2015 Annual Geotechnical Inspection – Lupin Mine Tailings Containment Area, Nunavut

Prepared for

Lupin Mines Incorporated

Prepared by

SRK Consulting (Canada) Inc.
1CL008.002
October 2015

2015 Annual Geotechnical Inspection – Lupin Mine Tailings Containment Area, Nunavut

October 2015

Prepared for

Lupin Mines Incorporated
201 – 750 West Pender Street
Vancouver, BC VC 2T8
Canada

Prepared by

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2
Canada

Project No: 1CL008.002

File Name: Lupin_1CL008 002_2015 Annual Inspection Report_AT_PMH_20151009_FNL.docx

srk consulting

Table of Contents

List of Figures

List of Tables

Appendicies

1 Introduction

The Lupin Mine site is currently under care and maintenance status and at the time of the inspection was operating under expired Nunavut Water Licence 2AM-LUP0914 (NWB 2009) by Lupin Mines Incorporated (LMI), a wholly-owned indirect subsidiary of Elgin Mining Inc. On October 5, 2015 the Minister of the Aboriginal Affairs and Northern affairs approved the renewed and amended Type A water licence, 2AM_LUP1520.

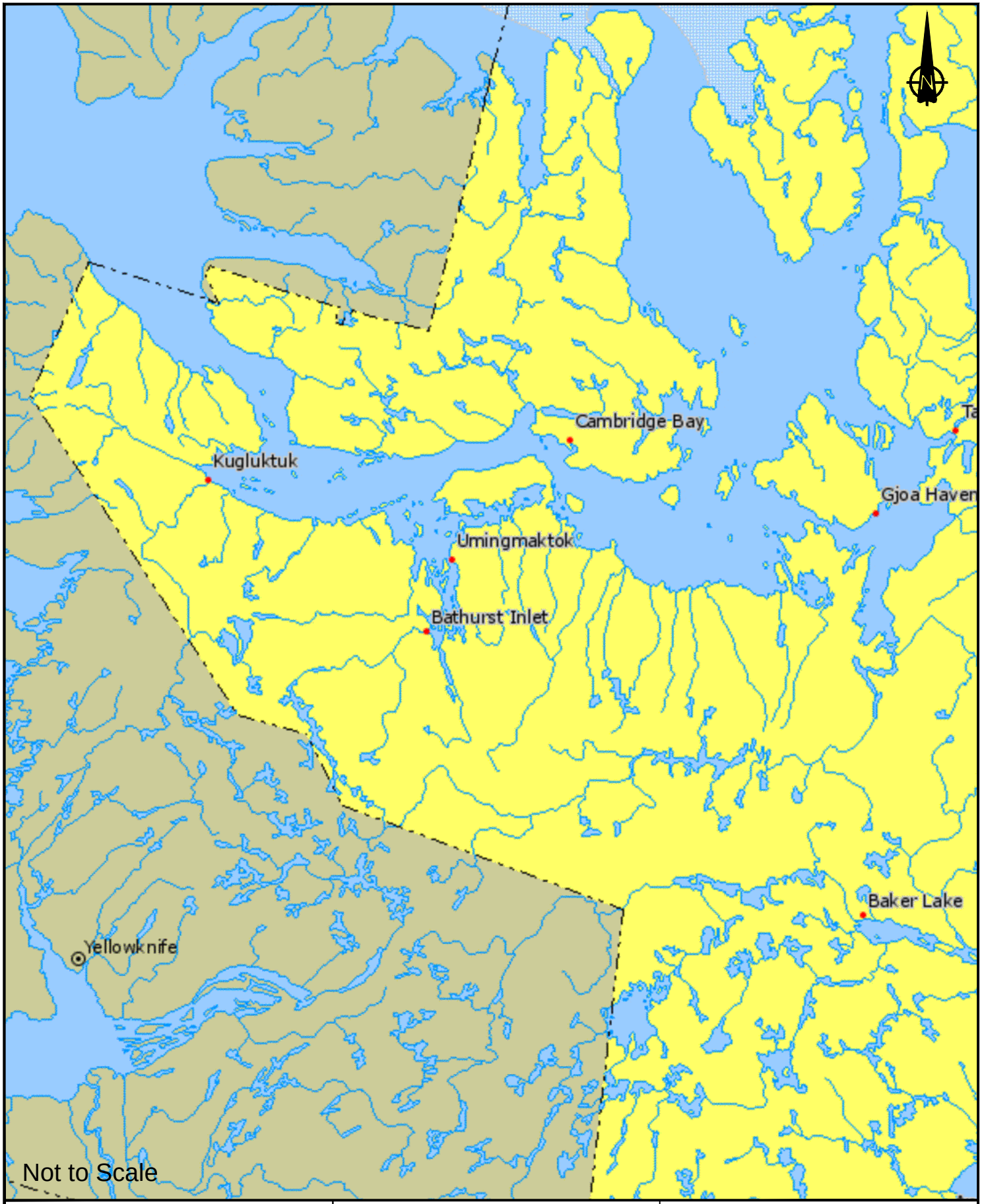
The mine is located on the west shore of Contwoyto Lake, approximately 285 km southeast of Kugluktuk, Nunavut and 400 km northeast of Yellowknife (Figure 1-1). As a part of the Water Licence requirement, an annual geotechnical inspection is required for the tailings containment area (TCA) perimeter dams, TCA Covers, including an assessment of any seepage from the TCA (NWB 2009). In fulfillment of the regulatory requirements, LMI has retained SRK Consulting (Canada) Inc. to conduct the 2015 geotechnical site inspection. Part E Item 6 of expired water licence (NWB 2009) applies to the inspection and stipulates the following:

"*Clause E.6. The TCA shall be constructed, operated and maintained to engineering standards such that:*

a. A freeboard limit of 1.0 m shall be maintain at all times or as recommended by a Geotechnical Engineer and as approved by the Nunavut Water Board (the Board) in writing;
b. Seepage from the TCA is minimized;
c. Any seepage that occurs is collected and returned immediately to the TCA;
d. Erosion of constructed facilities is addressed immediately;
e. The solids fraction of the mill Tailings shall be permanently contained within the TCA or underground as Backfill;
f. Weekly inspections of the dam(s), Tailings line(s), and catchment basin(s) shall be carried out and records of these inspections shall be kept for review upon the request of an Inspector, or as otherwise approved by the Board. More frequent inspections shall be performed at the request of an Inspector; and
g. *An inspection of the TCA shall be carried out annually during ice free, open water conditions by a Geotechnical Engineer. The Engineer's report shall be submitted to the Board within sixty (60) days following the inspection and shall include a covering letter from the Licensee outlining an implementation plan to respond to the Engineer's recommendations*."

This report summarizes SRK's observations of the TCA's condition and our recommendations. Previous annual inspections and closure planning reports on record, available to the author included:

- Inspections from 2012-2014 by SRK Consulting,
- Inspections from 2009-2011 by TBT Engineering Consulting Group,
- Inspections from 1997, 2000-2008 by BGC Engineering and Golder Associates,
- TCA closure design reports by Holubec Consulting and Klohn-Crippen and
- The 2004 Dam Safety Review of the perimeter tailings dams performed by Golder Associates.



srk consulting

Lupin Mine Inc.

LUPIN MINE

Location Plan

SRK JOB NO.: 1CL008.000

FILE NAME: Lupin-SiteFacil-utm-12_ATedits_RevD_09092017.dwg

Lupin Mine Incorporated

DATE:	APPROVED:	FIGURE:
Sept 2015	AT	1.1

S:\1040_AutoCAD\Lupin-SiteFacil-utm-12_ATedits_RevD_09092017.dwg

2 Site Conditions

2.1 History of the Lupin TCA

A brief summary of the development history of the TCA is listed in Table 2-1. A detailed history of the Tailings Containment Area (TCA) is provided in the closure plan prepared by Holubec Consulting Inc. in 2005 (Holubec 2005).

Table 2-1: Lupin Mine TCA Development Historical Summary

Year	Comment
1960	Ore deposit discovered by Canadian Nickel Company Ltd.
1980	Property purchased by Echo Bay Mines Ltd.
1981	TCA developed by the construction of Dam 1A and Dam 2.
1982	Mining operations commenced in October and tailings slurry discharged from the northern edge of the TCA into future Cell 5. Dam 3 constructed.
1985	Tailings management strategy revised and tailings deposited within cells. Excess water from the cells is directed into two ponds in series within the TCA prior to discharge. Internal Dam 3C and Dam J constructed.
1988	Covering of tailings in parts of Cell 1 with gravelly sand commenced.
1990	Internal Dam K constructed and Cell 4 provides an additional clarification pond.
1992	Perimeter Dam 4, Dam 5 and Dam 6 and internal Dam L and Dam M constructed.
1995	Reminder of Cell 1 and parts of Cell 2 were covered.
1997	Internal Dam N constructed.
1998	Production stopped and site placed on care and maintenance in January.
2000	Production resumed in April. Dam M raised.
2002	Echo Bay Mines Ltd., TVX Gold and Kinross Gold Corp. merged and Kinross assumed control of operations.
2003	Site placed on care and maintenance in August. Parts of Cell 3 were covered.
2004	Production resumed between March and December. Reminder of Cell 2 was covered. Parts of Cell 3 were covered.
2005	Closure of operation announced in February and site placed on care and maintenance. Parts of Cell 3 and 5 were covered. The small cell formed by Dam N was covered.
2006	Ownership is purchased by LMI, a subsidiary of Wolfden Resources.
2007	Wolfden Resources acquired by Zinifex Ltd.
2008	Zinifex Ltd. merged with Oxiana Ltd. to form OZ Minerals Ltd.
2009	Canadian assets of OZ Minerals sold to China Minmetals Ltd. MMG Resources Inc., a wholly owned subsidiary of Minerals and Metals Group Ltd., was the Canadian operating company set up after that transaction to hold the Lupin Mine.
2011	Ownership of LMI purchased by Elgin Mining Inc. in July.
2014	Elgin Mining Inc. acquired by Mandalay Resources Corp.

About 84% of the tailings areas are covered with at least 1 m of sand/gravel (Holubec 2006). The property has remained in care and maintenance since 2005 and no tailings has been produced since then, nor has the remaining exposed tailings been covered.

2.2 Site Infrastructures

Because of its isolated location, the mine site was constructed to be totally self-sufficient, with all (then) operations and (now) maintenance personnel housed on site. The only year-round access to the site is via aircraft. Historically, the mine was annually resupplied in bulk via a 570 km ice-road from Tibbitt Lake during February and March.

The Lupin Mine site (Figure 2-1) consists of two major areas: an industrial complex and the TCA. The industrial complex consists of the administration buildings, mill, maintenance shops, fuel tank farms, camp buildings, and the airstrip (Figure 2-2). The 2015 waste management facilities geotechnical inspection focused on facilities at the industrial complex and is reported separately.

