



Klohn Crippen Berger

Teck Highland Valley Copper Partnership

2019 Dam Safety Inspection Report

7 Day Pond Tailings Storage Facility

FINAL



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April 2020

April 3, 2020

Teck Highland Valley Copper Partnership
PO Box 1500
Logan Lake, British Columbia
V0K 1W0

Mr. Chris Anderson
Manager, Tailings and Water

Dear Mr. Anderson:

2019 Dam Safety Inspection Report
7-Day Pond Tailings Storage Facility
FINAL

We are pleased to submit the 2019 Dam Safety Inspection report for the 7-Day Pond facility. The inspection and this report were prepared to comply with Section 10.5.3 of the Health, Safety and Reclamation Code for Mines in British Columbia (the Code) (MEM 2017), and Section 4.2 of the Code Guidance Document (MEM 2016).

Yours truly,

KLOHN CRIPPEN BERGER LTD.



Rick Friedel, P.Eng.
Engineer of Record, Designated Representative
Senior Geotechnical Engineer, Principal

RF/NS:cd

Teck Highland Valley Copper Partnership

2019 Dam Safety Inspection

7 Day Pond Tailings Storage Facility

FINAL

EXECUTIVE SUMMARY

Klohn Crippen Berger Ltd. (KCB) was engaged by Teck Highland Valley Copper Partnership (THVCP) to complete the 2019 dam safety inspection (DSI) of the 7-Day Pond facility on the Highland Valley Copper (HVC) mine site in accordance with the requirements of the Health, Safety and Reclamation Code for Mines in British Columbia (the Code). The inspection was completed by the Engineer of Record (EoR), Mr. Rick Friedel, P.Eng., Pablo Urrutia, P.Eng., and Ms. Narges Solgi, EIT, as representatives of KCB on June 10, 2019. During the inspection, the weather was cloudy. Mr. Chris Anderson, P. Eng., THVCP Tailings and Water Manager, is the TSF Qualified Person (as defined by the Code) for the 7-Day Pond TSF.

The 7-Day Pond facility was visually in good physical condition, the observed performance during the 2019 site inspections is within expected design conditions, and 2019 surveillance data is consistent with past performance.

The 7-Day Pond is located 180 m north of the Mill and Bulk Flotation Building and is used as storage for tailings and water from the Highland Mill (Mill) during upset conditions. The pond also serves as contingency storage for other pumped flows as needed. Discharge of tailings into the south of the pond has formed a beach sloping to the north.

The 7-Day Pond has existed at the HVC site for several decades. The pond is contained by haul roads and access roads of varying crest widths and heights on all sides. In 2013 and 2014, the pond was partially backfilled and reduced in size to accommodate the alignment of a new ore conveyor. The minimum crest elevation is along the east perimeter road berm where the road fill acts as a retaining berm which, if overtopped at this location, would result in uncontrolled release of water and potentially tailings into the adjacent treed area.

The 7-Day Pond has been assigned a “Low” consequence classification as defined by CDA (2013). A dam safety review (DSR) for 7-Day Pond was completed by SRK Consulting in 2018 and the report was submitted to THVCP in March 2019 (SRK 2019). THVCP has scheduled the next DSR for 2023 (i.e. every 5 years). SRK (2019) concluded the following:

- the 7-Day Pond TSF is “safe” with, in general, some minor deficiencies and non-conformances, per CDA (2013) guidelines;
- the 7-Day Pond TSF is a well-managed facility with a high level of technical stewardship and appropriate operating procedures. The credible failure modes are understood and effectively controlled; and
- no changes to the consequence classification were recommended.

The DSR included four recommendations related to dam safety for the 7-Day Pond TSF and seepage ponds. Two of the recommendations were assigned a Priority Level¹ of 1 or 2 which represent issues that should be resolved as a priority. Progress was made on each of these recommendations during 2019 and both are scheduled for close-out in 2020.

In 2019, THVCP agreed to a work plan with the BC Ministry of Energy, Mines and Petroleum Resources (EMRP) to bring the facility into compliance during 2020. THVCP completed the activities scheduled for 2019 and are on track to meet the agreed deadline. For the interim period, as the flood upgrades are complete, THVCP mobilizes a temporary pumping system, on an as needed basis, to 7-Day Pond to draw down the pond level. With the pumping system in place the facility can store a 100-year to 200-year return period flood event depending on tailings level at the time.

During 2019, the key components needed to develop an OMS manual were completed and routine monitoring activities implemented. Preparation of the OMS manual was started in 2019 but completion has been delayed into 2020. Routine visual inspections were completed by THVCP during 2019. No event-driven inspections were triggered in 2019 by precipitation or earthquake events. 2019 pond levels were consistent with recent history.

Water quality downstream of the 7-Day Pond TSF during 2019 and compliance with requirements of Permit PE-376, and associated amendments is reported by THVCP in a separate report. KCB reviewed the 2019 data relevant to 7-Day Pond which indicates there were no exceedances of permit limits measured at any related sampling site.

The status of recommendations to address deficiencies and non-conformances identified during past DSIs are summarized in Table 1. Closed recommendations are shown in *italics*. Recommendations to address deficiencies and non-conformances identified during the 2019 DSI are summarized in Table 2.

Table 1 Previous Recommendations for Deficiencies and Non-Conformances – Status Update

ID No.	Deficiency or Non-Conformance	Applicable Reg. or OMS Reference	Recommended Action	Priority ¹	Recommended Deadline (Status)
SDP-2016-02	Operations	OMS and EPRP	Prepare an OMS manual and EPRP (This recommendation addresses DSR recommendation 7D-001).	3	Q3, 2017 (Open, scheduled for early 2020)
SDP-2018-01	Flood Routing	10.1.8	Execute agreed work plan to bring 7-Day Pond into compliance with the IDF under the Code (This recommendation addresses DSR recommendation 7D-002).	2	September 2020 (Open)

Notes:

- Recommendation priority guidelines, specified by Teck and assigned by KCB:
 - Priority 1: *A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant risk of regulatory enforcement.*
 - Priority 2: *If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory enforcement; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.*
 - Priority 3: *Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.*
 - Priority 4: *Best Management Practice – Further improvements are necessary to meet industry best practices or reduce potential risks.*

¹ Refer to Table 1 for summary of Priority Levels.

Table 2 2019 Recommendations for Deficiencies and Non-Conformances

ID No.	Deficiency or Non-Conformance	Applicable Reg. or OMS Reference	Recommended Action	Priority ¹	Recommended Deadline
SDP-2019-01	Storage Capacity	-	As part of flood routing work, THVCP to close out the 2018 DSR Recommendation (7D-004) regarding the non-conformance of operational freeboard against Code/CDA requirements.	3	Q3, 2020
SDP-2019-02	Flood Routing	-	As part of close-out of flood compliance activities, confirm minimum freeboard under normal conditions (in addition to flood) and report in OMS Manual.	4	Q3, 2020

Notes:

- Recommendation priority guidelines, specified by Teck and assigned by KCB:
 - Priority 1: A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant risk of regulatory enforcement.*
 - Priority 2: If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory enforcement; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.*
 - Priority 3: Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.*
 - Priority 4: Best Management Practice – Further improvements are necessary to meet industry best practices or reduce potential risks.*

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1 INTRODUCTION

Klohn Crippen Berger Ltd. (KCB) was engaged by Teck Highland Valley Copper Partnership (THVCP) to complete the 2019 dam safety inspection (DSI) of the 7-Day Pond facility on the Highland Valley Copper (HVC) mine site. The DSI include the review of facility over the period between January 2019 to September 2019².

7-Day Pond is used as storage for tailings and water from the Highland Mill (Mill) during upset conditions. Under the revised Health, Safety and Reclamation Code for Mines in British Columbia (the Code) issued in 2017 (MEM 2017), the 7-Day Pond is a tailings storage facility and is subject to the Code requirements for a “Low” consequence classification facility. Prior to 2016 this facility was classified as a sediment pond. This change increased the requirements for this facility significantly relative to previous years.

The DSI scope of work consisted of:

- a visual inspection of the physical condition;
- a review of climate and water balance data, as well as reservoir levels and threshold values for the site;
- a review of the relevant dam safety management documents (within the DSI review period) including HVC Response Letters to EMPR Geotechnical Inspection (THVCP 2019a, 2019b, 2019c); and
- a review of the past year’s construction and monitoring records, where applicable.

