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TECK COAL LIMITED
GREENHILLS OPERATIONS

2017 Dam Safety Inspection for Greenhills Tailings Facility

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REPORT

Golder Associates

Executive Summary

This report presents the 2017 annual dam safety inspection (DSI) for the tailings facility at the Greenhills Operations (GHO) mine site, located near Elkford, British Columbia. This report was prepared based on a site visit carried out on 21 September 2017 and a review of data provided by Teck Coal Limited (Teck) GHO.

Summary of Facility Description

The tailings pond is retained on the southeast by the Main Tailings Dam and on the west by the West Tailings Dam.

The Main Tailings Dam is an approximately 50-m high zoned earth fill embankment structure. The dam shell is constructed from compacted coarse coal refuse material with a 6-m wide zone of compacted clay till (clay blanket) on the inclined upstream face. The dam has a design upstream slope of 2 horizontal to 1 vertical (2H:1V) and a design downstream slope of 2.5H:1V, and has been raised in stages since 1983. Coarse coal refuse dumps Site C and D are located immediately downstream of the Main Tailings Dam. These dumps result in a wider dam section than required in the design and hence act as a buttress to the dam.

The West Tailings Dam is a zoned earth-fill dam similar in design to the Main Tailings Dam. The West Dam has a maximum height of around 22 m, and fills a topographic low located at the northwest end of the tailings basin.

Summary of Key Hazards

The key hazards are as follows:

- Potential for overtopping due to surface water inflows during storm events larger than the design flood or inappropriate water management.
- Internal instability of the Main and West Dams due to piping (internal erosion).
- Instability due to seismic shaking.

Dam Consequence Classification

The Main and West Tailings dams are classified as High consequence dams, as per the criteria in the Canadian Dam Association (CDA) *Dam Safety Guidelines* (CDA 2013). The consequence classification for the dams has not changed based on this DSI.

Summary of Significant Changes

The Main Dam was raised to a crest elevation of 1,728.85 m, and West Dam crest was raised to a crest elevation of 1,728.73 m during 2017. The downstream shell of the West Dam was also extended, and the temporary emergency spillway that was constructed in 2016 by the south abutment of the West Dam was removed so that the West Dam could be raised. The strategy for managing storms greater than the design event is being reviewed.

Significant Changes in Instrumentation and/or Visual Monitoring Records

There were no significant changes in instrumentation measurements and no significant changes were noted in visual inspections.

Significant Changes to Stability and/or Surface Water Control

There were no significant changes to stability. Surface water management on Site C was improved by installing a diversion structure and a pipe on the steep section, and a SmartDitch drain at the toe of the Site C and D refuse spoils.

Operation, Maintenance, and Surveillance Manual

No changes have been made to the Operation, Maintenance, and Surveillance (OMS) Manual for the tailings facility since it was last updated in 2017 (GHO 2017). Review of the OMS Manual indicates that it meets the guidelines provided by the CDA (2013) and the Mining Association of Canada (MAC 2011).

Emergency Preparedness Plan

An Emergency Preparedness Plan (EPP) for the tailings facility (GHO 2013; Standard Practices and Procedures No. 1543) is in the process of being updated by Teck. An inundation study for a potential breach of the TSF was completed by Golder in 2012 (Golder 2012) and updated in 2016 (Golder 2017c). The 2016 study was conducted to reassess an overtopping or piping failure of the Main Dam and assess an overtopping failure of the West Dam.

Dam Safety Review

A DSR was commenced in June 2017, and issued in December 2017 (KCB 2017). The DSR concluded that the tailings dams meet current safety standards.

The July 2016 revision of the Health, Safety and Reclamation Code (HSRC) (BC MEMPR 2016a) requires a DSR be completed at least every 5 years. The next DSR is required before 2023.

Recommended Actions

The 2016 dam safety inspection deficiencies and non-conformances are summarized in Table E-1 (Golder 2017d). The incomplete or partially complete issues were brought forward and are included with the 2017 DSI recommendations, provided in Table E-2.

Table E-1: Status of Previous (2016) Recommended Actions

ID Number	Deficiency or Non-conformance	Applicable Regulation or OMS Reference	Risk to Structure	Priority	Recommended Actions	Target Date	Status as of February 2018	Photo
2016-01	No data for piezometers VW11-MD-2B and 3B, VW11-MD-5A and 5B, VW11-WD-2A and 3B.	n/a	Potentially unstable condition not measured.	2	Confirm that the dataloggers are functioning. Repair or replace the piezometers.	Q2 2017	In progress. VW11-MD-2B is not functioning and has been removed from service. No repair or replacement is necessary at this time, since sufficient monitoring coverage is provided by SD-16-03 and VW11-MD-2A. VW11-MD-5A and 5B are functioning but the cables have been damaged and need replacing. VW11-WD-2A and 3B are functioning.	-
2016-02	Portion of upstream slope of Main Dam steeper than 2H:1V. Signs of sloughing.	OMS Section 7.0	Reduction of thickness of till layer, which could lead to increased seepage rate.	3	Reslope above pond level to 2H:1V or flatter.	Q3 2017	Complete Slope has been regraded and riprap has been placed to prevent future erosion.	3, 4, 5, 19, and 20
2016-03	Stormwater runoff erosion channel has formed on the west side of Site C.	OMS Section 7.0	Continued erosion of Site C.	3	Site C erosion is to be repaired.	Q3 2017	Complete	10 to 12
2016-04	Capacity of the West Dam spillway may be insufficient.	n/a	Overtopping of the Main Dam during a large storm event.	3	Review the capacity of the West Dam spillway.	Q2 2017	No longer applicable. The emergency spillway was removed and the strategy for managing storms greater than the design event is currently being reviewed.	-
2016-05 (2015-01)	Broken seepage collection pipe at the toe of Site C.	n/a	Site C drainage impeded.	3	Repair drainage at toe of Site C. Review drainage design.	Q3 2017	Complete	13 to 14
2016-06 (2015-04)	No visual indicator of freeboard.	n/a	Potential for overtopping if GPS data is erroneous.	4	Provide visual marker (staff gauge or other).	Q3 2017	Complete A staff gauge, indicating the TARP warning levels, was installed in 2017.	3

El. = elevation; EoR = Engineer of Record.

Table E-2: 2017 Dam Safety Inspection Recommended Actions for the Greenhills Tailings Facility

ID Number	Deficiency or Non-conformance	Photo	Applicable Regulation or OMS Reference	Potential Dam Safety Risk	Recommended Action	Priority Level	Recommended Deadline
2017-01 (2016-01)	■ VW11-MD-1B is reporting erroneous data. ■ VW11-MD-1B, VW11-WD-1A and 1B, VW11-WD-2B, VW11-WD-3A did not report data (VW11-MD-3B, VW11-WD-2A and VW11-WD-3B also reported erroneous and/or no data for the reporting period, but are functioning correctly as of January 2018).VW11-MD-5A and 5B cables have been damaged. ■ SD-16-01 has no new readings since August 2017 when casing cover was partially buried during dam construction.	-	n/a	Potentially unstable condition not measured.	Confirm that dataloggers are functioning correctly and communication is restored as needed. Repair or replace damaged piezometer cables as necessary. Gain access to SD-16-01 and connect to datalogger.	2	Q3 2018
2017-02	QPOs for the inclinometers have not been developed since data is still being collected to establish the baseline.	-	n/a	Potentially unstable condition not identified promptly.	Develop QPOs for the inclinometers once the baseline has been established.	2	Q3 2018
2017-03	The weirs at the toe of Site C and West Dam were damaged in 2017. The weir at the toe of the West Dam has been moved downstream to the other side of the road and is now functioning again.	13, 23	n/a	Potentially unstable condition not measured.	Reinstate the weir at the toe of Site C. Establish baseline monitoring for weirs and consider automating to ensure continual data collection.	2	Q3 2018
2017-04	Pond against upstream slope of Main Dam	1 to 6	n/a	Increased potential for piping, and potential increased zone of influence if dam integrity is compromised.	Review options to move pond away from upstream slope of Main Dam.	4	Q3 2018
2017-05	Closure plan does not meet HSRC requirements	-	HSRC, OMS	n/a	Develop the current concept level closure plan into a more detailed plan aligned with the current LOM strategy and HSRC requirements.	4	Q1 2019
2017-06	In 2014, flood protection berms were constructed along the river near Elkford. The 2016 inundation study update (Golder 2017c) used the 2011 LiDAR, which did not include the flood protection berms. The inundation study needs to be updated with the 2017 LiDAR data to include the recently 2014 flood protection constructed berms.	-	n/a	n/a	Update inundation study with 2017 LiDAR for West Dam breach.	4	Q4 2018

Priority Level	Description
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.
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.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice – Further improvements are necessary to meet industry best practices or reduce potential risks.

OMS = Operation, Maintenance, and Surveillance; n/a = not applicable; QPOs = Quantitative Performance Objectives.

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1.0 INTRODUCTION

At the request of Teck Coal Limited (Teck), Golder Associates (Golder) has completed this annual dam safety inspection (DSI) for the Greenhills tailings facility at Teck's Greenhills Operations (GHO) near Elkford, BC. The reporting period for the data review was from September 2016 through September 2017. This inspection included the following structures:

- Main Tailings Dam
- West Tailings Dam

The DSI report has been prepared in accordance with Part 10 of the Health, Safety and Reclamation Code (HSRC) for Mines in British Columbia (BC MEMPR 2016a) which sets out the frequency for inspection of the dams and appurtenant works. It is understood that this report will be submitted by Teck to the Chief Mines Inspector.

The guidelines for annual dam safety inspection reports by the BC Ministry of Energy and Mines (BC MEM 2013) and BC MEMPR 2016a were followed during the preparation of this report.

The report is based on a site visit carried out on 21 September 2017, discussions with GHO staff, and review of data provided by GHO. The report consists of the following:

- a summary of the site conditions and background information
- a summary of the construction, operating, and/or repair activities for the 2016/2017 period
- review of the dam consequence classification and required operational documents
- site photographs and records of dam inspection
- review of climate data
- review of water balance
- review of assessment of dam safety relative to potential failure modes
- review of instrumentation data
- findings and recommended actions

The previous annual dam safety inspection for the tailings facility dams was carried out in August 2016, and is reported in the 2016 DSI report (Golder 2017d).

2.0 BACKGROUND

2.1 Site History

The GHO site is an active open pit coal mine located near Elkford, BC. The mine was started by Westar Mining Ltd. and initiated production in 1982, but shut down in 1992. Starting in December 1993, the mine was owned as a joint venture between Fording Coal Limited (Fording) and Pohang Steel Canada Ltd., and operated by Fording. The operating company was changed from Fording to Elk Valley Coal Corporation in 2003 and then to Teck Coal Limited in 2008.

Figure 1 shows a location and plan view of the GHO site and the location of the Greenhills Tailings facility.

2.2 Overview of Operations

Raw coal from the pit is processed at the wash plant to produce marketable coal with by-product streams of coarse refuse material and fine refuse tailings; this process is summarized in the process flowsheet which is attached as Appendix E. The coarse refuse material, consisting of 50 millimetres (mm) minus sand and gravel sized particles of rock and coal, is placed into dumps located near the wash plant (Sites A to E in Figure 2[1]). A tailings slurry of fine particles of rock and coal is discharged at a solids content of around 30 percent (%) by mass into the tailings facility, located on the west side of the wash plant (Figure 2).

From September 2016 to August 2017 the water balance estimate of tailings water inflow is 3,279,700 m^3 or an average flow or 374 cubic metres per hour (m^3/h). The slurry density was assumed to be about 1.13 tonnes per cubic metre (t/m^3). After the solids have settled from suspension, the clarified tailings water is recovered and re-circulated by barge pumps to the wash plant for reuse.

The tailings are silt sized with a D_{50} of around 0.2 mm.

2.3 Site Characteristics

Climate

The typical range of climatic conditions for the GHO site are summarized in Table 1.

Table 1: Typical Range of GHO Climatic Conditions

Parameter	Monthly Minimum	Monthly Maximum	Annual Mean
Temperature	- 21.3°C	18.9°C	- 0.5°C
Precipitation	3 mm	229 mm	645 mm
Lake (1 m-depth) Potential Evaporation	- 2 mm	160 mm	814 mm
Actual Lake (1 m-depth) Evaporation	- 2 mm	117 mm	586 mm

Source: Golder (2015b).

°C = degrees Celsius.

[1] "Site F", shown on Figure 2, is a future proposed stockpile area.

Seismicity

The site is located in an area of relatively low seismicity. Golder developed a site-specific seismic hazard model for the GHO site based on historical seismicity and a review of geologic and paleoseismological features (Golder 2016b). Golder's model includes four area sources from the 5th Generation Seismic Hazard Model and nine faults and fault segments mapped in northwest Montana. The 5th Generation Seismic Hazard Model was developed by Natural Resources Canada for use in the 2015 National Building Code of Canada.

Probabilistic analysis results from site-specific hazard model are listed in Table 2. All site-specific peak ground acceleration was evaluated for a Class C soil site as described in the 2010 National Building Code of Canada as this represents Golder's understanding of the general foundation conditions at the dam locations.

Table 2: Seismic Hazard Values

Exceedance Probability	Return Period (Years)	Peak Ground Acceleration (PGA) (g)
40% in 50 years	100	0.020
10% in 50 years	475	0.063
5% in 50 years	1,000	0.097
2% in 50 years	**2,475**	**0.158**
1% in 50 years	5,000	0.222
½% in 50 years	10,000	0.300

Notes:

For firm ground site class "C," very dense soil and soft rock foundation, as defined by 2010 National Building Code of Canada.

Return periods are not exact representations of annual exceedance probabilities, rounding as per CDA (2013, 2014) is shown.

GHO/FRO site coordinates for Golder (2016b) *Site Specific Probabilistic Seismic Hazard Assessment*: 50.202°N, -114.876°W.

NRC = Natural Resources Canada; n/a = not applicable.

The Canadian Dam Association (CDA) *Dam Safety Guidelines* (2013) recommends a 2,475-year seismic event for High consequence structures.

2.4 Subsurface Conditions

Main Tailings Dam

A geotechnical investigation was carried out by Hardy Associates in 1980 to determine the subsurface conditions underlying the Main Dam. It was inferred that a 1.5 to 2.0 m thick layer of colluvial clay (varying proportions of clay, sand and gravel) was present. Where the colluvium was predominantly clay, it is generally soft to stiff, whereas colluvium that is predominantly gravel or sand is generally very dense (Hardy 1980a). The foundation preparation involved the removal of soft or unsuitable materials (Hardy 1980b). Hard glacial till underlies the colluvial clay. Shale bedrock was encountered in boreholes 80-RA1 and 80-RA2 at depths of 12.5 and 12.2 m, respectively. All of the other fourteen boreholes were terminated within the till. Inferred stratigraphy based on Hardy 1978 can be seen in Sections A and B of Figure 4.

The design report indicated that unsuitable or soft materials with undrained shear strengths (Cu) less than 35 kilopascals (kPa) were to be removed during foundation preparation (Hardy 1980a, b). A geotechnical drilling program to determine the extent of removal of the unsuitable or soft materials in the Main Dam and Site C coarse refuse dump foundations was undertaken from October to December 2016. The investigation did not encounter soft colluvial clays. The investigation indicated that foundation conditions of the Main Dam typically comprise very stiff to hard glacial till; with a shear strength of about 32º and 50 kPa cohesion. The stiff to hard state of the till is supported by the Standard Penetrometer Test (SPT) results by Hardy (1980), where 92% of the tests had an "N" value greater than 30; which indicates that the till is typically dense to very dense. The water content of the till samples were all below the Liquid Limit (LL), and about 80% of the samples had a Liquidity Index (LI) less than or equal to zero (Golder 2017e). The thickness of the till ranged from 3.10 m to 56.75 m, and is underlain by fine-grained sedimentary rock. The glacial till was anticipated to be over-consolidated relative to the stresses applied by the range of dam raises.

West Tailings Dam

Geotechnical investigations were completed in the West Dam area in 1992 and 2013. On the upstream side of the West Dam and underneath the tailings pond itself, the West Dam is underlain by a varying thickness of glacial till, with colluvial clays occurring on the downstream side of the dam. Thicknesses of glacial till were found to vary from 0.8 m to 2.8 m based on the 2013 field investigation. Inferred stratigraphy based on Golder (2014b) is shown on Sections C and D in Figure 5.

Removal of superficial loose, soft, organic or other deleterious materials from the West Dam foundation footprint was carried out for foundation preparation in the dam footprint area on the west side of the mine road, and replaced with select free-draining material (Golder 1999).

No foundation preparation beneath the original mine road foundation was reported during initial construction, but pockets of clay fill or colluvial clay would have been restricted to the upstream portion of the dam, and therefore not affect downstream stability.

Fill and colluvial clay were removed from the downstream toe of the West Dam footprint during 2016, as part of ongoing preparation for the dam raise. The resulting in situ foundation conditions beneath the new construction footprint (for El. 1,735 m dam design) are glacial till or bedrock.

2.5 Overview of Dam Design and Construction

The tailings pond is retained on the southeast by the Main Tailings Dam (Figure 4), and on the west by the West Tailings Dam (Figure 5). The original design of the Main Tailings Dam to crest elevation 1,706 m was carried out by Hardy Associates Ltd. for the former owner Westar Mining Ltd. in September 1980. Information concerning the geology, stratigraphy, and ground water conditions is presented in the Hardy Associates Ltd. reports (Hardy 1980a, 1980b, 1981). A design for the West Tailings Dam was completed by Golder in 1993 (Golder 1993). To increase the storage capacity of the tailings facility a design for a raise to crest elevation of 1,725 m (with a dam height of between 10 and 50 m) was completed by Golder in January 1994. Designs to raise the Main and West Dams to a crest elevation of 1,735 m have been completed by Golder in 2005 and 2014 (Golder 2005, 2014b).

The tailings facility is being actively raised during the development of the mine.

A stage-storage curve of the facility is shown below in Chart 1. The current tailings storage capacity of the facility is approximately 14 million m^3. The facility has sufficient storage capacity to hold the design flood (72-hour duration event, 1/3 between 1-in-1000-year flood and the probable maximum flood), and can store approximately 1.1 million m^3 of water while maintaining the minimum freeboard, and approximately 1.7 million m^3 of water to the minimum crest elevation.

The following is a list of the owner, operator, and companies involved in design and construction reporting for this facility:

- Owner: Teck Coal Limited, Greenhills Operations
- Operator: Teck Coal Limited, Greenhills Operations
- Design Report: prepared by Hardy Associates (1978) Ltd. (1981)
- Engineer of Record: Andy Haynes, P.Eng. (Golder Associates Ltd.)
- GHO Qualified Person for Dam Safety Management: Mark Slater, P.Eng.

GHO operates the tailings facility following Operations, Maintenance and Surveillance Manual, Standard Practices and Procedures (SP&P) No. 1543 (GHO 2017). This requires that a daily visual inspection of the pond is carried out by the plant staff, weekly review of monitoring data is carried out by a site geotechnical engineer, and monthly engineering inspections are carried out by a GHO geotechnical engineer.

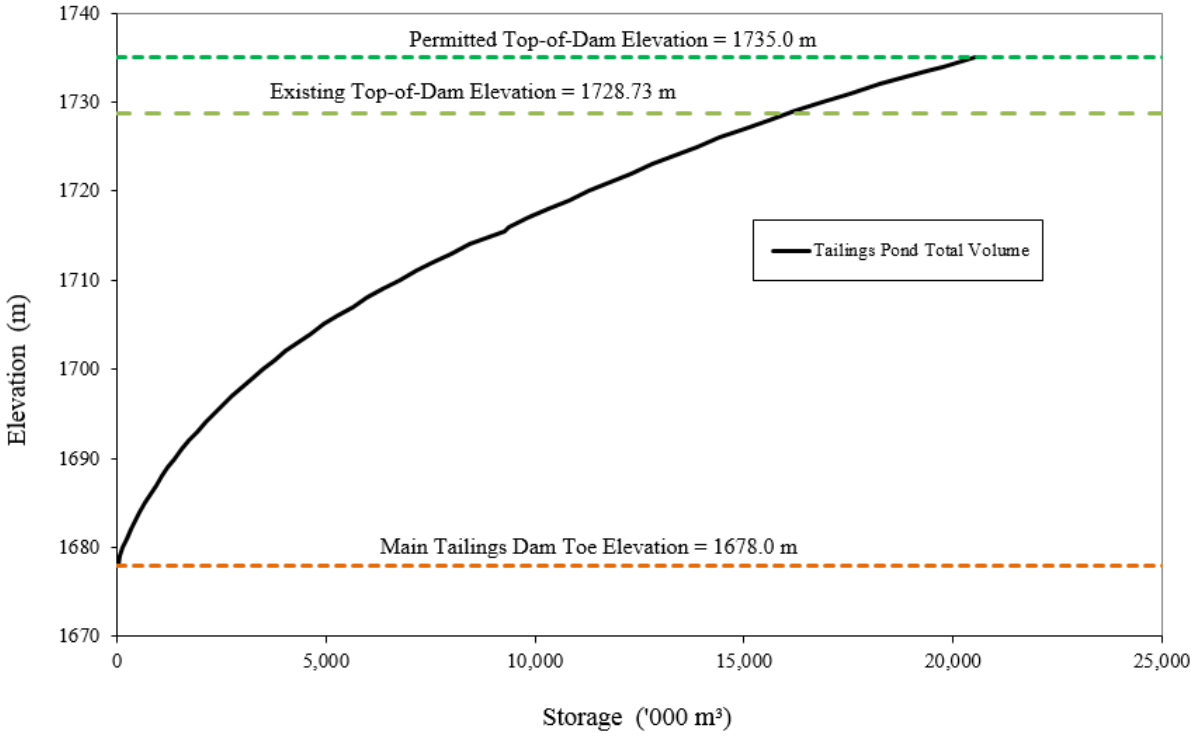


Chart 1: Elevation-Storage Curve

Main Tailings Dam

The Main Tailings Dam is an approximately 50-m high zoned earth fill embankment structure. The dam consists of a bulk fill of compacted coarse refuse material with a 6-m wide zone of compacted clay till (clay blanket) on the inclined upstream face. The design geometry of the Main Dam is outlined in the 2005 Design report (Golder 2005). The dam was designed with an upstream slope of 2H:1V and downstream slope of 2.5H:1V, with 6-m wide berms at approximately 15-m intervals as shown in Figure 4. The ultimate crest width at an elevation of 1,735 is 12 m. GHO develops coarse refuse dumps Site A to E around the tailings facility (Figure 2). Coarse refuse dumps Site C and D are located immediately downstream of the Main Tailings Dam. They result in a wider dam section than required in the design and hence act as a buttress to the dam.

The Main Dam has been raised in stages since 1983 as summarized in Table 3.

Table 3: Main Dam Construction Summary

Year	Construction	Elevation (m)	References
1982–1983	Starter Dam, piezometers installed	1,687	Hardy 1980a, 1980b, 1984
1984–1985	Raise	1,695	No documentation
1986	Raise, piezometers damage, 10 pneumatic piezometers installed	1,699	Hardy 1987
1987	Coarse refuse shell raised, French drains installed beneath shell	1,700	Hardy 1988
1988	Rock drains (French drain) below coarse refuse spoil	No change	Westar 1988
1989	Raise	1,702	Golder 1989
1990	Raise	1,704	Golder 1990
1991	Raise	1,707	Golder 1992
1994	Coarse refuse shell raised	1,710	Golder 1995
1995	Raise, 3 standpipe piezometers installed	1,712	Golder 1996
1996	Coarse refuse shell raised	1,718	Golder 1997
1997	Blanket to El. 1,718 m, coarse refuse shell raise, rock drains extended beneath Site C and Site D refuse spoils	1,720	Golder 1998
2003	Raise	1,720.1	Golder 2004
2009	Raise	1,723.0	Golder 2010b
2010	Raise	1,724.6	Golder 2010c
2011	5 vibrating wire piezometers locations (2 sensors each location)	No change	Golder 2012a
2014	Raise	1,727.5	Golder 2015a
2015	Raise	1,727.9	Golder 2016a
2016	No construction raises. Additional instrumentation installed.	1,727.9	Golder 2017b
2017	Raise	1,728.85	Golder 2017f

El. = elevation.

The active instrumentation in the Main Dam is summarized in Table 4.

Table 4: Summary of Active Main Dam Instrumentation

Instrumentation Type	Number	Comments
Vibrating Wire Piezometers	17	Each location, except SD-16-04, has two piezometers; one piezometer in the foundation and another piezometer above the subgrade transition in the coarse reject material.
Surface GPS Monitoring Stations	3	Two monitoring stations (319 and 320) are located on the downstream slope of Site C, and one monitoring station is on the pond reclaim barge.
Prisms	7	The prisms are situated on the crest of the Main Dam.
Seepage Weir	1	At toe of Site C. The weir was damaged during the 2017 upgrade of the seepage collection channel. Plans have been made to reinstate the weir in 2018.
Inclinometers	2	In downstream shell of Main Dam.

Note: Of the 17 Vibrating Wire Piezometers, 12 sensors were installed during the November/December 2016 geotechnical field investigation. The two inclinometers were also installed as part of this investigation.

On September 13, 2017, the read-out/transmitter stations for V11-MD-4 and V11-MD-5 were moved laterally to the downstream edge of the crest. Cross-sections of the relocated readout stations are included in the 2017 Construction Report (Golder 2017f).

Seepage from the Main Tailings Dam is collected by rock drains installed in 1996 through the Site C and D dump footprints. These rock drains consist of geotextile-wrapped crushed limestone. The seepage exits at the toe of the dumps and is collected in a seepage collection channel, which was upgraded in 2017.

Following observed ground movement at Site C in 2011 and 2012, including the development of a scarp in the dumps and a bulge downslope from the dumps, Global Positioning System (GPS) monitors #319 and #320 were installed on the benches of the Site C coarse refuse dump to monitor the displacement, and the impact to the Main Tailings Dam was preliminarily reviewed by GHO (2012). The locations of the GPS monitors and 2012 scarp and toe bulge areas are shown in Figure 3.

Golder recommended that ground movement monitoring on the Site C dump should continue. GHO provided monitoring data up to 30 September 2017 from the two GPS monitors for this review.

West Tailings Dam

A design for the raising of the West Dam to elevation 1,735 m was prepared by GHO and provided to Golder in 2013. The West Tailings Dam is a zoned earth-fill dam similar in design to the Main Tailings Dam, consisting of compacted coarse refuse bulk fill with a 6 m wide zone of compacted clay till (clay blanket) on the upstream face. The West Dam has a maximum height of around 22 m. The dam crosses a depression located at the northwest end of the tailings basin. The mine road is located to the west of the West Tailings Dam. The West Dam has an upstream slope of 2H:1V and a downstream slope of 2.5H:1V, with 6 m wide berms at approximately 15 m intervals. The design includes a relatively wide 40 m crest width to provide access for haul trucks to the adjacent refuse spoils. Cross-sections of the West Tailings Dam are shown in Figure 5.

Issued for Construction drawings to raise the Main and West Dams to El. 1,728 m (Golder 2014c,d) were submitted to GHO in May and June of 2014. The design included an enlarged West Dam footprint to support a future raise of the dam to El. 1,735 m.

West Tailings Dam construction started in 1993 with a clay blanket on the upstream side of the mine road. The construction history of the West Dam is summarized in Table 5.

Table 5: West Dam Construction Summary

Year	Construction	Elevation (m)	References
1993	Raise as blanket on mine road	1,711	Golder 1993
1996	Raise as blanket on mine road	1,714.3	Golder 1997
1998	Foundation preparation to till and bedrock of El. 1,725 design footprint	No change	Golder 1999
1999	Raise, mine road relocated to west	1,719.1	Golder 2000
2004	Raise	1,721.6	No documentation
2010	Raise	1,724.8	Golder 2010b
2011	3 vibrating wire piezometers (2 sensors each)	No change	Golder 2012a
2014	Raise, mine road relocated to west	1,726.6	Golder 2015a
2015	Raise	1,727.9	Golder 2016a
2016	Extension of the downstream portion of the West Dam and construction of the temporary emergency spillway.	No change	Golder 2017b
2017	Raise, extension of the downstream portion of the West Dam and removal of the temporary emergency spillway.	1,728.73	Golder 2017f

El. = elevation.

The active instrumentation in the West Dam is summarized in Table 6.

Table 6: Summary of Active West Dam Instrumentation

Instrumentation Type	Number	Comments
Vibrating Wire Piezometers	6	Each location has two piezometers, one piezometer in the foundation and another piezometer above the subgrade transition in the reject material.
Prisms	5	The prisms are situated on the crest of the West Dam.
Seepage Weir	1	At toe of West Dam. The weir was damaged by a boulder during August 2017 West Dam construction. The weir has been moved downstream to the other side of the road and is now functioning again.

Three VW piezometers locations were installed on the West Dam in August 2011; each location has two sensors. The VW piezometers were installed in standpipes, similar to those installed on the Main Dam in 2011, as discussed in the preceding section. As was done for the Main Dam in 2011, the lower piezometer is in the foundation beneath the dam, either silty clay (till) or bedrock, and the upper piezometer is in the coarse reject material nominally above the subgrade elevation at each location. The locations of the piezometers are shown in Figure 3.

The read-out/transmitter stations for the vibrating wire piezometers on the West Dam were relocated laterally downstream in 2017. Cross-sections of the relocated readout stations are included in the 2017 Construction Report (Golder 2017f).

2.6 Material Properties

Material properties of the embankment fill materials and subsurface materials are provided in Table 7. The properties are based on the 2016 geotechnical investigation of the Main Dam (Golder 2017a), and the 2013 geotechnical report for the West Dam (Golder 2014c).

Table 7: Design Material Properties

Material	Unit Weight (kN/m^3)	Cohesion (kPa)	Friction Angle (Φ)
Glacial Till	19.0	50	32°
Clay Blanket	21.5	50	n/a
Compacted Coarse Refuse	18.0	0	40°
Uncompacted Coarse Refuse	17.0	0	37°
Weathered Bedrock	25.0	300	n/a

kN/m^3 = kilonewtons per cubic metre; kPa = kilopascal; ° = degree; n/a = not applicable.

2.7 Dam Consequence Classification

The Health, Safety and Reclamation Code (BC MEMPR 2016a) references the CDA *Dam Safety Guidelines* (CDA 2013) with respect to consequence classification of tailings dams. Table 8 presents the dam classification criteria. Consequence categories are based on the incremental losses that a failure of the dam may inflict on downstream or upstream areas, or at the dam location. Incremental losses are those over and above losses that might have occurred in the same natural event or condition had the dam not failed. The consequences of a dam failure are ranked as Low, Significant, High, Very High, or Extreme for each of loss categories (CDA 2013). The classification assigned to a dam is the highest rank determined among the four loss categories.

Table 8: Dam Classification in Terms of Consequences of Failure

Dam Class	Population at Risk[a]	Incremental Losses		
		Loss of Life [b]	Environmental and Cultural Values	Infrastructure and Economics
Low	None	0	Minimal short term loss or no long term loss.	Low economic losses; area contains limited infrastructure or service.
Significant	Temporary Only	The appropriate level of safety required depends on the number of people, the exposure time, the nature of their activity, and other considerations.	No significant loss or deterioration of fish or wildlife habitat, or loss of marginal habitat only. Restoration or compensation in kind highly possible.	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes.
High	**Permanent**	**10 or fewer**	**Significant loss or deterioration of important fish or wildlife habitat. Restoration or compensation in kind highly possible.**	**High economic losses affecting infrastructure, public transport, and commercial facilities.**
Very High	Permanent	100 or fewer	Significant loss or deterioration of critical fish or wildlife habitat. Restoration or compensation in kind possible but impractical.	Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances).
Extreme	Permanent	More than 100	Major loss of critical fish or wildlife habitat. Restoration or compensation in kind impossible.	Extreme losses affecting critical infrastructure or services (e.g., hospital, major industrial complex, major storage facilities for dangerous substances).

Source: CDA (2013), Table 2-1.

(a) Definition for Population at Risk:

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

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

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

(b) Implications for loss of life:

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

The CDA (2013) guidelines were used to assign a dam failure consequence classification to the GHO dams. The tailings facility Main and West Dams continue to be classified as High Consequence because the population at risk is expected to be permanent residents in houses in the floodway, loss of life is expected to be less than 10, infrastructure and economic damages downstream are expected to be significant, and environmental damages are expected to be significant loss of fish and wildlife habitat, but for which compensation in kind is possible.

An inundation study for a potential breach of the TSF was completed by Golder in 2012 (Golder 2012) and updated in 2016 (Golder 2017c). The 2016 study was conducted to reassess an overtopping or piping failure of the Main Dam and assess an overtopping failure of the West Dam.

In 2014, flood protection berms were constructed along the river near Elkford. The 2016 inundation study update (Golder 2017c) used the 2011 LiDAR, which did not include the flood protection berms. The inundation study needs to be updated with the 2017 LiDAR data to include the recently 2014 flood protection constructed berms.

2.8 Quantitative Performance Objectives

Quantitative performance objectives (QPOs) form part of the operating framework for a tailings dam, and provide an early warning indication of anomalous conditions which may be detrimental to a dam's integrity. QPOs are a best practice measure for tailings dam management. Golder developed QPOs for the piezometers, pond freeboard, and survey prisms for the GHO Tailings Pond dams in 2016 (Golder 2016d). In 2017 Golder updated the QPOs (Golder 2017g) for the piezometers, to reflect the findings of the 2016 Main Dam foundation investigation (Golder 2017e) and to align the piezometer QPOs with the Trigger Action Response Plan (TARP), and determined new QPOs for the GPS units. QPOs for the inclinometers have not been developed since data is still being collected to establish the baseline. QPOs for the inclinometers will be developed once the baseline has been established.

Piezometers

The Orange Level alerts for the piezometers were determined based on the phreatic levels at which the factor of safety was equal to or below the static or pseudostatic criteria, based the CDA *Dam Safety Guidelines* for long-term conditions. The analyses were completed for the dams' current configuration assuming drained conditions and not considering the buttressing effect from the Site C and Site D/E coarse refuse dumps. The readings of the piezometers were reviewed, and compared to the alarm levels. No orange/yellow alarms were triggered in 2017. The 2016/2017 piezometer ranges are shown in Table 9.

Table 9: Piezometer Quantitative Performance Objectives

Dam	Instrument	Range of 2016 to 2017 Values		Yellow Warning		Orange Alarm	Red Alarm
		Minimum (m)	Maximum (m)	Water Elevation (m)		Water Elevation (m)	
Main	VW11-MD-1A[a]	El. 1706.78	El. 1707.73	±2	1,718.5	1,724	n/a
	VW11-MD-1B[a]	El. 1,708.90	El. 1,710.73				
	VW11-MD-2A	El. 1,692.41	El. 1,693.48				
	VW11-MD-2B[b]	VWP stopped working Sept 2015					
	VW11-MD-3A	El. 1,687.36	El. 1,688.43				
	VW11-MD-3B[c]	El. 1,689.50	El. 1,689.67				
	VW11-MD-4A[d]	El. 1,685.33	El. 1,686.39				
	VW11-MD-4B	El. 1,683.65	El. 1,685.39				
	VW11-MD-5A[b]	El. 1,683.70	El. 1,684.14				
	VW11-MD-5B[b]	El. 1,684.20	El. 1,684.54				
	SD-16-01A (VW26133)	El. 1,685.82	El. 1,686.25	±2	1705.5	1713.5	
	SD-16-01B (VW29871)	El. 1,707.59	El. 1,709.53		n/a – bedrock groundwater flow		
	SD-16-02A (VW5439)	El. 1,685.06	El. 1,685.71		1692.5	1708	
	SD-16-02B (VW29869)	El. 1,692.27	El. 1,693.19		n/a – bedrock groundwater flow		
	SD-16-03A (VW5330)	El. 1,690.18	El. 1,691.80		1705.5	1713.5	
	SD-16-03B (1504178)	El. 1,705.98	El. 1,707.91		n/a – bedrock groundwater flow		
	SD-16-04 (VW29873)	El. 1,673.76	El. 1,676.68		1697	1710	
	SD-16-05A (VW5441)	El. 1,682.11	El. 1,686.30		1699.5	1710.5	
	SD-16-05B (1504179)	El. 1,690.18	El. 1,698.08		n/a – bedrock groundwater flow		
	SD-16-06A (VW28871)	El. 1,685.11	El. 1,685.46		1697	1710	
	SD-16-06B (VW26204)	El. 1,703.32	El. 1,705.32		n/a – bedrock groundwater flow		
	SD-16-07A (1402102)	El. 1,649.20	El. 1,651.25		1682	1686.5	
	SD-16-07B (VW5438)	El. 1,650.27	El. 1,650.86		n/a – bedrock groundwater flow		
	SD-16-08A (VW28872)	El. 1,668.01	El. 1,668.59		1682	1686.5	
	SD-16-08B (VW5440)	El. 1,687.85	El. 1,688.71		n/a – bedrock groundwater flow		
West	VW11-WD-1A	El. 1,712.56	El. 1,712.85	±2	1,733	1,733	n/a
	VW11-WD-1B	El. 1,713.66	El. 1,714.00				
	VW11-WD-2A[b]	El. 1,712.87	El. 1,713.25				
	VW11-WD-2B[e]	El. 1,711.95	El. 1,713.18				
	VW11-WD-3A[f]	El. 1,713.50	El. 1,713.82				
	VW11-WD-3B[b]	El. 1,714.08	El. 1,714.60				

Notes:
Main and West Dam piezometers (VW11-MD-1 to VW11-MD-5 and VW11-WD-1 to VW11-WD-3) minimum and maximum taken from between 1 September 2016 and 30 September 2017, excluding anomalous readings. Newly installed Main dam piezometers (SD-16-01 to SD-16-08) minimum and maximum taken from 17 January 2017 to 18 August 2017. The yellow warning range (±2 m) is based on the typical range of piezometer values recorded between 2016 and 2017.
Orange alarm levels for VW11-WD-1, VW11-WD-2, VW11-MD-1, VW11-MD-2, VW11-MD-4, VW11-MD-5, SD-16-03A, SD-16-04, and SD-16-07A inferred from adjacent stability sections.
As agreed with Teck, no red alarm levels were defined since the Engineer of Record will be contacted when the orange alarm level is triggered. The situation can be then evaluated prior to any evacuation orders being given.
(a) Data from 10 to 15 August 2017 likely erroneous and has been excluded.
(b) Connections re-established on VWP. Dates: MD-3B 10 August 2017, MD-5A and 5B 23 May 2017, WD-2A 13 April 2017, WD-3B 24 March 2017. MD-2B was reconnected on 24 May 2017 but is reporting erroneous readings. Data from this VWP has therefore been excluded.
(c) Data above El. 1,689.67 likely erroneous and has been excluded.
(d) Data from 1 to 22 March, 2017, and 20 to 22 September 2017 likely erroneous and has been excluded.
(e) Data from 1 September 2016 to 3 April 2017 likely erroneous and has been excluded.
(f) Data from 1 September 2016 to 24 March 2017 likely erroneous and has been excluded.
n/a = not applicable; VWP = vibrating wire piezometer; El. = Elevation; QPO = Quantitative Performance Objective; ≤ = less than or equal; ≥ greater than or equal.

Freeboard

GHO uses a maximum standard pond operating level of 2.0 m below the minimum dam crest elevation. The pond is therefore generally operated with a greater freeboard than the required 1.3 m minimum freeboard as calculated using the CDA guidelines (2013), and provides additional safety. No warning, alert or alarm levels were triggered in the 2016/2017 period. QPOs for the pond freeboard are shown below in Table 10.

Table 10: Freeboard Quantitative Performance Objectives

Pond Freeboard	Range of 2016/2017 Values		Warning (Yellow) (m)	Alert (Orange) (m)	Alarm (Red) (m)
	Minimum (m)	Maximum (m)			
	2.04	7.15	2.0	1.3	0.5

Survey Prisms

QPOs for the survey prisms were updated in September 2017 and are summarized in Table 11.

Table 11: Survey Prism Quantitative Performance Objectives

Dam	Instrument	Range of 2016/2017 Annual Displacement Values[(a)]		Range of 2016/2017 Monthly Displacement Values		Yellow Warning	Orange Alarm	Red Alarm
		Minimum (m)	Maximum (m)	Minimum (m)	Maximum (m)			
Main	PR-A to PR-H	0.023	0.136	-0.05	0.08[(c)]	3D Displacement = 0.025 m/week or 0.1 m cumulative	3D Displacement = 0.050 m/week or 0.2 m cumulative	Refer to Note b.
West	PR-I to PR-M	0.008	0.156	-0.09	0.07			

(a) The minimum and maximum annual values are all relative to 23 October 2015, which is the last reading from the 2015 DSI review period.

(b) An Alarm (red) decision is to be made by the Engineer of Record and GHO's Qualified Person for Dam Safety Management.

(c) A cumulative displacement of 0.126 m was recorded for Prism B (near the Main Dam upstream crest) from 19 January 2017 to 2 February 2017. This value has been excluded as it is thought to be erroneous or disturbed by activities in the area, since the movement was in the southwest direction, and was preceded by a 0.09 m cumulative displacement in the northeast direction.

GPS Units

QPOs for the GPS units on the Main Dam were determined in September 2017 (Golder 2017g), and are summarized in Table 12. The QPOs were based on engineering judgement related to tolerable deformations. There are no GPS units on the West Dam.

Table 12: GPS Units Quantitative Performance Objectives

Dam	Instrument	Range of 2016/2017 Cumulative Displacement Values[a]		Range of 2016/2017 Weekly Displacement Values		Yellow Warning	Orange Alarm	Red Alarm
		Minimum (m)	Maximum (m)	Minimum (m)	Maximum (m)			
Main	GPS #320	0.001	0.039	0.000	0.020	3D Displacement = 0.025 m/week or 0.1 m cumulative	3D Displacement = 0.050 m/week or 0.2 m cumulative	n/a
	GPS #319	0.004	0.041	0.001	0.025			

(a) The minimum and maximum annual cumulative displacement values are all relative to 23 October 2012.

The maximum weekly reading for the GPS units was 0.025 m (GPS #320 from 24 to 30 July 2017). The data indicated that the GPS unit moved in a northeast direction.

Inclinometers

QPOs for the inclinometers have not been developed since data is still being collected to establish the baseline. The QPOs for the inclinometers will be developed once the baseline has been established.

Seepage Weirs

QPOs for the seepage weirs downstream of the Main and West Dams are summarized in Table 13. The QPOs will be reviewed once monitoring of the weirs has been automated and sufficient data is gathered to determine annual trends.

Table 13: Seepage Weirs Quantitative Performance Objectives

Instrument	Range of 2016/2017 [b]		Yellow Warning (L/s)	Orange Alarm (L/s)	Red Alarm
	Minimum (L/s)	Maximum (L/s)			
Main Dam Weir	0.29	0.97	2	4	Refer to Note a.
West Dam Weir	0.01	0.16	1	2	

(a) An Alarm (red) decision is to be made by the Engineer of Record and GHO's Qualified Person for Dam Safety Management.

(b) Range of 2016/2017 is from September 2016 to September 2017.

3.0 OPERATION AND CONSTRUCTION DURING 2017

Construction and changes in the monitoring plans for the inspected structures and facilities since the 2016 inspection are discussed in the following sections.

Inspections of the Greenhills Tailings Facility were completed monthly. The inspections from September 2016 to September 2017 are provided in Appendix D.

3.1 Tailings Facility Storage and Operation

GHO tracks in-place tailings volume through bathymetric surveys. The tailings volume accumulated in the pond between September 2016 and August 2017 is reported by GHO to be about 507,679 cubic metres (m^3). GHO estimated an annual deposition volume of about 543,410 m^3.

The tailings deposition location was moved, between September 2016 and September 2017, to approximately 250 m northwest of the 2016 location (Photograph 1, Appendix A).

3.2 2017 Construction

The Main Dam crest was raised to 1,728.85 m, and the West Dam crest was raised 1,728.73 m during 2017. The raise included placement of till and CCR on the crests of the Main Dam and West Dam. The downstream shell of the West Dam was also extended, and the temporary emergency spillway, which was constructed in 2016 by the south abutment of the West Dam, was removed to facilitate raising the West Dam.

The upstream slope of the Main Dam was regraded and riprap was placed to prevent further erosion from occurring.

Erosion in the downstream Site C area was repaired and the surface water management facilities were upgraded. This included an interception weir to divert water into a pipe to convey water down a relatively steep section, and the installation of a SmartDitch plastic liner in a channel to convey water past the downstream slope of the Site C and Site D Spoils. The V-Notch weir was being relocated and it is understood that a vibrating-wire monitor will be installed in the weir to allow monitoring throughout the year.