The 2015 TCA geotechnical inspection focused on the terms stipulated by the expired water licence 2AM-LUP0914 (NWB 2009). The TCA is located approximately 6 km south of the industrial complex, and is divided into two main components: five solid retention cells and two settling ponds in series (Figure 2-3). The TCA is characterized by six main perimeter dams and nine internal dams for cell separation. The perimeter dams consist of Dams 1A, 1B, 1C, and Dams 2 to 6. The dams range in height from 1-8 m. The nine internal dams consist of Dams 3C, 3D and 3E, and Dams J thru N. Internal dams range from 5.7-11.2 m in height. All dams are constructed from esker sands and gravels, with the perimeter dam including a liner for seepage control. All perimeter dams are frozen core structures founded on permafrost.

The care and maintenance procedures for water management at the TCA have runoff flowing from Cell 3 to Cell 4, where solids settle out prior to the water flowing to Pond 1. It is assumed water flows from Cell 4 to Pond 1, via a gated culvert and trench. Water in Pond 1 is then transferred by siphon to Pond 2 for clarification and settling and, if needed, treatment, prior to discharge to the environment. Water in Cell 5 is siphoned to Pond 1 as needed for water management. Prior to discharge by siphon from Pond 2 to the environment the quality of water is tested for pH, metals and toxicity to rainbow trout and *Daphnia* species.

2.3 Dam Classifications

According to the Canadian Dam Association (CDA) guideline (Table 2-2), the perimeter Dams 1A, 1B, 1C, and Dams 2 to 6 are classified as “Significant” as there is no population at risk, no significant loss or deterioration of fish or wildlife habitat in the immediate impact areas and no losses to recreational facilities, workplace or transportation routes. The nine internal Dams 3C, 3D and 3E and Dams J thru N are classified as “Low” as no loss of life and external environmental losses are expected (Golder 2004).

Table 2-2: Dam Classifications as per CDA (2007, Revised 2013)

Dam Class	Population at Risk[1]	Incremental losses		
		Loss of Life[2]	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 services
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 affection infrastructure, public transportation, 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)

[1] Definitions 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.

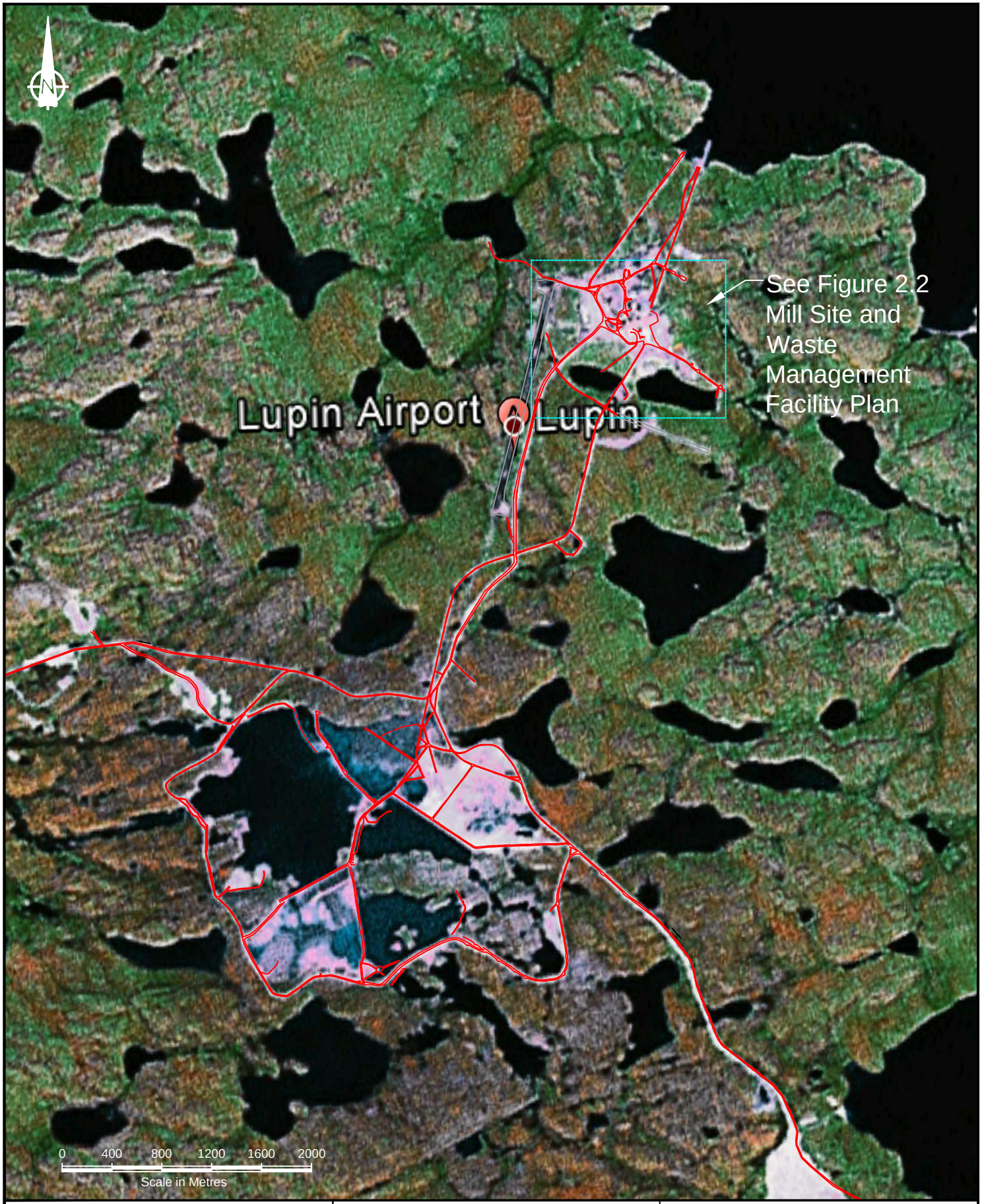
Temporary—People are only temporarily in the dam-breach inundation zone (e.g., seasonal cottage use, passing through on transportation routes, participating in recreational activities).

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).

[2] Implications for loss of life:

Unspecified – The appropriate level of safety required at 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.

The classifications of these dams do not require an Emergency Preparedness Plan (EPP) or a dam break inundation study.



srk consulting

Lupin Mine Inc.

LUPIN MINE

General Site Plan

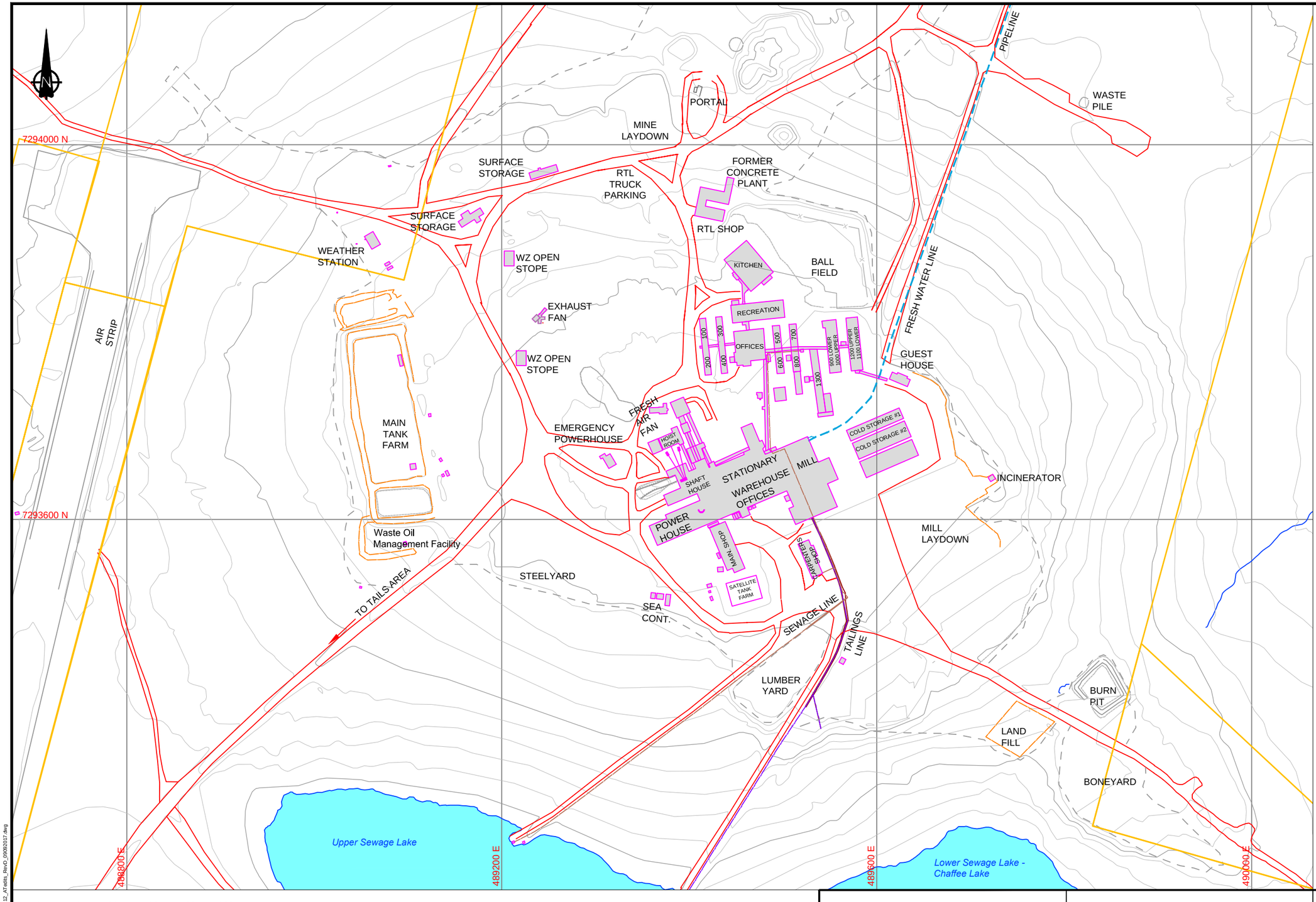
SRK JOB NO.: 1CL008.000

FILE NAME: Lupin-SiteFacil-utm-12_ATedits_RevD_09092017.dwg

Lupin Mine Incorporated

DATE:	APPROVED:	FIGURE:
Sept 2015	AT	2.1

S:\1040_AutoCAD\Lupin-SiteFacil-utm-12_ATedits_RevD_09092017.dwg



LEGEND

- Lake Pond
- Tank Farm Berm Outline
- Building
- Water Pipeline (8 in Diam) (Not in Use)
- Tailings Line Route (Not in Use)
- Sewage Pipeline (6 in Diam) (Not in Use)
- Lake Shore, Drainage
- Contour 1 m
- Contour 5 m
- Roads
- Site Features Miscellaneous
- Cleared Area
- Berm Area
- Slope Toe
- Slope Top
- Culvert
- Fence

NOTES

1. Topographic information and facilities outline provided by Lupin Mine Inc. on August 13, 2012.

0 40 80 120 160 200

Scale in Metres

Coordinate System: Nad_1983_UTM_Zone_12N
NTS Map Sheets 076E11 and 076E14

srk consulting

SRK JOB NO.: 1CL008.000

FILE NAME: Lupin-SiteFacil-utm-12_ATedits_RevD_09092017.dwg

Lupin Mine Inc.

