Klohn Crippen Berger

Teck Coal Ltd.

Quintette Coal Operations

Shikano North Tailings Dam

2019 Dam Safety Inspection

CANADA BEST MANAGED COMPANIES Platinum member

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M09684A16.730

March 2020

March 17, 2020

Teck Coal Ltd.
P.O. Box 1500
23097 Murray Forest Service Road
Tumbler Ridge, British Columbia
V0C 2W0

Mr. Rob Muise
Site Lead, Care and Maintenance

Dear Mr. Muise:

Quintette Coal Operations
Shikano North Tailings Dam
2019 Dam Safety Inspection

We are pleased to submit the 2019 Dam Safety Inspection Report for the Shikano North Tailings Dam.

Please contact us if you have any questions regarding this report.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

Robert W. Chambers, P.Eng.
Project Manager
Senior Geotechnical Engineer, Principal

MC:jc

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CANADA'S BEST MANAGED COMPANIES Platinum member

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Shikano North Tailings Dam

2019 Dam Safety Inspection

EXECUTIVE SUMMARY

Klohn Crippen Berger Ltd. (KCB) was engaged by Teck Coal Ltd. (Teck) to complete the 2019 Dam Safety Inspection (DSI) of the Shikano North Tailings Dam (SNTD) at the Quintette Coal Operations (QCO) mine site, to comply with Section 10.5.3 of the Health, Safety and Reclamation Code (HSRC) for Mines in British Columbia (also referred to as the Code) (EMPR[1] 2017). This report was prepared following:

- Ministry of Energy, Mines and Petroleum Resources (EMPR), British Columbia (BC) Section 4.2 "Annual Tailings Facility and Dam Safety Inspection Report" of the 2016 HSRC Guidance Document; and
- Teck 2019 Guideline for Tailings and Water Retaining Structures (TWRS).

The 2019 inspection was completed by the Engineer of Record (EoR), KCB representative Mr. Bob Chambers, P.Eng. and Mr. Max Cronk, P.Eng., on May 27, 2019. Teck have designated Mr. Andrew Bidwell, P.Eng., as the Tailings Storage Facility (TSF) Qualified Person (as defined by the Code) for the SNTD.

This Executive Summary is provided solely for the purposes of overview. Any party who relies on this report must read the full report. The summary omits a number of details and context which are crucial to the proper application and interpretation of this report.

Summary of Facility Description

QCO has not been in operation since 2000. Portions of the site have been reclaimed, but otherwise the site has been under care and maintenance status since operations stopped. Under the current level of site presence, the SNTD is consistent with "Closure-Active Care" phase as defined by the Canadian Dam Association (CDA) Mining Dam Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (CDA 2014). During care and maintenance, Teck staff are onsite for environmental sampling, inspections and maintenance activities.

The SNTD is approximately 16 km south of the Municipality of Tumbler Ridge in northeastern BC. The SNTD is constructed across the mined-out Shikano North Pit. The SNTD crest is approximately 200 m long and at El. 827.7 masl. The SNTD has a maximum height of 45 m (crest to downstream toe) with 2H:1V downstream slope and 2.25H:1V upstream slope.

The dam was designed as a "flow-through" rockfill dam with internal granular filters and a non-woven geotextile to restrict fine coal tailings passing through the dam while allowing seepage through the structure. Seepage is routed to Sedimentation Pond S3 through a culvert before being discharged to the environment towards the Murray River (west of the SNTD). No construction has been carried out on the dam since 2000 and no construction is planned while the site remains in care and maintenance.

[1] Formerly referred to as MEMPR.

Summary of Key Hazards

Internal Erosion and Piping: Several sinkholes have been observed on the tailings beach since the 2010 DSI inspection but may have been present or started to develop prior to this date. There was no visually obvious change in the sinkholes observed during the 2019 site visit, and the sinkholes do not represent a dam safety concern. A comparison of aerial drone surveys taken in 2018 and 2019 suggests that the sinkholes have continued to gradually increase in size. The sinkholes are most likely a local condition where tailings are migrating into the upstream coarse rockfill shell or into "windows" of high permeability fill, but not through the internal filters into the downstream shell. The "windows" of high permeability fill on the upstream slope were introduced during construction to encourage seepage flow through the dam as per the overall design concept because the material available for the fine filter zone of the embankment had a permeability lower than expected. If piping of tailings into the downstream shell were to occur, the likelihood of triggering a dam failure is very low.

Other Hazards: such as overtopping, slope instability, foundation failure, surface erosion, rockfill degradation, and earthquakes are not considered "key hazards" for this facility and are discussed in the main text of this report.