The inspection and this report were prepared to comply with Section 10.5.3 of the Health, Safety and Reclamation Code for Mines in British Columbia (the Code) (MEM 2017), and Section 4.2 of the Code Guidance Document (MEM 2016).

The inspection was completed by the Engineer of Record (EoR), Mr. Rick Friedel, P.Eng., Pablo Urrutia, P.Eng., and Narges Solgi, EIT, as representatives of KCB on June 10, 2019. During the inspection, the weather was sunny with some cloudy periods. Mr. Chris Anderson, P. Eng., THVCP Tailings and Water Manager, is the TSF Qualified Person (as defined by the Code) for the 7-Day Pond TSF.

The pond is operated under the general British Columbia Ministry of Energy, Mines and Petroleum Resources (EMPR) geotechnical permit M-11 for the mine (Mine ref. 0300010 HVC). The 7-Day Pond, referred to as the Emergency Tailings Pond, is also permitted under the British Columbia Ministry of Environment (MOE) effluent permit PE-376 to receive upset condition discharges from the Mill and Bulk Flotation Building.

² During 2019, THVCP and KCB agreed to modify the review period for the annual DSI to October through September (previously was January to December). This change was made to allow adequate time to compile all DSIs undertaken at the HVC mine site and submit them to EMPR prior to the March 31st deadline. The change in review period shortens the review period of the 2019 DSI to 9 months as the period from October 2018 to December 2018 was captured under the 2018 DSI (KCB 2019a).

The 7-Day Pond has been assigned a “Low” consequence classification as defined by CDA (2013). No change in consequence classification was recommended during the most recent dam consequence review hosted by THVCP on January 23, 2019, or by the 2018 dam safety review (DSR).

The Code requires a DSR to be undertaken for any tailings facility, regardless of consequence category, every five years. SRK Consulting completed a DSR in 2018 and the report was submitted in March 2019 (SRK 2019). Next DSR should be scheduled for 2023.

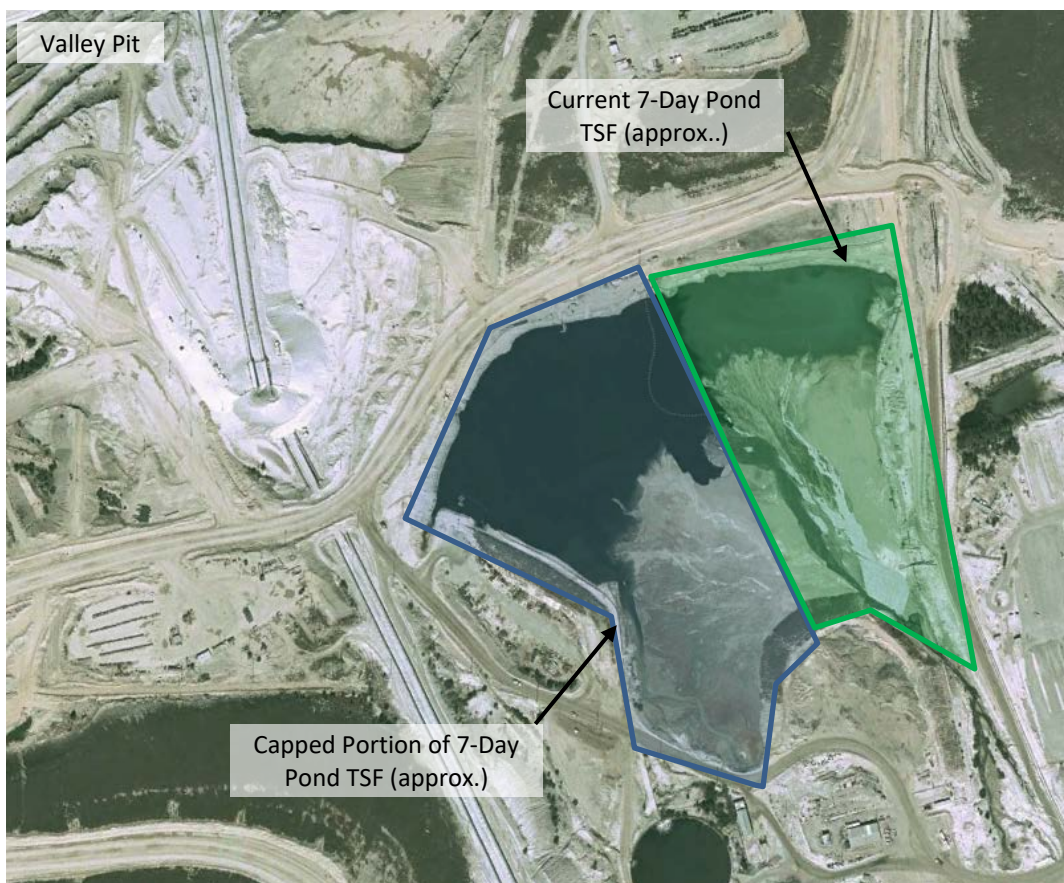
2 FACILITY DESCRIPTION

The HVC site is located near Logan Lake, approximately 45 km south of Kamloops, in the interior of British Columbia. The 7-Day Pond is located approximately 1 km southeast of the Valley Pit; refer to Figure 1.

The pond is used as storage for tailings from the Mill during upset conditions. Mill Operations control discharge of tailings, as well as contributing sources of water including overflow from the thickeners, sewage treatment plant (STP) effluent, and other pumped flows/surface runoff, as needed. Water leaves the 7-Day Pond mostly as seepage to the Valley Pit where it becomes part of pit water management. Historically, when needed, Mill Operations deploy portable pumps to draw down the water level in the 7-Day Pond; pumped outflows are returned to the Mill.

In 2013 and 2014 the majority of the 7-Day Pond impoundment area was capped with rockfill from mine waste. The current configuration of the 7-Day Pond is approximately 40% of the original footprint as shown on Figure 2.1. This capping was done to accommodate the alignment of a new ore conveyor to the northwest and did not alter the operation of the facility. The work did reduce the storage capacity of the facility and increased the distance between the ponded water surface and Valley Pit crest.

Figure 2.1 Original 7-Day Pond TSF Footprint



In the current configuration, containment is provided by access roads of varying crest widths and heights on all sides of the 7-Day Pond; a low point is located along the east perimeter road berm where the road fill (about El. 1260 m) creates a 30 m wide, 4 m high retaining berm. Immediately downstream of this low point are two vegetated depressions (also created by the surrounding access road fills with crests at about El. 1261.5 m), referred to herein as the treed areas. Thus, the 7-Day Pond and treed areas, together form the low points of the surrounding catchment with the east perimeter road berm of the 7-Day Pond forming an internal berm with a crest elevation (El. 1260 m) below the outer perimeter.

Discharge of tailings into the south end of the 7-Day Pond has formed a beach sloping to the north and a semi-permanent pond within the basin. Typically, the pond is too shallow to require any sustained long periods of pumping over the course of a year. Pumping to maintain flood storage and to manage freeboard is generally not required outside of freshet periods.

3 BACKGROUND AND RECENT ACTIVITY

3.1 History

The 7-Day Pond has existed at the HVC site for several decades and there is no documentation of its construction history. Comparison of historic and current topography supports the interpretation of the surrounding access roads as fills. As discussed in Section 2, the interior of the pond was partially backfilled (packed using mine trucks and other heavy equipment) and reduced in size.

3.2 2019 Activities

Other than routine maintenance activities there were no major repairs or construction activities completed during 2019. Based on comparison of October 2018 and September 2019 surveys, an estimated 15,000 m³ of tailings were discharged into the facility.

3.3 2018 Dam Safety Review

A DSR of the 7-Day Pond TSF was completed by SRK Consulting (SRK) in 2018 with the final report issued in March 2019 (SRK 2019). SRK (2019) concluded the following:

- the 7-Day Pond TSF is “safe” with, in general, minor deficiencies and non-conformances, per CDA (2013) guidelines;
- the 7-Day Pond TSF is a well-managed facility with a high level of technical stewardship and appropriate operating procedures. The credible failure modes are understood and effectively controlled; and
- no changes to the consequence classification were recommended.

The DSR included 4 recommendations related to dam safety for the 7-Day Pond TSF and seepage ponds. Two of the recommendations were assigned a Priority Level³ of 1 or 2 which represent issues that should be resolved as a priority:

- ID 7D-001 (Priority 2): develop an OMS and EPRP for the 7-Day Pond; and
- ID 7D-002 (Priority 1): bring the facility into compliance with flood routing requirements under the Code.

