

Part G: Conditions Applying to Contingency Planning

1. The Licensee shall act in accordance with the **Spill Contingency Plan**, once approved by the Board. The Licensee shall annually review the approved Plan and make any necessary revisions to reflect changes in operations, technology, chemicals, or fuels, or as directed by the Board. The revised Plan shall include a brief summary of the changes made, and shall be submitted to the Board, for approval, at least 60 days prior to any proposed changes to the requirements in the approved Plan.

2. If, during the period of this Licence, a spill or an Unauthorized Discharge occurs, or is foreseeable, the Licensee shall:
   a) Implement the Spill Contingency Plan referred to in Part G, item 1;
   b) Report the incident immediately via the 24-Hour Spill Reporting Line (867) 920-8130 in accordance with the instructions contained in the Spill Report Form NWT 1752/0593;
   c) Report each spill and Unauthorized Discharge to the Board and an Inspector within 24 hours; and
   d) Submit a detailed report on each spill and Unauthorized Discharge, including descriptions of root causes, response actions and any changes to procedures to prevent similar occurrences in the future, to the Board within 30 days.

3. All spills and Unauthorized Discharges of Water or Waste shall be reclaimed to the satisfaction of an Inspector.

Part H: Conditions Applying to Closure and Reclamation

1. The Licensee shall act in accordance with the **Closure and Reclamation Plan** in the Accepted Application, and submit a revised Plan, by December 31, 2020, for approval, in accordance with the Mackenzie Valley Land and Water Board and Aboriginal Affairs and Northern Development Canada's November 2013 *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories.*

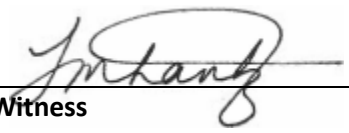
2. The Licensee shall annually review the approved Closure and Reclamation Plan and make any necessary revisions to reflect changes in operations, technology, chemicals, or fuels, or as directed by the Board. The revised Plan shall include a brief summary of the changes made, and shall be submitted to the Board, for approval, at least 60 days prior to any proposed changes to the requirements in the approved Plan.

3. The Licensee shall submit to the Board for approval, by May 1, 2018, a **Reclamation Research Plan**. This Plan shall detail the type of research required to update to the Closure and Reclamation Plan as required in Part H, item 1.

4. The Licensee shall carry out progressive Reclamation of areas as soon as is reasonably practicable.

Signed on behalf of the Mackenzie Valley Land and Water Board

Chair



Witness

Schedule 1:

Part B, item 12: Annual Water Licence Report

1. The **Annual Water Licence Report** referred to in Part B, item 12 of this Licence shall include, but not be limited to, the following:
   a) A summary of the calibration and status of the meters and devices referred to in Part B of this Licence;
   b) A summary of engagement activities conducted in accordance with the approved **Engagement Plan**, in Part B of this Licence, undertaken during the previous calendar year and shall include a brief description of activities planned for the forthcoming year;
   c) A summary of **Construction** activities and major maintenance work conducted in accordance with Part E of this Licence, undertaken during the previous calendar year;
   d) A summary of activities conducted in accordance with the approved **Water Management Plan**, required in Part F of this Licence, undertaken during the previous calendar year, including:
      i. A summary of updates or changes to the process or facilities required for the management of Water and Wastewater;
      ii. Daily, monthly and annual quantities in cubic metres of all Water and Wastewater collected, treated and pumped from the Post-Treatment Effluent Discharge point, identified by Discharge location;
   e) A summary of activities conducted in accordance with the approved **Operations and Maintenance Plan**, required in Part F of this Licence, undertaken during the previous calendar year, including:
      i. A summary of updates or changes to the process or facilities required for the management of the Tailings Impoundment Area;
      ii. A description of response actions that were carried out if any Action Levels were exceeded.
   f) A summary of activities conducted in accordance with the approved **Spill Contingency Plan**, required in Part G of this Licence, undertaken during the previous calendar year, including:
      i. A list and description for all Unauthorized Discharges that occurred during the previous calendar year, including the date, NWT spill number, volume, location, summary of the circumstances and follow-up actions taken, and status (i.e. open or closed), in accordance with the reporting requirements in Part G of this Licence; and
      ii. An outline of any spill training and communications exercises carried out during the previous calendar year.
   g) A summary of activities conducted in accordance with the **Closure and Reclamation Plan**, required in Part H of this Licence, completed during the year, a summary of updates or changes made, and an outline of any work anticipated for the next year;
   h) Any other details on Water Use or Waste disposal requested by the Board by November 1 of the year being reported;
   i) Electronic and tabular summaries of all data and information generated under the **Surveillance Network Program** for the previous year, in excel, or an electronic and printed format acceptable to the Board. This shall also include, but not be limited to the following:
      a. Rationale for SNP stations where samples were not collected and results and interpretation of quality assurance/quality control procedures;
      b. Graphical summaries and interpretation of the analytical results from the SNP samples collected at the points of compliance (SNP station 35-1) compared to the Effluent Quality Criteria under Part F of this Licence, for the previous two

consecutive years;

c. An explanation of any actions taken in response to any exceedances of the Effluent Quality Criteria;
d. Results from the Hach system monitoring, including all calibration and maintenance records for the Hach system;

j) A summary of actions taken to address concerns, non-conformances, or deficiencies in any reports filed by an Inspector.

Schedule 2:

Part C, item 1: Security Requirements

1. Pursuant to section 35 of the Act and section 11 of the Waters Regulations, the Licensee shall post security totaling $8,815,000.00 prior to the deposit of Waste.

Annex A: Surveillance Network Program
Annexed to Water Licence MV2017L2-0007
Teck Metals Inc. – Pine Point Tailings Impoundment Area

Part A: Reporting Requirements

1. The effective date of this Surveillance Network Program (SNP) is October 25, 2017.

2. The **Surveillance Network Program Report** is required as a component of the Annual Water Licence Report referred to in Part B, item 12 of this Licence.

3. More frequent sample collection may be required at the request of an Inspector.

4. All sampling, sample preservation, and analyses shall be conducted in accordance with methods prescribed in the current edition of American Public Health Association's (APHA) *Standard Methods for the Examination of Water and Wastewater* at the time of analysis, or by other such methods approved by an Analyst.

5. All analyses shall be performed in a laboratory accredited by the Canadian Association for Laboratory Accreditation (CALA) for the specific analyses to be performed or as approved by an Analyst.

6. Prior to the collection of SNP samples, the Licensee shall submit to the Board and an Analyst, a **Quality Assurance and Quality Control Plan**, which shall include a list of techniques that will be used to collect and analyze samples collected under the SNP, for the purposes of quality assurance and quality control. An Analyst shall provide a recommendation to the Board. The Licensee shall not commence Discharge of Water until an Analyst has approved the Plan.

7. The Licensee shall adhere to the Quality Assurance and Quality Control Plan, once approved, and shall annually review the Plan and make any necessary revisions to reflect changes in Operations or as directed by the Board. Revisions to the Plan shall be submitted to the Board for a decision.

8. If the Quality Assurance and Quality Control Plan is not approved by an Analyst, the Licensee shall revise the Plan according to an Analyst's direction and re-submit it to an Analyst for a decision.

Part B: Site Descriptions and Monitoring Requirements

1. The location of sampling sites is subject to approval of an Inspector.

2. The sampling station locations and monitoring requirements are as follows:

SNP station 35-1a and 35-1b

Description	The Tailings area Discharge at the decant structure.		
Location	60°53’41.3"N 114°25’30.7"W		
	35-1a: Main Pond		**35-1b: Post-Treatment Effluent Discharge**
Sampling Frequency	Weekly during Discharge	Water Level	Weekly during Discharge
Sampling Parameters	Total Copper; Total Lead; Total Zinc; pH; and Total Suspended Solids	3 times per year, once in Spring, Summer, and Fall; during periods of open Water	Volume, measured and recorded in cubic meters
Rationale	Compliance monitoring site, in accordance with EQCs listed in Part F of this Licence.		
Status	Active during Discharge.		

SNP station 35-4

Description	Muskeg surface Water due north of SNP station 35-1, 4.0 km from Great Slave Lake.
Location	60°54’41.8"N 114°26’17.2"W
Sampling Frequency	Annually; in Fall following Discharge.
Sampling Parameters	Total Copper; Total Lead; Total Zinc; and pH
Rationale	To ensure there are no mine-related impacts to the Receiving Environment.
Status	Active.

SNP station 35-5

Description	Muskeg surface Water 1.6 km south of Great Slave Lake.
Location	60°54’27.7"N 114°26’17.2"W)
Sampling Frequency	Annually; in Fall following Discharge.
Sampling Parameters	Total Copper; Total Lead; Total Zinc; and pH
Rationale	To ensure there are no mine-related impacts to the Receiving Environment.
Status	Active.

SNP station 35-6

Description	Muskeg surface Water 2.4 km due south of SNP station 35-5.
Location	60°55’26.6"N 114°28’25.4"W
Sampling Frequency	Annually; in Fall following Discharge.
Sampling Parameters	Total Copper; Total Lead; Total Zinc; and pH
Rationale	To ensure there are no mine-related impacts to the Receiving Environment.
Status	Active.

SNP station 35-9

Description	Great Slave Lake, 2.4 km southwest of Presquile Point.
Location	60°55’35.0"N 114°36’04.1"W
Sampling Frequency	Annually; in Fall following Discharge.
Sampling Parameters	Total Copper; Total Lead; Total Zinc; and pH
Rationale	To ensure there are no mine-related impacts to the Receiving Environment.
Status	Active.

SNP station 35-10

Description	Great Slave Lake, 4.8 km east of Presquile Point.
Location	60°57’00.2"N 114°27’56.6"W
Sampling Frequency	Annually; in Fall following Discharge.
Sampling Parameters	Total Copper; Total Lead; Total Zinc; and pH
Rationale	To ensure there are no mine-related impacts to the Receiving Environment.
Status	Active.

SNP station 35-12

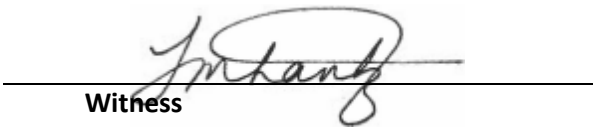
Description	Muskeg surface Water 4.8 km north of Tailings area decant structures, 0.8 km south of Great Slave Lake shoreline.
Location	60°57’02.1"N 114°25’06.6"W
Sampling Frequency	Annually; in Fall following Discharge.
Sampling Parameters	Total Copper; Total Lead; Total Zinc; and pH
Rationale	To ensure there are no mine-related impacts to the Receiving Environment.
Status	Active.

SNP station 35-13

Description	Muskeg surface Water, 4.0 km east of SNP Station 35-9, and 0.8 km south of Great Slave Lake shoreline.
Location	60°55’59.1"N 114°31’59.0"W
Sampling Frequency	Annually; in Fall following Discharge.
Sampling Parameters	Total Copper; Total Lead; Total Zinc; and pH
Rationale	To ensure there are no mine-related impacts to the Receiving Environment.
Status	Active.

Signed the 25 day of October, 2017 on behalf of the Mackenzie Valley Land and Water Board

Chair



Witness

Annex B: Concordance Table of Items Requiring Submission

Supplemental information to be submitted by Licensee as required through Water Licence conditions.

Part	Item	Date
B	Annual Water Licence Report	- March 31, 2018 - Annually on each March 31
B	Engagement Plan	- Annual Review
C	Security Deposit	- Prior to the deposit of Waste
F	Water Management Plan	- Annual Review
F	Operations and Maintenance Plan	- February 1, 2018 - Annual Review
F	Notification to an Inspector of Annual Geotechnical Inspection	- Two weeks prior to annual inspection
F	Geotechnical Inspection Report	- Report and implementation plan to be submitted 90 days from date of each inspection
F	Provide Water sampling results from SNP station 35-1b to an Inspector	- 5 days prior to the first annual Discharge of treated Wastewater
G	Spill Contingency Plan	- Annual Review
H	Closure and Reclamation Plan	- December 31, 2020
H	Reclamation Research Plan	- May 1, 2018
Annex A	Surveillance Network Program Report	- Component of Annual Water Licence Report
Annex A	Quality Assurance Quality Control Plan	- Prior to the collection of SNP samples - Annual Review

Annex C: Revisions to Water Licence # MV2017L2-0007

List of changes that have been made to the Water Licence since issuance

Date	Location of Change	What has changed
December 18, 2017	Annex B	To clarify that the security deposit is to be posted prior to the deposit of Waste.

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Reasons for Decision

Issued pursuant to sections 72.25 and 121 of the *Mackenzie Valley Resource Management Act* (MVRMA)

Type B Water Licence Renewal Application	
Preliminary Screener	Mackenzie Valley Land and Water Board
Reference/File Number	MV2017L2-0007
Applicant	Teck Metals Ltd.
Project	Water Monitoring and Management, Pine Point, NT
Date of Decision	October 25, 2017 (administrative update: December 18, 2017)

These Reasons for Decision set out the Mackenzie Valley Land and Water Board's (the Board or MVLWB) decision on an Application made by Teck Metals Ltd. (Teck Metals) to the Board on August 22, 2017 for a Type B Water Licence MV2017L2-0007 (Licence).

1.0 Background

Project History

The Pine Point mine was operated by Cominco from 1964 to 1988 and produced 70 million tons of ore, with grades of 2.9% lead and 6.8% zinc. The project has operated under a water licence since 1975. When the mine closed in 1988, a Closure and Reclamation Plan, which had been approved June 1987, was implemented. The Plan was updated in 1990 and 1991 during reclamation activities. A Type B Licence N1L3-0035 was issued on June 1, 1993 for five years, which was followed by Type B Licence N1L2-0035, issued on July 1, 1997, for a ten-year term to June 30, 2007. In July 2001, Cominco and Teck Metals merged. Since the merger, Teck Metals has managed the site. In June 2009, Teck Cominco Metals Ltd. changed its name to Teck Metals Ltd. The current Type B Licence MV2006L2-0013 expires on October 28, 2017; this is also referred to as a post-closure licence.

Submission Description

On August 22, 2017, Teck Metals submitted a renewal application for a Type B Water Licence to the Board. The purpose of this Application is to continue water monitoring and management at the Pine Point Tailings Impoundment Area (TIA). The TIA is located to the north of the former Pine Point mill site on terrain which slopes downwards towards the northwest. The terrain slopes gently for about 13 km towards Great Slave Lake from an approximate elevation of 230 m at the former mill site to an approximate lake elevation of 160 m.

The effluent is the result of accumulation of natural precipitation and snowmelt that falls within the TIA, and then ponds at the north end of the facility. The contact water is then treated each open water season using a temporary water treatment plant located at the north end of the TIA. The treatment plan injects a lime/water mixture into the contact water as it flows into a serpentine settling channel (located within the TIA). As the water flows through the channel, the pH of the water is increased by the lime and zinc is precipitated out of solution and settles out of the water

column. At the end of the settling channel, the water is periodically discharged from the TIA during the open water season to the receiving environment. The facility typically operates for 3 to 6 weeks each summer.

The existing SNP sample locations that were monitored during operation of the mine have been maintained through closure and into post-closure. These include one sample of tailings water before treatment, one sample of tailings water after treatment, and seven downstream stations between the impoundment and Great Slave Lake.

The 2006 update to the Closure and Reclamation Plan (previously titled Abandonment and Restoration Plan), which was included with this Application and was last updated prior to the issuance of the previous Licence MV2006L2-0013, clarified that the primary issue associated with effluent quality is dissolved zinc in the pond water, which exceeds the Licence limits and requires treatment prior to discharge. This water has been treated for each of the 10 years of the current Licence MV2006L2-0013.

As the mine remains permanently closed, there are no personnel on-site except during the summer when the treatment plant is operated.

Management Plans

A Water Management Plan, Operations and Maintenance Plan, Closure and Reclamation Plan, Spill Contingency Plan, and Engagement Plan were included with the Application.

The Engagement Plan and Spill Contingency Plan appear to meet applicable guidelines and sufficiently reflect the scope of the proposed activities.

The Water Management Plan (or Water Treatment Manual) describes how water flows and is treated on site to meet Licence requirements.

The Operation and Maintenance Plan submitted with the Application was completed in February 2017, and contained appropriate and relevant information, and is an adequate Plan. However, Board staff included a condition in the draft Licence that went out for review, requesting the submission of a revised Plan by February 1, 2018, to include the following additional information:

a) *A description, including detailed rationale, of the monitoring endpoints (Action Levels) for each parameter monitored in the Surveillance Network Program;*
b) *A description of response actions to be carried out if the Action Levels are exceeded; and*
c) *Any other item as directed by the Board.*

The Closure and Reclamation Plan submitted with this Application was a 2006 update to the 1991 Abandonment and Restoration Plan. This Plan (1991 version with 2006 update) does not adhere to the Mackenzie Valley Land and Water Board and Aboriginal Affairs and Northern Development Canada's November 2013 Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories.

Eligibility

Following initial implementation of the closure and reclamation activities in accordance with the Closure and Reclamation Plan (1991 version), surface leases were surrendered back to the Crown during the mid to late 1990s, with the exception of one surface lease (#85B/16-9-9), which encompasses the TIA. This retained surface lease allows Teck Metals to continue to manage the TIA and treat ponded water. All mining claims were also surrendered back to the Crown.

2.0 Public Review

Application

By September 21, 2017, comments and recommendations on the Application were received from the following reviewers:

- Environment and Climate Change Canada (ECCC); and
- Government of the Northwest Territories – Environment and Natural Resources (GNWT-ENR).

Teck Metals responded on October 3, 2017.

GNWT-ENR and ECCC commented that certain Figures were incorrect and missing from the Application cover letter. Teck Metals responded by resubmitting an updated cover letter.

Further information was requested by ECCC and ENR on the Surveillance Network Program (SNP), and on water quality results, correlations and trends. This information was provided in the responses, and raw data was provided in an attached excel spreadsheet.

Draft Licence

By October 6, 2017, comments and recommendations on the Draft Licence were received from GNWT – Environment and Natural Resources (GNWT-ENR). Teck Metals responded on October 13, 2017.

Notable Comments and Responses

Evidence and recommendations regarding the upper limit for pH discharge criteria were presented, as seen in GNWT-ENR comments 7 and 13. Teck Metal's current water treatment methods rely upon elevated pH to assist in precipitating metals (e.g. zinc), which makes it difficult for them to meet CCME guidelines of pH 9.0. Based on review comments, GNWT-ENR has suggested discharge criteria for pH of 9.5, which is consistent with the Metal Mining Effluent Regulations (MMER). Teck Metals has requested discharge criteria of pH 10. Board staff agree with GNWT-ENR, in that Board staff can only support a maximum upper limit of pH 9.5 to be included in the authorization. In the mean time, Teck Metals has agreed to research and test treatment mechanisms or controls to lower pH in the existing treatment system, which will allow Teck Metals to meet the upper limit of pH 9.5 during treatment. Teck Metals could be required to update their Water Management Plan prior to implementing the proposed changes. Board staff recognize that prior to implementing additional treatment mechanisms to reduce pH, Teck Metals may have difficulties meeting discharge criteria of pH 9.5 in the 2018 season.

In addition, GNWT-ENR stated that they support Teck Metals request to change the sampling frequency at SNP station 35-1 from daily to weekly, as seen in GNWT-ENR comment 19, and requested that results from the Hach treatment system monitoring be included in annual SNP Report.

Additionally, in the Application, Teck Metals requested to remove SNP station 35-6, as it has been dry since 2011, and samples that were taken previously were well below Licence limits. As described in GNWT-ENR comment 22, ENR recommends keeping this sampling station for two additional years, and if no flow or no exceedances are noted in that time, then Teck Metals could request to amend the Licence SNP, or have an Inspector submit an SNP change/discontinuance request to the Board. Teck Metals agreed with this recommendation in their response.

Multiple comments and recommendations were made during the application and draft Licence reviews on Closure and Reclamation. During the review, ENR recommended that Teck Metals update the Closure and Reclamation Plan to include closure strategies, methods and activities that are

intended to set closure goals, objectives and criteria. The current Plan does not fully meet the Mackenzie Valley Land and Water Board and Aboriginal Affairs and Northern Development Canada's November 2013 Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories. In the draft Licence that went out for review, Board staff included a condition for an updated Closure and Reclamation Plan to be submitted by May 1, 2018. Teck Metals responded stating that the development of these strategies and methodologies will require a significant amount of technical evaluation and engineering studies, and requested that the Board allow Teck Metals to complete these evaluations and studies as a requirement under the renewed Licence MV2017L2-0007 with a commitment to submit the results of these analyses and studies by December 31, 2020. ENR commented on this request, supporting a deadline of December 31, 2020 to provide a more complete assessment of the Pine Point site, given the relative stability of the site. ENR suggested that Teck Metals provide a research and study plan that would provide necessary detail and type of research or study it believes would be required to provide an updated Closure and Reclamation Plan as a requirement of the Licence. Board staff agree with the recommendations made by both Teck Metals and ENR, and have updated the draft Licence to include a Closure and Reclamation Plan submission by December 31, 2020, and a Reclamation Research Plan by May 1, 2018.

Preliminary Screening

Teck Metals requested to be exempt from Preliminary Screening and provided evidence in their Application in the form of a letter from the Minister of Indian and Northern Development, from 1993, which states:

> *A screening of the water use application pursuant to the **Environmental Assessment and Review Process Guidelines Order** was completed and I am satisfied that any potentially adverse environmental and related social effects that may be caused by the project are insignificant or mitigatable with known technology.*

The Board confirmed the exemption of a Preliminary Screening in 2007 prior to issuance of Licence MV2006L2-0013, as per Schedule 1, Part 1, item 2 of the Exemption Regulations. As these activities have not changed since the 2007 screening, the Board decided this Application is exempt from further screening pursuant to Part 1(2) of Schedule 1 (Section 2) of the Exemption List Regulations.

3.0 Decision

The Board is satisfied that:

- the project has been screened pursuant to the MVRMA;
- any potential adverse environmental effects are insignificant or mitigable with known technology; and,
- there is no likelihood that the proposed development might be a cause of public concern.

After reviewing the evidence and submissions from Teck Metals Ltd. and the written comments and submissions from parties received by the Board, the Staff Report prepared for the Board, and having due regard to the facts, circumstances, and the merits of the submissions made to it, and to the purpose, scope, and intent of the MVRMA and *Waters Act* and Regulations made thereunder, the Board has determined that Water Licence MV2017L2-0007 be issued, subject to the scope, term, and conditions contained therein. The Board's determinations and reasons for this decision are set out below.

4.0 General Principles for Water Licence MV2017L2-0007

In conducting the review process for the renewal Application, the Board has ensured that all applicable legal and procedural requirements have been satisfied, including:

- Notice of the Licence application was given in accordance with sections 63 and 64 of the MVRMA and section 43 of the *Waters Act*. The Board is satisfied that a reasonable period of notice was given to Communities and First Nations so that they could provide comments to the Board.
- The use of water and/or deposit of waste proposed by the Applicant is of a nature contemplated by the MVRMA.
- It is the opinion of the Board that the terms and conditions attached to Licence MV2017L2-0007, pursuant to the MVRMA and the *Waters Act*, will prevent or mitigate any potential significant environmental impacts which might result from Teck Metal Ltd.'s management of water and discharge of treated effluent. Specific conditions and how they relate to issues raised during the regulatory proceeding are discussed below.

The scope, definitions, conditions, and term set forth in the Licence have been developed in order to address the Board's statutory responsibilities and the concerns that arose during the regulatory proceeding.

5.0 Determinations Pertaining to the Water Licence (MV2017L2-0007)

5.1 Requirements of Section 26 of the *Waters Act*

5.1.1 Existing Licensees

After reviewing the submissions filed on the Public Registry, the Board is satisfied that, with respect to paragraph 26(5)(a) of the *Waters Act*, the granting of this Licence will not adversely affect, in a significant way, any existing Licensee, provided that compliance with the conditions of the Licence are adhered to. There are no applicants with precedence.

5.1.2 Existing Water Users

Paragraph 26(5)(b) of the *Waters Act* prohibits renewal of a Licence unless the Board is satisfied that appropriate compensation has been or will be paid by the Applicant to people who were, at the time when the Applicant filed its application with the Board, members of the classes of water users, depositors, owners, occupiers, or holders listed under paragraph 26(5)(b), who would be adversely affected by the use of waters, or deposit of waste proposed by the Applicant.

The Board received no claims for compensation either during the prescribed period or afterwards. Provided that compliance with the renewed Licence conditions is achieved, the Board does not believe that any water users or persons listed in paragraph 26(5)(b) of the *Waters Act* will be adversely affected by the deposit of Waste proposed by the Applicant.

5.1.3 Water Quality Standards

With regards to subparagraph 26(5)(c)(i) of the *Waters Act*, the Board is satisfied that compliance with the renewed Licence conditions will ensure that waste will be collected and disposed of in a manner which will maintain water quality consistent with applicable standards and the Board's *Water and Effluent Quality Management Policy*.

5.1.4 Effluent Quality Standards

Consistent with subparagraph 26(5)(c)(ii) of the *Waters Act*, the Board is satisfied that the effluent quality standards it has set out in the renewed Licence as conditions are consistent with the Board's *Water and Effluent Quality Management Policy* and will protect the receiving waters and environment.

5.1.5 Financial Responsibility of the Applicant

The Board must satisfy itself of the financial responsibility of the Applicant under paragraph 26(5)(d) of the *Waters Act* before it can issue the renewed Licence.

Security in the amount of $8,815,000.00 has been set by the Board. The Board is satisfied that there will not be any further deposit of Waste associated with this undertaking until adequate security to reclaim the site has been posted.

5.2 Water Licence MV2017L2-0007 Terms and Conditions

The Board presents the following information and rationale to support Licence MV2017L2-0007:

5.2.1 Water Licence Term

Teck Metals applied for a term of 10 years. The existing Licence MV2006L2-0007 expires October 28, 2017. The Board has approved Licence MV2017L2-0007 for a term of 10 years.

5.2.2 Part A: Scope and Definitions

Scope

The scope of the Licence ensures the Teck Metals is entitled to conduct activities which have been applied for and screened by the Board. In setting out the scope of the Licence, the Board endeavoured to provide enough detail to describe the authorized activities, and allow for project flexibility.

The Board has notified the Applicant, through a statement included in the scope, that compliance with the term and conditions of this Licence does not absolve Teck Metals from responsibility for compliance with the requirements of any other legislation.

Part A, items 1(b) through 1(e) are consistent with other recently issued water licences. These conditions ensure that the scope of the authorization includes all water uses and deposits of waste associated with the Project, reflect and comply with all applicable legislation for the life of the MV2017L2-0007 authorization, and consider and incorporate scientific and traditional knowledge where available in the Licensee's effort to protect the environment.

Definitions

The Board included a list of defined terms used in the Permit in order to ensure a common understanding of conditions and to avoid future differences in interpretation. The definitions and conditions in the Licence are based on recent Licences of similar scope and scale including recently issued Type B Licences, and reflect upon information in the Application and recommendations or concerns raised by reviewers. Where appropriate, the Board created new definitions, as described below:

Tailings Impoundment Area – this definition was provided by Teck Metals to replace the outdated term 'Tailings Containment Area' used in the current Licence MV2006L2-0013, and to align with their renewal application terminology and updated Management Plan terminology.

5.2.3 Part B: General Conditions and Schedule 1

Part B of the Licence applies to matters regarding compliance and conformity with the MVRMA and *Waters Act*, and is consistent with standard conditions found in previous Licences issued by the Board. This section addresses conformity and compliance with plans, submission timelines, revisions, and format of the Surveillance Network Program (SNP) and the Schedules which are

annexed to and form part of the Licence. This section also addresses signage, measuring devices, public engagement requirements, and annual water licence reporting.

Part B, item 11 refers to an Engagement Plan. This Plan describes how Teck Metals will engage with stakeholders about their licenced activities. The Plan is to be annually reviewed to ensure that any changes are submitted for a public review, and Board approval.

Part B, item 12 and Schedule 1 details the requirements for the Annual Water Licence Report. The purpose of the Annual Water Licence Report is to provide the Board and reviewers with a summary of activities that have occurred on-site during the previous year, and are not meant to be onerous. These summaries include engagement activities, summary of works/maintenance completed onsite, summaries of all monitoring data, and anticipated activities for the following year.

5.2.4 Part C: Conditions Applying to Security Requirements and Schedule 2

Security requirements are standard in licences issued by the Board to any non-government entity, to ensure any liabilities incurred as a result of licenced and permitted activities are borne by the Applicant, and do not become the responsibility of the landowner, which in this case is the GNWT. When setting security for a licence, the Board endeavors to adhere to the direction provided in INAC's *Mine Site Reclamation Policy for the Northwest Territories*, chiefly, that "[a]dequate security should be provided to ensure the cost of reclamation, including shutdown, closure and post-closure, is born (sic) by the operator of the mine rather than the Crown".[1] The Board's authority to require a licence holder to post and maintain security is granted by subsection 35(1) of the *Waters Act* and subsection 71(1) of the MVRMA. Regulations promulgated under the *Waters Act* and MVRMA authorize the Board to determine the total amount of security to be posted, taking into consideration the aggregate costs of abandonment and restoration of the undertaking, and any ongoing measures that may be necessary following abandonment of the undertaking.[2]

Teck Metals included a security estimate calculated using RECLAIM in the Application, and determined a total reclamation cost of $2,176,095.00. The GNWT-ENR noted during the Application review period that this includes provisions for carrying out 10 years of water treatment and 10 years of site monitoring and inspection. GNWT-ENR noted that this approach does not align with the requirements under Indian Affairs and Northern Development Canada's *Mine Site Reclamation Policy for the Northwest Territories*, which states that the purpose of the reclamation security is to provide access to sufficient funds to complete all the activities required to bring a site to final closure, including conducting any long-term monitoring that is required to confirm that all closure objectives have been met. As such, security should include activities that are to be completed beyond the current Water Licence term. In response, Teck Metals considered these recommendations and submitted an updated RECLAIM calculation on October 3, 2017, totalling $5,534,500.00.

During the draft Licence review, on October 6, 2017, GNWT-ENR stated their intent to submit a RECLAIM estimate by October 13, 2017. On October 17, 2017, GNWT-ENR submitted a RECLAIM estimate, totalling $8,905,028.00. This was provided to Teck Metals on October 17, 2017 for comment. On October 19, 2017, Teck Metals provided their response to the GNWT's estimate. This response clarified some of the monetary values that were used in Teck Metals' estimate that the GNWT had adopted in their estimate. In the October 19, 2017 response, Teck Metals stated that they recognized the cost for completing the TIA final design and closure activities were not

[1] http://www.aadnc-aandc.gc.ca/eng/1100100036038/1100100036040#chp4
[2] Subsection 11(1) of the Waters Regulations and subsection 32(1) of the MVLUR

included within the Water Licence application and accepted the security estimate provided by the GNWT.

Teck Metals had included an 'Other' activity item in their estimate, which the GNWT had adopted into their estimate but had stated that they were unsure what it was for. Teck Metals clarified that this 'Other' item of $4,500 x 20 years, was meant to cover the Dam Safety Review that is required every 10 years (2 times in 20 years or 3 times in 30 years); therefore, GNWT's estimate includes this line item twice, as they had also included a 3-time cost of $60,000 as a separate line item in their estimate. As such, the Board determined that a security of **$8,815,000.00** shall be posted with the GNWT, which removes the 'Other' line item that was covered under the Dam Safety Review line item in the GNWT's estimate. The Board agrees with all other components of the estimate provided by the GNWT, and notes that Teck Metals accepted the GNWT's estimate in their response.

This section of the Licence, with reference to Schedule 2, sets the level of security to be maintained by the Licensee and sets out requirements related to posting and updating security. As in other licences, the Board may request a security update from the proponent at any time, and may adjust the security amount at any time, based on available information. The conditions in this section are standard conditions found in other Licences issued by the Board.

In the cover letter submitted with the GNWT-ENR's RECLAIM security estimate, it was noted that they consider this estimate to be an interim security estimate until such time that additional information is available following approval of an updated Closure and Reclamation Plan.

5.2.5 Part D: Conditions Applying to Construction

Part D of the Licence contains conditions related to all structures in the TIA, including Engineered Structures, and is consistent with standard conditions found in previous Licences issued by the Board. These conditions ensure that Engineered Structures are built and maintained to appropriate guidelines and standards.