Summary – there are no current dam safety concerns.

Consequence Classification of Dam

The SNTD was classified as having a "Significant" (KCB 2014a) failure consequence under existing conditions, based on CDA (2013). There have been no changes to the downstream environment or operation of the structure that would warrant a review of this classification. The EMPR permit C-156 (EMPR 2013) for the restart of operations at the QCO site refers to the SNTD as a "High" consequence classification dam. Teck has indicated that the permit reference to "High" consequence classification would be applied if tailings deposition in the facility resumes with restart of mining (i.e. not applicable to existing condition); mining had not restarted at the time of writing.

Changes in Instrumentation and/or Visual Monitoring Records

Overall, piezometer readings are below historical levels during operations and there were no threshold exceedances in 2019. No continuous downstream movement or settlement of the crest has been observed since survey monument re-initiation in 2014. No changes are recommended to the instrument reading frequency or threshold levels for 2019.

Teck began completing annual drone LiDAR surveys of the SNTD in 2018. The second such survey was completed in October, 2019. The purpose of the surveys is to assist with tracking changes in the sinkholes on the tailings beach and, as a secondary objective, with monitoring embankment deformations. A comparison of the 2018 and 2019 surveys showed the following:

- There were no significant differences in crest elevation or the downstream slope between the two surveys, with the difference on average being less than the accuracy of the survey equipment (+/- 5 cm) (UAViation 2019). There were some discrepancies (ranging from 0.3 m

to 0.6 m) between the drone LiDAR and the survey monument pin elevations, and these should be resolved by confirming that both are using the same survey datum.

- The survey appears to have been sufficient to track gradual changes in the sinkholes.

Overall, the drone surveys appear adequate to monitor changes in the sinkholes, and, provided the survey datum discrepancies can be resolved, the surveys may turn out to be a potential alternative to monitor embankment deformations moving forward. Further confidence in the data will be gained as additional surveys are completed.

Changes to Surface Water Control

There were no changes to surface water control in 2019.

The catchment for the SNTD impoundment is 76.4 ha including the tailings beach and pond area. During operations, tailings were discharged from the eastern edge of the impoundment which formed a tailings beach sloping towards the dam. Impounded water ponds in a depression on the tailings surface near the dam face.

A spillway is not required based on the large available storage capacity within the impoundment under existing conditions. Even during a 72-hour probable maximum flood (PMF), which is greater than the IDF required under the Code, there would be approximately 18 m of freeboard, meeting the Code requirement for flood storage.

Operation, Maintenance, and Surveillance Manual

The Operation, Maintenance and Surveillance Manual (OMS) manual was updated in March 2019. Quantifiable Performance Objectives (QPOs) (i.e., thresholds) and responses levels for piezometers, survey monuments and freeboard are included in the document.

Emergency Preparedness and Response Plan

Teck developed an Emergency Preparedness and Response Plan (EPRP) for the SNTD in 2019.

Dam Safety Review

The most recent DSR was completed in 2014 (KCB 2014a). Teck have indicated that the next DSR should be completed by July 2021, which is 5 years from effective date of the Code requirement for DSRs to be performed at least every 5 years.

2019 DSI Observations and Recommendations

The SNTD appears to be in good condition with respect to stability and water management. Comparison between available annual inspection reports indicates there have been no significant changes to the condition of the structure since 2000.

Recommendations from previous DSI inspections are summarized in Table E-1. Recommendations resulting from the 2019 DSI are summarized in Table E-2. Closed recommendations are shown in grey italics and will be removed from the table in the next DSI report.

KCB have assigned priority to the various recommendations using the 2016 HSRC Guidance Document priority definitions, which are as follows:

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

Table E-1 Previous Recommendations

ID Number	Deficiency or Non-Conformance	Applicable Regulation or OMS Manual Reference	Recommended Action	Priority	Recommended Deadline (Status)
SNTD-2016-01	*Sinkhole Monitoring Program*	*OMS Manual*	*Establish a monitoring program (i.e. stakes) for the sinkholes within the tailings beach to determine if new ones are forming and/or if current ones are getting larger. To be conducted by Teck during the visual inspections and procedure included in the OMS manual. KCB to provide guidance on monitoring program.*	*3*	*(CLOSED – incorporated in LiDAR review)*
SNTD-2017-01	*Lack of an Emergency Preparedness and Response Plan (EPRP)*	*HSRC Code*	*Prepare an EPRP for the SNTD.*	*3*	*(CLOSED)*
SNTD-2018-01	Upper and Lower Met rain gauges unreliable in winter	n/a	Repair or improve the Upper and Lower Met climate station rain gauges to improve reliability of precipitation measurements during the winter months.	4	December 2020 (OPEN - Teck plan to establish a heated rain gauge on site to allow precipitation readings to be taken in the winter, Upper Met station may be excluded due to difficult winter access. Teck have indicated this work will be deferred into 2020.)

