October 31, 2014

KLONDIKE SILVER - SILVANA MINE

2014 Annual Dam Safety Inspection

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REPORT

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Executive Summary

This report presents the results of the 2014 annual Dam Safety Inspection (DSI) for the Tailings Management Facility (TMF) at Silvana Mine, BC, including dams for Ponds 1, 2 and 3, which are under active care and maintenance activities by Klondike Silver Limited (Klondike). This report was written by Golder Associates Ltd. (Golder) and is supported by a site visit carried out on July 23, 2014.

Dam Classification

The table below presents a summary of the dam classification for the dams at Ponds 1, 2 and 3 at the Silvana Mine TMF, and follows the guidelines from the Canadian Dam Association *Dam Safety Guidelines* (CDA 2013) and *British Columbia Dam Safety Regulation* (Government of British Columbia 2011).

Table E-1: Dam Failure Consequence Classification for the TMF Dams at Tailings Ponds 1, 2 & 3

Dam	Dam Class	Population at Risk	Consequences of Failure		
			Loss of Life	Environment and Cultural Values	Infrastructure and Economics
Pond 1 TMF Dam	High	Permanent	Low	Significant to High	Significant to High
Pond 2 TMF Dam	High	Permanent	Low	Significant to High	Significant to High
Pond 3 TMF Dam	High	Permanent	Low	Significant to High	Significant to High

The evaluation of the dam classification for the three ponds is based on no current active mining at the site and no water stored in any of the three ponds. It is anticipated that a re-evaluation of dam classification of at least the dam for Pond 3 will be required before the mine re-starts operations.

Operation, Maintenance and Surveillance Manual, Emergency Preparedness and Response Plan and Dam Safety Review

An Operation, Maintenance and Surveillance (OMS) Manual (Golder 2014) and Emergency Preparedness and Response Plan (EPRP) for the Silvana Mine TMF were completed in 2014. The documentation is up to date and reflects current conditions at the TMF. No modification is required to this documentation for the current care and maintenance status of the mine.

A Dam Safety Review of the TMF has not been completed in the last 10 years. The Canadian Dam Association *Dam Safety Guidelines* (CDA 2013) recommended that a dam safety review be conducted once every 10 years for embankments with a 'High' dam classification. It is recommended that a Dam Safety Review for the embankments at the Silvana Mine be completed in early 2015.

2014 Annual Dam Safety Inspection

From the observations made during the site visit of July 23, 2014, the dams appeared to be stable and in reasonable condition given the current care and maintenance status at the mine and with no mining operation and no water stored in any of the three ponds.

Key Recommended Actions

Deficiency or Non-conformance	Applicable Guideline	Potential Dam Safety Impact or Risk	Recommended Action	Recommended Timing for Completion
Inspection	CDA (2013)	Inadequate notice of potential for dam failure	Institute regular, documented inspections based as per CDA recommendations.	2014
Stream erosion protection below the three dams	CDA (2013)	Erosion of toe causing dam instability, potential loss of dam and tailings into stream.	Repair of the bank protection at and upstream of Pond 1 and in the area of the office some 100 metres upstream of the Tailings Management Facility	Completed before the 2015 freshet
Trees on slopes of all three ponds	CDA (2013)	Degradation of slope, increased permeability.	Trees on the slopes of all three ponds should be removed. A second inspection should be completed in the spring once the trees have been removed from the slope.	Spring 2015
Slope geometry	CDA (2013)	Risk of slope instability.	The dams for Ponds 1 and 2 should be re-sloped to a slope less than 2 horizontal to 1 vertical (2H:1V) or flatter. Steeper slopes could be used if confirmed with stability analysis.	2015 prior to placement of tailings from new operations
Exposed tailings slope in Pond 1	CDA (2013)	Potential for erosion of tailings.	Place a surface cover layer of 0.5 m of gravel to protect the slope from erosion.	2015
Design record missing	CDA (2013)	Undefined potential for failure.	Dam safety review, including dam stability evaluation.	2015

Study Limitations

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1.0 INTRODUCTION

As requested by Klondike Silver Corp (Klondike), Golder Associates Ltd. (Golder) prepared this 2014 annual Dam Safety Inspection (DSI) report for the embankments of the Tailings Management Facility (TMF) at the Klondike Silver Silvana Mine in British Columbia.

This inspection included the embankments of the dams for Tailings Pond 1, 2 and 3.

This report has been prepared in accordance with Part 10 of the *Health, Safety and Reclamation Code for Mines in British Columbia* (BC MEMPR 2008, Section 10.5.3) and it is understood that this report will be submitted by Klondike to the Chief Mines Inspector. The development of the report followed the guidance provided in the *Guidelines for Annual Dam Safety Inspection Reports* by the British Columbia Ministry of Energy, Mines and Natural Gas (BC MEMNG 2012).

This report was prepared based on a site visit carried out on July 23, 2014 including a walkover of TMF area with Klondike staff involved in the operation, maintenance, and surveillance of the TMF.

This report includes a review of site conditions summarized with photographs and written observations, dam classification, and recommendations for future assessment and maintenance.

The report should be read in conjunction with the "***Study Limitations***" provided at the beginning of the report.

2.0 METHOD

2.1 2014 Site Visit

A site visit was conducted on July 23 2014, as part of this DSI, for a visual inspection of the TMF dams. The people present at the site visit were John Hull P.Eng., Allan Bronsro P.Eng. (Golder) and Ed Craft (Klondike Silver).

2.2 Review of Background Information

Klondike provided the following information for this dam safety inspection.

- 2007 Annual Inspection Report (Craft 2008)
- 2009 Annual Inspection Report (Craft 2010)
- Plan view of the tailings ponds.
- Results of a soils investigation at the site (Golder 1981).