³ Refer to Table 8.1 for summary of Priority Levels.

Progress has been made on each of these recommendations as discussed in Sections 4.4 and 5.1 and are scheduled for close out in 2020. The remaining two recommendations were assigned Priority Level 3 which are items that should be done to meet compliance requirements or best practice but alone do not represent a dam safety concern. One of the recommendations related to completing site investigation and stability analyses have been completed and documented (KCB 2019b and 2019c). The other recommendation related to documenting freeboard will be resolved as part of ongoing flood routing activities.

THVCP and KCB have reviewed the DSR recommendations and a formal work plan with targeted timelines to address them is planned to be developed prior to April 2020. Appendix IV includes a table of all recommendations with initial responses, responses and actions planned to resolve (where confirmed).

4 WATER MANAGEMENT

4.1 Overview

A schematic of the tailings and water management system for 7-Day Pond is shown on Figure 4.1. Inflow and outflow rates/volumes are not monitored.

In addition to precipitation and surface runoff, inflow to the pond includes discharge from eight sources:

- 1x regular: treated effluent from the STP;
- 5x irregular but annually recurring: Inflow #2 from Mill, Inflow #3 from thickeners, overflow from Mill Water Pumphouse, inflow from No. 4 Crusher and Truck Wash; and
- 2x emergency, i.e. irregular: tailings dump and Witches Brook.

Outflows include evaporation, seepage into the Wishing Well Sump in the Valley Pit which are then pumped to the Mill, and pumped flows to the Mill Diversion Line (MDL) which is commissioned as needed. THVCP mobilizes a temporary pumping system, on an as needed basis, to 7-Day Pond to draw down the pond level. The pumping system was in operation during 2019 as a proactive measure to draw the pond level down (i.e. not in response to a flood event). THVCP completed detailed design of a permanent dewatering pump system in 2019 with the installation scheduled for 2020 as per the flood management compliance work plan agreed with EMPR.

Figure 4.1 Flow Schematic for 7-Day Pond



No.	Name	Description	Status
1	Inflow #1	HDPE pipe	Non-operational
2	Inflow #2 (a.k.a. Dog & Easy)	36" dia. HDPE pipe, irregular flow from: i) overflow from MOP (connects U/S of discharge point); ii) overflow from sump in Mill which collects excess surface water from cleaning activities.	Operational
3	Inflow #3	HDPE pipe, semi-regular flow from thickener overflow (majority) and surface water around the Mill (minor component).	Operational
4	Tailings Dump Line	No line existing. If needed, a new one could be opened up to 7-Day Pond.	Non-operational
5	Overflow from Mill Water Pumphouse	Irregular open channel overflow from 325 ft Thickeners	Operational
6	Inflow Culvert	900 mm dia. HDPE legacy culvert	Decommissioned
7	Seepage to Valley Pit	Seepage reports to Wishing Well Sump in Valley Pit	N/A
8	Pump to Mill Diversion Line	1x HDPE pipeline and portable pump (deployed when needed)	N/A
9	Witches Brook Drain	1x HDPE pipe with control valve	Operational
10	Inflow from Sewage Treatment Plant	Regular, treated effluent in trench running south to north and discharging at the NE corner of the pond	Operational
11	Inflow from No. 4 Crusher	1x HDPE pipe, irregular flow	Operational
12	Inflow from Truck Wash	Surface runoff from truck wash collected by drainage ditch	Operational

4.2 Climate

THVCP provided weather data from the L-L Dam climate station (El. 1186 m) which is the nearest climate station to the site but is at a lower elevation than 7-Day Pond catchment (>El. 1260.0 m, i.e. dam crest). Climate data was adjusted for elevation, using the recommended adjustment factor from L-L Dam to Main Area (El. 1,100 m to 1,300 m), from Golder (2016). To support key precipitation trends and impacts on observed dam performance, data from Kamloops Airport (Environment Canada Station No. 1163781, El. 345 m) was reviewed for comparison. Precipitation records from L-L

Dam (adjusted) and Kamloops Airport between October 2018 and September 2019 are tabulated and plotted with average monthly values or climate normals in Table 4.1 and Figure 4.2 respectively. Normal precipitation data, reported in Table 4.1, is based on the Highland Valley Lornex climate station, adjusted for elevation to Main Area using Golder (2016).

Seasonal snowpack depth is not measured at the L-L Dam weather station. Instead, monthly measurements at the Highland Valley snow survey station (Station No. 1C09A) near the Trojan TSF are used by THVCP to monitor snowpack. The measurements are sorted by survey period (the first of January through May) to compare snowpack depths, in snow-water equivalent (SWE), for the same period each year. Historical average and 2019 snowpack depths based on available records are summarized in Table 4.2. The following observations were noted for 2019:

- January through April precipitation measured at 7-Day Pond TSF was significantly less than historic normals (based on Highland Valley Lornex adjusted to Main Area) which, along with reduced snowpack, contributed to a less severe freshet than recent years.
- June and July 2019 were noticeably wetter than normal.
- Snowpack depths were not measured in January and February 2019. Snowpack was significantly shallower than average in April and May 2019.

Table 4.1 Monthly Precipitation

Month	Precipitation (mm)			
	L-L Dam Weather Station Data Adjusted to Main Area ⁽¹⁾	1976-2011 Highland Valley Lornex Normals ⁽²⁾	Kamloops Airport Weather Station ⁽³⁾	1981-2010 Kamloops Airport Weather Station Normals ⁽⁴⁾
Oct 2018 ⁽⁵⁾	19.3	30.0	27.5	19.4
Nov 2018 ⁽⁵⁾	21.2	40.4	33.5	23.3
Dec 2018 ⁽⁵⁾	14.1	40.8	20.2	25.4
Jan 2019	11.2	27.5	5.7	21.1
Feb 2019	16.3	21.0	13.8	12.4
Mar 2019	6.1	16.7	4.3	12.8
Apr 2019	15.2	21.3	11.5	14.2
May 2019	37.5	41.3	17.4	27.3
Jun 2019	86.6	47.9	21.2	37.4
Jul 2019	79.9	43.5	36.0	31.4
Aug 2019	10.5	31.7	16.7	23.7
Sep 2019	42.7	31.2	39.1	29.4
Annual Total	360.5	393.3	246.9	277.6

Notes:

1. Available data from L-L Dam climate station was adjusted by a L-L Dam-to-Main Area adjustment factor of 0.95 (Golder 2016).
2. Golder (2016) considered Highland Valley Lornex climate station (Environment Canada ID No. 1123469 at El. 1268 m) to be representative of Main Area.
3. 2019 data from Kamloops Airport station with ID No. 1163781. Kamloops Airport Climate Station was relocated 500 m in 2013 from station ID No. 1163780.
4. Climate normals from data collected at previous Kamloops Airport station location (ID No. 1163780).
5. October to December 2018 were reported in 2018 DSI and outside of 2019 DSI reporting period but are included for reference.