5.2.6 Part E: Conditions Applying to Modifications

Part E of the Licence contains conditions outlining when and how modifications of existing or planned physical works may be authorized. The conditions also ensure the Board and the Inspector are kept informed and have had the opportunity to request more information or reject the proposed modification. This section is closely linked to the construction section (Part D), which contains conditions related to the design and construction of Engineered Structures. Part E relies on the definition of modification, which does not include expansions, nor alterations of the purpose or function of a structure. The conditions in Part E are consistent with standard conditions found in previous Licences issued by the Board. The purpose of Part E is to streamline the process for authorizing modifications and ensure that any proposed changes to structures that might be outside the scope of the Licence are brought to the Board's attention.

5.2.7 Part F: Conditions Applying to Waste and Water Management

Part F of the Licence contains conditions related to water and waste management activities at the Project site, and is consistent with standard conditions included in previous Licences issued by the Board. Site-specific conditions were developed where necessary.

Part F, item 1 sets out the objectives for the management of water and waste for the Project. This condition is consistent with the principles of objective-based regulation: it essentially defines the objectives of any required management actions, plans or reports. This condition is standard for Licences issued by the Board, and reminds the Licensee of the need to manage water and waste with the goal of minimizing impacts on the receiving environment.

Part F, item 2 refers to a Water Management Plan. This Plan was submitted with the Application, and was titled 'Water Treatment Manual'. The name has been updated to Water Management Plan to align with previous Licences issued by the Board. This Plan describes how water flows and is treated on site in order to meet Licence discharge requirements. The Plan is to be annually reviewed to ensure that any changes in water management or treatment methods (e.g. technologies or chemicals used) require an update to the plan, a public review, and Board approval.

Part F, item 3 refers to an Operations and Maintenance Plan. This Plan was submitted with the Application and includes a variety of site information, including: site reference data, information on site conditions, facility components and information on site design and design criteria. The condition requires the Operations and Maintenance Plan to be revised and resubmitted by February 1, 2018, to include action levels for each parameter monitored in the SNP, and response actions if action levels are triggered. This resubmission is to also include mitigation measures for decreasing pH when it does not meet Effluent Quality Criteria; Teck Metals' current water treatment methods rely upon elevated pH to assist in precipitating metals (e.g. zinc) making it difficult for Teck Metals to ensure they stay within the upper limit of pH 9.5 as stipulated in the Licence. Teck Metals has agreed (see GNWT-ENR comment 13) to research and test treatment mechanisms or controls to lower pH in the existing treatment system, which will allow them to remain compliant and meet the upper limit of 9.5 during treatment. Therefore, an update to the Operations and Maintenance Plan is required to outline that research and testing is taking place, and to identify how pH exceedances will be addressed. Part F, item 4 requires the approved Plan to be annually reviewed to reflect any changes to operations, or as directed by the Board.

Part F, item 5 is a standard condition included in Licences issued by the Board that requires waste storage areas to be constructed and operated in such a way as to ensure compliance with Part F, item 5, and prevent release of waste to the receiving environment. Similarly, Part F, items 6, 7 and 8 are also standard conditions, and require regular inspections of discharge points and waste storage facilities to ensure the facilities are operating as intended, and in compliance with the Licence.

Effluent Quality Criteria (EQC)

The Board's approach to managing the deposit of waste to the receiving environment through water licence terms and conditions is described in the MVLWB's *Water and Effluent Quality Management Policy*[3]. Effective March 31, 2011, this Policy is applied to all new and renewal water licence applications throughout the Mackenzie Valley.

EQC are included for the discharge from the SNP station 35-1b as per Part F, item 10 of the Licence. For this location, Board staff proposed the parameters in the draft Licence, and requested input from reviewers on the listed parameters and associated EQC.

During the draft Licence review, comments were received by the GNWT-ENR to ensure arsenic and cyanide are included in the Licence MV2017L2-0007, but did not provide recommendations

[3] Water and Effluent Quality Management Policy, Standard Procedure and Consistency Working Groups (WG), March 2011.

on the EQC. Discussions also took place throughout the review of the Application and draft Licence regarding the upper limit of pH, as the previous Licence MV2006L2-0013 EQC for pH was >6.0, and therefore did not contain an upper limit. Currently, Teck Metal's water treatment methods rely upon elevated pH to assist in precipitating metals (e.g. zinc), which makes it difficult for them to meet CCME guidelines of pH 9.0. Based on review comments, ENR suggested discharge criteria of pH 9.5, which is consistent with the Metal Mining Effluent Regulations (MMER). Teck Metals requested discharge criteria of pH 10. The Board has decided on an EQC of pH 9.5 as requested by GNWT-ENR, and as outlined in the MMER.

Teck Metals requested the removal of BOD and Faecal Coliforms as they were not in the previous Licence MV2006L2-0013 and they are unnecessary parameters for this particular undertaking. Nitrate as N and Total Dissolved Solids were included in the draft and were not part of the previous licence. As no comments were received on these parameters, and they are not parameters of concern, the Board has decided to remove them from Licence MV2017L2-0007.

The parameters and EQC listed below have been set by the Board in Licence MV2017L2-0007. All EQC are consistent with the MMER and/or the previous Licence MV2006L2-0013.

Discharges from SNP station 35-1b shall have a pH between 6.5 and 9.0 and meet the following EQC:		
Parameter	**Maximum Average Concentration (in mg/L)**	**Maximum Grab Concentration (in mg/L)**
Total Arsenic	0.50	1.00
Total Copper	0.15	0.30
Total Cyanide	0.10	0.20
Total Lead	0.20	0.40
Total Zinc	0.50	1.00
Ammonia as N	2.00	4.00
Total Suspended Solids	25.0	50.0

Part F, item 11 is a standard condition consistent with previously issued licences by the Board. This condition states that if the EQC's in Part F item 10 are exceeded, the Licensee shall cease all discharge to the receiving environment, notify the Board and an Inspector, and take the necessary corrective action to mitigate the exceedance, as outlined in the approved Operations and Maintenance Plan. The intent of this condition is to protect the receiving environment.

5.2.8 Part G: Conditions Applying to Contingency Planning

Part G of the Licence contains conditions related to spill contingency planning and reporting, and the reclamation of spills and unauthorized discharges. The purpose of this part is to ensure that the Licensee is fully prepared to respond to spills and unauthorized discharges. The planning and reporting requirements in this part ensure that Teck Metals has identified the lines of authority and responsibility, has an action plan(s) for responses to spills and unauthorized discharges, and has established reliable reporting and communication procedures. This will ensure that any spills or unauthorized discharges are effectively controlled and cleaned up, with the goal of preventing or limiting damage to the receiving environment. The conditions in Part G are consistent with standard conditions found in previous Licences issued by the Board. The Board determined that the Spill Contingency Plan submitted with the Applications was in compliance with applicable guidelines. Since no comments or concerns were received related to this Plan during review of the Application, the Board approved the Plan.

5.2.9 Part H: Conditions Applying to Closure and Reclamation

Part H contains conditions related to the submission of a Closure and Reclamation Plan. Part H, item 1 requires the submission of a revised Plan by December 31, 2020, for approval, and in accordance with the Mackenzie Valley Land and Water Board and Aboriginal Affairs and Northern Development Canada's November 2013 *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories.* The 2006 Closure and Reclamation Plan that was submitted with the Application does not meet the guidelines, in that it does not include closure strategies, methods and activities that are intended to set closure goals, objectives and criteria. The submission date of December 31, 2020 was requested during the review period by Teck Metals, and accepted by the Board. Part H, items 2 and 4 are standard conditions requiring annual reviews of the approved Plan and progressive reclamation activities.

Part H, item 3 requires the submission of a Reclamation Research Plan to be submitted by May 1, 2018. The intent of this condition is to have Teck Metals provide necessary detail and information on the type of research or study it believes would be required to provide an updated Closure and Reclamation Plan. This submission will be sent for review and approved by the Board, and therefore will aid Teck Metals in the development of their Closure and Reclamation Plan referred to in Part H, item 1.

5.2.10 Annex A: Surveillance Network Program

The SNP has been annexed to the Licence to detail sampling and monitoring requirements related to compliance with conditions and plans required by the Licence.

Part A: Reporting Requirements

Items 1-8 are standard reporting requirements for Licences issued by the Board which require SNP monitoring.

Part B: Site Descriptions and Monitoring Requirements

In the Application, Teck Metals requested to reduce the sampling frequency at SNP station 35-1 from daily during discharge to weekly during discharge. This proposed change was included in the draft Licence that was circulated for review. After providing some additional rationale requested by GNWT-ENR during the review, GNWT-ENR commented, supporting this sampling frequency change. The Board agrees, and has decided to include a sampling frequency of weekly during discharge at SNP station 35-1.

Additionally, in the Application, Teck Metals requested to remove SNP station 35-6, as it has been dry since 2011, and samples that were taken previously were well below Licence limits. As described in GNWT-ENR comment 22, ENR recommends keeping this sampling station for 2 additional years, and if no flow or no exceedances are noted in that time, then Teck Metals could request to amend the Licence SNP, or have the Inspector submit an SNP change/discontinuance request to the Board. Teck Metals agreed with this recommendation in their response. The Board has decided to include SNP station 35-6 in Licence MV2017L2-0007.

All the SNP station locations, sampling frequencies (aside from station 35-1), and measured parameters included in Licence MV2017L2-0007 are consistent with those from the previous Licence MV2006L2-0013. The SNP station locations include one sample of tailings water prior to treatment (SNP station 35-1a), one sample of tailings water post treatment (35-1b), and seven downstream stations (SNP stations 35-4, 35-5, 35-6, 35-9, 35-10, 35-12, 35-13) between the TIA and Great Slake Lake (Figure 2 of the Water License Renewal Form).

6.0 Conclusion

Subject to the term and conditions set out in the Licence, and for the reasons expressed herein, the Board is of the opinion that the undertaking for water treatment and discharge associated with the Teck Metals Ltd. water management at the Pine Point Mine Tailings Impoundment Area can be completed by Teck Metals Ltd. while providing for the conservation of Waters in a manner that will provide the optimum benefit for all Canadians and in particular for the residents of the Mackenzie Valley.

Water Licence MV2017L2-0007 contain provisions that the Board feels necessary to ensure and monitor compliance with the MVRMA and *Waters Act*, and the Regulations made thereunder, and to provide appropriate safeguards in respect of the Applicant's management of waters.

Mackenzie Valley Land and Water Board

Mavis Cli-Michaud, Chair

December 18, 2017

Date

General Procedures for the Administration of Licences
Issued Under the *Waters Act*
in the Northwest Territories

1. At the time of issuance, a copy of the Licence is placed on the Public Registry in the office of the Mackenzie Valley Land and Water Board (MVLWB or the Board) in Yellowknife and is then available to the public.

2. To enforce the term and conditions of the Licence, the Minister of Environment and Natural Resources has appointed Inspectors in accordance with subsection 65(1) of the *Waters Act*. The Inspectors coordinate their activities with staff of the MVLWB. The Inspector responsible for Licence MV2017L2-0007 is located in the South Slave Region, Fort Smith office.

3. To keep the MVLWB and members of the public informed of the Licensee's conformity to the Licence's conditions, the inspectors prepare reports which detail observations on how each item in the Licence has been met. These reports are forwarded to the Licensee with a covering letter indicating which action, if any, should be taken. The inspection reports and cover letters are placed on the Public Registry, as are any responses received from the Licensee pertaining to the inspection reports. It is therefore of prime importance that you react in all areas of concern regarding all inspection reports so that these concerns may be clarified.

4. Licence MV2017L2-0007 will expire on October 24, 2027, if required; it is the responsibility of the Licensee to apply to the MVLWB for a new licence. The past performance of the Licensee, new documentation and information, and points raised during a public hearing, if required, will be used to determine the terms and conditions of any new licence. Please note that if the Licence expires and another has not been issued, then water and waste disposal must cease, or you, the Licensee, would be in contravention of the *Waters Act*. For a Type A Licence, an application for a new licence shall be made at least one year in advance of the Licence's expiry date. In the case of a Type B Licence, an application shall be made at least six months in advance of the Licence's expiry date.

5. If, for some reason, Licence MV2017L2-0007 requires amendment, a public hearing may be required. You are reminded that applications for amendments should be submitted as soon as possible to provide the MVLWB ample time to complete the amendment process. The process may take up to six months or more depending on the scope of the amendment requested.

.../2

6. Specific clauses of your Licence make reference to the Board, Analyst, or Inspector. The contact person, address, phone, and fax number of each is:

Mackenzie Valley Land and Water Board:

Public Registry Clerk
Mackenzie Valley Land and Water Board
7th Floor - 4922 48 Street,
P.O. Box 2130
YELLOWKNIFE NT XIA 2P6
Phone: (867) 669-0506
Fax: (867) 873-6610

Analyst:

Street Address:
Taiga Environmental Laboratory
4601 – 52nd Ave
Yellowknife, NT
X1A 1L4

Mailing Address:
Taiga Environmental Laboratory
P.O. Box 1320
Yellowknife, NT
X1A 2L9

Phone: (867) 767-9235, ext 53151
Fax: (867) 920-8740
General Email: taiga@gov.nt.ca

Inspector:

Wendy Bidwell, Water Resource Officer
South Slave Region
Government of the Northwest Territories
P.O. Box 900
Fort Smith, NT
X0E 0P0
Phone: (867) 872-6421

7. Specific clauses of your licence may reference security. The contact person, address, and phone and fax numbers of the individual administering security deposits is:

Director, Water Resources
Department of Environment and Natural Resources
Government of the Northwest Territories
P.O. Box 1320
YELLOWKNIFE NT X1A 2L9
Phone: (867) 873-7401
Fax: (867) 669-2716

APPENDIX E

Water Treatment Manual and Water Treatment Management Plan for Upset Conditions

Teck

Pine Point Mine Tailings Impoundment Area

Water Treatment Manual

Revised April 2017

Table of Contents:

List of Appendices

1. Introduction

The Tailings Impoundment Area is leased from the NWT Government and is the last operational area left from the former Pine Point Mine. The Tailings Area has been covered to prevent dust migration and to assist in establishing a vegetation cover.

Water accumulates in the pond every spring from snowmelt and rainfall. The water is elevated in Zinc, Lead and Copper and cannot be released to the environment without treatment. Therefore every summer the accumulated water is treated and the water level in the pond is dropped to a minimum level.

The water treatment plant is a simple lime treatment system that consists of: a lime silo, trailer mounted pump/blower unit, lime slurry tank, jet mixer, water pump and a trailer mounted laboratory. Most of the equipment is stored in Hay River through the winter and is assembled for the operating period.

The treatment process is usually started in late June and runs for 4 -6 weeks or whatever is required to bring the pond level down. The operating personnel stay on the site and make trips to Hay River to deliver samples as necessary.

2. Location

2.1. Site Location

The Pine Point Location is shown in Figure 1.

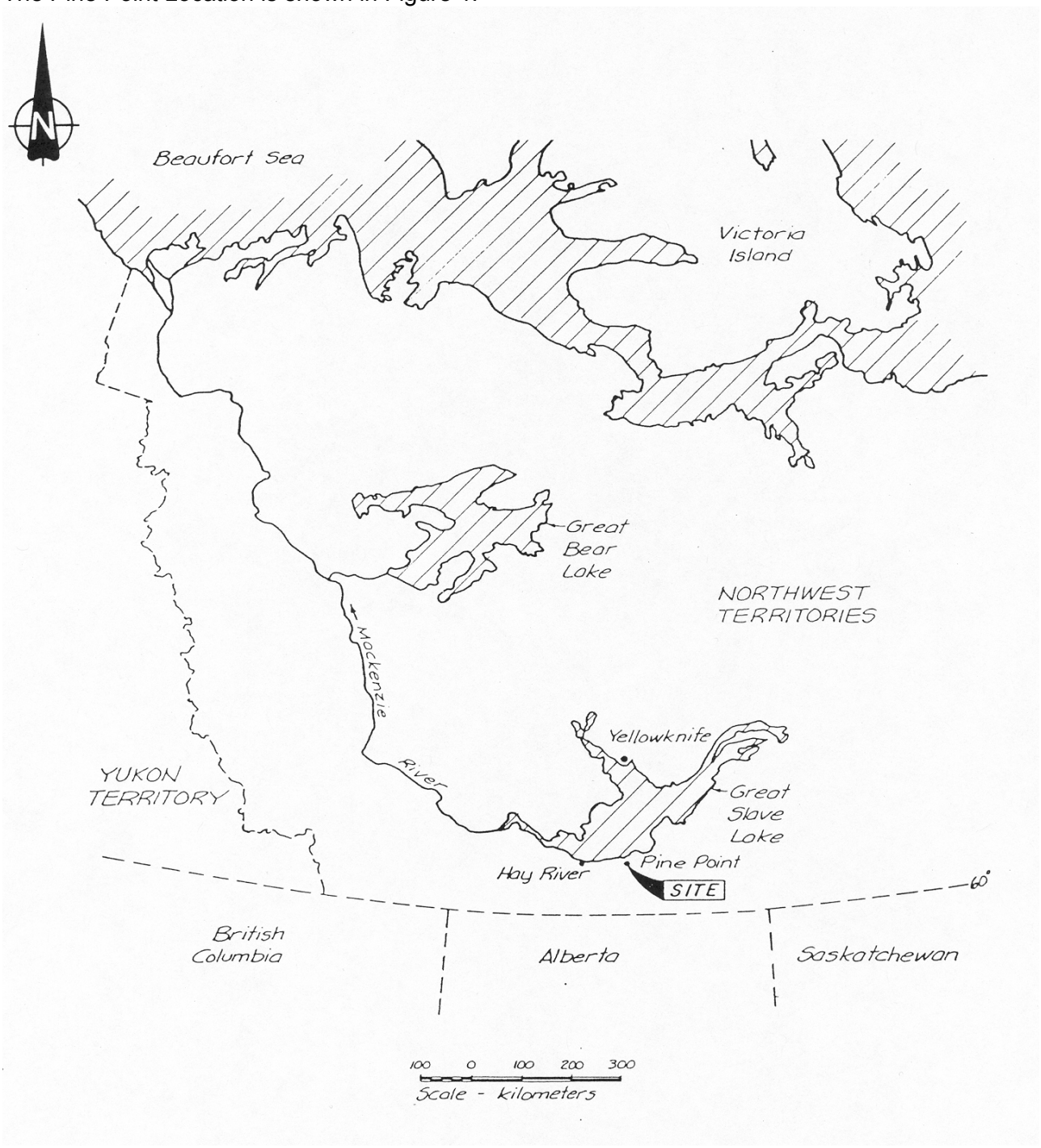


Figure 1: Site Location

2.2. Tailings Pond Impoundment

Pine Point Tailings Impoundment July 2006

The Tailings Impoundment is approximately 2.5 km by 2.8 km and contains about 60 million tons of tailings. Surface runoff covers the north end of the impoundment and the extent of the water is dependent on the water elevation. Modeling of the pond volumes/elevation and runoff done for the Operating, Maintenance and Surveillance Manual (OM&S) determined the key pond elevations as shown in the following figure.

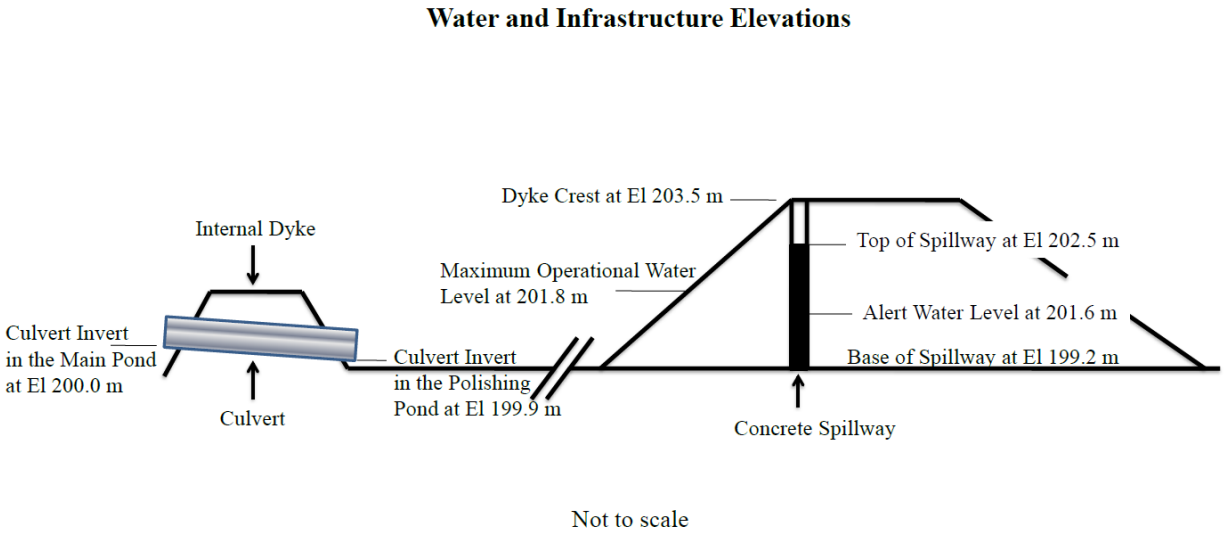
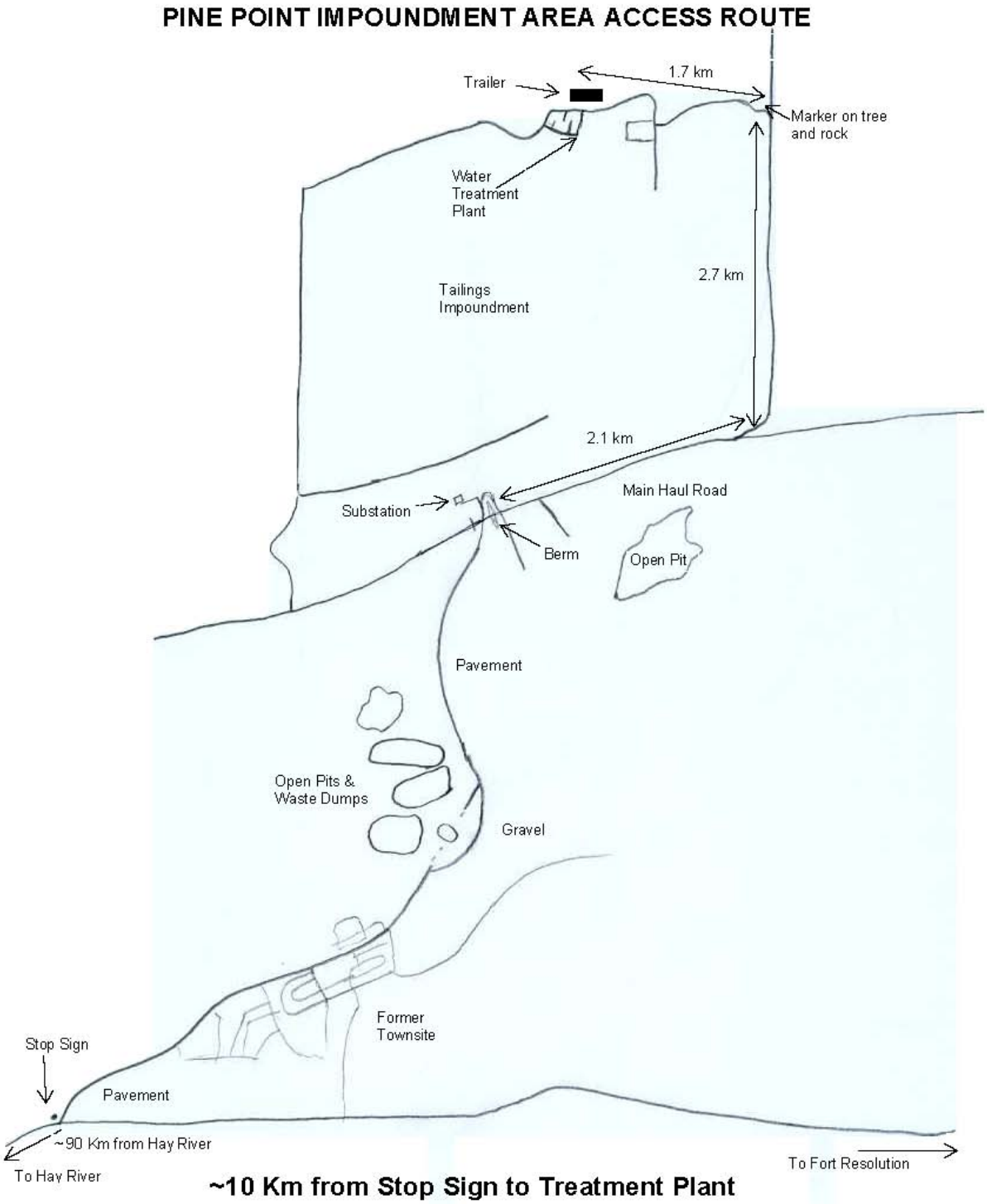


Figure 2: Critical Water and Infrastructure Elevations

2.3. Access Route



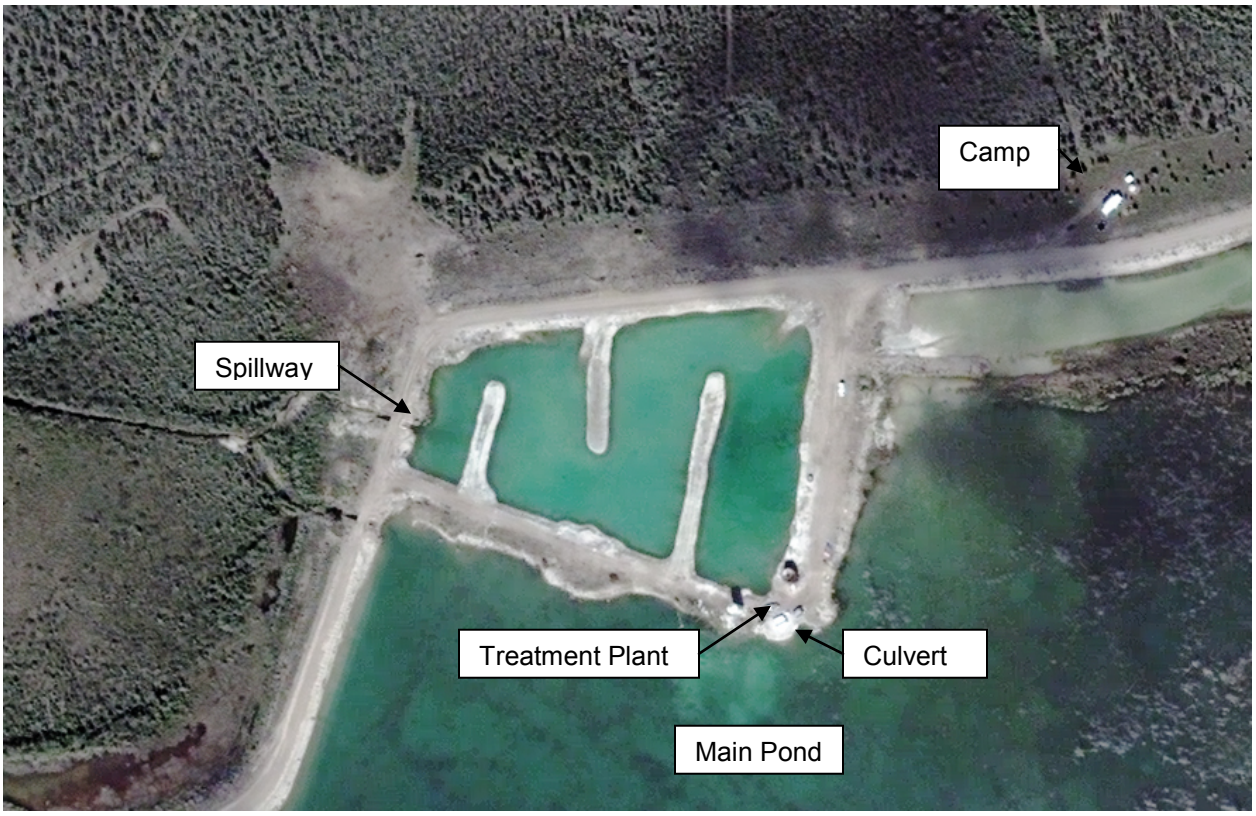
3. Process Description:

The water treatment process is a basic lime precipitation method to remove metals from the water by precipitating them out as metal hydroxides. Hydrated lime is slurried to about 18% solids by weight and then is metered into a culvert and mixed into the water. The culvert allows water from the main pond to flow into the serpentine settling channel before discharging into the swamp at the treatment spillway. After the lime is added into the culvert air is used to mix the lime along with a twelve foot static mixer installed inside the culvert to promote uniform mixing of the water and lime before discharging into the serpentine channel.

An excess of lime is used to raise the pH to 9.5 – 10.0 to ensure that the metals will precipitate out quickly. With deepening of the channel in 2012 lower pH's, 9.5-10.0, can be used while maintaining flow rates. If the water and lime slurry were treated in a large agitated tank then lower pH levels could be used and lime consumption could be drastically reduced.

4. System Overview:

The treatment system is a gravity flow process from the main pond through the serpentine channel to the discharge spillway located at the end of the serpentine channel. The flow through the channel is controlled by five siphons in the discharge spillway.
The serpentine channel is connected to the Main Pond by a culvert that is equipped with a gate valve to isolate the channel from the Main Pond.



Overview of Serpentine Channel

The Treatment Plant Equipment is located near the culvert and the Lime Silo and Lime Slurry Tank are left on site at all times. The lime silo is a gravity flow bin with gate and an auger located on the bottom to feed lime into the jet mixer. The lime pump and air blower are mounted on a trailer as is the Laboratory. The lime pump is used for circulating lime through the slurry tank and mixing the lime. The blower is used to agitate the lime slurry tank and to mix the lime and water in the culvert. Other equipment includes: 5 KW generator, jet mixer, water pump, peristaltic pumps, diesel fuel tank, fuel pump and laboratory equipment.

5. Environment

5.1. Teck Resources Limited Safety and Health Policy

Teck Resources Limited

Teck is Canada's largest diversified resource company, committed to responsible mining and mineral development with major business units focused on copper, steelmaking coal, zinc and energy. We also have teams committed to exploration, project development and technological innovation. While our operations are predominantly located in Canada, the U.S., Chile and Peru, our activity footprint is global.

Health and Safety Policy

Safety is a core value of our company and we believe all incidents that could cause serious harm to our employees and contractors are preventable.

We are responsible for providing a safe workplace, effectively managing workplace risk and are committed to providing leadership and resources for managing health and safety. We will ensure that all employees and contractors have the knowledge and ability to safely perform their duties. We will identify and manage occupational health and hygiene exposures for the protection of longer term health. We will strive for continual improvement and hold ourselves accountable through verification and reporting of our performance.

We expect all employees and contractors to be leaders in health and safety through identification of hazards and the elimination and control of high potential risk. We all share in the responsibility for our safety and that of our co-workers.

Working together we can eliminate fatalities and serious injuries in the workplace; we will accept nothing less. Everyone has the right to a safe and healthy workplace.

Everyone Going Home Safe and Healthy Every Day

Donald R. Lindsay
President and CEO

September 2014

Teck

Water Licence MV2006L2-0013

Under the water licence issued by the Northwest Territories Water board the following requirements are applicable to the Water Treatment process.

Part C: 1d) The Tailings Containment Area operated and maintained such that "a freeboard limit of 1.0 metre shall be maintained at all times"

Part C: 1e) "The rate of waste discharge is at all times controlled and measured"

Part C: 2 "All wastes discharged by the Licensee from the Tailings Containment Area shall meet the following effluent quality requirements:"

Parameters	Maximum Average Concentration	Maximum Concentration of any Grab Sample
Total Arsenic	0.50 mg/L	1.00 mg/L
Total Copper	0.15 mg/L	0.30 mg/L
Cyanide	0.10 mg/L	0.20 mg/L
Total Lead	0.20 mg/L	0.40 mg/L
Total Zinc	0.50 mg/L	1.00 mg/L
Suspended Solids	25.00 mg/L	50.00 mg/L
Ammonia	2.00 mg/L	4.00 mg/L

"The Waste discharged shall have a pH greater than six (6) and no waste discharged shall contain floating solids, or visible sheen of oil and grease."