3.0 BACKGROUND

3.1 Site History

The Silvana Mine is in the Slocan Mining District which has produced more than 24 million ounces of silver since the first discoveries in the late 1800s. The mine is approximately 8 km east of New Denver, BC and is accessed through Highway 31A.

Silvana Mine is currently under active care and maintenance while further exploration is completed to determine when mining would continue. The mine is permitted under the *Mines Act* of British Columbia (Government of British Columbia 1996), through Permit M-65, issued by BC MEM. Consequently, mine is subject to the *Health, Safety and Reclamation Code for Mines in British Columbia* (BC MEMPR 2008), which includes the requirement of conducting annual DSI's.

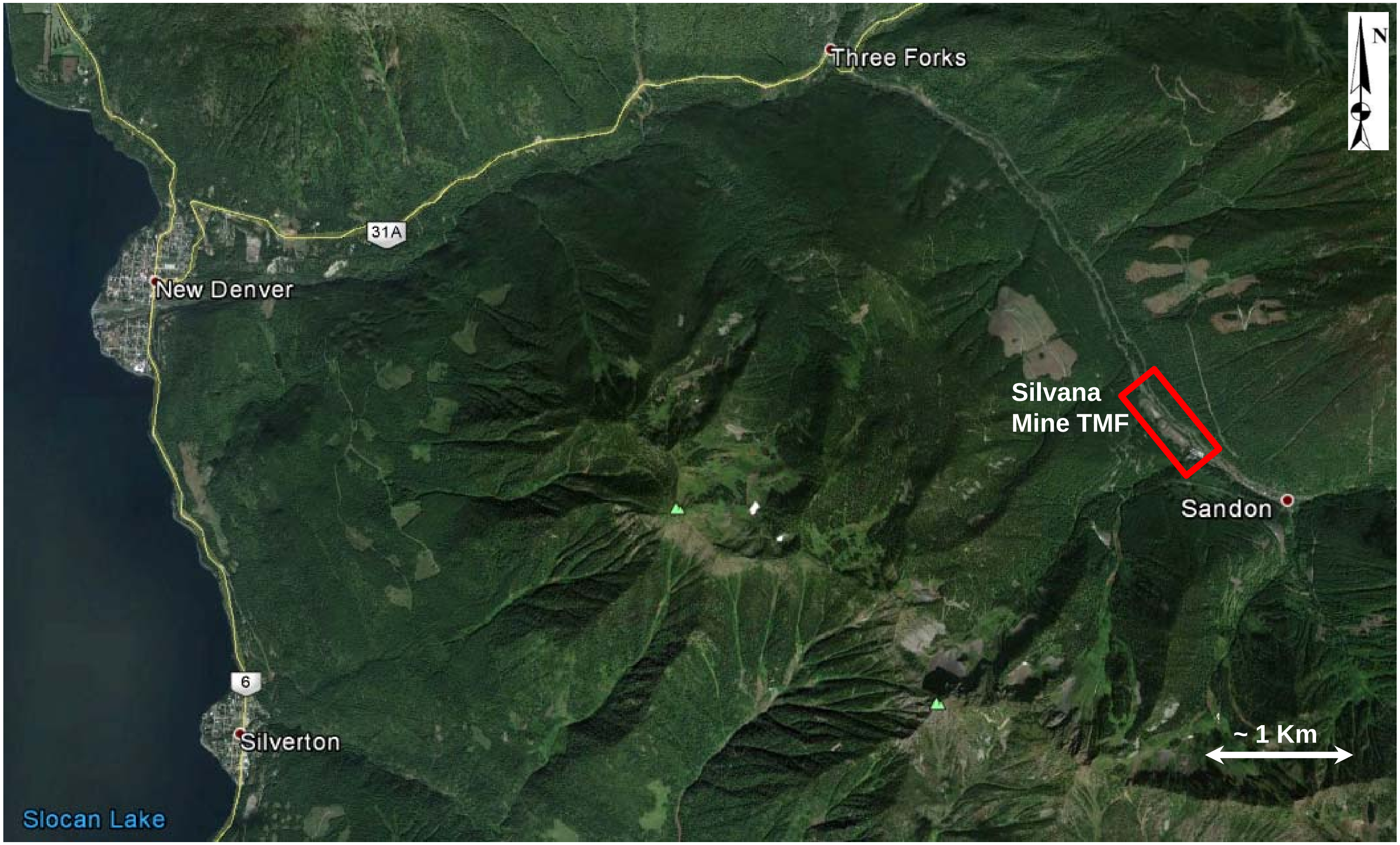
The first Silver discovery in the Sandon area was in 1890 followed by the staking rush in 1891. The Sandon area was explored by many companies over the years but moving forward to 1970 when the productive Silmonac zone or area that is now the Silvana mine site was first discovered by Silmonac Mines Ltd. In 1977 Silmonac Mines Ltd. became Silvana Mines Inc. which then amalgamated with Dickenson Mines Limited in 1980. Power was connected to the property in 1985 by Dickenson during a time of sporadic production. Treminco Resources Ltd. purchased the property via the purchase of Dickenson Mines Limited's Silvana Division in 1989 and continued the exploration of the "Main Lode". In 1983 Treminco suspended their Sandon operations due to lack of developed economic resources in a prevailing low metal price regime.

In May 1999 Klondike Gold Corp. of the Hughes Group acquired the Silvana and Hinckley Mines claims blocks from Treminco. During this time selective mining from the Silvana 4625 level commenced. In 2005 Klondike Silver Corp. was established to explore and operate the Sandon area. To date since 2005, limited production and exploration have occurred due to down markets and suppressed metal prices. It is estimated that some 750,000 tonnes of crude ore came out of the Sandon camp and 400,000 tonnes of material have been placed in the tailings ponds after processing.

The Silvana Mine TMF consists of three ponds adjacent to Carpenter Creek, named Pond 1, Pond 2 and Pond 3. Pond 1 and 2 are currently inactive and Pond 3 would be the used as the active pond where mine tailings would be placed once operations are resumed. Figure 1 provides a general view of the area just north of Sandon BC.