A visual pond level indicator was installed, with colour coded plates that match the Trigger Action Response Plan (TARP) levels, to provide a simple visual complementary measurement to the GPS monitor that is located on the reclaim barge.

The 2017 construction records are documented in Golder (2017f).

4.0 REVIEW OF CLIMATE DATA, WATER BALANCE, AND WATER QUALITY

4.1 Review of Climatic Information

Chart 2 summarizes the GHO site monthly total precipitation, and the Elkford climate station for September 2016 to August 2017, along with the 1970 to 2015 adjusted climate normal, for comparison purposes. The historical climate normals were calculated in Golder 2015b using regional and available local precipitation data from 1970 to 2015 based on Fording River Cominco Station (#1152899) and infilled with an adjusted Sparwood Climate Station precipitation data set (Station ID #1157631), and an adjusted Elkford precipitation data set (Station ID #1152653). Adjustments to climate stations where made to account for differences in station elevations, details can be found in Golder 2015b.

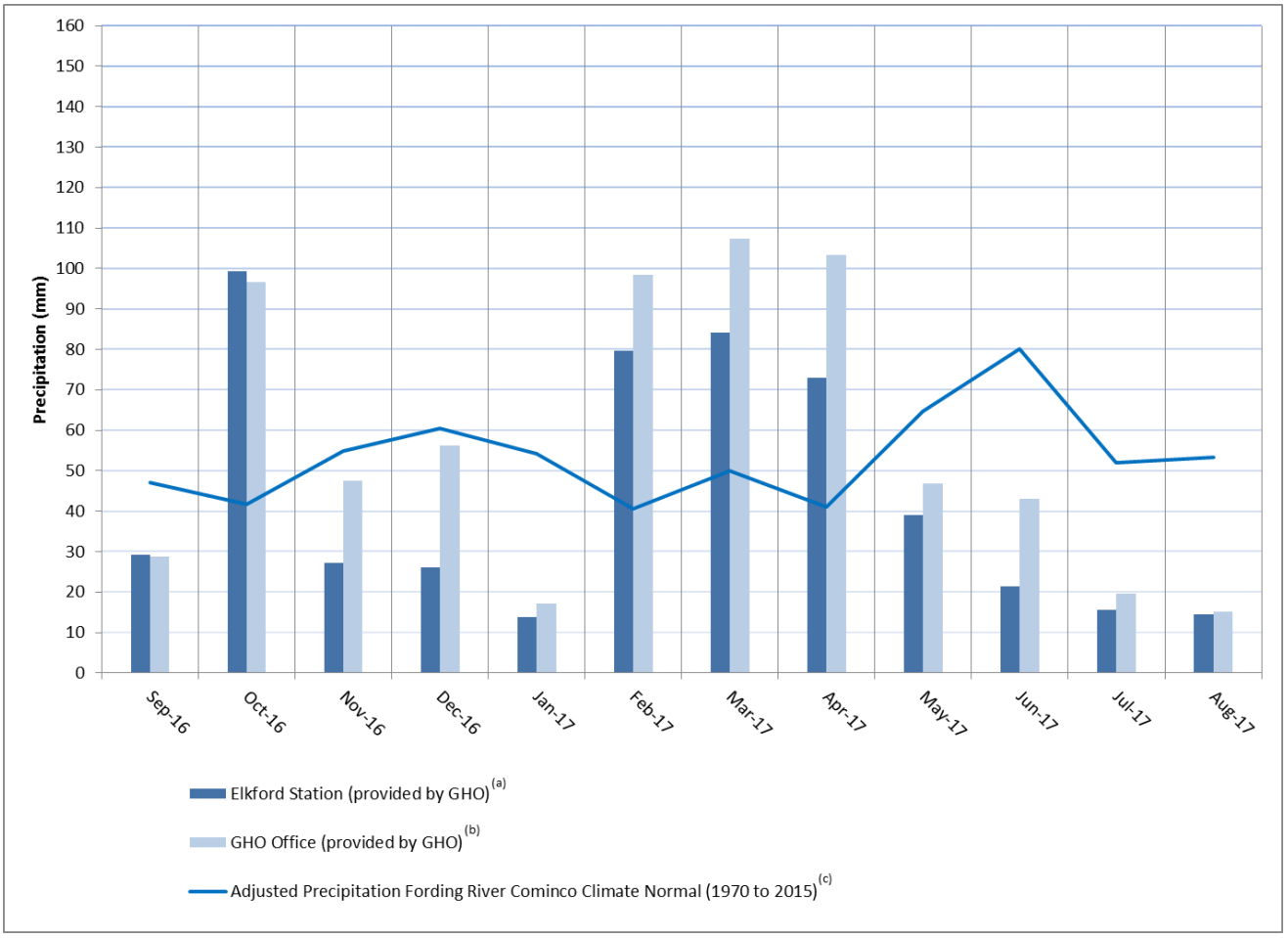


Chart 2: 2017 Total Precipitation Data

(a) Elkford Total Precipitation received from GHO.

(b) GHO Total Precipitation received from GHO.

(c) Fording River Cominco data obtained from Environment Canada website, Climate ID: 1152899.

The total recorded precipitation from September 2016 to August 2017 at the GHO site was about 680 mm compared to 640 mm based on the climate normal, indicating a slightly higher than average annual precipitation. The data shows that the GHO site had lower precipitation than the climate normal in September, November to January, and May to August, and higher than the climate normal in October, February, March, and April.

4.2 Water Balance

The 2017 water balance for the Tailings Pond was completed by Golder based on inflow and outflow data provided by GHO personnel and using the GHO site water balance model (Golder 2013b). The model characterizes the conveyance and storage of water at the mine site, and is intended to be used as a tool to support decision making on water management practices at the site. This model was developed based on available monitoring data supplemented by a site visit, regional data, assumptions, and guidance from Teck. The model was updated with 2016/2017 inflow and outflow data and was calibrated using the measured pond water elevations provided by GHO.

Table 14 summarizes the water balance review for the period of September 2016 to August 2017.

Table 14: September 2016 to August 2017 Greenhills Tailings Pond Water Balance

IN	Volume (m^3)	OUT	Volume (m^3)	Total Inventory Change (m^3)
Direct Precipitation	62,100	Seepage	68,300	-
Surface Runoff	491,600	Evaporation	120,500	-
Water Discharge with Tailings[(a)]	2,726,000	Reclaim water to Plant	2,830,100	-
		Water retained in tailings[(b)]	330,400	
Sum	3,279,700		3,349,300	(69,600)

(a) Includes plant system loss to pond.
(b) The pore water volume is estimated by multiplying the annual tailings dry tonnage of 543,410 tonnes by a water content of 60.8%. The water content is based on laboratory test results from the 2016 inundation study (Golder 2017c). Represents newly deposited tailings only, not total tailings volume.
m^3 = cubic metre; t/m^3 = tonnes per cubic metre.

The total inventory change (a loss of 69,600 m^3) matched relatively well with the calculated change in pond volume between 2015 and 2016 (a reduction of 65,500 m^3), as measured via change in the pond elevation and bathymetry (provided by GHO). Teck provided daily flow measurements of process water discharging into the reclaim pond for the period of August 2016 and October 2017.

The water balance model indicates an annual seepage loss of approximately 68,300 m^3 (approximately 130 litres/minute). This rate is within the expected range given the facility composition and geometry and is not a dam safety concern.

4.3 Water Quality

The Tailings Storage Facility (TSF) water is monitored as required by Environmental Management Act (EMA) Permits 6248 and 107517. The required monitoring includes semi-annual sampling for extractable petroleum hydrocarbons (EPH), conventional parameters, major ions, nutrients, total metals and dissolved metals.

GHO is required to submit quarterly and annual compliance reports for both EMA Permits 6248 and 107517.

5.0 TAILINGS FACILITY DAM SAFETY ASSESSMENT

This section presents the dam safety analysis for the tailings facility dams based on the observations and data review for each of the failure modes that are most relevant to these types of dams.

5.1 Method

5.1.1 Site Visit

A site inspection was carried out on 21 September 2017 by Mr. Andy Haynes, P.Eng., and Mr. Malcolm Shang, of Golder, accompanied by Kristin Snider of GHO. Andy Haynes also inspected the TSF area with Kristin Snider on 30 July 2017.

The weather was overcast with light rain and snow. The temperature during the visit was approximately 0 degrees Celsius (°C).

Appendix A presents a summary of photographs of the pond from the site inspection. The location and direction for each photograph are indicated in Figure 2.

A summary of the observations is included in the inspection reports in Appendix B. The Greenhills Main and West Tailings Dams were observed to be in good condition at the time of the 2017 annual inspection.

Details of the site observations relative to the potential failure modes are discussed in Section 5.3.

5.1.2 Review of Background Information and Instrumentation

GHO provided the following information for this dam safety inspection:

- 2017 GHO Site LiDAR Survey Data
- 2017 Tailings Dam Area Survey Data (24 October 2017)
- 2017 GHO Site Air Photo
- 2017 Tailings Pond Bathymetric Survey Data (23 October 2017)
- 2017 GHO Site Climate Data
- Piezometer Data
- Pond water level GPS data
- Site C Ground Movement GPS Monitoring Data
- Dam Survey Prism Data
- Plant Production Records up to August 2017
- Records of Visual Inspections
- Inspection Reports
- Operation, Maintenance, and Surveillance (OMS) Manual and Emergency Preparedness Plan (EPP)

5.2 Review of Operational Documents

5.2.1 Operation, Maintenance, and Surveillance Manual

The OMS Manual for the tailings facility (GHO 2017; SP&P No.1543) was updated by Golder and GHO in 2017 (GHO 2017). The OMS Manual meets the guidelines provided by the CDA (2013) and the Mining Association of Canada (MAC 2011).

5.2.2 Emergency Preparedness Plan

An Emergency Preparedness Plan (EPP) for the tailings facility (GHO 2013; Standard Practices and Procedures No. 1543) is in the process of being updated by Teck. An inundation study for a potential breach of the TSF was completed by Golder in 2012 (Golder 2012) and updated in 2016 (Golder 2017c). The 2016 study was conducted to reassess an overtopping or piping failure of the Main Dam and assess an overtopping failure of the West Dam.

5.2.3 Dam Safety Review

A DSR was commenced in June 2017, and issued in December 2017 (KCB 2017). The DSR concluded that the tailings dams meet current safety standards.

The July 2016 revision of the Health, Safety and Reclamation Code (HSRC) (BC MEMPR 2016a) requires a DSR be completed at least every 5 years. The next DSR is required before 2023.

5.3 Assessment of Dam Safety Relative to Potential Failure Modes

This section reviews the dam safety implications of the instrumentation data and the 21 September 2017, site observations relative to potential failure modes that typically apply to similar dams. The design basis relevant to each of the typical potential failure modes is also presented.

5.3.1 Internal Erosion

Internal instability of a dam can be caused by materials migrating out of the dam via seepage and leaving voids. This generally happens with materials that do not have filter compatibility; that is, the fines fraction of one material can migrate into or through the voids of the adjacent material under a sufficient hydraulic gradient. Piping is induced by regressive erosion of particles towards an outside environment until forming a continuous pipe. Suffusion is the migration of soil particles through the soil matrix.

Design Basis

As part of the 2017 dam raises (Golder 2017f), grain size distribution testing was performed on 20 coarse refuse and 1 clay sample. 19 of the 20 CCR (filter) gradations met the filter criterion of D15 ≤ 0.7 mm; however, 6 of the 20 CCR gradations were slightly finer than the D_{50} criterion. CDA (2007) recommends that suffusion be considered based on an assessment of internal stability of the filter. Internal stability was assessed based on an update to the original Kenney-Lau criteria (Kenney and Lau 1985) by Li and Fannin (Li et al. 2009.) All 20 of the samples met the updated Li-Fannin criterion.

As part of the 2016 inundation study (Golder 2017c) Golder received samples of coal tailings from Teck, collected at the exit of the tailings spigot, on 10 May 2016. The particle size distribution (PSD) of the tailings was determined using mechanical sieving and a Fritsch laser particle size analyzer (ASTM D4464). The results are documented in Golder (2017c) and presented in Table 15. The filter compatibility of the tailings and the clay blanket samples (Golder 2010b) was reviewed, and the piping criteria were met.

Table 15: Particle Size Distribution

Sample	D_{10} (mm)	D_{30} (mm)	D_{50} (mm)	D_{60} (mm)	D_{80} (mm)
1528359 Tailings	0.011	0.079	0.220	0.297	0.506

D_{10} = 10 percent passing by mass.

The review indicates that the piping criteria are generally met between the clay blanket and the coarse refuse, and between the tailings and clay blanket.

Instrumentation

V-notch weirs are located below the Main Dam and in the ditch adjacent to the West Dam in order to measure the seepage flows. The weir at the toe of Site C was damaged during the 2017 upgrade of the seepage collection channel. Plans have been made to reinstate the weir in the summer of 2018. Seepage flow into the collection channel at the toe of Site C, and through the West Dam weir was observed to be clear on the day of the site visit (Photographs 13 and 23, Appendix A). Flow measurements were taken 10 times at the West Dam and 9 times at the Main Dam from September 2016 to September 2017. The flow varied from 0.29 to 0.97 L/s at the Main Dam and from 0.01 to 0.16 L/s at the West Dam during this time period.

The measurements of flow rates at the Main Dam and West Dam weirs are shown in Chart 3.

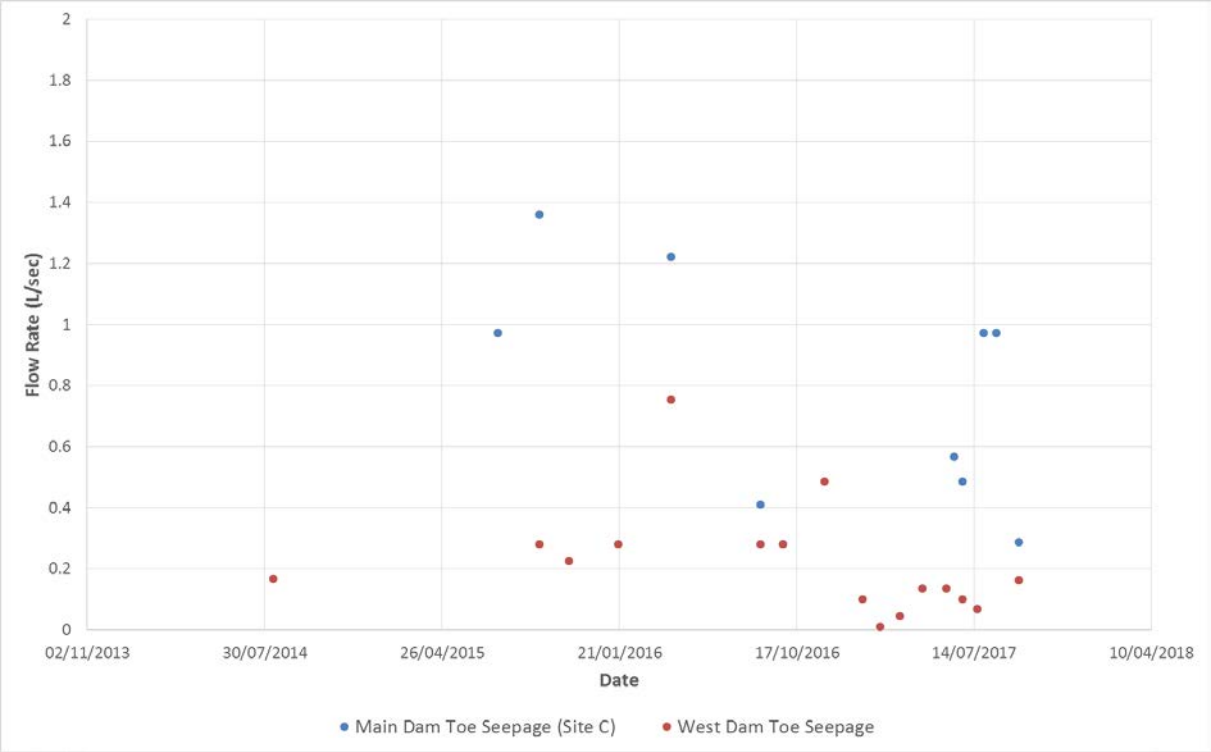


Chart 3: Flow rates at Main Dam and West Dam Seepage Weirs

Observed Performance

Seepage from the Main Tailings Dam is collected by rock drains installed in 1996 through the Site C and D dump footprints. These rock drains consist of geotextile-wrapped crushed limestone. During the inspection, it was observed that the water flowing from the rock drains was clear and did not contain visible suspended particles. The water was noted to be causing red-brown staining (Photograph 12, Appendix A); which is expected based on the water chemistry. The flow rates appeared to be similar to those observed in previous inspections.

Seepage flow through the V-notch weir installed in the ditch adjacent to the West Dam was observed to be clear on the day of the site visit (Photograph 23, Appendix A). The weir was damaged by a boulder during the 2017 West Dam construction (Photograph 23, Appendix A). Since the inspection the weir has been moved downstream to the other side of the road and is now functioning again.

No zones of subsidence or any sink holes were observed which would indicate voids due to either suffusion or piping.

No evidence of internal erosion was observed.

5.3.2 Overtopping

Design Basis

The CDA (2013) provides the following two calculations for freeboard; the more critical of the two cases sets the minimum freeboard:

- no overtopping by 95% of the waves caused by the most critical wind with a return period of 1,000 years with the pond at its maximum normal operating elevation
- no overtopping by 95% of the waves caused by the most critical wind with a return period of 2 years (for High consequence structures), with the pond at the maximum level during the passage of the inflow design flood

The maximum allowable pond levels for the Main and West Dams are presented in Table 16. The minimum freeboard has been updated to comply with the 2016 amendment to Part 10 of the HSRC for Mines in British Columbia (BC MEMPR 2016a).

The 2016 amendment requires that design floods for tailings impoundments consider 72- rather than 24-hour duration events, and that probable maximum floods (PMF) include precipitation and snowmelt. Previously the 24-hour duration event was considered, and snowmelt was not included in the PMF. As a result of the update, the minimum required freeboard has increased from 1.1 m to 1.3 m. The updated PMF event (72-hour duration event inclusive of snowmelt) is documented in Golder (2017a), and the updated inflow design flood allowance is presented in Table 16. The 1-in-1000-year flood is estimated to be 445,120 m^3 and the PMF is estimated to be 621,670 m^3.

Table 16: Maximum Allowable Pond Levels

Item	Value (Current Condition) (m)
Lowest elevation on Main Tailings Dam or West Tailings Dam crests	1,728.73
Allowance for inflow design flood ($^1/_3$ between 1:1000-year flood[b] and the probable maximum flood [a])	0.93
Allowance for wave run-up due to 1:2-year wind [a]	0.25 to 0.35
Minimum required freeboard (as per CDA 2013)[b]	1.3
Minimum required freeboard (as designated in OMS)	1.3
Standard operating maximum pond level (distance below dam crest)[c]	2.0
Maximum pond elevation to maintain minimum freeboard (1.3 m)	1,727.43
Standard pond operating elevation (2.0 m below minimum dam crest)	1,726.73

(a) Flood and wave run-up values reported in OMS Manual (GHO 2017).

(b) Freeboard calculated per CDA 2013 is reported as 1.3 m in OMS Manual (GHO 2017).

(c) When pond level exceeds standard pond operating level GHO implements increased monitoring and pond level controls.

OMS = Operation, Maintenance, and Surveillance.

GHO uses a standard maximum operating pond level of 2.0 m below the minimum dam crest elevation. The pond is therefore generally operated with a greater freeboard than the required 1.3 m minimum freeboard as calculated using the CDA guidelines (2013), and provides additional safety.

The technical bulletin *Application of Dam Safety Guidelines to Mining Dams* (CDA 2014) recommends examination of the condition where the high water level (inflow design flood) occurs at a similar time as the high wind event for calculation of the minimum freeboard. Recommendations for the return period of the high wind event are not provided. However, a 1-in-1000-year wind combined with the inflow design flood would result in a freeboard of 1.5 m. Therefore, the standard pond operating level of 2.0 m below the minimum dam elevation used by GHO is conservative and no modifications to the operating practices are needed based on CDA (2014).

Instrumentation Data

The water level in the pond is controlled by pumping at the reclaim barge. The tailings pond elevation is measured by a GPS monitor (#313) mounted on the reclaim barge, and the data are corrected for the elevation difference between the GPS and the pond level.

Installation of a staff gauge was recommended in the 2014 DSI (Golder 2014f) in order to provide a secondary pond level measurement. The staff gauge is intended to provide a quick way to confirm freeboard, especially with the performance issues with the GPS monitoring noted in the 2014 DSI. Visual indicators of water level in addition to electronic measurement are considered to be best practice. A staff gauge, indicating the TARP warning levels, was installed in 2017 (Photograph 3, Appendix A).

The pond levels measured from September 2013 to 31 August 2017 are presented in Chart 3 along with the minimum crest elevation, minimum freeboard, and standard pond operating level.

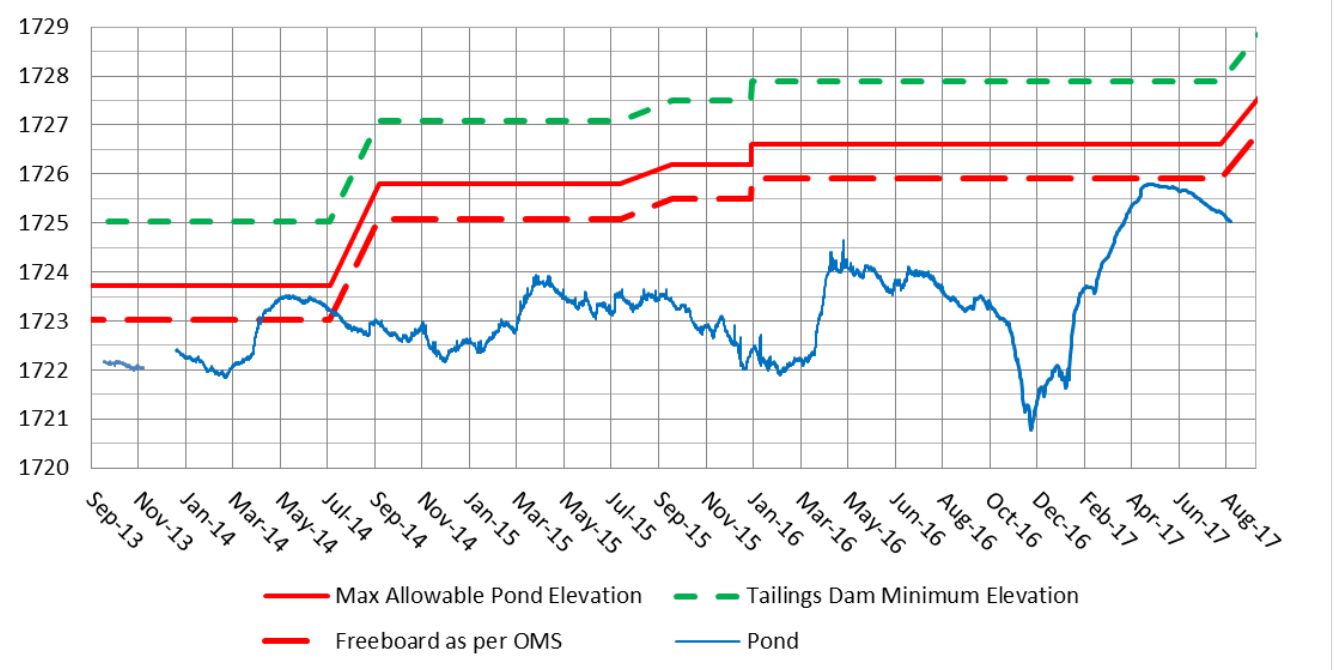


Chart 4: Tailings Pond Elevation Relative to Minimum Freeboard and Standard Pond Operating Level

The pond water elevations measured between September 2016 and August 2017 were provided by GHO for this review, and have fluctuated between El. 1,720.8 and 1,725.8 m, resulting in freeboard of between 7.1 m and 2.1 m. Pond levels were below the standard pond operating level for the reporting period. The pond elevation is currently well below the standard pond operating level of El. 1,726.48 m (greater than 2.0 m below the current dam elevation of 1,728.73 m). The minimum CDA freeboard requirements were maintained throughout 2017.

The 2017 bathymetric survey indicates that the deepest area, with an elevation of about 1,720.9 m, is approximately 50 m northwest of the barge, with a depth of about 4 m. This is an operational consideration and does not impact dam safety.

The highest point of the tailings surface is near the tailings discharge at the north side of the pond, and was at approximately El. 1,729.3 m based on the 2017 survey. Potential liquefaction of tailings during earthquake may trigger re-distribution of tailings into the pond, and increase the pond level. The maximum potential pond increase that could occur from such a scenario (conservatively assuming that all tailings above the pond migrated into the pond) is estimated to be around 1.2 m, which would not overtop the dam under standard operating conditions.

Observed Performance

The pond was at approximately El. 1,724.8 m based on the GPS 313 readings at the time of the site inspection, which gave a freeboard of 3.7 m.

The minimum required freeboard was achieved during the entire reporting period.

In addition to meeting the design criteria, it was noted that the facility had capacity to contain the PMF throughout the reporting period.

5.3.3 Instability

Design Basis

The dams are designed to provide factors of safety that meet or exceed the requirements of the CDA (2013) (minimum factor of safety of 1.5 under normal operating conditions and a minimum factor of safety of 1.0 under seismic conditions). The CDA recommends that an earthquake design ground motion based on an annual exceedance probability of 1 in 2,475 years be used for the design of High consequence dams (CDA 2013). The predicted peak ground acceleration (PGA) for this return period is 0.158 g based on the Golder's site-specific hazard model (Golder 2016b).

Instrumentation

The *Dam Safety Guidelines* (CDA 2013) Section 3.6.3, recommends use of dam instrumentation to augment ongoing visual assessment of dam performance relative to potential failure modes. Survey monitoring of the dam was conducted starting in September of 2015 using prisms.

Prism monitoring data and data from Site C GPS monitors #319 and #320 are presented in Appendix C. There was no evidence of ongoing movement of the dumps or settlement of the dam crests.

Charts 4 and 5 present the VW piezometer data from the piezometers installed in 2011 for the Main Tailings Dam and West Tailings Dam.

Erroneous data was reported by the dataloggers for VW11-MD-1B, VW11-MD-2B, and VW11-MD-3B for the reporting period, and no data was reported by the dataloggers for the following piezometers:

- VW11-MD-1B, no data from April to August 2017
- VW11-MD-2B, no data from September 2016 to May 2017
- VW11-MD-3B, no data from September 2016 to January 2017
- SD-16-01 to SD-16-08 (new piezometers installed in November/December 2016), no data prior to January 2017 because the instruments were only connected on 17 January 2017. SD-16-01 has no readings since August 2017 as it could not be accessed because the casing cover was partially buried during the 2017 dam raise.
- VW11-WD-1A and 1B, no data from October 2016 to March 2017
- VW11-WD-2A, no data from September 2016 to April 2017
- VW11-WD-2B, no data from October 2016 to April 2017
- VW11-WD-3A, no data from September 2016 to March 2017
- VW11-WD-3B, no data from October 2016 to March 2017

VW11-MD-2B is not functioning and has been removed from service. No repair or replacement is necessary at this time, since sufficient monitoring coverage is provided by SD-16-03 and VW11-MD-2A.

VW11-MD-5A and 5B are functioning but the cables have been damaged and need replacing. The readings of the functioning piezometers in the CCR and shallow till are consistent with previous trends and indicate phreatic surface ranges of El. 1,683.6 to 1,710.7 m at the Main Dam, and of El. 1,711.9 to 1,714.6 m at West Dam from 1 September 2016 to 31 August 2017 (Table 9, and Charts 4 and 5). The readings of the 2016 piezometers that were installed at the till/bedrock interface indicate groundwater phreatic surface ranges of El. 1,650.2 to 1,709.5 m, which are higher than the shallow piezometers in the same holes. The higher piezometric pressures in the deeper piezometers are considered to be isolated to the groundwater flow within the bedrock, and separate from the upper groundwater system. A sensitivity analysis of the stability of the Main Dam to the presence of a confined groundwater unit was completed by Golder (Golder 2017g). The results of the sensitivity analysis indicated that the stability was not sensitive to the presence of a confined groundwater unit.

None of the alarm levels of these piezometers were exceeded. The phreatic surface in the Main Tailings Dam was generally about 10 to 13 m above the original ground surface, and the phreatic surface in the West Tailings Dam was generally within the dam foundation, based on the September 2016 to August 2017 readings. These piezometer readings are relatively stable, and typically show seasonal increases in the range of 1 to 3 m during annual freshets. The data acquisition system records water levels approximately every 5 to 62 minutes. A frequency of once per 12 hours is considered adequate. The standpipe water levels were manually recorded up to September 2012, and have been automatically monitored by the remote monitoring system since September 2012. Most of the Main Dam piezometers show a damped response between the measured pressure and the pond level as expected. To date, the West Dam piezometers are not showing a response to the pond level.

Overall, there appears to be little change in the measured phreatic surface in 2017 compared to previous measurements and the phreatic surface in the compacted coarse refuse material was relatively low and stable.

It is recommended that the dataloggers be checked for the piezometers which reported erroneous data (VW11-MD-1B) and for the 2011 piezometers for which no data was reported for the reporting period (VW11-MD-1B, VW11-MD-3B, VW11-WD-1A and 1B, VW11-WD- 2B, VW11-WD-3A). VW11-MD-3B, VW11-WD-2A and VW11-WD-3B, which also reported erroneous and/or no data for the reporting period, are functioning correctly as of January 2018. If the dataloggers are functioning correctly and the piezometers are found to be faulty, a plan should be developed to repair or replace the faulty piezometers in any areas identified as critical and not covered by the recently installed instruments.

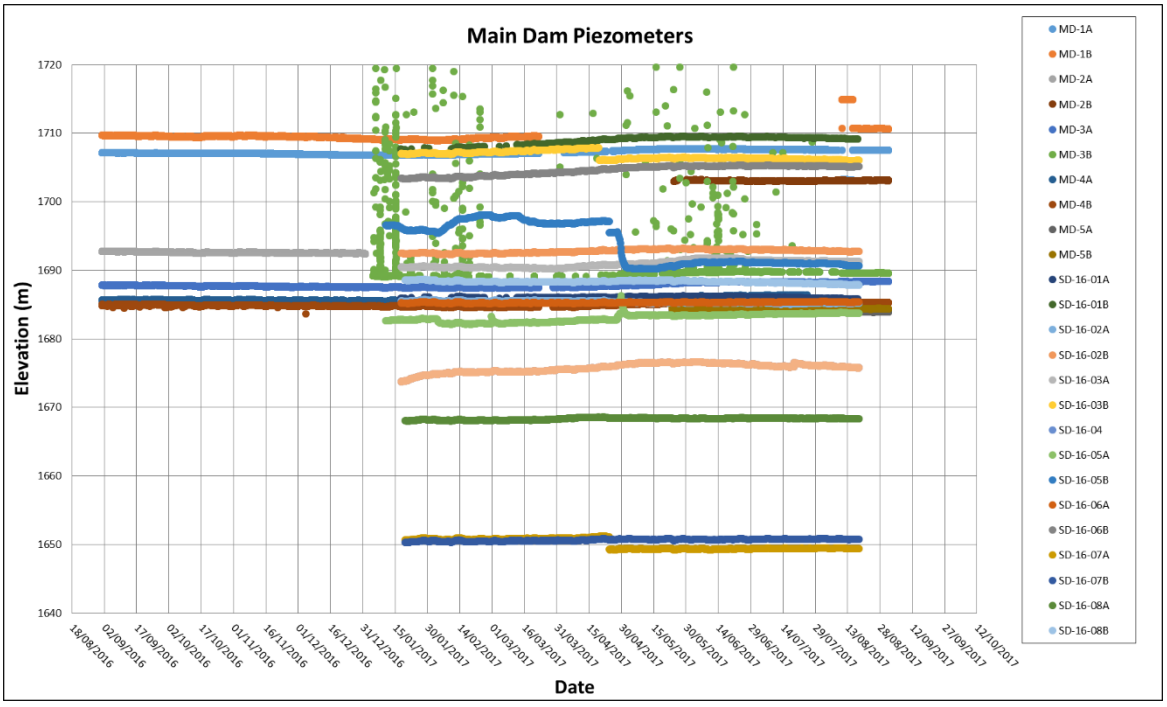


Chart 5: Main Tailings Dam Piezometer Data

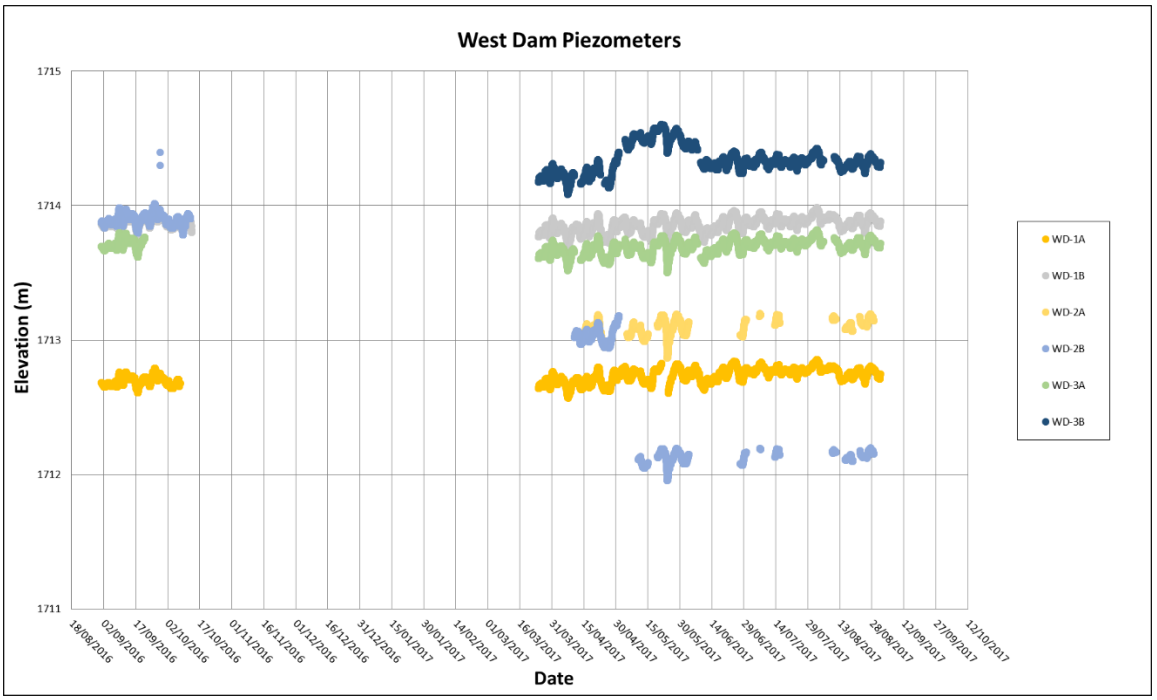


Chart 6: West Tailings Dam Piezometer Data

Observed Performance

The majority of the upstream slopes of the Main and West Dams were observed to be 2H:1V. Golder and Teck has observed some minor sloughing of the upstream slope during the reporting period. At the time of the inspection, the upstream slope was being regraded to 2H:1V and riprap was being placed to protect the steeper slopes from further erosion (Photographs 3, 4, 5, 19, and 20 in Appendix A).

In the area downstream of the Main Dam, the downstream face is buttressed by the Site C and Site D coarse refuse spoils. The Site C coarse refuse spoil (located downstream of the Main Tailings Dam) provides additional support to the Main Dam. The instability observed on the lowest bench of Site C in 2012 (Golder 2013a) appears to have been arrested by the combination of improving surface drainage and not placing additional coarse refuse (Photographs 15 in Appendix A).

Following the 2016 geotechnical investigation, Golder reassessed the stability of the Main Dam (Golder 2017g). The results indicated that:

- The development of excess pore pressures is considered unlikely to occur in the foundation materials given the absence of soft colluvium or clay material found in the foundation during the 2016 geotechnical investigation (2017a), and the dense to very dense state and low liquidity index values of the glacial till in the foundation.
- The stability of the Main Dam meets the minimum requirements for static and pseudostatic stability under drained conditions.

No evidence of instability (tension cracks, bulges, etc.) was observed on the Main Dam.

Teck have improved the stormwater management on the downstream slope of Site C such that ponding of water has been minimized and the erosion, observed in 2016 DSI, has been repaired (Photographs 10 to 12 in Appendix A). Improvements have also been made to the seepage collection at the downstream toe of Site C (Photographs 13 and 14 in Appendix A).

No evidence of instability of the West Dam was observed at the time of the inspection.

5.4 Review of Previous Deficiencies and Non-conformances

The following deficiencies and non-conformances were noted in the 2016 DSI (Golder 2017d). The incomplete or partially complete issues were brought forward and included in the 2017 DSI recommendations.

Table 17: Status of Previous (2016) Recommended Actions

ID Number	Deficiency or Non-conformance	Applicable Regulation or OMS Reference	Risk to Structure	Priority	Recommended Actions	Target Date	Status as of February 2018	Photo
2016-01	No data for piezometers VW11-MD-2B and 3B, VW11-MD-5A and 5B, VW11-WD-2A and 3B.	n/a	Potentially unstable condition not measured.	2	Confirm that the dataloggers are functioning. Repair or replace the piezometers.	Q2 2017	In progress. VW11-MD-2B is not functioning and has been removed from service. No repair or replacement is necessary at this time, since sufficient monitoring coverage is provided by SD-16-03 and VW11-MD-2A. VW11-MD-5A and 5B are functioning but the cables have been damaged and need replacing. VW11-WD-2A and 3B are functioning.	-
2016-02	Portion of upstream slope of Main Dam steeper than 2H:1V. Signs of sloughing.	OMS Section 7.0	Reduction of thickness of till layer, which could lead to increased seepage rate.	3	Reslope above pond level to 2H:1V or flatter.	Q3 2017	Complete Slope has been regraded and riprap has been placed to prevent future erosion.	3, 4, 5, 19, and 20
2016-03	Stormwater runoff erosion channel has formed on the west side of Site C.	OMS Section 7.0	Continued erosion of Site C	3	Site C erosion is to be repaired.	Q3 2017	Complete	10 to 12
2016-04	Capacity of the West Dam spillway may be insufficient.	n/a	Overtopping of the Main Dam during a large storm event.	3	Review the capacity of the West Dam spillway.	Q2 2017	No longer applicable. The emergency spillway was removed and the strategy for managing storms greater than the design event is currently being reviewed.	-
2016-05 (2015-01)	Broken seepage collection pipe at the toe of Site C.	n/a	Site C drainage impeded.	3	Repair drainage at toe of Site C. Review drainage design.	Q3 2017	Complete	13 to 14
2016-06 (2015-04)	No visual indicator of freeboard.	n/a	Potential for overtopping if GPS data is erroneous.	4	Provide visual marker (staff gauge or other).	Q3 2017	Complete A staff gauge, indicating the TARP warning levels, was installed in 2017.	3

El. = elevation; EoR = Engineer of Record.

6.0 FINDINGS AND RECOMMENDED ACTIONS

The Main Tailings Dam and West Tailings Dam were observed to be in good condition at the time of the 2017 site visit. No significant changes in the condition of the dams since the 2016 DSI were noted.

Table 18 summarizes the recommended actions for the Greenhills Tailings Facility.

The Main Dam had been designed to accommodate a pond against it. However, it is recognized that such a configuration increases the consequence in the unlikely event that the integrity of the Main Dam was to be compromised. Some preliminary deposition planning has been performed to assess the feasibility of developing beach against the Main Dam. It is recommended that additional evaluation of such options be performed as part of the ongoing planning for the tailings facility.

Table 18: 2017 Dam Safety Inspection Recommended Actions for the Greenhills Tailings Facility

ID Number	Deficiency or Non-conformance	Photo	Applicable Regulation or OMS Reference	Potential Dam Safety Risk	Recommended Action	Priority Level	Recommended Deadline
2017-01 (2016-01)	■ VW11-MD-1B is reporting erroneous data. VW11-MD-1B, VW11-WD-1A and 1B, VW11-WD-2B, VW11-WD-3A did not report data (VW11-MD-3B, VW11-WD-2A and VW11-WD-3B also reported erroneous and/or no data for the reporting period, but are functioning correctly as of January 2018). ■ VW11-MD-5A and 5B cables have been damaged. ■ SD-16-01 has no new readings since August 2017 when casing cover was partially buried during dam construction.	-	n/a	Potentially unstable condition not measured.	Confirm that dataloggers are functioning correctly and communication is restored as needed. Repair or replace damaged piezometer cables as necessary. Gain access to SD-16-01 and connect to datalogger.	2	Q3 2018
2017-02	QPOs for the inclinometers have not been developed since data is still being collected to establish the baseline.	-	n/a	Potentially unstable condition not identified promptly.	Develop QPOs for the inclinometers once the baseline has been established.	2	Q3 2018
2017-03	The weirs at the toe of Site C and West Dam were damaged in 2017. The weir at the toe of the West Dam has been moved downstream to the other side of the road and is now functioning again.	13, 23	n/a	Potentially unstable condition not measured.	Reinstate the weir at the toe of Site C. Establish baseline monitoring and QPOs for weirs and consider automating to ensure continual data collection.	2	Q3 2018
2017-04	Pond against upstream slope of Main Dam.	1 to 6	n/a	Increased potential for piping, and potential increased zone of influence if dam integrity is compromised.	Review options to move pond away from upstream slope of Main Dam.	4	Q3 2018
2017-05	Closure plan does not meet HSRC requirements.	-	HSRC, OMS	n/a	Develop the current concept level closure plan into a more detailed plan aligned with the current LOM strategy and HSRC requirements.	4	Q1 2019
2017-06	In 2014, flood protection berms were constructed along the river near Elkford. The 2016 inundation study update (Golder 2017c) used the 2011 LiDAR, which did not include the flood protection berms. The inundation study needs to be updated with the 2017 LiDAR data to include the 2014 flood protection berms.	-	n/a	n/a	Update inundation study with 2017 LiDAR for West Dam breach.	4	Q4 2018

Priority Level	Description
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.
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.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in dam safety issues.
4	Best Management Practice – Further improvements are necessary to meet industry best practices or reduce potential risks.

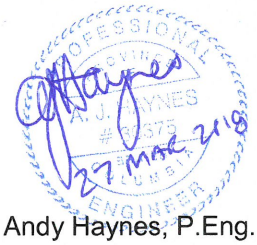
OMS = Operation, Maintenance, and Surveillance; n/a = not applicable; QPOs = Quantitative Performance Objectives.

7.0 CLOSURE

The reader is referred to the Study Limitations, which follows the text and forms an integral part of this report.

We trust that this report meets your present requirements. If you have any questions or requirements, please contact the undersigned.

GOLDER ASSOCIATES LTD.