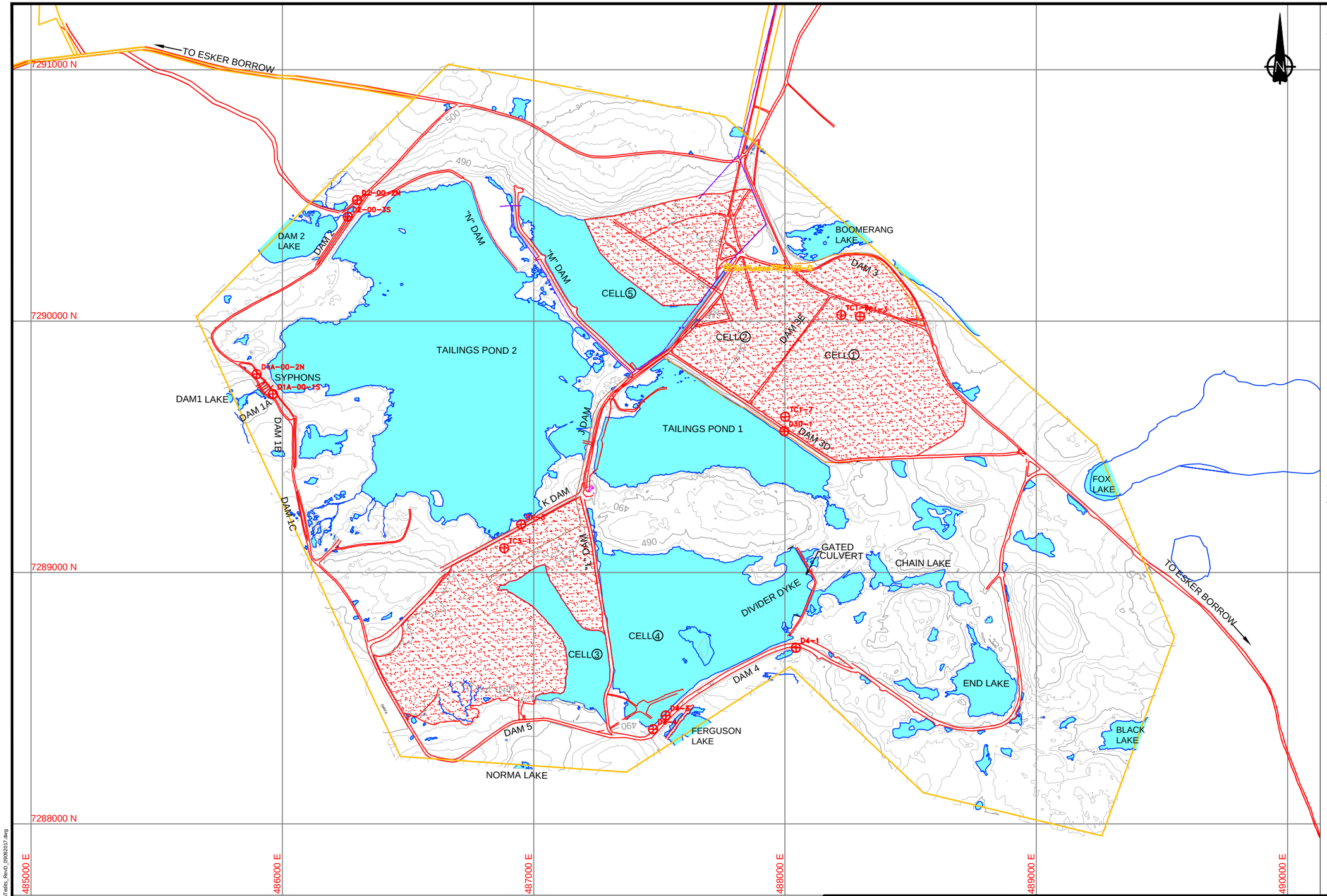
Lupin Mine Incorporated

LUPIN MINE

Mill Site and Support Facility Plan

DATE:	APPROVED:	FIGURE:
September 2015		2.2

S:\1040_AutoCAD\Lupin-SiteFacil-utm-12_ATedits_RevD_09092017.dwg



LEGEND

- Water Body
- Granular Tailings Cover
- Lease Boundary
- Lake Shore, Drainage
- Tailings Line Route (Not in Use)
- Contour 1 m
- Contour 5 m
- Roads
- Berm Area
- Thermistor
- Cells

NOTES

1. Topographic information and facilities outline provided by Lupin Mine Inc. on August 13, 2012.

0 100 200 300 400 500

Scale in Metres

Coordinate System: Nad_1983_UTM_Zone_12N
NTS Map Sheets 076E11 and 076E14

srk consulting

SRK JOB NO.: —

FILE NAME: Lupin–SiteFacil–utm–12_ATedits_RevD_09092017.dwg

Lupin Mine Inc.

Lupin Mine Incorporated

LUPIN MINE

Tailings Containment Area

DATE:	APPROVED:	FIGURE:
September 2015		2.3

S:\1040_AutoCAD\Lupin-SiteFacil-utm-12_ATedits_RevD_09092017.dwg

2.4 Climate

Climate conditions were recorded at the Lupin manned weather station until October 2006. An automated weather station known as Lupin (MAPS) (CWIJ) in Weather Underground database, or Lupin CS Climate ID 230N002 in Environment Canada database, has recorded data intermittently at the site. Reviewing the data from the end of October 2006 to the present, the station has reported an arctic climate with a mean annual temperature of -9.8°C. Winter is considered to last from October to May and summer is considered to last from June to September. The average summer daily temperature is 7.6°C and the average winter daily temperature is -19.2°C. There are persistent winds at an annual mean of 17.4 km/h and gusts up to 95.0 km/h. Measured site precipitation is reported at an annual mean of around 405 mm. The data does not breakdown the precipitation into rain and snow (WU 2015).

2.5 Site Geology

The Lupin gold deposit is situated in an Archean metaturbidite sequence of the Contwoyto Formation, part of the Yellowknife Supergroup of supracrustal metasedimentary and metavolcanic rocks of the Slave Geologic Province. The rocks have been subjected to both regional and contact metamorphism and to several phases of deformation and intrusion.

The Contwoyto Lake area lies within the Upland unit of the Kazan physiographic region of the Canadian Shield. The area was glaciated during the Pleistocene Epoch. Isostatic rebound after ice melt resulted in emergent landforms, and during this process all parts of the land were washed by runoff and lakes. The easily erodible glaciolacustrine sediment, till and glacio-fluvial sand and gravels were subsequently reworked by melts and runoff. This has resulted in the present day outcrops with thin soil veneers, abandoned beaches and esker formations (Kinross 2005).

Tailings are primarily composed of the gangue minerals amphibole and quartz, which account for over 80% of the volume. Pyrrhotite and arsenopyrite make up an additional 17% (Klohn-Crippen 1995). The tailings have been shown through various studies to be capable of generating acid upon oxidation (Kinross 2005).

2.6 Permafrost and Dam Geotechnical Conditions

The area is completely within Canada's cold continuous permafrost region. The active layer is observed to be somewhat variable between the depths of 1.3-3.1 m based on available data. There has been long-term discontinuous monitoring of the permafrost conditions in dams at the Lupin TCA since 1995. The recordings are made by thermistors installed in various dam and cover locations. While a number of thermistors are defunct and others have suffered physical damages, there are sufficient operating thermistors that are read regularly during inspections. They continue to show the presence of permafrost through the dams and foundations. While there are some fluctuations in recorded ground temperature readings, the 2015 reading are within the record limits.

3 TCA Inspection

3.1 General

Mr Alvin Tong, PEng, a Senior Consultant with SRK, conducted the geotechnical inspection on 5th and 19th August, 2015. After a general overview of the site from the air, the detailed site inspection was carried out using ground transportation with frequent stops for thorough visual inspections. Mr Patrick Downey and Ms. Karyn Lewis, LMI representatives, accompanied SRK on the inspection on 19 August 2015.

Weather conditions during the inspection were cool and sunny with periods of high winds. A detailed photographic log of the inspection is included in Appendix A.

Generally, the inspection revealed the perimeter dams are in good condition with the exception of the erosion damage on Dam 3, which was repaired this season after the inspection. Tension cracks were observed on the crests of the internal Dam K and M. Minor erosion was observed on all the inspected dams. Dam N was submerged at the time of inspection.

The Divider Dyke is located east of Cell 4 and southeast of Pond 1. This structure was not included as part of the annual inspection as it was not designed or intended to contain tailings.