Figure 4.2 Monthly Precipitation

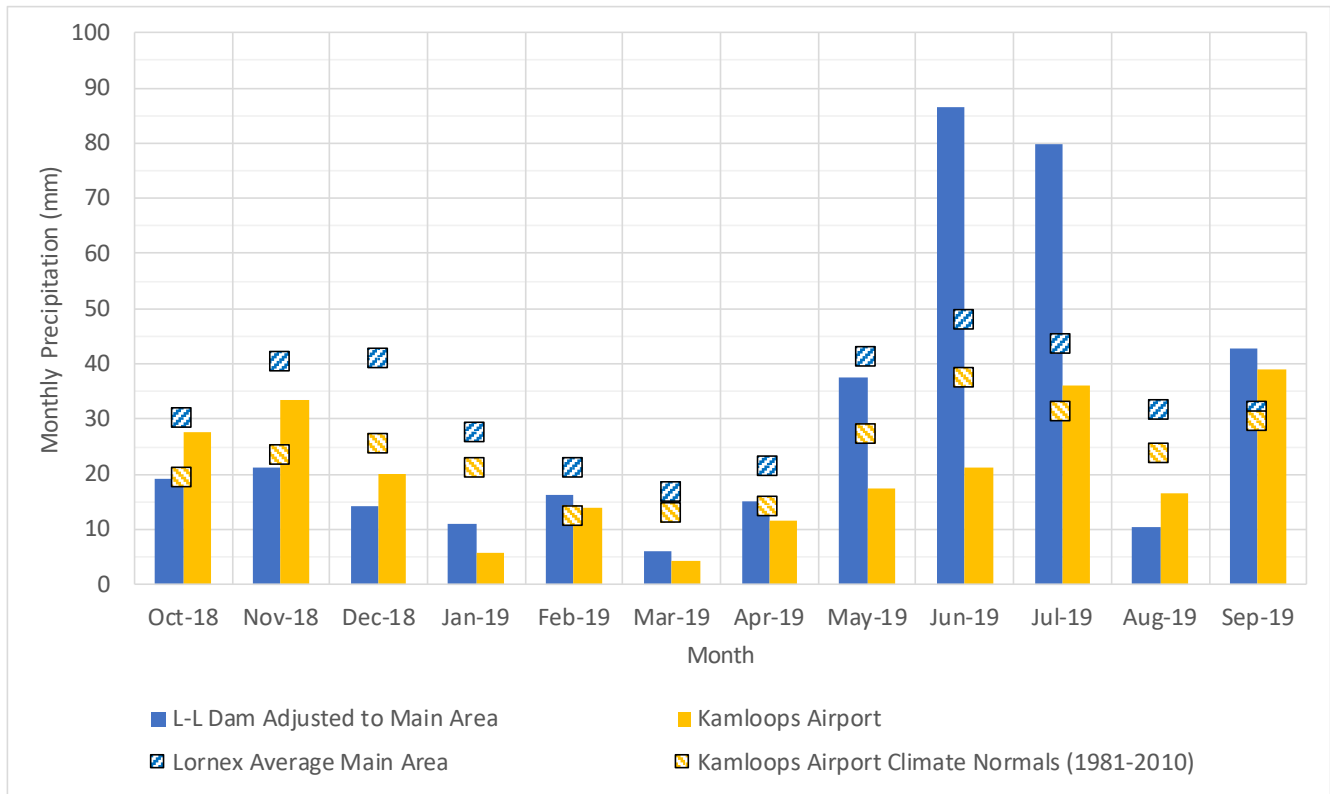


Table 4.2 Historical Average and 2019 Snowpack Depths

Survey Period	Years of Record ⁽¹⁾	Historic Average Snowpack Depth ⁽²⁾ (mm SWE ⁽³⁾)	2019 Snowpack Depth (mm SWE ⁽³⁾)	Percent Change Relative to Historic Average
January 1 st	11	50.2	Not surveyed	N/A
February 1 st	25	83.5	Not surveyed	N/A
March 1 st	53	90.8	90	-1%
April 1 st	52	100.8	54	-46%
May 1 st	52	28.6	Trace	-100%
May 15 th	25	2.4	Not surveyed (assumed to be 0)	-
June 1 st	8	0.0	Not surveyed (assumed to be 0)	-

Notes:

1. At the Highland Valley snow survey station (Station No. 1C09A) near the Bethlehem TSF. Data prior to 1966 was not included as the station was moved to its current location in 1965.
2. Calculated based on available period on record. 2019 surveys were completed within 48-hours of the Survey Period date.
3. SWE = snow water equivalent.

4.3 Water Balance

Figure 4.1 is a simplified water schematic for the pond. Inflows and outflows are not measured. THVCP reviews tailings level annually to define operating and flood levels. Going forward, THVCP will maintain adequate tailings and flood storage through dredging, or some other means, on an as needed basis. The pond levels at the first quarter (Q1) of 2019 was similar to the levels in Q1 2018. However, in Q2 and Q3, the water elevations were higher than historical elevations except in August (refer to Section 5.3).

4.4 Flood Management

Based on the dam's consequence classification of "Low", the Inflow Design Flood (IDF) required by the Code is one-third between the 975-year flood and Probable Maximum Flood (PMF). For facilities that store the IDF, rather than route, a minimum IDF duration of 72 hours is required, per the Code.

In 2019, a work plan was accepted by EMPR to bring 7-Day Pond into compliance with flood management. The related work scheduled for 2019 was completed:

- site investigation program (drilling and test pits) of the east perimeter road berm fill and foundation (KCB 2019b);
- detailed design and issued for construction drawings prepared for preferred raise of the east perimeter road berm to provide adequate flood storage to meet requirements under the Code (KCB 2019c); and
- detailed design of the permanent dewatering system.

THVCP reports they are on schedule to construct the raise before September 2020 and to meet all milestone dates in the work plan accepted by EMPR. To increase overall flood routing capacity during the interim period when the facility is being brought into compliance, THVCP mobilizes a temporary pumping system, on an as needed basis, to 7-Day Pond to draw down the pond level. The pumping system was in operation during 2019 as a proactive measure to draw the pond level down (i.e. not in response to a flood event).

4.5 Freeboard

THVCP has adopted 0.5 m as the minimum freeboard for 7 Day Pond, which exceeds the Code and CDA design requirements. Minimum observed freeboard in 2019 was 1.1 m and remained below "Flood Normal" range as shown on Figure 5.1.

5 REVIEW OF MONITORING RECORDS AND DOCUMENTS

5.1 Monitoring Plan

An OMS manual has not been prepared for the 7-Day Pond because under the previous Code, one was not required for a dam with a “Low” consequence classification. However, one is required under the current Code and therefore KCB recommended one be prepared in 2017. The failure mode review, risk assessment and DSR have been completed for the 7-Day Pond and THVCP have incorporated 7-Day Pond inspection as part of routine activities. However, preparation of the OMS manual which consolidates the relevant information into a single document was started in 2019 but completion has been delayed into 2020. The delay is the result of prioritizing updates to the OMS manual for other larger tailings facilities at the site over 7-Day Pond. The document will be consistent with the intent of the Mining Association of Canada (MAC 2019) and CDA (2013) guidelines.

5.2 Inspections

The monitoring program includes the following inspections:

- Annual DSI (this report) – completed by the EoR to comply with Section 10.5.3 of the Code and submitted to EMPR.
- Routine – in 2019, routine inspections were completed by THVCP staff quarterly for 7-Day Pond. Summaries of dam inspection observations were provided to the EoR and have been reviewed as part of this DSI.
- Event-driven – completed by THVCP staff in response to the following threshold exceedances (to be included in the OMS manual):
 - ◆ Earthquake greater than magnitude 5, within 100 km of the site or any earthquake felt at site.
 - ◆ Rainfall event greater than the 10-year, 24-hour duration storm; 41 mm (Golder 2016).
- No event-driven inspections were triggered during 2019.

5.3 Reservoir Level

THVCP monitors 7-Day Pond levels roughly weekly throughout the year; refer to Figure 5.1. Alert levels of freeboard for 7-Day Pond defined by THVCP and reviewed by KCB are summarized in Table 5.1. Reservoir alert levels will be revised during 2020, following completion of the flood routing upgrade works, during which the crest of the east perimeter road berm will be raised. A summary of the review of reservoir level in 2019 (up to end of September 2019) is as follows:

- The peak pond level in 2019 was ~0.1 m less than the peak level recorded in 2018. During 2019, pond levels were within normal operating conditions.
- The available freeboard during 2019 was greater than 1.1 m (measured using the crest elevation of 1260 m, corresponding to the east perimeter road berm elevation).

- Trend of rising pond level is more influence by tailings deposition than water accumulation:
 - ◆ Between the 2018 and 2019 surveys approximately 15,000 m³ of tailings were deposited in 7-Day Pond.