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https://golderassociates.sharepoint.com/sites/13539g/deliverables/issued/2017-130-r-rev0-2000-2017 dsi tsf/1778487-2017-130-r-rev0-2000-gho 2017 dsi tsf 27mar_18.docx

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STUDY LIMITATIONS

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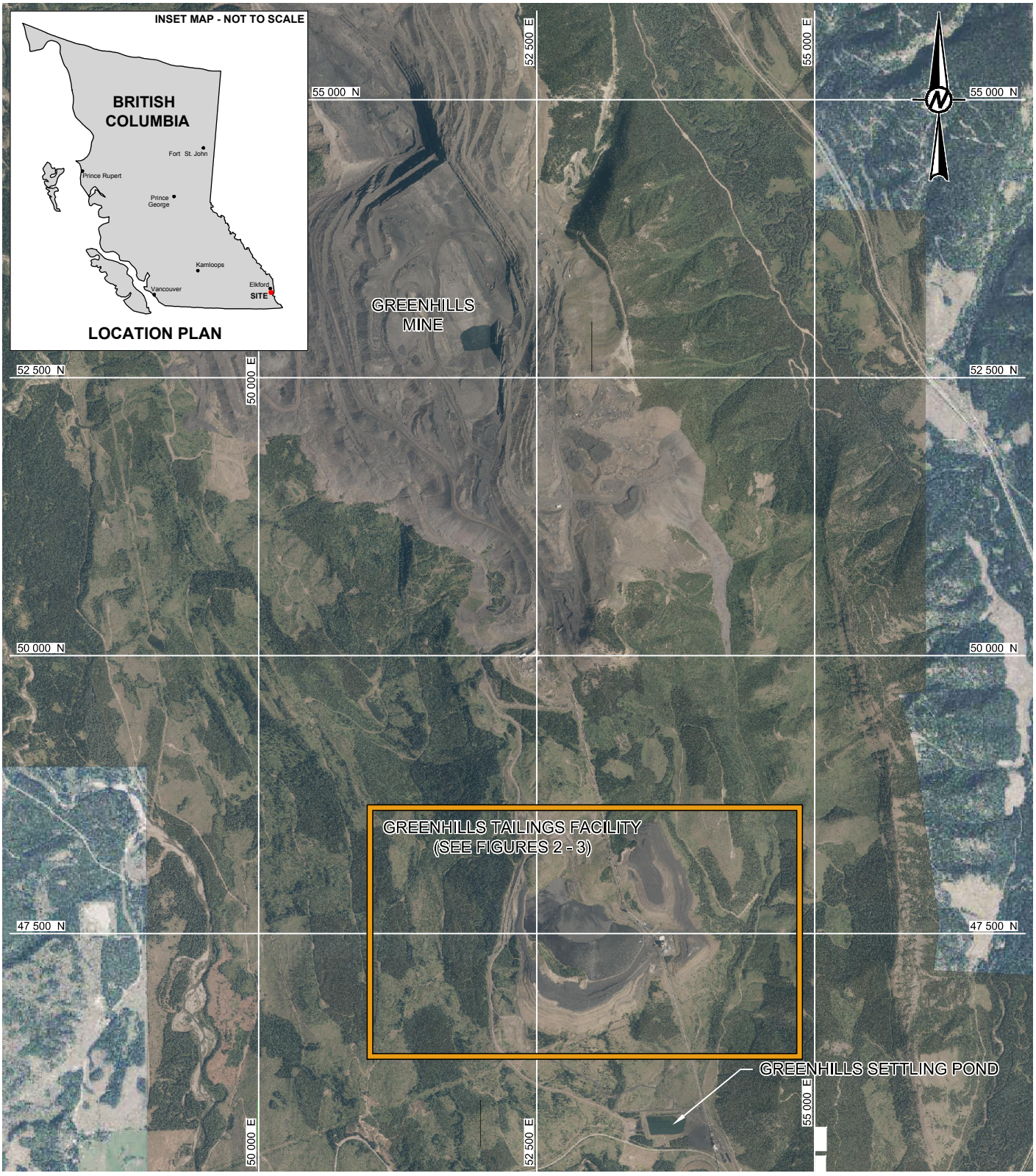

REFERENCE

1. 2013 AERIAL PHOTO PROVIDED BY TECK COAL LIMITED GREENHILLS OPERATIONS.
2. 2017 AERIAL PHOTO PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS. FLOWN JULY 25 TO 27, 2017.

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN GHO MINE GRID.

0 1,000 2,000
1:50,000 METRES

CLIENT
TECK COAL LIMITED
GREENHILLS OPERATIONS
ELKFORD, B.C.

PROJECT
2017 GREENHILLS TAILINGS FACILITY
ANNUAL DAM SAFETY INSPECTIONS

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-19
DESIGNED	CTM
PREPARED	JY
REVIEWED	MS
APPROVED	AJH

TITLE
GREENHILLS SITE PLAN

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1778487	2000/2060/2017-130	0	1

Path: \\golder.gds\gat\burnaby\CAD-GIS\Client\Teck Coal\Greenhills\99_PROJECTS\1778487\02_PRODUCTION\2000\2060\Doc. 2017-130\ | File Name: 1778487_2000_2060_2017-130 - 01.dwg

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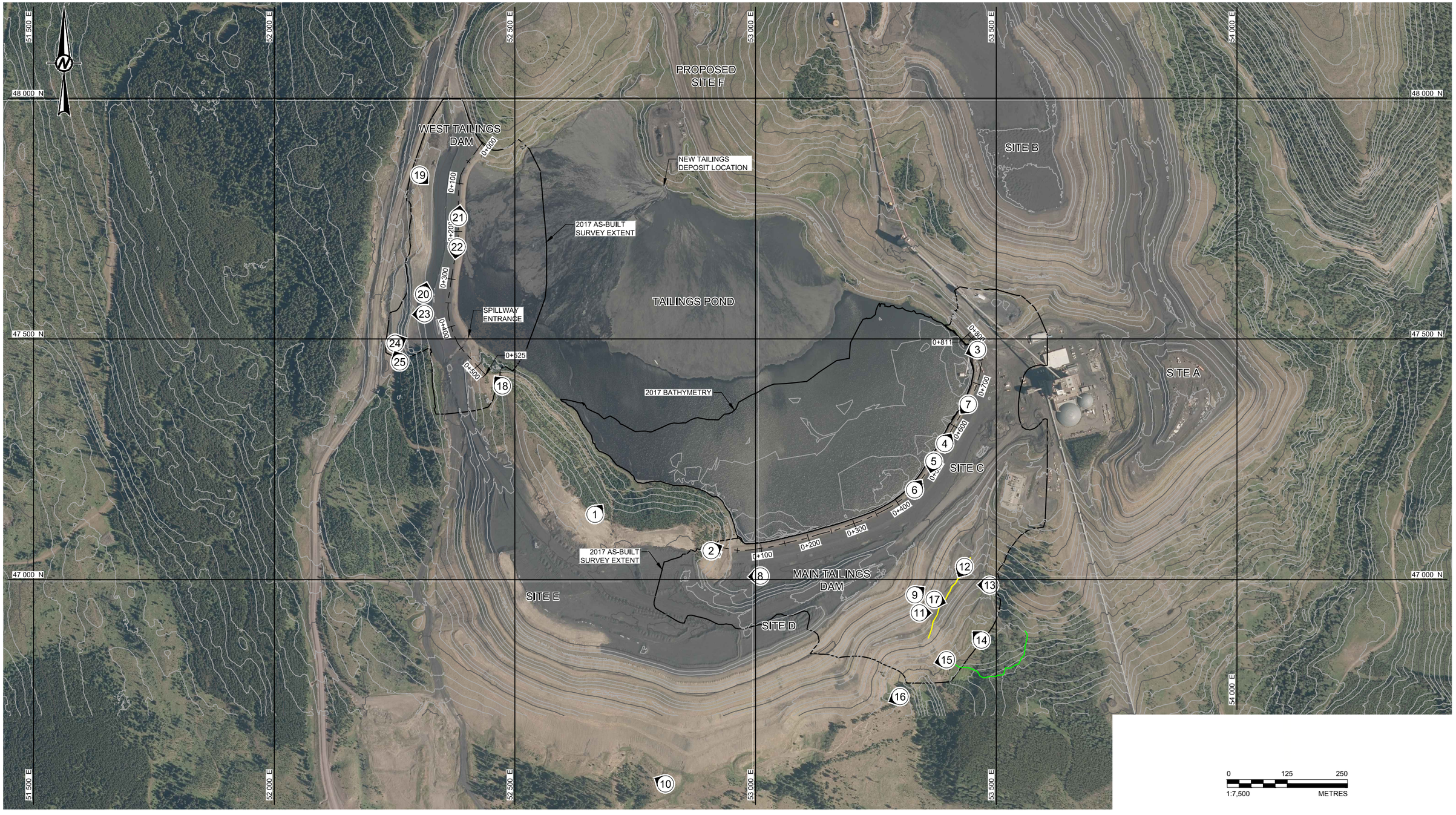

0 125 250
1:7,500 METRES

LEGEND

- 2017 SURVEY (SEE REFERENCE 2)
- (#) 2017 SITE VISIT PHOTO LOCATION
- 2012 TOE BULGE (SITE C)
- 2012 SCARP (SITE C)

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN GHO MINE GRID.
3. TOPOGRAPHIC CONTOURS SHOWN AT 5.0 m MINOR AND 25.0 m MAJOR INTERVAL.

REFERENCES

1. 2017 AERIAL PHOTO PROVIDED BY TECK COAL LIMITED. FLOWN 25 TO 27 JULY 2017.
2. 2017 LIDAR DATA PROVIDED BY TECK COAL LIMITED, FLOWN: 25 TO 27 JULY 2017
3. 2017 AS-BUILT INFORMATION PROVIDED BY TECK COAL LIMITED, DATED: 20 OCTOBER 2017 FILE NAME: TOPO OF 171020_WESTDAM_DSM_100CM.dxf, TOPO OF 171020_MAINDAM_DSM_100CM.dxf
4. 2017 BATHYMETRY INFORMATION PROVIDED BY TECK COAL LIMITED, DATED 25 AUGUST 2017 FILE NAME: pond_170825_final.dxf
5. 2012 SCARP AND TOE BULGE LOCATIONS PROVIDED BY TECK COAL LIMITED GREENHILLS OPERATIONS ON 13 MARCH 2014.

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GREENHILLS OPERATIONS
ELKFORD, B.C.

CONSULTANT
Golder Associates

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DESIGNED	CTM
PREPARED	TAK
REVIEWED	MS
APPROVED	AJH

PROJECT
2017 GREENHILLS TAILINGS FACILITY
ANNUAL DAM SAFETY INSPECTIONS

TITLE
GREENHILLS SITE PLAN
PHOTO LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1778487	2000/2060/2017-130	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25 mm

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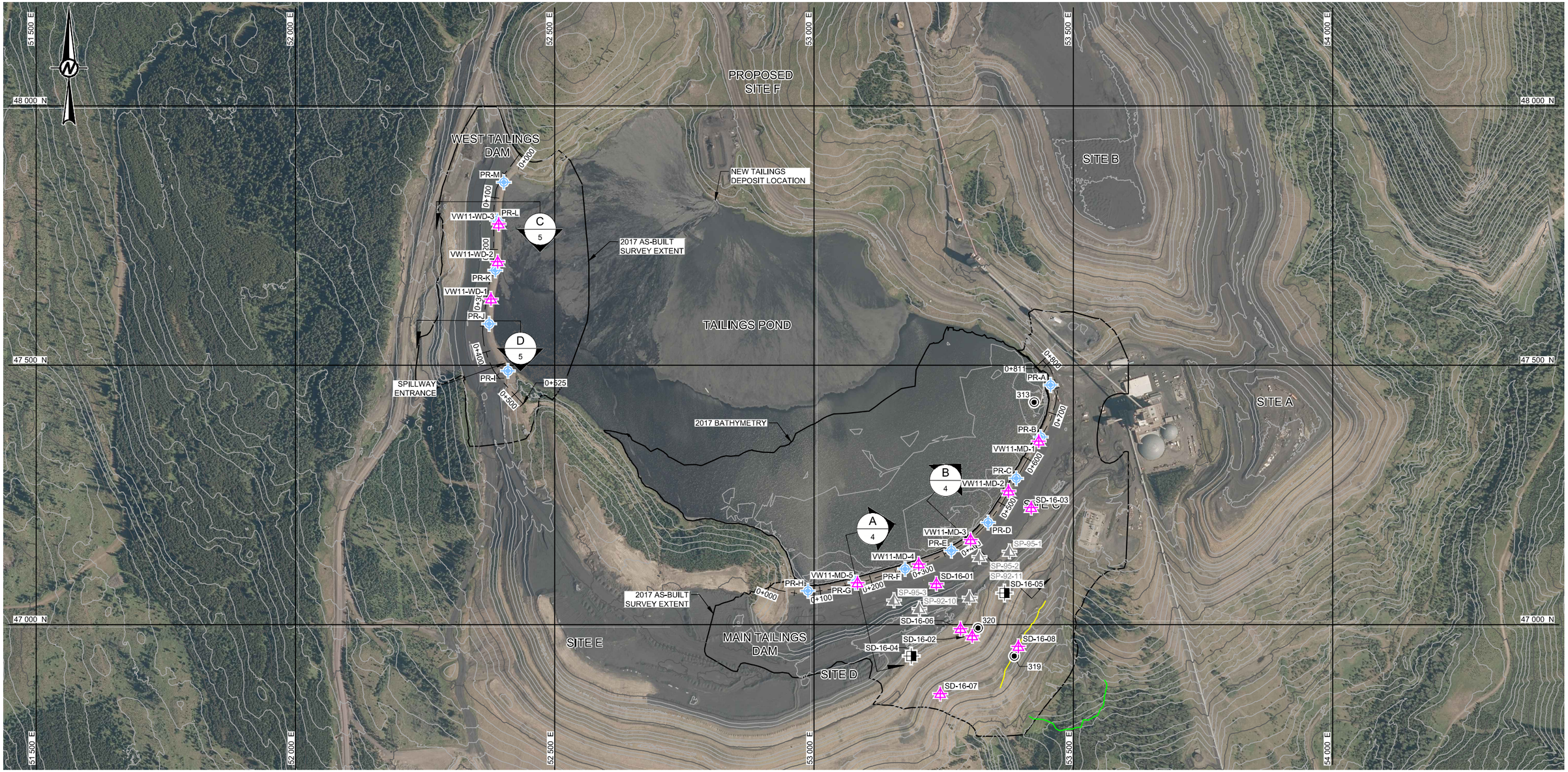

LEGEND

- 2017 TOPOGRAPHIC CONTOURS (SEE REFERENCE 2)
- PNEUMATIC PIEZOMETER LOCATION (INACTIVE)
- STANDPIPE PIEZOMETER LOCATION (INACTIVE)
- VIBRATING WIRE PIEZOMETER LOCATION
- GPS MONITORING LOCATION
- PRISM LOCATION
- INCLINOMETER AND VIBRATING WIRE PIEZOMETER LOCATION
- 2012 TOE BULGE (SITE C)
- 2012 SCARP (SITE C)

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN GHO MINE GRID.
3. TOPOGRAPHIC CONTOURS SHOWN AT 5.0 m MINOR AND 25.0 m MAJOR INTERVAL.
4. LOCATIONS OF SP-92-10 AND 92-SP-11 HAVE BEEN APPROXIMATED.

REFERENCES

1. 2017 AERIAL PHOTO PROVIDED BY TECK COAL LIMITED. FLOWN 25 TO 27 JULY 2017.
2. 2017 LIDAR DATA PROVIDED BY TECK COAL LIMITED, FLOWN: 25 TO 27 JULY 2017.
3. 2017 AS-BUILT INFORMATION PROVIDED BY TECK COAL LIMITED, DATED: 20 OCTOBER 2017
   FILE NAME: TOPO OF 171020_WESTDAM_DSM_100CM.dxf, TOPO OF 171020_MAINDAM_DSM_100CM.dxf.
4. INACTIVE STANDPIPE LOCATIONS BASED ON DATA PROVIDED BY TECK COAL LIMITED GREENHILLS OPERATIONS,
   FILE NAME: "Exported Sensor Locations.csv", RECEIVED: 3 NOVEMBER 2016.
5. GPS AND VIBRATING WIRE PIEZOMETER LOCATIONS PROVIDED BY TECK COAL LIMITED GREENHILLS OPERATIONS,
   FILE NAME: "Exported Sensor Locations.csv", RECEIVED: 9 SEPTEMBER 2014.
6. GPS 313 LOCATION PROVIDED BY TECK COAL LIMITED GREENHILL OPERARIONS, FILENAME: "TSF_313_Barge.csv",
   RECEIVED: 5 NOVEMBER 2015.
7. PRISM LOCATIONS PROVIDED BY TECK COAL LIMITED GREENHILLS OPERATIONS, FILE NAME: "Dam Prism Data.xlsx",
   RECEIVED: 5 NOVEMBER 2015.
8. 2017 BATHYMETRY INFORMATION PROVIDED BY TECK COAL LIMITED, DATED 25 AUGUST 2017, FILE NAME: pond_170825_final.dxf.
9. 2012 SCARP AND TOE BULGE LOCATIONS PROVIDED BY TECK COAL LIMITED GREENHILLS OPERATIONS ON 13 MARCH 2014.

0 125 250
1:7,500 METRES

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TECK COAL LIMITED
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ELKFORD, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-27
DESIGNED	CTM
PREPARED	TAK
REVIEWED	MS
APPROVED	AJH

PROJECT
2017 GREENHILLS TAILINGS FACILITY
ANNUAL DAM SAFETY INSPECTIONS

TITLE
GREENHILLS SITE PLAN
MONITORING AND PRISM LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1778487	2000/2060/2017-130	0	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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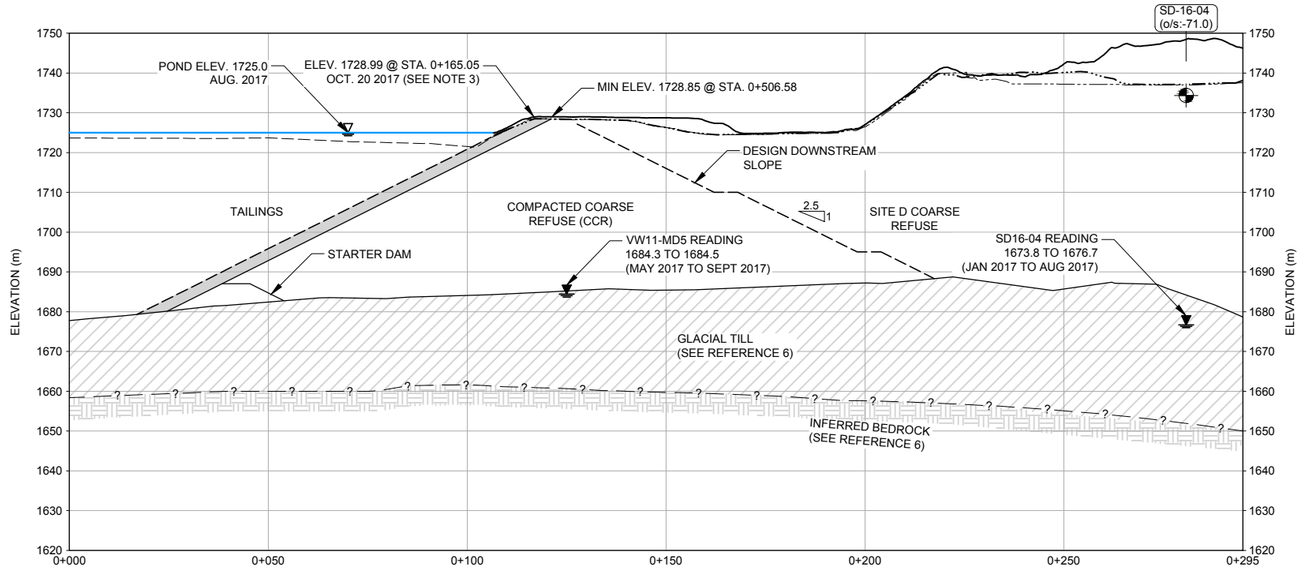
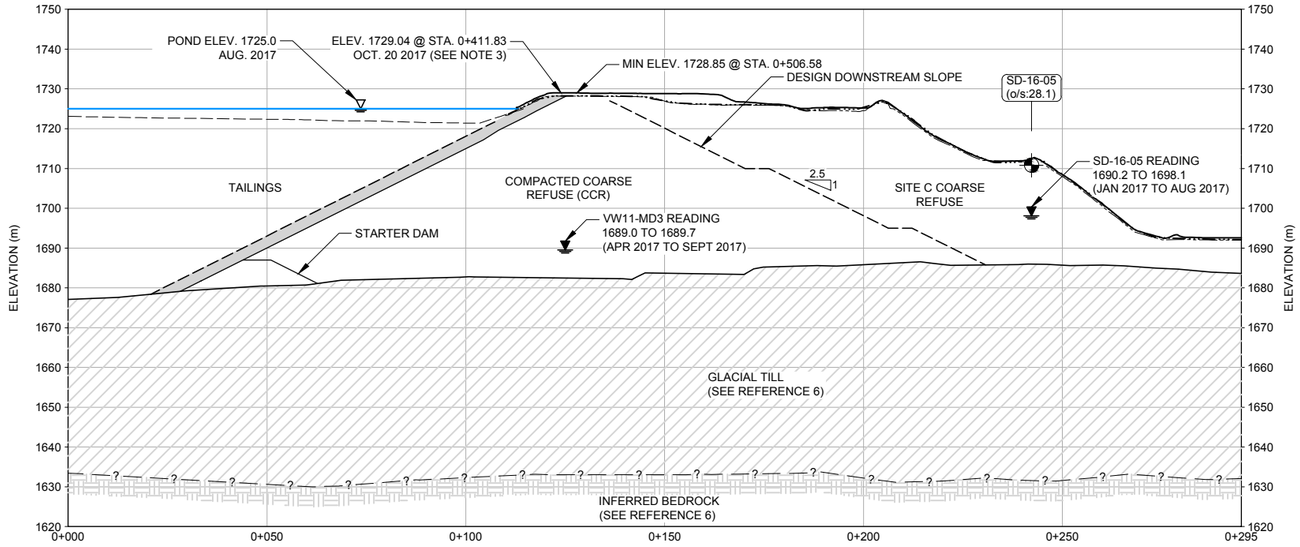


SCALE 1:1,500 m

A
3

MAIN TAILINGS DAM CROSS-SECTION (0+172.41)



SCALE 1:1,500 m

B
3

MAIN TAILINGS DAM CROSS-SECTION (0+405.36)

LEGEND

- OCTOBER 2017 SURVEY (SEE REFERENCE 1)
- AUGUST 2016 GROUND SURFACE
- AUGUST 2017 BATHYMETRY
- CLAY TILL BLANKET
- GLACIAL TILL
- BEDROCK

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. DAM ZONINGS ARE APPROXIMATE.
3. MINIMUM CREST ELEVATIONS ON 20 OCTOBER 2017 ARE 1728.85 m AT MAIN DAM AND 1728.73 m AT WEST DAM BASED ON 2017 CONSTRUCTION REPORT. GREENHILLS OPERATIONS MAIN AND WEST TAILINGS DAMS. REPORT PREPARED FOR TECK COAL LIMITED, GREENHILLS OPERATIONS REPORT NUMBER 1782871_RP0001. SUBMITTED DECEMBER 2017.

REFERENCES

1. 2017 LIDAR DATA PROVIDED BY TECK COAL LIMITED, FLOWN: 25 TO 27 JULY 2017.
2. 2017 AS-BUILT INFORMATION PROVIDED BY TECK COAL LIMITED, DATED: 20 OCTOBER 2017 FILE NAME: TOPO OF 171020_WESTDAM_DSM_100CM.dxf, TOPO OF 171020_MAINDAM_DSM_100CM.dxf
3. NOVEMBER 2015 GROUND SURFACE PROVIDED BY TECK GHO, FILE NAMES: "MAIN DAM FINAL 2015.dxf" AND "WEST DAM FINAL 2015.dxf", RECEIVED: 26 NOVEMBER 2015.
4. 2017 BATHYMETRY INFORMATION PROVIDED BY TECK COAL LIMITED, DATED 25 AUGUST 2017 FILE NAME: pond_170825_final.dxf
5. APPROXIMATE ORIGINAL GROUND SURFACE PROVIDED BY TECK GHO.
6. MAIN DAM SECTION INFERRED GLACIAL TILL AND INFERRED BEDROCK BASED ON HARDY 1980 REPORT ON TAILINGS DAM GREENHILLS SURFACE COAL MINING PROJECT AND GOLDER 2016 MAIN TAILINGS DAM INVESTIGATION. GOLDER REFERENCE NUMBER: 1658561-2017-021-R-REV0-3000

0 25 50
1:1,500 METRES

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TECK COAL LIMITED
GREENHILLS OPERATIONS
ELKFORD, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-27
DESIGNED	CTM
PREPARED	TAK
REVIEWED	MS
APPROVED	AJH

PROJECT
2017 GREENHILLS TAILINGS FACILITY
ANNUAL DAM SAFETY INSPECTIONS

TITLE
GREENHILLS SITE PLAN
MAIN TAILINGS DAM CROSS SECTIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1778487	2000/2060/2017-130	0	4

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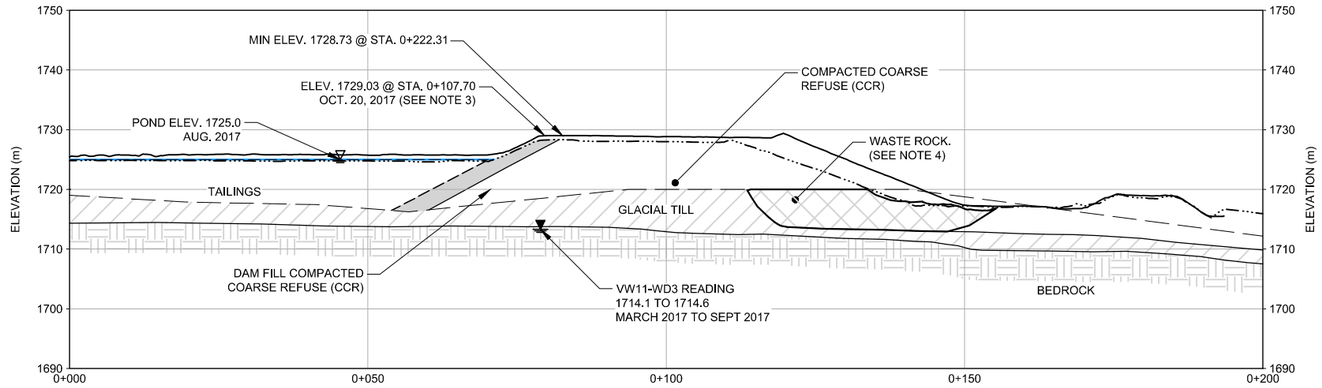
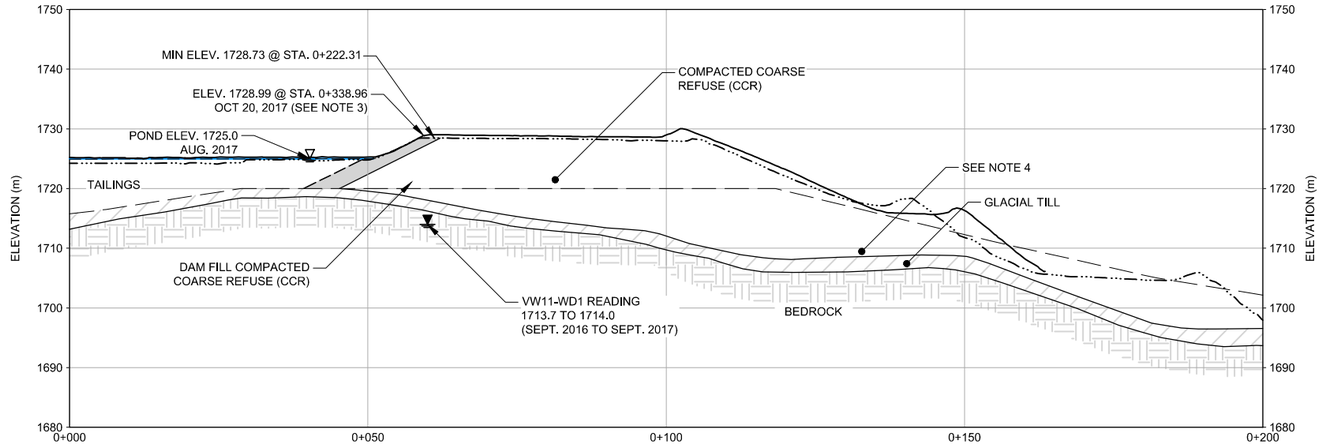


SCALE 1:1,000 m

C
3

WEST TAILINGS DAM CROSS-SECTION (0+107.70)



SCALE 1:1,000 m

D
3

WEST TAILINGS DAM CROSS-SECTION (0+338.96)

LEGEND

- OCTOBER 2017 SURVEY (SEE REFERENCE 1)
- NOVEMBER 2016 SURVEY
- APPROXIMATE ORIGINAL GROUND SURFACE (SEE REFERENCE 3)
- CLAY TILL BLANKET
- GLACIAL TILL
- BEDROCK

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. DAM ZONINGS ARE APPROXIMATE.
3. MINIMUM CREST ELEVATIONS ON 20 OCTOBER 2017 ARE 1728.48 m AT MAIN DAM AND 1728.73 m AT WEST DAM BASED ON 2017 CONSTRUCTION REPORT. GREENHILLS OPERATIONS MAIN AND WEST TAILINGS DAMS. REPORT PREPARED FOR TECK COAL LIMITED, GREENHILLS OPERATIONS REPORT NUMBER 1782871_RP0001. SUBMITTED DECEMBER 2017.
4. LOOSE MATERIAL STRIPPED FROM FOUNDATION AND BACKFILLED WITH WASTE ROCK BASED ON GOLDER 2016 *GREENHILLS OPERATIONS MAIN AND WEST TAILINGS DAMS*. REPORT PREPARED FOR TECK COAL LIMITED, GHO. REPORT NO. 1313960014.3000. SUBMITTED 26 JANUARY 2016.

REFERENCES

1. 2017 LIDAR DATA PROVIDED BY TECK COAL LIMITED, FLOWN: 25 TO 27 JULY 2017.
2. 2017 AS-BUILT INFORMATION PROVIDED BY TECK COAL LIMITED, DATED: 20 OCTOBER 2017
   FILE NAME: TOPO OF 171020_WESTDAM_DSM_100CM.dxf, TOPO OF 171020_MAINDAM_DSM_100CM.dxf
3. SEPTEMBER 2014 GROUND SURFACE PROVIDED BY TECK GHO, RECEIVED: 23 SEPTEMBER 2014.
4. APPROXIMATE ORIGINAL GROUND SURFACE PROVIDED BY TECK GHO.
5. WEST DAM SECTION TYPICAL STRATIGRAPHY OBTAINED FROM GOLDER. 2014. *GREENHILLS OPERATIONS WEST TAILING DAM RAISE TO ELEVATION 1,735 m.* REPORT PREPARED FOR TECK GHO. REPORT NO. 13-1321-0018. SUBMITTED 11 FEBRUARY 2014.

0 25 50
1:1,000 METRES

CLIENT
TECK COAL LIMITED
GREENHILLS OPERATIONS
ELKFORD, B.C.

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-03-27
DESIGNED	CTM
PREPARED	JY
REVIEWED	MS
APPROVED	AJH

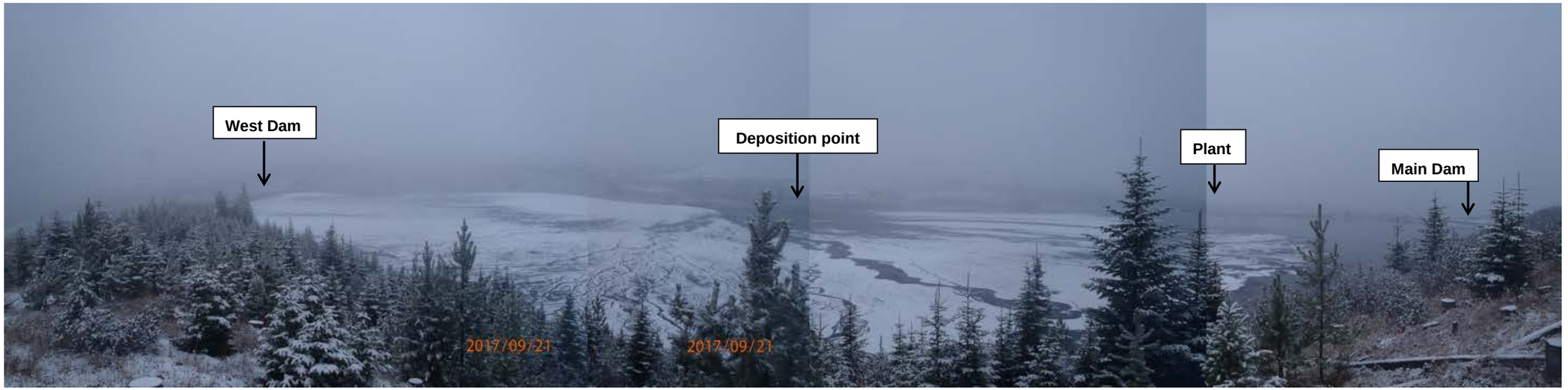
PROJECT
2017 GREENHILLS TAILINGS FACILITY
ANNUAL DAM SAFETY INSPECTIONS

TITLE
GREEN HILLS SITE PLAN
WEST TAILINGS SAM CROSS SECTIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
1778487	2000/2060/2017-130	0	5

APPENDIX A

Site Photographs



Photograph 1: Overview from rise of natural ground to the south, looking northeast. 21 September 2017.

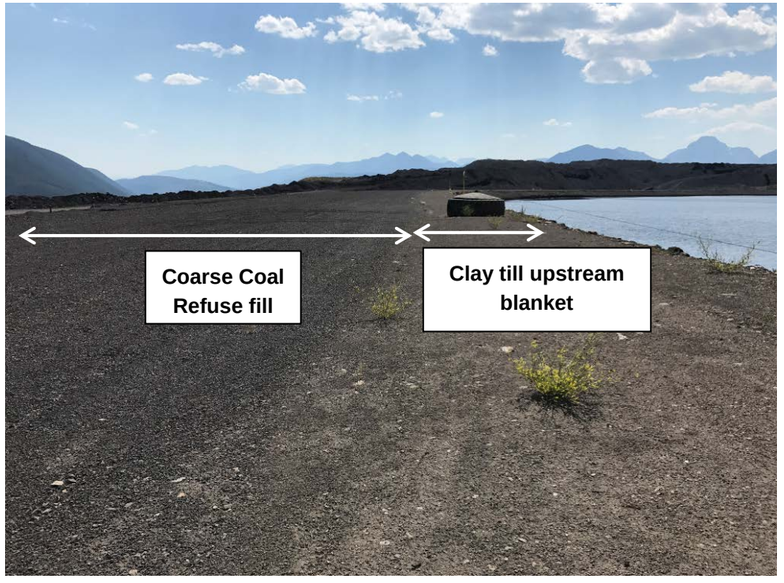
Photograph 2: Main Dam – overview from natural ground above west abutment, looking northeast. 21 September 2017.

Photograph 3: Main Dam – overview of barge, looking southwest. 30 July 2017.

Photograph 4: Main Dam – overview of barge, east abutment, pond level indicator, and natural ground north of GHO Tailings Pond, looking north. 21 September 2017.

Photograph 5: Main Dam – upstream slope and crest, looking southwest. 21 September 2017.

Photograph 6: Main Dam – upstream slope, looking northeast. 30 July 2017.

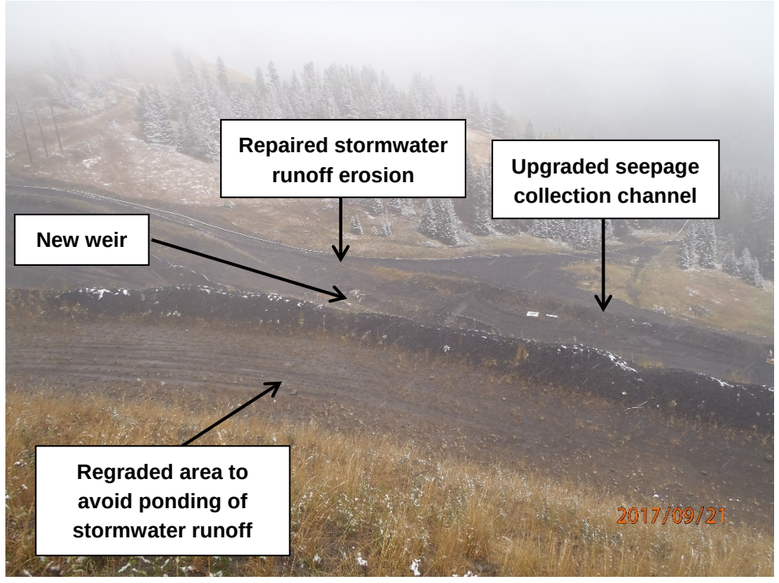


Photograph 7: Main Dam – crest, note clay till upstream blanket and coarse coal refuse fill, looking southwest. 30 July 2017.

Photograph 8: Main Dam – west abutment, looking west. 21 September 2017.

Photograph 9: Site C – overview of Site C coarse coal refuse dump, looking northeast. 21 September 2017.

Photograph 10: Site D and E – overview of Site D and Site E coarse coal refuse spoils, looking northwest. 21 September 2017.



Photograph 11: Site C – view of west side of refuse dump, looking east. 21 September 2017.

Photograph 12: Site C – view of new weir under construction on west side of refuse dump, looking north. 21 September 2017.

Photograph 13: Site C – repaired stormwater runoff erosion on west side of refuse dump, looking northwest. 21 September 2017.

Photograph 14: Site C – view of upgraded seepage collection channel. Seepage water is red-brown. Looking northwest. 21 September 2017.

Photograph 15: Site C – upgraded seepage trench at toe of Site C refuse spoil, looking southwest. 21 September 2017.

Photograph 16: Site C – weir at toe of Site C refuse spoil prior to trench upgrade, looking west. 30 July 2017.

Photograph 17: Historic 2012 Site C failure scarp and toe bulge, looking east. No significant change since 2012. 30 July 2017.

Photograph 18: West Dam – overview of upstream slope, looking northwest. 21 September 2017.

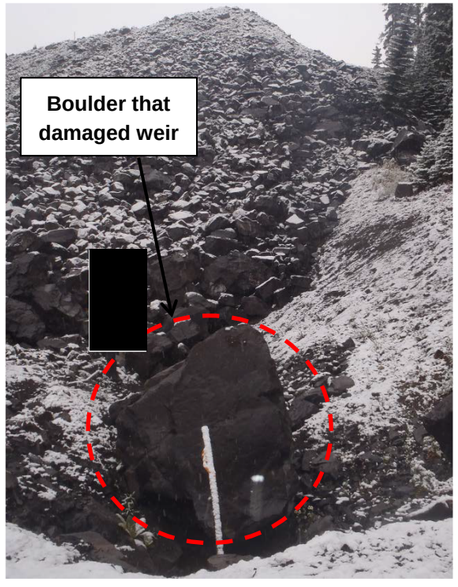
Photograph 19: West Dam – overview of downstream slope under construction, looking southeast. 21 September 2017.

Photograph 20: West Dam – downstream slope under construction, looking north. 21 September 2017.

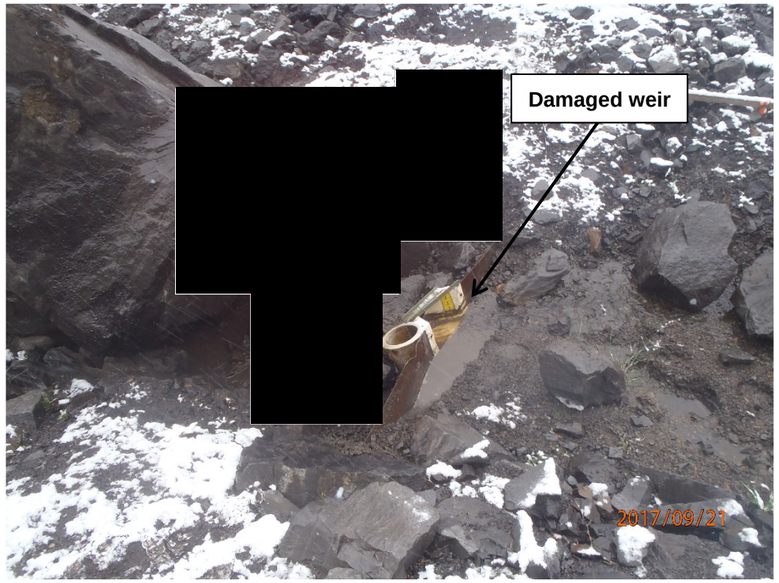
Photograph 21: West Dam – upstream slope, crest and north abutment looking north. 21 September 2017.

Photograph 22: West Dam – upstream slope, crest and south abutment, looking south. 21 September 2017.

Photograph 23: West Dam – downstream slope at south abutment, looking west.



Photograph 24: West Dam – view drainage channel along downstream slope at south abutment, looking east. 21 September 2017.



Photograph 25: West Dam – view of damaged weir in drainage channel along downstream slope at south abutment, looking north. 21 September 2017.

APPENDIX B

Dam Inspection Report

Client:	**Teck Coal Limited**	**By:**	**Andy Haynes, P.Eng. and Malcolm Shang**
Project:	**GHO Annual Dam Safety Inspection**	**Date:**	**21 September 2017**
Location:	**Main Tailings Dam**		

GENERAL INFORMATION

Dam Type: Zoned Earth Fill

Weather Conditions:	Overcast, fog, light rain / snow	**Temp:**	0°C (average)

INSPECTION ITEM	OBSERVATIONS/DATA	PHOTO	COMMENTS & OTHER DATA
1. DAM CREST		2, 3, 4, 5, 6, 7	
1.1 Crest Elevation (Till)	El. 1,728.85		■ ~ 1 m dam raise in 2017. ■ Crest El. from Oct. 2017 GHO survey.
1.2 Reservoir Level / Freeboard	El. 1,724.8 Freeboard = 2.7 m	3, 4	■ Pond level from GHO GPS reading in 21 Sept. 2017 ■ Minimum crest on Main Dam El. 1728.48 m limits freeboard.
1.3 Distance to Tailings Pond (if applicable)	0 m (at dam)	3, 4, 5, 6	
1.4 Surface Cracking	None		
1.5 Unexpected Settlement	None		
1.6 Lateral Movement	None		
1.7 Other Unusual Conditions	Yes		■ Under construction at time of inspection.
2. UPSTREAM SLOPE		3, 4, 5, 6	
2.1 Slope Angle	2H:1V	3, 4, 5, 6	■ Resloped above pond level, using riprap, since 2016 inspection.
2.2 Signs of Erosion	Yes, minor	4	■ Minor erosion visible. ■ Riprap was being placed to protect against future erosion of the till layer.
2.3 Signs of Movement (Deformation)	None		
2.4 Cracks	None		
2.5 Face Liner Condition (if applicable)	N/A		

INSPECTION ITEM	OBSERVATIONS/DATA	PHOTO	COMMENTS & OTHER DATA
2.5 Other Unusual Conditions	Yes		■ At the time of inspection, riprap was being placed to protect against future erosion of the till layer.
3. DOWNSTREAM SLOPE		2, 9 - 13	■ Site C and Site D spoils buttress downstream slope.
3.1 Slope Angle	~ 4 H:1 V (overall)		
3.2 Signs of Erosion	None	11, 13	■ Erosion channels on Site C downstream slope have been repaired since 2016 inspection.
3.3 Signs of Movement (Deformation)	None		
3.4 Cracks	None		
3.5 Seepage or Wet Areas	None		■ Site C downstream slope was regraded since 2016 inspection to minimize ponding.
3.6 Vegetation Growth	No concern		
3.7 Other Unusual Conditions	Yes	2, 10	■ Site C and Site D spoils buttress downstream slope.
4. DOWNSTREAM TOE AREA		14 - 16	
4.1 Seepage from Dam	Yes	14 - 16	■ Seepage from rock drains below Site C and Site D ■ Seepage pipe fixed, and seepage collection channel has been upgraded since 2016 inspection.
4.2 Signs of Erosion	None		
4.3 Signs of Turbidity in Seepage Water	None	14 - 16	
4.4 Discoloration/Staining	Yes (red-brown)	14 - 16	■ Red-brown staining along seepage discharge path.
4.5 Outlet Operating Problem (if applicable)	N/A		
4.6 Other Unusual Conditions	Yes	17	■ Failure in surficial soils beneath and downslope of toe. No change since 2012.
5. ABUTMENTS		4, 8	
5.1 Seepage at Contact Zone (abutment/embankment)	None		
5.2 Signs of Erosion	None		

INSPECTION ITEM	OBSERVATIONS/DATA	PHOTO	COMMENTS & OTHER DATA
5.3 Excessive Vegetation	None		
5.4 Presence of Rodent Burrows	None		
5.5 Other Unusual Conditions	None		
6. RESERVOIR		1, 2 - 7	■ Tailings discharge point at north side of impoundment ■ Tailings discharge point has been moved about 250 m northwest of the 2016 location.
6.1 Stability of Slopes	No concern		■ Resloped above pond level, using riprap, since 2016 inspection.
6.2 Floating Debris	None		
6.3 Other Unusual Conditions	Yes	4	■ TARP warning levels installed.
7. EMERGENCY SPILLWAY/ OUTLET STRUCTURE	N/A. Emergency spillway removed near the south abutment of the West Dam in 2017 (prior to site visit)		■ Emergency spillway removed near the south abutment of the West Dam in 2017 (prior to site visit).
8. INSTRUMENTATION			
8.1 Piezometers	Yes		■ 10 VW piezometers installed in 2011 (in standpipes) on dam crest. ■ 12 VW piezometers installed on dam crest and Site C downstream slope during Oct-Dec 2016 field investigation.
8.2 Settlement Cells	Yes		■ Prisms A to H on dam crest.
8.3 Thermistors	None		
8.4 Survey Monuments	None		
8.5 Accelerograph	None		
8.6 Inclinometer	None		■ 3 slope indicators and 2 inclinometer casings installed during Oct-Nov 2016 field investigation.
8.7 Weirs and Flow Monitors	Yes	12	■ New flow weir installed on the downstream slope of the Site C refuse stockpile ■ Flow weir damaged at toe of Site C refuse stockpile during the upgrade to the seepage collection channel.