Part C: 3 "The Licensee shall notify an Inspector of any planned discharge of waste from the Tailings Containment Area at least seven (7) days prior to such discharge occurring."

SNP Part B 1. " The tailings area discharge at Station number 35-1 shall be sampled daily during discharge and analysed for the following parameters:"

Total Copper	pH
Total Lead	Suspended Solids
Total Zinc	

SNP Part C 1. "The daily and annual quantity of treated waste water discharged from Surveillance Network Program Station Number 35-1 shall be measured and recorded in cubic meters."

SNP Part B 3. "Water in the Tailings Containment Area shall be sampled three times a year (spring, summer, and fall), during periods of open water and analyzed for the following parameters:

Total Zinc	Total Copper
Total Lead	

SNP Part C 2. " The water level of the holding pond within the Tailings Containment Area shall be recorded three times a year, (spring , summer, and fall), in conjunction with sampling referred to in Part B, Item 3 during periods of open water."

5.2. Response Organization

The mine remains permanently closed and therefore there are no personnel on-site except during the summer water treatment period. There are no Hazardous Materials on the site except during the water treatment period. The only possible spills, other than during the water treatment period, would be related to the TIA dykes. In the event of an incident the Site Manager is responsible for coordinating activities.

As the Incident Commander, the Site Manager is responsible for:

- Overall command and control of an incident.
- Establishing response objectives and strategies.
- Providing information to authorities regarding reportable incidents.
- Scheduling meetings to update the response plan.

During the water treatment period, there will be personnel on-site with Hazardous Materials, in relatively small volumes, under their control. In the event of a spill, the personnel would react immediately to a spill and contact the Site Manager.

5.3. Reportable Spills

A spill in excess of the following thresholds is considered a spill under the N.W.T. Spill Contingency Planning and Reporting Regulations (N.W.T. Reg. 068-93), pursuant to the Environment Protection Act. In these regulations “Federal Regulations” means the amended Transportation of Dangerous Goods Regulations (International Harmonization Update, 2016) SOR/2016-95.

Table 1: Reportable Spill Quantity of Dangerous Goods

Substance Spilled	Severe Marine Pollutant	TDG Code	Reportable Quantity
Explosives of Class 1 as defined in section 3.9 of the Federal Regulations.		1	Any amount
Flammable gases, of Division 1 of Class 2 as defined in section 3.11 (a) of the Federal Regulations.	**Gasoline**	2.1	Any amount of gas from a container larger than 100L, or where the spill results from equipment failure, error or deliberate action or inaction.
Non-flammable gases of Division 2 of Class 2 as defined in section 3.11 (d) of the Federal Regulations.		2.2	Any amount of gas from a container larger than 100L, or where the spill results from equipment failure, error or deliberate action or inaction.
Poisonous gases of Division 3 of Class 2 as defined in section 3.11(b) of the Federal Regulations.		2.3	Any amount
Corrosive gases of Division 4 of Class 2 as defined in section 3.11 (c) of the Federal Regulations.		2.4	Any amount
Flammable liquids of Class 3 as defined in section 3.12 of the Federal Regulations.	**Diesel**	3	200L (Any amount if spilled into a watercourse)
Flammable solids of Class 4 as defined in section 3.15 of the Federal Regulations.		4	25 kg
Products or substances that are oxidizing substances of Division 1 of Class 5 as defined in sections 3.17(a) and 3.18(a) of the Federal Regulations.		5.1	50 kg or 50 L
Products or substances that are organic compounds that contain the bivalent “-0-0-“structure of Division 2 of Class 5 as defined in sections 3.17 (b) and 3.18 (b) of the Federal Regulations.		5.2	1 kg or 1L
Products or substances that are poisons of Division 1 of Class 6 as defined in sections 3.19 (a) to (e) and 3.20 (a) of the Federal Regulations.		6.1	5 kg or 5 L
Organisms that are infectious or that are reasonable believed to be infectious and the toxins of these organisms as defined in sections 3.19(f) and 3.20(b) of the Federal Regulations.		6.2	Any amount
Radioactive materials of Class 7 as defined by section 3.24 of the Federal Regulations.		7	Any discharge or a radiation level exceeding 10 mSv/h at the package surface and 200 mSv/h at 1 m from the package surface.
Products or substances of Class 8 as defined by section 3.24 of the Federal Regulations.		8	5 kg or 5 L
Miscellaneous products or substances of Division 1 of Class 9 as defined by sections 3.27 (1) and 2 (a) of the Federal Regulations.		9	50 kg or 50 L

TDG = Transportation of Dangerous Goods.

5.4. Discovery and Response to Spills

The following provides a general response to any spill upon initial discovery. Refer to Appendices A and B for more specific information including spill response procedures and MSDS documents for the particular substances located at the mine site.

Appendix B2 - **Diesel**

Appendix B3 – **Gasoline**

FIRST PERSON TO OBSERVE THE SPILL:

Ensure personal and worker safety, if you cannot identify the spilled substance consider it dangerous.

If personnel are injured

- Call for medical help, attend to injured person, and administer first aid if safe to do so.

If Safe

- Stop all sources of ignition and stop or reduce the source flow of the spill
- Shut off all valves
- Shut off all electrical power
- Initiate containment
- Put down adsorbent pads and berm spill area, if possible
- Do not enter confined spaces
- Do not expose self to fire hazard
- Complete the spill report form and report the spill

If Unsafe

- Initiate evacuation (upgrade or upwind) – move to safe area
- Notify Site Manager
- Report the following as per requirements in Section 5.7
- Isolate area and deny entry until qualified response personnel arrive
- Deny access to all unauthorized personnel
- Complete the spill report form and report the spill
- Update Site Manager on spill status

Permit Exceedance: If the permit criteria are exceeded for the water quality in the weir discharge then the treatment process must be stopped. The spill must be reported. The channel must then be sprayed or the solids allowed to settle and operation can be re-started slowly when all the parameters are again within permit.

5.5. Communication: Spill Reporting

5.5.1. Teck Metals Ltd Reporting and Contact Information

Spills with quantities greater than those shown in section 4.2 must be immediately reported to the Site Manager. If the Site Manager is unavailable, contact Teck's designated alternate.

If the on-site person is unable to make direct contact with the Site Manager or designated alternate they shall report the incident to the N.W.T. 24 Hour Spill Report Line at 1-867-920-8130.

If possible contact the local Resource Management Officer, Olivia Villebrun, at 867-872-2558 and inform her of the situation.

Site Manager: Dana Haggar	
Office Tel.	250-427-8413
Cell	250-602-9361
Alternate #1: Michelle Unger	
Office Tel.	250-427-8422
Cell	250-432-5264

If the SM deems that the spill has exceeded the reporting threshold for the spilled substance, Teck's Head Office in Vancouver and the appropriate government agencies will be notified. The government procedure is outlined in the following section, "External Notification".

5.6. External Notification

All spills of petroleum products or other hazardous materials exceeding the appropriate threshold must be reported. The SM is responsible for all external reporting. Although several government agencies at the federal, territorial and municipal levels may ultimately be involved, only one government contact is required to be made by the SM or his designate for mine site spills. Affected Agencies will be contacted at:

Northwest Territory 24 HOUR SPILL REPORT LINE

Telephone: 1-867-920-8130

This is a 24 Hour telephone number to Environment Canada. They will notify all other concerned agencies when necessary. The following information shall be conveyed to the affected agencies through the 24 Hour Spill Report Line. This information is to be documented on the "Spill Reporting Form" provided in Appendix A-1.

The reporting person must give as much of the following information as possible:

A) Report Date and time

B) Occurrence Date and time of spill

C) Water Licence Number: N1L2-0035

D) Location of Spill:
Pine Point Tailings Area 100 km by road east of Hay River, 10 km south of Great Slave Lake

E) Latitude: Station 35-1 60°53'41.3"N Longitude: Station 35-1 114°25'30.7"W

F) Responsible Party name and address

G) If Contractor involved name and address

H) Product spilled, quantity spilled, UN number, Second product spilled (if applicable)

I) Spill source, cause and area of contamination in square meters

J) Factors affecting spill or recovery, describe assistance required, hazards to persons, property or equipment.

K) Additional information, comments actions taken to contain, recover or dispose of spilled product and contaminated materials

L) name, position, employer, location calling from and phone number of person reporting spill

M) name, position, employer, location and phone number of alternate contact person (site Manager)

A list of typical spill response equipment is provided in Appendix A-2.

5.7. External Technical Advice – CANUTEC

The Canadian Transport Emergency Center (CANUTEC), a branch of Transport Canada, can also be contacted for 24-hour technical advice on Dangerous Goods, as needed. The CANUTEC – help line for dangerous goods is 1-888-226-8832 or 613-996-6666.

5.8. Spill Incident Investigation

Upon resolution and completion of clean-up of a spill and investigation must be performed into the incident. The objective of the Investigation is to prevent a re-occurrence of an incident. The Incident Investigation Report form in Appendix C8 must be completed and approved by the Site Manager and action taken to prevent a re-occurrence.

6. Safety

There are several substances on site that must be used with care; hydrated lime, diesel fuel, gasoline and laboratory reagents.

6.1. High Calcium Hydrated Lime

Hydrated Lime causes burns.

PRECAUTIONS: Avoid contact with eyes. Avoid prolonged contact with skin. Do not breath dust.

FIRST AID: Wash skin with soap and water. In case of contact with eyes, wash with running water for at least 30 minutes and obtain medical attention. For inhalation of dust remove to fresh air, give artificial respiration if necessary and obtain medical attention. If swallowed give one to two glasses of water or milk. **DO NOT INDUCE VOMITING**, obtain medical attention immediately.

For more details see MSDS in Appendix B1.

6.2. Diesel Fuel

Diesel Fuel is a flammable liquid and care should be taken when handling it.

PRECAUTIONS: It is recommended safety goggles, chemical resistant overalls and chemically impervious gloves be used when handling diesel fuel.

For more details see MSDS in Appendix B2.

6.3. Gasoline

Gasoline is a very flammable liquid and care should be taken when handling it.

PRECAUTIONS: It is recommended safety goggles, chemical resistant overalls and chemically impervious gloves be used when handling diesel fuel. Use outside where there is good ventilation.

For more details see MSDS in Appendix B3.

6.4. Laboratory Chemicals

6.4.1. Hydrochloric Acid

Hydrochloric Acid is a very corrosive liquid and a higher concentrations produces vapours that should not be breathed.

PRECAUTIONS: Use in a well ventilated area. Wear goggles and shield, Lab coat & apron and proper gloves.

For more details see MSDS in Appendix B4.

6.4.2. Cyclohexanone

Cyclohexane is a combustible liquid and vapours must be avoided.

PRECAUTIONS: Use in a well ventilated area. Wear goggles and shield, Lab coat & apron and proper gloves. Do not breath mist/vapour.

For more details see MSDS in Appendix B5.

6.4.3. ZincoVer 5, Zinc Reagent Powder Pillows (contains Potassium cyanide)

The Zinc Reagent Powder Pillows contain potassium cyanide which may be fatal if swallowed.

PRECAUTIONS: Use in a well ventilated area. Avoid contact with eyes, skin and clothing. Wear goggles and shield, Lab coat & apron and proper gloves. Have an eyewash station nearby.

For more details see MSDS in Appendix B5.

6.4.4. Nitric Acid

Nitric Acid is a strong oxidizer and can cause severe eye and skin burns. Do not inhale fumes.

PRECAUTIONS: Use in a well ventilated area. Do not breath vapours. Avoid contact with eyes, skin and clothing. Wear goggles and shield, Lab coat & apron and proper gloves.

For more details see MSDS in Appendix B6.

6.4.5. Buffer Solutions

PRECAUTIONS: Buffer Solutions are irritants and should be used with caution. Use in a well ventilated area. Wear goggles and shield, Lab coat & apron and proper gloves.

For more details see MSDS in Appendix B6.

6.5. Eyewash Stations

All eye wash stations should be checked regularly and any defect corrected immediately. The purpose of eye wash stations is to flush lime or chemicals from your eyes.

LOCATIONS: 1: On side of Lime Silo
2: End wall in the Laboratory trailer

6.6. Fire Extinguisher Locations

There are two ABC fire extinguishers available to use on small fires.

LOCATIONS: 1: On Pump/Blower trailer
2: Inside the door of the Laboratory trailer

Note: Fire Extinguishers are to be checked at the start of each operating period.

6.7. Safety Incident Investigation

In the event of any safety incident related to personnel or equipment an Incident Investigation must be performed. The objective of the investigation is to prevent a re-occurrence of the incident. The Incident Investigation Report in Appendix C8 must be completed and submitted to the Site Manager.

7. Major Process Equipment Description & Operation

7.1. Lime Silo

Description:

The Lime Silo was bought from Wheatland Bins in early 2006 and was installed onto a concrete pad at the beginning of July 2006. The bin is a Model WB1417-55 14' in diameter and 33' high with a capacity of 3,381 ft^3. Depending on the bulk density of the hydrated lime the bin will hold a minimum of 45 metric tonnes (in 2006 one truck load with a capacity of 2,200 ft^3 hauled 30 tonnes). The bin is bolted to a concrete pad.

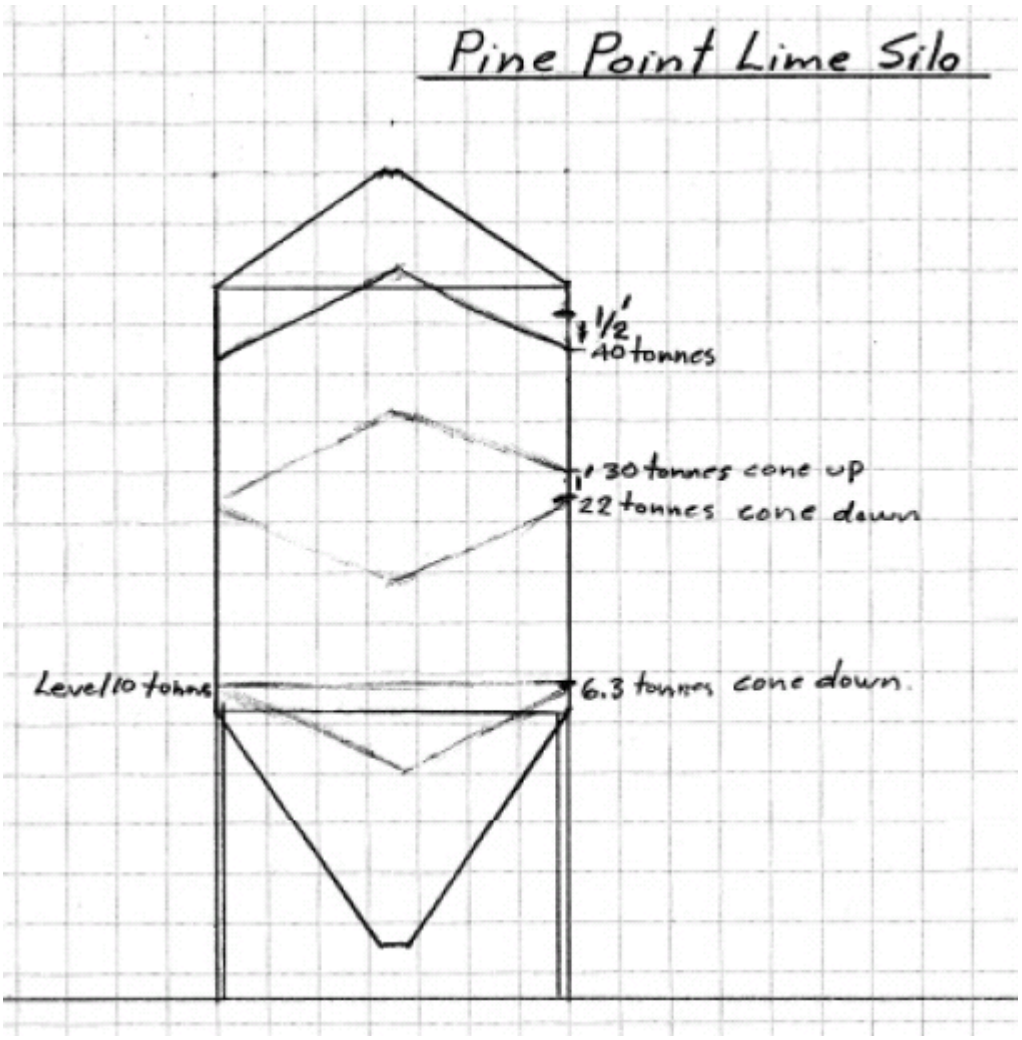
The bin is non pressurized with a 4.5" fill tube with a 4" male camlock connector, running to the top of the bin. There is a 6" vent line from the top to 4' above ground level. A ladder goes up the side of the side of the bin to access the top. On the bottom of the silo there is a manway hatch and a pokehole to clear any blockages. Around the lower part of the bin there are 8 fluidizer air jets to assist with the lime flow when required. The air jets are connected to the air blower by a 1" line. On the bottom of the bin there is a crank operated "knife gate" that can be used to control the lime flow to the auger. The 4" x 12' auger is mounted at a 20° angle and is powered by a 2 HP motor. The auger is used to feed the Hydrated Lime into the Jet Mixer. When installing the Auger be sure the joints are sealed well to prevent leakage.

There are three bin level indicators on the cylindrical part of the silo:

Top indicator ~2,976 ft^3 if lime is level = 40 tonnes of lime
Middle indicator ~1,821 ft^3 if lime is level = 25 tonnes of lime
Bottom indicator ~ 667 ft^3 if lime is level = 10 tonnes of lime

Normally the bin is first filled so the lime will be heaped up in the center and when the lime is being drawn down then the lime is low in the middle. Therefore:

- If 40 tonnes of lime were unloaded into the silo the level would be 1.5' below the top indicator
- If 30 tonnes of lime were unloaded into the silo the level would be 1' above the middle indicator
- When the lime is being drawn down then when the middle indicator goes off then there will be about 22 tonnes of lime remaining
- When the lime is being drawn down then when the bottom indicator goes off then there will be about 6.3 tonnes of lime remaining



Start-up/ Shutdown:

At the end of each operating period the lower part of the ladder, auger, hoses and the hand crank are removed to minimize vandalism. Also all the hatches are chained and locked. Therefore at the start of the operating period these components must be re-installed before the silo is filled with lime.

Lime Silo, Auger and Jet Mixer July 2007

7.2. Lime Pump/ Blower Unit

Description:

The Lime Pump/ Blower Unit is a trailer mounted unit consisting of a diesel engine directly driving the air blower and a clutch to drive the lime pump. The unit was constructed by Frontier Power Products in Calgary.

The engine is a John Deere 4045T turbocharged diesel engine (4.5 liter) with SAE 4-10 housing/flywheel. The unit is rated at 87 Hp (7.4 KW) @ 2,100 rpm continuous.

Mounted on the engine drive is a Twin Disc 10-5 clutch assembly to connect to the lime pump.

The Lime pump is a Berkley B4JRMBH frame mounted pump rated at 900 US gpm @60 psi.

The air blower is a Gardner Denver Sutorbilt 5MVP blower rated for 353 cfm @9 psi.

There is also a 60 gallon fuel tank mounted under the engine.

Preparation:

Locate the trailer unit between the lime Slurry tank and the Lime Silo. Ensure the pump is lower than the full slurry level in the Lime Slurry tank and then level the unit. Block it up to ensure the trailer is stable.

Place a sheet of plastic under the unit to ensure no hydrocarbons are spilled on the ground.

Engine Operation:

Before operating check all the fluid levels and ensure the clutch is disengaged.

To start the engine hold the start button in, turn the key to START while holding the button in, release the button once the engine is running, let the engine warm up and then increase to the desired rpm.

Review the John Deere Operators Manual for detailed instructions on how to start and operate the engine. Also review the Twin Disc manual for the clutch operation.

Blower Operation:

The blower is directly driven by belts from the engine and the other than belt tension and lubrication the blower is easy to operate. The operating pressure is controlled by the number of disks on the pressure relief arrangement and need not be adjusted.

Review the Sutorbilt manual before operating.

Pump Operation:

Ensure the intake and discharge lines are connected and the intake valve is open. With the pump located below the slurry level in the Lime Slurry Tank the pump will be self priming.

Note: Due to the problem with the exhaust height interfering with storing in the shipping container and problems with the valves the priming capability has been disabled.
Priming: To prime the pump open the ½" line on the pump casing. Engage the clutch and close the flapper on the engine exhaust assembly. Hold the flapper closed until liquid exhausts out the exhaust assembly. Immediately close the valve on the ½" line (this prevents liquid in the engine exhaust manifold).

Once the pump is running adjust the engine rpm to give the volume and pressure desired.

Adjusting the gland: The pump gland (pump shaft seal) should be adjusted to allow a slow drip of slurry through it. When the flow through the gland increases the packing can be

tightened. If the packing is tightened too much then the face of the packing burns and it will be impossible to prevent leaking.

Running low pump volumes at high engine rpm will result in the pump being back pressured and can result in high slurry leakage through the gland. To prevent the pump from being back pressured two 3” discharge lines should be operated at all times.

Lime Pump/Blower Unit July 2007

The discharge manifold has four valved ports: three for 3” lines and one for 2” fire hose. Two of the 3” lines connect to the two headers on the Lime Slurry Tank and one 3” hose connects to the Jet Mixer. The fire hose is used for spraying the channel, disposing of excess lime and is connected to the Jet Mixer for mixing lime.

7.3. Lime Slurry Tank

The lime slurry tank is a 21,800 liter rectangular tank that is continuously circulated and agitated to keep lime in suspension. The lime slurry is circulated through the lime pump which discharges the slurry from two headers into the upper side of the tank and the pump is feed from an outlet located at one end near the bottom of the tank.

The tank is agitated by 7 air lances that are distributed around the tank. It is important that the lances are not located too close to the tank outlet otherwise air gets into the pump and it stops pumping. Lime builds up on the lances resulting in the need to clean them every few days and before start-up.

Lime Slurry Tank: Discharge Line from Jet Mixer and Suction Line to the Lime Pump

In 2007 a second header was installed to reduce the pump back pressure when mixing lime.

Lime Slurry Tank: New 2007 discharge header and air lances

Lime Slurry Tank: New discharge header and air lines to the lances

7.4. Jet Mixer

The Jet Mixer is used to mix the lime by contacting the dry lime with a high speed jet of water. The Jet Mixer was purchased from Crown Industries in Calgary and it came with several jets. The Mixer consists of a hopper that drops the lime onto jet of water in the mixing bowl. There is a 3” line that feeds in a rectangular nozzle that emits a flat spray of water at high speed. The lime slurry exits out a 4” discharge line that drops the slurry into the Lime Slurry Tank. There is also a 2” line with a deflector plate that helps to push the lime slurry up into the Lime Slurry Tank.

When operating the jet mixer it is important to have the 2” line operating along with a second 3” line to prevent the lime pump from getting back pressured and leaking excessively from the gland. The other alternative is to operate the engine at a lower rpm when mixing the lime.

7.5. Peristaltic Pumps

There are three Masterflex peristaltic metering pumps, one or two running and a spare, that feed the lime down a vertical pipe into the culvert where it is mixed with the water to be treated. Each pump is connected to a variable speed drive and they are all hooked up to the generator.

The peristaltic pumps are mounted in a plywood box with the suction lines dropping into the Lime Slurry Tank and the discharge lines going to the bottom of the pipe in the culvert. The discharge point is in the water to prevent plugging of the vertical pipe.

Peristaltic Pumps set up inside the protective stand July 2006

7.6. Water Pump

Daily a 2” gasoline water pump is used to fill the Lime Slurry Tank with water from the main pond before mixing the next batch of lime.

7.7. Generator

The generator is a 5 KW Honda EX5DCC9 Diesel with two 30amp/120 volt receptacles and one 18.8amp/240 volt receptacle. The generator will run about 18 hours on a tank of fuel. Before starting ensure the power switch is in the OFF position, start the generator, let it warm up and then turn the power switch ON. Review the Honda Owner's manual before operating.

7.8. Laboratory

The Laboratory is mounted on a trailer and is positioned on the other side of the culvert from the Lime Slurry Tank. The trailer is levelled and blocked up before use. Inside there is a work bench for the pH meter, Hach meter and scale and on the other side is some shelving for storage and tools.

8. Laboratory Procedures

8.1. PH Meters

We have 3 pH meters. Every morning the pH meters must be calibrated with 4.00, 7.00 and 10.00 ph buffers (see MSDS Appendix B8).

1. Pour a known PH buffer standard solution into a clean, dry container. Power on the meter and it automatically enters into the measurement mode. Select PH mode by pressing MODE key.

2. Dip both PH electrode and temperature probe into the buffer solution. Swirl gently and wait for reading to stabilize. (approx 30 seconds depending on electrode's condition)

3. Press CAL key to enter PH calibration mode. A "CA" displays momentarily and the display shows the current uncalibrated reading flashing.

4. To abort or cancel calibration without accepting new value, pres CAL key. The meter then reverts to PH measurement mode.

5. To proceed with calibration, allow reading to stabilize. The meter automatically recognizes PH 4.01, 7.00, or 10.01 buffers. Press ENTER key to confirm calibration and the LCD displays "CO" momentarily. The meter reverts to measurement mode.

6. For 2 or 3 point calibration, repeat step 3 with other PH buffer values of 4.01 7.0 and 10.01 for higher accuracy.

After closing down everything at night, the PH meter probes are briefly put into 10% hydrochloric acid (see MSDS Appendix B4) and distilled water in order to clean off the build-up of lime.

8.2. Hach DR 100 Colorimeter

A Hach test is done to measure the amount of zinc that is in the water. Hach Company is the manufacturer of the Hach DR 100 Colorimeter, Model 41100-20 that is the Zincon Method with a range of 0-1.5, 0-3.0 mg/L.

Samples are taken in 3 - 500ml bottles at the discharge weir. Each bottle is rinsed in the water 3 times, try not to disturb anything, filled to the top and placed into a Tupperware carrier (so not to change the temperature). The samples are taken back to the lab and in one bottle we put the pH probe in and get a temperature reading, then a ph reading. According to "background lab work", the target ph at the weir is 9.5 – 10.0. After this we dump the sample down the drain. Another bottle is used for the zinc test and the third is for the turbidity measurement.

1. Fill a clean 25mL mixing cylinder to the 20 mL mark with the water to be tested.

2. Add the contents of one ZincoVer Reagent Powder Pillow. Note: There is a 4 year shelf life so be sure the reagent is not dated. WARNING: This reagent contains cyanide and is extremely poisonous if taken internally or if the fumes are inhaled (see MSDS Appendix B6). Stopper the cylinder and invert repeatedly until all particles are dissolved (this takes longer usually when the water is cooler).

3. Fill a clean 2.5cm sample cell to the 10mL mark with the treated sample, leaving 10mL in the mixing cylinder. Cap the sample cell.

4. Using the calibrated dropper, add 0.50mL of cyclohexanone (see MSDS Appendix B5) to the sample in the mixing cylinder. Stopper and shake for 30 seconds. Allow at least six minutes for the color to develop fully, but do not wait more that 15 minutes.

5. Open the light shield and turn the Right Set control fully clockwise. Place the 1cm cell holder into the Left Set position of the sample well. Press down firmly to seat it into place. Close the light shield.

6. While holding the ON button down, adjust the Left Set control to align the meter needle with the arrow at the far left of the scale arc. Remove the cell holder.

7. Place the sample cell without cyclohexanone into the sample well. Press down firmly to seat it into place. Close the light shield. While holding the ON button down, adjust the Right Set control for a meter reading of zero mg/L.

8. Fill a clean 2.5cm sample cell to the 10mL mark with the solution in the mixing cylinder and place it into the sample well. Press down firmly to seat it into place. Close the light shield. While holding the ON button down, allow the meter reading to stabilize, then read and record the mg/L zinc from the 0-1.5mg/L scale.

Empty the samples into the Cyanide Waste Container rinsing with distilled water 3 times, as well as the calibrated dropper and the mixing cylinder. When this container is close to being full, it is dumped into the lake (1A). After the contract, all batteries are removed from the Hach Colorimeters & PH meters.

8.3. Turbidity Meter (LaMotte 2020)

Turbidity measurements are taken at the same time that zinc concentration is checked at the weir. The third sample bottle in the above procedure is used for the tubidity measurement.

The turbidity meter should normally be calibrated in the 0 -10 NTU range.

Calibrate:

1. Turn Meter **ON**
2. Select **MEASURE, press */OK**
3. Rinse Tube labelled B and Fill with the **BLANK** Standard
4. Dry the tube, keep for future use (Step 3 can then be skipped the next time).
5. Place the Blank tube into the meter, close the cover and **press */OK** to scan the Blank
6. Rinse Tube labelled 10 and Fill with NTU 10 standard.
7. Dry the tube, keep for future use (Step 6 can then be skipped the next time).
8. Place the 10 standard into the meter, close the cover and **press */OK** to scan the sample
9. Press ⩛ and then **press */OK** to select calibrate
10. Change the highlighted digits one at a time using ⩛or ⩓ to match the standard concentration. **Press */OK** to accept a digit and move to the next digit.
11. When the display matches the standard, **press */OK** to select **SET**
12. **Press */OK** to proceed to turbidity analysis or turn the meter **OFF**.

Analysis (with calibrated meter):

1. Turn Meter **ON**
2. Select **MEASURE, press */OK**
3. Insert the **BLANK** Standard from above.
4. **press */OK** to scan the Blank
5. Rinse Tube and fill with the sample
6. Dry the tube, place in the meter and close the cover
7. **press */OK** to scan the sample
8. Record the turbidity result
9. Turn the meter **OFF**

If a sample is much higher than 10 NTU the meter may indicate that the value is out of range. When this happens carefully dilute the sample by half and measure again. Be sure to double the measured value.

Note that NTU does not necessarily correlate directly to TSS, therefore it is important to compare the turbidity meter result to the lab result on the daily sample to develop a correlation.

A Model 3150 Insite IG Suspended Solids meter is also used to cross check for TSS.

8.4. Lime Slurry Density

The Lime Slurry is mixed to 18% solids and a 500 ml cylinder is used to determine the slurry density. The 500 cc cylinder is zeroed on the scale and then the weight of 500 ml of slurry should be 557 gm. See Table in Appendix E2. Note that in the past a rough calculation was used for determining the %Solids and that the target slurry weight for 500 ml remains unchanged.