Table E-2 2019 Recommendations

ID Number	Deficiency or Non-Conformance	Applicable Regulation or OMS Manual Reference	Recommended Action	Priority	Recommended Deadline (Status)
SNTD-2019-01	Piezometers	n/a	Re-label the piezometers at the toe of the dam.	4	June 2020
SNTD-2019-02	Survey Datum	n/a	Confirm that the drone LiDAR and crest monument surveys are being done using the same survey datums, and confirm key facility metrics (e.g., crest, downstream slope, etc.).	4	December 2020

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LIST OF ACRONYMS

Acronym	Definition
BC	British Columbia
CDA	Canadian Dam Association
DSI	Dam Safety Inspection
DSR	Dam Safety Review
EDGM	Earthquake Design Ground Motion
EoR	Engineer of Record
EPRP	Emergency Preparedness and Response Plan
FoS	Factor of Safety
HSRC	Health, Safety and Reclamation Code for Mines in BC
IDF	Inflow Design Flood
KL	Klohn Leonoff
KCB	Klohn Crippen Berger Ltd.
MAC	Mining Association of Canada
EMPR	Ministry of Energy, Mines and Petroleum Resources (BC)
MoE	Ministry of Environment (BC)
NBCC	National Building Code of Canada
OMS	Operational, Maintenance and Surveillance
PMF	Probable Maximum Flood
QCO	Quintette Coal Operations
QOC	Quintette Operating Corporation
QPO	Quantifiable Performance Objectives
SNTD	Shikano North Tailings Dam
TSF	Tailings Storage Facility

1 INTRODUCTION

Klohn Crippen Berger Ltd. (KCB) was engaged by Teck Coal Ltd. (Teck) to complete the 2019 Dam Safety Inspection (DSI) of the Shikano North Tailings Dam (SNTD) at the Quintette Coal Operations (QCO) mine site. The inspection and this report were prepared to comply with Section 10.5.3 of the Health, Safety and Reclamation Code (HSRC) for Mines in British Columbia (also referred to as the Code) (EMPR[2] 2017). This report was prepared following:

- Ministry of Energy, Mines and Petroleum Resources (EMPR), British Columbia (BC) Section 4.2 "Annual Tailings Facility and Dam Safety Inspection Report" of the 2016 HSRC Guidance Document; and
- Teck 2019 Guideline for Tailings and Water Retaining Structures (TWRS).

A site visit was completed on May 27, 2019 by the Engineer of Record (EoR), KCB representative Mr. Bob Chambers, P.Eng., along with Mr. Max Cronk, P.Eng., of KCB. At the time of the inspection, the weather was sunny. No precipitation was recorded 24 hours prior to the inspection. Refer to Figure 1 and Figure 2 for general site location and layout, and Figure 3 for an overview of the facility and DSI inspection photograph locations. Inspection observations are summarized in the following sections of the report. DSI inspection photographs are provided in Appendix I.

During the inspection, KCB engineers were accompanied by Mr. Andrew Bidwell, P.Eng of Teck. Teck have designated Mr. Andrew Bidwell, P.Eng., as the Tailings Storage Facility (TSF) Qualified Person (as defined by the Code) for the SNTD. Mr. Rob Muise and Mr. Ray Proulx are the designated Dam Inspectors for the SNTD.

QCO has not been in operation since 2000. Portions of the site have been reclaimed, but otherwise the site has been under care and maintenance status since operations stopped. During care and maintenance, Teck staff are onsite for environmental sampling, inspections and maintenance activities. Under this level of site presence, the SNTD status is consistent with "Closure-Active Care" phase as defined by the Canadian Dam Association (CDA) Mining Dam Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (2014).

In 2013 and 2014, Teck received new permits for a restart of QCO mining operations:

- Ministry of Energy, Mines and Petroleum Resources (EMPR), Permit No. C-156 (amended June 20, 2013); and
- Ministry of Environment (MoE), Permit No. PE-06739 (amended July 9, 2014).

Fine coal tailings from restart operations would be discharged into the SNTD impoundment. However, Teck have deferred the restart of operations pending an improvement in market conditions. The 2014 MoE permit amendment includes provisions for water quality monitoring of the SNTD that apply to care and maintenance as well as to restart operations. The DSI is based on the

[2] Formerly referred to as MEMPR.

condition of the structure on the inspection date and does not consider a potential future restart of the QCO.