INSPECTION ITEM	OBSERVATIONS/DATA	PHOTO	COMMENTS & OTHER DATA
8.8 Data Logger(s)	Yes		■ VW piezometers included in GHO Geoexplorer monitoring system.
8.9 Other	Yes		■ GPS #313 on barge to monitor pond level. ■ GPS #319 and 320 on Site C coarse refuse stockpile.
9. DOCUMENTATION			
9.1 Operation, Maintenance and Surveillance (OMS) Manual 9.1.1 OMS Manual exists	Yes		■ GHO (2017) ■ GHO SP&P No. 1543 v3.
9.1.2 OMS Plan reflects current dam conditions	Yes		
9.1.3 Date of last revision	March 2017		
9.2 Emergency Preparedness Plan (EPP) 9.2.1 EPP Exists	Yes		■ GHO (2013a) ■ GHO SP&P No. 1583 v0.
9.2.2 EPP Reflects Current Conditions	In the process of being updated.		
9.2.3 Date of Last Revision	31 January 2013		

10. NOTES

Inspector's Signature		**Date:**	27 March 2018

https://golderassociates.sharepoint.com/sites/13539g/deliverables/issued/2017-130-r-rev0-2000-2017 dsi tsf/appendices/appendix b/appendix b1 - dam inspection_main dam.docx

Client:	**Teck Coal Limited**	**By:**	**Andy Haynes, P.Eng. and Malcolm Shang**
Project:	**GHO Annual Dam Safety Inspection**	**Date:**	**21 September 2017**
Location:	**West Tailings Dam**		

GENERAL INFORMATION

Dam Type: Zoned Earth Fill

Weather Conditions:	Overcast, light snow	**Temp:**	0°C (average)

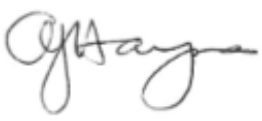
INSPECTION ITEM	OBSERVATIONS/DATA	PHOTO	COMMENTS & OTHER DATA
1. DAM CREST		1, 18, 21, 22	
1.1 Crest Elevation (Till)	El. 1728.73		■ ~ 1 m dam raise in 2017. ■ Crest El. from Oct. 2017 GHO survey.
1.2 Reservoir Level / Freeboard	El. 1,724.8 Freeboard = 2.7 m		■ Pond level from GHO GPS reading in 21 Sept. 2017. ■ Minimum crest on Main Dam El. 1728.48 m limits freeboard.
1.3 Distance to Tailings Pond (if applicable)	>200 m	1	
1.4 Surface Cracking	None		
1.5 Unexpected Settlement	None		
1.6 Lateral Movement	None		
1.7 Other Unusual Conditions	N/A. Temporary emergency spillway removed near the south abutment of the West Dam in 2017 (prior to site visit)		■ Temporary emergency spillway removed near the south abutment of the West Dam in 2017 (prior to site visit).
2. UPSTREAM SLOPE		18, 21, 22	
2.1 Slope Angle	2H : 1V	18, 21, 22	
2.2 Signs of Erosion	None		
2.3 Signs of Movement (Deformation)	None		
2.4 Cracks	None		
2.5 Face Liner Condition (if applicable)	N/A		
2.5 Other Unusual Conditions	None		

INSPECTION ITEM	OBSERVATIONS/DATA	PHOTO	COMMENTS & OTHER DATA
3. DOWNSTREAM SLOPE		19, 20, 23, 24	
3.1 Slope Angle	~ 2 to 2.5 H:1 V		■ In process of widening downstream slope at time of inspection.
3.2 Signs of Erosion	None		
3.3 Signs of Movement (Deformation)	None		
3.4 Cracks	None		
3.5 Seepage or Wet Areas	None		
3.6 Vegetation Growth	None		
3.7 Other Unusual Conditions	Yes		■ Under construction at time of inspection.
4. DOWNSTREAM TOE AREA		24, 25	
4.1 Seepage from Dam	Yes, minor	24, 25	■ Seepage in ditch at toe.
4.2 Signs of Erosion	None		
4.3 Signs of Turbidity in Seepage Water	None	24, 25	
4.4 Discoloration/Staining	None	24, 25	
4.5 Outlet Operating Problem (if applicable)	N/A		
4.6 Other Unusual Conditions	Yes, minor	24, 25	■ Weir damaged by boulder.
5. ABUTMENTS		21, 22	
5.1 Seepage at Contact Zone (abutment/embankment)	None		
5.2 Signs of Erosion	None		
5.3 Excessive Vegetation	No	21, 22	
5.4 Presence of Rodent Burrows	None		
5.5 Other Unusual Conditions	None		
6. RESERVOIR		1, 18	■ Tailings discharge point at north side of impoundment.
6.1 Stability of Slopes	Stable		■ Natural slopes located south of pond.
6.2 Floating Debris	None		
6.3 Other Unusual Conditions	None		
7. EMERGENCY SPILLWAY/ OUTLET STRUCTURE	N/A. Temporary emergency spillway removed near the south abutment of the West Dam in 2017 (prior to site visit)		■ Temporary emergency spillway removed near the south abutment of the West Dam in 2017 (prior to site visit).

INSPECTION ITEM	OBSERVATIONS/DATA	PHOTO	COMMENTS & OTHER DATA
8. INSTRUMENTATION			
8.1 Piezometers	Yes		■ 3 VW piezometers (in standpipe) (each has two depths) on dam crest.
8.2 Settlement Cells	Yes		■ Prisms I to M on dam crest.
8.3 Thermistors	None		
8.4 Survey Monuments	None		
8.5 Accelerograph	None		
8.6 Inclinometer	None		
8.7 Weirs and Flow Monitors	Yes	24, 25	
8.8 Data Logger(s)	Yes		■ VW piezometers included in GHO Geoexplorer monitoring system.
8.9 Other	Yes		■ GPS #313 on barge to monitor pond level.
9. DOCUMENTATION			
9.1 Operation, Maintenance, and Surveillance (OMS) Manual 9.1.1 OMS Manual Exists	Yes		■ GHO (2017) ■ GHO SP&P No. 1543 v3.
9.1.2 OMS Plan reflects current conditions	Yes		
9.1.3 Date of Last Revision	March 2017		
9.2 Emergency Preparedness Plan (EPP) 9.2.1 EPP exists	Yes		■ GHO (2013a) ■ GHO SP&P No. 1583 v0.
9.2.2 EPP reflects current conditions	In the process of being updated.		
9.2.3 Date of Last Revision	31 January 2013		

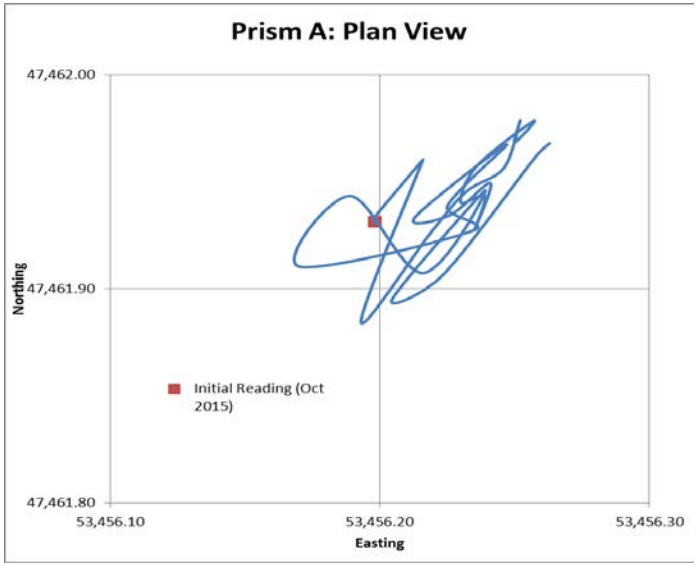
10. NOTES

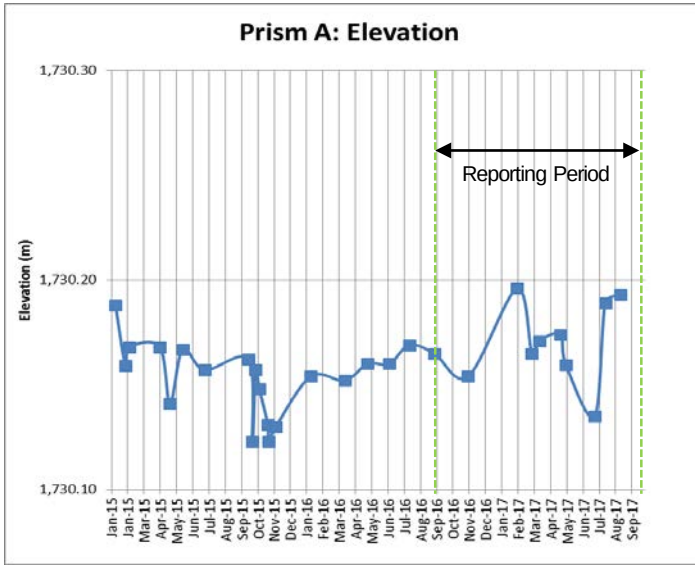
Dam construction underway during dam safety inspection.

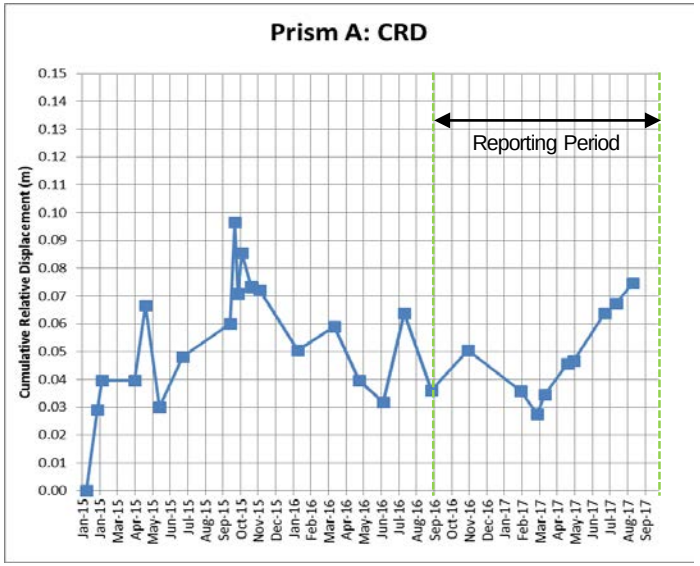
Inspector's Signature		**Date:**	27 March 2018

APPENDIX C

Site C and GPS Monitoring







Initial Reading (Jan 2015)

Readings (2015 to 2017)

CRD = Cumulative Relative Displacement

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PROJECT
2017 GREENHILLS TAILINGS FACILITY
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TITLE
GREENHILLS TAILINGS FACILITY
PRISM A

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
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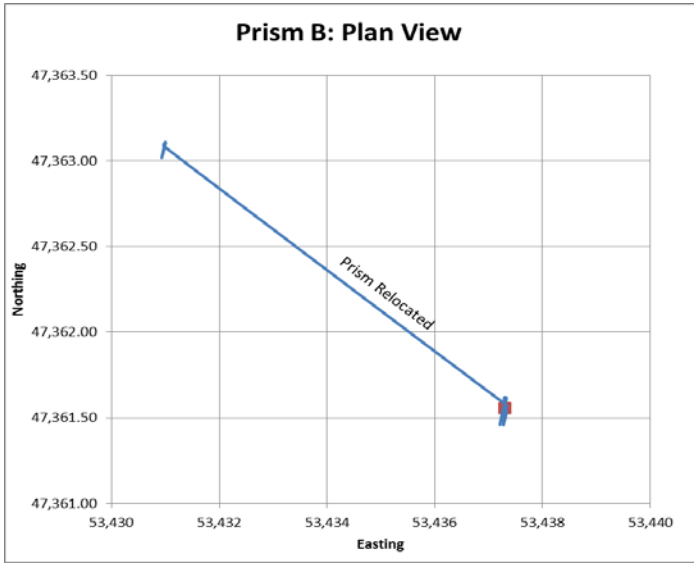

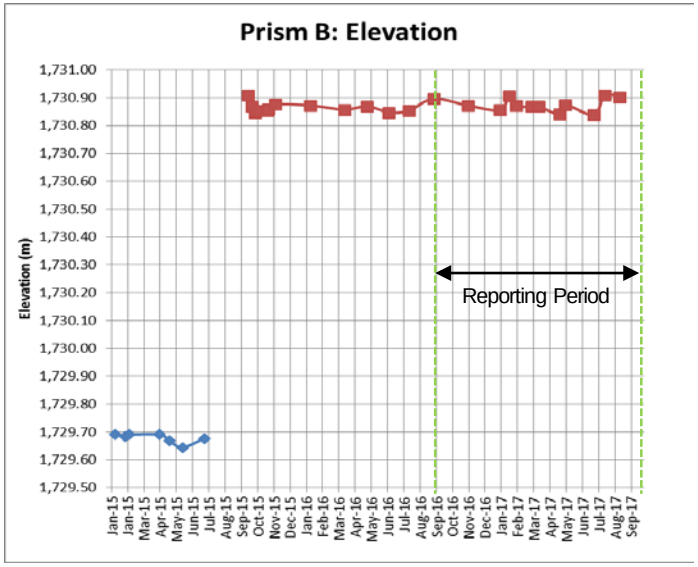

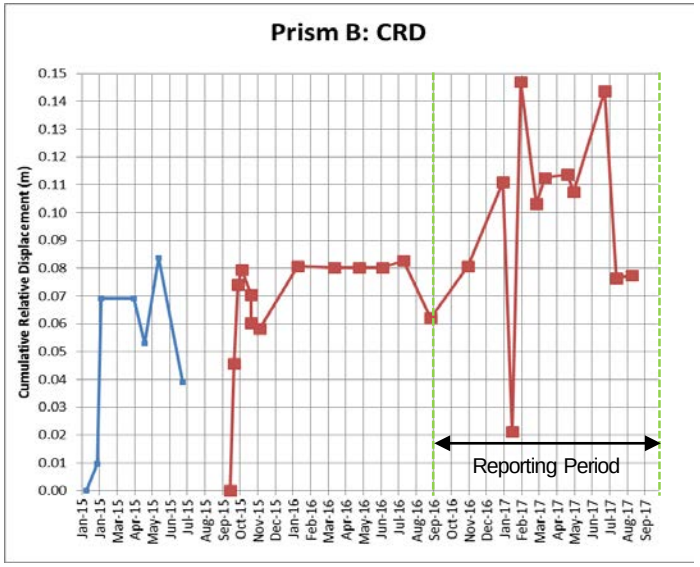

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PRISM B

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
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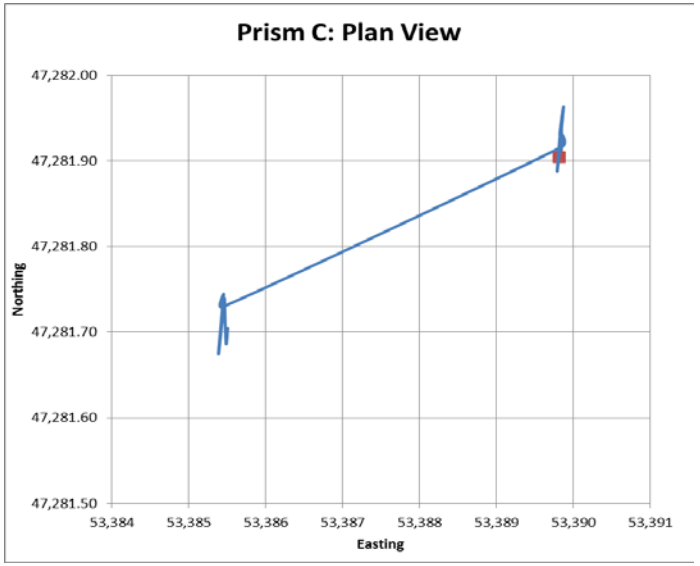

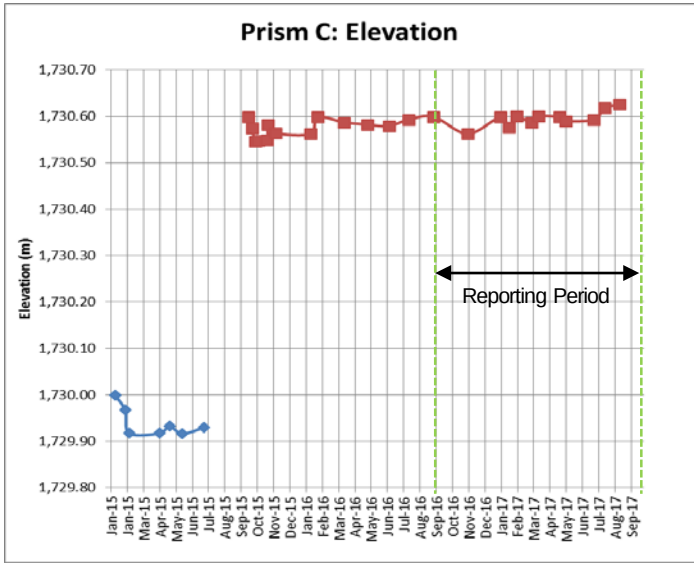

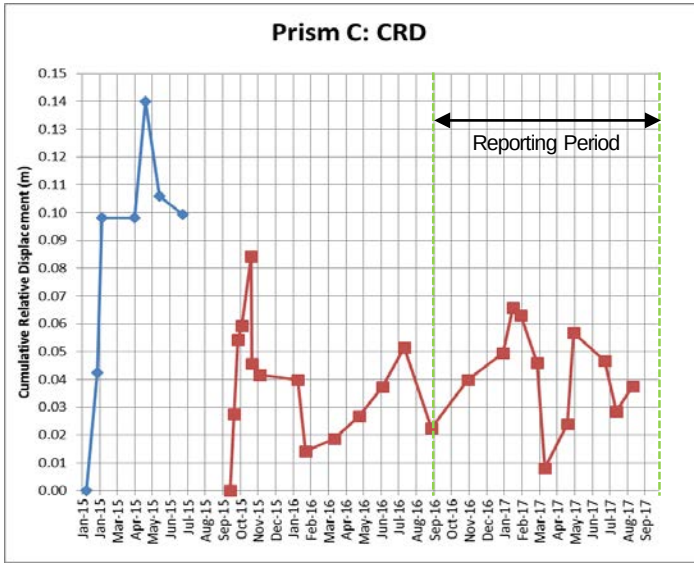

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PRISM C

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
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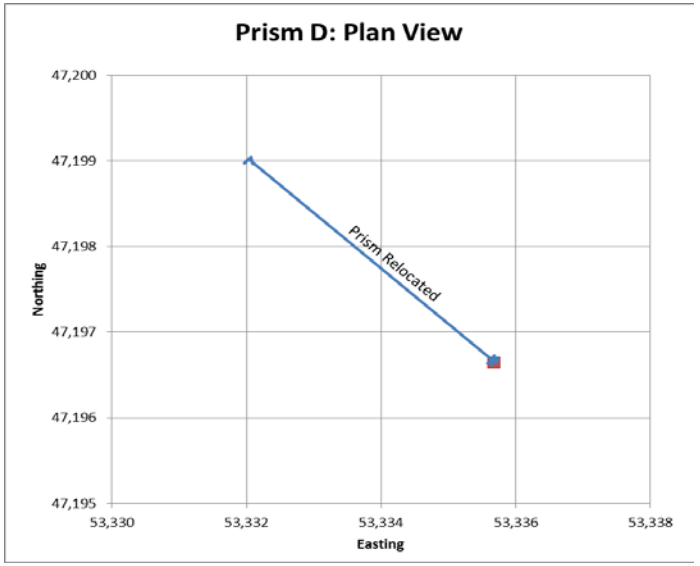

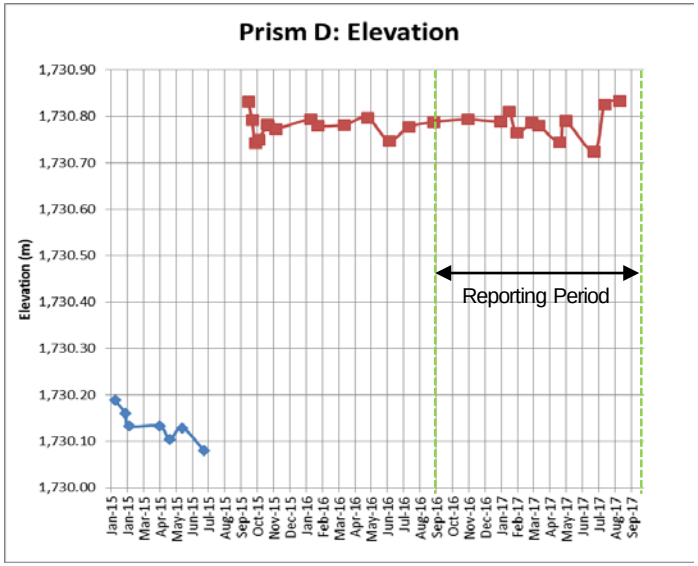

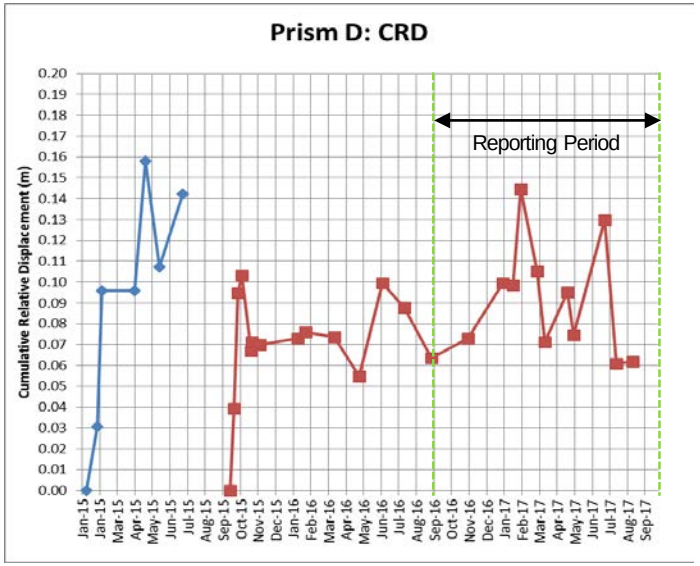

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PRISM D

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
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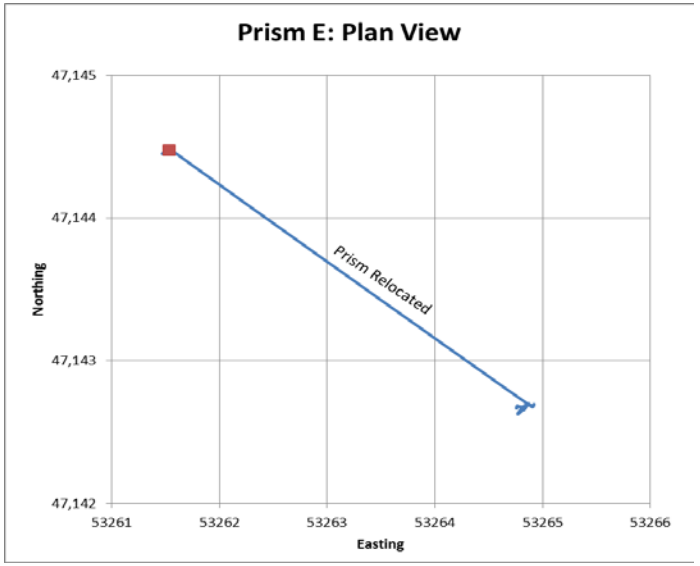

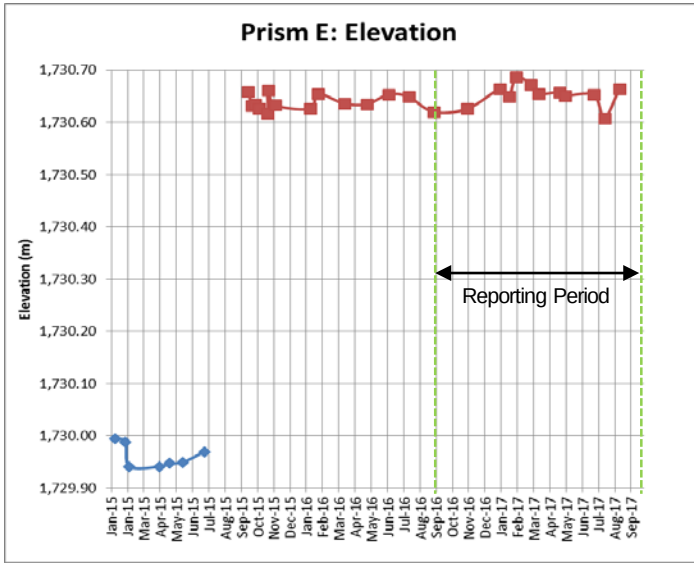

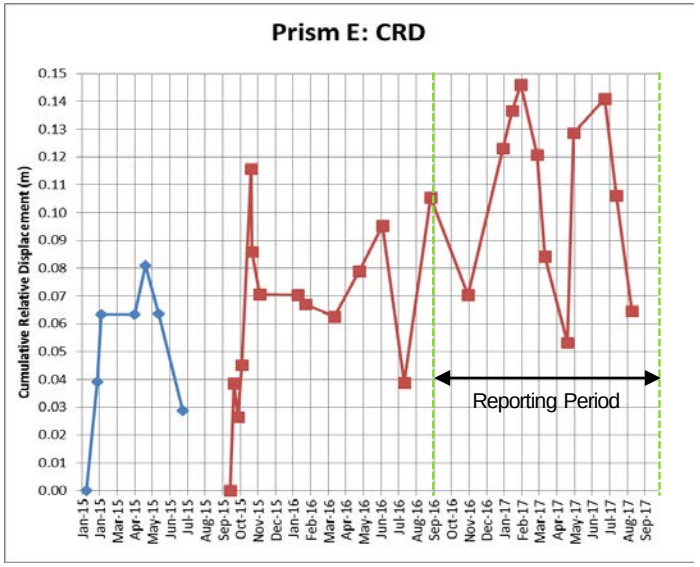

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PRISM E

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
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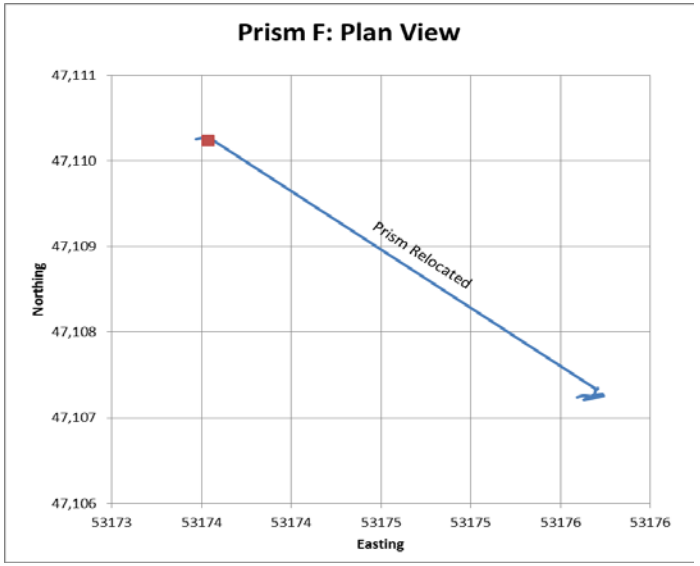

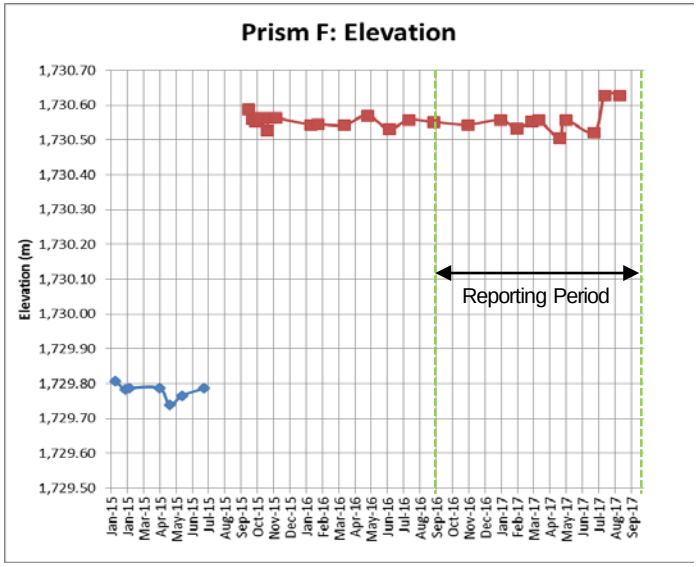

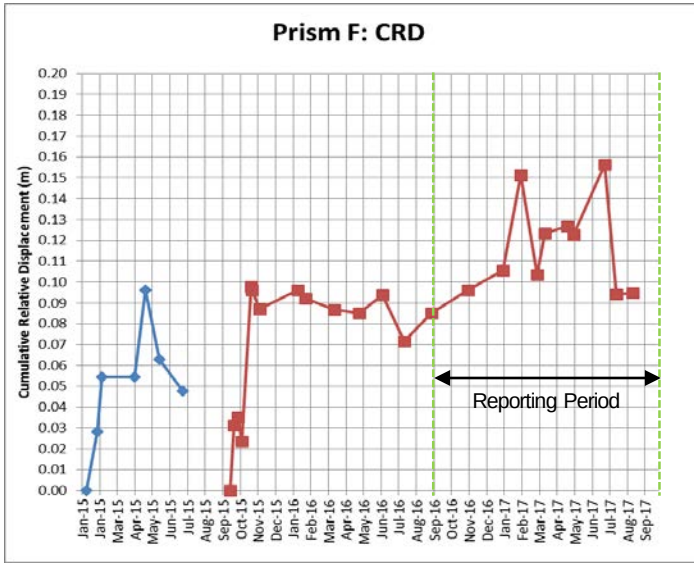

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PRISM F

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
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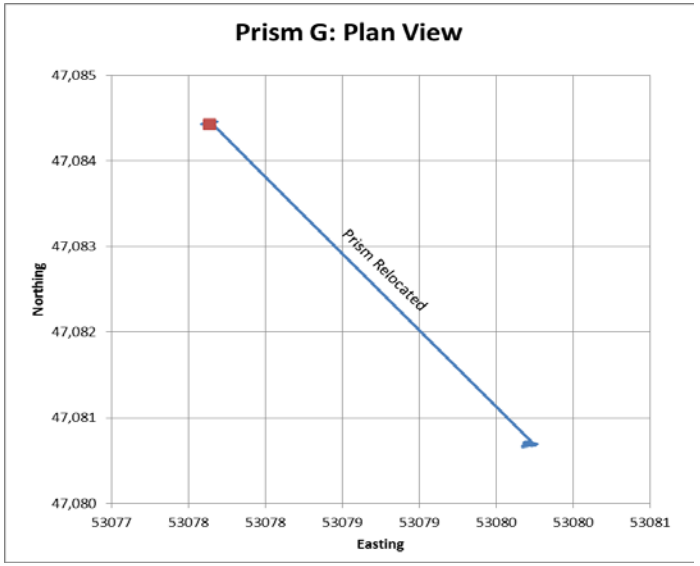

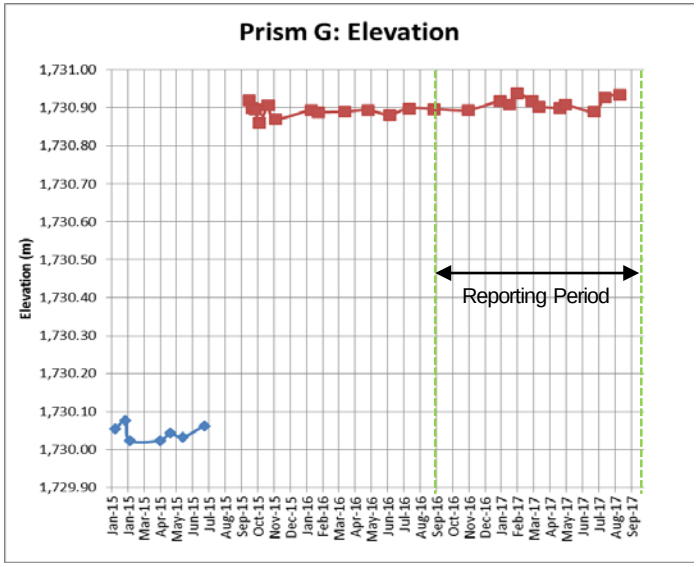

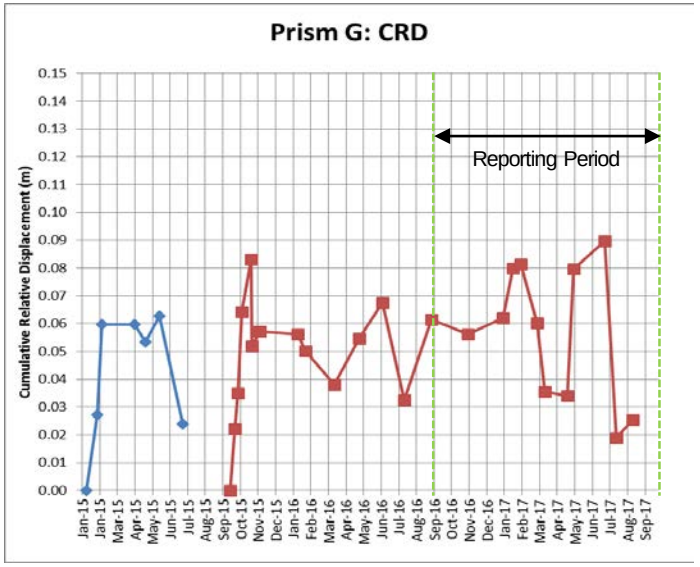

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PRISM G

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
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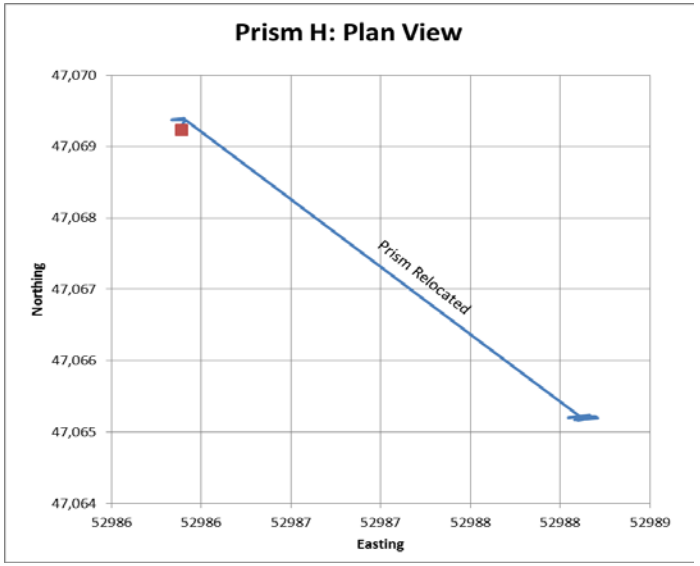

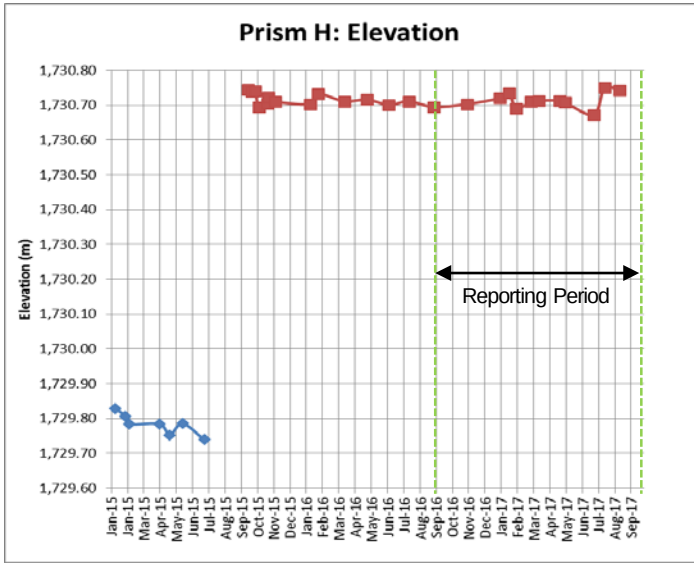

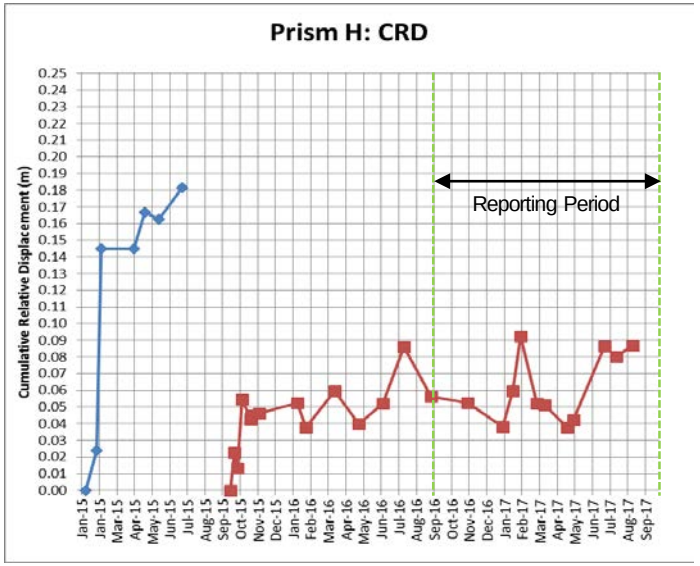

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PRISM H

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
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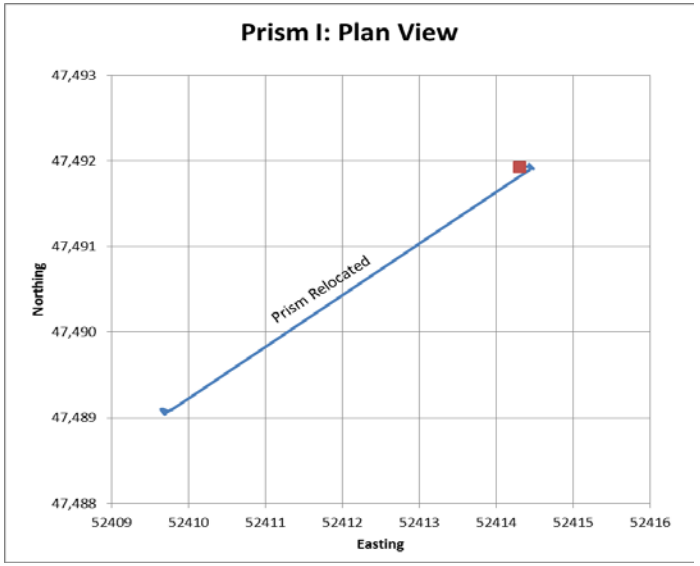

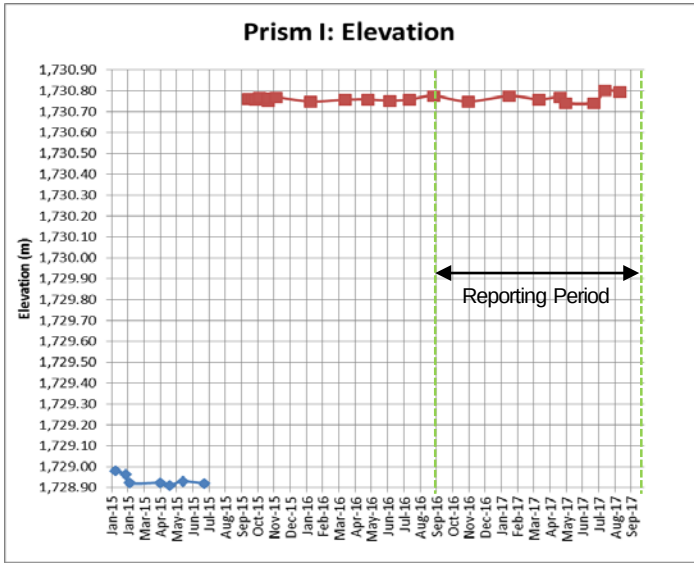

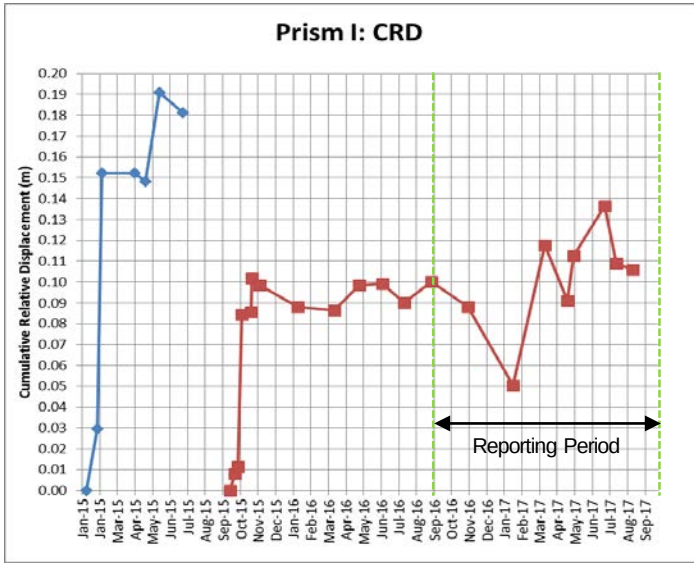

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PRISM I

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
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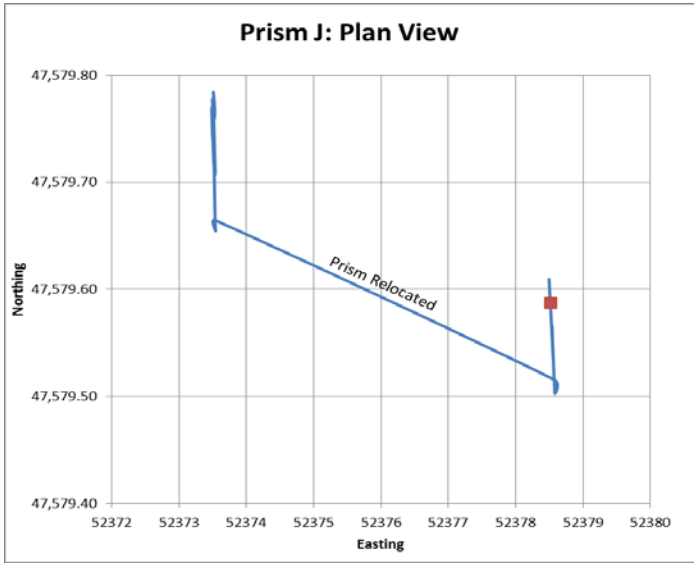