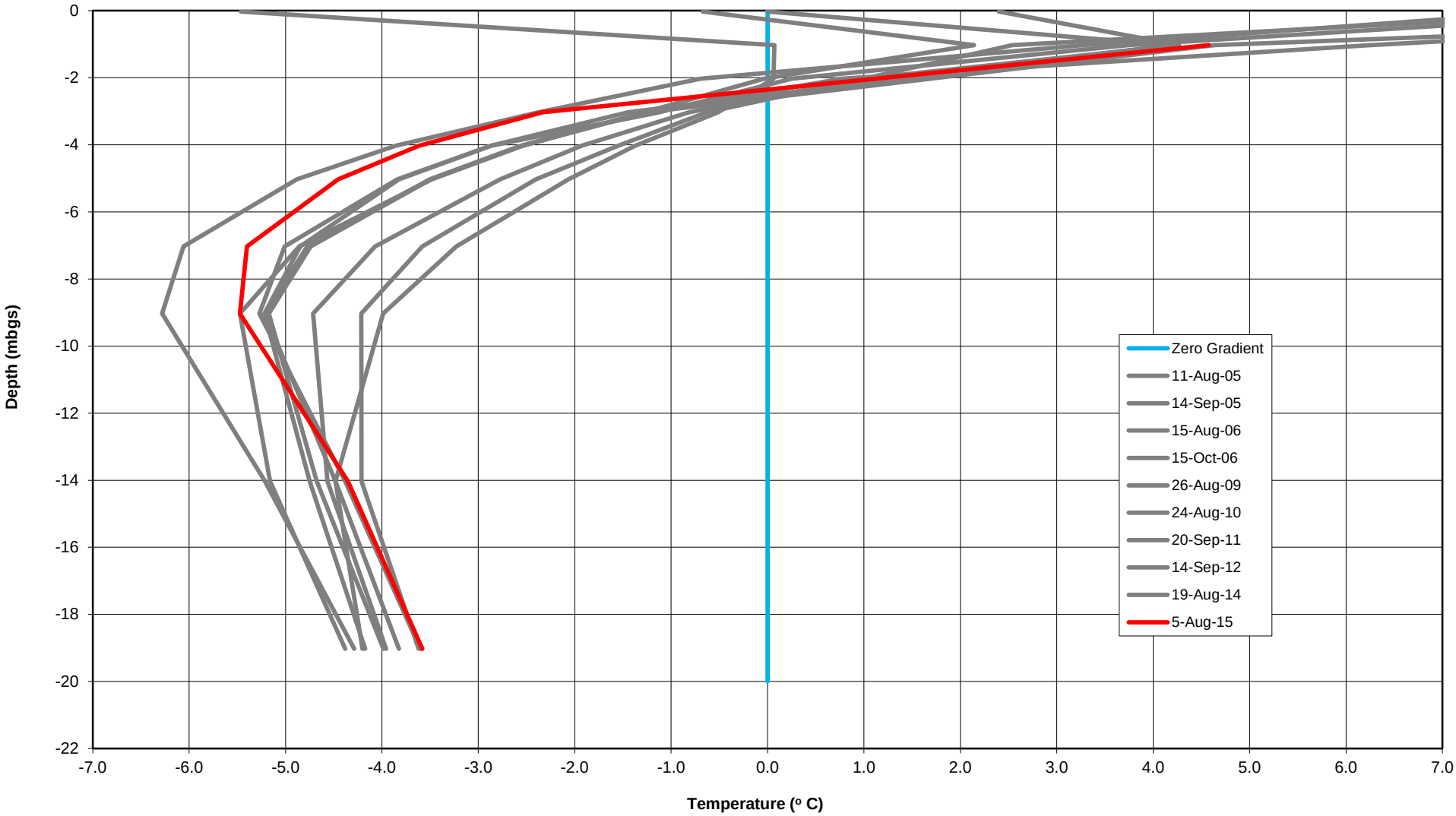
Since our inspection, LMI has siphoned Cell 5 to lowest point possible allowed by the siphon pipes. LMI provided photographs showing the results of the siphon operation. At the time of writing this report LMI was currently discharging from Pond 2 to lower the water level.

3.2 Thermistors

Figure 2-3 presents the locations of five functioning TCA thermistors that were installed between 1995 and 2004. In addition to the thermistor strings shown, there are a number of historical thermistor installations that are no longer functional. Furthermore, only thermistor data recorded after production and deposition of tailings ended in 2005 are presented in this document, as this data best reflects the current care and maintenance status. To provide a point of reference, selected data from August to October are shown for comparison.

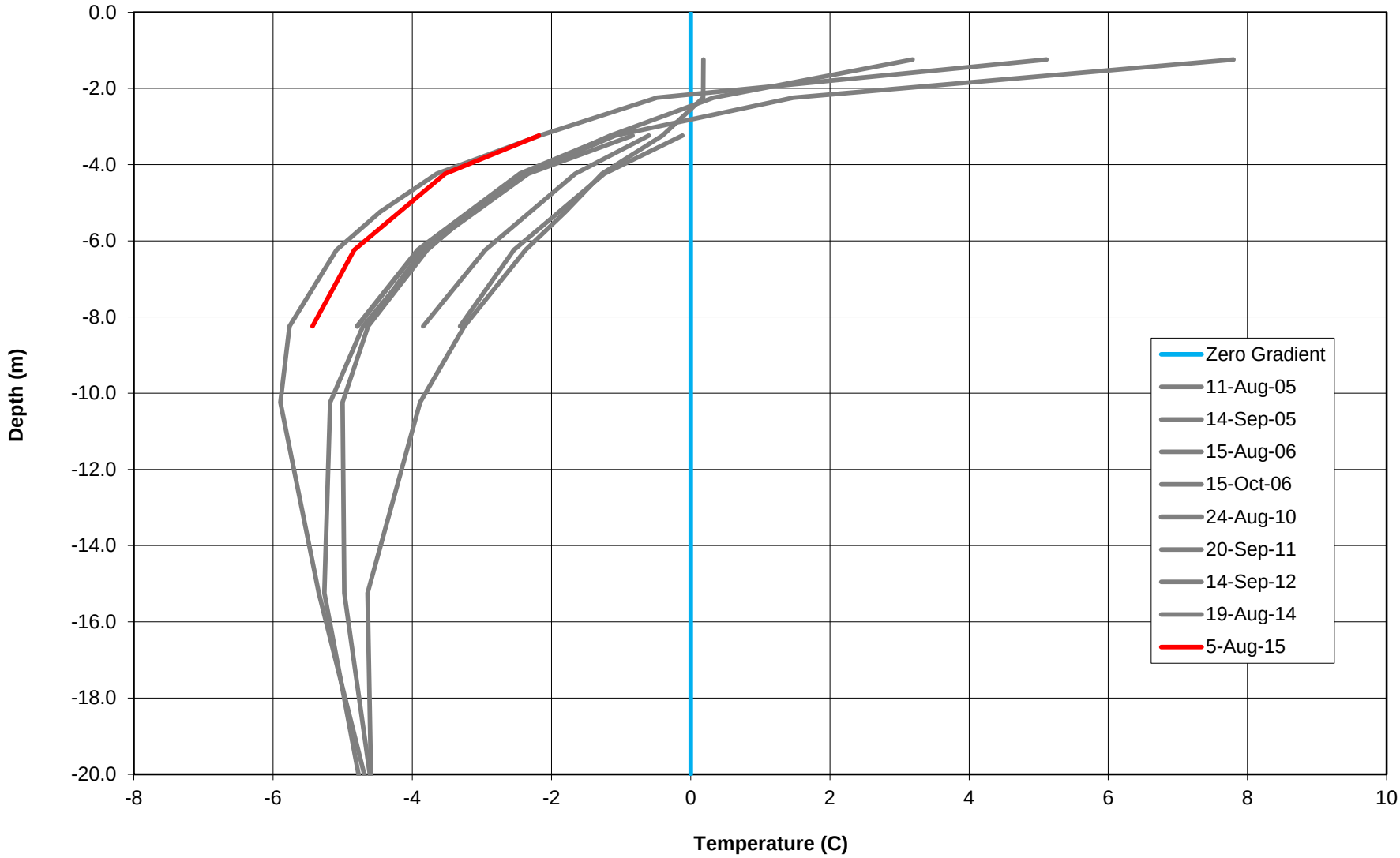
In the TCA, all five of the thermistors are less than 20 m deep. Based on the data between 2005 and 2015, taking into account annual climatic variations, the 2015 readings are within the historical variations. The largest historical variation in the given data set of 4°C occurs in Dam 3D, at approximately 4 m below the dam crest. This variation occurs below -1°C; and the 0°C gradient occurs at approximately 3 m below the surface. This concurs with the regional active zone based on in-house information and national research (Penner 1983). These records indicate the frozen cores in the majority of the dams are within the seasonal limits and visual physical inspection support the conclusion that permafrost is not degrading in most of the structures. Figure 3-1 to Figure 3-7 show the thermistor data read during summer periods from 2005-2015.

Thermistor D1A-00-01 - Installed November 9, 2000
(Vertical Thermistor installed on the crest of Dam 1A, south of Syphons)



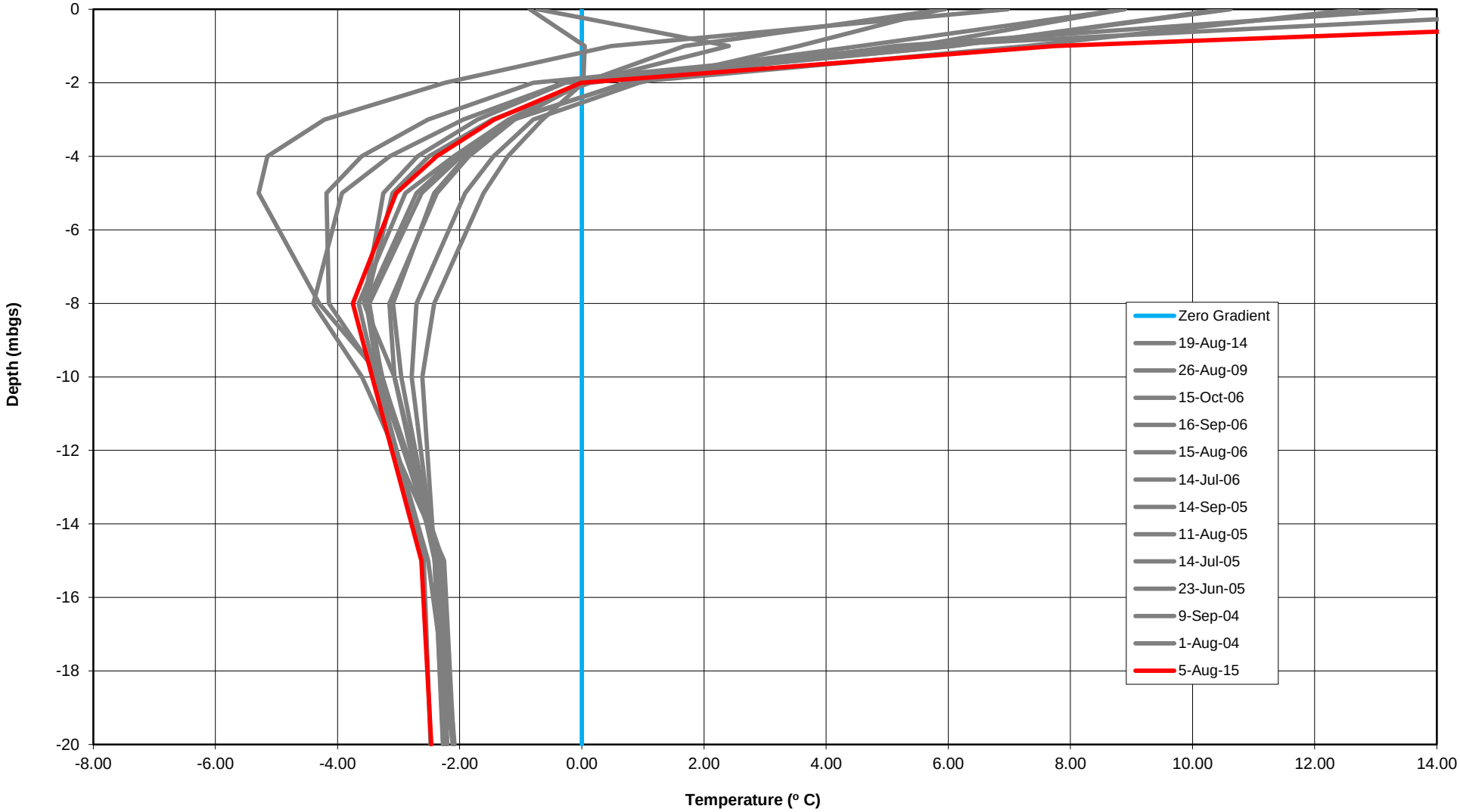
srk consulting	**Lupin Mines Incorporated**	2015 Annual Geotechnical Inspection on Perimeter Dams
		Thermistor Reading D1A-00-01
Job No: 1CL008.001 Filename: Lupin Annual Inspection_Figure 3.1_3.5.pptx	Lupin Mine	Date: Sept 2015 / Approved: AT / Figure: **3-1**