Figure 2 illustrates the general view of the TMF, which is divided into three areas or components:

- Pond 1 TMF, adjacent to the mill and the initial pond
- Pond 2 TMF below Pond 1; and
- Pond 3 TMF the newest tailings storage area.



Source: Google Earth

PROJECT

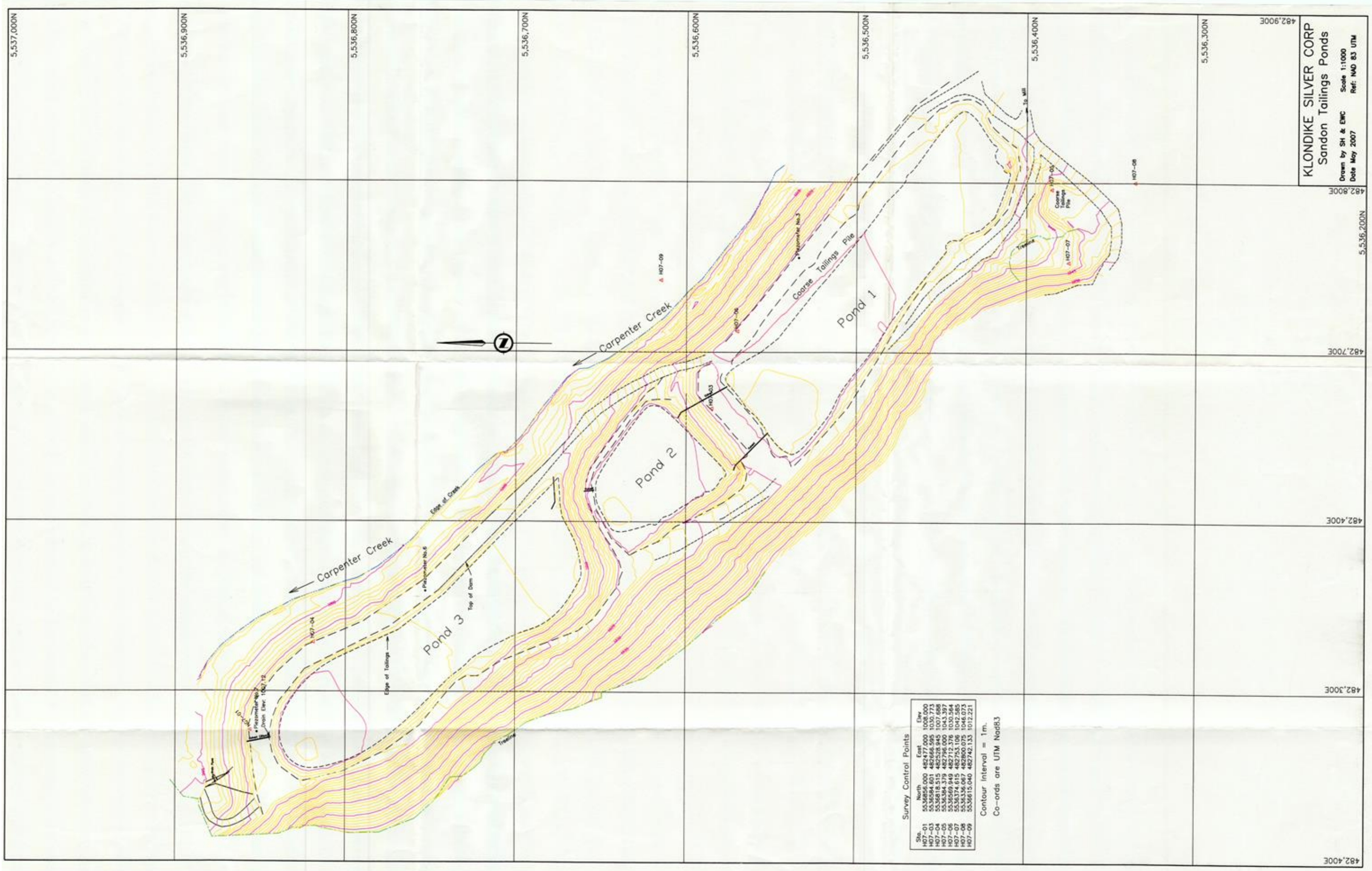
KLONDIKE SILVER
SILVANA MINE

TITLE

GENERAL AREA OF SILVANA MINE TAILINGS MANAGEMENT FACILITY

Golder Associates

PROJECT No. 1406428			Phase No. 2000	
DESIGN	ES	OCT14	SCALE: NTS	REV. B
CADD	--	--	**FIGURE 1**	
CHECK				
REVIEW	JAH			



Source: Craft, E.W. 2007

PROJECT

KLONDIKE SILVER
SILVANA MINE

TITLE

TAILINGS MANAGEMENT FACILITY PLAN VIEW

Golder Associates

PROJECT No. 1406428			Phase No. 2000	
DESIGN	ES	OCT14	SCALE: NTS	REV. B
CADD	--	--	**FIGURE 2**	
CHECK				
REVIEW	JAH			

3.2 Overview of Design and Previous Operation

The current layout of the TMF including the three existing ponds is shown in Figure 3. Aside from a foundation investigation (Golder 1981), and a stability analysis (Craft 2007), no design for the impoundment was available.

The tailings ponds are located southwest of Carpenter Creek in a narrow, steeply sloping valley immediately downstream of the mill complex and Sandon, B.C. The site is approximately 490 m long by 90 m wide at the southeastern end and 60 m wide at its northwestern end. The area is bounded by Carpenter Creek to the east and the steep heavily treed valley slope to the west. The site slopes gently downwards to the north and east. The southwestern portion of site is occupied by a fan of material from an earlier hydraulic mining operation. A portion of this material was excavated and used for the construction of tailings Pond 3.