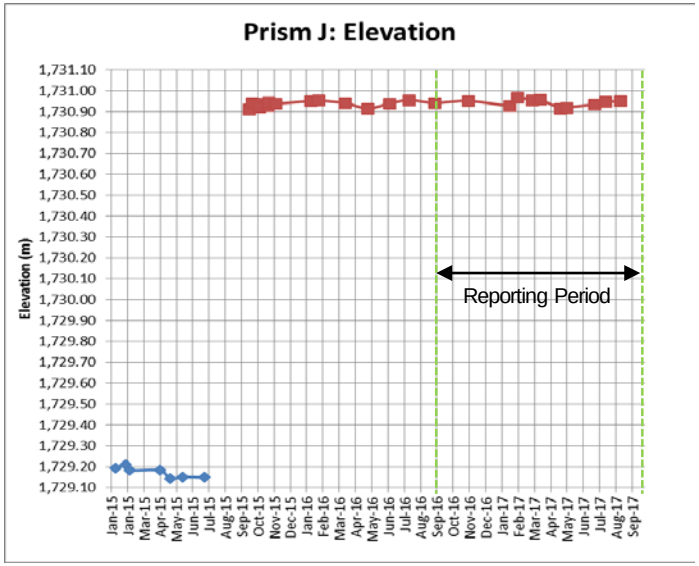

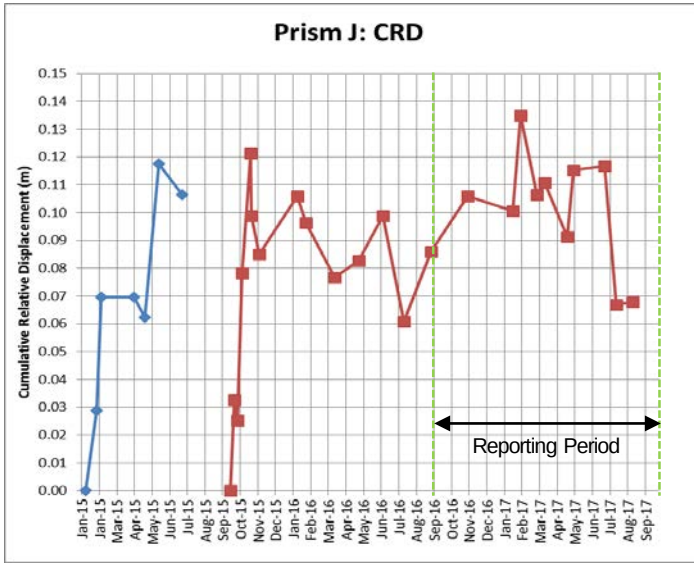

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PRISM J

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
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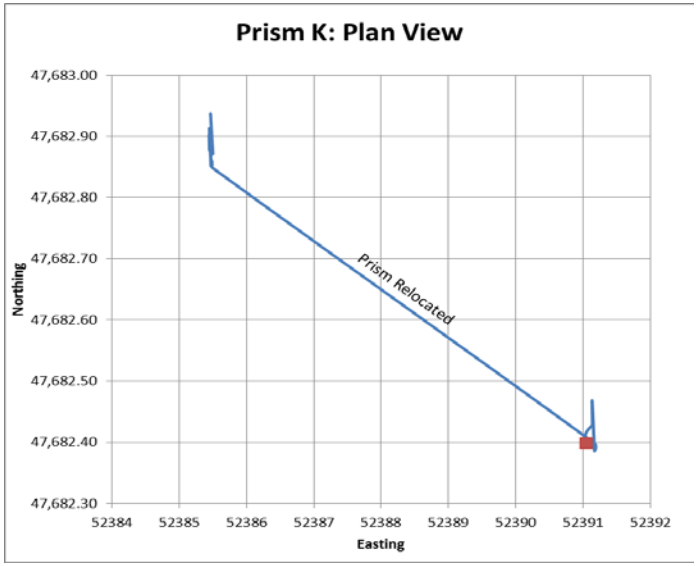

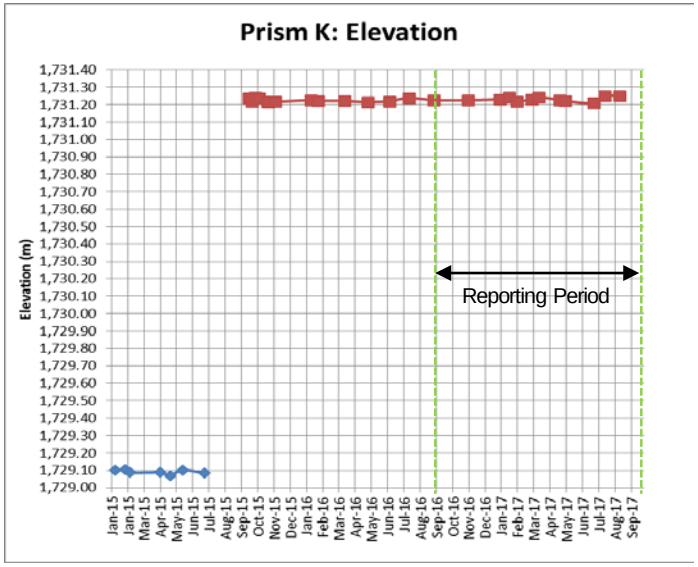

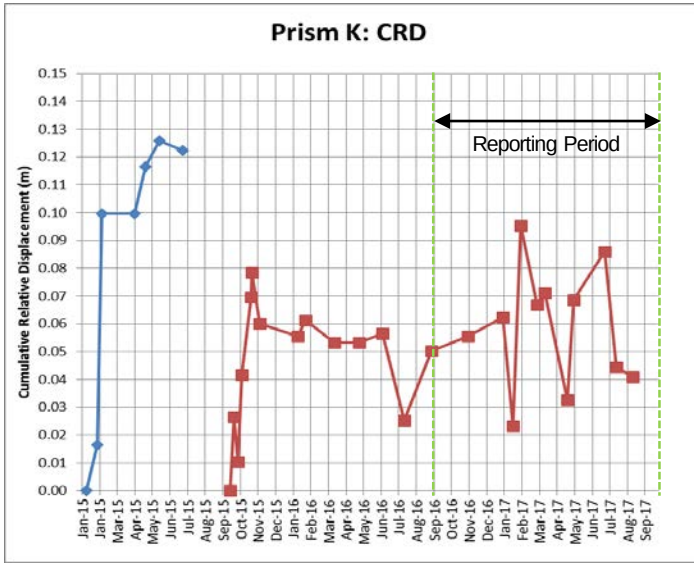

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CRD = Cumulative Relative Displacement

CLIENT
TECK COAL LIMITED
GREENHILLS OPERATIONS
ELKFORD, BC

CONSULTANT

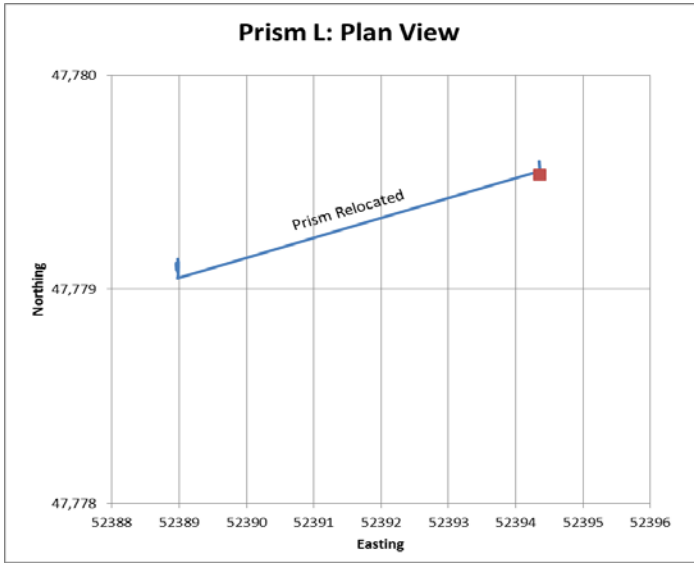
Golder Associates

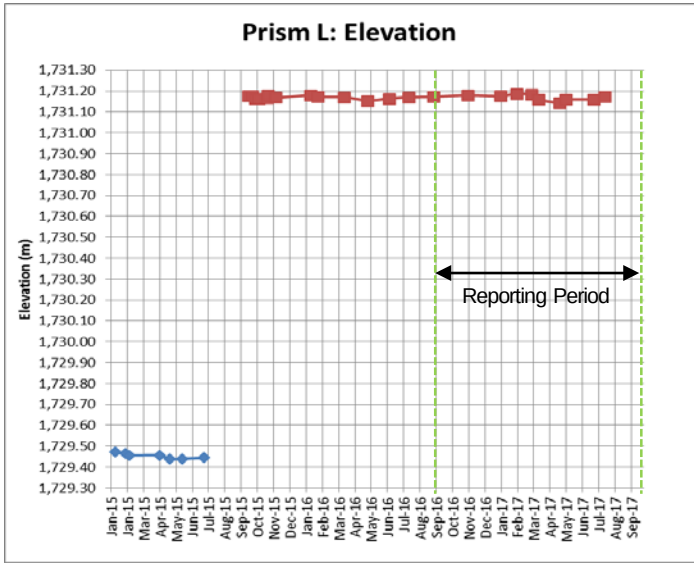
YYYY-MM-DD	2017-10-26
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AJH

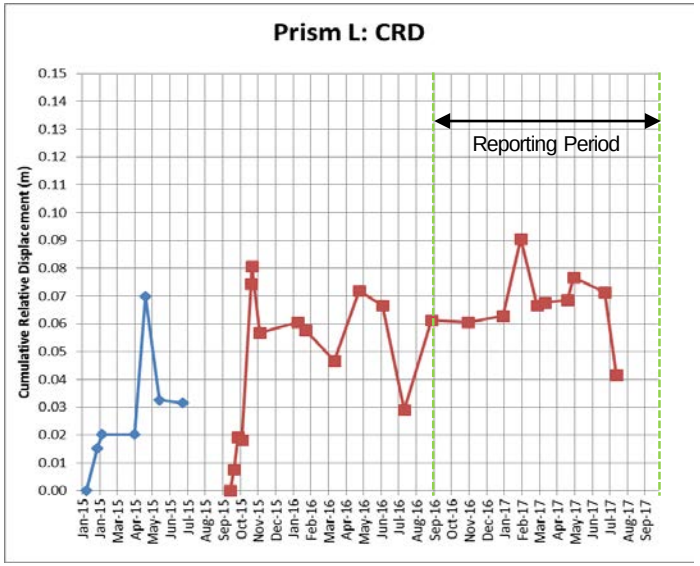
PROJECT
2017 GREENHILLS TAILINGS FACILITY
ANNUAL DAM SAFETY INSPECTION

TITLE
GREENHILLS TAILINGS FACILITY
PRISM K

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
17788487	**2000/2060/2017-130**	**0**	**C-11**







Initial Reading (Jan 2015)

Readings Before Relocation (2015)

Readings After Relocation (2015 to 2017)

CRD = Cumulative Relative Displacement

CLIENT
TECK COAL LIMITED
GREENHILLS OPERATIONS
ELKFORD, BC

CONSULTANT

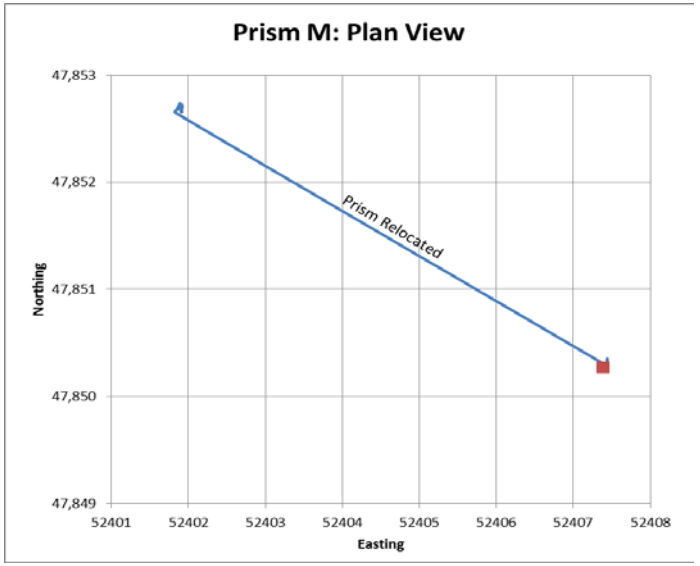
Golder Associates

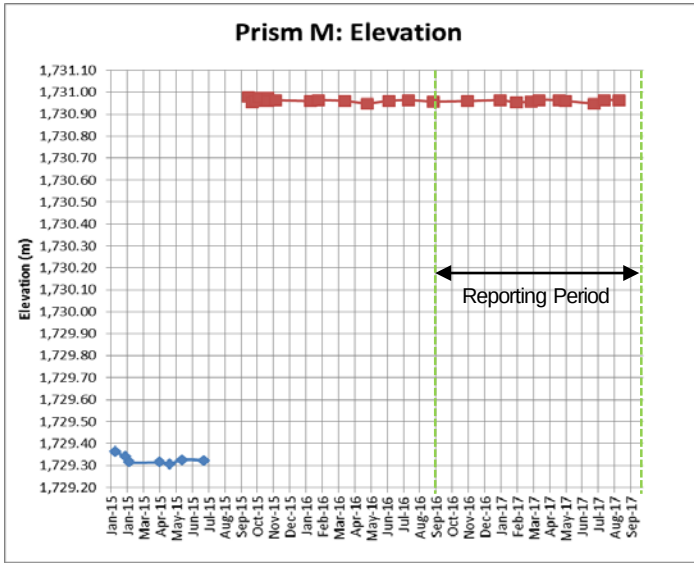
YYYY-MM-DD	2017-10-26
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AJH

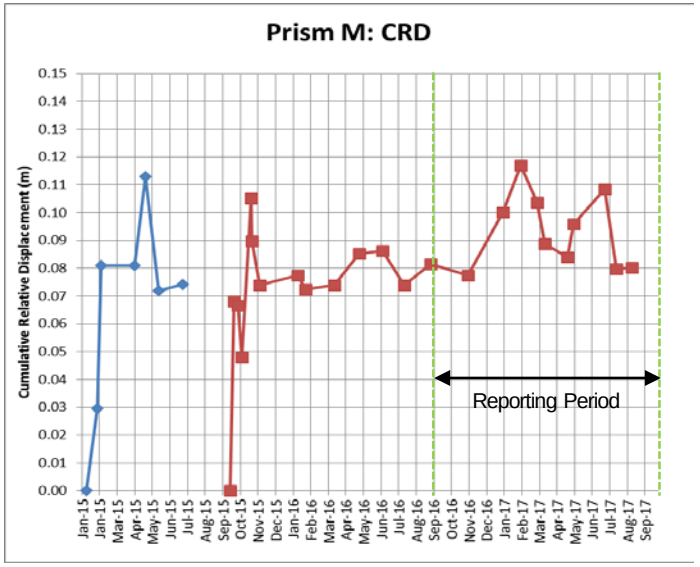
PROJECT
2017 GREENHILLS TAILINGS FACILITY
ANNUAL DAM SAFETY INSPECTION

TITLE
GREENHILLS TAILINGS FACILITY
PRISM L

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
17788487	**2000/2060/2017-130**	**0**	**C-12**







- Initial Reading (Jan 2015)
- Readings Before Relocation (2015)
- Readings After Relocation (2015 to 2017)

CRD = Cumulative Relative Displacement

CLIENT
TECK COAL LIMITED
GREENHILLS OPERATIONS
ELKFORD, BC

CONSULTANT

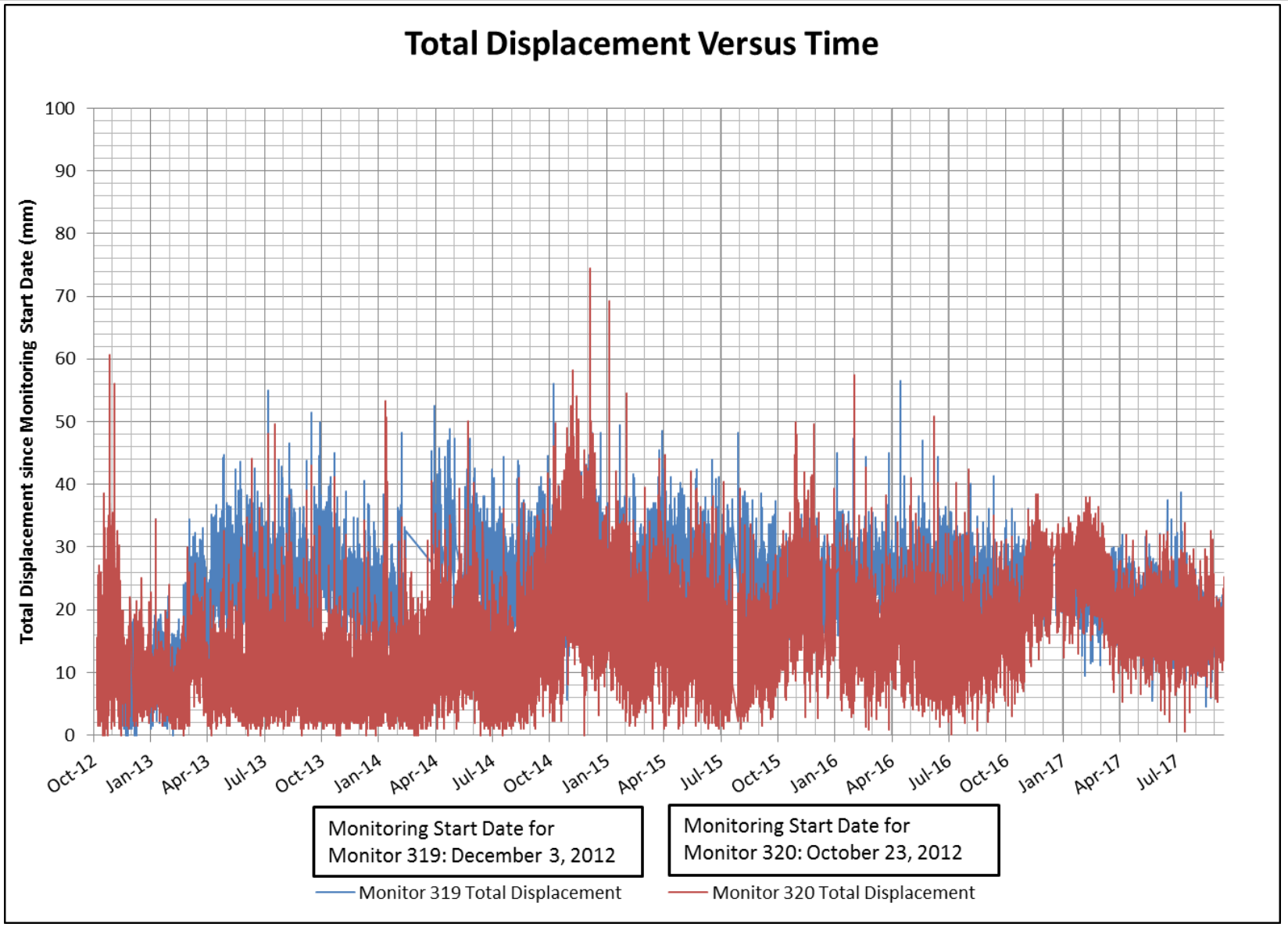
Golder Associates

YYYY-MM-DD	2017-10-26
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AJH

PROJECT
2017 GREENHILLS TAILINGS FACILITY
ANNUAL DAM SAFETY INSPECTION

TITLE
GREENHILLS TAILINGS FACILITY
PRISM M

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
17788487	**2000/2060/2017-130**	**0**	**C-13**



CLIENT
TECK COAL LIMITED
GREENHILLS OPERATIONS
ELKFORD, BC

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-10-26
PREPARED	CTM
DESIGN	CTM
REVIEW	MS
APPROVED	AJH

PROJECT
2017 GREENHILLS TAILINGS FACILITY
ANNUAL DAM SAFETY INSPECTION

TITLE
GREENHILLS TAILINGS FACILITY
GPS 319 & 320

PROJECT No.	Phase/Task/DOC.	Rev.	FIGURE
17788487	**2000/2060/2017-130**	**0**	**C -14**

APPENDIX D

Geotechnical Inspections

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: MARK SLATER

Inspection Type: [X] Routine [ ] Event Driven

Inspection Date: 2016 - 09 - 26

Weather / Visibility: SUNNY / CLEAR — [ ] Raining? [X] Snow Covered?

Inspection Time: 14 : 20

Reviewed By: Reviewer To Sign This Form

Review Date: Y Y Y Y - M M - D D

	Y	N	N/A
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	N/A
Maintenance Work Required?		X	N/A
Repair Log Entry Made?			N/A
Work Order Created?			N/A

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?		X	
Ruts?		X	
Water Ponding?		X	
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	

Estimated Freeboard: 5.0 M

Freeboard - Observations? WL IS LOW

Site C:	Y	N	N/A
New Movement Detected?		X	
Trees Indicating Movement?		X	
Drain Pipe Broken?	X		
Water Not Flowing in Ditch?	X		

V-Notch Weir Reading: 0.1 FA

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	
Site C GPS Physical Issues?		X	
Site C GPS Data Issues?		X	
Changes in GPS Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?		X	
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments:

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?	X		
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		X	
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

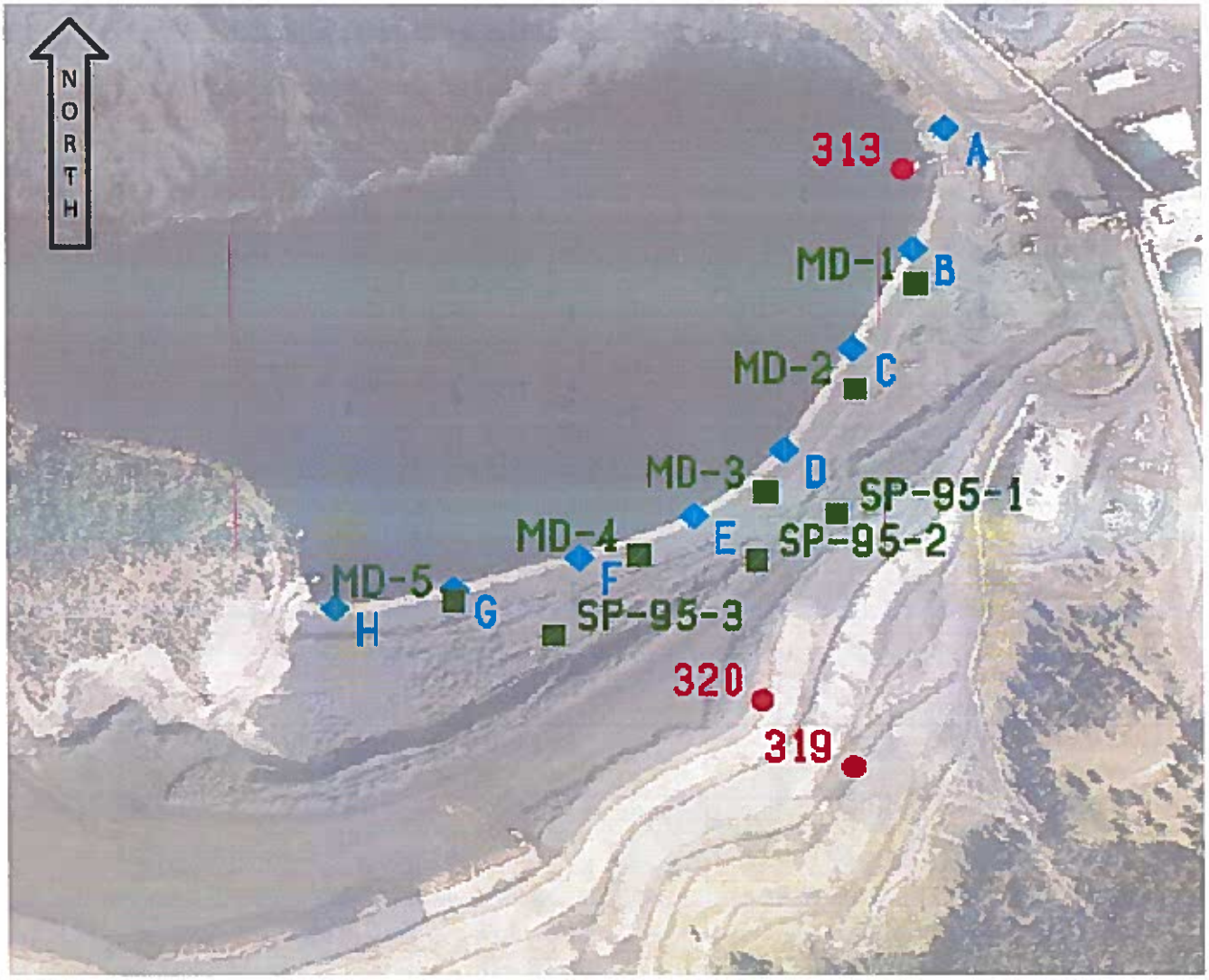
Appearance:

	Y	N	N/A
Environment Notified?			X
Samples Requested?			X

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- SITE C DRAINAGE BROKEN
  - ↳ FOLLOW UP REQUIRED → SITELINK NOTICE
    → WORK ORDER IS OUTSTANDING
- WATER LEVEL IS VERY LOW

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: MARK SLATER

Inspection Date: 2016 - 09 - 26

Inspection Time: 13 : 45

Reviewed By: Reviewer To Sign This Form

Review Date: Y Y Y Y / M M / D D

Inspection Type: [X] Routine [ ] Event Driven

	Y	N
Weather / Visibility: SUNNY / CLEAR — Raining?		X
Snow Covered?		X

From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	N/A
Maintenance Work Required?		X	N/A
Repair Log Entry Made?		X	N/A
Work Order Created?		X	N/A

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?		X	
Ruts?		X	
Water Ponding?		X	
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard: 4 M			
Freeboard - Observations? GOOD			

GH 1 Road:	Y	N	N/A
Signs of Deformation?		X	
Trees Indicating Movement?		X	
Culverts Blocked?		X	
Sediment in Water Flow?		X	
V-Notch Weir Reading: 0.1 M			

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?		X	
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments:

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		X	
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		X	
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

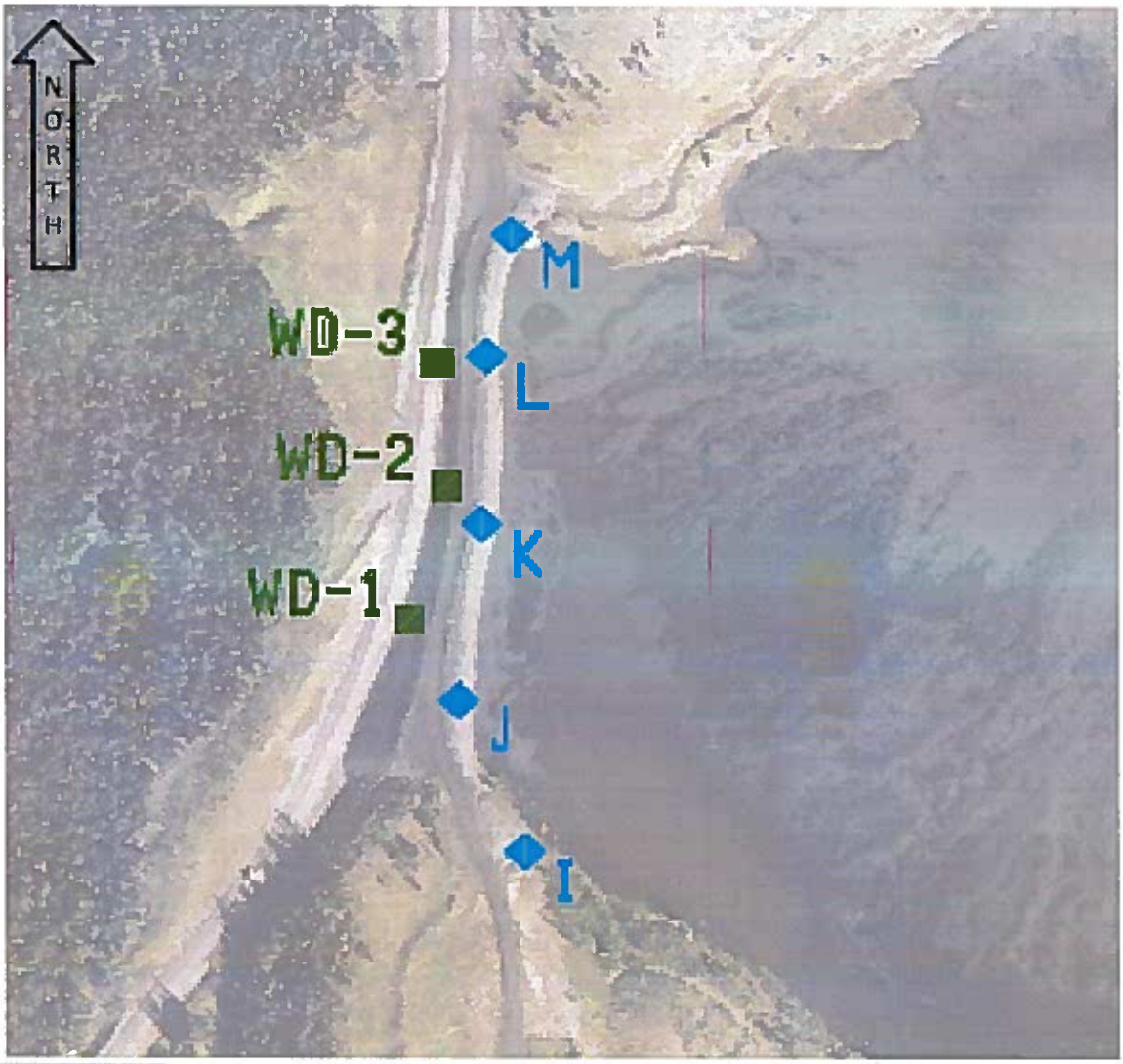
Appearance:

Environment Notified?			X
Samples Requested?			X

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

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* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- CONSTRUCTION FINISHED
  - DEPRESSIONS & EROSION FIXED
  - WEIR FIXED.

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: M. SLAMER

Inspection Date: 2016-10-24 / 2016-11-03

Inspection Time: 09 : 45

Reviewed By: Reviewer To Sign This Form

Review Date: Y Y Y Y - M M - D D

Inspection Type: [X] Routine [ ] Event Driven

Weather / Visibility: CLEAR

	Y	N
Raining?		X
Snow Covered?		X

	Y	N	N/A
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	N/A
Maintenance Work Required?		N	X
Repair Log Entry Made?		N	X
Work Order Created?		N	X

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?		X	
Ruts?		X	
Water Ponding?		X	
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard:	4.5m		
Freeboard - Observations?	GOOD		

Site C:	Y	N	N/A
New Movement Detected?		X	
Trees Indicating Movement?		X	
Drain Pipe Broken?			X
Water Not Flowing in Ditch?			X

V-Notch Weir Reading: N/A

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?	X		
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?			X
Site C GPS Physical Issues?		X	
Site C GPS Data Issues?		X	
Changes in GPS Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?			X
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments: NEED PRISM READINGS FOR NOV.

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?			X
Signs of Erosion?			X
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?			X
Ponded water at the downstream toe?			X
Observed Piping?			X

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

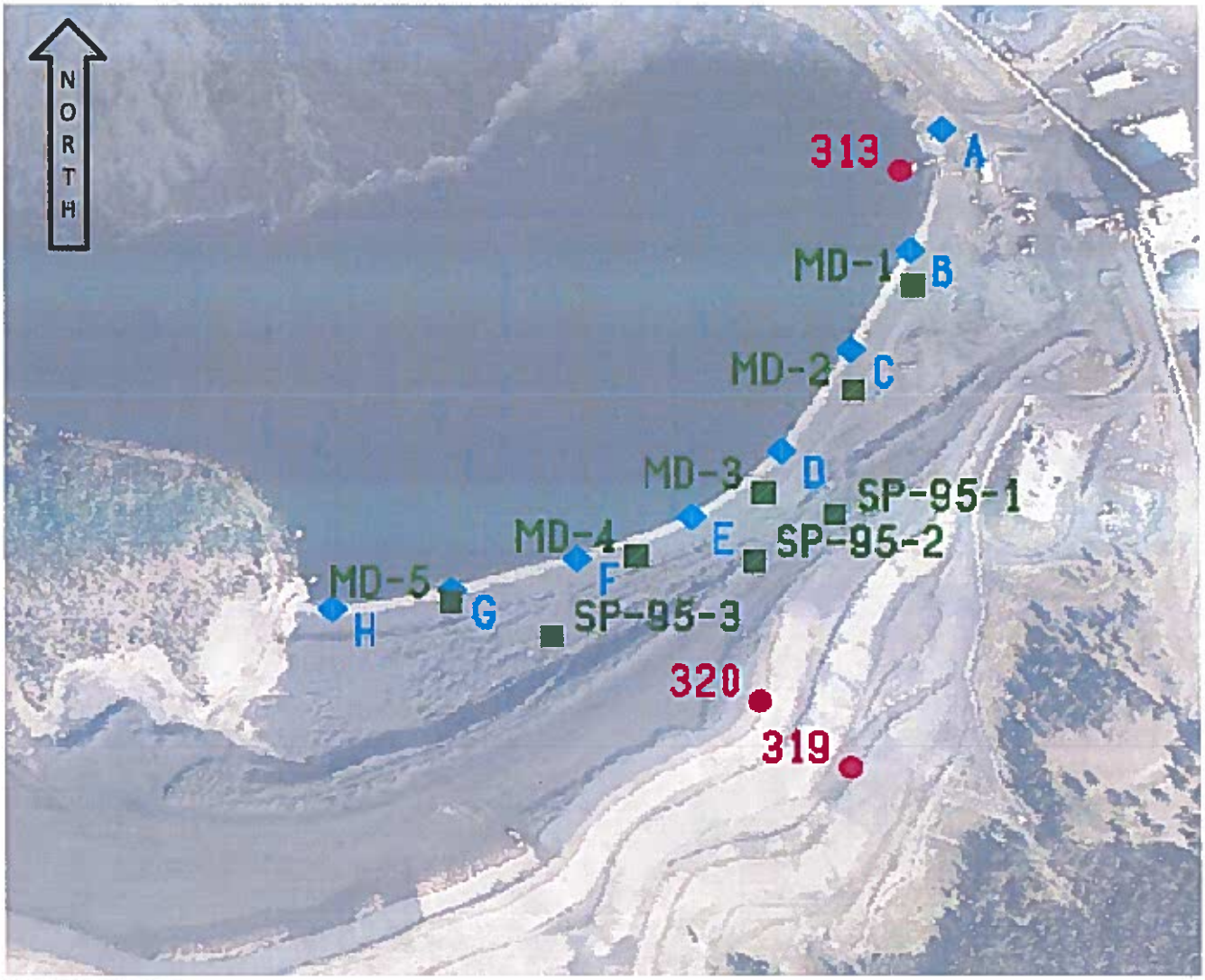
Appearance:

	Y	N	N/A
Environment Notified?			X
Samples Requested?			X

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

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* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- INSPECTION STARTED ON OCT 24 & FINISHED W/ PHOTO NOV 3.

- NO ACCESS TO SITE C DRAIN DUE TO EROSION ON ROAD & DAM DRILLING PROJECT.

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: M. SLATER

Inspection Type: [X] Routine [ ] Event Driven

Inspection Date: 2016-10/24 / 2016-11-03

Weather / Visibility: CLEAR — Raining? [ ] Y [X] N; Snow Covered? [ ] Y [X] N

Inspection Time: 09 : 20

Reviewed By: Reviewer To Sign This Form

Review Date: Y Y Y Y M M D D

	Y	N	
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	
Maintenance Work Required?			X
Repair Log Entry Made?			X
Work Order Created?			X

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?		X	
Ruts?		X	
Water Ponding?	X		
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard:	~ 5 M		Units
Freeboard - Observations?	MORE THAN NEEDED		

GH 1 Road:	Y	N	N/A
Signs of Deformation?		X	
Trees Indicating Movement?		X	
Culverts Blocked?		X	
Sediment in Water Flow?		X	
V-Notch Weir Reading:	Reading		Units

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?	X		
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?			X

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?			X
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments: * NEED PRISM READINGS FOR NOVEMBER.

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		X	
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		X	
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

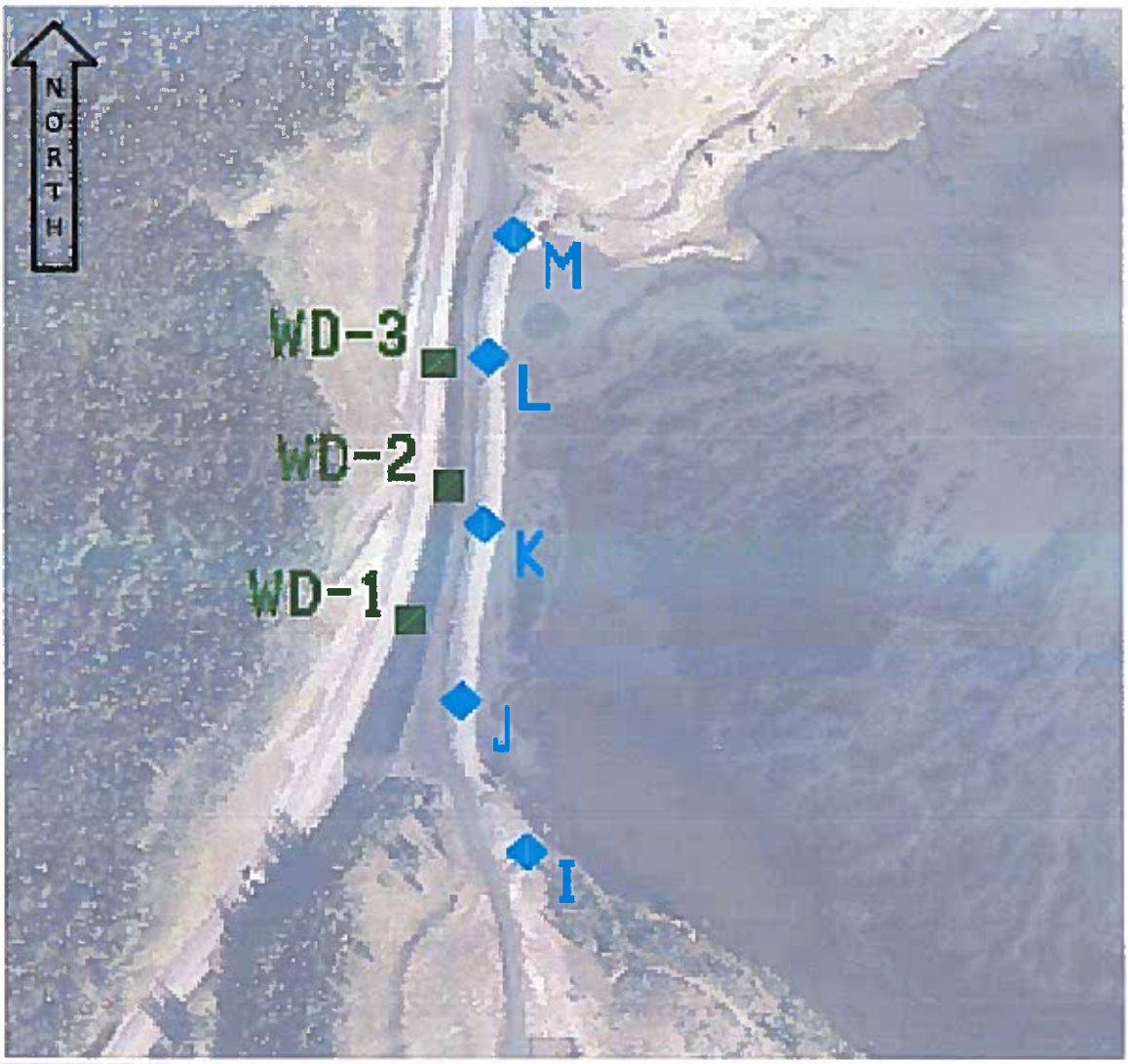
Appearance:

	Y	N	N/A
Environment Notified?			X
Samples Requested?			X

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

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* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- EROSION SCAR UNDER PIEZO WD-1 → TOP DRESSED BY PLANT UP S
  ↳ WILL OBSERVE SCAR ON D/S SLOPE OVER WINTER

- SLIGHT LOW SPOT BTW PRISMS K-L → PONDS FLOWING.

* INSPECTION STARTED 6:17 & COMPLETED W/ PHOTOS @ NOV 3

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: M. SLATER

Inspection Type: [X] Routine [ ] Event Driven

Inspection Date: 2016 - 11 - 25

Weather / Visibility: CLEAR — Raining? Y [ ] N [X]; Snow Covered? Y [X] N [ ]

Inspection Time: 10 : 30

Reviewed By: Reviewer To Sign This Form

Review Date: Y Y Y Y - M M - D D

From this inspection, is this dam safe? Y [X] N [ ]

Siteline Notification Required? Y [ ] N [X] N/A [ ]

Maintenance Work Required? Y [ ] N [ ] N/A [X]

Repair Log Entry Made? Y [ ] N [ ] N/A [X]

Work Order Created? Y [ ] N [ ] N/A [X]

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?		X	
Ruts?		X	
Water Ponding?		X	
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	

Estimated Freeboard: 5.0 M Units

Freeboard - Observations? GOOD.

Site C:	Y	N	N/A
New Movement Detected?			X
Trees Indicating Movement?			X
Drain Pipe Broken?			X
Water Not Flowing in Ditch?			X

V-Notch Weir Reading: N/A. In

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	
Site C GPS Physical Issues?		X	
Site C GPS Data Issues?		X	
Changes in GPS Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?			X
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments: PRISM READINGS IN NOV. LOOK GOOD.

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		X	
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		X	
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

Appearance:

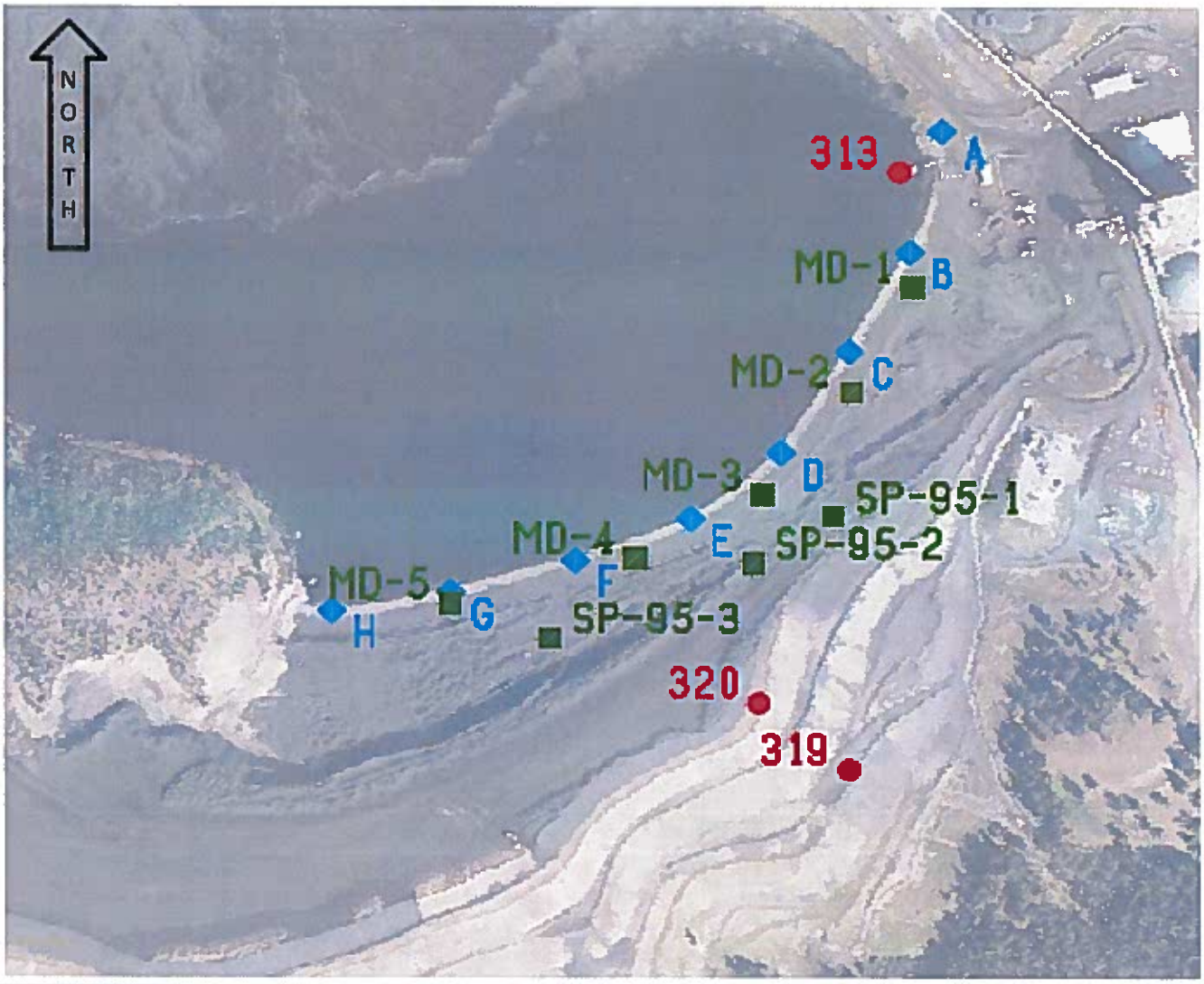
Environment Notified? Y [ ] N [ ] N/A [X]

Samples Requested? Y [ ] N [X]

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

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* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

* NO ACCESS BELOW DUE TO SNOW.

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: M SCATER

Inspection Date: 2016 - 11 - 28

Inspection Time: 10 : 15

Reviewed By: Reviewer To Sign This Form

Review Date: Y Y Y Y - M M - D D

Inspection Type: [X] Routine [ ] Event Driven

Weather / Visibility: CLEAR

	Y	N	
Raining?		X	
Snow Covered?	X		

From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	N/A
Maintenance Work Required?		X	
Repair Log Entry Made?			X
Work Order Created?			X

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?		X	
Ruts?		X	
Water Ponding?		X	
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard:	4.5 m		
Freeboard - Observations?	GREAT.		

GH 1 Road:	Y	N	N/A
Signs of Deformation?		X	
Trees Indicating Movement?		X	
Culverts Blocked?		X	
Sediment in Water Flow?		X	
V-Notch Weir Reading:	0.13 Ft.		