Thermistor D2-00-2 n- Installed November 8, 2000
(Vertical Termistor Installed on the crest of Dam 2, at the north end)



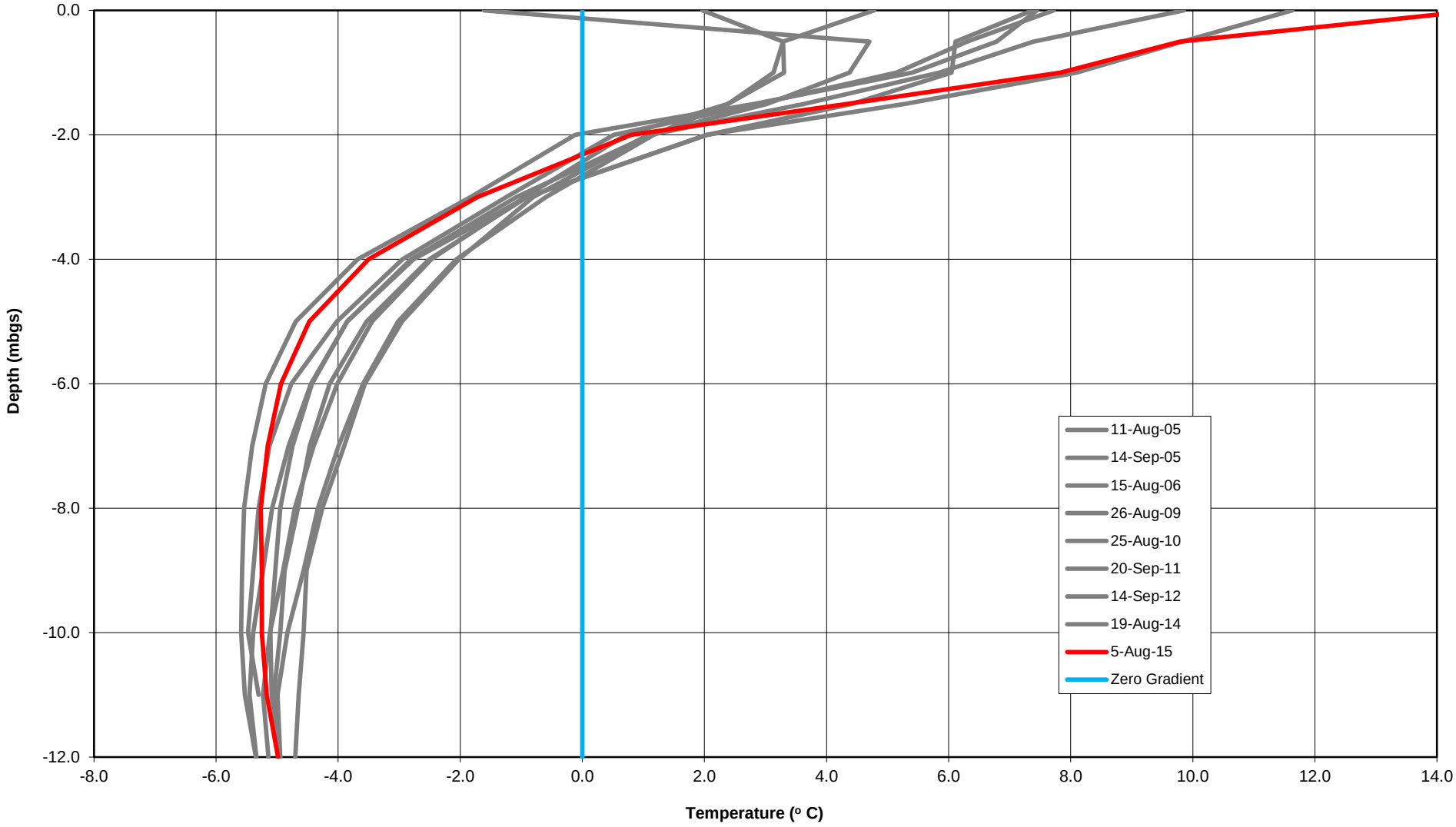
srk consulting	**Lupin Mines Incorporated**	2015 Annual Geotechnical Inspection on Perimeter Dams
		Thermistor Reading D2-00-02
Job No: 1CL008.001 Filename: Lupin Annual Inspection_Figure 3.1_3.5.pptx	Lupin Mine	Date: Sept 2015 / Approved: AT / Figure: **3-2**

Thermistor D3D-1 - Installed June 13, 2004
(Vertical Thermistor installed on the crest of Dam 3, near middle)



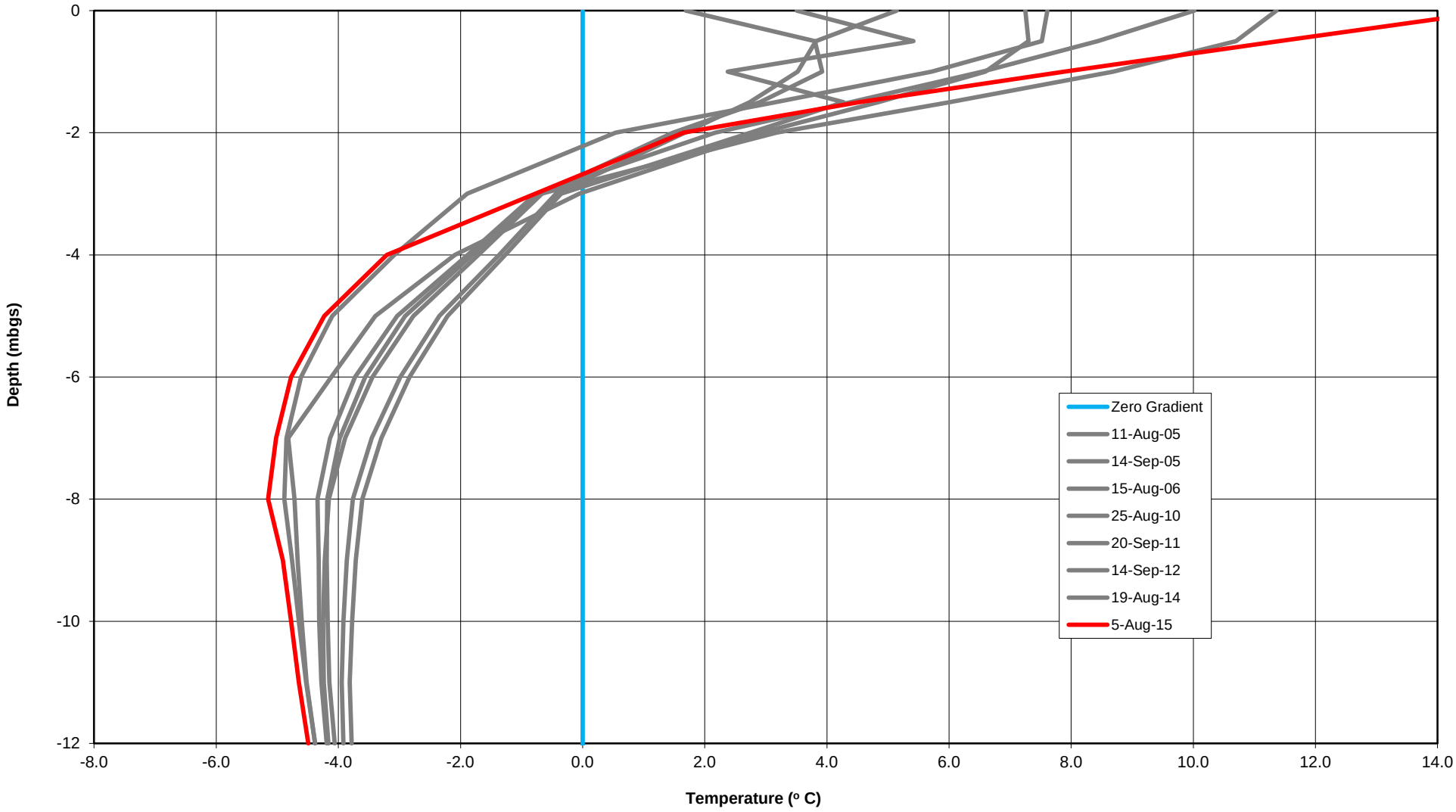
srk consulting	**Lupin Mines Incorporated**	2015 Annual Geotechnical Inspection on Perimeter Dams
		Thermistor Reading D3D-1
Job No: 1CL008.001 Filename: Lupin Annual Inspection_Figure 3.1_3.5.pptx	Lupin Mine	Date: Sept 2015 / Approved: AT / Figure: **3-3**

Thermistor D4-1 - Installed October 24, 1995
(Vertical Thermistor installed on the crest of Dam 4, Far East End)