Available information for the site indicates that the TMF is underlain by coarse granular deposits (coarse sandy gravels). These materials have been described as highly permeable, but competent for support of the existing tailings pond dykes (Golder 1981). The fan of hydraulic mining waste is composed of angular cobbles, sand and gravel with some silt. Bedrock is exposed at a few locations adjacent to the existing tailings pond where the fan has been excavated to the natural slope.

Groundwater in the TMF area is encountered at depths varying from 0.6 to 0.9 m below original ground surface and levels are likely controlled by the adjacent creek (with the highest levels occurring during the spring).

Creek levels vary seasonally and may reach the banks adjacent to the TMF. In some areas, the stream reaches the left bank of Carpenter Creek directly below the pond embankment.

Pond 1 and 2

Pond 1 is located in the south end of the TMF and was constructed for disposal of coarse tailings material. Pond 2 is located northwest of Pond 1 and was used to contain fine tailings. The embankments of Pond 1 and 2 have slopes of approximately 1.3 horizontal to1 vertical (1.3H: 1V). Ponds 1 and 2 currently consist of a dried tailings surface with approximately 0.5 m of freeboard and do not have capacity to contain additional tailings. It is understood that the dams for Ponds 1 and 2 were developed using upstream construction methods.

Pond 3

Pond 3 is located at the northwest end of the TMF and was constructed within a fan of hydraulic mine waste. Pond 3 was originally designed to store an approximate mass of tailings of 164,000 tonnes. The design considered a final crest elevation of 3145 ft. which should result in maximum heights of about 18 metres for the dyke (Golder 1981). Current storage capacity of Pond 3 has been reported to be 14,500 tonnes (Craft 2010).

The embankment for Pond 3 was constructed using locally available borrow material and coarse mine waste existing at the footprint of the facility. The embankment does not include a low permeable layer to reduce seepage and therefore water from the tailings is anticipated to seep through the embankment towards Carpenter Creek. A filter layer was designed for the pond side slope of the dam. There is no record the material was placed on the upstream face of the dam. The embankment was originally designed to achieve its final elevation through centreline construction. To date, we understand no centreline raises have taken place (only the starter embankment has been constructed). The dam was designed to maintain a crest width of 6 m throughout operations. The outer embankment slope was to be constructed at 2H:1V in the lower portion of the slope and at 1.5H:1V for the upper portion Figure 2). The upstream slopes of the dyke were to be constructed at 1.5H:1V.

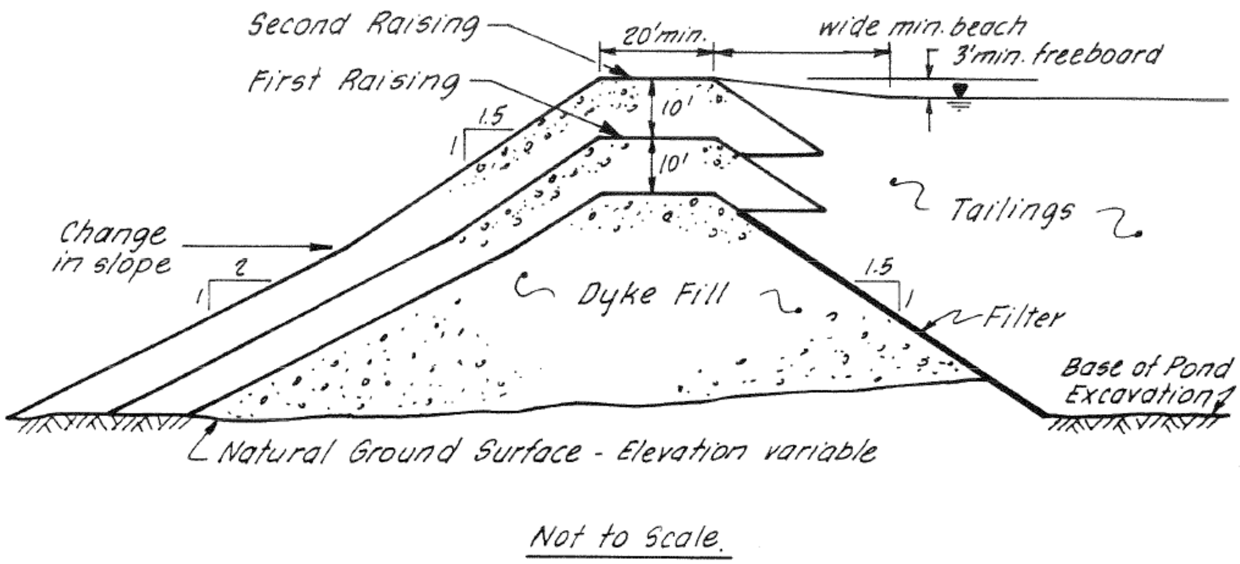


Figure 3: Dam Section

Klondike is planning to use Pond 3 for future deposition of tailings. Additional raises of the embankments will be by the centerline method as per the original design (Golder 1981).

3.3 Previous Issues of Concern

The previous available DSI was from 2009 (Craft 2010), which noted the following issues:

- Minor erosion due to local run-off – requires stabilization of unvegetated slopes for permanent shutdown.
- The rip-rapping between the tails dams and Carpenter Creek appears to be adequate as long as personnel are on site to monitor the conditions.

4.0 OPERATION AND CONSTRUCTION IN 2014

No operation or construction was undertaken in 2014.

5.0 REVIEW OF SITE CLIMATE DATA AND WATER BALANCE

5.1 Review of Climatic Information

The Silvana Mine is located in the Kootenay region of British Columbia, approximately 55 kilometres north of City of Nelson. Within the area there are three weather stations part of the Environment Canada (EC) surface weather network (Table 1).