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?		N	X
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		N	X

Comments: READINGS MID-NOV. LOOK GOOD.

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		X	
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		X	
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

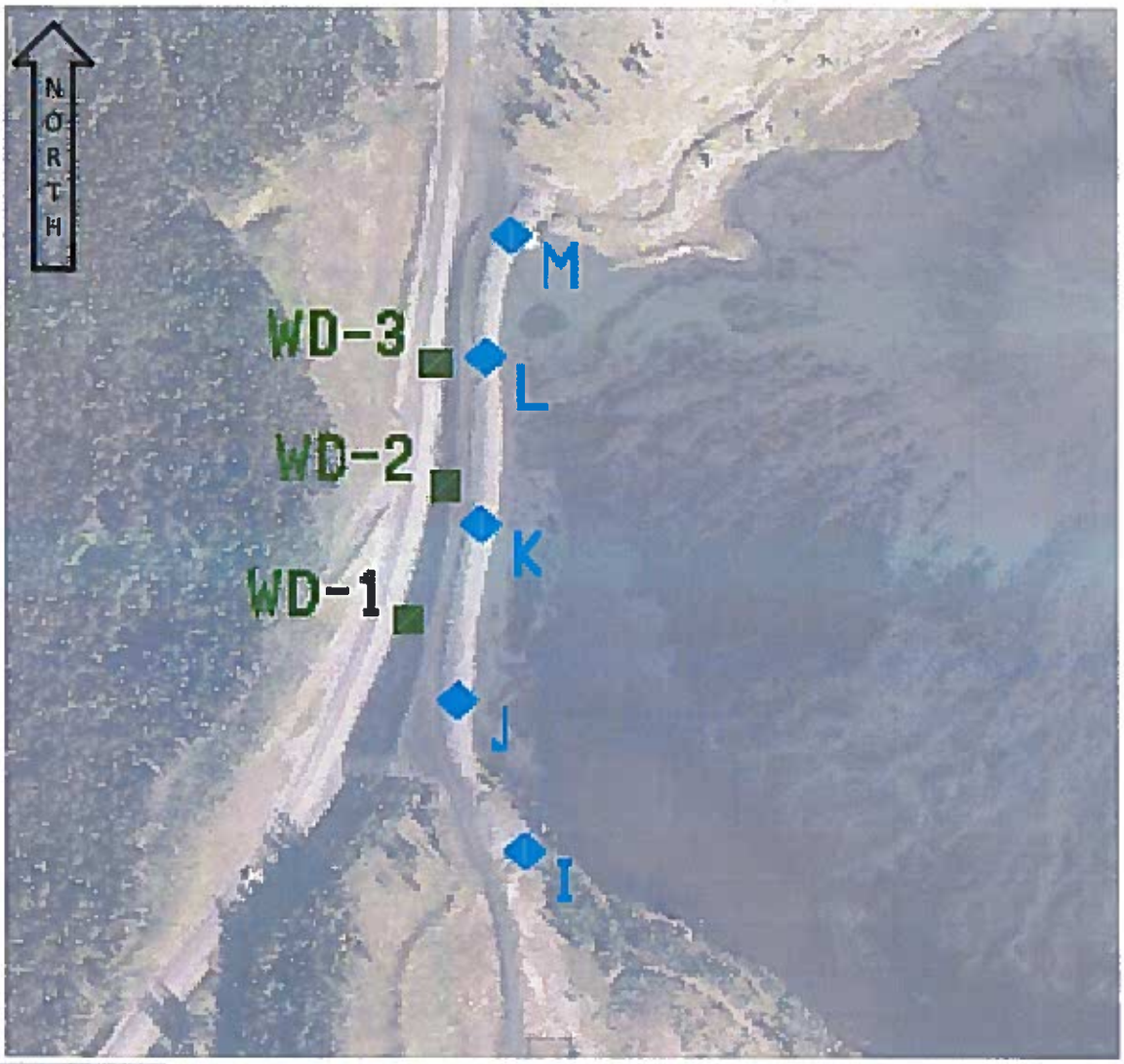
Appearance:

	Y	N	N/A
Environment Notified?			X
Samples Requested?			X

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



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Comments, Notes or Deficiencies Found:

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: MARK SLATER

Inspection Date: 2016-12-28

Inspection Time: 11:00

Reviewed By: Reviewer To Sign This Form

Review Date: YYYY-MM-DD

Inspection Type: [X] Routine [ ] Event Driven

Weather / Visibility: CLEAR

	Y	N
Raining?		X
Snow Covered?	X	

	Y	N	N/A
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	
Maintenance Work Required?			X
Repair Log Entry Made?			X
Work Order Created?			X

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?			X
Settlement?			X
Depressions / Sinkholes?			X
Ruts?			X
Water Ponding?			X
Surface Protection Issues?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard:	6+ M		
Freeboard - Observations?	FROZEN SNOW COVERED.		

Site C:	Y	N	N/A
New Movement Detected?			X
Trees Indicating Movement?			X
Drain Pipe Broken?			X
Water Not Flowing in Ditch?			X
V-Notch Weir Reading:	SNOW COVERED		

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	
Site C GPS Physical Issues?		X	
Site C GPS Data Issues?		X	
Changes in GPS Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?		X	
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments:

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?			X
Signs of Erosion?			X
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?			X
Ponded water at the downstream toe?			X
Observed Piping?			X

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

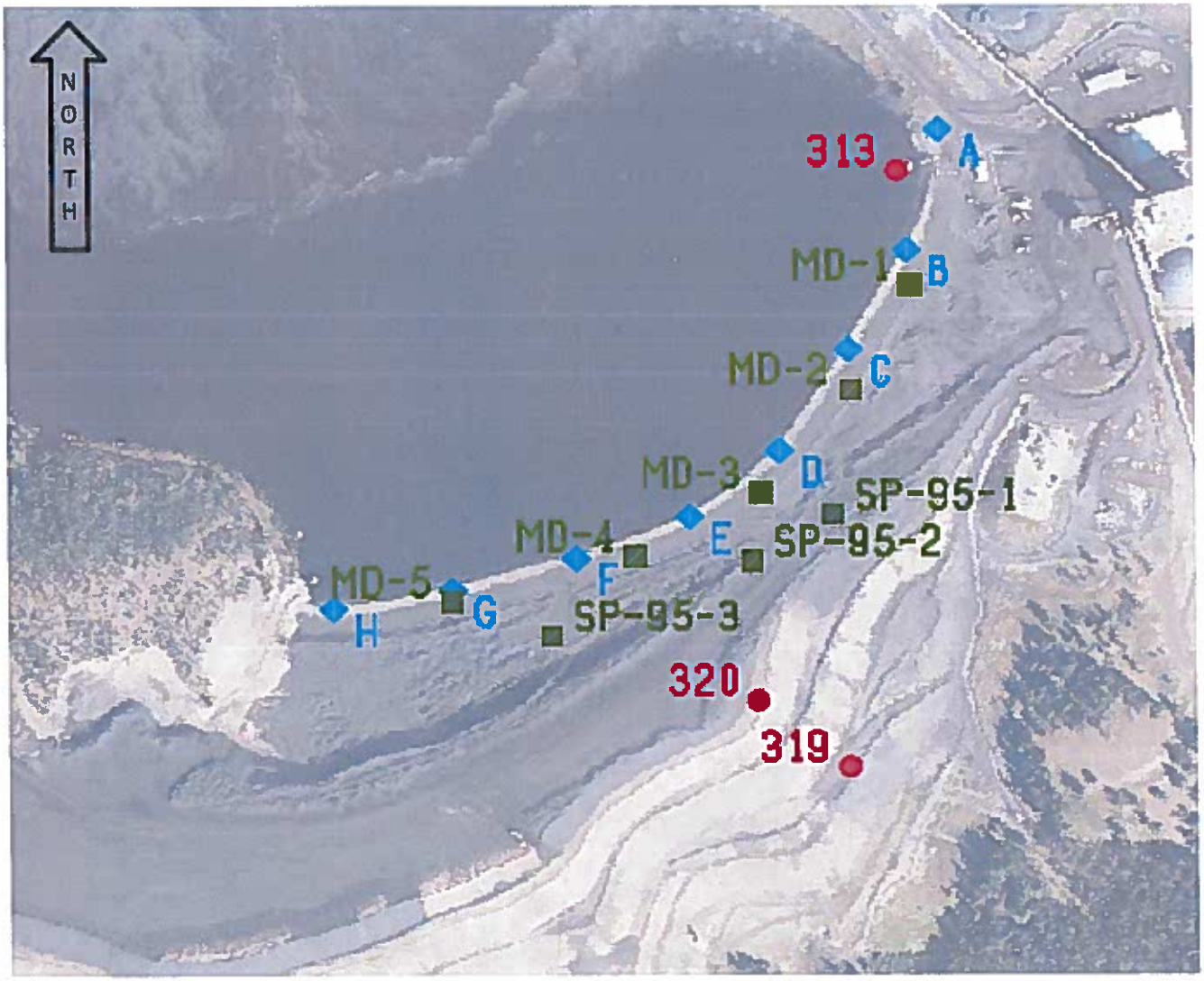
Appearance:

Environment Notified?			X
Samples Requested?			X

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



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Comments, Notes or Deficiencies Found:

-SNOW COVERED -> NO ACCESS TO WEIR
1) WEIR IS SNOW COVERED.

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: MARK SLATER

Inspection Date: 2016 - 12 - 28

Inspection Time: 10 : 30

Reviewed By: Reviewer To Sign This Form

Review Date: Y Y Y Y - M M - D D

Inspection Type: [X] Routine [ ] Event Driven

Weather / Visibility: CLEAR

	Y	N
Raining?		X
Snow Covered?	X	

	Y	N	N/A
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	
Maintenance Work Required?		N	X
Repair Log Entry Made?		N	X
Work Order Created?		N	X

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?			X
Settlement?			X
Depressions / Sinkholes?			X
Ruts?			X
Water Ponding?			X
Surface Protection Issues?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard:	5+ M		Units
Freeboard - Observations?	FROZEN / SNOW COVERED.		

GH 1 Road:	Y	N	N/A
Signs of Deformation?		X	
Trees Indicating Movement?		X	
Culverts Blocked?		X	
Sediment in Water Flow?		X	
V-Notch Weir Reading:	N/A → SNOW		

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?			X
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments:

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?			X
Signs of Erosion?			X
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?			X
Ponded water at the downstream toe?			X
Observed Piping?			X

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

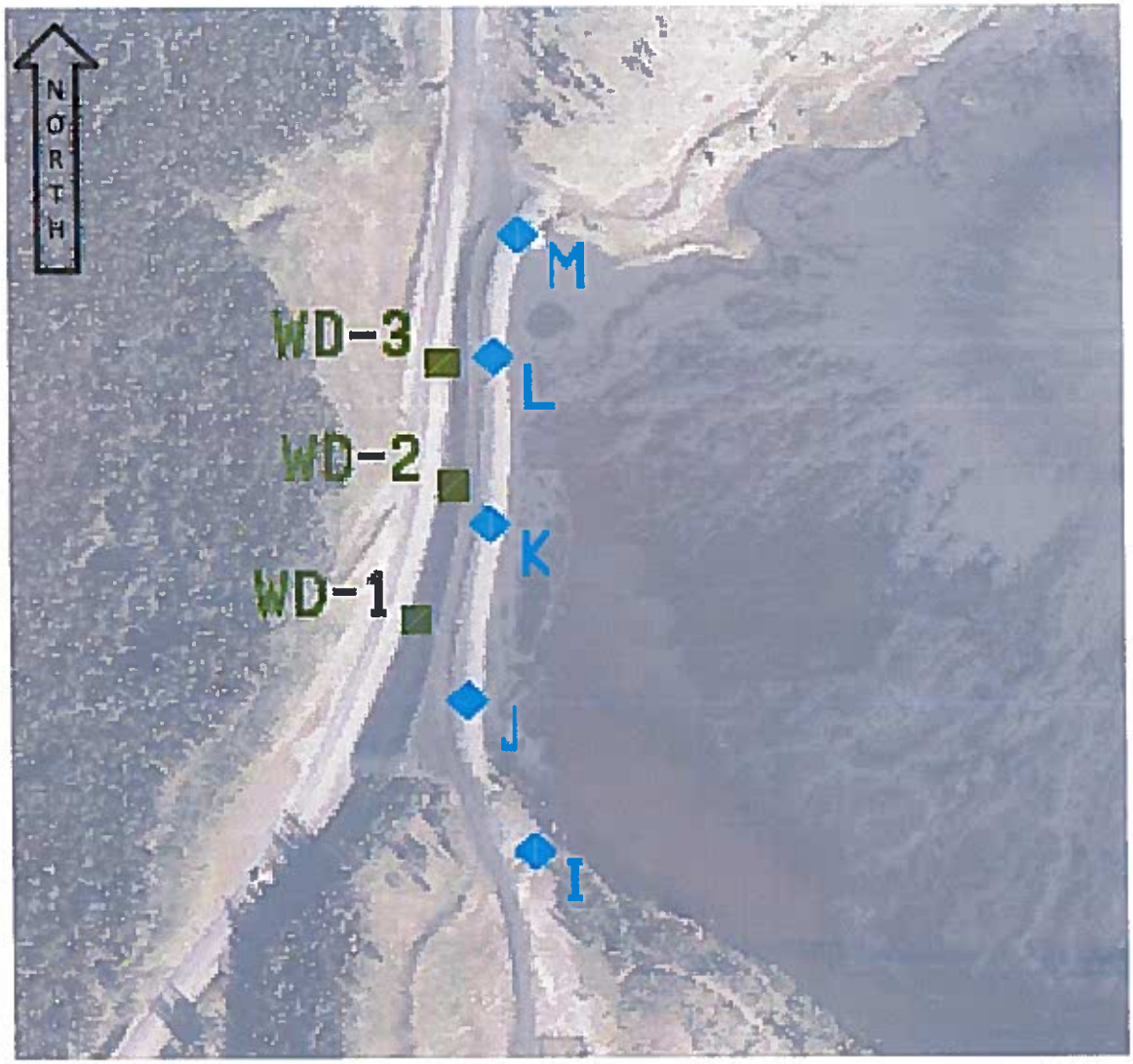
Appearance:

	Y	N	N/A
Environment Notified?			X
Samples Requested?			X

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



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Comments, Notes or Deficiencies Found:

- SNOW COVERED. → NO WATER READINGS.

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider & Brad Leconte

Inspection Type: [X] Routine [ ] Event Driven

Inspection Date: 2017-01-25

Weather / Visibility: -3, cloudy

Raining? [ ] Y [X] N

Snow Covered? [X] Y [ ] N

Inspection Time: 2:30

Reviewed By: Mark Slater

Review Date: 2017-01-31

	Y	N	N/A
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	N/A
Maintenance Work Required?		X	N/A
Repair Log Entry Made?		X	N/A
Work Order Created?		Y	N/A

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?		X	
Ruts?		X	
Water Ponding?		X	
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	

Estimated Freeboard: 5+m Units

Freeboard - Observations? snow covered

Site C: not visited	Y	N	N/A
New Movement Detected?			
Trees Indicating Movement?			
Drain Pipe Broken?			
Water Not Flowing in Ditch?			

V-Notch Weir Reading: Rate Unit

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?			X
Changes in Prism Data Trend?			X
Site C GPS Physical Issues?		X	
Site C GPS Data Issues?		X	
Changes in GPS Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?		X	
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments: No new prism data since Nov 2/16, trend consistent up to then; No reading on MD-2A since 1/17/13 - box being upgraded; MD 2B, 3B, 5A, 5B not functioning (no change)

Downstream Toe and Seepage: not visited.	Y	N	N/A
Wet areas or seepage on downstream slope/toe?			
Signs of Erosion?			
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?			
Ponded water at the downstream toe?			
Observed Piping?			

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

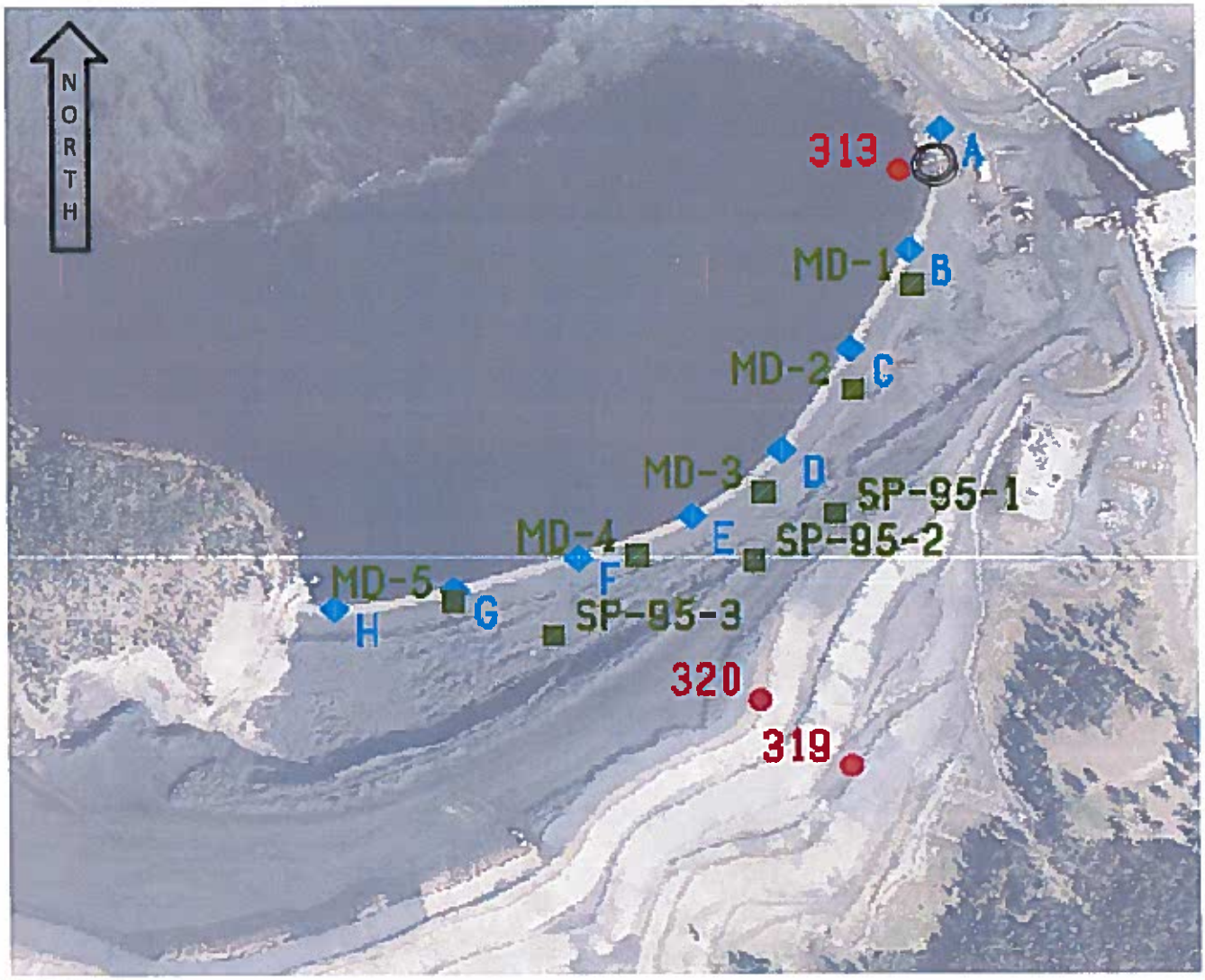
Appearance:

	Y	N	N/A
Environment Notified?			
Samples Requested?			

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



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Comments, Notes or Deficiencies Found:

→ ice building up beneath pipeline / walkway to barge; due to water leaking from pipeline; no immediate concern but continue to monitor as possible to cause erosion come spring/summer; photo taken

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider & Brad Lecomte

Inspection Type: [X] Routine [ ] Event Driven

Inspection Date: 2017-01-25

Inspection Time: 2:30

Weather / Visibility: -3°C, Cloudy

Raining? Y [ ] N [X]

Snow Covered? Y [X] N [ ]

Reviewed By: Mark Slater

Review Date: 2017-01-31

	Y	N	N/A
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	
Maintenance Work Required?		X	
Repair Log Entry Made?		X	
Work Order Created?		X	

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?			X
Settlement?			X
Depressions / Sinkholes?			X
Ruts?			X
Water Ponding?			X
Surface Protection Issues?			X
Concerning Vegetation?		X	
Animal Burrows?			X
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard:	low		Units
Freeboard - Observations?	snow covered		

GH 1 Road:	Y	N	N/A
Signs of Deformation?		X	
Trees Indicating Movement?		X	
Culverts Blocked?		X	
Sediment in Water Flow?		X	
V-Notch Weir Reading:	0.0		Unit

Upstream Slope:	Y	N	N/A
Slope Stability Issues?			X
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?		X	
Animal Burrows?			X
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?			X
Changes in Prism Data Trend?			X

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?			X
Manual Readings Taken?		X	
Piezometer Data Issues?			
Changes in Piezo Data Trend?			

Comments: west dam weir should be cleared of rock/debris; no new prism data since Nov 2/16, consistent to then; piezo data gap from 1/18 - 1/24 due to Geoexplorer/box upgrades

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		X	
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		X	
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map: not observed.

Rate: Quantity Units

Appearance:

	Y	N	N/A
Environment Notified?			
Samples Requested?			

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

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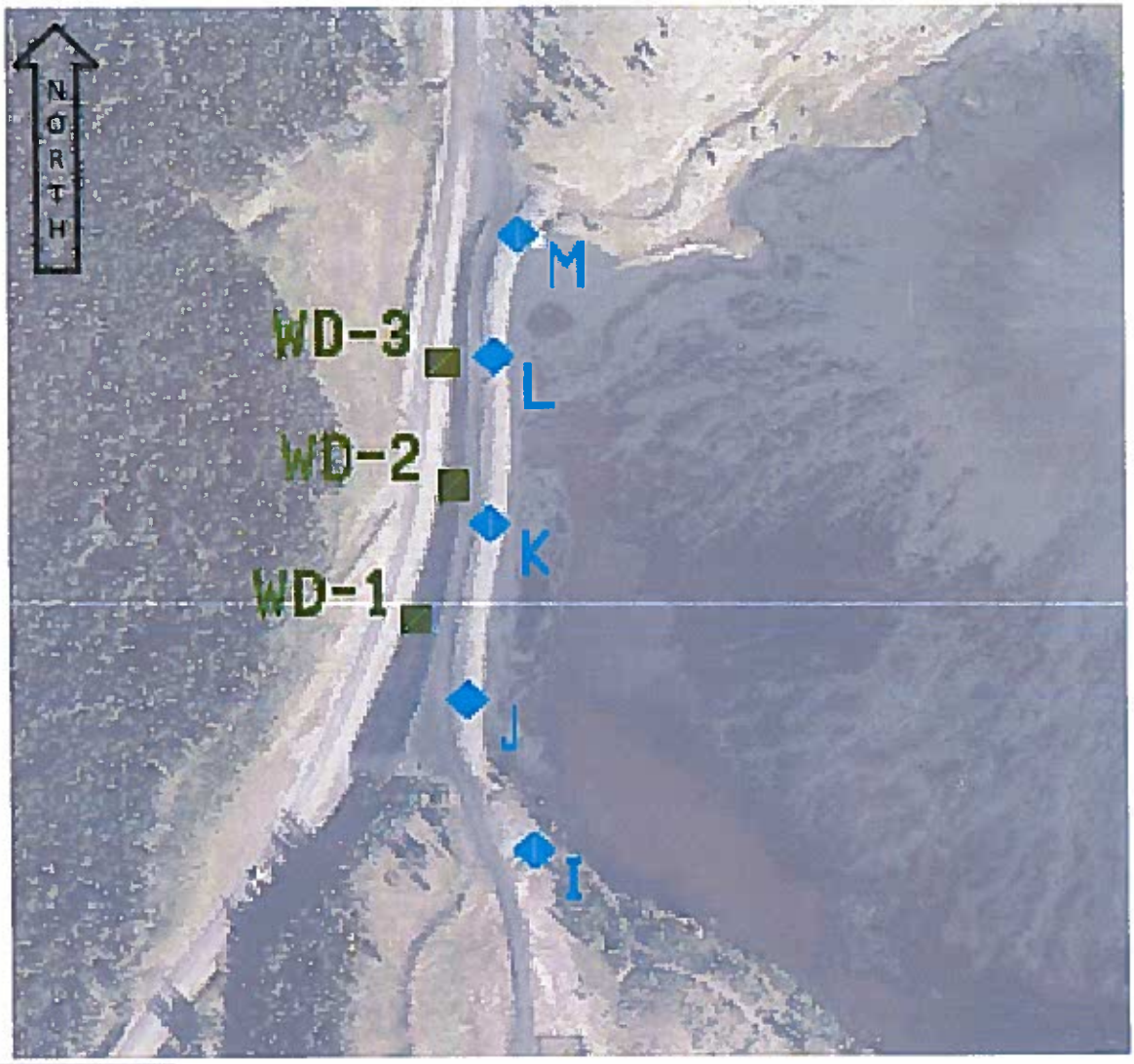

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* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

→ weir cleared by hand @ v-notch of rock/debris; more thorough cleaning required to remove build-up.; no immediate concern

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Type: ☑ Routine ☐ Event Driven

Inspection Date: Feb 21, 2017

Weather / Visibility: -3; partly sunny

	Y	N
Raining?		X
Snow Covered?	X	

Inspection Time: 10:15

Reviewed By: Mark Slater

Review Date: 2017-02-23

	Y	N	N/A
From this inspection, is this dam safe?			
Siteline Notification Required?			
Maintenance Work Required?			
Repair Log Entry Made?			
Work Order Created?			

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?			X
Settlement?			X
Depressions / Sinkholes?			X
Ruts?			X
Water Ponding?			X
Surface Protection Issues?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.
snow covered; no concerns visible.

Pond Level:	Y	N	N/A
Floating Debris?		X	

Estimated Freeboard: >5m Units

Freeboard - Observations? snow covered

GH 1 Road:	Y	N	N/A
Signs of Deformation?			X
Trees Indicating Movement?		X	
Culverts Blocked?		X	
Sediment in Water Flow?	X		

snow covere

V-Notch Weir Reading: 0.02 cm Unit

cleared to take reading; should be dug out

Upstream Slope:	Y	N	N/A
Slope Stability Issues?			X
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.
snow covered; no concerns visible

Downstream Slope:	Y	N	N/A
Slope Stability Issues?			X
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.
snow covered; no concerns visible

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?			X
Protection / Casing Broken?			X
Manual Readings Taken?		X	
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments: Prism data consistent;
WD-1A & 1B have several short (less than 24 hr) data gaps;
WD-2A & 2B have numerous multiday data gaps & no readings since Feb 15/17;
WD-3A & 3B have same data gaps as 1A & 1B; overall data is consistent

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?			X
Signs of Erosion?			X
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?			X
Ponded water at the downstream toe?			X
Observed Piping?			X

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

Appearance:

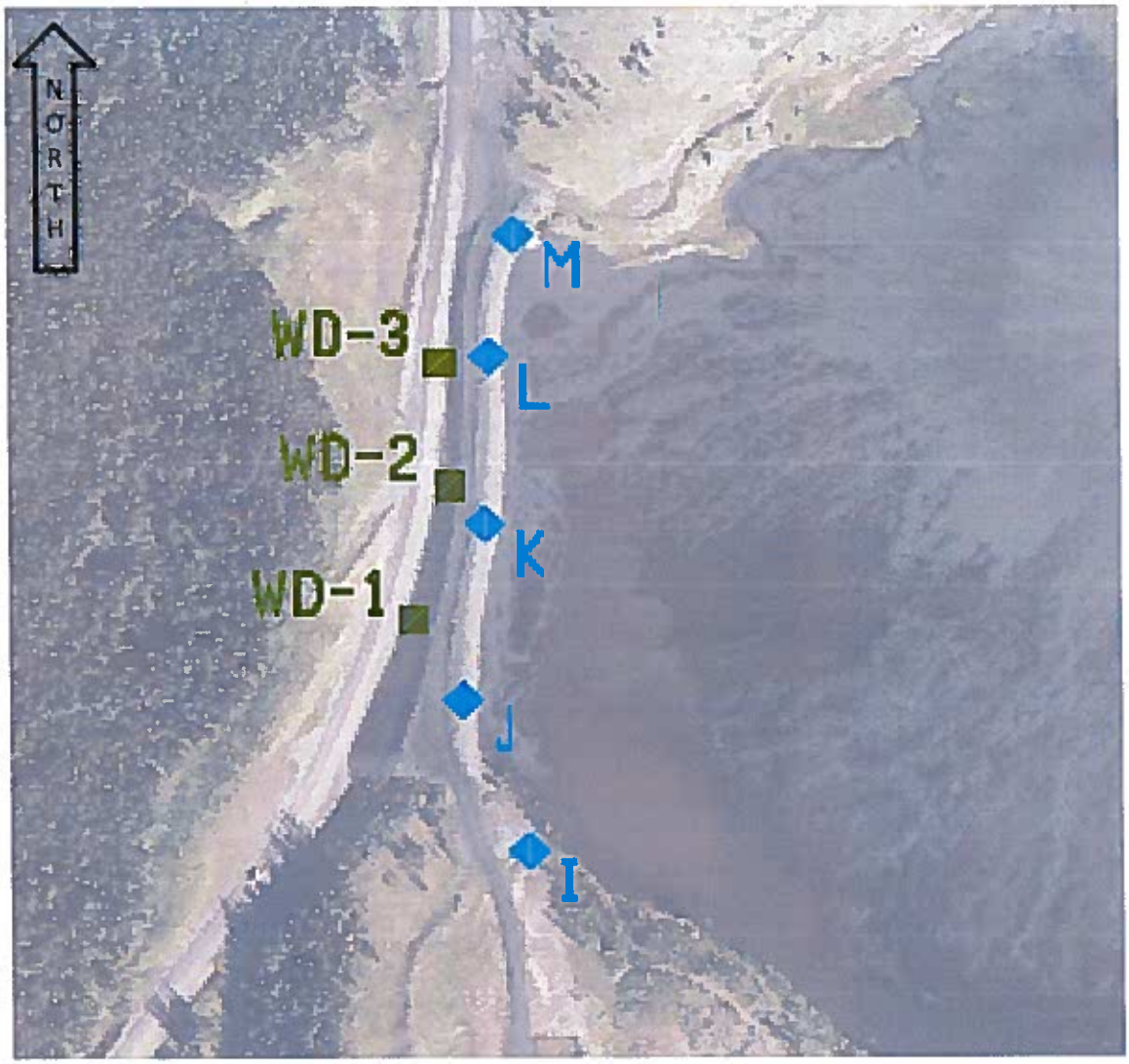
	Y	N	N/A
Environment Notified?			
Samples Requested?			

Snow covered; no concerns visible.

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



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* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- Weir basin partially filled with sediment/debris, not yet blocking flow but should be cleared prior to snow melt to accomodate increased flow

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Type: ☑ Routine ☐ Event Driven

Inspection Date: Feb 21, 2017

Weather / Visibility: partly sunny

Y	N	
	X	Raining?
X		Snow Covered?

Inspection Time: 11:00

Reviewed By: Mark Slater

Review Date: 2017-02-23

	Y	N	N/A
From this inspection, is this dam safe?	Y	N	
Siteline Notification Required?	Y	N	N/A
Maintenance Work Required?	Y	N	N/A
Repair Log Entry Made?	Y	N	N/A
Work Order Created?	Y	N	N/A

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?			X
Settlement?			X
Depressions / Sinkholes?			X
Ruts?			X
Water Ponding?			X
Surface Protection Issues?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.
snow covered; no concerns observed

Pond Level:	Y	N	N/A
Floating Debris?			X
Estimated Freeboard:	>5m		Units
Freeboard - Observations?	snow/ice covered		

Site C:	Y	N	N/A
New Movement Detected?		X	
Trees Indicating Movement?		X	
Drain Pipe Broken?			
Water Not Flowing in Ditch?			
V-Notch Weir Reading:	Rate		Unit

not visited

Upstream Slope:	Y	N	N/A
Slope Stability Issues?			X
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.
snow covered; no concerns observed

Downstream Slope:	Y	N	N/A
Slope Stability Issues?			X
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?	X		
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.
snow covered; see reverse.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	
Site C GPS Physical Issues?			X
Site C GPS Data Issues?		X	
Changes in GPS Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?	X		
Protection / Casing Broken?		X	
Manual Readings Taken?	X		
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments: manual readings taken on piezos installed in fall 2016, [redacted] one snow covered & unable to locate at time of inspect.

Downstream Toe and Seepage: see reverse.	Y	N	N/A
Wet areas or seepage on downstream slope/toe?	X		
Signs of Erosion?	X		
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?			X
Ponded water at the downstream toe?	X		
Observed Piping?		X	

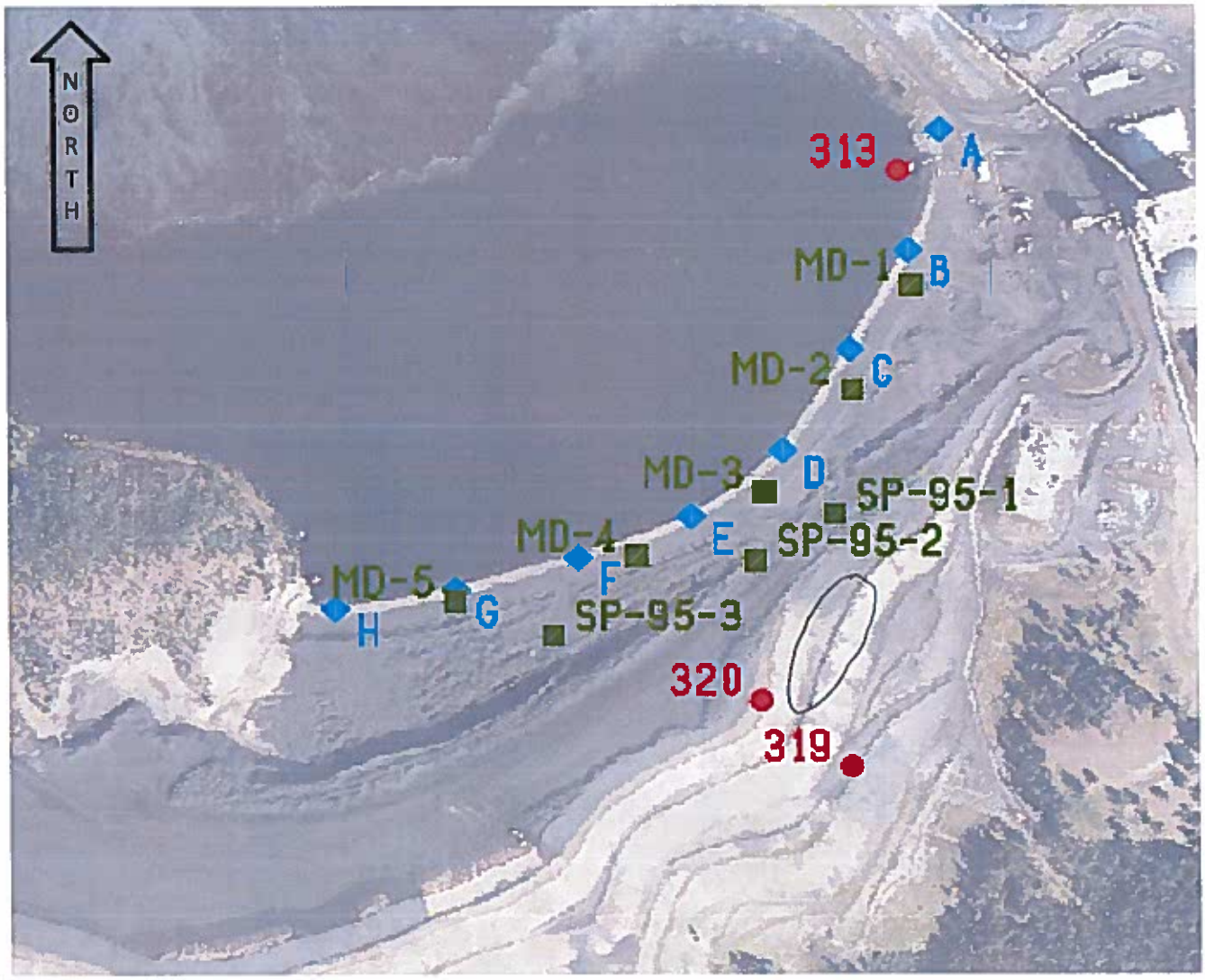
If seepage is observed, complete the following and note location / extent on map:

Rate:	Quantity	Units	Environment Notified?	
Appearance:			Samples Requested?	

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

-Circled downstream slope – some water/snow melt pooled in area; continue to monitor

-Downstream slope along east side – several areas of minor rill erosion; continue to monitor

-Instrumentation:

- MD-2B, 3B, 5A & 5B not functioning
- MD-2A no data in 34 days
- otherwise data fairly consistent (piezo)
- no unusual spikes/dips (piezo)
- 319 & 320 GPS: data consistent but showing spike on Feb 15/16
- Prism data consistent

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Date: March 23/17

Inspection Time: 14 : 15

Reviewed By: [signature]

Review Date: 2017-03-27

Inspection Type: [X] Routine [ ] Event Driven

Weather / Visibility: 3°C / overcast

	Y	N	
Raining?		X	
Snow Covered?	X		
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	
Maintenance Work Required?	X		(weir)
Repair Log Entry Made?		X	
Work Order Created?		X	

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?	X		
Ruts?		X	
Water Ponding?	X		
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map. See reverse.

Pond Level:	Y	N	N/A
Floating Debris?		X	

Estimated Freeboard: ~4m

Freeboard - Observations? mainly snow covered, no debris observed.

GH 1 Road:	Y	N	N/A
Signs of Deformation?		X	
Trees Indicating Movement?		X	
Culverts Blocked?		X	
Sediment in Water Flow?	X		

V-Notch Weir Reading: ~0.04 see reverse

Upstream Slope:	Y	N	N/A
Slope Stability Issues?			X
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map. Snow covered

Downstream Slope:	Y	N	N/A
Slope Stability Issues?			X
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map. Snow covered.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?		X	
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments: - instrumentation data reviewed 3/22, no concerns
- geoexplorer undergoing updates 3/23 so data unavailable

Downstream Toe and Seepage: snow covered, no concerns observed.	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		X	
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		X	
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map:

Rate: _____ _____

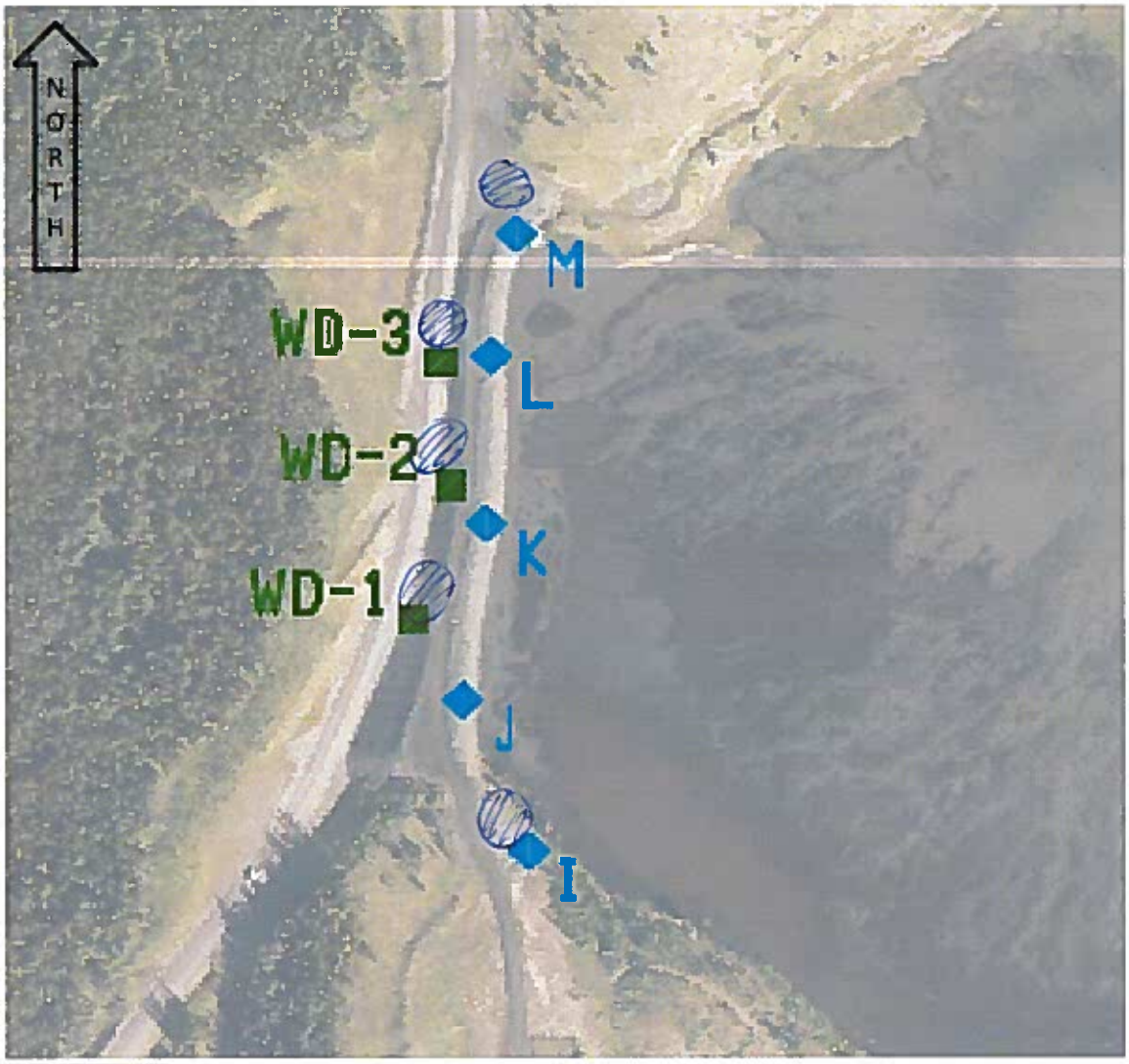
Appearance: _____

	Y	N	N/A
Environment Notified?			
Samples Requested?			

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

◎ – areas of ponded water in soft, mucky areas.
weir – basin should be cleared out, lot of sediment build up; maintenance to be completed this summer

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristan Snider

Inspection Date: March 23/17

Inspection Time: 14 : 45

Reviewed By: [signature]

Review Date: 2017-03-27

Inspection Type: [/] Routine [ ] Event Driven

Weather / Visibility: 3°C / overcast

	Y	N
Raining?		X
Snow Covered?	X	

	Y	N	N/A
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	
Maintenance Work Required?		X	
Repair Log Entry Made?		X	
Work Order Created?		X	

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?			X
Settlement?			X
Depressions / Sinkholes?			X
Ruts?			X
Water Ponding? (see reverse.)	X		
Surface Protection Issues?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.
snow covered; no concerns observed

Pond Level:	Y	N	N/A
Floating Debris?			X
Estimated Freeboard: ~4m			
Freeboard - Observations? snow covered; no debris observed.			