The SNTD has a “Significant” consequence category under existing conditions based on CDA (2013) as reported in the most recent Dam Safety Review (DSR) (KCB 2014a). The factors considered in the classification of the SNTD are listed in Table 1.1.

Table 1.1 Classification of SNTD Based on Consequence Category (KCB 2014a)

Population at Risk	Loss of Life	Economic and Social Loss	Environmental and Cultural Losses
No Permanent Population	Significant	Low	Low to Significant

EMPR permit C-156 (EMPR 2013) refers to the SNTD as a “High” consequence classification dam, which Teck confirm is applicable to the structure if the facility becomes an active tailings facility and not applicable to existing condition. The “High” consequence classification in the permit was appropriate because of the potential for increased downstream effects in the event of a SNTD failure with the tailings and pond volumes near ultimate capacity.

Teck have indicated that the next DSR is scheduled for 2021, which is 5 years from effective date of the Code requirement for DSRs to be performed at least every 5 years.

2 BACKGROUND AND RECENT ACTIVITY

2.1 Background Information

The SNTD is approximately 16 km south of the Municipality of Tumbler Ridge in northeastern BC and is approximately 2.5 km west of the QCO plantsite and gatehouse. The dam is constructed across the mined-out Shikano North Pit to form the Shikano North Tailings Storage Facility. The SNTD is surrounded by the Centre Waste Dump to the south, Seepage Collection Pond S3 and the Murray River to the northwest, waste dumps/natural slopes to the east, and the Shikano North Spoil to the north.

The facility was commissioned in 1997 when the Plantsite TSF reached capacity. No construction has been carried out on the dam since operations were suspended in 2000 and no construction is planned while the site remains in care and maintenance. A summary of available SNTD key reference documents is included in Appendix IV.

The SNTD was designed as a "flow-through" rockfill dam with internal granular filters and a non-woven geotextile filter fabric to restrict fine coal tailings passing through the dam while allowing seepage through the dam. "Windows" of high permeability gravel, upstream of the filters, were introduced as a design modification during construction to encourage seepage flow through the dam (as per design concept) because the material available for fine filter construction had a permeability lower than expected. Each window was approximately 1 m thick (KC 1997). The seepage discharges to S3 Pond through a culvert in the downstream shell of the dam (Figure 3).

The SNTD has a maximum downstream slope height of 45 m (crest to toe) with 2H:1V downstream and 2.25H:1V upstream slopes. The dam crest is 200 m long. The SNTD has a storage capacity of approximately 6 Mm^3 and has 2.8 Mm^3 of tailings and water stored to date (KCB 2014b).

The SNTD design was completed by Klohn Crippen Consultants Ltd. (KC) (1996). Select dam record drawings including cross sections of the SNTD are included in Appendix II. The SNTD was raised to the current crest elevation in two stages:

- Stage I (May to November 1996): crest elevation 810 masl.
- Stage II (December 1998 to March 1999): crest raised to elevation 829 masl.

Construction record reports were issued following each raise (KC 1997 and KC 1999b). No significant construction or performance related issues were noted in the construction record documents, 1999 Annual Review (AR) (KC 1999a) or DSI reports from 2010 to 2018. No construction has been carried out at the SNTD since completion in 1999.

When mining operations were suspended in 2000, tailings stored in the impoundment were well below design capacity. The current tailings are approximately at elevation 796 masl based on a 2010 LiDAR survey (provided by Teck, survey completed by McElhanney Consulting Services Ltd.) which is more than 30 m below the crest.

The current dam crest elevation, measured from survey monument pins in 2016, is 827.7 masl (KCB 2016b), 1.3 m lower than reported elevation in the Stage II construction record report (El. 829 masl)

(KC 1999b). For reference, post-construction settlements reported in the 1999 Annual Review (KC 1999a) indicated that 3 of the 4 survey monuments settled by approximately 0.2 m between March and September of 1999, while the 4th monument did not settle noticeably. A portion of the change in crest elevation is likely due to some post-construction settlements but is unlikely to be the sole source. Neither the vertical datum nor the survey method used in 1999 are stated in the 1999 reports (KC 1999a, 1999b). A difference in either of these could also be a contributing factor to the change in crest elevation.

2.2 Recent Activity

In 2019, Teck completed routine inspections of the facility as specified in the Operation, Maintenance, and Surveillance (OMS) manual. There were no construction or maintenance activities undertaken in 2019.

3 WATER MANAGEMENT, CLIMATE AND WATER ACCOUNTING

3.1 Overview

The SNTD is an inactive facility in care and maintenance. The catchment for the SNTD impoundment is 76.4 ha (Figure 4) including the tailings beach and pond area (8.3 ha).