9. Spring Preparation

9.1. Purchase Orders

Purchase orders for equipment and supplies are set up in the Spring by Teck office personnel. Below is a list of typical PO's:

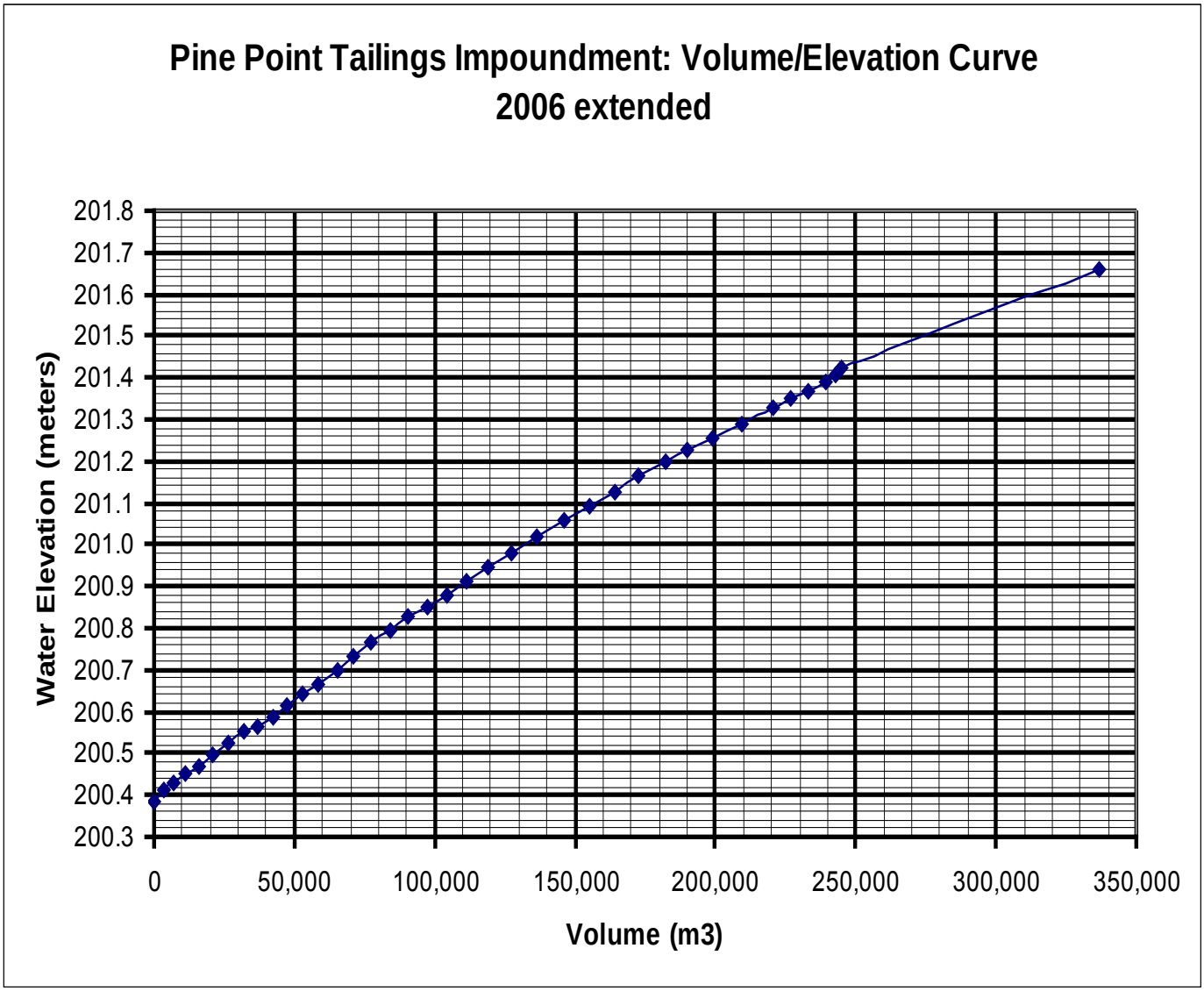
1	Cobb Enterprises	Annual water treatment program
2	ALS	Laboratory analysis
3	Exova	Water quality analysis
4	Rowe's Construction	Miscellaneous equipment rental
5	Buffalo Air Express	Freight for water samples
6	The Northwest Company	Food purchases for caretakers
7	Midnight Petroleum	Fuel for mine site and vehicles
8	SMS Limited	Rental storage unit
9	Golder Associates	Engineer's Geotechnical Inspection
10	Network Innovations	Rental OR Purchase of Sat Phone
11	Summit Helicopters	Air service for fall water sampling
12	Maskwa Engineering	Technician for fall water sampling
13	Kingland Freightliner	Miscellaneous parts
14	Northern Metalic Sales	Miscellaneous Supplies
15	Graymont Western Canada	Hydrated Lime
16	Westcan bulk carriers	Hydrated Lime Delivery
17	Fisher Scientific	Lab Chemicals and supplies

9.2. Insurance for Trailers

There are two trailer units, Laboratory and Pump/Blower Unit, that must be insured each year and the insurance papers must be passed onto the contractor. Teck personnel will renew the insurance annually.

9.3. Estimating Lime Requirements

Before Start-up the lime requirements must be estimated in order to set Purchase Order Quantities and schedule lime deliveries. The lime requirement is estimated by knowing the water level in the Main Pond ahead of the scheduled start-up and estimating the pond volume from the following Chart. The estimated volume is then multiplied by an assumed lime consumption of 0.2 Kg/m^3 to give the estimated lime consumption in Kg. Divide the number of Kg by 1,000 to get the estimated lime consumption in metric tonnes.



10. Start-up

10.1. Water Samples

Upon arrival at the site water samples should be taken from the Main Pond and the Channel and sent for analysis as soon as possible. The results can then be used as a check to ensure the field analysis is good. The results from the channel sample are used to determine if spraying the channel is required before starting treatment.

10.2. Tailings Impoundment Inspection

Soon after arrival the Tailings Impoundment should be inspected and the inspection form (Appendix C3) completed. If there are any obvious issues then the site manager must be contacted immediately.

10.3. Daily Spot Checks

An “inReach” devise has been provided to the Water Treatment contractor to provide Daily contact with the site manager to ensure the safety of the personal on site. As part of the contract the operators are required to check in daily.

10.4. Plant Assembly

To prepare for start-up all the equipment stored in Hay River must be moved out to the site and then organized and assembled. Some wood, the air lances and assorted materials are stored in the bush near the end of the East Dyke. The Lab trailer unit is positioned near the culvert and Lime Slurry Tank. The Pump/Blower Unit is parked between the Lime Silo and the Lime Slurry Tank. The trailers are levelled and blocked up.

Check that the Fire Extinguishers are charged and not expired. Place one fire extinguisher on the Pump/Blower trailer and one inside the door of the Laboratory trailer.

Place the Spill Kit beside the Laboratory Trailer.

The Lime Slurry Tank is cleaned out to prevent plugging of the Jet Mixer.

The Lime Auger is installed and the silo re-assembled; ladder, air lines, hand crank for knife gate and power to the auger motor.

The Jet mixer is positioned under the auger discharge spout and the plastic chute is connected to the auger spout. The top area of the mixer is shrouded in with a couple of pieces of plywood to minimize dusting.

Hoses are connected to the equipment: 4” Intake hose from the Lime Slurry Tank to the pump inlet, 3” Discharge hose from the pump discharge header to the Jet Mixer, 2” fire hose from the discharge header to the Jet Mixer, 4” Discharge hose from the Jet Mixer to the

Lime Slurry Tank, 3” Discharge hose from the pump discharge header to the Lime Slurry Tank.

Air hoses are connected from the Blower header to the lime silo, the Air Lance header and the culvert.

The generator is located between the Lab Trailer and camp to enable power to be supplied to the Treatment Plant Equipment and the camp.

The peristaltic pumps are set up near the culvert and are plugged into the generator.

Power is provided into the laboratory trailer in order to operate the Lab equipment

The water pump is set up beside the Main Pond below the Lime Slurry Tank so that the pumping distance is minimized.

At the discharge weir the level indicating float assembly is set up for easy weir measuring.

10.5. Spraying the Channel

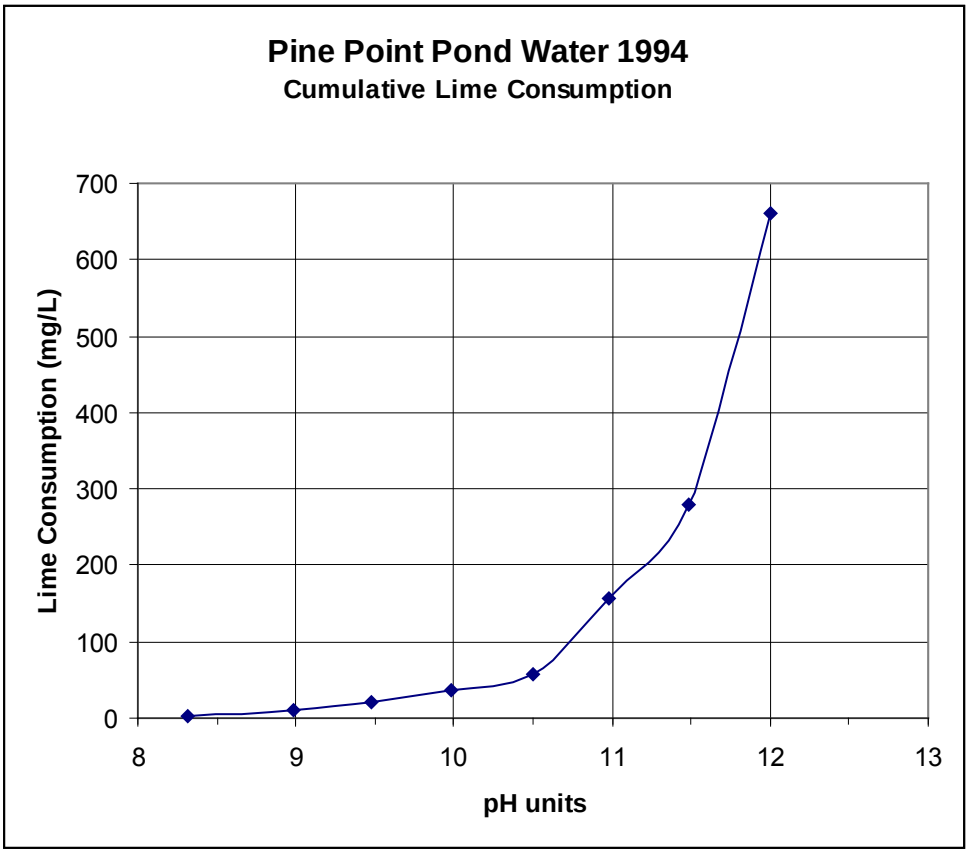
Before starting the process a batch of lime must be mixed and then the serpentine channel must be sprayed with lime. The water be below the permit but in quality but it is good practice to treat this water first. The channel is sprayed using 2” fire hoses and a nozzle to spray lime over the whole length of the channel. Enough lime should be added to raise the pH over 9.5. The lime should be allowed to settle for at least 12 hours or over night. Note that the lime slurry must continue to be recycled back to the Lime Slurry Tank to prevent over pressuring the lime pump. After spraying the channel clean the hoses out with water and leave in place in case the channel needs to be sprayed in an emergency.

11. Operating Strategy

The water treatment process must treat the water from the Tailings Impoundment by precipitating out metals by using lime. The sludge produced in the treated water is settled out in the serpentine channel. The treated water is released to the environment at the spillway and must meet the water quality criteria in the permit.

The pH control is critical to staying within the effluent permit. In 1994 Research in Trail performed some lab tests to determine the optimum operating pH. Increasing pH resulted in lower zinc concentrations and that the pH should be above 10 to ensure the zinc concentration is within the permit. When the pH goes higher than 11 the zinc concentration starts increasing again therefore the operating pH should be between 10 and 11.

Increasing the pH increases lime consumption and over pH 10.5 the amount of lime required to achieve the desired pH increases exponentially. To minimize the cost of lime the closer the pH is to 10.5 the better.



Years of operating experience have shown that operating at a high pH, 10.9-11.0, is required to ensure that the effluent meets the permit with the normal target at 10.95. The pH required is dependent on the flow rate through the culvert and how deep the water is in the serpentine channel. The higher the flow rate the shorter the settling time is in the channel. Therefore the deeper the water is in the channel (highest at start-up) the greater the flow rate can be. In 2008 the channel was deepened which results in higher retention time and

slower flowrates through the channel throughout the treatment period. The deepened channel enables lower operating pH.

The daily starting and shutdown procedures must ensure that at all times lime is being added when there is flow through the culvert. Untreated water entering the serpentine channel will result in higher metal levels at the siphons.

12. Daily Duties

12.1. Summary of Daily Routine

1. Generally start up in the morning at 7:00 AM and start shutting down at 7:00 PM.
2. Start the generator, ensure power switch is off before starting and once it is warm then turn the power switch on.
3. Start pump/blower unit; hold the start button in, turn the key to START while holding the button in, once the engine is running release the button, let the engine warm up at 1,000 rpm.
4. Install air lances in the lime slurry tank while the engine is warming up.
5. Engage the lime pump, prime if necessary, and then increase the engine rpm to 1600-1700.
6. Mix lime to increase the slurry density to 17% solids (note: formerly 10% solids but there was an error in the calculation so the weight of the 500cc cylinder remains unchanged at 557gm). See procedure below.
7. Read the water level in the main pond.
8. Open the culvert.
9. Start the lime metering pump to the culvert.
10. Take a grab sample at the siphons and run on the Hach Meter and LaMotte Meter.
11. Start the 5 siphons if water is compliant flows will be automatically read by the data logger
12. Adjust the peristaltic pump speed to give the desired pH
13. Between 10:00 and noon take a grab sample to ship to the lab and at the same time run it on the Hach meter and LaMotte Meter for comparison.
14. Check the combined flows on the data logger.
15. Ship the grab sample to the lab
16. Around 5:00 PM take another grab sample at the siphons and run on the Hach Meter and LaMotte Meter.
17. Record flow at the data logger
18. At 7:00 PM start shutting down. Close the each siphon line.
19. Close the culvert.
20. Reverse the direction on the lime metering pumps to flush them and then turn them off (note: if the water level in the channel is too low then use a bucket of water to flush the lines) .
21. Reduce the engine speed to 1000 rpm on the pump/blower unit.
22. Remove the air lances from the lime slurry tank and allow them to be blown out.
23. Turn off the pump/blower unit.
24. Fill the Lime Slurry Tank with water using the gas powered water pump. Fill to 1 ½ feet from the top to avoid spillage when the bubblers are running and the lime is added.
25. Fuel the pump/blower unit and generator.
26. Lubricate pump and other equipment as required.
27. Read the water level in the main pond
28. Complete Daily Report
29. Close up the lab.

12.2. Mixing Lime

Lime is mixed every morning before starting up the treatment process. Water is added the Lime Slurry Tank the night before and the lime concentration must be increased back to 18% solids by weight. The density of the lime slurry is determined by filling a 500 ml cylinder with slurry and weighing it on the lab scale. Note: in the past a rough calculation was used to estimate the percent solids and the weight of 557 gm for 500 ml of slurry remains unchanged.

The lime is mixed by feed dry lime from the lime silo into the jet mixer to contact the lime with a high speed jet of water. The slurry then flows into the Lime Slurry Tank and then pumped back into the jet mixer. Lime is added until the density is correct.

1. Open the 3 " valve on the lime pump header to feed the inlet of the jet mixer
2. Open the 2" valve on the lime pump header to feed second jet on the mixer to assist pushing the lime slurry into the lime slurry tank.
3. Start the auger from the lime silo.
4. Control the flow of lime from the silo to the jet mixer with the crank operated knife gate.
5. If the lime stops flowing into the auger then use the air fluidizers on the bottom of the silo to loosen up the lime. Be sure the knife gate is closed when doing this.
6. Check the density of the slurry and continue to add lime until 17% solids by weight is achieved.
7. Close the 2" valve to the Jet Mixer.
8. Close the 3" valve to the Jet Mixer.
9. Connect the 3" hose to the 4" discharge hose using the adapter.
10. Run to 3" lines to circulate the lime while minimizing the back pressure on the pump.

12.3. Flow monitoring

The flow is calculated using Fisher Scientific flow meters attached to each of the 5 siphon lines and is continuous monitored by a data logger. The total flow for the day is recorded on the Daily Operating Log and the record for the cumulative volumes treated.

12.4. Pond Level

The water level in the Main Pond is measured in the morning and evening using the staff gauge mounted on the culvert. The level is recorded on the Daily Operating Log. The gauge indicates the depth of water relative to mean sea level. The reference elevation is marked on the valve assembly and is 201.001m. The gauge must be read carefully using the marks which are varying lengths and shapes. Note that the bottom of the bars are even numbers and the top of the bars are odd numbers and the new gauge has these marked. Examine the chart in Appendix E4 to understand how to read the depth gauge.

Metric Depth Gauge on Culvert Valve, May 2010

Metric Depth Gauge in the Main Pond, July 2007

12.5. pH Monitoring

The pH is measured frequently, at least every hour, at the discharge of the culvert (35-1E) and the flow from the peristaltic pumps is watched to ensure the pH remains in the target range. At high water levels the pH probe is lowered down a plastic pipe so that it measures the water exiting the culvert before it mixes with the water in the channel.

The pH should also be checked at the weir (35-1B) when samples are taken, 3 times a day. Normally the pH will drop about 0.2-0.3 pH units from the culvert to the weir.

When starting up the pump speed on the peristaltic pumps can be set to give the approximate target pH based on the estimated flow see table in Appendix E5.

If difficulties are encountered sampling at intermediary points in the channel may be required. The following diagram identifies the various sample points.

Pine Point Sampling Points

35-1 A Main Pond at weir
35-1 B Settling Pond at weir
35-1 C Settling Pond at mid point
35-1 D Settling Pond at first point
35-1 E Settling Pond near end of culvert

12.6. Zinc Concentration Monitoring

The zinc concentration is at the discharge weir is measured with the Hach meter at least 3 time a day; ~7:15 AM, ~11:00 AM, and ~5:00 PM. Measurements are taken more frequently when the zinc concentration is higher than normal. The zinc concentration is recorded on the Daily Operating Log.

If it is found that the zinc concentration is increasing measures must be taken to prevent the permit form being exceeded. If the zinc concentration is approaching 0.5 mg/L Normally the first action would be to reduce the flow rate and then increase pH if it is lower than normal. The objective is to take action to prevent a spill. Therefore when the zinc concentration reaches 0.5 mg/L the process should be shutdown and the channel sprayed.

If the zinc concentration exceeds the permit, 1 mg/L in a grab sample, then the process must be shutdown. The spill report must be completed and the reporting procedures completed. The channel is then sprayed, time allowed for solids settlement and once the zinc concentration has dropped the process can be re-started.

12.7. TSS Monitoring

The turbidity should be monitored whenever samples are taken or when there are solids visibly in suspension near the end of the serpentine channel. The turbidity is measured in National Turbidity Units (NTU) which are roughly correlated to total suspended solids (mg/L). The relationship between NTU and TSS will need to be developed for the site by comparing Laboratory data with the meter. Therefore measure the turbidity at the same time the Daily Lab Sample is taken and record it on the Daily Operating Log.

12.8. Start-up, Daily and Weekly Water Samples

Before start-up the permit requires a sample from the Main Pond, 35-1A, be submitted for analysis (same as Daily sample).

A water grab sample is done between 10:00am and 12:00pm that is sent to Exova out of Edmonton, AB. Each sample consists of two Bottles, one (250 ml) for metals (Zinc/Copper/Lead) and the other (500ml) for general parameters (PH & TSS). The metals bottle gets preserved by adding a vial of Nitric Acid (see MSDS Appendix B7). A Chain of Custody form (example in Appendix C4) is completed one copy is retained and the remainder go with the sample. The samples are kept in the fridge in the lab until they are ready to be put into a cooler with a frozen ice pack and newspaper.

Grab samples are not shipped on Saturday and Sunday but samples are taken and stored in the fridge until after the Monday's grab, and then all 3 Daily Samples are shipped. The samples are sent via Buffalo Air Express daily (actually by overnight truck).

The coolers & ice packs are supplied by Exova. The lab must be contacted to let them know how many are required and they send them to Hay River via Buffalo Air Express.

Once a week a Weekly sample is taken and is analyzed for additional parameters. Total and Dissolved metal scans are done along with ammonia, TSS and cyanide. There are 5 bottles to be filled; 250 ml for Dissolved metals, 250 ml for Total metals, 250 ml Nutrient (Ammonia-N) preserved with sulphuric acid, small cyanide bottle preserved with sodium hydroxide NaOH and a 500 ml Routine for pH and TSS. The Chain of Custody is completed with the additional parameters (example Appendix C5).

Note: When a Weekly Sample is taken it is not required to take a Daily Sample.

When samples are taken the Sample Shipment Log (Appendix C6) must be updated. When analytical results are received from the lab the Commercial Lab Assays form and Lab and Field Assays form (Appendix C7) must be updated. The results should be compared to the Hach meter for Zn and to the Turbidity Meter for TSS to ensure the field meters are close.

12.9. Daily Report

The Daily Operating Log must be completed. Record ph (at culvert and data logger), and flow, lime flow, Hach readings, Turbidity readings and when samples are taken. Complete all the other boxes in the report. In particular record any unusual events that impacted the treatment process during the day. For example equipment failures, high winds, etc.

Update the Treated Water Discharge Volume report daily.

12.10. Equipment Lubrication and Maintenance

Generator:
Change oil every 100 hours with 15w40 oil. Clean oil filter every 200 hours and check air filer. Change or clean fuel filter. Check water level in battery. Remove battery when storing generator.

Pump/Blower Unit:
Engine: Oil change every 500 hours. Check the Air filters and fuel filters every 500 hours.
Lime Pump: Grease every day after shut down. Check the packing throughout the day and adjust it so there is a small drip. Change the packing as needed.
Clutch: Grease clutch every day after shut down (minimum 50 hours).
Blower: Grease every 500 hours. Change Oil every 3000 to 4000 hours.

13. Shutdown

13.1. Emptying the Lime Silo

The water treatment will end either when the Main Pond level is at 3.6' or the lime runs out. If the process is stopped and there is still lime in the silo then it is mixed and then discharged into the Main pond. All the fire hoses are connected together and strung out on the dyke and the lime slurry is poured into the pond. The lime must be dumped as far away from the culvert as possible. Ideally the lime should flow into the deepest part of the pool so that wind action won't stir up the lime.

13.2. Cleaning Lime Pump and Hoses

Before dismantling the lime hoses flush the pump and lines using the 2" water pump to prevent build-up and plugging next year.

13.3. Winterizing and Storage of Equipment

Remove valves and flow meter equipment from siphons. Return data logger to Kimberley for downloading and servicing. The siphon lines remain in place.

When the water treatment is complete the equipment is dismantled and stored in Hay River. The auger and lower part of ladder are removed from the lime silo and the hatches locked.

At the end of the contract all equipment that has a build up of lime gets cleaned with water & 10% acid. Everything on site is cleaned. All wood and the burning barrel is driven to our stash close by (near the end of the road on the East Dyke). The silo is rinsed out and locked up.

The engine on the Pump/Blower unit is winterized at a local shop before storing in a shipping container at South Mackenzie Storage.

The Lab trailer is stored beside the two containers at South Mackenzie Storage.

All the smaller equipment such as the generator, water pump, hoses, lime auger, Jet mixer, electrical cables etc. are stored in the second shipping container.

Teck

Pine Point Mine Tailings Impoundment Area

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APPENDIX A

A1: Spill Reporting Form

A2: List of Typical Spill Response Equipment

NT-NU SPILL REPORT

OIL, GASOLINE, CHEMICALS AND OTHER HAZARDOUS MATERIALS

NT-NU 24-HOUR SPILL REPORT LINE
TEL: (867) 920-8130
FAX: (867) 873-6924
EMAIL: spills@gov.nt.ca

REPORT LINE USE ONLY

A	REPORT DATE: MONTH – DAY – YEAR	REPORT TIME	☐ ORIGINAL SPILL REPORT, OR ☐ UPDATE # _____ TO THE ORIGINAL SPILL REPORT	REPORT NUMBER ____-_____
B	OCCURRENCE DATE: MONTH – DAY – YEAR	OCCURRENCE TIME		
C	LAND USE PERMIT NUMBER (IF APPLICABLE)	WATER LICENCE NUMBER (IF APPLICABLE)		
D	GEOGRAPHIC PLACE NAME OR DISTANCE AND DIRECTION FROM NAMED LOCATION	REGION ☐ NWT ☐ NUNAVUT ☐ ADJACENT JURISDICTION OR OCEAN		
E	LATITUDE DEGREES MINUTES SECONDS	LONGITUDE DEGREES MINUTES SECONDS		
F	RESPONSIBLE PARTY OR VESSEL NAME	RESPONSIBLE PARTY ADDRESS OR OFFICE LOCATION		
G	ANY CONTRACTOR INVOLVED	CONTRACTOR ADDRESS OR OFFICE LOCATION		
H	PRODUCT SPILLED	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER	
	SECOND PRODUCT SPILLED (IF APPLICABLE)	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER	
I	SPILL SOURCE	SPILL CAUSE	AREA OF CONTAMINATION IN SQUARE METRES	
J	FACTORS AFFECTING SPILL OR RECOVERY	DESCRIBE ANY ASSISTANCE REQUIRED	HAZARDS TO PERSONS, PROPERTY OR EQUIPMENT	
K	ADDITIONAL INFORMATION, COMMENTS, ACTIONS PROPOSED OR TAKEN TO CONTAIN, RECOVER OR DISPOSE OF SPILLED PRODUCT AND CONTAMINATED MATERIALS			

L	REPORTED TO SPILL LINE BY	POSITION	EMPLOYER	LOCATION CALLING FROM	TELEPHONE
M	ANY ALTERNATE CONTACT	POSITION	EMPLOYER	ALTERNATE CONTACT LOCATION	ALTERNATE TELEPHONE

REPORT LINE USE ONLY

N	RECEIVED AT SPILL LINE BY	POSITION STATION OPERATOR	EMPLOYER	LOCATION CALLED YELLOWKNIFE, NT	REPORT LINE NUMBER (867) 920-8130

LEAD AGENCY ☐ EC ☐ CCG ☐ GNWT ☐ GN ☐ ILA ☐ INAC ☐ NEB ☐ TC	SIGNIFICANCE ☐ MINOR ☐ MAJOR ☐ UNKNOWN	FILE STATUS ☐ OPEN ☐ CLOSED

AGENCY	CONTACT NAME	CONTACT TIME	REMARKS
LEAD AGENCY			
FIRST SUPPORT AGENCY			
SECOND SUPPORT AGENCY			
THIRD SUPPORT AGENCY			

A2: List of Typical Response Equipment

- **Absorbents** (For Petroleum Hydrocarbon (Fuels, Lubricants, and Solvents) and Wastewater)
  - Booms
  - Sheets
  - Towels
  - Absorbent granules

- **Contaminated Soils Recovery Tools**
  - Shovels
  - Picks
  - Excavators
  - Loaders
  - Trucks

- **Liquid Recovery Tools**
  - Pumps
  - Containers
  - Vacuum/Eductor Truck

- **Fire Suppression Equipment**
  - Fire Extinguishers for different material types

- **Personal Safety Equipment**
  - Protective Clothing
  - Eye Protection
  - Breathing Apparatus

Note to Plan User:

This is by no means an exhaustive list of materials and tools that can be assembled and used for spill response.

More information on spill response equipment and equipment suppliers can be found on the Internet. Supplies of this sort of equipment and material can also be found in Hay River, Fort Smith or Yellowknife and other communities in the Northwest Territories.

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APPENDIX B1

MSDS FOR HYDRATED LIME

GRAYMONT

MATERIAL SAFETY DATA SHEET

SECTION I - CHEMICAL PRODUCT AND COMPANY INFORMATION

Product Name: **HIGH CALCIUM HYDRATED LIME**	**WHMIS – CLASSIFICATION: D2A / D2B: MATERIALS CAUSING OTHER TOXIC EFFECTS E: CORROSIVE MATERIAL**

MANUFACTURER'S AND SUPPLIER'S NAME:

GRAYMONT (NB) INC	4634, Route 880, Havelock, New Brunswick, E4Z 5K8.
GRAYMONT (QC) INC.	25, rue De Lauzon, Boucherville (Québec), J4B 1E7.
GRAYMONT (PA) INC.	965, East College avenue, Pleasant Gap, PA 16823
GRAYMONT (WESTERN CANADA) INC.	190 – 3025, 12 Street N.E., Calgary, Alberta, T2E 7J2
GRAYMONT (WESTERN US) INC.	3950 South, 700 East, Suite 301, Salt Lake City, Utah 84107

EMERGENCY TEL. No.: (613) 996 – 6666 CANUTEC (Canada) (800) 424 – 9300 CHEMTREC (US)

Chemical Name	Chemical Family	Chemical Formula
Calcium hydroxide	**Alkaline earth hydroxide**	**Complex mixture - mostly $Ca(OH)_2$**
Molecular Weight	Trade Name and Synonyms	Material Use
$Ca(OH)_2$ = 74.096	**Hydrated Lime, Lime, Slaked lime, Lime Putty, Lime Slurry, Milk of Lime, Calcium Hydroxide**	**Neutralization, Flocculation, Stabilization, absorption**

SECTION II - COMPOSITION AND INFORMATION ON INGREDIENTS

Hazardous Ingredients	Approximate Concentration (% by weight)	C.A.S. Number	Exposure limits (mg/m^3)					
			OSHA PEL	ACGIH TLV	RSST VEMP	MSHA PEL (Note 2)	NIOSH REL	NIOSH IDLH
(Complex Mixture)	**(% by weight)**		**(TWA) 8/40h**	**(TWA) 8/40h**	**(TWA) 8/40h**	**(TWA) 8/40h**	**(TWA) 10/40h**	
Calcium hydroxide	**92 to 100**	**1305-62-0**	**15 (tot dust) 5 resp dust**	**5**	**5**	**5**	**5**	**N/A**
Crystalline Silica, Quartz	**0.1 to 1**	**14808-60-7**	**10/(%SiO_2)+2 respirable silica dust**	**0.025 respirable silica dust**	**0.1 respirable silica dust**	**10/(%SiO_2)+2 respirable silica dust**	**0.05 respirable free silica**	**50**
Crystalline Silica, Quartz	**0 to 0.1 (Note 1)**	**14808-60-7**	**10/(%SiO2)+2 respirable silica dust**	**0.025 respirable silica dust**	**0.1 respirable silica dust**	**10/(%SiO2)+2 (respirable silica dust)**	**0.05 respirable free silica**	**50**

(**Note 1**): Concentration of crystalline silica in a series of lime products will vary from source to source. It was not detected on some samples (< 0.1% w/w). Therefore two ranges are being disclosed. **(Note 2)**: ACGIH TLV Version 1973 has been adopted by the Mine Safety Health Administration (MSHA) as the regulatory Exposure Standard.

SECTION III - PHYSICAL AND CHEMICAL DATA

Physical State Gas ☐ Liquid ☐ Solid ☑	Odor and Appearance **Slight earthy odor – Fine white powder**		Odor Threshold (p.p.m.) **Not applicable**	Specific Gravity **2.3 – 2.4**
Vapor Pressure (mm) **Not applicable**	Vapor Density (Air = 1) **Not applicable**	Evaporation Rate **Not applicable**	Boiling Point (°C) **Not applicable**	Melting Point (°C) **Not applicable**
Solubility in Water (20°C) **0.165g/100g Sat.soln**	Volatiles (% by volume) **Not applicable**	pH (25 °C) **Sat. soln $Ca(OH)_2$ 12.45**	Bulk Density (kg/m^3) **320 - 690**	Coefficient of water/oil distribution **Not applicable**

SECTION IV - FIRE OR EXPLOSION HAZARD DATA

Flammability

Yes ☐ No ☑ If yes, under which conditions?

Extinguishing Media

Calcium Hydroxide does not burn. Use extinguishing media appropriate to surrounding fire conditions.

Special Fire Fighting Procedures

Not applicable

Flash point (° C) and Method	Upper flammable limit (% by volume)	Lower flammable limit (% by volume)
Not applicable	**Not applicable**	**Not applicable**
Auto Ignition Temperature (°C)	TDG Flammability Classification	Hazardous Combustion Products
Not applicable	**Non-flammable**	**None**

Dangerous Combustion Products **None**

EXPLOSION DATA

Sensitivity to Chemical Impact	Rate of Burning	Explosive Power	Sensitivity to Static Discharge
Not applicable	**Not applicable**	**Not applicable**	**Not applicable**

SECTION V - REACTIVITY DATA

Chemical Stability		
Yes ☐ No ☑	If no, under which conditions?	**Absorbs carbon dioxide in the air to form calcium carbonate.**
Incompatibility to other substances		
Yes ☑ No ☐	If so, which ones?	**Boron tri-fluoride, chlorine tri-fluoride, ethanol, fluorine, hydrogen fluoride, phosphorus pentoxide; and acids (violent reaction with generating heat and possible explosion in confined area).**
Reactivity		
Yes ☑ No ☐	If so, under which conditions?	**Reacts violently with strong acids. Reacts chemically with acids and many other compounds and chemical elements to form calcium based compounds. Explosive when mixed with nitro organic compounds.**
Hazardous Decomposition Products		**Thermal decomposition at 540°C will produce calcium oxide and water.**
Hazardous Polymerization Products		**Will not occur.**

SECTION VI - TOXICOLOGICAL PROPERTIES

Route of Entry

☑ Skin Contact	☐ Skin Absorption	☑ Eye Contact	☑ Acute Inhalation	☐ Chronic Inhalation	☑ Ingestion

Effects of Acute Exposure to Product

Skin	**Severe irritation of mucous and skin, removes natural skin oils.**
Eyes	**Severe eye irritation, intense watering of the eyes, possible lesions, possible blindness when exposed for prolonged period. Eye-Rabbit-10mg/ 24 h – Severe.**
Inhalation	**If inhaled in form of dust, irritation of breathing passages, cough, sneezing.**
Ingestion	**If ingested: pain, vomiting blood, diarrhea, collapse, drop in blood pressure (indicates perforation of esophagus or stomach).**

Effects of Chronic Exposure to Product:

Contact dermatitis. Following repeated or prolonged contact, this product can cause redness, desquamation and fissures. This product may contain trace amounts of crystalline silica. Excessive inhalation of respirable crystalline silica dust may result in respiratory disease, including silicosis, pneumoconiosis and pulmonary fibrosis.