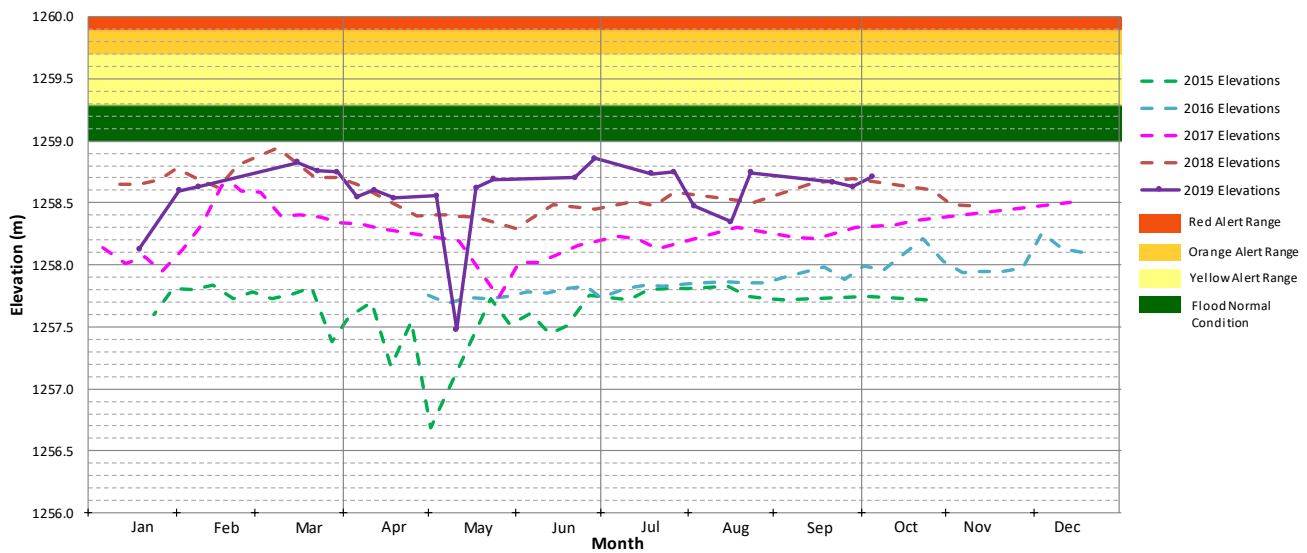
Table 5.1 7-Day Pond Reservoir Alert Levels

Water Level	Freeboard (m)
Flood Normal Condition	1.0
Yellow Alert Level (Level 1: Unusual Condition)	0.7
Orange Alert Level (Level 2: Emergency Condition)	0.3
Red Alert Level (Level 3: Crisis Condition)	0.1

Notes:

1. Alert levels are defined by THVCP and reviewed by KCB.

Figure 5.1 7-Day Pond Reservoir Levels with Threshold Ranges



5.4 Geotechnical Instrumentation

There are no geotechnical instruments at 7-Day Pond. None are recommended at this time.

5.5 Seepage

Seepage from 7-Day Pond is collected in the Wishing Well Sump located in the Valley Pit. This sump also collects water from other sources and the total pumped volumes to the thickeners are measured. Direct measurements of seepage from 7-Day Pond are not regularly taken and none was observed during the 2019 DSI site visit.

5.6 Water Quality

As required by permit (PE-376), water quality in the Highland Valley Pit area, where the 7-day Pond is located, is monitored by THVCP. A summary of data to be included in the 2019 Annual Water Quality Monitoring Report was provided to KCB by THVCP for review as part of the DSI. Select observations and findings from the monitoring data are summarized as follows:

- There are three permitted surface water quality monitoring sites in the Highland Valley Pit area, as shown on the site monitoring plan in Appendix III.
- There were no exceedances of permit limits measured at any related sampling site. Required sampling frequency was also met in 2019 except for:
 - ◆ Sample Site #202 (Lornex Waste Rock Dump Seepage) missing measurements of total organic carbon (TOC) and dissolved organic carbon (DOC) in June; and
 - ◆ Sample Site #602 (Waste Water Treatment Plant) missing measurement of total suspended solids (TSS) in November.

The 2019 monitoring results were screened against applicable BC Water Quality Guidelines (WQG). Further discussion on specific WQG exceedances and water quality trends observed during 2019 are separately reported in the 2019 Annual Water Quality Monitoring Report which is submitted by THVCP to Ministry of Environment and EMPR.

6 VISUAL OBSERVATIONS AND PHOTOGRAPHS

The visual observations made during the DSI site visit are summarized below. A copy of the field inspection forms is included in Appendix I. Photographs are included in Appendix II.

- **Crest:** The haul road which forms the crest of the dam around 7-Day Pond was in good physical condition. No indicators of significant concern were observed (e.g. cracking, slumping) (Photo II-1).
- **Upstream and Downstream Slopes:** Upstream slopes were in good physical. The upstream slopes were not vegetated, but no indicators of significant concern were observed (e.g. animal activity, cracking, slumping, surface erosion features). The visible parts of the downstream slope of the haul road forming the east containment of the impoundment was in good physical condition. Ponding was observed in the two adjacent treed areas, i.e. at the downstream toe of the east perimeter access road (Photo II-3 to Photo II-5).
- **Tailings Beach:** Was partially covered by tailings piles (southern and northwest end of pond) and by the pond (northeast end of pond) at time of inspection (Photo II-5 and Photo II-6).
- **Pond:** At the time of inspection, freeboard was more than 1 m (Photo II-8).
- **Outflow Pump:** Had not been installed at the time of inspection.
- **Seepage:** None observed.

7 ASSESSMENT OF DAM SAFETY

7.1 Dam Classification Review

The 7-Day Pond has been assigned a “Low” consequence classification as defined by CDA (2013) based on a dam consequence review held on January 23, 2019, which the EoR (Mr. Rick Friedel, P.Eng. of KCB) participated in via teleconference.

7.2 Failure Mode Review

Based on the DSI and review of available documents, the potential failure modes included in the Canadian Dam Safety Guidelines (CDA 2013) were reviewed:

Overtopping

As discussed in Section 4.4, the 7-Day Pond cannot store the IDF required under the Code. THVCP and EMPR have agreed to a work plan and schedule to bring the facility into compliance with the Code. While this work is being completed, THVCP has implemented short-term actions to reduce the likelihood of overtopping the facility. With the short-term plan in place, the 7-Day Pond TSF can manage a 100-year to 200-year event depending on tailings level at the time of the flood event.

Internal Erosion and Piping

No seepage or piping related indicators have been observed along the berm section of the west perimeter and a low seepage gradient is present through the berm. In addition, under normal conditions, a tailings beach separates the berm from the pond.

Slope Stability – Foundation Irregularities / Dam Fill / Earthquake

The overall downstream slope of the east perimeter road berm is shallow (~3H:1V) with a height up to 6 m. Based on site investigations (KCB 2019b), the berm is founded on competent Glacial Till material. The fill and foundation materials are not susceptible to significant strength loss or liquefaction based on comparison to similar materials under similar conditions around the site. Slope stability under static and dynamic loadings was estimated based on characterization of the fill and foundation (Glacial Till). Factor of safety values exceeded criteria for both loading conditions as reported by KCB (2019c).

Surface Erosion

No significant erosion damage of the downstream slopes has been observed. Sufficient surface erosion of the dam slope resulting in a failure from a single event is considered negligible and progressive erosion is managed by the existing regular inspection and maintenance program.

7.3 Emergency Preparedness and Response

An Emergency Preparedness and Response Plan (EPRP) has not been prepared for the 7-Day Pond and was not a requirement under the previous Code for a dam with a “Low” consequence classification. However, one is required under the current Code and therefore KCB recommended that one be prepared in 2017. The failure mode review, risk assessment and DSR have been completed for the 7-Day Pond and THVCP have incorporated 7-Day Pond inspection as part of routine activities. However, similar to preparation of the OMS manual, the preparation of a consolidated EPRP document has been delayed into 2020. The updated EPRP will be consistent with the intent of the Mining Association of Canada (MAC 2019) and CDA (2013) guidelines.

8 SUMMARY

The 7-Day Pond facility appears to be in good physical condition and the observed performance during the 2019 site inspections was consistent with past performance. The status of recommendations to address deficiencies and non-conformances identified during past DSIs are summarized in Table 8.1. Closed recommendations are shown in *italics*. Recommendations to address deficiencies and non-conformances identified during the 2019 DSI are summarized in Table 8.2.