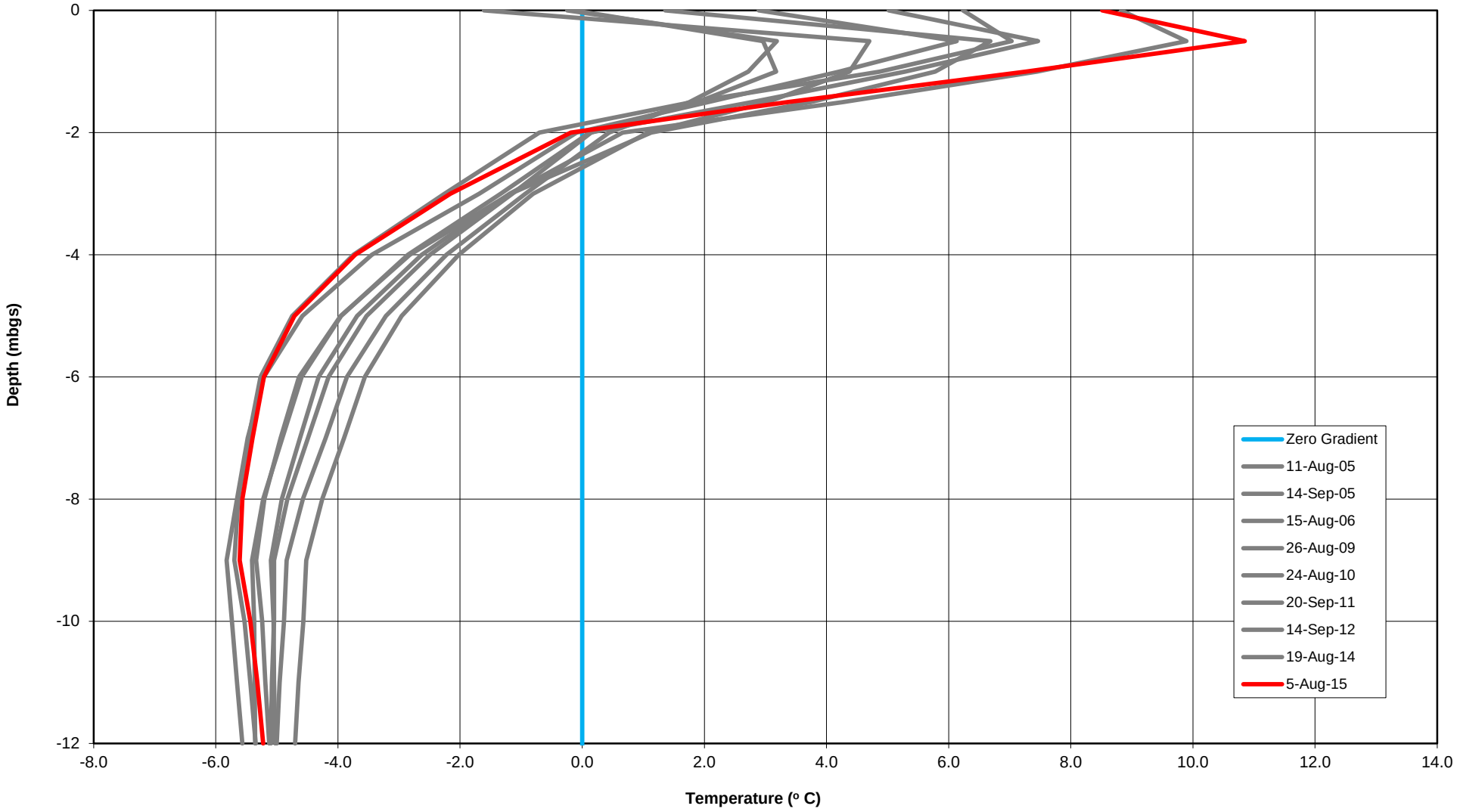
srk consulting	**Lupin Mines Incorporated**	2015 Annual Geotechnical Inspection on Perimeter Dams
		Thermistor Reading D4-1
Job No: 1CL008.001 Filename: Lupin Annual Inspection_Figure 3.1_3.5.pptx	Lupin Mine	Date: Sept 2015 / Approved: AT / Figure: **3-4**

Thermistor D4-3 - Installed October 25, 1995
(Vertical Thermistor installed on the crest of Dam 4, West End, Just East of TD4-4)



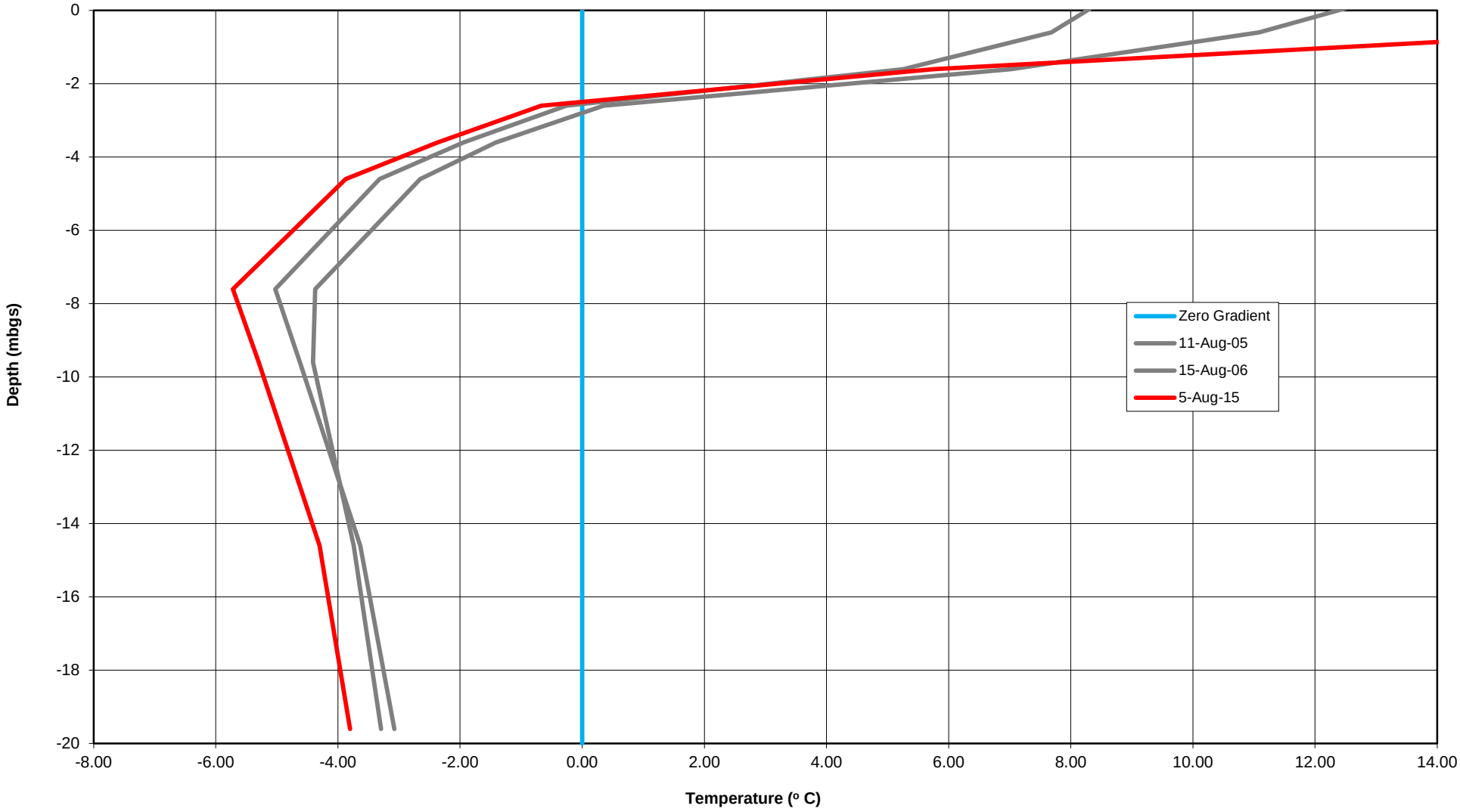
srk consulting	**Lupin Mines Incorporated**	2015 Annual Geotechnical Inspection on Perimeter Dams
		Thermistor Reading D4-3
Job No: 1CL008.001 Filename: Lupin Annual Inspection_Figure 3.1_3.5.pptx	Lupin Mine	Date: Sept 2015 / Approved: AT / Figure: **3-5**

Thermistor D4-4
(Vertical Thermistor installed on Dam 4)



srk consulting	**Lupin Mines Incorporated**	2015 Annual Geotechnical Inspection on Perimeter Dams
		Thermistor Reading D4-4
Job No: 1CL008.001 Filename: Lupin Annual Inspection_Figure 3.1_3.5.pptx	Lupin Mine	Date: Sept 2015 / Approved: AT / Figure: **3-6**

Thermistor DK-3 - Installed June 14, 2004
(Vertical Thermistor installed on the crest of Dam K, near middle)



srk consulting	**Lupin Mines Incorporated**	2015 Annual Geotechnical Inspection on Perimeter Dams
		Thermistor Reading DK-3
Job No: 1CL008.001 Filename: Lupin Annual Inspection_Figure 3.1_3.5.pptx	Lupin Mine	Date: Sept 2015 / Approved: AT / Figure: **3-7**

3.3 TCA Perimeter Dams

The perimeter dams are generally in good condition in terms of stability and performance. There are minor erosion issues which are typically associated with sand and gravel construction material. While most of the erosion is minor, the repair work on the downstream face of Dam 1A should be completed in 2016. The rest of the dams should be monitored and repaired as required to prevent any continuous erosion that could worsen and impair the dam's structural integrity.

The previous annual inspection found seepage in the western buttress toe of Dam 4 into Ferguson Lake and the northern buttress toe of Dam 2 into a pond created by a cofferdam adjacent to Dam 2 Lake. Seepage at Dam 4 has not been observed since the 2011 inspection. Seepage at the toe of Dam 2 was observed in 2015, at similar flowrates since 2012. In 2015, this seepage was contained by the cofferdam downstream of north abutment and pumped back into Pond 2 when it pooled.

The storm ditch built within the top 2 m of Dam 3 has suffered some erosion damages from the 2014 freshet. It is believed that ponding in sections of the ditch is the main cause of the erosion damage. Because of the poor grading, the closure cover runoff water pooled, froze, and created an ice dam; which in turn forced the freshet water to overtop the ditch, over a small portion of Dam 3. Repair was completed on the damaged area in 2015 by constructing an armored channel along the alignment of the erosion, to let the drainage bypass the ponding section.

The observed freeboard on the perimeter dams ranges from approximately 1.5-2 m depending on the individual perimeter dam elevations. The observed freeboards are in compliance with the 1.0 m minimum stipulated by the water license for all the perimeter dams. LMI is currently treating and discharging water hence the freeboard on the perimeter dams is expected to increase.

3.4 Internal Dams

All of the internal dams have experienced typical erosion associated with dams constructed from esker sand material. Dam 3D is in good condition. Dam J, Dam K, and Dam M require some repair and maintenance and the condition of Dam N cannot be determined until water levels in Pond 2 are lowered.

During the 2012 inspection, an erosion breach was observed at the south end of Dam L. The erosion damage was repaired this year. The Dam L slope facing Cell 3 is observed to have considerable erosion near the toe.

Dam J has erosion on both sides of the dam.

Dam K has historically experienced erosion (undercutting) at the toe of the slope due to wave action on the adjacent water in Pond 2. Minor tension cracks and a few erosion gullies were observed in the dam crest. Recent observations made by an SRK engineer during an inspection on October 7 indicate that there is in fact riprap armoring along the northern toe of Dam K. This riprap armoring was submerged during previous inspections and was only exposed recently as Pond 2 was lowered. Animal burrows were observed in the eroded gullies. It is unknown what type of animal made these burrows.