LD_{50} of Product (Specify Species and Route)	Irritancy of Product	Exposure limits of Product
(Food grade $Ca(OH)_2$: 7340mg/kg) (Rats, ingestion)	**Severe to moist tissues**	**Unavailable**
LC_{50} of Product (Specify Species)	Sensitization to Product	Synergistic materials
Unavailable	**None**	**None reported**

SECTION VI - TOXICOLOGICAL PROPERTIES (Cont'd)

☑ Carcinogenicity ☐ Reproductive effects ☐ Tératogenicity ☐ Mutagenicity

Calcium Hydroxide is not listed as a carcinogen by ACGIH, MSHA, OSHA, NTP or IARC. It may, however, contain trace amounts of Crystalline Silica listed carcinogens by these organizations.

Crystalline Silica, which inhaled in the form of quartz or crystobalite from occupational sources, is classified by IARC as (Group 1) carcinogenic to humans.

Silica, crystalline (Airborne particles of respirable size) is regulated under California's Safe Drinking Water and Toxic Enforcement Act of 1986. (Proposition 65).

NIOSH considers crystalline silica to be potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

NTP lists respirable Crystalline Silica as known to be human carcinogens based on sufficient evidence of carcinogenicity in humans.

ACGIH lists respirable Crystalline Silica (quartz) as suspected human carcinogen (A-2).

RSST lists respirable Crystalline Silica (quartz) as suspected human carcinogen.

SECTION VII - PREVENTIVE MEASURES

Personal Protective Equipment (PPE) **Wear clean, dry gloves, full length pants over boots, long sleeved shirt buttoned at the neck, head protection and approved eye protection selected for the working conditions.**

Gloves (Specify)	Respiratory (Specify)	Eyes (Specify)	Footwear (Specify)
Gauntlets Cuff style	**NIOSH approved (N/R/P95) dust respirator**	**Tight fitting goggles with side shields. Do not wear contact lenses when handling this chemical.**	**Resistant to caustics**

Clothing (Specify)	Other (Specify)
Fully covering skin	**Evaluate degree of exposure and use PPE if necessary. After handling lime, employees must shower. If exposed daily, use oil, Vaseline, silicone base creme etc. to protect exposed skin, particularly neck, face and wrists.**

Engineering Controls (e.g. ventilation, enclosed process, specify)

Enclose dust sources; use exhaust ventilation (dust collector) at handling points, keep levels below Max. Concentration Permitted.

Leak and Spill Procedure

Limit access to trained personnel. Use industrial vacuums for large spills. Ventilate area.

SECTION VII - PREVENTIVE MEASURES (Cont'd)

Waste Disposal

Transport to disposal area or bury. Review Federal, Provincial and local Environmental regulations.

Handling Procedures and Equipment

Avoid skin and eye contact. Minimize dust generation. Wear protective goggles and in cases of insufficient ventilation, use anti-dust mask. An eye wash station and safety shower should be readily available where this material or its water dispersions are used. Contact lenses should not be worn when working with this chemical.

Storage Requirements

Keep tightly closed containers in a cool, dry and well-ventilated area, away from acids. Keep out of reach of children.

Special Shipment Information

Calcium Hydroxide is neither regulated by the Transportation of Dangerous Goods (TDG) Regulations (Canada) nor by the Hazardous Materials Regulations (USA).

SECTION VIII - FIRST AID MEASURES

Skin

Carefully and gently brush the contaminated body surfaces in order to remove all traces of lime. Use a brush, cloth or gloves. Remove all lime-contaminated clothing. Rinse contaminated area with lukewarm water for 15 to 20 minutes. Consult a physician if exposed area is large or if irritation persists.

Eyes

Immediately rinse contaminated eye(s) with gently running lukewarm water (saline solution is preferred) for 15 to 20 minutes. In the case of an embedded particle in the eye, or chemical burn, as assessed by first aid trained personnel, contact a physician.

Inhalation

Move source of dust or move victim to fresh air. Obtain medical attention immediately. If victim does not breathe, give artificial respiration.

Ingestion

If victim is conscious, give 300 ml (10 oz) of water, followed by diluted vinegar (1 part vinegar, 2 parts water) or fruit juice to neutralize the alkali. Do not induce vomiting. Contact a physician immediately.

General Advise

Consult a physician for all exposures except minor instances of inhalation.

SECTION IX - REGULATORY INFORMATION

Superfund Amendments and Reauthorization Act of 1986 (SARA Title III). / The Emergency Planning and "Community Right-to-Know" Act (EPCRA). / Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). / Resource Conservation and Recovery Act (**RCRA**).

Component Calcium Hydroxide has been reviewed against the following regulatory listings:

- **SARA Section 302 – Emergency Planning Notification. Extremely Hazardous Substances (EHS) List and Threshold Planning Quantity (TPQ). (40 CFR, Part 355, Section 30) : Not listed.**
- **SARA Section 304 – Emergency Release Notification. Extremely Hazardous Substances (EHS) and Reportable Quantity (RQ) List. (40 CFR, Part 355, Section 40) : Not listed.**
- **SARA Section 311/312 – Hazard Categories (40 CFR, Part 370) : This product is regulated under CFR 1910.1200 (OSHA Hazard Communication) as Immediate (Acute) Health Hazards – Irritant.**
- **SARA Section 313 – Toxics Release Inventory (TRI). Toxic Chemical List (40 CFR, Part 372). Not listed.**
- **CERCLA – Hazardous Substance (40 CFR, Part 302): Not listed in Table 302.4.**
- **RCRA – Hazardous Waste Number (40 CFR, Part 261, Subpart D): Not listed.**
- **RCRA – Hazardous Waste Classification (40 CFR, Part 261, Subpart C): Not classified.**

CWA 311. - Clean Water Act List of Hazardous Substances.

Calcium Hydroxide has been withdrawn from the Clean Water Act (CWA) list of hazardous substances. (11/13/79) (44FR65400)

California Proposition 65.

Component Calcium Hydroxide does not appear on the above regulatory listing. This product may contain small amounts of crystalline silica. Silica, crystalline (Airborne particles of respirable size) is regulated under California's Safe Drinking Water and Toxic Enforcement Act of 1986. (Proposition 65)

Transportation - Hazardous Materials Regulations (USA) & Transportation of Dangerous Goods (TDG) Regulations (Can).

Calcium Hydroxide does not appear on the above regulatory listings

Toxic Substances Control Act (TSCA).

All naturally occurring components of this product are automatically included in the USEPA TSCA Inventory List per 40 CFR 710.4 (b). All other components are one the USEPA TSCA Inventory List. Calcium Hydroxide is exempt from reporting under the inventory update rule.

Canadian Environmental Protection Act (CEPA) – Substances Lists (DSL/NDSL).

Calcium Hydroxide appears on the Domestic Substances List (DSL).

ANSI/NSF 60 - Drinking Water Treatment Additives.

Hydrated Lime has been investigated with respect to elements identified by EPA as toxic and it has been classified for use in direct contact with drinking water. (in accordance with Standard ANSI/NSF 60). For a list of classified products, refer to Underwriters Laboratories Inc.'s Online Certifications Directory.

FDA - U.S. Food and Drug Administration, Department of Health and Human Services.

Calcium Hydroxide has been determined as "Generally Recognized As Safe" (GRAS) by FDA. See 21CFR184.1205. (CFR Title 21 Part 184 - - Direct food substances affirmed as generally recognized as safe).

SECTION X - OTHER INFORMATION

Hazardous Materials Identification System (U.S.)

National Fire Protection Association (U.S.)

WHMIS – Classification:

"E" Corrosive Materials.

Symbol:

WHMIS – Classification:

"D2A" and "D2B" Materials causing other toxic effects.

Symbol:

Additional Information/Comments:

The technical data contained herein is given as information only and is believed to be reliable. GRAYMONT makes no guarantee of results and assumes no obligation or liability in connection therewith.

Sources Used:

NFPA, NLA, TDG, CSST, RSST, (LSRO-FASEB), Hazardous Products Act, Environment Canada, Enviroguide, OSHA, ACGIH, IARC, NIOSH, CFR, NTP, HSDB, EPA SRS, Chemistry and Technology of Lime and Limestone (John Wiley and Sons, Inc.), Lime and Limestone (WILEY-VCH).

SECTION XI - PREPARATION INFORMATION

Prepared by:	Telephone number:	Date :
GRAYMONT (QC) INC. **Technical Services**	**(450) 449-2262**	**April 2006**

An electronic version of this MSDS is available at: www.graymont.com under the PRODUCTS section.

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APPENDIX B2

SPECIFIC SPILL INFORMATION AND RESPONSE FOR DIESEL (MSDS INCLUDED)

Diesel

CAS# 68334-30-5

Other Names: Diesel fuel, diesel oil, fuel oil.

Physical Traits: Clear colorless or dyed liquid.

Special Precautions:

- Combustible/flammable liquid.
- May contain PAHs that may be carcinogenic.
- Generally regarded as being of low toxicity unless exposure is repeated and/or prolonged.
- Skin and respiratory tract irritant.

Incompatible Materials:

- Strong acids
- Oxidizing agents
- Halogens

Personal Protective Equipment / Response Equipment

Level D

Coveralls (disposable); gloves and boots made from neoprene or butyl rubber; safety glasses or goggles; hardhat. Additional equipment at discretion of Incident Commander.

Cleanup Procedures and Options:

- Keep unprotected personnel upwind of spill.
- Stop spill at the source, contain in smallest possible area.
- Protect waterways.

If on land and it is safe to do so:

1. Stop or reduce discharge if safe to do so by plugging, righting, adjusting valves or other suitable method.
2. Contain spill by diking with earth, snow or ice or other barrier, possible trenching or creating a lined sump down gradient from the spill source.
3. Ensure that you have reported the spill.
4. Remove fuel from containment area with pumps, vacuum equipment and place in drums or empty storage tanks, "TIDY" tanks or bladders.
5. Absorb residual liquid on natural or synthetic absorbents (e.g. 3M products).
6. Remove contaminated soils in the spill to an appropriate disposal site if spill site is located near water supply or stream/river course or for aesthetic reasons.
7. Dispose of contaminated fuel by recycling or incineration. In site, incineration may be possible if permission granted from environmental and forestry officials.

If in water and if safe to do so:

1. Stop, or reduce discharge if safe to do so by plugging, righting, adjusting valves, or other suitable method. This material floats on water and is toxic to aquatic life in low concentrations.
2. If possible, contain discharge by booming using commercial boom material, logs or other material at hand.
3. If in rapidly flowing water, direct to quieter backwater using booms to deflect material.
4. Ensure that you have reported the spill.
5. Remove from water by skimming, using absorbents, and collect in suitable container (tanks, drums, plastic lined depression in ground or snow).
6. Dispose by recycling or incineration, if conditions are suitable and regulatory authorities grant permission.

If on snow and it is safe to do so:

1. Stop, or reduce discharge if safe to do so by plugging, righting, adjusting valves, or other suitable method.
2. Compact the snow around the perimeter of the spill area.
3. Construct and compact snow dams.
4. Locate the low point of the spill area, then clear channels in the snow to allow material not absorbed to flow into the low area.
5. Once collected in the low area, shovel the spilled material into containers or pick it up with mobile heavy equipment, then transport it to an approved disposal or recovery site.

Material Safety Data Sheet

Trade Name: DIESEL FUEL **Manufacturer:** ESSO - IMPERIAL OIL

MSDS Code: 00826 **Type of Chemical:** GAS

Notes:

1. PRODUCT INFORMATION

Product identifier: MIDDLE DISTILLATE
ESSO MARINE GAS OIL (DYED OR CLEAR)
ESSO RAILROAD DIESEL (DYED OR CLEAR)
HEATING OIL (DYED OR CLEAR)
DIESEL (DYED OR CLEAR)
DIESEL QUALITY FURNACE FUEL (DYED OR CLEAR)
DIESEL QUALITY HEATING OIL (DYED OR CLEAR)
ESSO DIESEL (DYED OR CLEAR)
ESSO DIESEL QUALITY COMMERCIAL FUEL (DYED OR CLEAR)
ESSO DIESEL QUALITY FURNACE FUEL
ESSO DIESEL QUALITY HEATING OIL
ESSO FURNACE FUEL (DYED OR CLEAR)
ESSO HEATING OIL (DYED OR CLEAR)
ESSO MARINE DIESEL FUEL (DYED OR CLEAR)
ESSO RAILROAD DIESEL FUEL #3 (DYED OR CLEAR)
ESSO TOBACCO CURING OIL
FUEL OIL 75
FUEL OIL 76
DIESEL MARINE (DYED OR CLEAR)
DIESEL MARINE GAS OIL (DYED OR CLEAR)
FURNACE (DYED OR CLEAR)
DIESEL MARINE – POUR DEPRESSED (DYED OR CLEAR)
NO.2 FUEL OIL
NAVAL FUEL OIL 3-GP – 11M (DYED)
ESSO DIESEL FUEL LS
DIESEL LOW SULPHUR (DYED OR CLEAR)
NO. 2 FUEL OIL FOR EXPORT
DIESEL FOR EXPORT (DYED OR CLEAR)
FURNACE TOBACCO CURING OIL
DIESEL NAVAL 3GP-11 (DYED OR CLEAR)
DIESEL NAVAL 3GP – 15 (DYED OR CLEAR)
DIESEL LOW SULPHUR RAIL (DYED OR CLEAR)
DIESEL LOW SULPHUR DYED EP
DIESEL RAIL (DYED OR CLEAR)
DIESEL RAIL #3 (DYED OR CLEAR)
DIESEL RAIL #3 (DYED OR CLEAR)
DIESEL LOW SULPHUR <032> (DYED OR CLEAR)
FURNACE URBAN (DYED OR CLEAR)
DIESEL (032) (DYED OR CLEAR)
DIESEL LOW SULPHUR (EXP DYED)
FURNACE FUEL <032> DYED

DIESEL LOW SULPHUR
MARINE GAS OIL

Application and use:
Multi-purpose fuel
Product description:
A complex mixture of aliphatic, olefinic, naphthenic and aromatic hydrocarbons.

REGULATORY CLASSIFICATION

WHMIS:
Class B, Division 3: Combustible Liquids
Class D, Division 2: Subdivision B: Toxic Material

CEPA: CANADIAN ENVIRONMENTAL PROTECTION ACT
All components of this product are either on the Domestic Substances List (DSL) or are exempt.

TDG INFORMATION(RAIL/ROAD):
Shipping Name: FUEL OIL
Class: 3
Packing Group: III
PIN Number: UN1202

Please be aware that other regulations may apply.

TELEPHONE NUMBERS MANUFACTURER / SUPPLIER:
EMERGENCY 24 HOUR: (519) 339-2145 IMPERIAL OIL
TECHNICAL INFO: (800) 268-3183 Products Division
111 St. Clair Avenue West
Toronto, Ontario
M5W 1K3
(416) 968-4441

2. REGULATED COMPONENTS

The following components are defined in accordance with sub-paragraph 13(a)(I) or (iv) or paragraph 14(a) of the Hazardous Products Act:
NAME % CAS #
Fuel Oil No. 2 >99.9 v/v 68476-30-2

3. TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Liquid
Specific gravity: 0.820 to 0.900 at 15 deg C
Viscosity: 1.30 cSt at 40 deg C
Vapour density: 4
Boiling point: 150 to 370 deg C
Evaporation rate: <1 (1=n-butylacetate)
Solubility in water: negligible
Freezing/pour point: -4 deg C –39 (range)
Odour Threshold: not available
Vapour Pressure: 4 kPa at 38 deg C
Appearance/odour: white or pale yellow liquid, petroleum odour.

4. HEALTH HAZARD INFORMATION

NATURE OF HAZARD

INHALATION:
Negligible hazard at normal temperatures (up to 38 deg C).
High vapour concentrations are irritating to the eyes, nose, throat and lungs.
May cause headaches and dizziness. May be anesthetic and may cause other central nervous system effects. Avoid breathing vapours or mists.

EYE CONTACT:
Slightly irritating, but will not injure eye tissue.

SKIN CONTACT:
Low toxicity, irritating.

INGESTION:
Low toxicity.
Small amounts of this liquid drawn into the lungs from swallowing or vomiting may cause severe health effects (e.g. bronchopneumonia or pulmonary edema)

CHRONIC:
Lifetime skin painting tests indicate that materials of similar composition have produced skin cancer in experimental animals. The relationship of these results to humans has not been fully established.

ACUTE TOXICITY DATA:
Based on animal testing data from similar materials and products, the acute toxicity of this product is expected to be:
ORAL: LD50 > 5000 mg/kg (RAT)
DERMAL: LD50 > 2000 mg/kg (RABBIT)
INHALATION: LC50 > 2500 mg/m3 (RAT)

OCCUPATIONAL EXPOSURE LIMIT:
Manufacturer recommends: 100 ppm based on composition
Local regulated limits may vary.

5. FIRST AID MEASURES

INHALATION:
In emergency situations use proper respiratory protection to immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.

EYE CONTACT:
Flush eyes with large amounts of water until irritation subsides. If irritation persists, get medical attention.

SKIN CONTACT:
Immediately flush with large amounts of water. Use soap if available. Remove contaminated clothing, including shoes, after flushing has begun. If irritation persists, seek medical attention.

INGESTION:
DO NOT induce vomiting since it is important that no amount of the material should enter the lungs (aspiration). Keep at rest. Get prompt medical attention.

6. PREVENTITIVE AND CORRECTIVE MEASURES

PERSONAL PROTECTION:
The selection of personal protective equipment varies, depending upon conditions of use. In open systems where contact is likely, wear safety goggles, chemical resistant overalls, and chemically impervious gloves.
Where concentrations in air may exceed the occupational exposure limits given in Section 4 and where engineering, work practices or other means of exposure reduction are not adequate, approved respirators may be necessary to prevent overexposure by inhalation.

ENGINEERING CONTROLS:
The use of local exhaust ventilation is recommended to control emissions near the source. Laboratory samples should be handled in a fumehood. Provide mechanical ventilation of confined spaces.

HANDLING, STORAGE AND SHIPPING:
Keep containers closed. Handle and open containers with care. Store in a cool, well ventilated place away from incompatible materials. In keeping with good personal hygiene practices, wash hands thoroughly after handling the material.
Do not handle or store near an open flame, sources of heat, or sources of ignition.
Material will accumulate static charges which may cause a spark. Static charge build-up could become an ignition source. Use proper relaxation and grounding procedures.
Empty containers may contain product residue. Do not pressurize, cut, heat, or weld empty containers. Do not reuse empty containers without commercial cleaning or reconditioning.

LAND SPILL:
Eliminate source of ignition. Keep public away. Prevent additional discharge of material, if possible to do so without hazard. Prevent spills from entering sewers, water courses or low areas. Contain spilled liquid with sand or earth. Do not use combustible materials such as sawdust. Recover by pumping (use an explosion proof motor or hand pump), or by using a suitable absorbent.
Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

WATER SPILL:
Remove from surface by skimming or with suitable absorbents, if allowed by local authorities and environmental agencies, sinking and / or suitable dispersants may be used in unconfined waters. Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

7. FIRE AND EXPLOSION HAZARD

Flashpoint and method: >40 deg C PMCT ASTM D93
Autoignition: NA Flammable Limits: LEL: 0.7% UEL: 6.5%

GENERAL HAZARDS:
Combustible liquid: may form combustible mixtures at or above the flash point.
Toxic gases will form upon combustion.
Static Discharge: material may accumulate static charges which may cause a fire.

FIRE FIGHTING:
Use water spray to cool fire exposed surfaces and to protect personnel.
Shut off fuel to fire.
Use foam, dry chemical or water spray to extinguish fire.

Respiratory and eye protection required for fire fighting personnel.
Avoid spraying water directly into storage containers due to danger f boilover.
A self contained breathing apparatus (SCBA) should be used for all indoor fires and any significant outdoor fires. For small outdoor fires, which may easily be extinguished with a portable fire extinguisher, use of an SCBA may not be required.

HAZARDOUS COMBUSTION PRODUCTS:
Smoke, carbon monoxide, carbon dioxide and traces of oxides of sulphur.

8. REACTIVITY DATA

STABILITY: This product is stable. Hazardous polymerization will not occur.

INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID: strong oxidizing agents.

HAZARDOUS DECOMPOSITION: None.

9. NOTES

All components of this product are listed on the US TSCA inventory.
Three year WHMIS review.
This MSDS has been revised in Section 3.

10. PREPARATION

Prepared by: Lubricants & Specialties
IMPERIAL OIL
Products Division
111 St. Clair Avenue West
Toronto, Ontario
M5W 1K3
(800) 268-3183

CAUTION:
The information contained herein relates only to this product or material and may not be valid when used in combination with any other product or material or in any process. If the product is not to be used for a purpose or under conditions which are normal or reasonably forseeable. This information cannot be relied upon as complete or applicable. For greater certainty. Uses other than those described in Section 1 must be reviewed with the supplier. The information herein is based on the information available at he indicated date of preparation. This MSDS is for the use of Imperial Oil customers and their employees and agents only. Any further distribution of this MSDS by Imperial Oil customers is prohibited without the written consent of Imperial Oil.

Teck

Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX B3

SPECIFIC SPILL INFORMATION AND RESPONSE FOR GASOLINE (MSDS INCLUDED)

Gasoline

CAS# 86290-81-5

Other Names: Gasoline of all grades.

Physical Traits: Clear or coloured liquid with a strong hydrocarbon odour.

Special Precautions:

- Combustible/flammable liquid.
- Moderately toxic by inhalation, avoid prolonged exposure to fumes.
- Harmful or fatal if swallowed.

Incompatible Materials:

- Incompatible or can react with strong oxidizers.

Personal Protective Equipment / Response Equipment

Impermeable protective gloves (i.e.) nitrile) should be worn during routine handling of gasoline. Respiratory protection is not normally required, however, if working in enclosed areas or at high temperatures, conditions may warrant NIOSH approved respiratory equipment. If splashing is likely a face shield and goggles should be worn. Standard work clothing is sufficient when handling gasoline, as long as fastidious cleanliness practices are employed.

Cleanup Procedures and Options:

- Keep unprotected personnel upwind of spill.
- Stop spill at the source, contain in smallest possible area.
- Protect waterways.

If on land and it is safe to do so:

1. Stop, or reduce discharge if safe to do so by plugging, righting, adjusting valves or other suitable method.
2. Contain spill by diking with earth, snow and ice or other barrier, possible trenching or creating a lined sump down gradient from the spill source.
3. Ensure that you have reported the spill.
4. Remove fuel from containment area with pumps, vacuum equipment and place in appropriate containers. Ensure equipment intrinsically safe (does not have a source of ignition/spark).
5. Absorb residual liquid on natural or synthetic absorbents (e.g. 3M products).
6. Remove contaminated soils in the spill site to an appropriate disposal site if spill located near water supply or stream/river course or for aesthetic reasons.
7. Dispose of contaminated fuel by recycling or incineration. In situ, incineration may be possible if permission granted from environmental and forestry officials contacted through the Emergency Spill Response Line.

If in water and if safe to do so:

1. Stop or reduce discharge if safe to do so by plugging, righting, adjusting valves, or other suitable method. This material floats on water and is harmful to aquatic life.
2. If possible, contain discharge by booming using commercial boom material, logs, or other material at hand.
3. If in rapidly flowing water, direct to quieter backwater using booms to deflect material.
4. Ensure that you have reported the spill.
5. Remove from water by skimming, using absorbents, and collect in suitable container (tanks, drums, plastic lined depression in ground or snow).

NOTE: IN THE EVENT MATERIAL IS SPILLED DURING VERY WARM WEATHER AND THERE IS DANGER OF FIRE DUE TO FUMES, DO NOT ATTEMPT TO CONTAIN PRODUCT ON WATER. ALLOW PRODUCT TO DISPERSE AND EVAPORATE.

6. Dispose absorbents by recycling or incineration if conditions are suitable and after consultation with environmental authorities and/or forestry officials contacted through the Emergency Spill Response Line.

If on snow and it is safe to do so:

1. Stop, or reduce discharge if safe to do so by plugging, righting, adjusting valves, or other suitable method.
2. Compact the snow around the perimeter of the spill area.
3. Construct and compact snow dams.
4. Locate the low point of the spill area, then clear channels in the snow to allow material not absorbed to flow into the low area.
5. Once collected in the low area, shovel the spilled material into containers or pick it up with mobile heavy equipment, then transport it to an approved disposal or recovery site.

Material Safety Data Sheet

Trade Name: GASOLINE, UNLEADED **Manufacturer:** ESSO - IMPERIAL OIL

MSDS Code: 08522 **Type of Chemical:** GAS

Notes:
Material Safety Data Sheets

MSDS Number: 08522

1. PRODUCT INFORMATION

Product Identifier: UNLEADED GASOLINE
REGULAR UNLEADED
MIDGRADE UNLEADED
ESSO SUPER PREMIUM UNLEADED
PREMIUM UNLEADED
ESSO REGULAR UNLEADED
ESSO MIDGRADE UNLEADED
ESSO EXTRA MIDGRADE UNLEADED
ESSO PREMIUM UNLEADED
EXXON MIDGRADE UNLEADED
EXXON PREMIUM UNLEADED
INDOLENE GASOLINE
EXXON REGULAR UNLEADED
PREMIUM GASOLINE
ESSO EXTRA MIDGRADE GASOLINE
MIDGRADE GASOLINE
GASOLINE REGULAR UNLEADED
GASOLINE MIDGRADE UNLEADED MUL89 (DYED OR CLEAR)
GASOLINE REGULAR UNLEADED RUL87 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED PUL91 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED PUL92 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED SUL94
SUPERSUPREME 94 PREMIUM UNLEADED GASOLINE-MTBE
GASOLINE MIDGRADE UNLEADED MUL89 (P91/R87)
GASOLINE MIDGRADE UNLEADED MUL89 DCA (P92/R87)
REGULAR UNLEADED
MIDGRADE UNLEADED
ESSO SUPER PREMIUM UNLEADED
PREMIUM UNLEADED
ESSO REGULAR UNLEADED
ESSO MIDGRADE UNLEADED
ESSO EXTRA MIDGRADE UNLEADED
ESSO PREMIUM UNLEADED

EXXON MIDGRADE UNLEADED
EXXON PREMIUM UNLEADED
INDOLENE GASOLINE
EXXON REGULAR UNLEADED
PREMIUM GASOLINE
ESSO EXTRA MIDGRADE GASOLINE
MIDGRADE GASOLINE
GASOLINE REGULAR UNLEADED
GASOLINE MIDGRADE UNLEADED MUL89 (DYED OR CLEAR)
GASOLINE REGULAR UNLEADED RUL87 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED PUL91 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED PUL92 (DYED OR CLEAR)
GASOLINE PREMIUM UNLEADED SUL94
SUPERSUPREME 94 PREMIUM UNLEADED GASOLINE-MTBE
GASOLINE MIDGRADE UNLEADED MUL89 (P91/R87)
GASOLINE MIDGRADE UNLEADED MUL89 DCA (P92/R87)

Application and Use:
Motor gasoline fuel, for use in internal combustion engines only

Product Description:

A mixture of aliphatic and aromatic hydrocarbons and additives.

REGULATORY CLASSIFICATION

WHMIS:
Class D, Division 2, Subdivision A: Very Toxic Material.
Class B, Division 2: Flammable Liquids.

CEPA: CANADIAN ENVIRONMENTAL PROTECTION ACT
All components of this product are either on the Domestic Substances List (DSL) or are exempt.

TDG INFORMATION (RAIL/ROAD):

Shipping Name: Gasoline
Class: 3
Packing Group: II
PIN Number: UN1203
Marine Pollutant:P

Please be aware that other regulations may apply.

TELEPHONE NUMBERS MANUFACTURER/SUPPLIER:

Emergency 24 hr. (519) 339-2145 IMPERIAL OIL
Technical Info. (800) 268-3183 Products Division
111 St Clair Avenue West
Toronto, Ontario
M5W 1K3

(416) 968-4441

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2. REGULATED COMPONENTS

The following components are defined in accordance with sub-paragraph 13(a) (i) to (iv) or paragraph 14(a) of the Hazardous Products Act:

NAME % CAS #

Gasoline >99 V/V 8006-61-9 LD50>18ml/kg,orl,rat
LD50> 5ml/kg,skn,rbt

Methyl T-Butyl Ether 0-15 V/V 1634-04-4 LD50:3.9g/Kg,ing,rat
LD50:>10g/Kg,skn,rbt
LC50:142Mg/L,inh,rat

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3. TYPICAL PHYSICAL & CHEMICAL PROPERTIES

Physical State: Liquid
Specific gravity: not available
Viscosity: 0.80 cSt at 20 deg C
Vapour Density: 3.2
Boiling Point: 35 to 210 deg C
Evaporation rate: >10 (1= n-butylacetate)
Solubility in water: negligible
Freezing/Pour Point: -60 deg C less than
Odour Threshold: not available
Vapour Pressure: 76 kPa to 103 kPa at 38 deg C
Density: 0.73 g/cc at 15 deg C
Appearance/odour: Naturally occurring water white or pale yellow; may be dyed a variety of colours for tax or other purposes; petroleum odour.

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4. HEALTH HAZARD INFORMATION

NATURE OF HAZARD

INHALATION:

High vapour concentrations are irritating to the eyes, nose, throat and lungs; may cause headaches and dizziness; may be anesthetic and may cause other central nervous system effects.
Avoid breathing vapours or mists.

EYE CONTACT:

Slightly irritating, but will not injure eye tissue.

SKIN CONTACT:

Low toxicity.
Frequent or prolonged contact may irritate the skin and cause a skin rash (dermatitis).

INGESTION:

Low toxicity.
Small amounts of this liquid drawn into the lungs from swallowing or vomiting may cause severe health effects (e.g. bronchopneumonia or pulmonary edema).

CHRONIC:

The International Agency for Research on Cancer (IARC) has evaluated gasoline and found it to be a possible human carcinogen.
Contains benzene. Human health studies (epidemiology) indicate that prolonged and/or repeated overexposures to benzene may cause damage to the blood producing system and serious blood disorders, including leukemia.
Animal tests suggest that prolonged and/or repeated overexposures to benzene may damage the embryo/fetus. The relationship of these animal studies to humans has not been fully established.
Contains n-hexane. Prolonged and/or repeated exposures may cause damage to the peripheral nervous system (e.g. fingers, feet, arms etc.).
Methyl Tertiary Butyl Ether (MTBE) was tested for carcinogenicity, neurotoxicity, chronic, reproductive and developmental toxicity. The NOEL for all endpoints evaluated in three animal species was 400 ppm or greater. An increase in kidney tumors/damage and liver tumors was observed in animals exposed to high concentrations of MTBE. Some embryo/fetal toxicity and birth defects were observed in the offspring of pregnant mice exposed to maternally toxic doses of MTBE, however the offspring of exposed pregnant rabbits were unaffected. The significance of the animal findings at high exposures are not believed to be directly related to potential human health hazards in the workplace.

ACUTE TOXICITY DATA:

Based on animal testing data from similar materials and products, the acute toxicity of this product is expected to be:
Oral : LD50 > 18 ml/kg (Rat)
Dermal : LD50 > 5 ml/kg (Rabbit)

OCCUPATIONAL EXPOSURE LIMIT:

Manufacturer Recommends:
For gasoline, 300 mg/m3.
For Methyl-tert-Butyl Ether, 25 ppm (90 mg/m3) 8-hour TWA and 75 ppm (270 mg/m3) 15-minute STEL.