Table 8.1 Previous Recommendations for Deficiencies and Non-Conformances – Status Update

ID No.	Deficiency or Non-Conformance	Applicable Reg. or OMS Reference	Recommended Action	Priority ¹	Recommended Deadline (Status)
SDP-2016-02	Operations	OMS and EPRP	Prepare an OMS manual and EPRP (This recommendation addresses DSR recommendation 7D-001).	3	Q3, 2017 (Open, scheduled for early 2020)
SDP-2018-01	Flood Routing	10.1.8	Execute agreed work plan to bring 7-Day Pond into compliance with the IDF under the Code (This recommendation addresses DSR recommendation 7D-002).	2	September 2020 (Open)

Notes:

- Recommendation priority guidelines, specified by Teck and assigned by KCB:
 - Priority 1: *A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant risk of regulatory enforcement.*
 - Priority 2: *If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory enforcement; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.*
 - Priority 3: *Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.*
 - Priority 4: *Best Management Practice – Further improvements are necessary to meet industry best practices or reduce potential risks.*

Table 8.2 2019 Recommendations for Deficiencies and Non-Conformances

ID No.	Deficiency or Non-Conformance	Applicable Reg. or OMS Reference	Recommended Action	Priority ¹	Recommended Deadline
SDP-2019-01	Storage Capacity	-	As part of flood routing work, THVCP to close out the 2018 DSR Recommendation (7D-004) regarding the non-conformance of operational freeboard against Code/CDA requirements.	3	Q3, 2020
SDP-2019-02	Flood Routing	-	As part of close-out of flood compliance activities, confirm minimum freeboard under normal conditions (in addition to flood) and report in OMS Manual.	4	Q3, 2020

Notes:

- Recommendation priority guidelines, specified by Teck and assigned by KCB:
 - Priority 1: *A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant risk of regulatory enforcement.*
 - Priority 2: *If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory enforcement; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.*
 - Priority 3: *Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.*
 - Priority 4: *Best Management Practice – Further improvements are necessary to meet industry best practices or reduce potential risks.*

9 CLOSING

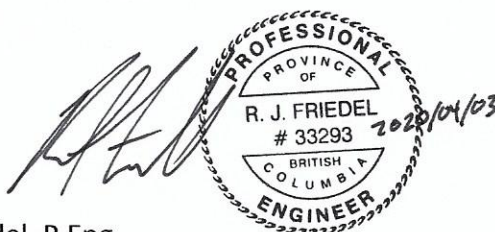
This report is an instrument of service of Klohn Crippen Berger (KCB). The report has been prepared for the exclusive use of Teck Highland Valley Copper Partnership (Client) for the specific application to the 2019 Dam Safety Inspection Project, and it may not be relied upon by any other party without KCB's written consent.

KCB has prepared this report in a manner consistent with the level of care, skill and diligence ordinarily provided by members of the same profession for projects of a similar nature at the time and place the services were rendered. KCB makes no warranty, express or implied.

Use of or reliance upon this instrument of service by the Client is subject to the following conditions:

1. The report is to be read in full, with sections or parts of the report relied upon in the context of the whole report.
2. The Executive Summary is a selection of key elements of the report. It does not include details needed for the proper application of the findings and recommendations in the report.
3. The observations, findings and conclusions in this report are based on observed factual data and conditions that existed at the time of the work and should not be relied upon to precisely represent conditions at any other time.
4. The report is based on information provided to KCB by the Client or by other parties on behalf of the client (Client-supplied information). KCB has not verified the correctness or accuracy of such information and makes no representations regarding its correctness or accuracy. KCB shall not be responsible to the Client for the consequences of any error or omission contained in Client-supplied information.
5. KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.

KLOHN CRIPPEN BERGER LTD.



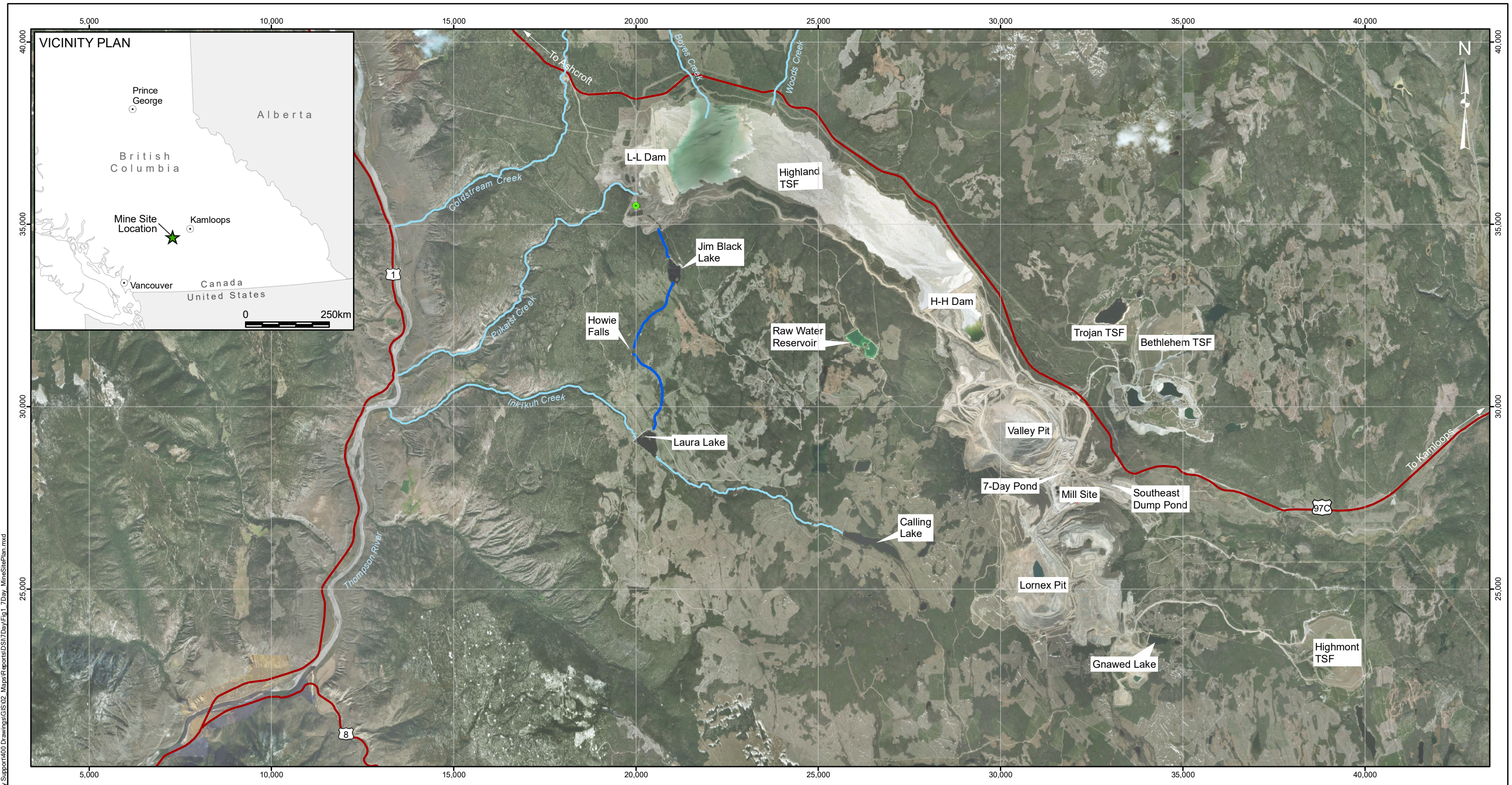
Rick Friedel, P.Eng.
Engineer of Record, Designated Representative
Senior Geotechnical Engineer, Principal

REFERENCES

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- KCB. 2019b. "2019 Site Investigation 7-Day Pond – East Berm", May 2.
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- THVCP. 2019b. "Re: HVC Response to EMPR Geotechnical Inspection – 7-Day Pond Update to June 27, 2019". Letter. June 27.
- THVCP. 2019c. "Re: HVC Response to EMPR Geotechnical Inspection – 7-Day Pond Update to September 30, 2019". Letter. September 30.

FIGURES

- | | |
|----------|-----------------|
| Figure 1 | Mine Site Plan |
| Figure 2 | 7-Day Pond Plan |



- Legend**
- L-L Dam Climate Station
 - Creek / River
 - Highway
 - Ditch



CLIENT Highland Valley Copper / Teck	PROJECT 7-DAY POND STORAGE FACILITY 2019 DAM SAFETY INSPECTIONS	
	TITLE MINE SITE PLAN	
	SCALE 1:100,000	PROJECT No. M02341B53
	FIG No. 1	

Notes:
 1. Projection: HVC Mine Grid.
 2. TSF = Tailings Storage Facility.
 3. Base data provided by the Government.
 4. Imagery provided by ESRI.