Table 1: Weather Office Climate Stations

Climate Station Name	Station ID	Latitude	Longitude	Elevation (m)	Period of record	Data interval	EC Climate Normals
Nelson	--	49°30' 00" N	117°17' 00" W	604.0	--	--	1961 - 1990
Nelson CS	1145M29	49°29' 29" N	117°18' 19" W	534.9	1994 - 2014	Hourly	--
Nakusp	1145300	50°15' 00" N	117°48' 00" W	457.2	1971 - 1994	--	1961 - 1990
Nakusp CS	1145297	50°16' 09" N	117°49' 01" W	512.1	1991 - 2014	Daily	--
Castlegar A	1141456	49°17' 46" N	117°37' 57" W	495.6	2013 - 2014	Hourly	--
Castlegar A	1141455	49°17' 47" N	117°37' 57" W	495.6	1966 - 2007	Monthly	1971 - 2000
Castlegar A	1141455	49°17' 47" N	117°37' 57" W	495.6	1954 - 2013	Hourly / Daily	1981 - 2010

Given the record length and location Castlegar A (Station ID 1141455) was selected to represent the climate normals for the area and further adjust the parameters to the mine site. Different climate parameters were recorded over the period of record and for the purpose of this inspection only temperature and precipitation were evaluated. The mine site is located in a mountainous area and snow is the main driver of the site hydrology. The closest snow survey stations are listed in **Table 2** and are part of the BC River Forecast Centre survey network.

Table 2: River Forecast Centre Snow Survey Stations

Station Name	Station ID	Latitude	Longitude	Elevation (m)	Period of record	Station Type
Sandon	2D03	49°58' N	117°13' W	1072	1938 - 2014	Manual
Redfish Creek	2D14P	49°41' N	117°05' W	2086	2001 - 2014	Automatic

Climate normals for Castlegar A (Station ID: 1141455) are reported by EC for two different periods 1971 – 2000 and 1981 – 2010. Table 3 and Table 4 present the long-term statistics and the 2014 hydrologic year statistics for temperature and precipitation.

Table 3: Temperature Long-Term Statistics and Observed in 2014 hydrologic year

Climate Station Name	EC Climate Normals Period	Long-Term Statistics			October 2013 to September 2014		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum
Castlegar A	1971 – 2000	-25.7	8.4	39.8	--	--	--
Castlegar A	1981 – 2010	-23.7	8.7	39.9	--	--	--
Castlegar A	1966 – 2014	-30.6	8.6	40.0	-21.5	8.6	38.8

Table 4: Total Annual Precipitation Long-Term Statistics and Observed in 2014 hydrologic year

Climate Station Name	EC Climate Normals Period	Long-Term Statistics			October 2013 to September 2014	
		Minimum	Mean	Maximum	Days with Observations	Total Precipitation
Castlegar A	1966 – 2014	472.4	727.5	1078.0	--	--
Castlegar A	2014	--	--	--	365	621.5

Snow survey data representative for the area is presented in Figure 4 for the continuous automated station Redfish Creek and in Table 5 for the manual station in Sandon.

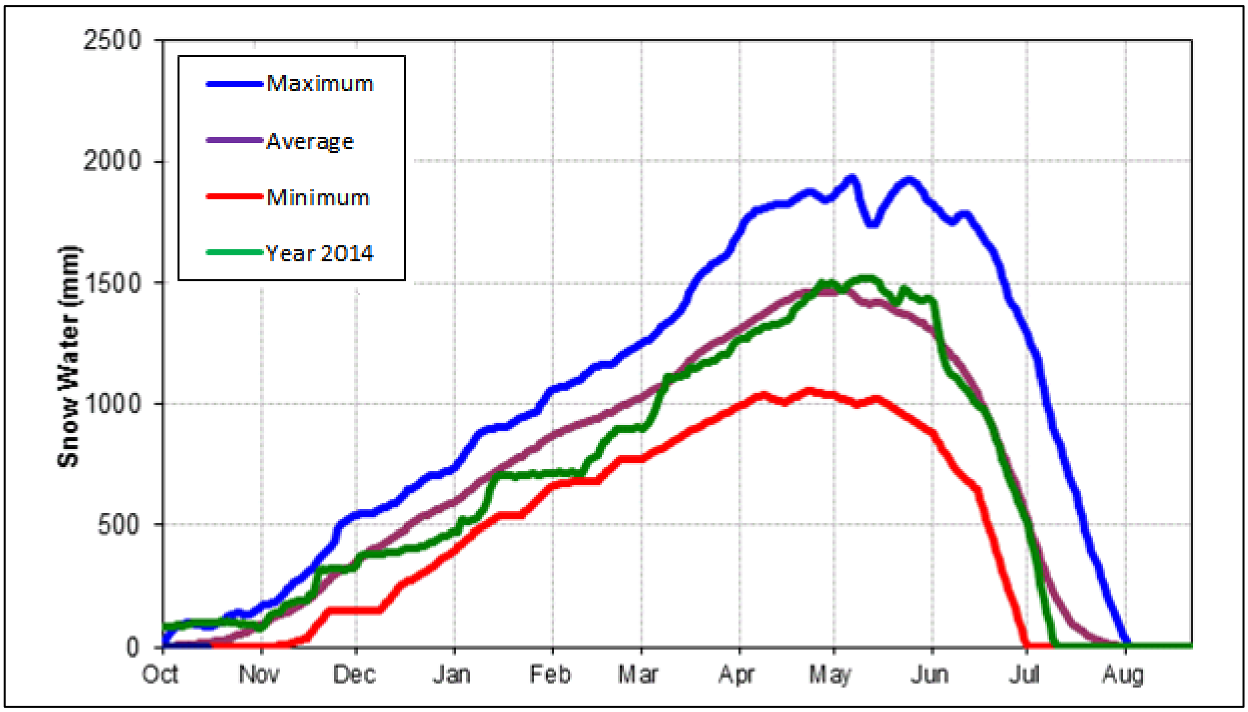


Figure 4: Redfish Creek Snow Survey Station

Table 5: Total Annual Precipitation Long-Term Statistics and Observed 2014 Hydrologic Year