ACGIH recommends:
For Gasoline, ACGIH recommends a TWA of 300 ppm (890 mg/m3) and

categorizes it as an animal carcinogen.
For n-Hexane (skin), 50 ppm (176 mg/m3).
For Benzene, ACGIH recommends a TWA of 0.5 ppm (1.6 mg/m3), (skin), and categorizes it as a confirmed human carcinogen.
For Methyl-tert-Butyl Ether, ACGIH recommends a TLV of 40 ppm (144 mg/m3) an categorizes it as an animal carcinogen.

Local regulated limits may vary.

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5. FIRST AID MEASURES

INHALATION:

In emergency situations use proper respiratory protection to immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.

EYE CONTACT:

Flush eyes with large amounts of water until irritation subsides. If irritation persists, get medical attention.

SKIN CONTACT:

Flush with large amounts of water. Use soap if available.
Remove severely contaminated clothing (including shoes) and launder before reuse.
If irritation persists, seek medical attention.

INGESTION:

DO NOT induce vomiting since it is important that no amount of the material should enter the lungs (aspiration). Keep at rest. Get prompt medical attention.

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6. PREVENTIVE AND CORRECTIVE MEASURES

PERSONAL PROTECTION:

The selection of personal protective equipment varies, depending upon conditions of use.
In open systems where contact is likely, wear safety goggles, chemical-resistant overalls, and chemically impervious gloves.
Where only incidental contact is likely, wear safety glasses with side shields. No other special precautions are necessary provided skin/eye contact is avoided.
Where concentrations in air may exceed the occupational exposure limits given in Section 4 and where engineering, work practices or other means

of exposure reduction are not adequate, approved respirators may be necessary to prevent overexposure by inhalation.

ENGINEERING CONTROLS:

The use of local exhaust ventilation is recommended to control emissions near the source. Laboratory samples should be handled in a fumehood. Provide mechanical ventilation of confined spaces.
Use explosion-proof ventilation equipment.

HANDLING, STORAGE AND SHIPPING:

Keep containers closed. Handle and open containers with care.
In keeping with good personal hygiene practices, wash hands thoroughly after handling the material.

Store and load at normal (up to 38 deg C) temperature and at atmospheric pressure.
Material will accumulate static charges which may cause a spark. Static charge build-up could become an ignition source. Use proper relaxation and grounding procedures.
For personnel entry into confined spaces (i.e. bulk storage tanks) a proper confined space entry procedure must be followed including ventilation and testing of tank atmosphere.
Empty containers may contain product residue. Do not pressurize cut, heat, or weld empty containers. Do not reuse empty containers without commercial cleaning or reconditioning.

LAND SPILL:

Eliminate source of ignition. Keep public away. Prevent additional discharge of material, if possible to do so without hazard.
Vapours or dust may be harmful or fatal. Warn occupants of downwind areas.
Prevent spills from entering sewers, watercourses or low areas. Contain spilled liquid with sand or earth. Do not use combustible materials such as sawdust.
Recover by pumping (use an explosion proof motor or hand pump), or by using a suitable absorbent.
Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately.
Take all additional action necessary to prevent and remedy the adverse effects of the spill.

WATER SPILL:

Eliminate all sources of ignition. Vapours or dust may be harmful or fatal. Warn occupants and shipping in downwind areas.
Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately.
Take all additional action necessary to prevent and remedy the adverse effects of the spill.

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7. FIRE AND EXPLOSION HAZARD

Flashpoint and method: -40 deg C COC D92 less than/moins de

Autoignition: NA Flammable Limits: LEL: 1.4% UEL: 7.6%

GENERAL HAZARDS:

Extremely flammable; material will readily ignite at normal temperatures.
Flammable Liquid; may release vapours that form flammable mixtures at or above the flash point.
Toxic gases will form upon combustion.
Static Discharge; material may accumulate static charges which may cause a fire.

FIRE FIGHTING:

Use water spray to cool fire exposed surfaces and to protect personnel.
Shut off fuel to fire if possible to do so without hazard. If a leak or spill has not ignited use water spray to disperse the vapours.
Either allow fire to burn out under controlled conditions or extinguish with foam or dry chemical. Try to cover liquid spills with foam.
Respiratory and eye protection required for fire fighting personnel.
Avoid spraying water directly into storage containers due to danger of boilover.
A self-contained breathing apparatus (SCBA) should be used for all indoor fires and any significant outdoor fires. For small outdoor fires, which may easily be extinguished with a portable fire extinguisher, use of an SCBA may not be required.

HAZARDOUS COMBUSTION PRODUCTS:

Smoke, carbon monoxide, carbon dioxide under thermal decomposition.

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8. REACTIVITY DATA

STABILITY:

This product is stable. Hazardous polymerization will not occur.

INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID:

Strong oxidizing agents

HAZARDOUS DECOMPOSITION:

none

9. NOTES

All components of this product are listed on the U.S. TSCA inventory.

10. PREPARATION

Prepared by: Lubricants & Specialties
IMPERIAL OIL
Products Division
111 St Clair Avenue West
Toronto, Ontario
M5W 1K3
(800) 268-3183

Teck

Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX B4

MSDS FOR 10% HYDROCHLORIC ACID

MSDS Number: **H3886** * * * * * *Effective Date:* ***02/16/06*** * * * * * *Supercedes:* ***05/07/03***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HYDROCHLORIC ACID (10%-33%)

1. Product Identification

Synonyms: This MSDS applies to the concentrated standard used to make laboratory solutions and any solution that contains more than 10% but less than 33% Hydrochloric acid. For diluted product, see MSDS for Hydrochloric Acid (less than 10%).
CAS No.: 7647-01-0
Molecular Weight: 36.46
Chemical Formula: HCl in H2O
Product Codes:
J.T. Baker: 0323, 0327, 0365, 4654, 4657, 5618, 5619
Mallinckrodt: 2608, 2625, H151, H168, V035

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hydrogen Chloride	7647-01-0	10 - 33%	Yes
Water	7732-18-5	67 - 90%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Corrosive! Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death.
Ingestion:
Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea, and in severe cases, death.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. May react with metals or heat to release flammable hydrogen gas.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Water or water spray. Neutralize with soda ash or slaked lime.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® acid neutralizers are recommended for spills of this product.

---

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Hydrochloric acid:
- OSHA Permissible Exposure Limit (PEL):
5 ppm (Ceiling)
- ACGIH Threshold Limit Value (TLV):
2 ppm (Ceiling), A4 Not classifiable as a human carcinogen

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Pungent odor.
Solubility:
Infinitely soluble.
Density:
1.05 @ 15C (59F)
pH:
For HCL solutions: 0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N)
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
101 - 103C (214 - 217F)
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes. Thermal oxidative decomposition produces toxic chlorine fumes and explosive hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.
Conditions to Avoid:
Heat, direct sunlight.

---

11. Toxicological Information

Hydrochloric acid: Inhalation rat LC50: 3124 ppm/1H; Oral rabbit LD50: 900 mg/kg. Investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hydrogen Chloride (7647-01-0)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to biodegrade. When released into the soil, this material may leach into groundwater.
Environmental Toxicity:
This material is expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

International (Water, I.M.O.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Hydrogen Chloride (7647-01-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Hydrogen Chloride (7647-01-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hydrogen Chloride (7647-01-0)	5000	500*	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hydrogen Chloride (7647-01-0)	5000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2R
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Avoid breathing vapor or mist.
Keep container closed.
Use with adequate ventilation.

Wash thoroughly after handling.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

****

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Teck

Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX B5

MSDS FOR CYCLOHEXANE

World Headquarters
Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

MSDS No: M00188

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Cyclohexanone
Catalog Number: 1403332

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00188
Chemical Name: Cyclohexanone
CAS No.: 108-941
Chemical Formula: $C_6H_{10}O$
Chemical Family: Ketones
Hazard: Combustible. Causes severe eye irritation. Experimental mutagen.
Date of MSDS Preparation:
Day: 22
Month: 09
Year: 2004

2. COMPOSITION / INFORMATION ON INGREDIENTS

Cyclohexanone
CAS No.: 108-94-1
TSCA CAS Number: 108-941
Percent Range: 100.0
Percent Range Units: weight / weight
LD50: Oral rat LD_{50} = 1535 mg/kg; Oral mouse LD_{50} = 1400 mg/kg; Oral rat LD_{50} = 1620 mg/kg; Oral rat LD_{50} = 1840 mg/kg.
LC50: Inhalation rat LC_{50} = 8000 ppm/4 hrs; Inhalation human TCLo = 75 ppm -nose, eye respiratory irritation.
TLV: 25 ppm - skin
PEL: 25 ppm - skin
Hazard: Combustible. Causes severe eye irritation. Experimental mutagen.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Clear, colorless liquid
Odor: Peppermint
HARMFUL IF ABSORBED THROUGH SKIN CAUSES EYE IRRITATION MAY CAUSE SKIN AND RESPIRATORY TRACT IRRITATION

COMBUSTIBLE LIQUID AND VAPOR

HMIS:
Health: 1
Flammability: 2
Reactivity: 0
Protective Equipment: X - See protective equipment, Section 8.
NFPA:
Health: 1

Flammability: 2
Reactivity: 0
Symbol: Not applicable

Potential Health Effects:

Eye Contact: Causes severe irritation

Skin Contact: Causes mild irritation

Skin Absorption: Harmful if absorbed through the skin Effects similar to those of inhalation

Target Organs: Kidneys Liver

Ingestion: May cause: central nervous system depression diarrhea dizziness drowsiness headache loss of coordination nausea vomiting weakness

Target Organs: Liver Kidneys

Inhalation: May cause: respiratory tract irritation nausea, vomiting diarrhea headache dizziness weakness incoordination central nervous system depression drowsiness loss of consciousness

Target Organs: Liver Kidneys

Medical Conditions Aggravated: Pre-existing: Kidney conditions Liver conditions

Chronic Effects: Chronic overexposure may cause liver damage kidney damage

Cancer / Reproductive Toxicity Information:

O.S.H.A. Listed: No

IARC Group 3: Non-classifiable
Cyclohexanone
NTP Listed: No

Additional Cancer / Reproductive Toxicity Information: Contains: an experimental mutagen.

Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.

Skin Contact (First Aid): Wash skin with soap and plenty of water. Remove contaminated clothing. Call physician immediately.

Ingestion (First Aid): Do not induce vomiting. Give 1-2 glasses of water. Never give anything by mouth to an unconscious person. Call physician immediately.

Inhalation: Remove to fresh air. Give artificial respiration if necessary. Call physician.

5. FIRE FIGHTING MEASURES

Flammable Properties: Combustible Liquid Vapors can travel to a source of ignition and flash back.

Flash Point: 44°C (111°F)

Method: Closed cup

Flammability Limits:

Lower Explosion Limits: 1.1 %

Upper Explosion Limits: 8.1 %

Autoignition Temperature: 420°C (788°F)

Hazardous Combustion Products: Toxic fumes of: carbon monoxide, carbon dioxide.

Fire / Explosion Hazards: Combustible liquid Do not expose to flames. Do not expose to sparks or other ignition sources. May react violently with: aldehydes strong acids strong bases strong oxidizers strong reducers

Static Discharge: None reported.

Mechanical Impact: None reported

Extinguishing Media: Carbon dioxide Dry chemical. Alcohol foam.

Fire Fighting Instruction: Containers can build up pressure if exposed to heat. As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear. Evacuate area and fight fire from a safe distance.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:

Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.

Containment Technique: Releases of this material may contaminate the environment. Remove all combustible material from spill area. Remove all ignition and spark-creating sources from the spill area. Cover spilled liquid with a

commercially available flammable liquid sorbent such as vapor barrier blanket or activated carbon to avoid evolution of fumes. Vapors may travel to a source of ignition and flash back. May be ignited by: heat, sparks, or flames. Material will float on water creating a fire hazard. Dike the material to create a barrier to combustibles.
Clean-up Technique: Eliminate all sources of ignition. Do not breathe the fumes. Cover with an inert material, such as sand. Use only non-sparking tools. Sweep up material. Incinerate material at an E.P.A. approved hazardous waste facility. Decontaminate the area of the spill with a soap solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Product is regulated as RCRA hazardous waste.
304 EHS RQ (40 CFR 355): Not applicable
D.O.T. Emergency Response Guide Number: 127

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin clothing Do not breathe mist or vapors. Wash thoroughly after handling. Use with adequate ventilation. Maintain general industrial hygiene practices when using this product.
Storage: Store between 10° and 25°C. Protect from: heat light Keep away from: acids alkalies oxidizers reducers
Flammability Class: Class II

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Use a fume hood to avoid exposure to dust, mist or vapor. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: laboratory fume hood
Precautionary Measures: Avoid contact with: eyes skin clothing Do not breathe: mist/vapor Wash thoroughly after handling. Use with adequate ventilation. Protect from: heat light Keep away from: acids/acid fumes alkalies oxidizers reducers
TLV: 25 ppm - skin
PEL: 25 ppm - skin

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Clear, colorless liquid
Physical State: Liquid
Molecular Weight: 98.14 g/mol
Odor: Peppermint
pH: Not determined
Vapor Pressure: 136 mm at 100°C
Vapor Density (air = 1): 3.4
Boiling Point: 155.6°C (312.1°F)
Melting Point: Not applicable
Specific Gravity (water = 1): 0.948
Evaporation Rate (water = 1): Not determined
Volatile Organic Compounds Content: 100 %
Partition Coefficient (n-octanol / water): Not determined
Solubility:
Water: Slightly soluble
Acid: Not determined
Other: Soluble in most organic solvents
Metal Corrosivity:
Steel: Not determined
Aluminum: Not determined

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Contact with heat, sparks, open flames or other ignition sources. Exposure to light.

Reactivity / Incompatibility: Incompatible with: acids alkalies oxidizers reducers
Hazardous Decomposition: Heating to decomposition releases toxic fumes of carbon monoxide and carbon dioxide.
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
LD50: Oral rat LD_{50} = 1535 mg/kg; Oral mouse LD_{50} = 1400 mg/kg; Oral rat LD_{50} = 1620 mg/kg; Oral rat LD_{50} = 1840 mg/kg.
LC50: Inhalation rat LC_{50} = 8000 ppm/4 hrs; Inhalation human TCLo = 75 ppm -nose, eye respiratory irritation.
Dermal Toxicity Data: Skin rabbit LD_{50} = 948 mg/kg.
Skin and Eye Irritation Data: Skin irritation rabbit: 500 mg = MILD; Eye irritation rabbit: 20 mg = SEVERE; Eye irritation rabbit: 250 µg/24 hrs = SEVERE.
Mutation Data: Cytogenetic analysis in human leukocytes @ 100 µmol/l; Cytogenetic analysis in human lymphocytes @ 5 µg/l; Sister chromatid exchange in hamster ovary @ 7500 µl/l; Mutation in mammalian somatic cells in hamster ovary @ 7500 µl/l.
Reproductive Effects Data: Inhalation rat (female) TCLo = 105 mg/m³/4 hrs (Fertility: pre-implantation mortality); Oral mouse (female) TDLo = 11 g/kg (Effects on newborn: growth statistics).
Ingredient Toxicological Data: --
Not applicable

12. ECOLOGICAL INFORMATION

Product Ecological Information: Aquatic toxicity: Golden ides LC50 = 536 mg/l/48 hrs; No inhibition of bacteria in effluent if properly introduced into acclimated biological treatment facility.

Ingredient Ecological Information: --
Not applicable

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: D001
Special Instructions (Disposal): Incinerate material at an E.P.A. approved hazardous waste facility.
Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Cyclohexanone
--
DOT Hazard Class: 3
DOT Subsidiary Risk: NA
DOT ID Number: UN1915
DOT Packing Group: III
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Cyclohexanone
--
ICAO Hazard Class: 3
ICAO Subsidiary Risk: NA
ICAO ID Number: UN1915
ICAO Packing Group: III
I.M.O.:
I.M.O. Proper Shipping Name: Cyclohexanone
--
I.M.O. Hazard Class: 3
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: UN1915
I.M.O. Packing Group: III

Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification: Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316

15. REGULATORY INFORMATION

U.S. Federal Regulations:

O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)

E.P.A.:

S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard Fire Hazard

S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.

--

302 (EHS) TPQ (40 CFR 355): Not applicable

304 CERCLA RQ (40 CFR 302.4): Cyclohexanone 5000 lbs.

304 EHS RQ (40 CFR 355): Not applicable

Clean Water Act (40 CFR 116.4): Not applicable

RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.

C.P.S.C.: Not applicable

State Regulations:

California Prop. 65: No Prop. 65 listed chemicals are present in this product.

Identification of Prop. 65 Ingredient(s): Not applicable

Trade Secret Registry: Not applicable

National Inventories:

U.S. Inventory Status: TSCA Listed: Yes

TSCA CAS Number: 108-941

16. OTHER INFORMATION

Intended Use: Laboratory Reagent

References: CCINFO MSDS/FTSS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Association, 1991. NIOSH Registry of Toxic Effects of Chemical Substances, 1985-86. Cincinnati: U.S. Department of Health and Human Services, April, 1987. Patty, Frank A. Industrial Hygiene and Toxicology, 3rd Revised Edition. Volume 2. New York: A Wiley-Interscience Publication, 1981. Technical Judgment. Sax, N. Irving. Dangerous Properties of Industrial Materials, 7th Ed. New York: Van Nostrand Reinhold Co., 1989. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. The Merck Index, 11th Ed. Rahway, New Jersey: Merck and Co., Inc., 1989. Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). IARC Monographs on the Evaluation of the Carcinogenic Risks to Humans. World Health Organization (Volumes 1-42) Supplement 7. France: 1987. List of Dangerous Substances Classified in Annex I of the EEC Directive (67/548) - Classification, Packaging and Labeling of Dangerous Substances, Amended July 1992. Sixth Annual Report on Carcinogens, 1991. U.S. Department of Health and Human Services. Rockville, MD: Technical Resources, Inc. 1991. Vendor Information. EU Occupational Exposure Limits On Line.

Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

Teck

Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX B6

MSDS FOR ZINCOVER5, ZINC REAGENT POWDER PILLOWS

World Headquarters
Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

MSDS No: M00048

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: ZincoVer ® 5 Zinc Reagent Powder Pillows
Catalog Number: 1403268

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00048
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: Toxic.
Date of MSDS Preparation:
Day: 06
Month: October
Year: 2006

2. COMPOSITION / INFORMATION ON INGREDIENTS

Potassium Borate
CAS No.: 1332-77-0
TSCA CAS Number: 1332-77-0
Percent Range: 50.0 - 60.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 3690 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

Other component
CAS No.: Not applicable
TSCA CAS Number: Not applicable
Percent Range: 0.01 - 0.1
Percent Range Units: weight / weight
LD50: Not applicable
LC50: Not applicable
TLV: Not established
PEL: Not established
Hazard: Any ingredient(s) of this product listed as "Other component(s)" is not considered a health hazard to the user of this product.

Boron Oxide
CAS No.: 1303-86-2
TSCA CAS Number: 1303-86-2
Percent Range: 15.0 - 25.0
Percent Range Units: weight / weight
LD50: Oral mouse LD50 = 3163 mg/kg
LC50: None reported
TLV: 10 mg/m³

PEL: 15 mg/m³
Hazard: May cause irritation.

Sodium Ascorbate
CAS No.: 134-03-2
TSCA CAS Number: 134-032
Percent Range: 20.0 - 30.0
Percent Range Units: weight / weight
LD50: None reported
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

Potassium Cyanide
CAS No.: 151-50-8
TSCA CAS Number: 151-508
Percent Range: 1.0 - 10.0
Percent Range Units: weight / weight
LD50: Oral human LD Lo = 2.857 mg/kg; Oral rat LD_{50} = 5 mg/kg; Ocular rabbit LD_{50} = 7.87 mg/kg.
LC50: None reported
TLV: 5 mg/m³ (skin)
PEL: 5 mg/m³ (skin)
Hazard: Fast-acting poison.

3. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance: Purple
Odor: Not determined
MAY BE FATAL IF SWALLOWED HARMFUL IF INHALED OR ABSORBED THROUGH SKIN MAY CAUSE EYE AND RESPIRATORY TRACT IRRITATION

CONTACT WITH ACIDS FORMS TOXIC FUMES
Emergency response to cyanide exposure should be planned and practiced prior to work with cyanides. First responders should start treatment and get medical attention immediately. Antidote: break an amyl nitrite pearl in cloth and hold lightly under nose for 15 seconds. Repeat 5 times at 15 second intervals. Transport to hospital immediately. Note to Physician: Have a cyanide first aid kit available. If patient has not responded to amyl nitrite, inject intraveneously 10 ml of a 3% solution of sodium nitrite at a rate not greater than 2.5 - 5 ml/min. Follow directly with 50 ml of a 25 % solution of sodium thiosulfate at the same rate by the same route. Keep patient under observation. If signs of poisoning persist or reappear, repeat nitrite and thiosulfate injections 1 hour later in one-half the original doses.

HMIS:
Health: 3
Flammability: 0
Reactivity: 1
Protective Equipment: X - See protective equipment, Section 8.

NFPA:
Health: 3
Flammability: 0
Reactivity: 1
Symbol: Not applicable

Potential Health Effects:
Eye Contact: May cause irritiation
Skin Contact: May cause irritiation
Skin Absorption: Harmful if absorbed through the skin
Target Organs: Brain
Ingestion: May be rapidly fatal. May cause: gastrointestinal irritation confusion irregular heartbeat
Target Organs: Brain
Inhalation: May cause: irritation of nose and throat irregular heartbeat confusion
Target Organs: Brain
Medical Conditions Aggravated: Pre-existing: Respiratory conditions Skin conditions

Chronic Effects: Chronic overexposure may cause brain damage
Cancer / Reproductive Toxicity Information:
This product does NOT contain any OSHA listed carcinogens.

This product does NOT contain any IARC listed chemicals.

This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: Contains: an experimental mutagen. an experimental teratogen.
Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.
Skin Contact (First Aid): Wash skin with soap and plenty of water for 15 minutes. Remove contaminated clothing. Call physician immediately.
Ingestion (First Aid): Break an amyl nitrite pearl in cloth and hold lightly under nose for 15 seconds. Repeat every five minutes. Administer artificial respiration with 100% oxygen. Transport to hospital immediately.
Inhalation: Break an amyl nitrite pearl in cloth and hold lightly under nose for 15 seconds. Repeat 5 times at 15 second intervals. Transport to hospital immediately.

5. FIRE FIGHTING MEASURES

Flammable Properties: Combustion generates toxic fumes. Dusts at sufficient concentrations can form explosive mixtures with air.
Flash Point: Not applicable
Method: Not applicable
Flammability Limits:
Lower Explosion Limits: Not applicable
Upper Explosion Limits: Not applicable
Autoignition Temperature: Not applicable
Hazardous Combustion Products: Toxic fumes of: cyanide compounds nitrogen oxides. potassium oxides boron compounds
Fire / Explosion Hazards: High concentrations of dust may form an explosive mixture with air.
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Alkali dry chemical. Do NOT use carbon dioxide.
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear. Evacuate area and fight fire from a safe distance. Water runoff can cause environmental damage. Dike and collect water used to fight fire.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:
Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.
Containment Technique: Releases of this material may contaminate the environment. Stop spilled material from being released to the environment.
Clean-up Technique: Carefully mist spill with bleach until saturated. Scoop up slurry into a large beaker. Oxidize spilled material with a 50% excess of bleach containing at least 5% sodium hypochlorite. Allow to react for 24 hours in a fume hood. Flush reacted material to the drain with a large excess of water. Decontaminate area with bleach solution.
Evacuation Procedure: Evacuate local area (15 foot radius or as directed by your facility's emergency response plan) when: any quantity is spilled. If conditions warrant, increase the size of the evacuation.
Special Instructions (for accidental release): Mixture contains a component which is regulated as hazardous waste. Mixture contains a component which is regulated as a hazardous air pollutant. Mixture contains a component which is regulated as a water pollutant.
304 EHS RQ (40 CFR 355): Potassium Cyanide 10 lbs
D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin clothing Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.
Storage: Protect from: moisture Keep away from: acids
Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Use a fume hood to avoid exposure to dust, mist or vapor. Maintain general industrial hygiene practices when using this product.
Personal Protective Equipment:
Eye Protection: safety glasses with top and side shields
Skin Protection: disposable latex gloves lab coat
Inhalation Protection: laboratory fume hood
Precautionary Measures: Avoid contact with: eyes skin clothing Do not breathe: dust Wash thoroughly after handling. Keep away from: acids/acid fumes Protect from: moisture
TLV: Not established
PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: Purple
Physical State: Solid
Molecular Weight: Not applicable
Odor: Not determined
pH: of 5% solution = 8.7
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: 155°C 311°F
Specific Gravity (water = 1): 1.83
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: Not determined
Partition Coefficient (n-octanol / water): Not determined
Solubility:
Water: Soluble
Acid: Generates HCN
Other: Not determined
Metal Corrosivity:
Steel: Not determined
Aluminum: Not determined

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Excess moisture Heating to decomposition.
Reactivity / Incompatibility: Incompatible with: acids
Hazardous Decomposition: Toxic fumes of: cyanide boron compounds nitrogen oxides potassium oxide Contact with acids/acid fumes releases toxic cyanide gas.
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
LD50: Oral rat LD_{50} = 383 mg/kg
LC50: None reported
Dermal Toxicity Data: None reported
Skin and Eye Irritation Data: None reported
Mutation Data: None reported

Reproductive Effects Data: None reported
Ingredient Toxicological Data: Boron Oxide: Oral mouse LD_{50} = 3163 mg/kg, Potassium Cyanide: Oral human LDLo = 2.857 mg/kg, Oral rat LD_{50} = 5mg/kg, Potassium Borate: Oral rat LD_{50} = 3690 mg/kg

12. ECOLOGICAL INFORMATION

Product Ecological Information: --
No ecological data available for this product.
Ingredient Ecological Information: --
No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: D003
Special Instructions (Disposal): Dispose of material in an E.P.A. approved hazardous waste facility.
Empty Containers: Rinse three times with an appropriate solvent. Rinsate from empty containers may contain sufficient product to require disposal as hazardous waste. Dispose of empty container as normal trash.
NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:
D.O.T. Proper Shipping Name: Not Currently Regulated
--
DOT Hazard Class: NA
DOT Subsidiary Risk: NA
DOT ID Number: NA
DOT Packing Group: NA
I.C.A.O.:
I.C.A.O. Proper Shipping Name: Not Currently Regulated
--
ICAO Hazard Class: NA
ICAO Subsidiary Risk: NA
ICAO ID Number: NA
ICAO Packing Group: NA
I.M.O.:
I.M.O. Proper Shipping Name: Not Currently Regulated
--
I.M.O. Hazard Class: NA
I.M.O. Subsidiary Risk: NA
I.M.O. ID Number: NA
I.M.O. Packing Group: NA
Additional Information: This product may be shipped as part of a chemical kit composed of various compatible dangerous goods for analytical or testing purposes. This kit would have the following classification:
Proper Shipping Name: Chemical Kit Hazard Class: 9 UN Number 3316.
ALSO NOTE: If the National Competent Authority declares this product an environmental hazard by Special Provision 909 (IMDG) and Special Provision A97 (IATA) the classification may be UN3077 or UN3082.

15. REGULATORY INFORMATION

U.S. Federal Regulations:
O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)
E.P.A.:
S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard Delayed (Chronic) Health Hazard
S.A.R.A. Title III Section 313 (40 CFR 372): This product contains a chemical(s) subject to the reporting requirements of Section 313 of Title III of SARA.

Potassium Cyanide

302 (EHS) TPQ (40 CFR 355): Potassium Cyanide - RQ 100 lbs.

304 CERCLA RQ (40 CFR 302.4): Potassium cyanide 10 lbs.

304 EHS RQ (40 CFR 355): Potassium Cyanide 10 lbs

Clean Water Act (40 CFR 116.4): Potassium cyanide - RQ 10 lbs.

RCRA: Contains RCRA regulated substances. See Section 13, EPA Waste ID Number.

C.P.S.C.: Not applicable

State Regulations:

California Prop. 65: No Prop. 65 listed chemicals are present in this product.

Identification of Prop. 65 Ingredient(s): Not applicable

Trade Secret Registry: Not applicable

National Inventories:

U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).

TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Determination of zinc

References: 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. CCINFO RTECS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Association, 1991. In-house information. Technical Judgment. TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992.

Revision Summary: Updates in Section(s) 14,

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

Teck

Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX B7

MSDS FOR NITRIC ACID

Material Safety Data Sheet

Creation Date 12-Mar-2009 **Revision Date** 30-Jun-2009 **Revision Number** 2

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name **Nitric acid (65 - 70%)**

Cat No. **A198C-212, A200-212, A200-212LC, A200-500, A200-500LC, A200-612GAL, A200C-212, A200S-212, A200S-212LC, A200S-500, A200SI-212, A467-1, A467-2, A467-250, A467-500, A483-212, A509-212, A509-212LC, A509-500, A509-SK212, A509-SK212LC**

Synonyms Azotic acid; Engraver's acid; Aqua fortis

Recommended Use Laboratory chemicals

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 703-527-3887

2. HAZARDS IDENTIFICATION

DANGER!

Emergency Overview

Oxidizer: Contact with combustible/organic material may cause fire. Causes severe burns by all exposure routes. May cause pulmonary edema.

Appearance Clear Colorless, Light yellow **Physical State** Liquid **odor** strong Acrid

Target Organs Eyes, Respiratory system, Skin, Teeth, Kidney, Gastrointestinal tract (GI)

Potential Health Effects

Acute Effects
Principle Routes of Exposure

Eyes	Causes severe burns. May cause blindness or permanent eye damage.
Skin	Causes severe burns. May be harmful in contact with skin.
Inhalation	Causes severe burns. May cause pulmonary edema. May be harmful if inhaled.
Ingestion	Ingestion causes burns of the upper digestive and respiratory tract. May be harmful if swallowed.

Chronic Effects Chronic exposure to corrosive fumes/gases may cause erosion of the teeth followed by jaw necrosis. Bronchial irritation with chronic cough and frequent attacks of pneumonia are common. Gastrointestinal disturbances may also be seen. May cause adverse kidney effects. Experiments have shown reproductive toxicity effects on laboratory animals.

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions Preexisting eye disorders. Skin disorders.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

Component	CAS-No	Weight %
Nitric acid	7697-37-2	65 - 70
Water	7732-18-5	30 - 35

4. FIRST AID MEASURES

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Immediate medical attention is required.

Ingestion Do not induce vomiting. Call a physician or Poison Control Center immediately.

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flash Point Not applicable
Method No information available.

Autoignition Temperature No information available.
Explosion Limits
Upper No data available
Lower No data available

Suitable Extinguishing Media Substance is nonflammable; use agent most appropriate to extinguish surrounding fire..

Unsuitable Extinguishing Media No information available.

Hazardous Combustion Products No information available.

Sensitivity to mechanical impact No information available.
Sensitivity to static discharge No information available.

Specific Hazards Arising from the Chemical
Oxidizer: Contact with combustible/organic material may cause fire. Corrosive Material. Causes severe burns by all exposure routes. Thermal decomposition can lead to release of irritating gases and vapors.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear

NFPA **Health** 4 **Flammability** 0 **Instability** 0 **Physical hazards** OX

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions Wear self-contained breathing apparatus and protective suit. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Do not get in eyes, on skin, or on clothing.

Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable and closed containers for disposal. Keep away from clothing and other combustible materials.

7. HANDLING AND STORAGE

Handling Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Keep away from clothing and other combustible materials. Do not breathe vapors/dust. Do not ingest. Contents under pressure.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Do not store near combustible materials. Corrosives area.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location.