Date: 2020-01-20
 Document Path: Z:\MVC\CR\M02341B53 - HVC-2019 Dam Safety Support\400 Drawings\GIS\02 - Maps\Reports\DSI\7Day\Fig1_7Day_MineSitePlan.mxd



- Legend**
- Embankment
 - Bench
 - Overtopping
 - Index Contour (5 m)
 - Intermediate Contour (1 m)



Date: 2020-01-20
 Document Path: Z:\M\VCR\M02341B53 - HVC-2019 Dam Safety Support\400 Drawings\GIS\02 - Maps\Reports\DSI\7Day\Fig2_7Day_DamPlan.mxd

Notes:
 1. Projection: HVC Mine Grid.
 2. Imagery and topography obtained September, 2019

CLIENT Highland Valley Copper / Teck	PROJECT 7-DAY POND STORAGE FACILITY 2019 DAM SAFETY INSPECTION	
	TITLE 7-DAY POND PLAN	
	SCALE 1:2,500	PROJECT No. M02341B53
		FIG No. 2

APPENDIX I

Dam Safety Inspection Checklist

2019 ANNUAL DAM INSPECTION CHECKLIST



Facility:	7-Day Pond	Inspection Date:	June 10 th , 2019
Weather:	Cloudy	Inspector(s):	Rick Friedel, P.Eng. Pablo Urrutia, P.Eng. Narges Solgi, EIT
Freeboard (pond level to dam crest):	Freeboard 1.3 m based on May 23 rd survey for Crest Elevation of 1260 m		

Outlet Condition Survey

Description	Outlet Controls?	Was it flowing?	Flow rate	Visual Review?	Testing / Detailed Inspection?
Portable Pump not installed at the time of the inspection	N/A	N/A	N/A	N/A	N/A

Are the following components of the facility in **SATISFACTORY CONDITION?**
(check one if applicable)

WASTE DUMP WALLS	Yes/No
U/S Slope	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Crest	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

Were any of the following **POTENTIAL PROBLEM INDICATORS** found?

INDICATOR	WASTE DUMP WALLS
Piping	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Sinkholes	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Seepage	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
External Erosion	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cracks	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Settlement	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Sloughing/Slides	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Animal Activity	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Excessive Growth	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Excessive Debris	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

List and describe any deficiencies (all deficiencies require assessment and/or repair):

- No dam safety deficiencies observed

Comments / Notes:

- Interior berm partially dividing TSF. Water can pond u/s of the berm in a corner where no, to little, tailings build up on downstream side
- Storage capacity should be checked to ensure the embankment could store IDF
- What is the discharge plan via pumping?

SITE PLAN
(Image provided by THVCP on Dec 03, 2019)



APPENDIX II

Inspection Photographs

Appendix II Inspection Photographs

LEGEND:

- SDP = 7-Day Pond.
- SDP-2019-## refers to 2019 DSI waypoint shown on Figure 2.
- All photographs taken during inspection June 10, 2019.

Photo II-1 Overview of east perimeter access road crest looking north (SDP-2019-01)



Photo II-2 Tailings and water pipelines along downstream side of east perimeter access road crest (SDP-2019-02)



Photo II-3 Treed area downstream (d/s) of 7-Day Pond retaining berm formed by east perimeter access road. Tailings and water pipelines along d/s side of crest (SDP-2019-02)



Photo II-4 Overview of pond and upstream slope of west and north perimeter access roads – good freeboard is maintained (SDP-2019-15)



Photo II-5 Overview of the upstream slope of western and northern perimeter access roads looking north (SDP-2019-01)



Photo II-6 Overview of the upstream slope and active discharge point looking south (SDP-2019-01)



Photo II-7 Overview of west and north perimeter access roads (SDP-2019-03)



Photo II-8 Overview of the pond looking south from north perimeter access road (SDP-2019-04)



Photo II-9 Lifebuoy is in place along east perimeter access road (SDP-2019-01)

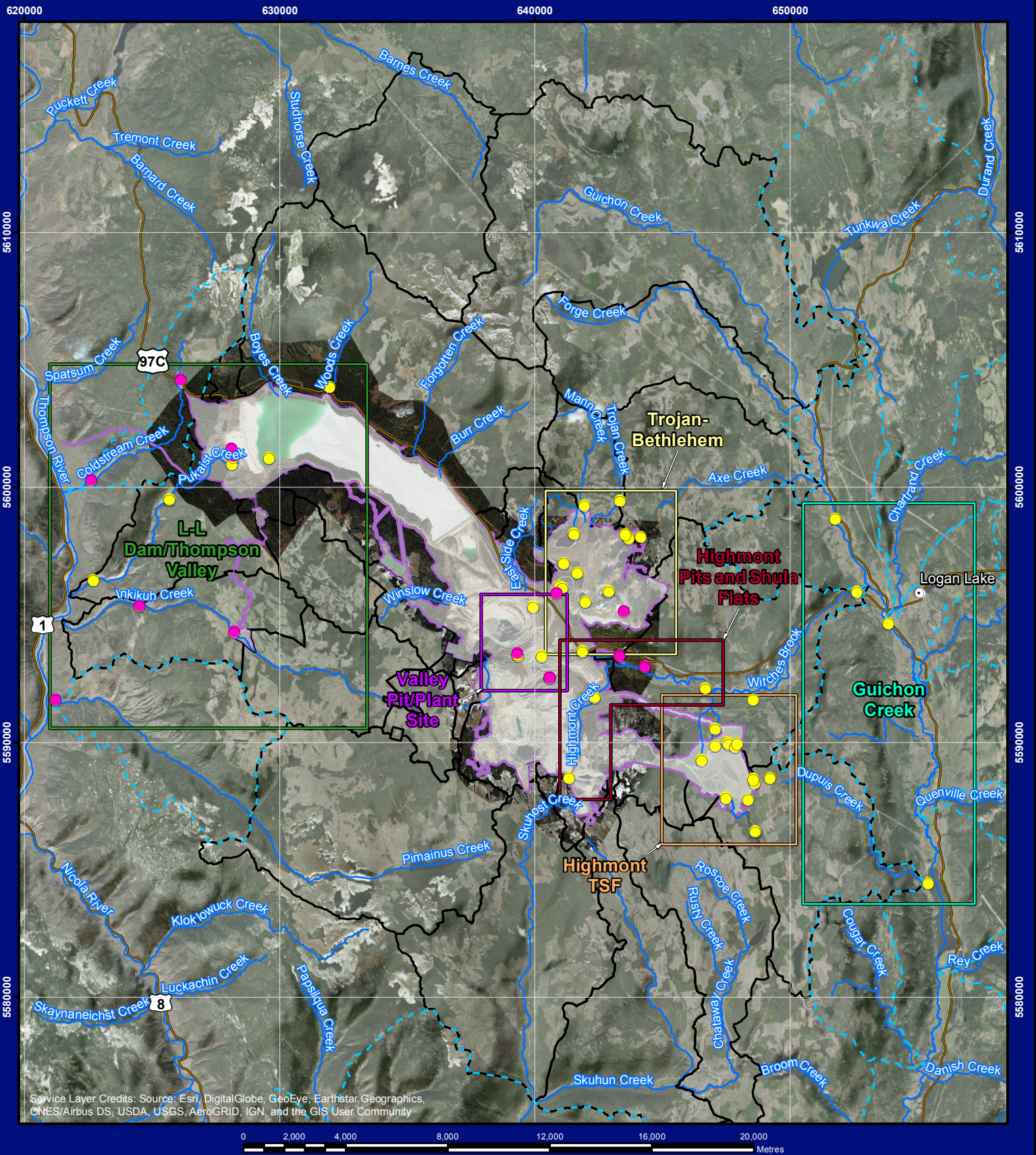


Photo II-10 Overview of the internal berm within the impoundment (SDP-2019-05)

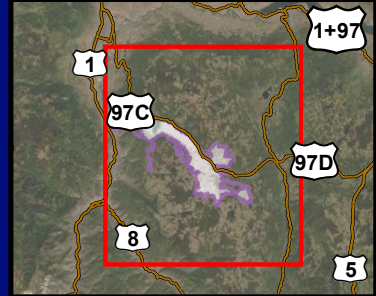


APPENDIX III

Map of Water Quality Monitoring Points



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



- | | |
|-------------------------------|----------------------|
| Guichon Creek | Permitted Mine Area |
| Highmont Pits and Shula Flats | Sampling Site |
| Highmont TSF | Permitted |
| L-L Dam/Thompson Valley | Voluntary |
| Trojan-Bethlehem | Watersheds |
| Valley Pit/Plant Site | Freshwater Atlas |
| Community | HVC Updated |
| Highway | |

Highland Valley / **Teck** Teck Resources Limited
 Copper PO Box 1500
 Logan Lake, BC, Canada

Figure E-1
Water Quality Monitoring Sites,
Highland Valley Copper, 2019
 1:200,000