Parameter	Snow Survey Date							
	01-Jan	01-Feb	01-Mar	01-Apr	01-May	15-May	01-Jun	15-Jun
Years of Record	1	1	35	70	60	8	2	0
Mean (mm)	157	328	321	333	95	27	0	--
Maximum (mm)	--	--	475	585	399	218	0	--
Minimum (mm)	--	--	196	71	0	0	0	--

No climate date is currently available for the mine site and therefore no comparison with the long term normals was possible. Temperature and precipitation are known to vary with elevation by different gradients specific to the local conditions at site. The average elevation of the watershed at the mine site is higher than 1500 m and is significantly different than the climate stations elevations used in the analysis, which are located between approximately 500 and 600 m.

5.2 Water Balance

Ponding of water at the Silvana Mine was not observed at the time of the site inspection. The ponds have overflow culverts which we understand would direct surface water from spring runoff or precipitation to a downstream area or the Green Zone. The Dam Safety Review to be completed in 2015 should include a new water balance and confirm that surface water would collect in the Green Zone or the ponds have sufficient capacity and the overflow culverts are large enough to manage a design storm event.

The Green Zone which is downstream of Pond 3 does not have a perimeter dike, however, a gravel road or low berm appears to surround and define the area. At the time of the inspection, water was ponded in the Green Zone and it appeared to be controlled by the creek water level. It is anticipated any water which collects in this area will seep through the gravel base in the Green Zone toward the creek.

6.0 DAM CONSEQUENCE CLASSIFICATION

Table 6 identifies the impoundments and embankments in the TMF that meet the definitions of major dams and impoundments in the *Health, Safety and Reclamation Code for Mines in British Columbia* (BC MEMPR 2008). Major dams and impoundments are defined as follows:

- Major Dam - a dam that is used to store and control water, slurry or solids and has a maximum height at any point that exceeds 15 metres or is between 10 and 15 metres in height and has either a crest length that exceeds 500 metres, a flood discharge rate that exceeds 2000 cubic metres per second, a reservoir capacity that exceeds one million cubic metres, or any other dam so declared by the chief inspector.
- Major Impoundment - an impoundment that has a maximum depth of material greater than 10 metres at any point, or a maximum height of retaining dam or dike at any point that exceeds 15 metres, or is a storage facility designed to contain more than one million cubic metres of material or is constructed with dams or dikes that contain more than 50,000 cubic metres of fill, or any other impoundment or water management facility so declared by the chief inspector.

Table 6: Characteristics of Embankments in the Silvana Mine Tailings Management Facility

Embankment	Approximate Length (m)	Approximate Maximum Height [(a)] (m)
Pond 1 Embankment	270	15
Pond 2 Embankment	100	12
Pond 3 Embankment	280	8

(a) From layout and cross sections of 2008

While a topographic survey of the ponds is available, there is no available topography of the creek adjacent to the TMF, or of the slope above the TMF. The classification was made on the limited survey data provided by Klondike Silver, shown in Table 7.

Table 7: Identification of Major Dams and Impoundments of the Silvana Mine

Embankment	Major Dam	Major Impoundment
Pond 1 - Embankment	Yes, maximum dam height of 15 m.	Yes, depth of tailings in impoundment expected to be larger than 10 m.
Pond 2 - Embankment	No, current maximum dam height of 12 m [(a)]	Yes, depth of tailings in impoundment expected to be larger than 10 m.
Pond 3 - Embankment	No, current maximum height is 8 m. [(a)]	Yes, depth of tailings in impoundment expected to be slightly larger than 10 m.

(a) May become a major dam based on maximum expected height.

Pond 1, 2 and 3 TMFs are considered major impoundments, since the facilities have impoundments that were estimated to be greater than or close to 10 m depth. The embankment for Pond 1 is a major dam, since the maximum height is estimated be greater than 10 m. The embankments for Pond 2 and Pond 3 are not considered to be major dams at present, but if the mine re-starts, the embankment heights would be increased above 10 m and the embankments would then be considered major dams. Thus, as TMF embankments are considered major impoundments, the Canadian Dam Association *Dam Safety Guidelines* (CDA 2013) apply.

CDA (2013) classifies dams from low to extreme consequence based on consequence of failure and incremental losses to attributes listed in Table 8. The overall dam classification is the highest consequence determined for the consequences of failure listed in Table 8. Table 9 summarizes the dam class assigned to each embankment at the Silvana Mine.

Table 8: Dam Failure Consequence Classification

Dam Failure Consequences Classification	Population at Risk	Consequences of Failure		
		Loss of Life	Environment and Cultural Values	Infrastructure and Economics
Low	None[(a)]	There is no possibility of loss of life other than through unforeseeable misadventure	Minimal short-term loss or deterioration and no long-term loss or deterioration of: ■ fisheries habitat or wildlife habitat, ■ rare or endangered species, or ■ unique landscapes or sites of cultural significance.	Minimal economic losses mostly limited to the dam owner's property, with virtually no pre-existing potential for development within the dam inundation zone.
Significant	Temporary only[(b)]	Low potential for multiple loss of life	No significant loss or deterioration of: ■ important fisheries habitat or important wildlife habitat, ■ rare or endangered species, or ■ unique landscapes or sites of cultural significance, and ■ restoration or compensation in kind is highly possible.	Low economic losses affecting limited infrastructure and residential buildings, public transportation or services or commercial facilities, or some destruction of or damage to locations used occasionally and irregularly for temporary purposes.
High	Permanent[(c)]	10 or fewer	Significant loss or deterioration of: ■ important fisheries habitat or important wildlife habitat, ■ rare or endangered species, or ■ unique landscapes or sites of cultural significance, and restoration or compensation in kind is highly possible.	High economic losses affecting infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to scattered residential buildings.
Very High	Permanent[(c)]	100 or fewer	Significant loss or deterioration of: ■ critical fisheries habitat or critical wildlife habitat, ■ rare or endangered species, or ■ unique landscapes or sites of cultural significance, and restoration or compensation in kind is possible but impractical.	Very high economic losses affecting important infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to residential areas.