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Nitric acid	TWA: 2 ppm STEL: 4 ppm	(Vacated) TWA: 2 ppm (Vacated) TWA: 5 mg/m^3 (Vacated) STEL: 10 mg/m^3 (Vacated) STEL: 4 ppm TWA: 2 ppm TWA: 5 mg/m^3	IDLH: 25 ppm TWA: 2 ppm TWA: 5 mg/m^3 STEL: 10 mg/m^3 STEL: 4 ppm

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Nitric acid	TWA: 2 ppm TWA: 5.2 mg/m^3 STEL: 10 mg/m^3 STEL: 4 ppm	TWA: 2 ppm TWA: 5 mg/m^3 STEL: 10 mg/m^3 STEL: 4 ppm	TWA: 2 ppm TWA: 5 mg/m^3 STEL: 10 mg/m^3 STEL: 4 ppm

NIOSH IDLH: *Immediately Dangerous to Life or Health*

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquid
Appearance	Clear Colorless, Light yellow
odor	strong Acrid
Odor Threshold	No information available.
pH	1.0 (0.1M)
Vapor Pressure	0.94 kPa (20°C)
Vapor Density	No information available.
Viscosity	No information available.
Boiling Point/Range	120.5°C / 248.9°F
Melting Point/Range	-41°C / -41.8°F
Decomposition temperature °C	No information available.
Flash Point	Not applicable
Evaporation Rate	No information available.
Specific Gravity	1.40
Solubility	No information available.
log Pow	No data available
Molecular Weight	63.02
Molecular Formula	HNO3

10. STABILITY AND REACTIVITY

Stability	Oxidizer: Contact with combustible/organic material may cause fire.
Conditions to Avoid	Incompatible products. Combustible material. Excess heat.
Incompatible Materials	Strong bases, Reducing agents, Organic materials, Aldehydes, Alcohols, Cyanides, Metals, Powdered metals, Ammonia
Hazardous Decomposition Products	Nitrogen oxides (NOx)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions .	None under normal processing..

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Nitric acid	Not listed	Not listed	130 mg/m^3 (Rat) 4 h 7 mg/L (Rat) 1 h
Water	90 mL/kg (Rat)	Not listed	Not listed

Irritation Causes severe burns by all exposure routes

Toxicologically Synergistic Products No information available.

Chronic Toxicity

Carcinogenicity There are no known carcinogenic chemicals in this product

Sensitization No information available.

Mutagenic Effects No information available.

Reproductive Effects Experiments have shown reproductive toxicity effects on laboratory animals.

Developmental Effects No information available.

Teratogenicity Teratogenic effects have occurred in experimental animals..

Other Adverse Effects See actual entry in RTECS for complete information.

Endocrine Disruptor Information No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity

Do not empty into drains.

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available

Mobility .

Component	log Pow
Nitric acid	-2.3

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. TRANSPORT INFORMATION

DOT

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

TDG

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IATA

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

IMDG/IMO

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

15. REGULATORY INFORMATION

All of the components in the product are on the following Inventory lists:

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	CHINA	KECL
Nitric acid	X	X	-	231-714-2	-		X	X	X	X	KE-25911 X
Water	X	X	-	231-791-2	-		X	-	X	X	KE-35400 X

Legend:
X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Nitric acid	7697-37-2	65 - 70	1.0

SARA 311/312 Hazardous Categorization

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Nitric acid	X	1000 lb	-	-

Clean Air Act
Not applicable

OSHA

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Nitric acid	-	TQ: 500 lb

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Nitric acid	1000 lb	1000 lb

California Proposition 65
This product does not contain any Proposition 65 chemicals.

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Nitric acid	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Nitric acid	2000 lb STQ

Other International Regulations

Mexico - Grade No information available

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class
C Oxidizing materials
E Corrosive material

16. OTHER INFORMATION

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Tel: (412) 490-8929

Creation Date 12-Mar-2009

Print Date 30-Jun-2009

Revision Summary "***", and red text indicates revision

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of MSDS

Teck

Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX B8

MSDS FOR pH BUFFER SOLUTIONS (pH 4, 7 & 10)

Material Safety Data Sheet

Creation Date 28-Jan-2010 **Revision Date** 28-Jan-2010 **Revision Number** 1

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name **Buffer Solution, pH 4.00, Color-Coded Red**

Cat No. **SB101-4; SB101-20; SB101-500**

Synonyms (Certified)

Recommended Use Laboratory chemicals

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 703-527-3887

2. HAZARDS IDENTIFICATION

CAUTION!

Emergency Overview

Contains a known or suspected carcinogen. May cause eye, skin, and respiratory tract irritation . The toxicological properties have not been fully investigated.

Appearance Red **Physical State** Liquid **odor** odorless

Target Organs None known.

Potential Health Effects

Acute Effects
Principle Routes of Exposure

Eyes	May cause irritation.
Skin	May cause irritation. May be harmful in contact with skin.
Inhalation	May cause irritation of respiratory tract. May be harmful if inhaled.
Ingestion	May be harmful if swallowed. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.

Chronic Effects Contains a known or suspected carcinogen.

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions No information available.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

Component	CAS-No	Weight %
Water	7732-18-5	98.91
1,2-Benzenedicarboxylic acid, monopotassium salt	877-24-7	1.0
Formaldehyde	50-00-0	0.05
Fluorescein, 2',4',5',7'-tetraiodo, disodium salt	16423-68-0	0.02
Methyl alcohol	67-56-1	0.02

4. FIRST AID MEASURES

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Get medical attention immediately if symptoms occur.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Get medical attention immediately if symptoms occur.

Ingestion Do not induce vomiting. Obtain medical attention.

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flash Point Not applicable
Method No information available.

Autoignition Temperature No information available.

Explosion Limits
Upper No data available
Lower No data available

Suitable Extinguishing Media Substance is nonflammable; use agent most appropriate to extinguish surrounding fire..

Unsuitable Extinguishing Media No information available.

Hazardous Combustion Products No information available.

Sensitivity to mechanical impact No information available.
Sensitivity to static discharge No information available.

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear

NFPA **Health** 1 **Flammability** 0 **Instability** 0 **Physical hazards** N/A

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.

Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable and closed containers for disposal.

7. HANDLING AND STORAGE

Handling Wear personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing. Do not breathe vapors or spray mist.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Measures Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Formaldehyde	Ceiling: 0.3 ppm	(Vacated) TWA: 3 ppm (Vacated) STEL: 10 ppm (Vacated) Ceiling: 5 ppm TWA: 0.75 ppm STEL: 2 ppm	IDLH: 20 ppm TWA: 0.016 ppm Ceiling: 0.1 ppm
Methyl alcohol	TWA: 200 ppm STEL: 250 ppm Skin	(Vacated) TWA: 200 ppm (Vacated) TWA: 260 mg/m^3 (Vacated) STEL: 325 mg/m^3 (Vacated) STEL: 250 ppm Skin TWA: 200 ppm TWA: 260 mg/m^3	IDLH: 6000 ppm TWA: 200 ppm TWA: 260 mg/m^3 STEL: 250 ppm STEL: 325 mg/m^3

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Formaldehyde	Ceiling: 3 mg/m^3 Ceiling: 2 ppm	Peak: 3 mg/m^3 Peak: 2 ppm	STEL: 1.0 ppm CEV: 1.5 ppm

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Methyl alcohol	TWA: 200 ppm TWA: 262 mg/m^3 STEL: 328 mg/m^3 STEL: 250 ppm Skin	TWA: 200 ppm TWA: 260 mg/m^3 STEL: 250 ppm STEL: 310 mg/m^3	TWA: 200 ppm TWA: 260 mg/m^3 STEL: 325 mg/m^3 STEL: 250 ppm Skin

NIOSH IDLH: *Immediately Dangerous to Life or Health*

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquid
Appearance	Red
odor	odorless
Odor Threshold	No information available.
pH	4.0
Vapor Pressure	No information available.
Vapor Density	0.7 (Water = 1.0)
Viscosity	No information available.
Boiling Point/Range	100°C / 212°F
Melting Point/Range	0°C / 32°F
Decomposition temperature °C	No information available.
Flash Point	Not applicable
Evaporation Rate	> 1.0 (Ether = 1.0)
Specific Gravity	1.0
Solubility	Soluble in water
log Pow	No data available

10. STABILITY AND REACTIVITY

Stability	Stable under normal conditions.
Conditions to Avoid	Excess heat.
Incompatible Materials	None known
Hazardous Decomposition Products	Thermal decomposition can lead to release of irritating gases and vapors
Hazardous Polymerization	Hazardous polymerization does not occur
Hazardous Reactions .	None under normal processing.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information No acute toxicity information is available for this product

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Water	90 mL/kg (Rat)	Not listed	Not listed
1,2-Benzenedicarboxylic acid, monopotassium salt	3200 mg/kg (Rat)	Not listed	Not listed
Formaldehyde	500 mg/kg (Rat)	Not listed	0.578 mg/L (Rat) 4 h
Fluorescein, 2',4',5',7'-tetraiodo, disodium salt	1840 mg/kg (Rat)	Not listed	Not listed
Methyl alcohol	5628 mg/kg (Rat)	15800 mg/kg (Rabbit)	64000 ppm (Rat) 4 h 83.2 mg/L (Rat) 4 h

Irritation No information available.

Toxicologically Synergistic Products No information available.

Chronic Toxicity

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	ACGIH	IARC	NTP	OSHA	Mexico
Formaldehyde	A2	Group 1	Reasonably Anticipated	X	Not listed

ACGIH: (American Conference of Governmental Industrial Hygienists)
A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)
IARC: (International Agency for Research on Cancer)
IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans
NTP: (National Toxicity Program)
NTP: (National Toxicity Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

Sensitization No information available.

Mutagenic Effects No information available.

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

Other Adverse Effects The toxicological properties have not been fully investigated.. See actual entry in RTECS for complete information.

Endocrine Disruptor Information No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity

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Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Formaldehyde	Not listed	Not listed	Not listed	EC50 96 h 20 mg/L EC50 48 h 2 mg/L EC50 96 h 20 mg/L
Methyl alcohol	Not listed	Not listed	EC50 = 39000 mg/L 25 min EC50 = 40000 mg/L 15 min EC50 = 43000 mg/L 5 min	Not listed

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available

Mobility .

Component	log Pow
Formaldehyde	0.35
Methyl alcohol	-0.74

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Formaldehyde - 50-00-0	U122	-
Methyl alcohol - 67-56-1	U154	-

14. TRANSPORT INFORMATION

DOT Not regulated

TDG Not regulated

IATA Not regulated

IMDG/IMO Not regulated

15. REGULATORY INFORMATION

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	CHINA	KECL
Water	X	X	-	231-791-2	-		X	-	X	X	KE-35400 X
1,2-Benzenedicarboxylic acid, monopotassium salt	X	X	-	212-889-4	-		X	X	X	X	KE-02310 X
Formaldehyde	X	X	-	200-001-8	-		X	X	X	X	KE-17074 X
Fluorescein, 2',4',5',7'-tetraiodo, disodium salt	X	X	-	240-474-8	-		X	X	X	X	KE-10872 X
Methyl alcohol	X	X	-	200-659-6	-		X	X	X	X	KE-23193 X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Formaldehyde	50-00-0	0.05	0.1
Methyl alcohol	67-56-1	0.02	1.0

SARA 311/312 Hazardous Categorization

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Formaldehyde	X	100 lb	-	-

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Formaldehyde	X		-
Methyl alcohol	X		-

OSHA

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Formaldehyde	0.5 ppm Action Level 0.75 ppm TWA 2 ppm STEL	TQ: 1000 lb

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Formaldehyde	100 lb	100 lb
Methyl alcohol	5000 lb	-

California Proposition 65
This product contains the following Proposition 65 chemicals:

Component	CAS-No	California Prop. 65	Prop 65 NSRL
Formaldehyde	50-00-0	Carcinogen	40 µg/day

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Formaldehyde	X	X	X	X	X
Methyl alcohol	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Formaldehyde	11250 lb STQ (solution)

Other International Regulations

Mexico - Grade No information available

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class
Non-controlled

16. OTHER INFORMATION

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Tel: (412) 490-8929

Creation Date 28-Jan-2010

Print Date 28-Jan-2010

Revision Summary "***", and red text indicates revision

Disclaimer
The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of MSDS

Material Safety Data Sheet

Creation Date 09-Dec-2009 **Revision Date** 09-Dec-2009 **Revision Number** 1

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name **Buffer Solution, pH 7.00, Color-Coded Yellow**

Cat No. **SB107-4; SB107-20; SB107-500**

Synonyms None.

Recommended Use Laboratory chemicals

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 703-527-3887

2. HAZARDS IDENTIFICATION

CAUTION!

Emergency Overview

May cause eye, skin, and respiratory tract irritation . Low hazard for usual industrial or commercial handling.

Appearance Yellow **Physical State** Liquid **Odor** odorless

Target Organs None known.

Potential Health Effects

Acute Effects
Principle Routes of Exposure

Eyes	May cause irritation.
Skin	May cause irritation. Low hazard for usual industrial or commercial handling.
Inhalation	May cause irritation of respiratory tract. Low hazard for usual industrial or commercial handling.
Ingestion	Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea. Low hazard for usual industrial or commercial handling.

Chronic Effects None known.

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions No information available.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

Component	CAS-No	Weight %
Water	7732-18-5	99.18
Dihydrogen potassium phosphate	7778-77-0	0.7
Sodium hydroxide	1310-73-2	0.1
FD&C yellow No. 5	1934-21-0	0.0 - 0.02

4. FIRST AID MEASURES

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Get medical attention immediately if symptoms occur.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Get medical attention immediately if symptoms occur.

Ingestion Do not induce vomiting. Obtain medical attention.

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flash Point Not applicable
Method No information available.

Autoignition Temperature No information available.

Explosion Limits
Upper No data available
Lower No data available

Suitable Extinguishing Media Substance is nonflammable; use agent most appropriate to extinguish surrounding fire..

Unsuitable Extinguishing Media No information available.

Hazardous Combustion Products No information available.

Sensitivity to mechanical impact No information available.
Sensitivity to static discharge No information available.

Specific Hazards Arising from the Chemical
None known.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear

NFPA **Health** 1 **Flammability** 0 **Instability** 0 **Physical hazards** N/A

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions Use personal protective equipment. Avoid contact with skin, eyes and clothing.

Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable and closed containers for disposal.

7. HANDLING AND STORAGE

Handling Handle in accordance with good industrial hygiene and safety practice. Wear personal protective equipment. Avoid contact with skin, eyes and clothing. Avoid ingestion and inhalation.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Measures Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Sodium hydroxide	Ceiling: 2 mg/m^3	(Vacated) Ceiling: 2 mg/m^3 TWA: 2 mg/m^3	IDLH: 10 mg/m^3 Ceiling: 2 mg/m^3

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Sodium hydroxide	Ceiling: 2 mg/m^3	Peak: 2 mg/m^3	CEV: 2 mg/m^3

NIOSH IDLH: *Immediately Dangerous to Life or Health*

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquid
Appearance	Yellow
Odor	odorless
Odor Threshold	No information available.
pH	7.00@ 25°C
Vapor Pressure	760 mmHg @ 20 °C
Vapor Density	No information available.
Viscosity	No information available.
Boiling Point/Range	100°C / 212°F

9. PHYSICAL AND CHEMICAL PROPERTIES

Melting Point/Range	0°C / 32°F
Decomposition temperature °C	No information available.
Flash Point	Not applicable
Evaporation Rate	No information available.
Specific Gravity	1.0
Solubility	Soluble in water
log Pow	No data available

10. STABILITY AND REACTIVITY

Stability	Stable under normal conditions.
Conditions to Avoid	None known.
Incompatible Materials	None known
Hazardous Decomposition Products	None known
Hazardous Polymerization	Hazardous polymerization does not occur
Hazardous Reactions .	None under normal processing.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information No acute toxicity information is available for this product

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Water	90 mL/kg (Rat)	Not listed	Not listed
Dihydrogen potassium phosphate	1700 mg/kg (Mouse)	4640 mg/kg (Rabbit)	Not listed
Sodium hydroxide	Not listed	1350 mg/kg (Rabbit)	Not listed
FD&C yellow No. 5	12750 mg/kg (Mouse)	Not listed	Not listed

Irritation No information available.

Toxicologically Synergistic Products No information available.

Chronic Toxicity

Carcinogenicity There are no known carcinogenic chemicals in this product

Sensitization No information available.

Mutagenic Effects No information available.

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

Other Adverse Effects The toxicological properties have not been fully investigated.. See actual entry in RTECS for complete information.

Endocrine Disruptor Information No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity

Do not empty into drains.

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available

Mobility No information available

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification

14. TRANSPORT INFORMATION

DOT Not regulated

TDG Not regulated

IATA Not regulated

IMDG/IMO Not regulated

15. REGULATORY INFORMATION

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	CHINA	KECL

15. REGULATORY INFORMATION											
Water	X	X	-	231-791-2	-		X	-	X	X	KE-35400 X
Dihydrogen potassium phosphate	X	X	-	231-913-4	-		X	X	X	X	KE-28622 X
Sodium hydroxide	X	X	-	215-185-5	-		X	X	X	X	KE-31487 X
FD&C yellow No. 5	X	X	-	217-699-5	-		X	X	X	X	KE-06857 X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313
Not applicable

SARA 311/312 Hazardous Categorization

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Sodium hydroxide	X	1000 lb	-	-

Clean Air Act
Not applicable

OSHA
Not applicable

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Sodium hydroxide	1000 lb	-

California Proposition 65
This product does not contain any Proposition 65 chemicals.

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Sodium hydroxide	X	X	X	-	X

U.S. Department of Transportation
Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class
Non-controlled

16. OTHER INFORMATION

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Tel: (412) 490-8929

Creation Date 09-Dec-2009

Print Date 09-Dec-2009

Revision Summary "***", and red text indicates revision

Disclaimer

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End of MSDS

Material Safety Data Sheet

Creation Date 28-Jan-2010 **Revision Date** 28-Jan-2010 **Revision Number** 1

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name **Buffer Solution, pH 10.00, Color-Coded Blue**

Cat No. **SB115-4; SB115-20; SB115-500**

Synonyms (Certified)

Recommended Use Laboratory chemicals

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 703-527-3887

2. HAZARDS IDENTIFICATION

CAUTION!

Emergency Overview

May cause eye, skin, and respiratory tract irritation . The toxicological properties have not been fully investigated.

Appearance Blue **Physical State** Liquid **odor** odorless

Target Organs None known.

Potential Health Effects

Acute Effects
Principle Routes of Exposure

Eyes	May cause irritation
Skin	May cause irritation
Inhalation	May cause irritation of respiratory tract
Ingestion	Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea

Chronic Effects None known.

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions No information available.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

Component	CAS-No	Weight %
Water	7732-18-5	97.78
Ethylenediaminetetraacetic acid, disodium salt dihydrate	6381-92-6	1.0
Potassium carbonate	584-08-7	0.6
Boron potassium oxide (B4K2O7)	1332-77-0	0.4
Potassium hydroxide	1310-58-3	0.2

4. FIRST AID MEASURES

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Get medical attention immediately if symptoms occur.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Get medical attention immediately if symptoms occur.

Ingestion Do not induce vomiting. Obtain medical attention.

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flash Point No information available.
Method No information available.

Autoignition Temperature No information available.

Explosion Limits
Upper No data available
Lower No data available

Suitable Extinguishing Media Substance is nonflammable; use agent most appropriate to extinguish surrounding fire..

Unsuitable Extinguishing Media No information available.

Hazardous Combustion Products No information available.

Sensitivity to mechanical impact No information available.
Sensitivity to static discharge No information available.

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear

NFPA **Health** 1 **Flammability** 0 **Instability** 0 **Physical hazards** N/A

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.

Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable and closed containers for disposal.

7. HANDLING AND STORAGE

Handling Wear personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing. Do not breathe vapors or spray mist.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Measures Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Potassium hydroxide	Ceiling: 2 mg/m^3	(Vacated) Ceiling: 2 mg/m^3	Ceiling: 2 mg/m^3

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Potassium hydroxide	Ceiling: 2 mg/m^3		CEV: 2 mg/m^3

NIOSH IDLH: *Immediately Dangerous to Life or Health*

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquid
Appearance	Blue
odor	odorless
Odor Threshold	No information available.
pH	10.0

9. PHYSICAL AND CHEMICAL PROPERTIES

Vapor Pressure	No information available.
Vapor Density	No information available.
Viscosity	No information available.
Boiling Point/Range	100°C / 212°F
Melting Point/Range	0°C / 32°F
Decomposition temperature °C	No information available.
Flash Point	No information available.
Evaporation Rate	> 1 (Water = 1.0)
Specific Gravity	1.013 @ 25°C
Solubility	Soluble in water
log Pow	No data available

10. STABILITY AND REACTIVITY

Stability	Stable under normal conditions.
Conditions to Avoid	Excess heat.
Incompatible Materials	None known
Hazardous Decomposition Products	Thermal decomposition can lead to release of irritating gases and vapors
Hazardous Polymerization	Hazardous polymerization does not occur
Hazardous Reactions .	None under normal processing.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information No acute toxicity information is available for this product

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Water	90 mL/kg (Rat)	Not listed	Not listed
Potassium carbonate	1870 mg/kg (Rat)	1.87 mg/kg (Rat)	Not listed
Potassium hydroxide	214 mg/kg (Rat)	Not listed	Not listed

Irritation No information available.

Toxicologically Synergistic Products No information available.

Chronic Toxicity

Carcinogenicity There are no known carcinogenic chemicals in this product

Sensitization	No information available.
Mutagenic Effects	No information available.
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
Other Adverse Effects	The toxicological properties have not been fully investigated.. See actual entry in RTECS for complete information.
Endocrine Disruptor Information	No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity

Do not empty into drains.

Persistence and Degradability	No information available
Bioaccumulation/ Accumulation	No information available
Mobility	.

Component	log Pow
Potassium hydroxide	0.65 0.83

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods	Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification

14. TRANSPORT INFORMATION

DOT	Not regulated
TDG	Not regulated
IATA	Not regulated
IMDG/IMO	Not regulated

14. TRANSPORT INFORMATION

15. REGULATORY INFORMATION

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	CHINA	KECL
Water	X	X	-	231-791-2	-		X	-	X	X	KE-35400 X
Ethylenediaminetetraacetic acid, disodium salt dihydrate	-	X	-	-	-		X	X	X	X	-
Potassium carbonate	X	X	-	209-529-3	-		X	X	X	X	KE-29083 X
Boron potassium oxide (B4K2O7)	X	X	-	215-575-5	-		X	-	X	X	KE-12187 X
Potassium hydroxide	X	X	-	215-181-3	-		X	X	X	X	KE-29139 X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313
Not applicable

SARA 311/312 Hazardous Categorization

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Potassium hydroxide	X	1000 lb	-	-

Clean Air Act
Not applicable

OSHA
Not applicable

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Potassium hydroxide	1000 lb	-

California Proposition 65
This product does not contain any Proposition 65 chemicals.

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Potassium hydroxide	X	X	X	-	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class
Non-controlled

16. OTHER INFORMATION

Prepared By	Regulatory Affairs Thermo Fisher Scientific Tel: (412) 490-8929
Creation Date	28-Jan-2010
Print Date	28-Jan-2010
Revision Summary	"***", and red text indicates revision

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of MSDS

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Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX C1

DAILY OPERATING LOG

Pine Point Water Treatment Year:
NWT Licence Site 35-1
Daily Operating Log

Date: Operator: Sample Tech:

Time	Culvert (1E) pH	Weir (1B) pH	Weir Head inches	Weir Flowrate m^3/min	Lime Flow L/min	Samp. Taken ✓	Hach Zn mg/L	Turb NTU	Remarks
6: am									
6: am									
7: am									
7: am									
8: am									
8: am									
9: am									
9: am									
10: am									
10: am									
11: am									
11: am									
12: am									
12: am									
1: pm									
1: pm									
2: pm									
2: pm									
3: pm									
3: pm									
4: pm									
4: pm									
5: pm									
5: pm									
6: pm									
6: pm									
7: pm									
7: pm									
8: pm									
8: pm									

Water Temp (°C) at Weir: (35-1B)	am:		Weather:	pm:
	pm:		Air Temp.:	pm:
			Wind:	pm:
Lime Slurry Strength (%)				
Main Pond Height (m) (35-1A)	am: pm:		Height change since last day (m):	
Volume Discharged Today (m^3)				

Comments:

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Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX C2

TREATED WATER DISCHARGE VOLUMES

Pine Point Water Treatment Year:
NWT Licence Site 35-1
Treated Water Discharge Volumes

Operating Date	Daily Discharge Volume (cubic metres)	Total Cumulative Discharge Volume (cubic metres)	Pond Elevaton (meters)

Note: Pond Elevation is reported at the end of the day.

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Pine Point MineTailings Impoundment Area

Water Treatment Manual

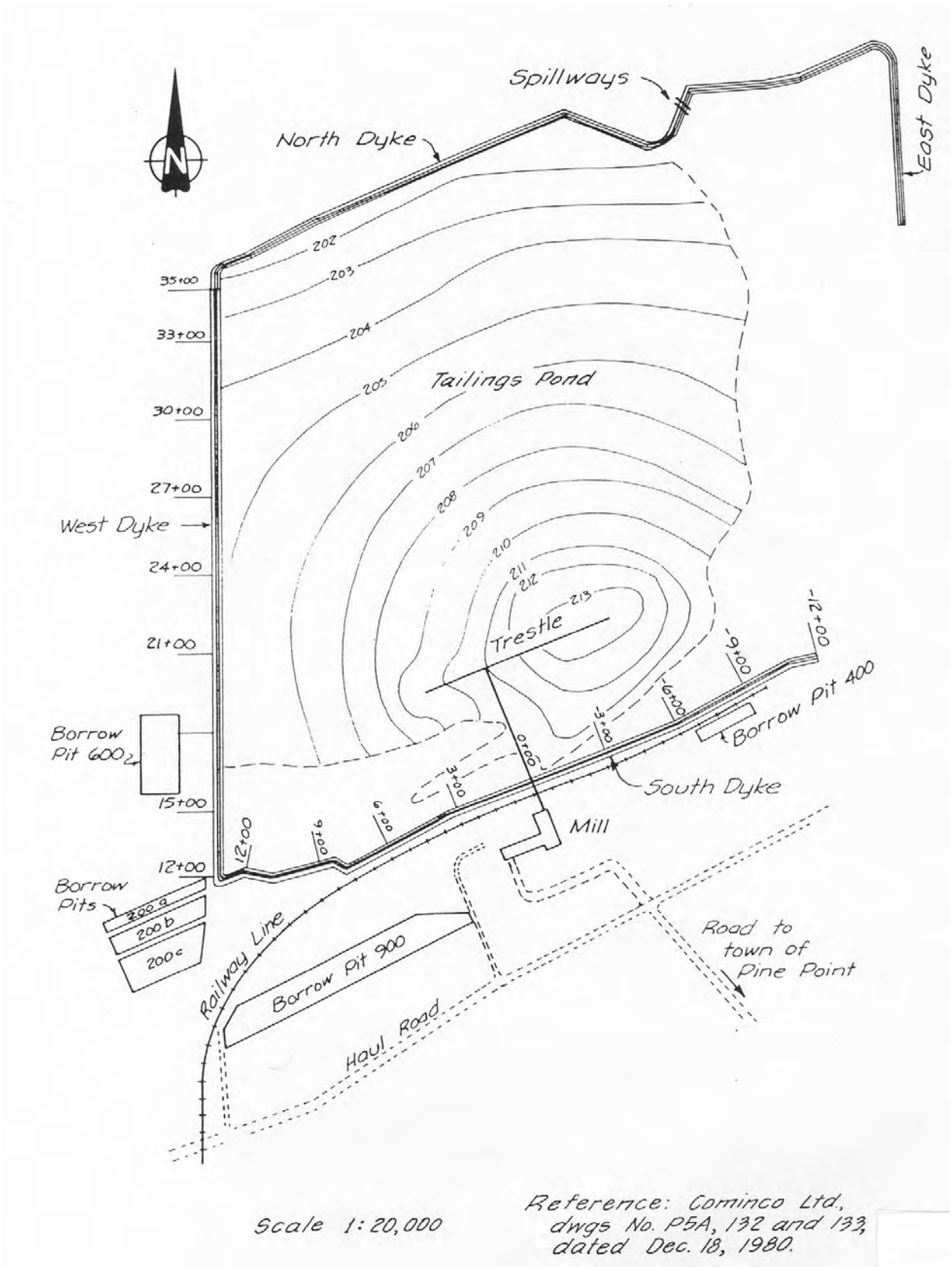
APPENDIX C3

DAM INSPECTION REPORT

Teck Metals Ltd
Tailings Impoundment Inspection Form
Pine Point Tailings Impoundment

Date:		Inspected By:
Weather:		
Tailings Pond Information:		
Pond Elevation:		Operating Limits:
Crest Elevation:		Freeboard: (Minimum 1m)
Dyke Inspection Check List (✓ = checked and no problems; Blank = not checked)		
Check: Upstream Slope of Dyke, Crest and Downstream Slope of Dyke		
South Dyke	**Checked**	**Comment**
Ponded Water		Where? GPS Coord.:
Erosion		
Settlement/Depressions		
Sinkholes		
Cracks/Movement		
Debris		
Vegetation		
Other		
West Dyke		
Ponded Water		
Erosion		
Settlement/Depressions		
Sinkholes		
Cracks/Movement		
Debris		
Vegetation		
Other		

North Dyke	**Checked**	**Comment**
Ponded Water		Where? GPS Coord.:
Erosion		
Settlement/Depressions		
Sinkholes		
Cracks/Movement		
Debris		
Vegetation		
Main Pond Spillway		
Treatment Spillway		
Other		
East Dyke		
Ponded Water		
Erosion		
Settlement/Depressions		
Sinkholes		
Cracks/Movement		
Debris		
Vegetation		
Other		


Spillways
East Dyke
North Dyke
N
202
203
204
205
Tailings Pond
206
207
208
209
210
211
212
213
Trestle
35+00
33+00
30+00
27+00
West Dyke
24+00
21+00
15+00
12+00
-12+00
-9+00
-6+00
-3+00
0+00
3+00
6+00
9+00
12+00
Borrow Pit 600
Borrow Pit 400
South Dyke
Mill
Borrow Pits
200a
200b
200c
Railway Line
Borrow Pit 900
Haul Road
Road to town of Pine Point
Scale 1:20,000
Reference: Cominco Ltd., dwgs No. P5A, 132 and 133, dated Dec. 18, 1980.

Tailings Impoundment Inspection
Explanation of Details

Ponded Water: Look for pools of water against the inside or outside slopes of the Dyke structure. The pooled water is a potential source of water to erode the dyke and therefore the presence of any water must be recorded and ideally the GPS location should be noted in the comments area. Another aspect of pooled water is that it may be a source of seepage water at the outside toe of the dyke therefore where pooled water is observed look for increased seepage at the toe. The presence of water at the dyke face can be an indication of increased water levels within the dyke which can decrease Dyke stability.

Erosion: The presence of small rills, up to 0.3m deep, on the faces of the dyke are normal and of no concern. If the rills start eroding into channels greater than 0.3 m and are cutting into the crest more than 0.5 m then the rills must be filled to prevent further progress.

Erosion can also be caused by wave action on the pooled water. Erosion has been occurring on the inside slope of the North Dyke and will soon require placement of material to armor the dyke face. Erosion into the till core must be prevented therefore any excessive erosion must be reported. Ideally record the GPS location so the area can be easily found.

Settlement/Depressions: Settlement or depressions in the crest or slopes indicate groundwater erosion of the interior of the dyke. Look for any visible seepage at the toe of the dyke. This is a very serious problem and it must be investigated by a professional. Ideally record the GPS location so the depression can be easily found.

Sinkholes: Sinkholes are localized deep depressions and are another indication of interior erosion of the dyke. This is a very serious problem and it must be investigated by a professional. Ideally record the GPS location so the depression can be easily found.

Cracks/Movement: Cracks accompanied by movement are an indication of a dyke failure and material would probably be seen flowing from the toe of the dyke. This is a very serious situation which must be reported immediately and be investigated by a professional. Ideally record the GPS location so the area can be easily found.

Debris: Accumulation of debris on the dyke can prevent inspection of the dyke and should be removed.

Vegetation: Small vegetation on the slopes of the dykes is good to minimize surface erosion. Larger vegetation hinders inspections of the dyke and can damage the dyke if root systems penetrate the till core or large root systems are ripped out by the wind. Therefore any trees on the dyke slopes over 1” diameter should be removed.