Site C: not visited.	Y	N	N/A
New Movement Detected?			
Trees Indicating Movement?			
Drain Pipe Broken?			
Water Not Flowing in Ditch?			
V-Notch Weir Reading:			

Upstream Slope:	Y	N	N/A
Slope Stability Issues?			X
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.
snow covered; no concerns observed

Downstream Slope:	Y	N	N/A
Slope Stability Issues?			X
Bulges / Depressions?			X
Slope Protection Issues?			X
Signs of Erosion?			X
Concerning Vegetation?			X
Animal Burrows?			X
Movement Observed?			X

Note: How Much, Where and Direction on Map.
snow covered; no concerns observed

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	
Site C GPS Physical Issues?			X (not visited)
Site C GPS Data Issues?		X	
Changes in GPS Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?		X	
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments: instrumentation data reviewed 3/20: 3/22; no concerns
- geoexplorer undergoing updates 3/23 so data unavailable

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?			X
Signs of Erosion?			X
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?			X
Ponded water at the downstream toe?			X
Observed Piping?			X

If seepage is observed, complete the following and note location / extent on map:

Rate: _____ _____

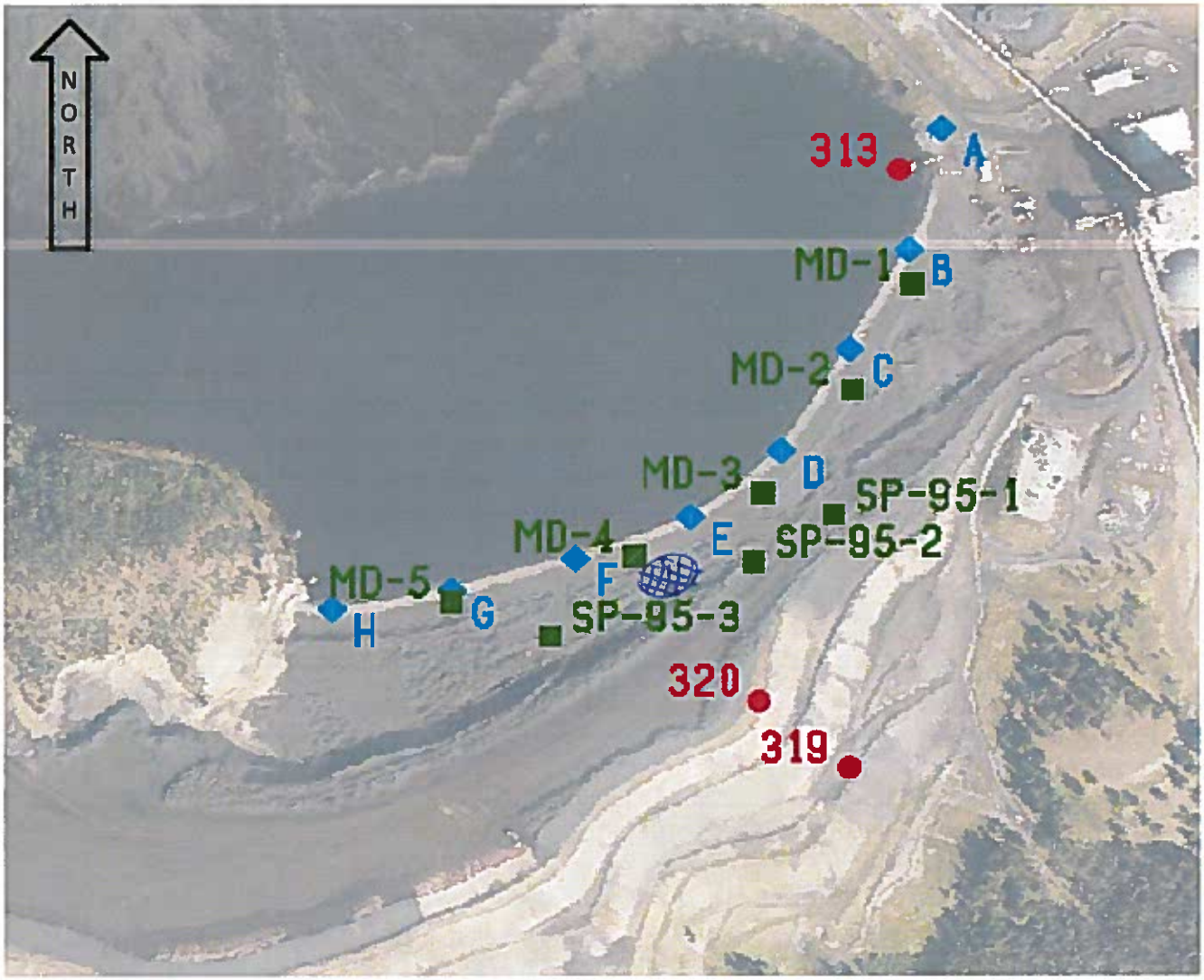
Appearance: _____

Environment Notified?			
Samples Requested?			

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

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* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

⊞ - small area of ponded water; in general downstream portion of crest very soft due to snow melt.

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Date: 2017 - Apr - 26

Inspection Time: 10 : 40

Reviewed By: [signature]

Review Date: 2017-06-29

Inspection Type: [X] Routine [ ] Event Driven

Weather / Visibility: overcast / foggy

	Y	N
Raining?		X
Snow Covered? (partial)	X	

	Y	N	N/A
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	
Maintenance Work Required?	X		
Repair Log Entry Made?		X	
Work Order Created?		X	

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?	X		
Ruts?	X		
Water Ponding? (see reverse, crest & spillway)	X		
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard: 2.5m			
Freeboard - Observations?			

GH 1 Road:	Y	N	N/A
Signs of Deformation?		X	
Trees Indicating Movement?		X	
Culverts Blocked?	X		
Sediment in Water Flow? (see reverse)	X		

V-Notch Weir Reading: 0.07 cm

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions? (see reverse WD2 - WD3)	X		
Slope Protection Issues?		X	
Signs of Erosion? (see reverse, WD1)	X		
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?		X	
Piezometer Data Issues?		X	
Changes in Piezo Data Trend?		X	

Comments: instrumentation data reviewed Apr 24 & 26, WD-2 no historical data; no concerns

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		X	
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)? see reverse.	X		
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map:

Rate: _____ (Quantity) _____ (Units)

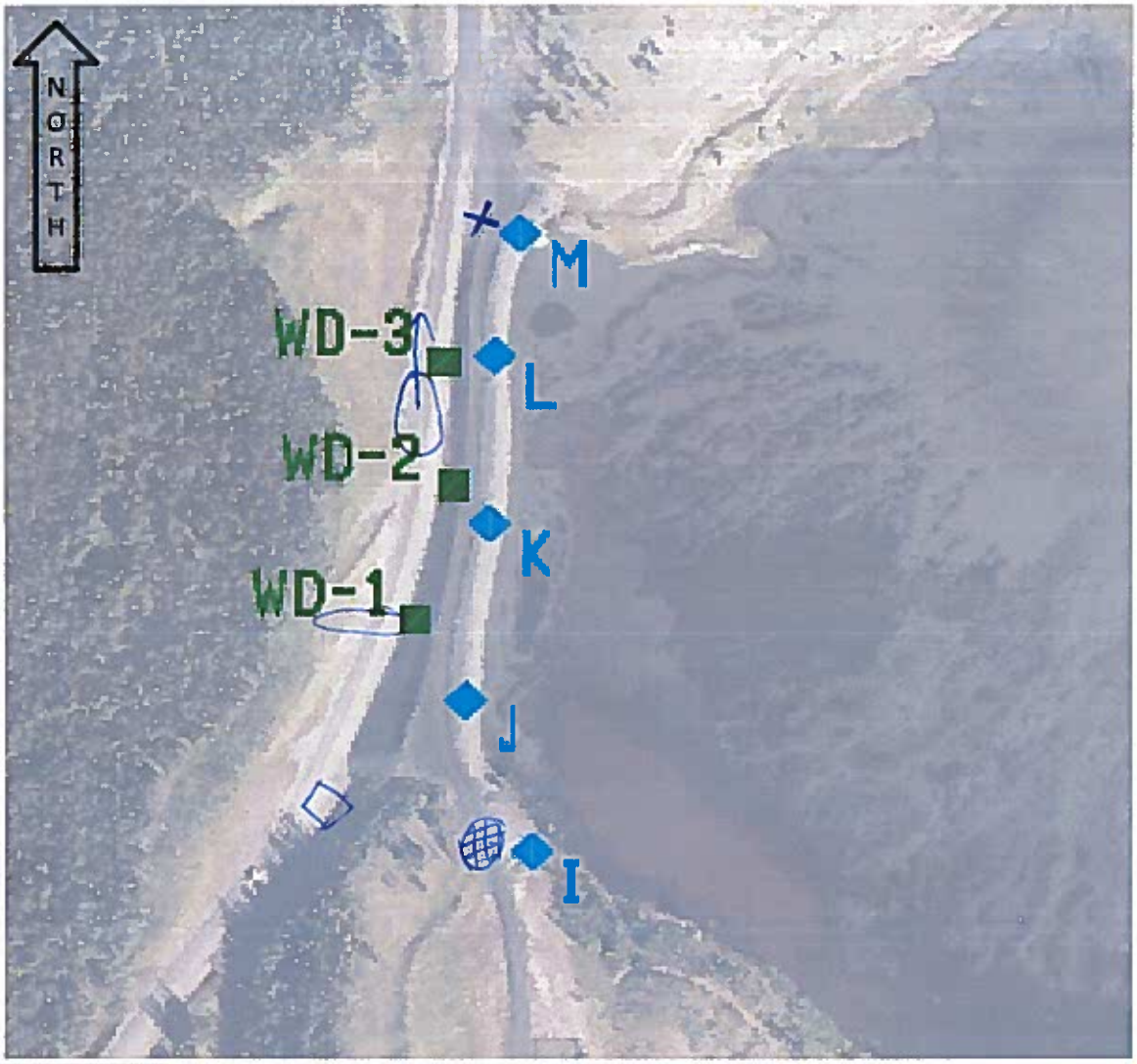
Appearance: _____

	Y	N	N/A
Environment Notified?			
Samples Requested?			

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- entire crest soft conditions & ponding water
- south portion of upstream slope still snow covered, remaining clear
- water in spillway, not flowing; possibly plugged or still frozen
- slight roll or bulge in downstream slope between WD2 & WD3 & slightly beyond
- erosion rill from WD-1 down downstream slope; continue to monitor for changing conditions
- weir requires cleaning in basin
- large area of ponded water
- culvert blocked/covered

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Date: 2017 - Apr - 26

Inspection Time: 11 : 30

Reviewed By: [signature]

Review Date: 2017-06-29

Inspection Type: [/] Routine [ ] Event Driven

Weather / Visibility: Overcast

	Y	N
Raining?		X
Snow Covered?	X	

partial

	Y	N	N/A
From this inspection, is this dam safe?	X		
Siteline Notification Required?		X	
Maintenance Work Required?	X		
Repair Log Entry Made?		X	
Work Order Created?		X	

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?		X	
Ruts?		X	
Water Ponding?		X	
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard:	2.5		
Freeboard - Observations?			

Site C:	Y	N	N/A
New Movement Detected?		X	
Trees Indicating Movement?		X	
Drain Pipe Broken? see reverse.	X		
Water Not Flowing in Ditch?		X	

V-Notch Weir Reading:

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion? see reverse	X		
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	
Site C GPS Physical Issues?		X	
Site C GPS Data Issues?		X	
Changes in GPS Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?		X	
Piezometer Data Issues?	X		
Changes in Piezo Data Trend?		X	

Comments: instrumentation data reviewed Apr 24 & 26; numerous data spikes (1800m+) observed, attributed to loggers requiring replacement (will be completed in ~3-4 weeks (waiting on order); overall all piezos having increasing data trend

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		X	
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		X	
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map:

Rate:

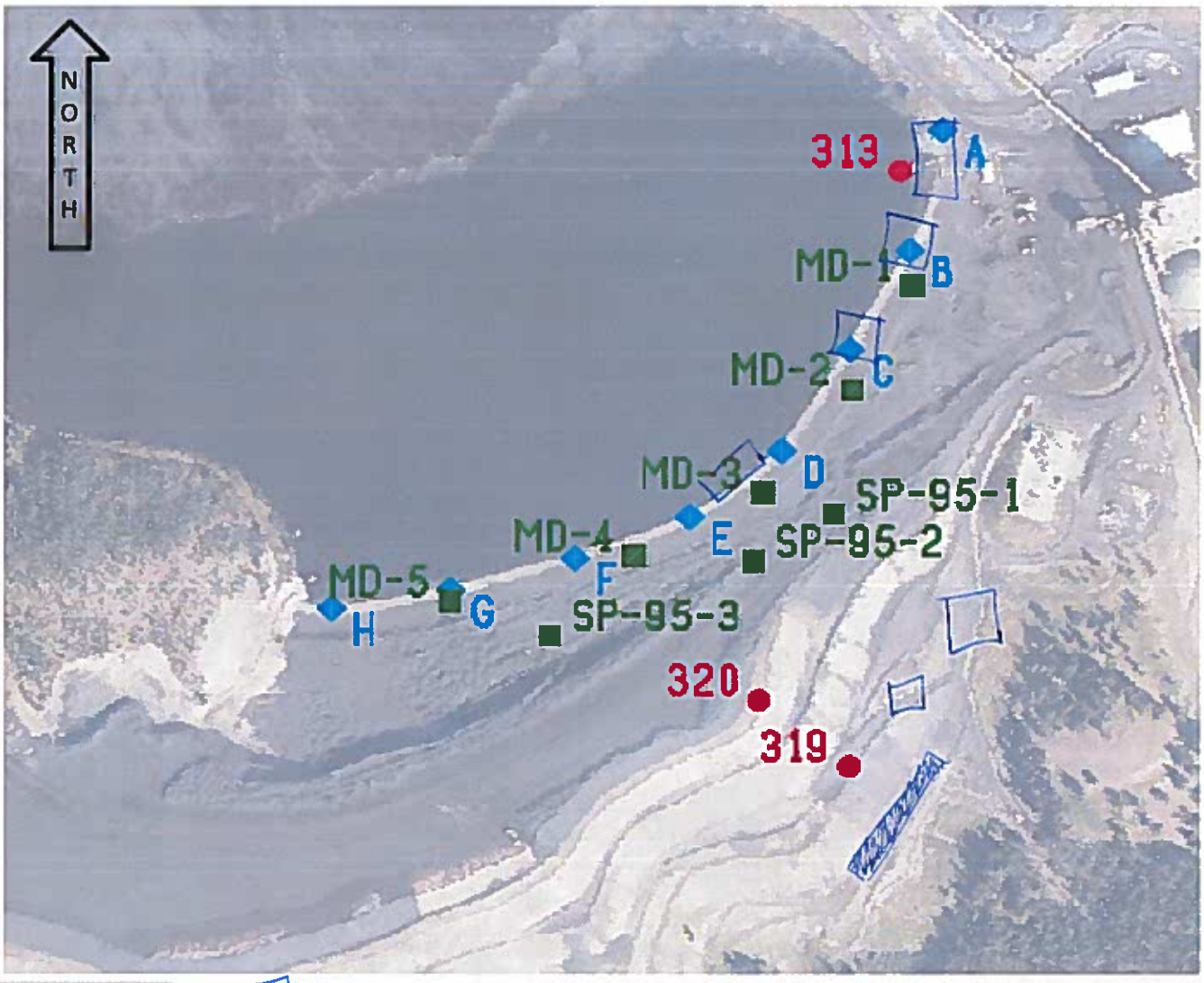
Appearance:

Environment Notified?			
Samples Requested?			

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips: ☐ erosion

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

☐ areas of erosion; upstream slope, site C roadways

broken seepage collection pipe; will be replaced during summer construction

- upstream slope erosion - possible to address same during summer construction; no immediate concerns; continue to monitor

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Date: 2017 – ~~05~~ 06 – ~~18~~ 01

Inspection Time: 08:40

Reviewed By: [signature]

Review Date: 2017-06-29

Inspection Type: [/] Routine [ ] Event Driven

Weather / Visibility: Overcast, 7°C

	Y	N
Raining?		/
Snow Covered?		/

	Y	N	N/A
From this inspection, is this dam safe?	/		
Siteline Notification Required?		/	
Maintenance Work Required?		/	
Repair Log Entry Made?			
Work Order Created?			

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps? see reverse	/		
Settlement?		/	
Depressions / Sinkholes?		/	
Ruts?		/	
Water Ponding?		/	
Surface Protection Issues?		/	
Concerning Vegetation?		/	
Animal Burrows?		/	
Movement Observed?		/	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		/	
Estimated Freeboard: ~1.8m			
Freeboard - Observations?			

visited June 13/17

Site C:	Y	N	N/A
New Movement Detected?		/	
Trees Indicating Movement?		/	
Drain Pipe Broken?	/		
Water Not Flowing in Ditch?		/	

V-Notch Weir Reading: 0.4 cm/s

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		/	
Bulges / Depressions?		/	
Slope Protection Issues?		/	
Signs of Erosion? see reverse.	/		
Concerning Vegetation?		/	
Animal Burrows?		/	
Movement Observed?		/	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		/	
Bulges / Depressions?		/	
Slope Protection Issues?		/	
Signs of Erosion? see reverse	/		
Concerning Vegetation?		/	
Animal Burrows?		/	
Movement Observed?		/	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		/	
Prism Data Issues?		/	
Changes in Prism Data Trend?		/	
Site C GPS Physical Issues?		/	
Site C GPS Data Issues?		/	
Changes in GPS Data Trend?		/	

	Y	N	N/A
Piezometer Condtion Issues?		/	
Protection / Casing Broken?		/	
Manual Readings Taken?		/	
Piezometer Data Issues?	/		
Changes in Piezo Data Trend?	/		

Measure Barge GPS height above water: [illegible]

Comments: piezo issues being worked on.

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		/	
Signs of Erosion?		/	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		/	
Ponded water at the downstream toe?		/	
Observed Piping?		/	

If seepage is observed, complete the following and note location / extent on map:

Rate: _____ Quantity _____ Units

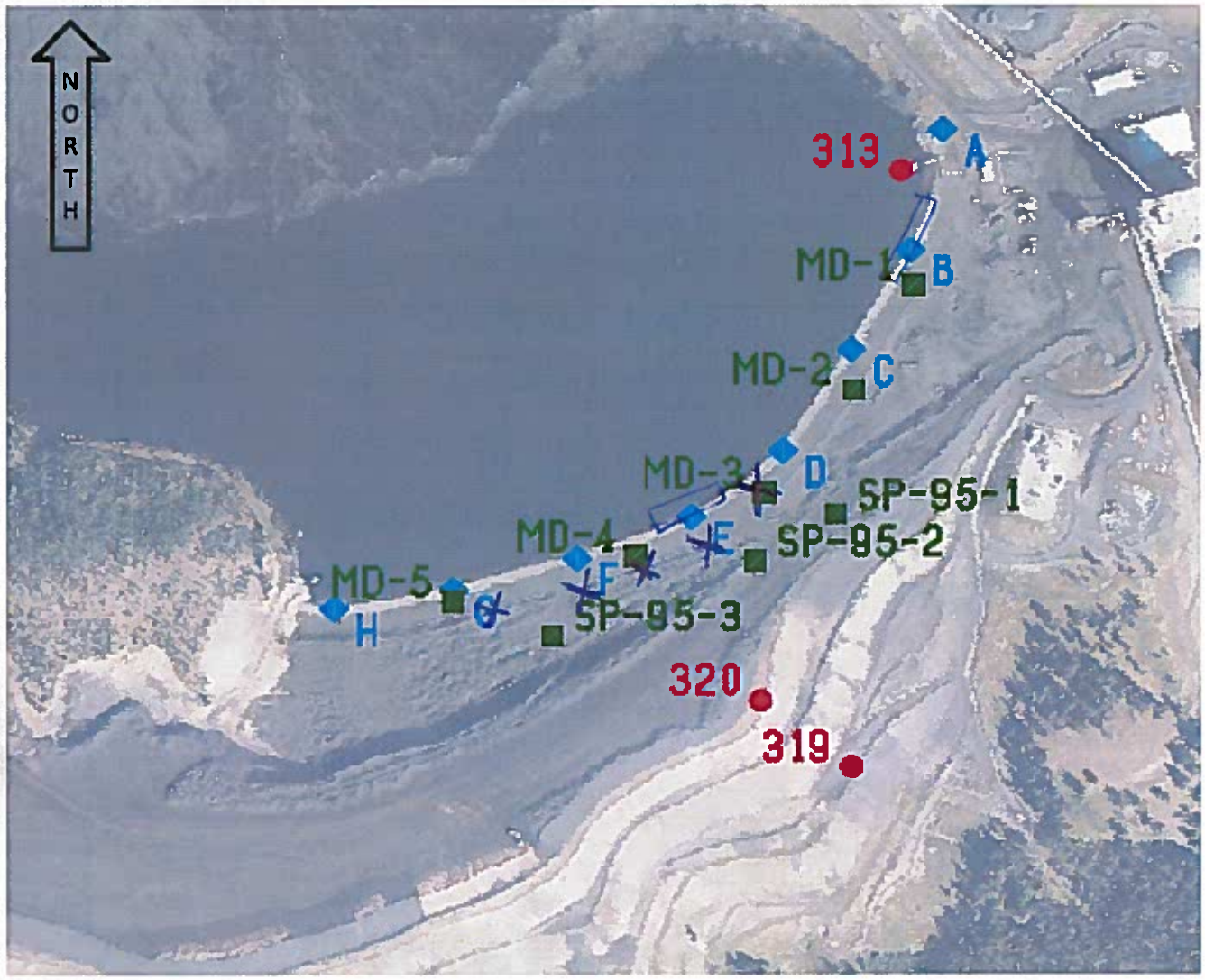
Appearance: _____

Environment Notified?			/
Samples Requested?			/

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

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* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- minor surficial cracking along most of liner crest, likely due to material drying out; continue to monitor for changes
- sloughing of upstream toe noted near prisms B & E; no changes observed; continue to monitor; should be addressed during 2017 dam raise work.
- several erosion channels on downstream slope; continue to monitor; to be addressed during 2017 dam raise work.

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Date: 2017 06-01 ~~05-18~~

Inspection Time: 07:40

Reviewed By:

Review Date: 2017-06-29

Inspection Type: ☐ Routine ☒ Event Driven

Weather / Visibility: Overcast; 7°C

	Y	N
Raining?		✓
Snow Covered?		✓

	Y	N
From this inspection, is this dam safe?	✓	
Siteline Notification Required?		✓
Maintenance Work Required?		✓
Repair Log Entry Made?	✓	
Work Order Created?	✓	

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps? see reverse	✓		
Settlement?		✓	
Depressions / Sinkholes?		✓	
Ruts?		✓	
Water Ponding?		✓	
Surface Protection Issues?		✓	
Concerning Vegetation?		✓	
Animal Burrows?		✓	
Movement Observed?		✓	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		✓	

Estimated Freeboard: ~1.8m

Freeboard - Observations?

GH 1 Road:	Y	N	N/A
Signs of Deformation?		✓	
Trees Indicating Movement?		✓	
Culverts Blocked?		✓	
Sediment in Water Flow?	✓		

V-Notch Weir Reading: 007 cm/s

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		✓	
Bulges / Depressions?		✓	
Slope Protection Issues?		✓	
Signs of Erosion? see reverse	✓		
Concerning Vegetation?		✓	
Animal Burrows?		✓	
Movement Observed?		✓	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		✓	
Bulges / Depressions? see reverse.	✓		
Slope Protection Issues?		✓	
Signs of Erosion? See reverse.	✓		
Concerning Vegetation?		✓	
Animal Burrows?		✓	
Movement Observed?		✓	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		✓	
Prism Data Issues?		✓	
Changes in Prism Data Trend?		✓	

	Y	N	N/A
Piezometer Condtion Issues?		✓	
Protection / Casing Broken?		✓	
Manual Readings Taken?		✓	
Piezometer Data Issues?		✓	
Changes in Piezo Data Trend?		✓	

Comments:

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		✓	
Signs of Erosion?		✓	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)? see reverse re: downstream slope bulge.	✓		
Ponded water at the downstream toe?		✓	
Observed Piping?		✓	

If seepage is observed, complete the following and note location / extent on map:

Rate: _____ Quantity _____ Units

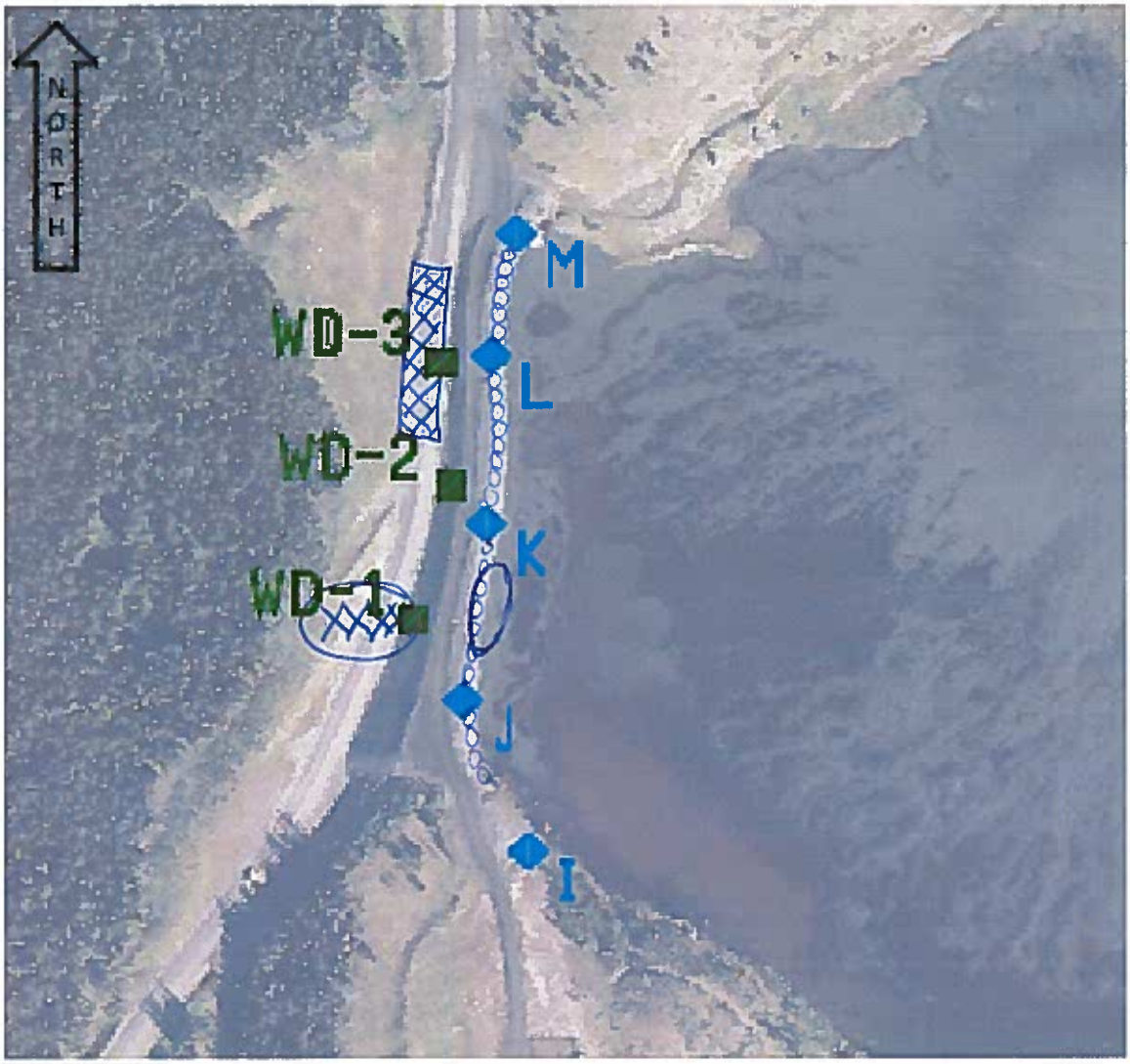
Appearance:

	Y	N	N/A
Environment Notified?			✓
Samples Requested?			✓

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



▨ - bulge.

oooo - minor surficial cracks on crest & rill erosion on slope

⬭ - low lying grass like veg shallow roots, no concern

(XXX) - up to 3ft deep erosion channel

Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- bulging noted on downstream crest north of WD-2; continue to monitor
- minor surficial cracks noted on upstream liner, likely just from material drying out; continue to monitor for changes
- crack noted in berm just south of WD-3, minor as not part of dam; will continue to monitor and between WD2 & WD1
- minor rill erosion noted on upstream slope, [redacted]; low concern, will continue to monitor
- deep erosion channel running downslope from WD-1, up to 3ft deep in some places; should be monitored & repaired during 2017 dam raise.

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider.

Inspection Date: 2017-06-26

Inspection Time: 01:45

Reviewed By: Mark Slater

Review Date: 2017-06-29

Inspection Type: [/] Routine [ ] Event Driven

Weather / Visibility: 28°C / partly cloudy

Raining? [ ] Y [/] N

Snow Covered? [ ] Y [/] N

From this inspection, is this dam safe? [/] Y [ ] N

Siteline Notification Required? [ ] Y [/] N [ ] N/A

Maintenance Work Required? [ ] Y [/] N [ ] N/A

Repair Log Entry Made? [ ] Y [ ] N [ ] N/A

Work Order Created? [ ] Y [ ] N [ ] N/A

Are any of the following conditions apparent?

Crest: (see reverse comment)	Y	N	N/A
Surface Cracking / Scarps?	[/]	[ ]	[ ]
Settlement?	[ ]	[/]	[ ]
Depressions / Sinkholes?	[ ]	[/]	[ ]
Ruts?	[ ]	[/]	[ ]
Water Ponding?	[ ]	[/]	[ ]
Surface Protection Issues?	[ ]	[/]	[ ]
Concerning Vegetation?	[ ]	[/]	[ ]
Animal Burrows?	[ ]	[/]	[ ]
Movement Observed? (none observed)	[ ]	[/]	[ ]

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?	[ ]	[/]	[ ]
Estimated Freeboard: ~2m			
Freeboard - Observations?			

Site C:	Y	N	N/A
New Movement Detected?	[ ]	[/]	[ ]
Trees Indicating Movement?	[ ]	[/]	[ ]
Drain Pipe Broken?	[/]	[ ]	[ ]
Water Not Flowing in Ditch?	[ ]	[/]	[ ]

V-Notch Weir Reading: 0.13 cm/s

Upstream Slope:	Y	N	N/A
Slope Stability Issues?	[ ]	[/]	[ ]
Bulges / Depressions?	[ ]	[/]	[ ]
Slope Protection Issues?	[ ]	[/]	[ ]
Signs of Erosion? (see reverse.)	[/]	[ ]	[ ]
Concerning Vegetation?	[ ]	[/]	[ ]
Animal Burrows?	[ ]	[/]	[ ]
Movement Observed? (none observed.)	[ ]	[/]	[ ]

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?	[ ]	[/]	[ ]
Bulges / Depressions?	[ ]	[/]	[ ]
Slope Protection Issues?	[ ]	[/]	[ ]
Signs of Erosion? (see reverse.)	[/]	[ ]	[ ]
Concerning Vegetation?	[ ]	[/]	[ ]
Animal Burrows?	[ ]	[/]	[ ]
Movement Observed? (none observed.)	[ ]	[/]	[ ]

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?	[ ]	[/]	[ ]
Prism Data Issues?	[ ]	[/]	[ ]
Changes in Prism Data Trend?	[ ]	[/]	[ ]
Site C GPS Physical Issues?	[ ]	[/]	[ ]
Site C GPS Data Issues?	[ ]	[/]	[ ]
Changes in GPS Data Trend?	[ ]	[/]	[ ]

	Y	N	N/A
Piezometer Condtion Issues?	[ ]	[/]	[ ]
Protection / Casing Broken?	[ ]	[/]	[ ]
Manual Readings Taken?	[/]	[ ]	[ ]
Piezometer Data Issues?	[/]	[ ]	[ ]
Changes in Piezo Data Trend?	[ ]	[/]	[ ]

Measure Barge GPS height above water: 218.5cm

Comments: SD-16 series piezos dataloaded/read; MD-2A and 3B not functioning properly; several piezos with data spikes (removed); trends consistent & slightly decreasing.

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?	[ ]	[/]	[ ]
Signs of Erosion?	[ ]	[/]	[ ]
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?	[ ]	[/]	[ ]
Ponded water at the downstream toe?	[ ]	[/]	[ ]
Observed Piping?	[ ]	[/]	[ ]

If seepage is observed, complete the following and note location / extent on map:

Rate: _____ _____

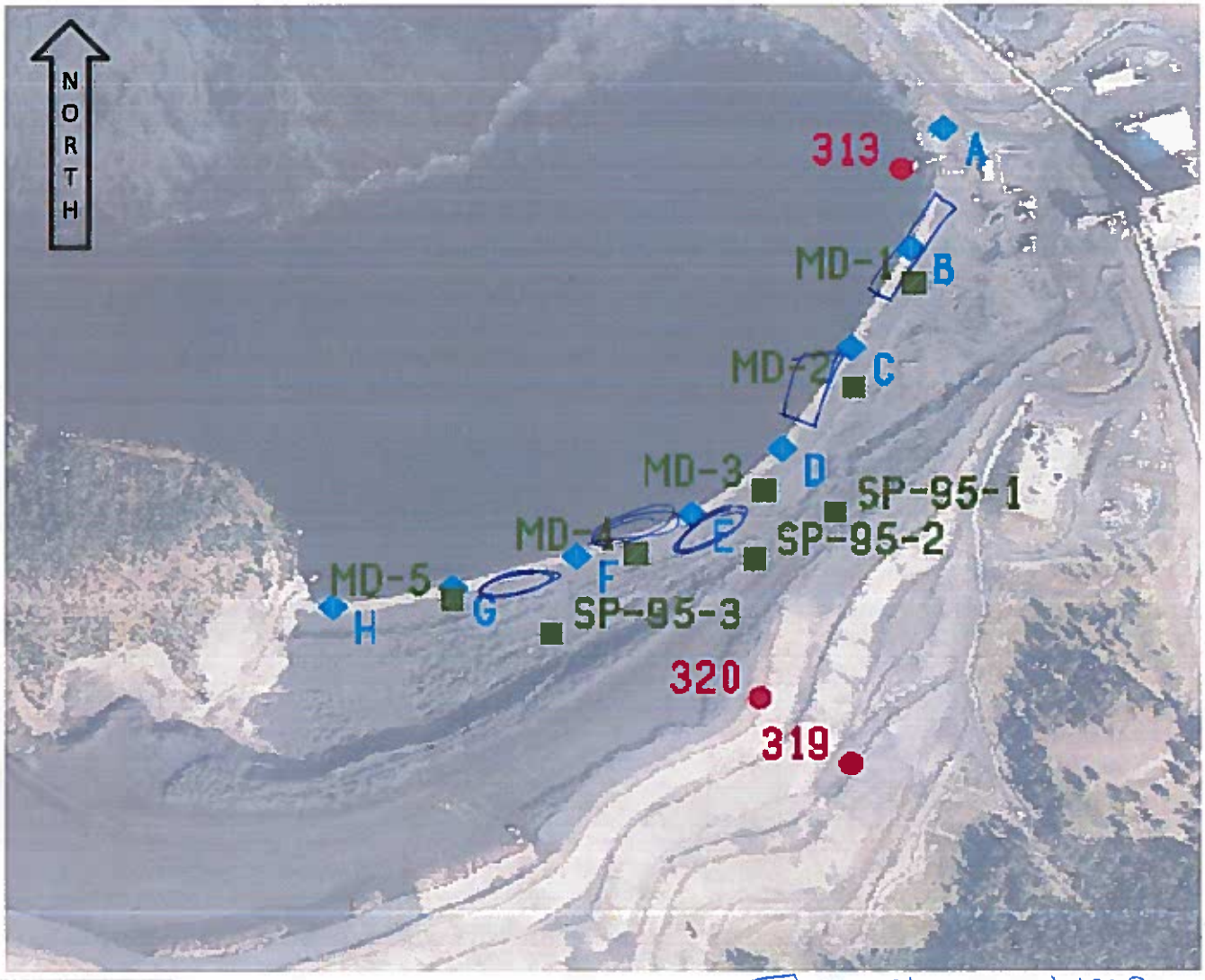
Appearance: _____

	Y	N	N/A
Environment Notified?	[ ]	[ ]	[ ]
Samples Requested?	[ ]	[ ]	[ ]

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



□ - upstream slump
○ - erosion

Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- slump on upstream slope between C and D prism stand; to be repaired during upcoming construction
- erosion channels on downstream slope between MD-5 and MD-4
- erosion on upstream between E and F prism; monitor for changes; will be addressed during construction
- slumping present between prisms A-C; continue to monitor; to be addressed during construction
- no change to till crest surface cracks noted in last inspection; continue to monitor; to be addressed during construction.

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Date: 2017-06-26

Inspection Time: 2:10

Reviewed By: Mark Slater

Review Date: 2017-06-29

Inspection Type: ☑ Routine ☐ Event Driven

Weather / Visibility: 24°C / partly cloudy

Raining? N

Snow Covered? N

From this inspection, is this dam safe? Y

Siteline Notification Required? N

Maintenance Work Required? Y

Repair Log Entry Made? N

Work Order Created? N

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps? (see reverse comment re: rill)	Y		
Settlement?		N	
Depressions / Sinkholes?		N	
Ruts?		N	
Water Ponding?		N	
Surface Protection Issues?		N	
Concerning Vegetation?		N	
Animal Burrows?		N	
Movement Observed? (none observed)		N	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		N	

Estimated Freeboard: ~2 m

Freeboard - Observations:

GH 1 Road:	Y	N	N/A
Signs of Deformation?		N	
Trees Indicating Movement?		N	
Culverts Blocked?		N	
Sediment in Water Flow? (in basin)	Y		

V-Notch Weir Reading: 0.016 cm/s

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		N	
Bulges / Depressions?		N	
Slope Protection Issues?		N	
Signs of Erosion? (see reverse re: rill)	Y		
Concerning Vegetation?		N	
Animal Burrows?		N	
Movement Observed? (none observed)		N	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		N	
Bulges / Depressions? (see reverse)	Y		
Slope Protection Issues?		N	
Signs of Erosion? (see reverse)	Y		
Concerning Vegetation?		N	
Animal Burrows?		N	
Movement Observed? (none observed)		N	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		N	
Prism Data Issues?		N	
Changes in Prism Data Trend?		N	

	Y	N	N/A
Piezometer Condtion Issues?		N	
Protection / Casing Broken?		N	
Manual Readings Taken?		N	
Piezometer Data Issues?	Y		
Changes in Piezo Data Trend?	Y		

Comments: WD-1 and WD-3 consistent trend; WD-2 major gaps in data and large spike/fall in data during month of June.

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		N	
Signs of Erosion?		N	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)? (see reverse re: possible bulge)	Y		
Ponded water at the downstream toe?		N	
Observed Piping?		N	

If seepage is observed, complete the following and note location / extent on map:

Rate: _____ _____

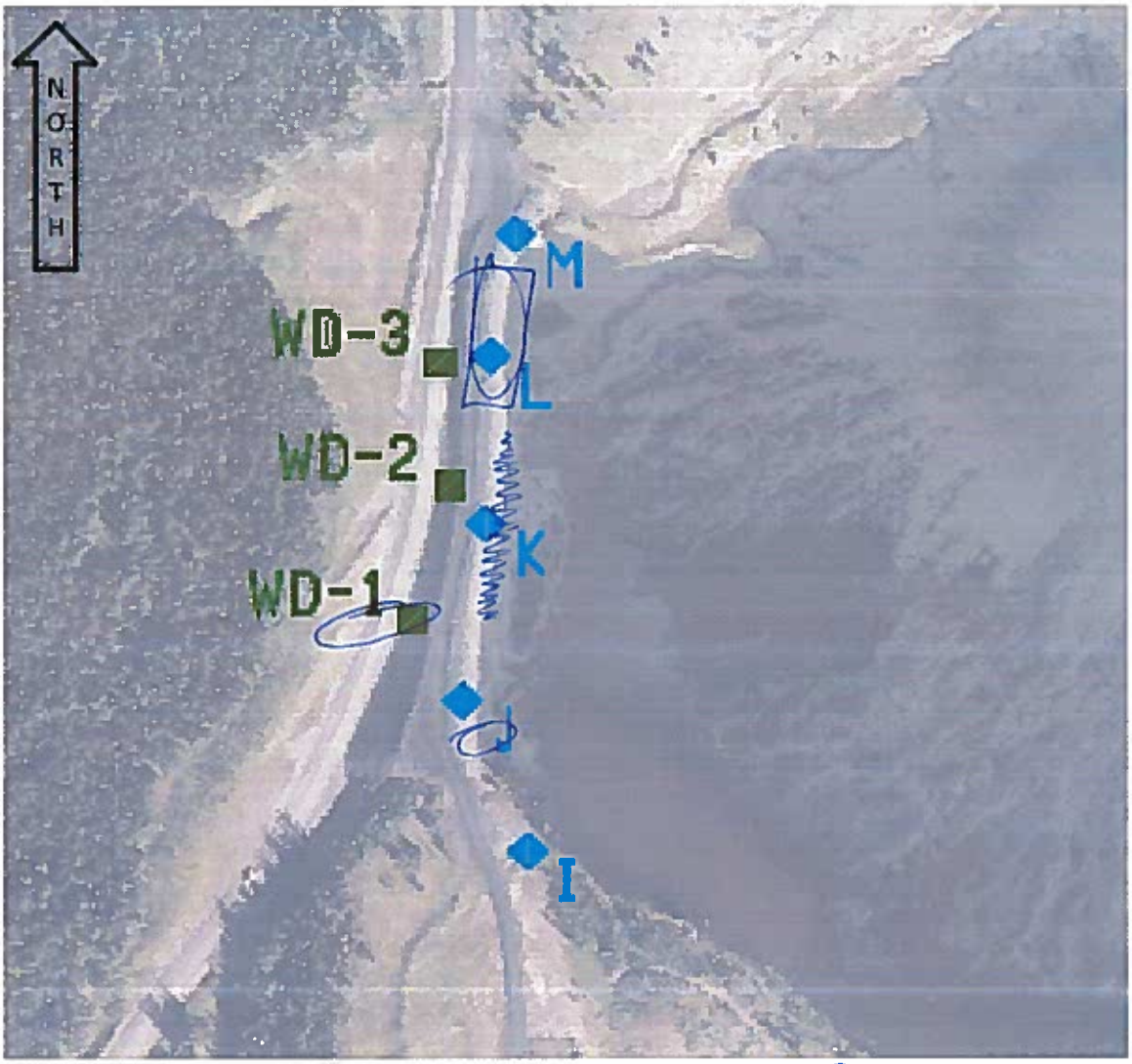
Appearance: _____

Environment Notified?			N/A
Samples Requested?			N/A

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

○ – erosion

≋ – shallow root veg

▭ – possible bulge

Comments, Notes or Deficiencies Found:

- large erosion gully downslope of WD-1; to be repaired during construction this summer
- weir basin should be cleared
- veg on upstream slope; shallow root; low concern
- rill erosion on upstream slope between I and J; to be repaired during upcoming construction
- possible bulging north of WD-2 on downstream toe; continue to monitor
- no changes to minor surface cracks noted in toll crest during last inspection.

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: K. Snider

Inspection Type: ☒ Routine ☐ Event Driven

Inspection Date: 2017-07-19

Weather / Visibility: ~25°C / sunny — Raining? N; Snow Covered? N

Inspection Time: 14 : 55

Reviewed By: Mark Slater

Review Date: 2017-08-09

	Y	N	N/A
From this inspection, is this dam safe?	✓		
Siteline Notification Required?		✓	N/A
Maintenance Work Required?	✓		
Repair Log Entry Made?		✓	N/A
Work Order Created?		✓	N/A

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps? (see reverse)	✓		
Settlement?		✓	
Depressions / Sinkholes?		✓	
Ruts?		✓	
Water Ponding?		✓	
Surface Protection Issues?		✓	
Concerning Vegetation?		✓	
Animal Burrows?		✓	
Movement Observed? (none observed)		✓	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		✓	
Estimated Freeboard: ~1.8m			
Freeboard - Observations?			