Dam Failure Consequences Classification	Population at Risk	Consequences of Failure		
		Loss of Life	Environment and Cultural Values	Infrastructure and Economics
Extreme	Permanent[(c)]	More than 100	Major loss or deterioration of: ■ critical fisheries habitat or critical wildlife habitat, ■ rare or endangered species, or ■ unique landscapes or sites of cultural significance, and restoration or compensation in kind is impossible.	Extremely high economic losses affecting critical infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to residential areas.

Sources: CDA 2013;

a) There is no identifiable population at risk.

b) People are only occasionally and irregularly in the dam-breach inundation zone, for example stopping temporarily, passing through on transportation routes, or participating in recreational activities.

c) The population at risk is ordinarily or regularly located in the dam-breach inundation zone, whether to live, work, or recreate.

Table 9: Dam Consequence Classification for the Silvana Mine Tailings Management Facility

Embankment	Dam Class	Population at Risk	Consequences of Failure		
			Loss of Life	Environment and Cultural Values	Infrastructure and Economics
Pond 1 - Embankment	**High**	Permanent	Low	Significant to **High**	Significant to **High**
Pond 2 - Embankment	**High**	Permanent	Low	Significant to **High**	Significant to **High**
Pond 3 - Embankment	**High**	Permanent	Low	Significant to **High**	Significant to **High**

All embankments are within the property boundary of Silvana Mine. Consequently any population at risk and loss of life were assigned based on the possibility that tailings or water would reach the populated areas downstream of Carpenter Creek, if failure of an embankment occurred. The closest populated area is New Denver, located approximately 8 kilometers downstream of the mine. Population at risk was therefore considered permanent. Although inundation areas have not been determined, it is considered unlikely that a failure could release sufficient volume of tailings that would present a risk of fatalities. The release of tailings would likely result in high consequences to the environment and economic loss due for restoration. The dams are therefore classified as High consequence structures. It is possible that the dams may be re-classified based on an inundation study.

7.0 TAILINGS MANAGEMENT FACILITY SAFETY ANALYSIS

The condition of the dams during the July 23, 2014 site visit from various locations is shown in Photos 1 to 12 in Appendix A. This section presents a summary of dam safety analysis for the Silvana Mine Tailings Management Facility.

7.1 Potential Failure Modes

The failure modes for the three embankments are considered similar.

7.1.1 Piping

Piping occurs due to the development of erosion to the extent that a hole develops through the embankment with rapid loss of water from the storage pond.

Design Basis

No design basis was available for this inspection.

Observed Performance

No evidence of piping was observed during the July 23, 2014, site visit. No seepage areas were observed on the dams. No water ponding was observed at the time of the visit. The ponds appear to have drained to the Green Zone area downstream of Pond 3 or the precipitation has infiltrated through the tailings in the ponds and / or dams to the local groundwater system under the ponds. Without ponding or seepage, the risk of piping is considered to be low.

7.1.2 Instability

Instability occurs due to imbalance of forces resulting in movement of a part of the dam with possible loss of integrity of the dam.

Design Basis

No design basis was available for review.

A dam stability evaluation should be completed. A Dam Safety Review is recommended for early 2015.

An initial assessment of the dams on site indicates the dams would have values of Factors of Safety (FoS) of at least 1.0 or better for static conditions under conditions during the July 23, 2014 inspection. The values of FoS of stability of the dams under seismic conditions is anticipated to be above 1.0 as the ponds are not in operation and the monitoring data from monitoring wells in the dams indicates the water table is below the base of the impoundments at this time.

The recommended design criteria for FoS for slope stability of embankments from CDA (2013) are presented in Table 5. The dams should be modified, if needed, to satisfy the design criteria for stability.

Table 10: Design Criteria for Minimum Factors of Safety for Embankment Stability

Assessment	Loading condition	Slope	Factor of Safety
Static	Long-term steady state seepage	Downstream	1.5
Seismic	Pseudo-static	Downstream	1.0
	Post-earthquake	Downstream	1.2

Source: CDA (2013)

Observed Performance

The embankments were inspected for signs of instability during the July 23, 2014, site visit.

Major erosion was observed downstream of the dam due to undercutting by Carpenter Creek, as shown in Photographs in Appendix A.

The dams did not exhibit any evidence of instability such as cracks, slumps, bulges, or sinkholes on the crest, downstream face, upstream face, or at the toe of the dam, with the following exceptions.

The dam for Pond 1 adjacent to Carpenter Creek appears to have a short section which may be as steep as 1.25 horizontal to 1 vertical (1.25H:1V). The downstream slopes of all the dams are tree covered and while the dams appear to be stable, the trees on the slopes should be removed in the spring of 2015 to allow a careful inspection of the slopes for the 2015 DSI. The inspection in 2015 may require re-sloping the dam slopes to 2H:1V or flatter based on a dam stability analysis.

The creek at Pond 1 appears to be eroding the bank protection placed originally to protect the toe of the creek bank below the Pond 1 dam. The current bank protection at this location should be reviewed and if needed the bank protection should be upgraded before the 2015 freshet.

We understand a study is underway to confirm what bank protection will be required for the section of Carpenter Creek below all three ponds. This study should be completed and if required the bank protection should be upgraded for the full length of the creek below the TMF area in 2015.

7.1.3 Overtopping

Overtopping occurs when the pond level rises above the dam crest level, resulting in flow over the dam that may result in progressive erosion of the dam and loss of the pond.

Design Basis

No design basis was available for this inspection.