Eight significant tension cracks were observed on Dam M. Visual comparison between 2012 and 2015 photographs showed the existing cracks are widening and lengthening. Potentially, the failed portions of the dam could breach and allow the supernatant water and tailings to flow from Cell 5 into Pond 2. Because of the severity of the cracks and potential breach, LMI was advised that all vehicle traffic should avoid this section for safety reasons. A risk assessment was completed by SRK in 2012 to evaluate the potential impact on water quality and the environment in the event of a breach. The results of the assessment indicated that there would be minimal impact to the environment due to the presence of the perimeter dam containment (SRK 2012b). However, a breach in Dam M would be a concern for worker safety, site infrastructure access, future operations, and ongoing care and maintenance activities. Section 4.1 provides recommendations to address the potential risks in the event of a full breach.

The water level in Pond 2 was higher than levels previously observed by SRK at the time of the site visits, just prior to discharge. Dam N was almost submerged. This made the dam surface difficult to travel on due to the fully saturated material. The difficulties in gaining access and the high water coverage on the dam made it difficult to carry out a proper inspection.

Previously, Dam 3D, Dam L and Dam N were not included in the annual inspections. Under pre-2014 CDA guidelines they were not considered as dams due to the absence of water ponded upstream of them. However under the updated CDA technical bulletin issued in 2014, a structure impounding liquefiable contaminants, such as unfrozen tailings, is considered a dam. Due to this update, Dam 3D, Dam L and Dam N should be included in future annual inspections until the tailings behind these dams are confirmed to be non-liquefiable. Thermistor readings from 2014 and 2015 in the structure of Dam 3D indicate the zero degree gradient is 2 m below surface. While it is likely that tailings behind the dam are also frozen 2 m below the cover surface, there are insufficient data to determine the exact depth of the zero degree gradient. If all the tailings impounded behind Dam 3D, L and N are found to be frozen, which would render them non liquefiable, the dams could be reclassified as embankments.

The observed freeboard during SRK's inspection of the internal dams varies up to 5 m.

4 Recommendations

Table 4-1 summarizes observations and recommendations from the inspections performed in 2014 and 2015. Highlighted recommendations are deemed critical and LMI should complete the work as high priorities.

Table 4-1: Inspection Observations and Recommendations

Inspection Item	2015 Inspection			2014 Inspection	
	Estimated Freeboard (m)	Observations	Recommendations	Observations	Recommendations
Perimeter Dams					
Dam 1A	>2 m	Minor erosion on slopes with some deep erosion gullies.	Repair deep erosion gullies.	Minor erosion on series and some deep erosion gullies.	Repair deep erosion gullies.

Inspection Item	2015 Inspection			2014 Inspection	
	Estimated Freeboard (m)	Observations	Recommendations	Observations	Recommendations
Dam 1B	~2 m	Minor surface erosions.	Surface maintenance e.g. grading and backfilling.	Minor surface erosions.	Consider surface maintenance.
Dam 1C	1.8 m	Minor surface erosions. No cracks observed.	Surface maintenance e.g. grading and backfilling.	Minor surface erosions. No cracks observed.	Consider surface maintenance.
Dam 2	~2 m	Minor surface erosion. Estimated seepage at the northern buttress is less than 0.1 L/min. Collection pond was emptied in 2015.	Monitor the seepage and water level in collection pond to pump the collected seepage back into Pond 2 as necessary.	Minor surface erosion. Estimated seepage at the northern buttress is less than 0.1 L/min. Collection pond is nearly full.	Consider surface maintenance. Monitor the water level in collection pond to pump the collected seepage back into Pond 2.
Dam 3	N/A (no water is impounded by this dam)	Erosion has once again damaged the dam crest due to the poor storm ditch grading. Mitigation included converting the erosion gully into an armored storm ditch to provide proper drainage.	Repairs were completed on the eroded section by LMI after the inspection. Monitoring should be carried out to check that the new ditch is performing as intended.	Minor surface erosion. Despite repairs to the storm ditch, it does not yet have a free-draining grade.	Repairs were completed on the eroded section after the inspection by LMI. Consider to re-grade ditch to minimize ponding and monitor during freshet to prevent ice blockages.
Dam 4	~2 m	Surface erosion with a number of erosion gullies. Exposed geogrid observed near the eastern downstream toe of the dam.	Repair the deep erosion gullies, re grade surface and backfill and depressions monitor the exposed geogrid for further erosion and potential water seepage.	Surface erosion with a number of deep erosion gullies. Exposed geogrid or similar synthetic reinforcements observed near the eastern downstream toe of the dam.	Repair the deep erosion gullies and maintain the surface. Monitor the exposed geogrid for further erosion and potential water seepage.
Dam 5	N/A (no water is impounded by this dam)	Minor surface erosions.	Surface maintenance e.g. backfilling and regrading.	Minor surface erosions.	Consider surface maintenance.
Dam 6	1.5 m	Surface erosion with some gullies.	Repair the deep erosion gullies, backfill depressions and regrade	Surface erosion with some gullies. No seepage or ponding.	Repair the deep erosion gullies and maintain surface.
Internal Dams[(1)]					
Dam 3D	~5 m	Minor surface and crest erosions.	Surface maintenance. e.g. backfilling and regrading Optionally, it is recommended to complete an evaluation on the depth of frozen tailings to de-classify this facility as a dam (see Section 3.4)		

Inspection Item	2015 Inspection			2014 Inspection	
	Estimated Freeboard (m)	Observations	Recommendations	Observations	Recommendations
Dam J	0.4 m (Pond 1), 1.5 m (Pond 2)	Reduced crest width due to erosion and placement of siphon pipes. Toe erosion likely due to wave action from Pond 1 and 2. Free board is around 0.2 m.	Repair eroded section and siphon pipes base. Rebuild crest width where possible. Place riprap along the dam face on both sides to protect against further erosion.	Reduced crest width due to erosion and placement of siphon pipes. Toe erosion likely due to wave action from Pond 1 and 2. Free board is around 0.3 m.	Repair eroded section and siphon pipes base. Rebuild crest width where possible. Place riprap along the dam face on both site to protect against further erosion.
Dam K	~4 m	Downstream crest erosion and undercutting at toe from Pond 2 wave action. Animal burrows are noted.	Surface maintenance. e.g. backfilling and regrading Recommend placing riprap near the toe for erosion protection. Monitor the animal burrows activity in the dam and consult an animal specialist for mitigative measures if burrow activities increase. Note See section 4.1 for further recommendations	Minor downstream slope surface erosion and some undercutting at toe; appears to be fine grained material, from Pond 2 wave action.	Consider surface maintenance. Consider placing riprap near the toe for erosion protection.
Dam L	0.5 m (Cell 5), 2 m (Cell 4)	Erosion of the dam face in Cell 3 and reduced crest width. Repair was done on the erosion damage from 2012.	Recommend placing riprap at the eroded areas for protection.	Minor slope surface erosions and some undercutting at toe. Breach at southern section of dam near buttress. No seepage observed	Consider surface maintenance. Consider placing riprap at the eroded areas for protection. Repair the breach with compacted well-graded esker material. Monitor and manage water in Cell 3 to prevent freshet overflow.
Dam M	0.8[(2)] m (Cell 5), 4 m (Pond 2)	Slope surface erosion. Tension cracks observed to be widening and lengthening prepared to previous year. Cracks are up to 30 m long and deeper than 30 cm.	Set up barricades on dam to prevent non-authorized personnel traffic. LMI should contact the engineer-of-record to identify proper mitigation repairs. Reference section 4.1 for detailed mitigation measures.	Slope surface erosion. New major tension cracks observed over 150 m section along the southwest facing slopes. Cracks are up to 10 m long and deeper than 30 cm.	Set up barricades on dam to prevent non-authorized personnel traffic. Consider construction of a buttress for stabilization. Reference section 4.1 for detailed mitigation measures.
Dam N	0 m	Nearly submerged at the time of visit. Water is noted to pond in the western abutment.	Monitoring of the dam is recommended once the Pond 2 water level is lowered to allow observations.		

Note [1]: Dam 3C and 3E are considered closed as they have been intergraded with the tailings granular cover with no difference in elevation and risk of failure.

Note [2]: the freeboard is estimated from the photograph provided by LMI after the siphoning.

4.1 Mitigation for Tension Cracks on Dam M

Based on a visual inspection of the tension cracks in Dam M, possible causes could include pore water pressure from Cell 5, foundation “creep” (movement between the active layer and permafrost), or undercut erosion of toe material. It is recommended that LMI consults with the engineer-of-record to better understand the mechanism behind the tension cracks and appropriate repairs. This could involve an investigation program to determine the exact mode(s) of failure before designing the appropriate remedial measures.

In the short term, all non-authorized personnel should avoid this dam for safety reasons. SRK further recommends that a monitoring program be established to determine the rate of failure and development of new cracks. The program should include pairs of monitoring monuments placed perpendicular to the cracks: one at each end, and one in the middle of the failing sections, each with a matching monitor on the stable section of the crest. Authorized personnel should measure and record the level and distance between each set of monuments on daily bases during the summer season. Results should be compiled and reviewed each year.

The risk assessment and water quality review (SRK 2012b) provided a summary of potential impact in the event of these cracks resulting in a full breach of Dam M. The assessment concluded that a breach of Dam M would not significantly impact the water quality in Pond 2 and would not prevent discharging of the treated water in Pond 2 to the receiving environment. Thus, the risks associated with a dam breach are mainly related to physical stability, health and safety, future operation of Cell 5 and accessibility for traffic around site.

To mitigate some of the stability risks, SRK recommends that LMI keep the water levels in Cell 5 and Pond 2 as low as possible to reduce potential for dam instability. It is recommended that LMI monitor Cell 5 water level and keep it as low as operable until the dam is deemed stable. Recent observations provided by SRK staff show that there is riprap armouring along the toe of Dam M and K. These armoured toes were submerged during previous inspections and were only exposed recently due to the lowering of Pond 2. It is recommended that LMI to keep the water in Pond 2 below this armored toe to minimize erosion damage and reduce stress on the dam.

To further maintain the stability of both Dams M and K, SRK recommends that as an emergency response, a toe buttress be constructed along the toe (Pond 2 side) of both dams as soon as practical. The buttress should be constructed of compacted, well-graded esker material, and placed with a downstream slope of 2H:1V (horizontal to vertical) and extend up to half the height to the existing dam crest. The buttress should have a minimum crest width of 3m and extend a minimum of 5 m beyond the failing sections at each end and armored with riprap at the Pond 2 water level. In addition to the construction of the buttress, SRK recommends that a more detailed investigation be undertaken in consultation with the Engineer-of-Record to further understand the mode of failure.