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Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX C4

DAILY CHAIN OF CUSTODY

Control Number

Environmental Sample Information Sheet

NOTE Proper completion of this form is required in order to proceed with analysis

See reverse for contacting your nearest Norwest location and proper sampling protoc

Billing Address		**Report To:**	**Copy of Report To:**		**Copy of invoice:**
Company:	Teck Cominco Limited		Company:		**Mail invoice to this**
Address:	Bag 2000 Kimberley, BC V1A 3E1	**QA/QC Report** x	Address:		**address for approval**
Attention:	Bruce Donald	**Report Result:**	Attention:	Cathy Korn / Chantale van Dieren	**Report Result:**
Phone:	(250) 427-8405	Fax	Phone:	(250) 448-4988 / (250) 427-8412	Fax
Fax:	(250) 427-8451	Mail x	Fax:		Mail
Cell:		Courier	Cell:		Courier
Email:	bruce.donald@teckcominco.com	Email x	Email:	chantale.vandieren@teckcominco.com	Email x

Information to be included on Report and Invoice

Project ID:
Project Name:
Project Location: **Pine Point 2007**
Legal Location: **NT**
PO#: **7365**
Proj. Acct. Code:
Agreement ID: **53796**

RUSH **Please contact the laboratory to confirm rush dates and times before submitting samples.**

Upon filling out this section, client accepts that surcharges will be attached to this analysis

Required on: all analyses **or** as indicated ☐ **or** ☐

Date required:___ **ASAP**

Signature:_____

Norwest Authorization:_____

Sample Custody (Please Print)

Sampled by: **Cathy Korn** Date

Company Signature

Relinquished by: **Cathy name the shipper**

Company Date

Waybill number: **Cathy put this in**

Received by:

Company Date

Processed by:

Norwest Labs Date

Special Instructions/Comments

Daily Sampling

	Sample Identification	Location	Depth	Date/Time Sampled	Matrix	Sampling Method	Number of Containers ↓	Zinc (Zn)	Copper (Cu)	Lead (Pb)	TSS	pH									
							v	Enter tests above (check off relevant samples below)													
1	351B01DDMMYR	35-1B	-				2	✓	✓	✓	✓	✓									
2																					
3																					
4																					
5			-																		
6			-																		
7			-																		
8			-																		
9			-																		
10			-																		
11			-																		
12			-																		
13			-																		
14			-																		

NOTE: All hazardous samples must be labeled according to WHMIS guidelines

Accredited by the Standards Council of Canada for specific tests ##

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Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX C5

WEEKLY CHAIN OF CUSTODY

Control Number

Environmental Sample Information Sheet

NOTE Proper completion of this form is required in order to proceed with analysis

See reverse for contacting your nearest Norwest location and proper sampling protoc

Billing Address		**Report To:**	**Copy of Report To:**		**Copy of invoice:**
Company:	Teck Cominco Limited		Company:		**Mail invoice to this**
Address:	Bag 2000 Kimberley, BC V1A 3E1	**QA/QC Report** [x]	Address:		**address for approval** [ ]
Attention:	Bruce Donald	**Report Result:**	Attention:	Cathy Korn	**Report Result:**
Phone:	(250) 427-8405	Fax [ ]	Phone:		Fax [ ]
Fax:	(250) 427-8451	Mail [x]	Fax:		Mail [ ]
Cell:		Courier [ ]	Cell:		Courier [ ]
Email:	bruce.donald@teckcominco.com	Email [x]	Email:	chantale.vandieren@teckcominco.com	Email [x]

Information to be included on Report and Invoice

Project ID:

Project Name:

Project Location: **Pine Point 2006**

Legal Location: **NT**

PO#: **7091**

Proj. Acct. Code:

Agreement ID:

RUSH **Please contact the laboratory to confirm rush dates and times before submitting samples.**

Upon filling out this section, client accepts that surcharges will be attached to this analysis

Required on: all analyses **or** as indicated [ ] **or** [x]

Date required:___ **ASAP**

Signature:_____

Norwest Authorization:_____

Sample Custody (Please Print)

Sampled by: **Cathy Korn** Date

Company Signature

Relinquished by: **Cathy name the shipper**

Company Date

Waybill number: **Cathy put this in**

Received by:

Company Date

Processed by:

Norwest Labs Date

Special Instructions/Comments

Only Total Metals and Routine Analysis needed on 100% RUSH
Everything else is normal turnaround

Weekly Sampling (one day per week)

	Sample Identification	Location	Depth	Date/Time Sampled	Matrix	Sampling Method	Number of Containers ↓	W-10	Total Metals (MS-ICP)	Dissolved Metals (MS-ICP)	Nutrients	TSS	Cyanide (Weak Acid)								
							v	Enter tests above (check off relevant samples below)													
1	351B01DDMMYR	35-1B	-				5	✓	✓	✓	✓	✓	✓								
2																					
3																					
4			-																		
5			-																		
6			-																		
7			-																		
8			-																		
9			-																		
10			-																		
11			-																		
12			-																		
13			-																		
14			-																		

NOTE: All hazardous samples must be labeled according to WHMIS guidelines

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Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX C6

SAMPLE SHIPMENT LOG

Pine Point Water Treatment **Year:**
NWT License Site 35-1
Sample Shipment Log

Shipping Number	Sample Number	Sampling Date	Shipping Date	Results Received Date	Comments

Teck

Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX C7

COMMERCIAL LAB ASSAYS AND COMPARISON

Pine Point Water Treatment **Year:**
NWT License Site 35-1
Commercial Lab Assays

Shipment Number	Sampling Date	Sampling Site	Assays (Total mg/L)			TSS (mg/L)	pH	Comments
			Zinc	Lead	Copper			

Pine Point Water Treatment Year:
Drainage Water Assays (Field & Lab)

Date	Sample Time	Sample Station	Shipping Sample Number	Field pH	Field TSS NTU	Field Zn (mg/l)	Lab pH	Lab TSS (mg/l)	Lab Zn (mg/l)

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Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX C8

INCIDENT INVESTIGATION REPORT

Teck Metals Ltd. – Legacy Properties Group

Incident/Accident Investigation Report

SUPERVISOR FILLING OUT FORM: _____

OHSC REPRESENTATIVE:

Mine Site:	Date of Occurrence:	Time: AM PM
Exact Location:	Date Reported:	Time: AM PM

Injury/Illness Incident	
Person Involved:	Present at Investigation ☐ Yes ☐ No
Type of Injury – Illness – Body Part – L or R	
Object / Equipment / Substance / Action Causing Injury/Illness	
Person with most control of Item above:	Name of Supervisor Notified:
Witnesses Name (s):	Interviewed? ☐ Yes ☐ No

Equipment/Property Damage
Property Damaged:
Nature of Damage:
Estimated Costs:
Object / Equipment / Substance Inflicting Damage
Person with most control of item above:

Environmental Incident	
Reported to Government: ☐ Yes ☐ No If Yes Date & Time: Reported to Supervisor - Name: Date & Time: Name of Person reporting the spill: Nearest water body or stream affected:	Substance Spilled: Quantity Spilled:
Action taken to contain, recover, clean up and dispose of contaminant:	

Description of Incident: Consider: Dimensions, Weight, Direction, Conditions, Circumstances. Location, Body Movement or Position, Safety Equipment, Simple Diagram or photograph if helpful

Conditions at time of Incident:

Cause (s): Why did this accident/incident happen?

Teck Metals Ltd. – Legacy Properties Group

Incident/Accident Investigation Report

TO BE FILLED OUT DURING/AFTER THE INVESTIGATION:

CONFIRMATION – CAUSE/CIRCUMSTANCE (Agreement with supervisor):

ACTIONS TO PREVENT RECURRENCE	PERSON RESPONSIBLE	TARGET DATE	DATE COMPLETED

POTENTIAL CONSEQUENCES	Catastrophic	Critical/Major	Serious/Marginal	Minor/Marginal	
PROBABILITY OF RECURRENCE	Frequent	Probable	Occasional	Remote	Improbable
RISK	High	Medium	Low		

Circle one in each of first 2 categories – RISK is then determined from chart below

REFERENCE:

SEVERITY	ILLNESS/INJURY	FINANCIAL IMPACT	ENVIRONMENTAL IMPACT	IMPACT TO IMAGE
Catastrophic	Fatality	>$5M	Major liquid release impacting water	Provincial/National
Critical/Major	Serious injury/illness	$1M - $5M	Major liquid release – not impacting water	Regional Attention
Serious/Marginal	Recordable injury	$50K - $1M	Liquid release on site – greater than 200 Liters	Local Attention
Minor/Marginal	Minor injury	<$50K	Small liquid release – less than 200 Liters	None

PROBABILITY OF RECURRENCE	DEFINITION	VALUE
Frequent	Likely to occur repeatedly	3 in 10
Probable	Likely to occur several times	3 in 100
Occasional	Likely to occur sometime	3 in 1,000
Remote	Not likely to occur, but possible	3 in 10,000
Improbable	Almost zero probability	3 in 100,000

RISK ASSESSMENT:

SEVERITY	PROBABILITY	Frequent	Probable	Occasional	Remote	Improbable
	Catastrophic	High	High	High	Medium	Low
	Critical/Major	High	High	Medium	Low	Low
	Serious/Marginal	High	Medium	Low	Low	Low
	Minor/Minimal	Medium	Low	Low	Low	Low

Teck Metals Ltd. – Legacy Properties Group

Incident/Accident Investigation Report

HIGH RISK	**Unacceptable for long term, immediate corrective action required to reduce risk**
MEDIUM RISK	**Undesirable condition, corrective action to be taken as soon as practical**
LOW RISK	**Acceptable condition, no further action required for existing conditions only – any procedural violations noted must be reviewed/addressed with crews**

Supervisor's Name: (print)	
Supervisor's Signature:	**Date:**
Manager's Signature:	**Date:**
OHSC REPRESENTATIVE Signature:	**Date:**

INCIDENT/ACCIDENT INVESTIGATION - PROCEDURE

SIGN OFF

Employee acknowledges that he/she has read and understood the above procedure:

Employee Name:	Signature:	Date:
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

NOTES:

_____

_____

_____

Teck

Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX D1

EQUIPMENT LIST

Pine Point Water Treatment Equipment List

Mar. 2007

Equipment	Model	Serial No.	Date Purchased	Other Details
Lime Silo, UFA Wheatland Bin	WB1417-55	20060518026	Feb. 2006	14' Diameter, 33' High, 3,381 ft^3, 6" Auger boot at 20°
Westfield Auger	UT-04-04		Feb. 2006	6" diameter, 16' long, 2 HP 110 V single phase motor
Solimar fluidizers	4500 Series		Feb. 2006	8 low pressure fluidizers <10 psi
John Deere Diesel Engine, Frontier Power Products	4045TF270 B	PE4045147767 5	Apr. 2006	4.5 Liter, 7.4 KW at 2500 rpm Oil Filter RE504836 Fuel Filter R 60 T
Twin Disc Clutch	4-11256	1V0405	Apr. 2006	Clutch 10-5, Housing Size 4
Berkley 4" Pump	B4JRMBH		Apr. 2006	Frame mounted pump, 900 USGPM @60 psi
Sutorbilt 5MVP Blower	GAEMPA	S195202	Apr. 2006	353 cfm @9psi
Jet Mixer Crown Energy Tech.			Nov. 2005	Mixing Bowl DMA1467 Hopper DMA 1468 Jet #30 DMA1085
Honda Generator	EX5DCC9		June 2005	The Power Factor, 5KW, Diesel
Water Pump 2" Subaru Robin	PKX201		June 2005	Renown Industries, 4.5 HP gasoline
Water Pump 2" Yamaha			?	gasoline
Mico Fuel Pump			June 2005	Renown Industries, with power head, 30' discharge hose, 24" standpipe
Hoses (Hose Headquarters)				
4" Suction Hose	G1341-400		June 2006	Two 17' Suction Hoses, 1 male and 1 female end.
4" Discharge Hose	G374-400		June 2006	Four 15' Discharge Hoses, 1 male and 1 female end
3" Discharge Hose	G374-300		June 2006	Seven 15' high pressure, discharge hoses, 1 male end and 1 female end
2" Fire Hose				
Various Stainless Steel Camlock Couplings	G65SSC G65SSE		June 2006	Female and Male hose shank couplers
Masterflex Pumps				
pH meters				3 meters
Scale				
Hach Meter	41100-20			Hach DR 100 Colorimeter, Zincon 0-1.5, 0-3.0 mg/L
La Motte Turbidimeter	2020e	PN-26858 SN-ME12396	Feb. 2007	Fisher Scientific

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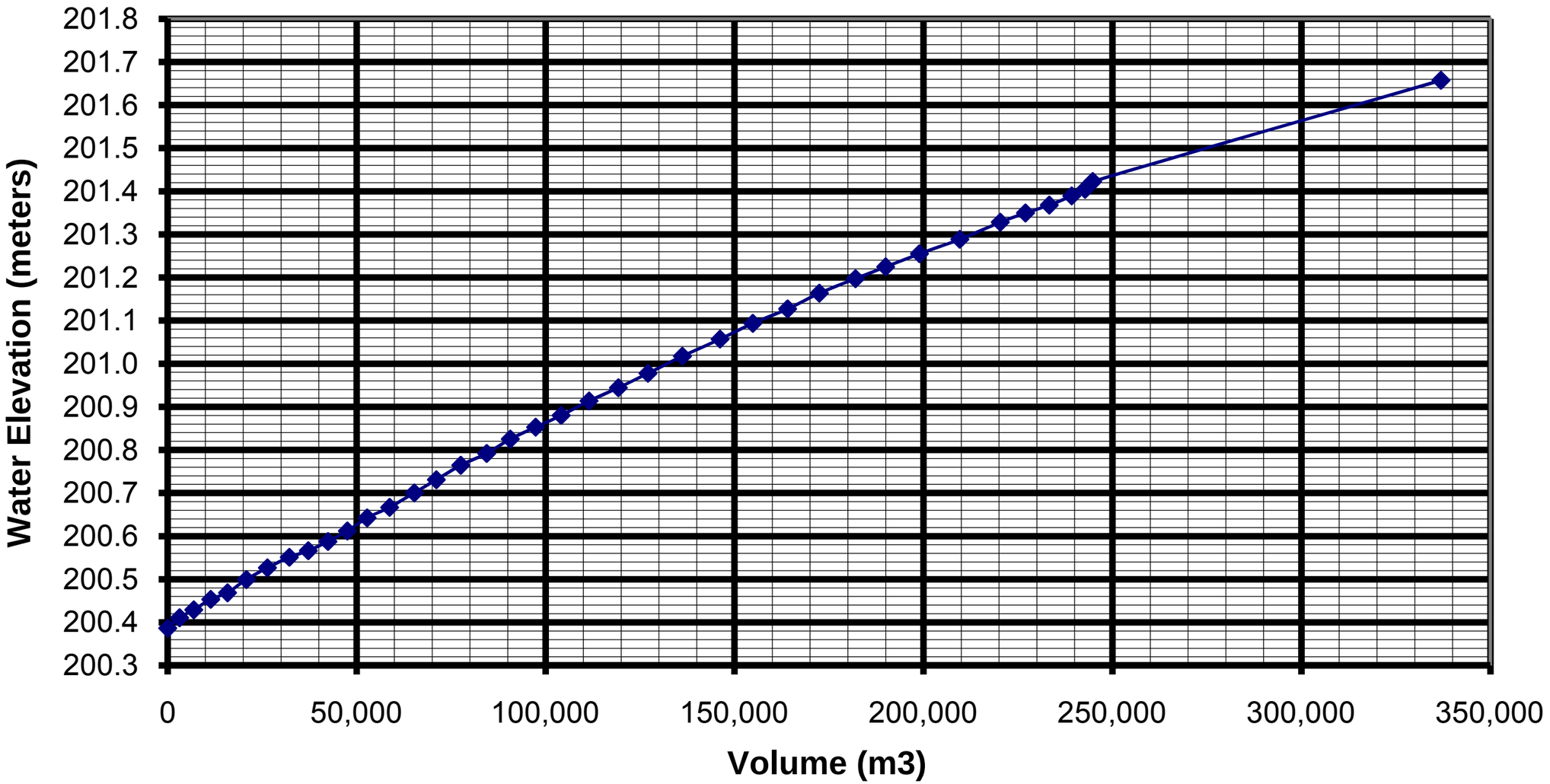
Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX E1

PINE POINT TAILINGS IMPOUNDMENT VOLUME/ELEVATION CURVE

Pine Point Tailings Impoundment: Volume/Elevation Curve
2006 extended



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Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX E2

LIME SLURRY %SOLIDS

Lime Slurry: Percent Solids

Lime Slurry weight percent solids P = $\frac{\text{Weight of Lime}}{\text{Weight of Slurry}}$ x 100

Weight of Slurry = Weight of Water + Weight of Lime

Volume of Slurry = Weight of Water + Weight of Lime/SG of lime

Specific Gravity of Lime = 2.5

Normally the slurry weight is measured using a 500 cc cylinder

500 = Ww + Wl/2.5 at 10% solids Ww = 9Wl 0.1 = Wl/(Ww + Wl)

500 = 9Wl + 0.4Wl Ww + Wl = 10Wl

Wl = 500/9.4 = 53.19 gm

Ww = 9 x 53.19 = 478.7 gm

Weight of Slurry = 478.7 + 53.2 = 531.9 gm

Weight %	Wl gm	Ww gm	Weight of Slurry gm
10	53	479	532
10.5	56	478	534
11	59	476	535
11.5	62	475	537
12	65	474	539
12.5	68	473	541
13	70	472	542
13.5	73	471	544
14	76	469	546
14.5	79	468	548
15	82	467	549
15.5	85	466	551
16	88	465	553
16.5	92	463	555
17	**95**	**462**	**557**
17.5	98	461	559
18	101	460	561
18.5	104	458	562
19	107	457	564
19.5	110	456	566
20	114	455	568

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Pine Point MineTailings Impoundment Area

Water Treatment Manual

APPENDIX E3

ESTIMATED LIME ADDITION RATES

Estimated Lime Addition Rates

For a target pH of 10.9 - 11

Lime Slurry at 17% solids by weight (190 gm/l of lime)

Target Lime addition rate of 0.188 gm/l of Pond Water

Discharge Weir inches	Water Flow m3/min	Lime Flow L/min
2	3.08	3.05
2 1/4	3.68	3.64
2 1/2	4.30	4.26
2 3/4	4.97	4.92
3	5.66	5.60
3 1/4	6.38	6.31
3 1/2	7.13	7.05
3 3/4	7.91	7.83
4	8.71	8.62
4 1/4	9.54	9.44
4 1/2	10.40	10.29
4 3/4	11.27	11.15
5	12.17	12.04
5 1/4	13.10	12.96
5 1/2	14.05	13.90
5 3/4	15.01	14.85
6	16.00	15.83
6 1/4	17.01	16.83
6 1/2	18.05	17.86
6 3/4	19.10	18.90
7	20.17	19.96
7 1/4	21.26	21.04
7 1/2	22.37	22.13
7 3/4	23.49	23.24
8	24.64	24.38
8 1/4	25.80	25.53
8 1/2	26.99	26.71
8 3/4	28.19	27.89
9	29.40	29.09
9 1/4	30.64	30.32
9 1/2	31.89	31.55
9 3/4	33.15	32.80
10	34.44	34.08
10 1/4	35.73	35.35
10 1/2	37.05	36.66
10 3/4	38.38	37.98
11	39.73	39.31

Water Treatment Management Plan for Upset Conditions

Prepared for

Teck Metals Ltd.

Prepared by

srk consulting

SRK Consulting (Canada) Inc.
1CT008.064
January 2018

Water Treatment Management Plan for Upset Conditions

January 2018

Prepared for

Teck Metals Ltd.
Legacy Properties
Bag 2000
Kimberley, BC V1A 3E1

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Saskatoon, SK S7L 6M6

Tel: +1 306 955 4778
Web: www.srk.com

Project No: 1CT008.064

File Name: Appendix E2_Teck_WaterTreatmentManagementPlan_Report.docx

srk consulting

Table of Contents

List of Figures

List of Tables

1 Introduction

This *Water Treatment Management Plan for Upset Conditions* (the plan) is intended as an attachment to and forms a part of the *Operation, Maintenance and Surveillance Manual for Pine Point Tailings Impoundment Area and the Pine Point Water Treatment Manual*, which were accepted and approved by the Mackenzie Valley Land and Water Board (MVLWB) on August 22, 2017.

Operation, Maintenance and Surveillance Manual for Pine Point Tailings Impoundment Area (the manual) was updated by Golder Associates Ltd. on February 22, 2017. The manual defines roles and responsibilities; describes components of the facility; discusses the operation, surveillance, and maintenance of the facility; and specifies reporting and communication.

As requested in the issuance of the Type B Water Licence for the facility on October 25, 2017, the manual must be updated to reflect three considerations (requested in Part F, item 3) by February 1, 2018:

- A description, including detailed rationale, of the monitoring endpoints (Action Levels) for each parameter monitored in the Surveillance Network Program (SNP; Section 3.1);
- Mitigation measures for decreasing pH at SNP station 35-1b when it exceeds effluent quality criteria, as specified in Part F, item 10 (Section 3.2); and
- A description of response actions to be carried out if the Action Levels are exceeded (Section 3.3).

Teck Metals Ltd. is in the process of evaluating engineering controls to reduce pH in effluent reporting to SNP station 35-1b and will implement one or more of these controls prior to the summer 2018 treatment campaign. Some of the engineering controls under consideration are listed in Section 2. However, the evaluation and selection of the most appropriate engineering controls will not be completed prior to the February 1, 2018 deadline set by MVLWB. One or more engineering controls will be in place to mitigate upset conditions as described in Section 3.

2 Engineering Controls Under Consideration

Teck is considering a number of engineering controls to reduce pH in the discharge from SNP station 35-1b to between 6.5 and 9.5, as required by the MVLWB decision on October 25, 2017. Teck will implement the most suitable of these controls in time for the summer 2018 treatment campaign. A second control measure may be identified and implemented dependent on the relative confidence in the preferred solution.

Some of the engineering controls currently under consideration include the following:

- Reducing the lime dose
- Adding ferric sulphate and flocculant

- Injecting treated effluent with carbon dioxide
- Increasing residence time of treated water in the serpentine channel
- Aerating the treated water
- Adding sulphuric acid (via a small metering pump)

In recent years, the pH at SNP station 35-1b has typically been between 9 and 10 (Figure 1). Reducing effluent pH can be achieved through minor modifications of the existing treatment system.

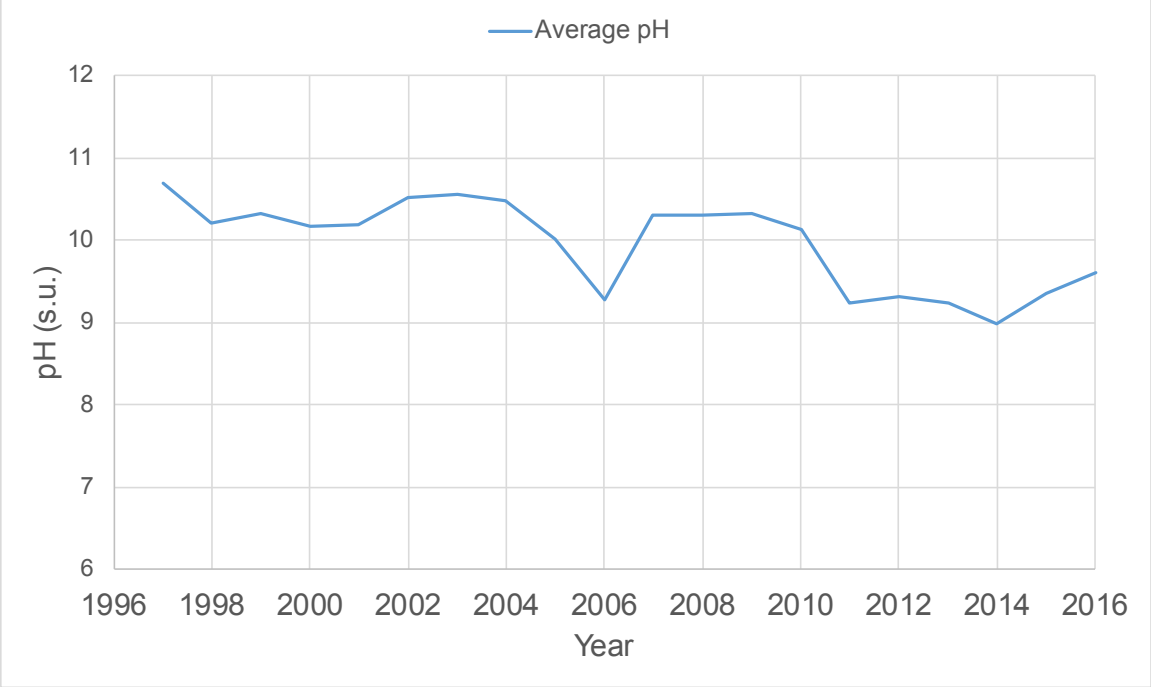

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Figure 1: pH at Station 35-1b from 1996 to 2016

3 Water Treatment Management Plan for Upset Conditions

One or more of the engineering controls listed in in Section 2 will be installed as part of the water management plan for upset conditions described in this section. Consequently, pH is expected to be below 9.5 at SNP station 35-1b throughout the treatment campaign and an exceedance of this level would be attributable to upset conditions.

3.1 Action Levels for Surveillance Monitoring Network

The SNP includes a monitoring location in the pond before treatment (Station 35-1a), a monitoring location for the treated discharge (Station 35-1b), and seven locations downstream of the tailings facility (Figure 2).

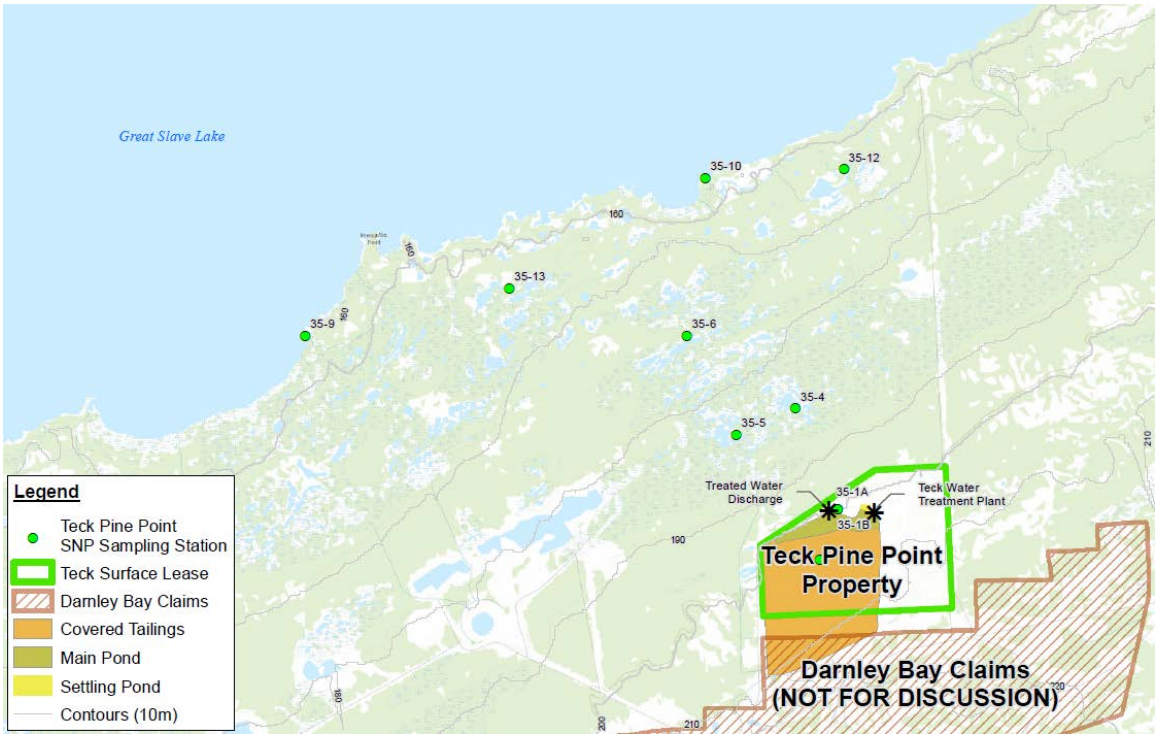


Figure 2: SNP Network

Monitoring endpoints (Action Levels) are only meaningful for Station 35-1b, where treated water is discharge from the facility. Station 35-1a is upstream of the water treatment system, and is therefore not relevant as a monitoring station because concentrations there do not reflect the performance of the treatment system and cannot be mitigated unto themselves.

The downstream stations (Stations 35-4, -5, -6, -9, -10, -12, and -13) are located between the facility and Great Slave Lake. Any effect on water quality at these downstream stations would occur only after the annual treatment campaign is over, and so concentrations at these stations cannot be used to identify potential issues with the treatment system. Additionally, the monitoring data from the past two decades demonstrate that if the discharged water meets the Water License limits, there will not be exceedances of guidelines at the downstream stations. Consequently, the only meaningful Action Levels for the facility are for Station 35-1b.

Proposed Action Levels for Station 35-1b are summarized in Table 1. The Action Levels for all parameters except for pH are the maximum average concentration specified in the Water License. The proposed Action Level for pH is 9.3 standard units (s.u.).

Table 1: Proposed Action Levels for Station 35-1b

Parameter	Maximum Average Concentration (mg/L)	Maximum Grab Concentration (mg/L)	Proposed Action Level for Station 35-1b
pH (in s.u.)	6.5 to 9.5 s.u.	6.5 to 9.5 s.u.	9.3 s.u. maximum
Arsenic, total	0.50	1.00	0.50
Copper, total	0.15	0.30	0.15
Cyanide, total	0.10	0.20	0.10
Lead, total	0.20	0.40	0.20
Zinc, total	0.50	1.00	0.50
Ammonia as N	2.00	4.00	2.00
Total Suspended Solids	25.00	50.00	25.00

3.2 Mitigation Measures for pH

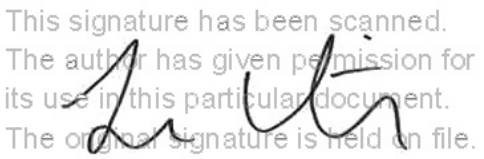
If the Action Level for pH (9.3 s.u.) is exceeded at Station 35-1b, the engineering control measure for reducing effluent pH would have failed. A number of possible mitigation measures can be implemented to correct the situation. The initial response would be to repair or adjust the engineering measure that is put in place. Should repeated attempts to correct the issue prove futile, another one of the engineering controls identified in Section 2 would be implemented. Some of these engineering controls (such as increasing residence time or the injection of sulphuric acid or carbon dioxide) are easier to implement as emergency or short-term “response actions” (Section 3.3) than others (such as aerating the water). A hierarchy of engineering controls, from most suitable to least preferred will be developed as part of the engineering review.

3.3 Response Actions

If an Action Level is not met at Station 35-1b, the sequence of response actions is as follows:

1. Immediately stop discharge.
2. Confirm that the measuring equipment is properly calibrated, then confirm the measurement.
3. If the Action Level is still not met, recirculate water to the beginning of the serpentine channel and notify Stephen Parris at (250)427-8438 or (250)427-6012. The site Manager (Stephen Parris) will notify the GNWT inspector.
4. If recirculating the water in the serpentine channel is not possible from a water management perspective, pump the water in the serpentine channel back to the pre-treatment pond on the facility.
5. Implement one or more mitigation measures (Section 3.2).
6. Do not discharge water that does not meet the Action Level. Repeat Step 5 until the water is acceptable to discharge.

This draft report, Water Treatment Management Plan for Upset Conditions – REVISED DRAFT, was prepared by SRK Consulting (Canada) Inc.



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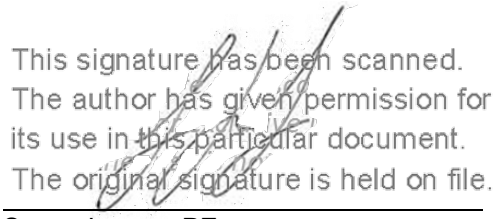

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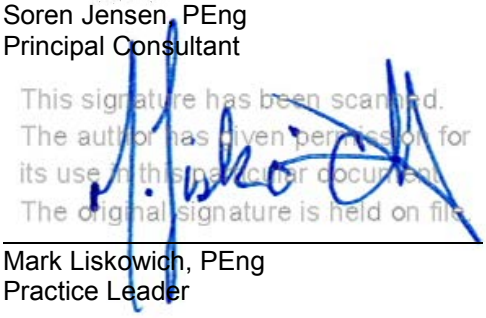

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.