Instrumentation Data

Instrumentation is present to monitor water levels in the ponds and under the dams at Pond 1 and 3. The data for 2014 indicated the water levels under the ponds were at creek level. The data appears to suggest the ponds are drained and the creek water level controlled the groundwater level under the ponds.

Observed Performance

The ponds appear to have drained to the Green Zone area downstream of Pond 3 or the precipitation has infiltrated through the tailings and / or dams to the local groundwater system under the TMF.

The embankments did not retain water during the July 23, 2014, site visit, and as such, the risk of overtopping was judged to be low.

7.2 Water Quality

There was no water quality data available at the time of the inspection. It is recommended that water quality sampling be carried out in Carpenter Creek in conformance to the Mine Permit for Silvana Mine

7.3 Review of Operational Documents

The Silvana mine TMF is currently under care and maintenance by Klondike Silver as exploration continues to evaluate potential reserves to re-start mining.

The mine manager lives in New Denver and is understood to inspect the site at least once a week. As no operation activities are required at the TMF at this time, this appears to be reasonable as the TMF does not include any structure that requires an operator.

An Operation, Maintenance and Surveillance (OMS) Manual and Emergency Preparedness Plan (EPP) for the Silvana Mine TMF was completed in 2014 by Golder (2014). The documentation is up to date and reflects current conditions at the TMF. No modification is required to this documentation for the current care and maintenance status of the mine.

7.4 Comments on Previous Issues

There were no major actions in the 2009 DSI which required addition for 2010. Previous issues are addressed in Table 5.

Table 11: Comments on Previous Issues

Issue	Comment
Minor erosion due to local run-off – requires stabilization of unvegetated slopes for permanent shutdown.	Slopes are vegetated.
The rip-rapping between the tails dams and Carpenter Creek appears to be adequate as long as personnel are on site to monitor the conditions.	On-going erosion due to Carpenter Creek.

8.0 FINDINGS AND RECOMMENDED ACTIONS

Key issues and recommended actions resulting from this annual dam safety inspection are presented in Table 12.

Table 12: Summary of Key Issues and Recommended Actions

Deficiency or Non-conformance	Applicable Guideline	Potential Dam Safety Impact or Risk	Recommended Action	Recommended Timing for Completion
Inspection	CDA (2013)	Inadequate notice of potential for dam failure	Institute regular, documented inspections based as per CDA recommendations.	2014
Stream erosion protection below the three dams	CDA (2013)	Erosion of toe causing dam instability, potential loss of dam and tailings into stream.	Repair of the bank protection at and upstream of Pond 1 and in the area of the office some 100 metres upstream of the Tailings Management Facility	Completed before the 2015 freshet
Trees on slopes of all three ponds	CDA (2013)	Degradation of slope, increased permeability.	Trees on the slopes of all three ponds should be removed. An inspection should be completed in the spring once the trees have been removed from the slope.	Spring 2015
Slope geometry	CDA (2013)	Risk of slope instability.	The dams for Ponds 1 and 2 should be re-sloped to a slope less than 2 horizontal to 1 vertical (2H:1V) or flatter. Steeper slopes could be used if confirmed with a stability analysis.	2015 prior to placement of tailings from new operations
Exposed tailings slope in Pond 1	CDA (2013)	Potential for erosion of tailings.	Place a surface cover layer of 0.5 m of gravel to protect the slope from erosion.	2015
Design record missing	CDA (2013)	Undefined potential for failure.	Dam safety review, including dam stability evaluation.	2015

CDA: Canadian Dam Association

Routine maintenance activities should include the following:

- Removal of trees on the dam faces after the 2015 freshet;
- Provide protection for the Carpenter Creek below Pond 1 dam before freshet in 2015,
- Confirm all ditches and culverts are operational before the start of the 2015 freshet.
- Cleaning out ditches and continuing to monitor the water levels in the wells should be continued.

Conclusions of the 2014 DSI are as follows:

- The dam classification for the Silvana Mine TMF dams should be reviewed in 2015 to confirm the 2014 assessments (High dam class for all embankments).

Table 7 summarizes the date of the last Dam Safety Review, regulatory frequency requirements, and schedule for next Dam Safety Review for the embankments. A Dam Safety Review should be completed as soon as practical and before June 2015. A dam stability evaluation should be completed as part of the study.

Table 13: Schedule for Next Dam Safety Review

Structure	Date of Last Dam Safety Review	Dam Safety Review Frequency by CDA[a]	Suggested Schedule for Next Dam Safety Review
Embankments for Ponds 1, 2, 3	Unknown	7 years	2015

a) CDA (2013).

CDA = Canadian Dam Association

From the observations made during the site visit of July 2014, the dams for Pond 1, 2 and 3 of the TMF are deemed in fair to good condition. Issues noted above should be completed as soon as reasonable.

9.0 CLOSURE

We trust that this report meets your current needs. Should you have any questions regarding this report or require additional information, please feel free to contact either of the undersigned.

GOLDER ASSOCIATES LTD.

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APPENDIX A

Photographs

Photograph 1: Looking Downstream towards Pond 1 TMF Dam - in trees on left

Photograph 2: Pond 1 – stockpile tailings on left

Photograph 3: Downstream slope Pond 1 from toe area – tree covered

Photograph 4: Pond 1 from downstream end looking back to mill

Photograph 5: Pond 1 decant

Photograph 6: Downstream Face of Pond 1 – Pond 1 overflow pipe on slope to Pond 2

Photograph 7: Dam Pond 3 – piezometer in foreground

Photograph 8: Downstream Face of Pond 3 Dam – creek on left

Photograph 9: Downstream Face Pond 3 Dam – over flow pipe

Photograph 10: Return water tank below Pond 3

Photograph 11: Downstream area below Pond 3

Photograph 12: Creek adjacent to Pond 3 dam – 8 m wide bench to toe of dam

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