Site C: visited 28 Jul 17	Y	N	N/A
New Movement Detected?		✓	
Trees Indicating Movement?		✓	
Drain Pipe Broken?		✓	
Water Not Flowing in Ditch?		✓	
V-Notch Weir Reading: 0.18 ft			

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		✓	
Bulges / Depressions?		✓	
Slope Protection Issues?		✓	
Signs of Erosion? (see reverse)	✓		
Concerning Vegetation? (see reverse)	✓		
Animal Burrows?		✓	
Movement Observed? (none observed)		✓	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		✓	
Bulges / Depressions?		✓	
Slope Protection Issues?		✓	
Signs of Erosion? (see reverse)	✓		
Concerning Vegetation?		✓	
Animal Burrows?		✓	
Movement Observed? (none observed.)		✓	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		✓	
Prism Data Issues?		✓	
Changes in Prism Data Trend?		✓	
Site C GPS Physical Issues?		✓	
Site C GPS Data Issues?		✓	
Changes in GPS Data Trend?		✓	

	Y	N	N/A
Piezometer Condtion Issues?		✓	
Protection / Casing Broken?		✓	
Manual Readings Taken? (July 28)	✓		
Piezometer Data Issues?	✓	✓ KS	
Changes in Piezo Data Trend?		✓	
Measure Barge GPS height above water: 217.5			

Comments: ND 2A & 3B not functioning; ND 1 & 3 currently being upgraded; ND 1 & 3 experiencing unknown splices, should be correct w above upgrade

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe? (within valley @ toe at site E/C, no changes since last observed on June 13)	✓		
Signs of Erosion?		✓	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		✓	
Ponded water at the downstream toe?		✓	
Observed Piping?		✓	

If seepage is observed, complete the following and note location / extent on map:

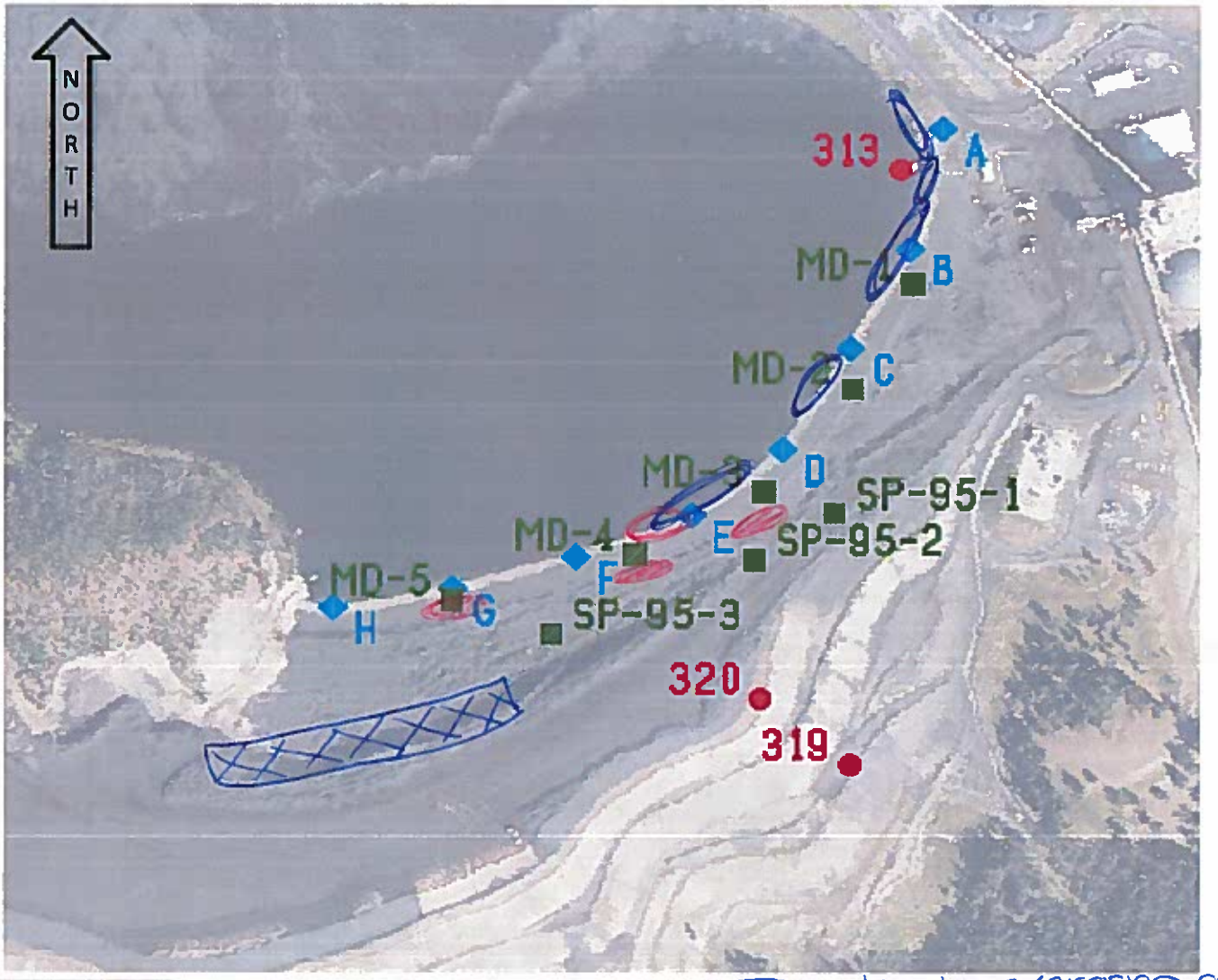
Rate: _____ Environment Notified? ☐ ☒ ☐

Appearance: [redacted] clear Samples Requested? ☐ ☒ ☐

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



- sloughing/erosion on upstream slope.

Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- sloughing/erosion on upstream slope; re-sloping to take place during 2017 construction

some shallow rooted weeds/plants on upstream slope mainly on east portion of dam; very low concern.

- minor rill erosion on upstream slope; will be addressed during 2017 construction

- rill erosion on downstream slope; will be addressed during 2017 construction

- access ramp constructed for 2017 construction

no changes in previously noted surface tall cracks; to be addressed during 2017 construction.

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: K. Snider

Inspection Date: July 19/17

Inspection Time: 14 : 15

Reviewed By: _____

Review Date: _____

Inspection Type: ☒ Routine ☐ Event Driven

Weather / Visibility: 25°C / sunny

Raining? N

Snow Covered? N

From this inspection, is this dam safe? Y

Siteline Notification Required? N/A

Maintenance Work Required? N

Repair Log Entry Made? N/A

Work Order Created? N/A

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps? (see reverse)	Y		
Settlement?		N	
Depressions / Sinkholes?		N	
Ruts?		N	
Water Ponding?		N	
Surface Protection Issues?		N	
Concerning Vegetation? (see reverse)	Y		
Animal Burrows?		N	
Movement Observed?		N	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		N	
Estimated Freeboard: ~1.8m			
Freeboard - Observations?			

GH 1 Road:	Y	N	N/A
Signs of Deformation?		N	
Trees Indicating Movement?		N	
Culverts Blocked?		N	
Sediment in Water Flow? (should be cleared)	Y		
V-Notch Weir Reading: 0.05 ft.			

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		N	
Bulges / Depressions?		N	
Slope Protection Issues?		N	
Signs of Erosion?		N	
Concerning Vegetation? (see reverse)	Y		
Animal Burrows?		N	
Movement Observed?		N	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		N	
Bulges / Depressions? (potential; see reverse)	Y		
Slope Protection Issues?		N	
Signs of Erosion? (see reverse)	Y		
Concerning Vegetation?		N	
Animal Burrows?		N	
Movement Observed?		N	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		N	
Prism Data Issues?		N	
Changes in Prism Data Trend?		N	
Piezometer Condtion Issues?		N	
Protection / Casing Broken?		N	
Manual Readings Taken?		N	
Piezometer Data Issues?	Y		
Changes in Piezo Data Trend?		N	

Comments: large gaps of missing data in WD-2 series; likely due to panel charging issues, plans to address underway.

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		N	
Signs of Erosion?		N	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		N	
Ponded water at the downstream toe?		N	
Observed Piping?		N	

If seepage is observed, complete the following and note location / extent on map:

Rate: _____ _____

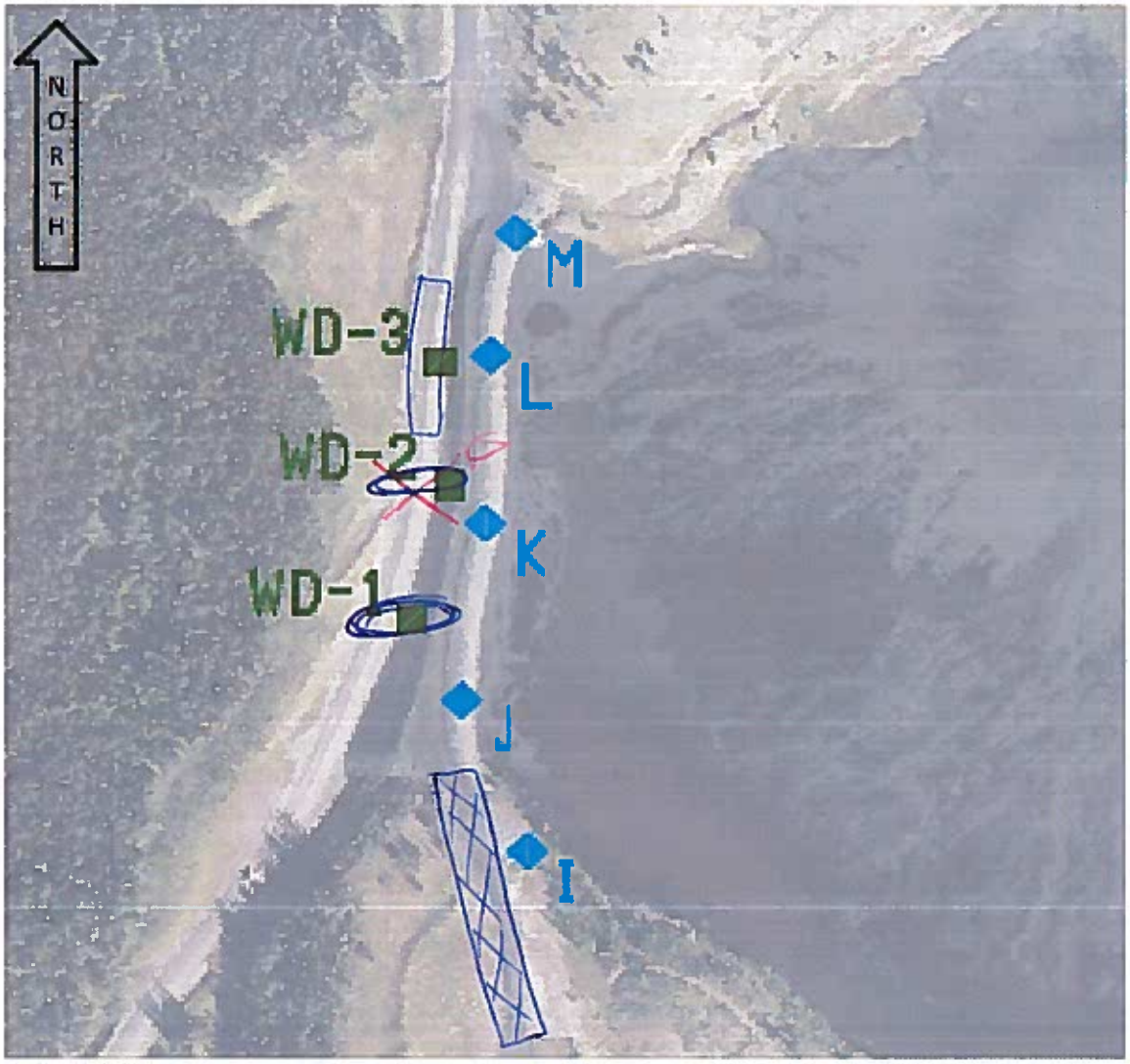
Appearance: _____

Environment Notified?	Y		N
Samples Requested?	Y	N	

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



▭ - potential area of bulging.

⬭ - major rill erosion/channel on downstream slope.

Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

weir to be cleaned of sediment.

Comments, Notes or Deficiencies Found:

▭ - potential area of bulging; EoR observed & discussed; EoR to check records to determine if left from construction in 2016 or happened since completion.

⬭ - major erosion channel on downstream slope; can be addressed during 2017 construction

shallow rooted veg present on upstream slope; no concern at this time

1720m bench tie-in (south) underway to pit rock

▨ - access road constructed for 2017 construction

no change to minor/previously noted surface cracks; to be addressed during 2017 construction.

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Date: 2017-08-17

Inspection Time: 13:40

Reviewed By: _____

Review Date: _____

Inspection Type: ☒ Routine ☐ Event Driven

Weather / Visibility: 24°C / partly cloudy

	Y	N
Raining?		☒
Snow Covered?		☒

	Y	N	N/A
From this inspection, is this dam safe?	☒		
Siteline Notification Required?		☒	
Maintenance Work Required? underway.	☒		
Repair Log Entry Made?		☒	
Work Order Created?		☒	

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps? (vs)	☒	☒	
Settlement?		☒	
Depressions / Sinkholes?		☒	
Ruts?		☒	
Water Ponding?		☒	
Surface Protection Issues?		☒	
Concerning Vegetation?		☒	
Animal Burrows?		☒	
Movement Observed? none observed		☒	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?	☐	☒	☐
Estimated Freeboard: ~2.5m			
Freeboard - Observations?			

Site C:	Y	N	N/A
New Movement Detected?		☒	
Trees Indicating Movement?		☒	
Drain Pipe Broken?	☒		
Water Not Flowing in Ditch?		☒	
V-Notch Weir Reading: 0.18			

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		☒	
Bulges / Depressions?		☒	
Slope Protection Issues?		☒	
Signs of Erosion? sloughing - see reverse	☒		
Concerning Vegetation?		☒	
Animal Burrows?		☒	
Movement Observed? none observed		☒	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		☒	
Bulges / Depressions?		☒	
Slope Protection Issues?		☒	
Signs of Erosion?	☒		
Concerning Vegetation?		☒	
Animal Burrows?		☒	
Movement Observed?		☒	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		☒	
Prism Data Issues?		☒	
Changes in Prism Data Trend?		☒	
Site C GPS Physical Issues?		☒	
Site C GPS Data Issues?		☒	
Changes in GPS Data Trend?		☒	

	Y	N	N/A
Piezometer Condtion Issues?		☒	
Protection / Casing Broken?		☒	
Manual Readings Taken?	☒		
Piezometer Data Issues?	☒		
Changes in Piezo Data Trend?	☒		
Measure Barge GPS height above water: construction underway			

Comments: MD-1A:B have short high/low between Aug 8-15; MD2A not reading? Probably broken; MD2B = good; MD3A jump in elevation due to system upgrade Aug 11; MD3B reset on Aug 10, good since; MD4 and MD5 all good. ? reading

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe? see reverse.	☒		
Signs of Erosion?		☒	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		☒	
Ponded water at the downstream toe?		☒	
Observed Piping?		☒	

If seepage is observed, complete the following and note location / extent on map:

Rate: _____ Site C above.

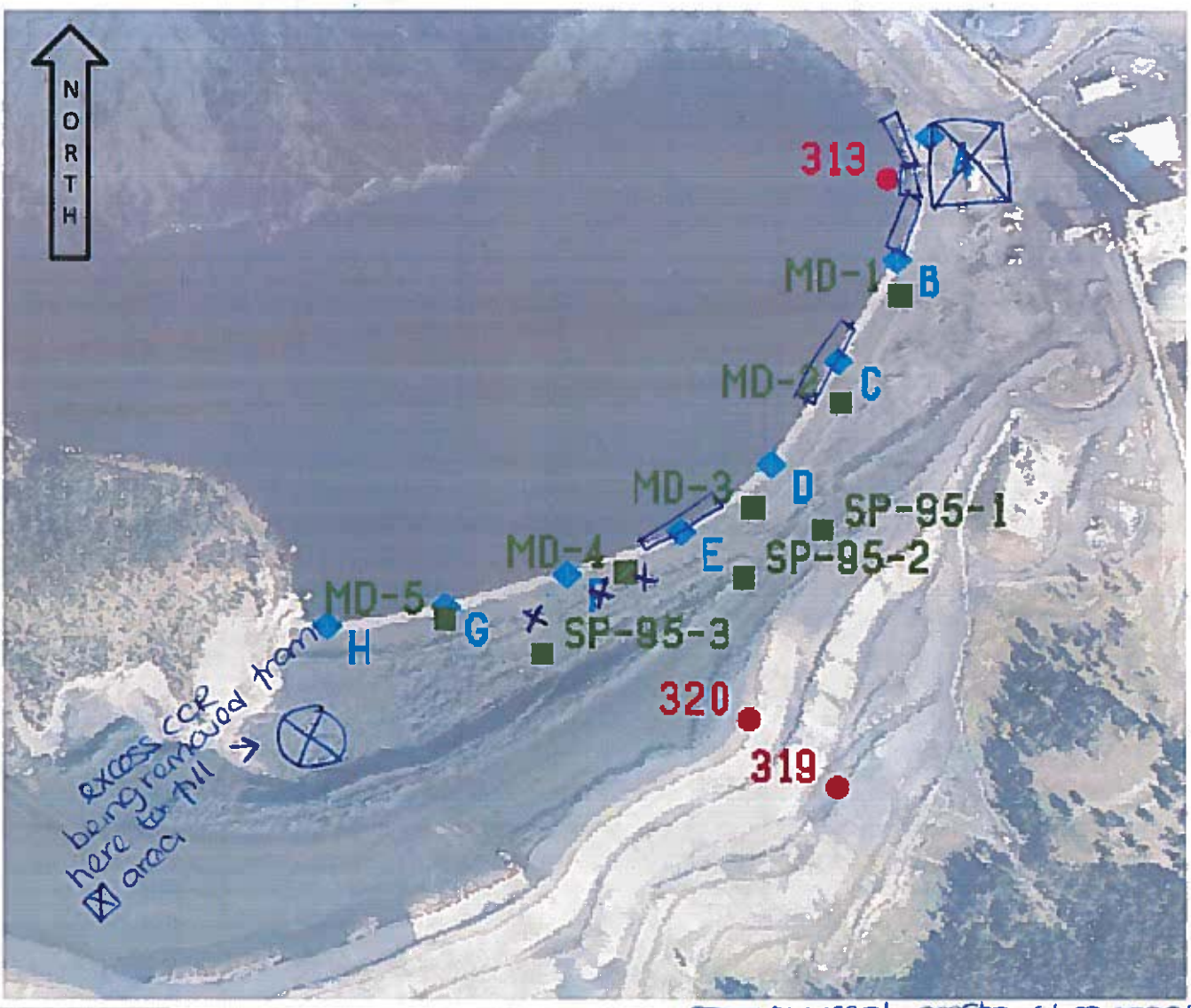
Appearance: clear, no material transport.

Environment Notified?	☐	☒	☐
Samples Requested?	☐	☒	☐

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map ☒ current construction zone: dug up till from old sewage building and recompacting; Golder QC on site for compaction testing.
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

X - erosion ☐ - slaughing.

Comments, Notes or Deficiencies Found:

- Main Dam construction underway; Site C drainage work starting up
- previously noted surface cracks in till layer [redacted] present; chang
- visual freeboard monitor in place (new)
- X - erosion on downstream slope
- ☐ - slaughing of upstream slope
- shallow root weeds/veg present in some areas; no concern; will be removed during construction activity.
- seepage at Site E observed to be clear & flowing.
- seepage in valley @ toe of Site E/C; no change since last observed.
- instrumentation issues being looked into.

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Date: Aug 21 2017

Inspection Time: 09:40

Reviewed By: _____

Review Date: _____

Inspection Type: [X] Routine [ ] Event Driven

Weather / Visibility: ~12°C / clear skies. Raining? [N] Snow Covered? [N]

From this inspection, is this dam safe? [Y]
Siteline Notification Required? [N]
Maintenance Work Required? underway
Repair Log Entry Made? [N]
Work Order Created? [N]

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps? till layer; see reverse	X		
Settlement?		X	
Depressions / Sinkholes?		X	
Ruts?		X	
Water Ponding?		X	
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard: ~2.5m			
Freeboard - Observations?			

GH 1 Road:	Y	N	N/A
Signs of Deformation?		X	
Trees Indicating Movement?		X	
Culverts Blocked?		X	
Sediment in Water Flow?	X		
V-Notch Weir Reading: see reverse			

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?	X		
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions? see reverse	X		
Slope Protection Issues?		X	
Signs of Erosion? see reverse	X		
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		X	
Prism Data Issues?		X	
Changes in Prism Data Trend?		X	

	Y	N	N/A
Piezometer Condtion Issues?		X	
Protection / Casing Broken?		X	
Manual Readings Taken?		X	
Piezometer Data Issues?	X		
Changes in Piezo Data Trend?		X	

Comments: WD 1 and 3 good; WD 2 reading are sporadic; reset WD 2 on Aug 22; possible need to replace NavStar box; being tracked into.

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		X	
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		X	
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map:

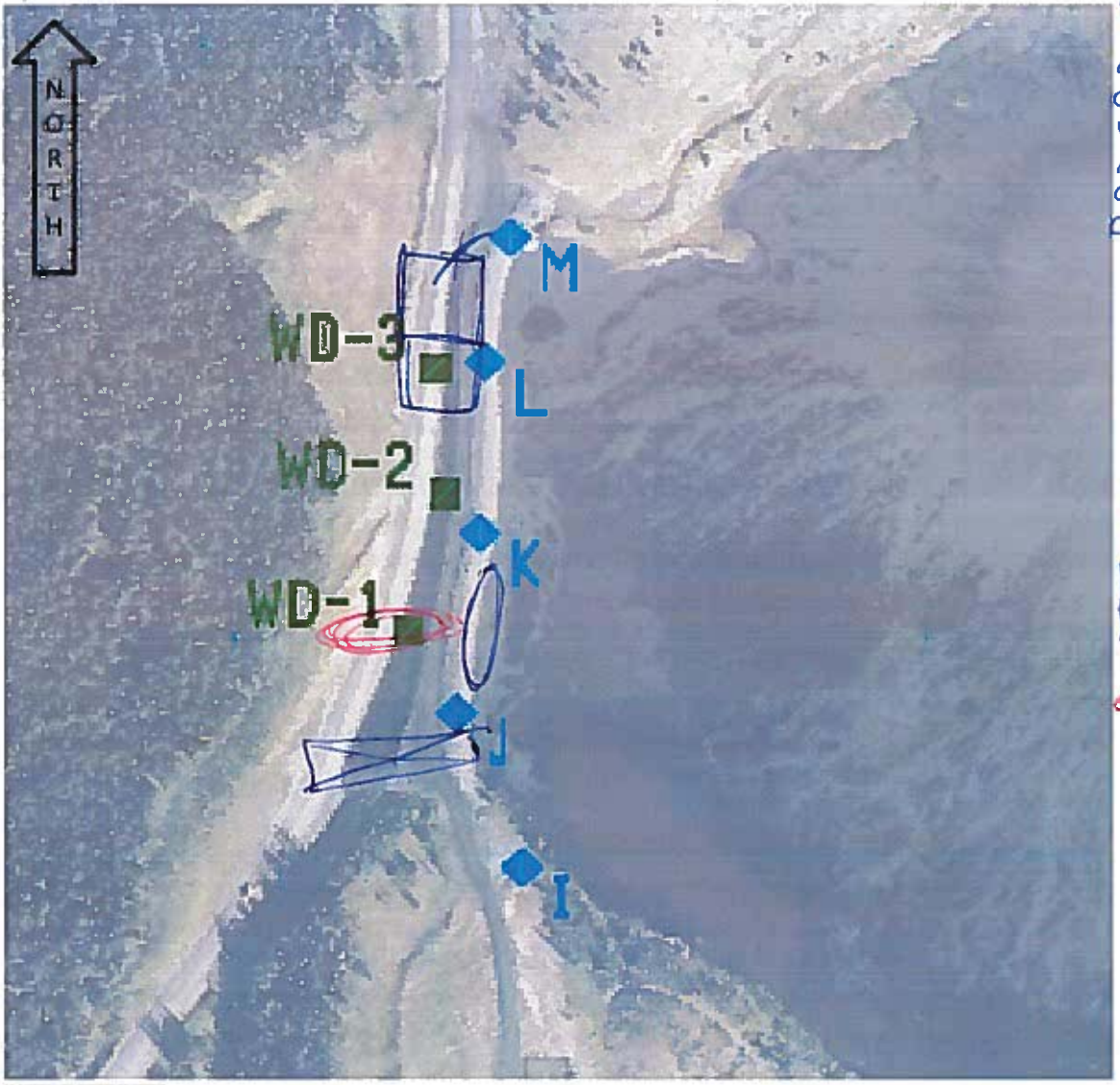
Rate: _____ _____ Environment Notified? [ ] [ ] [X]

Appearance: _____ Samples Requested? [ ] [ ] [X]

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



☒ - construction - work completed to remove spillway and replace with compacted OCR; work on 17 and 18 Aug; Golder QC on site and testing completed

( ) - minor rill - erosion on upstream surface of dam

* - animal path.

▭ - possible bulge.

○ - erosion channel.

Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- shallow rooting present on upstream slope; no real concern; likely be removed during dam raise; mainly between L-J stands.
- berm in place along east side ~8m from edge to act a barrier during construction as traffic to be routed over dam
- possible bulge area on downstream slope near WD-3; follow up in EoR
- no change to previously noted surface cracks on toll
- large erosion channel near WD-1
- spillway removed and recompacted
- weir filled with v. large rock from 1720m bench tie-in; weir not properly reading as has been knocked out of place.

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristan Snider

Inspection Date: 2017-09-20

Inspection Time: 09:45

Reviewed By: Reviewer To Sign This Form

Review Date: Y Y Y Y - M M - D D

Inspection Type: [/] Routine [ ] Event Driven

Weather / Visibility: ~1°C / cloudy — Raining? [ ] Y [/] N; Snow Covered? [ ] Y [/] N

From this inspection, is this dam safe? [/] Y [ ] N

Siteline Notification Required? [ ] Y [/] N N/A

Maintenance Work Required? underway [/] Y [ ] N N/A

Repair Log Entry Made? [ ] Y [/] N N/A

Work Order Created? [ ] Y [/] N N/A

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		/	
Settlement?		/	
Depressions / Sinkholes?		/	
Ruts?		/	
Water Ponding?		/	
Surface Protection Issues?		/	
Concerning Vegetation?		/	
Animal Burrows?		/	
Movement Observed?		/	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris? flagging tape or bdg!		/	
Estimated Freeboard: ~2.8 m			
Freeboard - Observations?			

GH 1 Road:	Y	N	N/A
Signs of Deformation?		/	
Trees Indicating Movement?		/	
Culverts Blocked?		/	
Sediment in Water Flow?	/		
V-Notch Weir Reading: 0.09 45 measured downstream after culvert.			

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		/	
Bulges / Depressions?		/	
Slope Protection Issues?		/	
Signs of Erosion?		/	
Concerning Vegetation? veg. no concern	/		
Animal Burrows?		/	
Movement Observed?		/	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		/	
Bulges / Depressions?		/	
Slope Protection Issues?		/	
Signs of Erosion?		/	
Concerning Vegetation?		/	
Animal Burrows?		/	
Movement Observed?		/	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?		/	
Prism Data Issues? not in place.			/
Changes in Prism Data Trend?			/

	Y	N	N/A
Piezometer Condtion Issues?		/	
Protection / Casing Broken?		/	
Manual Readings Taken?		/	
Piezometer Data Issues?	/		
Changes in Piezo Data Trend?			

Comments: piezo's 2:3 reading issues, correction underway; prism stands moved for construction

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		/	
Signs of Erosion?		/	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		/	
Ponded water at the downstream toe?		/	
Observed Piping?		/	

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

Appearance:

Environment Notified? [ ] Y [ ] N [/] N/A

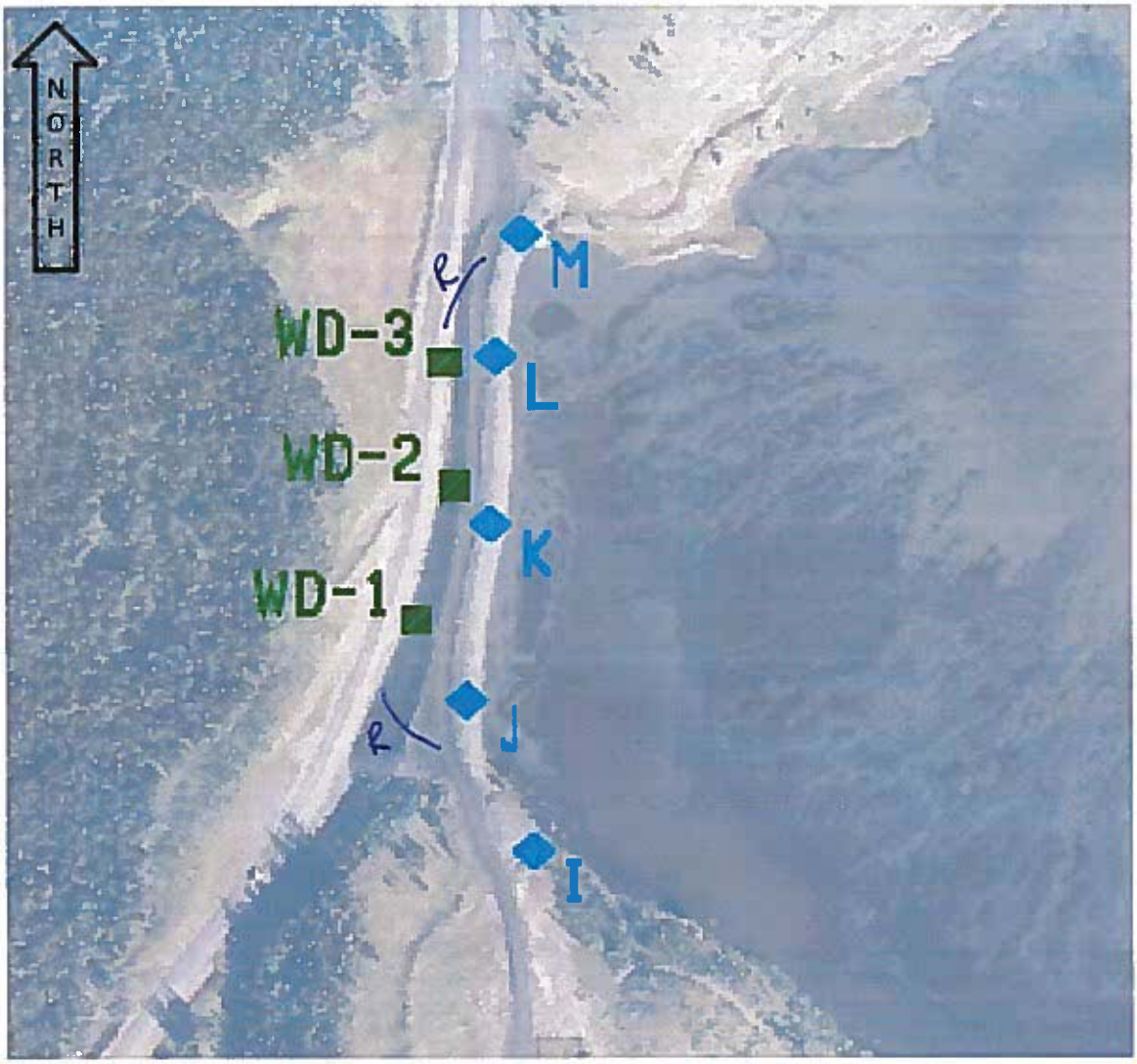
Samples Requested? [ ] Y [ ] N [/] N/A

WEST TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection

R/ = access ramp



Helpful Tips:

* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- till and CCR lifted on WD crest; few areas of fill require further lift prior to completion; till to be further pact after additional lifting
- downstream construction underway; repairing slope erosion as it proceeds
- minor small root veg on upstream slope to be removed before end of construction
- access ramps in place on N & S backside of dam for lift constructed access
- spillway removed and area repacked.
- minor fill cracks no longer visible as till lifted.
- 1720m bench key in complete
- weir requires cladding and relocation; to be completed prior to construction end.; rock in basin from 1720m to be in.

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 1 of 2)

Inspected By: Kristin Snider

Inspection Date: 2017-09-20

Inspection Time: 11:03

Reviewed By: Reviewer To Sign This Form

Review Date: Y Y Y Y M M D D

Inspection Type: [X] Routine [ ] Event Driven

Weather / Visibility: 3°C / cloudy

Raining? Y [ ] N [X]

Snow Covered? Y [ ] N [X]

From this inspection, is this dam safe? Y [X] N [ ]

Siteline Notification Required? Y [ ] N [X] N/A

Maintenance Work Required? underway Y [X] N [ ] N/A

Repair Log Entry Made? Y [X] N [ ] N/A

Work Order Created? Y [ ] N [X] N/A

Are any of the following conditions apparent?

Crest:	Y	N	N/A
Surface Cracking / Scarps?		X	
Settlement?		X	
Depressions / Sinkholes?		X	
Ruts?		X	
Water Ponding?		X	
Surface Protection Issues?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Pond Level:	Y	N	N/A
Floating Debris?		X	
Estimated Freeboard:	~2.8m		Units
Freeboard - Observations?			

Site C:	Y	N	N/A
New Movement Detected?		X	
Trees Indicating Movement?		X	
Drain Pipe Broken?		X	
Water Not Flowing in Ditch?		X	
V-Notch Weir Reading:	0.16 L/s		

Upstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?	X		
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Downstream Slope:	Y	N	N/A
Slope Stability Issues?		X	
Bulges / Depressions?		X	
Slope Protection Issues?		X	
Signs of Erosion?		X	
Concerning Vegetation?		X	
Animal Burrows?		X	
Movement Observed?		X	

Note: How Much, Where and Direction on Map.

Instrumentation / Data:	Y	N	N/A
Prism Stands Physical Issues?			X
Prism Data Issues? moved for work			X
Changes in Prism Data Trend?			X
Site C GPS Physical Issues?			X
Site C GPS Data Issues?			X
Changes in GPS Data Trend?			X

	Y	N	N/A
Piezometer Condtion Issues?			X
Protection / Casing Broken?			X
Manual Readings Taken?			X
Piezometer Data Issues? below	X		
Changes in Piezo Data Trend? "	X		
Measure Barge GPS height above water:			

Comments: MD 1 = lot of error points; MD2 not working proper; MD 3 = good; MD 4 = no reading, errors being worked on today; MD5 = good; new piezos = good; prisms moved for construction

Downstream Toe and Seepage:	Y	N	N/A
Wet areas or seepage on downstream slope/toe?		X	
Signs of Erosion?		X	
Signs of Foundation Movement (Toe Bulge / Heave / Tree Alignment)?		X	
Ponded water at the downstream toe?		X	
Observed Piping?		X	

If seepage is observed, complete the following and note location / extent on map:

Rate: Quantity Units

Appearance:

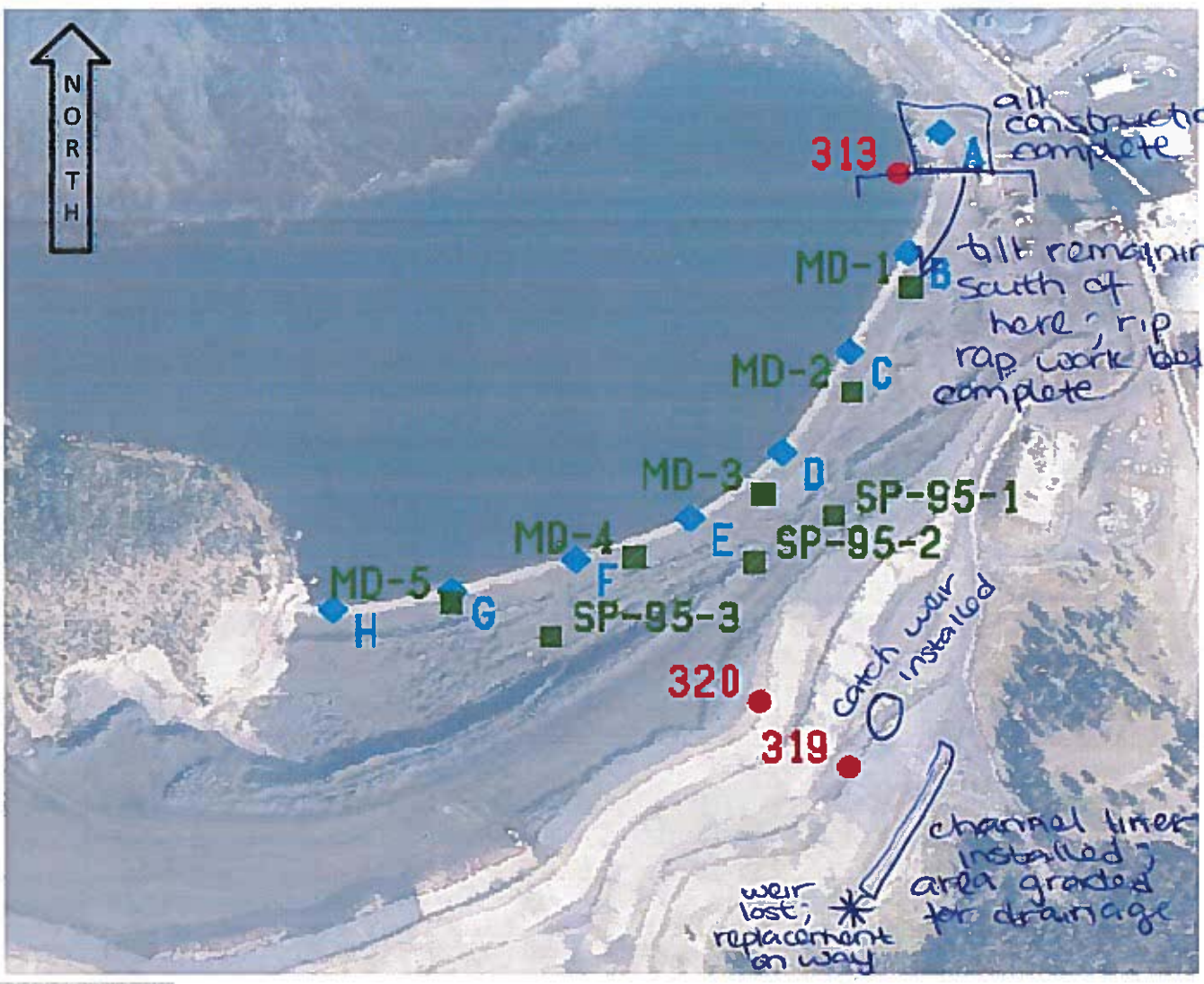
Environment Notified? Y [ ] N [ ] N/A [X]

Samples Requested? Y [ ] N [ ] N/A [X]

MAIN TAILINGS DAM INSPECTION CHECKLIST (Page 2 of 2)

Pond Map:

Draw deficiencies on the map below. If necessary, indicate the path followed during the inspection



313 → water level ~1724.7m

Helpful Tips:

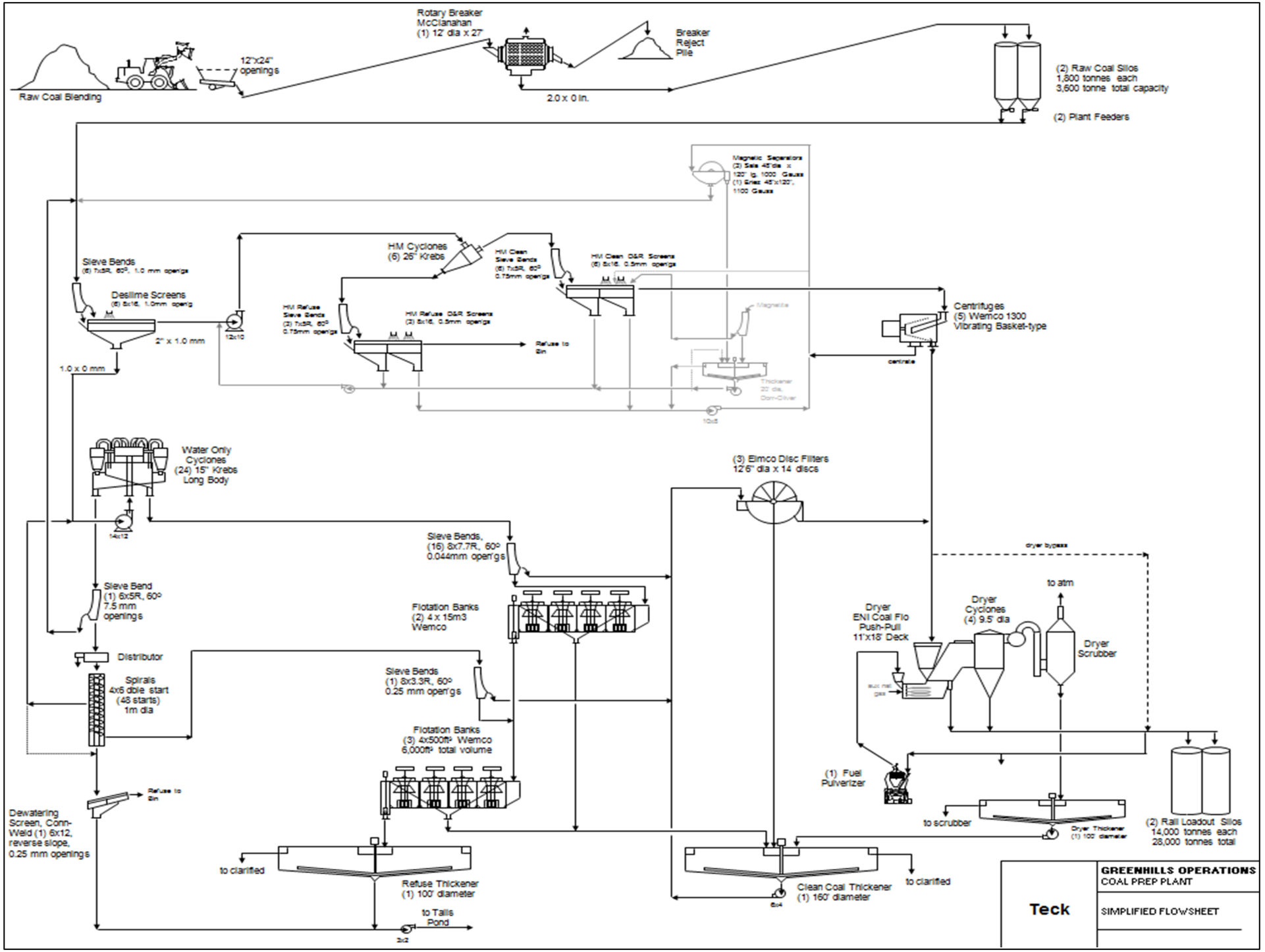
* Ensure all deficiencies are marked (included extent) on this map
* Use abbreviations or codes (if necessary) to reduce map clutter and reference these in the notes below
* Any significant concerns must be addressed immediately.
* Ensure photos are taken of all upstream and downstream slope conditions and any deficiencies

Comments, Notes or Deficiencies Found:

- CCR lifting mostly complete other than few spot lifts and tie in between N + south of barge
- CCR and till lift complete N of barge in prep for Sept 26 barge move
- till south of barge not complete; currently spreading CCR filter on upstream slope before placement of rip rap; once rip rap complete till lift to take place
- MD4 and 5 piezo stands moved to outside footprint
- minor shallow root veg on upslope to be taken care of during rip rap process
- minor toll cracks noted previously to be repaired during till lift
- site C drainage work mostly complete - weir installed on upper bench, grading, channel liner installed; scour to be complete week of October 2
- lower measuring weir lost during construction; replacement ordered; flow measured by bottle.

APPENDIX E

Process Flowsheet


Raw Coal Blending
12"x24" openings
Rotary Breaker
McClanahan
(1) 12' dia x 27'
2.0 x 0 in.
Breaker Reject Pile
(2) Raw Coal Silos
1,800 tonnes each
3,600 tonne total capacity
(2) Plant Feeders
Magnetic Separators
(2) Sala 48"dia x 120" lg, 1000 Gauss
(1) Eriez 48"x120", 1100 Gauss
Sieve Bends
(6) 7x5R, 60°, 1.0 mm openings
Desilime Screens
(6) 8x16, 1.0mm openings
2" x 1.0 mm
1.0 x 0 mm
12x10
HM Cyclones
(6) 26" Krebs
HM Clean Sieve Bends
(6) 7x5R, 60°
0.15mm openings
HM Clean D&R Screens
(6) 8x16, 0.5mm openings
HM Refuse Sieve Bends
(2) 7x5R, 60°
0.15mm openings
HM Refuse D&R Screens
(2) 8x16, 0.5mm openings
Refuse to Bin
Magnetite
Thickener
22' dia.
Dorr-Oliver
10x8
Centrifuges
(5) Wemco 1300
Vibrating Basket-type
centrate
Water Only Cyclones
(24) 15" Krebs
Long Body
14x12
(3) Elmco Disc Filters
12'6" dia x 14 discs
Sieve Bends,
(16) 8x7.7R, 60°
0.044mm openings
Sieve Bend
(1) 6x5R, 60°
7.5 mm openings
Flotation Banks
(2) 4 x 15m3
Wemco
Distributor
Spirals
4x6 dble start
(48 starts)
1m dia
Sieve Bends
(1) 8x3.3R, 60°
0.25 mm openings
Flotation Banks
(3) 4x500ft³ Wemco
6,000ft³ total volume
Refuse to Bin
Dewatering Screen, Conn-Weld (1) 6x12, reverse slope, 0.25 mm openings
to clarifier
Refuse Thickener
(1) 100' diameter
to Tails Pond
3x2
Clean Coal Thickener
(1) 160' diameter
to clarifier
8x4
dryer bypass
to atm
Dryer ENI Coal Flo Push-Pull 11'x18' Deck
Dryer Cyclones
(4) 9.5' dia
Dryer Scrubber
dust free gas
(1) Fuel Pulverizer
to scrubber
Dryer Thickener
(1) 100' diameter
(2) Rail Loadout Silos
14,000 tonnes each
28,000 tonnes total
Teck
GREENHILLS OPERATIONS
COAL PREP PLANT
SIMPLIFIED FLOWSHEET

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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