4.2 General Recommendations

The majority of the perimeter dams were generally found to be performing well and stable. SRK recommends that the observed erosion on Dams 1A, 3, 4, 6, J and N be monitored and repaired as required to reduce the risk of instability. LMI should consult with the engineer-of-record to regarding the current course of action to repair Dams M and K.

Monitoring is recommended at Dam K to track the animal burrow activities. While it is unlikely that the ground animal would be able to penetrate the frozen core, periodic monitoring of the burrows in the summer season is recommended to check on any increase in numbers. An animal specialist should be consulted to identify and remove the animal if significant animal activities are observed or large concentrations of burrows are found within a short distance, e.g., 10 burrows in 30 m distance based on engineering judgment.

As water levels in Pond 2 lower during discharge, Dam N monitoring is recommended by site personnel at the direction of a qualified person and the surveillance data should be communicated to the qualified person for review.

Additional evaluation is recommended to determine the depth of frozen tailings in Cell 1 and 2. This would help determine if Dam 3D can be considered a closed embankment rather than a dam under the 2014 CDA technical bulletin. Similar evaluation should be considered for the content of Dam N containment.

Periodic monitoring in the summer season of the side slopes of Dam L is recommended to determine the maintenance priority in order to minimize the impact of future erosion.

Of the repairs and maintenance recommended in Section 4.1, the following repairs should be prioritized as follows:

1. Keep the water in Cell 5 as low as operable,
2. Keep the water in Pond 2 below the riprap armouring along the toe of Dams M and K,
3. In consultation with the Engineer-of-Record (EOR) initiate an emergency construction of a toe buttress at Dam M as priority, then Dam K,
4. Initiate a consultation with the EOR on a detailed investigation for the potential failure mode(s) in Dams M and K,
5. Monitoring and repair the animal burrow activities in Dam K,
6. Monitoring and repair the erosion in Dam L, and
7. Monitoring and surveillance the physical conditions and stability for Dam N.

LMI should carry out inspections during summer season where practical to include the following:

- Monitoring of seepage flowrates at Dam 2,
- Monitoring of any potential seepage from Dam 4,
- Recording the water levels in Ponds 1 and 2 and Cells 3 and 5,
- General surface erosion and anomalies on dams,

- Monitoring of ground animal burrow activities ,
- Observe the physical condition of Dam N, and;
- Monitoring of tension cracks in Dam M and Dam K.

Observations and findings from site inspections should be included in the annual inspection records.

LMI has commissioned a dam safety review in 2015 as recommended in the Canadian Dam Association guideline. LMI should discuss the findings in that report with the engineer-of-record.

This report "*2015 Annual Geotechnical Inspection of Lupin Mine Tailings Containment Area, Nunavut*" has been prepared by SRK Consulting (Canada) Inc.

Prepared by

Alvin Tong, PEng

Senior Consultant

Reviewed by

Peter Healey, PEng

Project Reviewer

5 References

[CDA] Canadian Dam Association, 2007. Dam Safety Guidelines. ISBN 978-0-7726-5802-9.

[CDA] Canadian Dam Association, Technical Bulletin, Application of Dam Safety Guidelines to Mining Dams, 2014

Golder Associates, 2004. Dam Safety Review, Perimeter Dams, Lupin Mine, Nunavut. Report prepared for Kinross Gold Corp. December 2004.

Holubec Consulting. 2005. Lupin Operation—Closure Plan for Tailings Containment Area. Report prepared for Kinross Gold Corp. January 2005.

Holubec Consulting. 2006. Geotechnical, Seepage and Water Balance—Volume I of Seepage and Water Quality for Reclaimed Tailings Containment Area, Lupin Operation. Report prepared for Kinross Gold Corp. March 2006.

Kinross Gold Corp. 2006. Final Abandonment and Restoration Plan and 2006 Response to Technical Review Comments—Lupin Mine. Prepared for Nunavut Water Board, 2006.

Klohn-Crippen. 1995. Tailings Reclamation Test Cover Program, 1994 Report of Activities. Submitted to Echo Bay Mines Ltd., Lupin Operation. August 2005.

[NWB] Nunavut Water Board. 2009. Water Licence. Gjoa (NU): Nunavut Water Board. Licence No.: 2AM-LUP0914. Type “A”. Issued to Lupin Mines Incorporated. Dated February 25, 2009, as amended May 25, 2009.

Penner, E. and Crawford, C.B., 1983. Frost Action and Foundations, published as DBR paper no. 1090 of the Division of Building Research, National Research Council of Canada, March 1983.

SRK Consulting Ltd(a). 2012. Annual Geotechnical Inspection – Lupin Mine Tailings Containment Area, Nunavut. 1CL008.000. Prepared for Lupin Mines Incorporated.

SRK Consulting Ltd(b). 2012. Lupin Mine Site 2012 Geotechnical Inspection Follow-up Risk Assessment and Water Quality Review. 1CL008.000. Prepared for Lupin Mines Incorporated.

TBT Engineering Consulting Group. 2011. Annual Geotechnical Inspection—Perimeter Dams — Tailings Containment Area—Lupin Mine, Nunavut. Ref. No.: 11-293. Prepared for Elgin Mining Inc. November 2011.

[WU] Weather Underground. 2015. San Francisco (CA): Weather Underground, Inc. Accessed October. Available from: http://www.wunderground.com/cgi-bin/findweather/hdfForecast?query=lupin. WunderSearch.

Appendix A: Photo Log

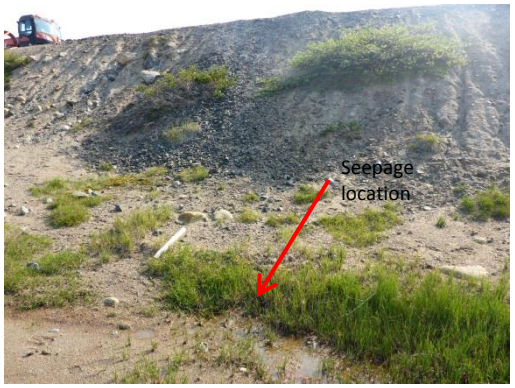


Photo 1: Seepage in the north abutment of Dam 2 and surface erosion

Photo 2: Looking south at the seepage collection ponds at toe of Dam 2.

Photo 3: Looking southwest on Dam 2 near the northern abutment.

Photo 4: Looking south at Dam 1A upstream face.

Photo 5: Downstream surface erosion of Dam 1A

Photo 6: Looking north from the southern abutment of Dam 1A

srk consulting	**Lupin Mines Incorporated**	2015 Annual Geotechnical Inspection Lupin Tailings Mine
		Appendix A: Photo Log
Job No: 1CL008.002 Filename:Appendix_A_Photo_Log_1CL008_002_JN_2014	Lupin Mine	Date: Sept 2015 / Approved: AT / Figure: 1

Photo 7: Looking south at the upstream face of Dam 1B

Photo 8: Look south at the downstream face of Dam 1B

Photo 9: Looking north at the downstream face of Dam 1B

Photo 10: Looking south at the upstream face of Dam 1C

Photo 11: Looking south at the centerline of Dam 1C

Photo 12: Looking south at the downstream face of Dam 1C

Photo 13: Looking south at the downstream face of Dam 6 near the northern abutment

Photo 14: Close up look at one of the large erosion gully in Dam 6.

Photo 15: Looking north at the downstream face of Dam 6 from the southern abutment

Photo 16: Looking east from at the upstream face of Dam 5, near the west abutment.

Photo 17: Looking east from at the center line of Dam 5.

Photo 18: View of the downstream face at the south abutment of Dam 5

Photo 19: Looking east at the upstream face of Dam 4 near the east abutment.

Photo 20: Looking west at the thermistor and downstream face of Dam 4 at near the west abutment.

Photo 21: Close up of erosion gully in Dam 4, the burrow from ground animal.

Photo 22: looking northwest at the storm ditch and erosion damage on crest of Dam 3.

Photo 23: Looking east at the storm channel on Dam 3.

Photo 24: Looking north at the repair work completed over the eroded gully in Dam 3, including geotextile and riprap armoring.

srk consulting	**Lupin Mines Incorporated**	2015 Annual Geotechnical Inspection Lupin Tailings Mine
		Appendix A: Photo Log
Job No: 1CL008.002 Filename:Appendix_A_Photo_Log_1CL008_002_JN_2014 .docx	Lupin Mine	Date: Sept 2015 / Approved: AT / Figure: **4**

Photo 25: Looking west at the crest and top part of the downstream face of Dam 3D

Photo 26: Looking at the lower part of the downstream face of Dam 3D.

Photo 27: Looking northeast at the downstream face of Dam 3D.

Photo 28: Looking northwest at original tension cracks on Dam M, with Dam N and Pond 2 to the left.

Photo 29: Close up view of the original tension cracks on Dam M.

Photo 30: Looking northwest on Dam M at the over steepen slope directly downstream of the cracks, with Dam N and Pond 2 to the left.

Photo 31: Close up view of Dam M at the new tension cracks observed in 2014, through the centerline of the dam, near the eastern abutment to Dam J.

Photo 32: Close up eastern view of Dam M at the new tension cracks observed in 2014, in face of the dam toward Pond 1.

Photo 33: Close up western view of Dam M the new tension cracks observed in 2014, in face of the dam toward Pond 1, upwards of 0.3m wide and 0.5m deep.

Photo 34: Looking east at the upstream face of Dam M and dewatered Cell 5, near the western abutment.

Photo 35: Looking west at the upstream face of Dam M and dewatered Cell 5, near the middle of the dam.

Photo 36: Looking northeast of at the Dam M facing toward pond 2. Note the failure surfaces at the toe.

Photo 37: Looking south on Dam J with Pond 2 at the right.

Photo 38: Looking North on Dam J crest with Pond 1 at the right.

Photo 39: Looking south on Dam J with Pond 1 at the left.

Photo 40: Looking south at Dam K facing pond 2. Note the under cut from at the toe of the dam.

Photo 41: Close up view of erosion gully in Dam K facing pond 2.

Photo 42: Looking west at Dam K with pond 2 at the left at the eastern abutment.

Photo 43: Looking south at the crest of Dam L with Cell 4 at the left.

Photo 44: Looking north at the crest and dam face with Cell 4 to the right.

Photo 45: Aerial view of Dam N. Note the near submergence due to the high water level in Pond 2 during the time of visit.

Photo 46: Picture taken on October 6th at Dam M showing the armored toe that was previously submerged in Pond 2.

Photo 47: Picture taken on October 6th at Dam L showing the armored toe that was previously submerged in Pond 2.