PROJECTION: NAD 1983 UTM Zone 10N
 DATE: 3/19/2020 GIS No. HVCE-01-004a

638000

639000

640000

641000

5595000

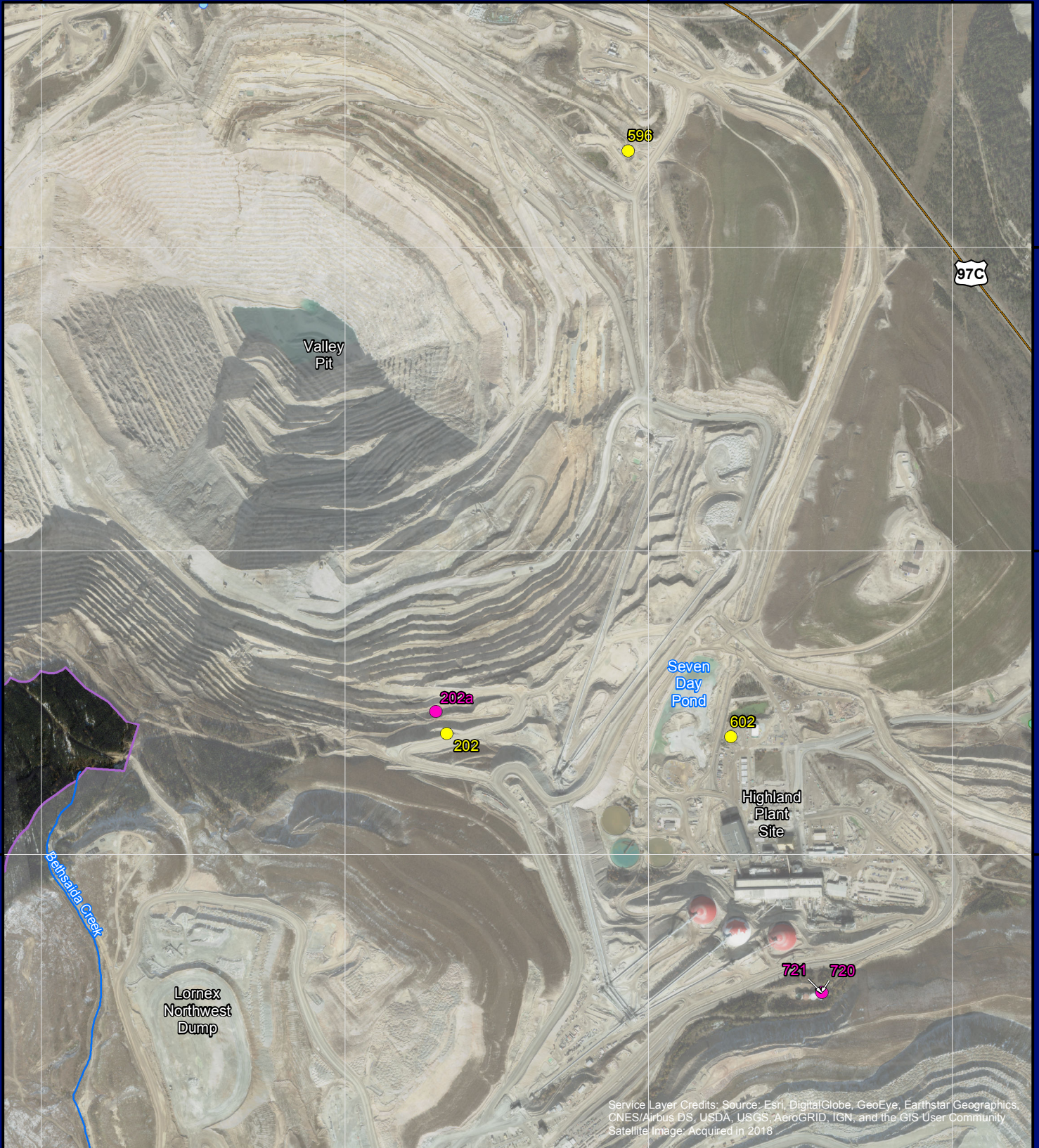
5595000

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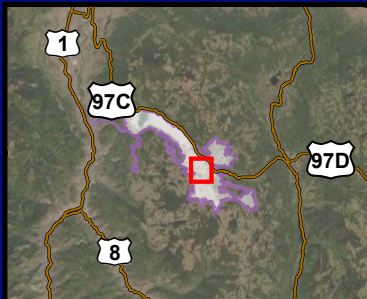
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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
 Satellite Image: Acquired in 2018



Sampling Site

- Permitted
- Voluntary
- Permitted Mine Area
- Wetland
- Highway

Highland Valley / **Teck** Copper

Teck Resources Limited
 PO Box 1500
 Logan Lake, BC, Canada

Figure 3.2-1
Water Quality Monitoring Sites in the Valley Pit/Plant Site Area, Highland Valley Copper, 2019
1:17,500



PROJECTION: NAD 1983 UTM Zone 10N

DATE: 3/19/2020

GIS No. HVCE-01-004b

APPENDIX IV

2018 DSR Recommendations

Appendix IV Dam Safety Review Recommendations

**Table IV-1 2018 Highmont TSF Dam Safety Review
Updates on Recommendation/Response Summary**

ID	Priority ¹	2018 DSR Comment	Topic
7D-001	2	<p>There is currently no OMS or EPRP for the 7-Day Pond TSF (it is understood that one is in progress)</p> <p>Prepare an OMS manual and EPRP that includes the following, at a minimum:</p> <ul style="list-style-type: none"> - Details on normal and maximum operating levels and freeboard requirements based on the outcomes of a flood routing assessment - Guidance on inspection activities and frequencies -Details on pumping requirements under normal conditions, during freshet, and as a response to storm events -Communication framework and clear designation of responsibilities between the Mill Operations team and Tailings Water Management group for managing the 7-Day Pond, including defined strategies for long-term tailings storage -Traffic safety plans and alternative routes in the event of an overtopping failure or 7-Day Pond breach (as part of the EPRP) 	OMS
7D-002	1	<p>Facility currently does not capacity to store the IDF. To meet Code requirements, one or more of the following methods needs to be implemented to provide IDF storage:</p> <ul style="list-style-type: none"> - Reduce upstream catchment area by confirming existing culverts, catch basins, and swales have capacity for the IDF and/or upgrade these components for the IDF. Or reduce upstream catchment area by constructing new diversions. - Remove and relocate tailings from 7-Day Pond to another facility - Install a continuous water management system to reduce reliance on storage (such as a spillway or pump with backup system) - Raising the perimeter of the facility to provide storage <p>SRK understands that the current plans involve raising the perimeter dam, installing permanent pumping systems, and continuously excavating tailings excavation to meet Code IDF storage requirements and provide contingency storage for tailings from the Mill.</p> <p>It is recommended that the initial options assessment also consider the feasibility of additional alternatives that do not require raising or constructing new dams, such as increasing tailings relocation rates, constructing/upgrading upstream diversions, or installing an emergency spillway.</p> <p>This should not impact the proposed milestone schedule in THVCP 2019, and the preferred option should still be selected by mid-2019 and implemented within a year.</p>	Storage Capacity
7D-003	3	<p>No site investigations have been undertaken to confirm foundation conditions and material properties. No stability analyses have been completed.</p> <p>To explicitly meet Code requirements, complete site investigation to confirm foundation conditions and assess susceptibility to liquefaction and/or strength reduction under seismic loading. Run stability analyses applying the results of the site investigation. It is understood that this work is underway.</p>	Geotechnical
7D-004	3	<p>Current operational freeboard requirements do not meet Code / CDA requirements and are not linked to a flood routing assessment.</p> <p>SRK supports KCB's initial recommendation to develop a long-term strategy for 7-Day pond to manage ongoing tailings storage requirements and meet Code requirements</p>	Storage Capacity

Notes:

1- Priority guidelines are defined as follows (MEM 2016):

- Priority 1: A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant risk of regulatory enforcement.
- Priority 2: If not corrected, could likely result in dam safety issues leading to injury, environmental impact or significant regulatory enforcement; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
- Priority 3: Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
- Priority 4: Best Management Practice – Further improvements are necessary to meet industry best practices or reduce potential risks.

2- Deficiency: an inadequacy, or uncertainty in the adequacy, of the dam system to meet its performance goals in accordance with good dam safety practices.

3- Non-Conformance: an inadequacy in the nonphysical controls (procedures, processes and management systems) necessary to maintain the safety of the dam.