During operations, tailings were discharged from the eastern edge of the impoundment which formed a tailings beach sloping towards the dam. Excess water would pond against the dam face and seep through the upstream filters. Water currently ponds in a shallow depression on the tailings beach formed by post-operations tailings consolidation. The pond level was similar to the level observed during the 2018 DSI site visit, which occurred at the same time of year.

Seepage through the dam accumulates in the coarse rockfill downstream shell. A 750 mm perforated corrugated steel pipe (CSP) buried in the coarse rockfill (invert El. 778 masl) is connected to a 750 mm solid pipe section buried beneath the haul road downstream of the dam and discharges into a channel that flows to S3 Pond (KC 1996) (Figure 3), before being released to the environment. Discharge from the S3 Pond is a monitoring location listed in the MoE Permit No. PE-06739 which requires quarterly water quality (suspended solids and metals) and weekly flow measurements between April and October of each year. There is no discharge from the SNTD to the M11/M15 Channel, therefore no monitoring is required as specified in the MoE Permit No. PE-06739.

3.2 Climate

As part of the DSI, climate data were reviewed between September 1, 2018 and August 31, 2019. Precipitation and temperature data are measured on site at two climate stations (Figure 2):

- Upper Met Climate Station (also referred to as Quintette 2), located near Kilometer 10 on the main haul road at El. 1543 masl; and
- Lower Met Climate Station, located near the QCO Plantsite at El. 914 masl.

There were no data available at the Upper Met Climate Station during the review period, as Teck noted that there was a hardware issue that prevented connectivity to the data logger. Data were available from the Lower Met climate station.

The rain gauges at both Upper Met and Lower Met climate stations are not heated, so winter precipitation data can be unreliable. As a result, climate data from Environment Canada Chetwynd Airport climate station (station No. 1181508, at elevation 610 masl and 86 km north of QCO) were used to supplement the precipitation readings from September to April. KCB suggest that Teck consider options to repair or upgrade the climate station to allow for on-going, year-round monitoring of climate data; however, this is not a dam safety concern, and therefore, is not a time sensitive issue.

Precipitation data from Lower Met and Chetwynd climate stations were corrected for orographic effects using the Mean Annual Precipitation (MAP) and elevation relationship developed from the 2013 Baseline Hydrology (Teck 2013). Corrected precipitation and temperature data are summarized in Table 3.1 for comparison.

Average temperatures from 1991 to 2000, taken from Teck's 2013 Baseline Hydrology and Design Basis Report (Teck 2013), are also summarized in Table 3.1 for comparison.

Seasonal snowpack data is measured digitally at the Plantsite climate station; however, data conversion details are not available. Therefore, snowpack information is not available for review.

The following observations are made based on the data from September 1, 2018 to August 31, 2019:

- Total precipitation at the SNTD (667 mm) was higher than the estimated Mean Annual Precipitation (561 mm).
- Winter months (October to January) were warmer than normal, while the summer months (March to August) were similar to the Lower Met normals. However, February was significantly colder than the normal (-5.4 ^{o}C), with an average temperature of -16.9 ^{o}C.
- No event-driven inspections were triggered in 2019. The largest precipitation event measured at the Lower Met climate station was 29.6 mm of rain on June 6, 2019.

Table 3.1 Precipitation and Temperature at Shikano North Tailings Dam

Month	Corrected SNTD Mean Annual Precipitation[1] Distribution (mm)	Corrected SNTD 2018-2019 Precipitation[2],[3] (mm)	Lower Met Station 1991-2000 Average Temperature[4] (°C)	Lower Met Station 2018-2019 Daily Max. Temperature[5] (°C)	Lower Met Station 2018-2019 Daily Min. Temperature[5] (°C)	Lower Met Station 2018-2019 Average Daily Mean Temperature[5] (°C)
September	42	67	10.1	15.9	-6.1	4.0
October	54	35	3.6	18.9	-9.1	4.2
November	56	67	-3.7	10.7	-16.7	-0.1
December	41	71	-6.8	5.0	-18.9	-4.0
January	44	40	-10.7	8.3	-18.6	-3.2
February	36	30	-5.4	-0.2	-38.1	-16.9
March	33	4	-2.1	20.8	-31.4	-1.8
April	27	42	3.5	12.5	-6.8	3.2
May	32	44	8.3	25.8	-4.4	9.7
June	71	109	12.3	24.6	0.6	11.9
July	75	87	14.5	26.1	3.0	14.0
August	50	70	13.9	25.9	2.0	12.5
Total	**561**	**667**				

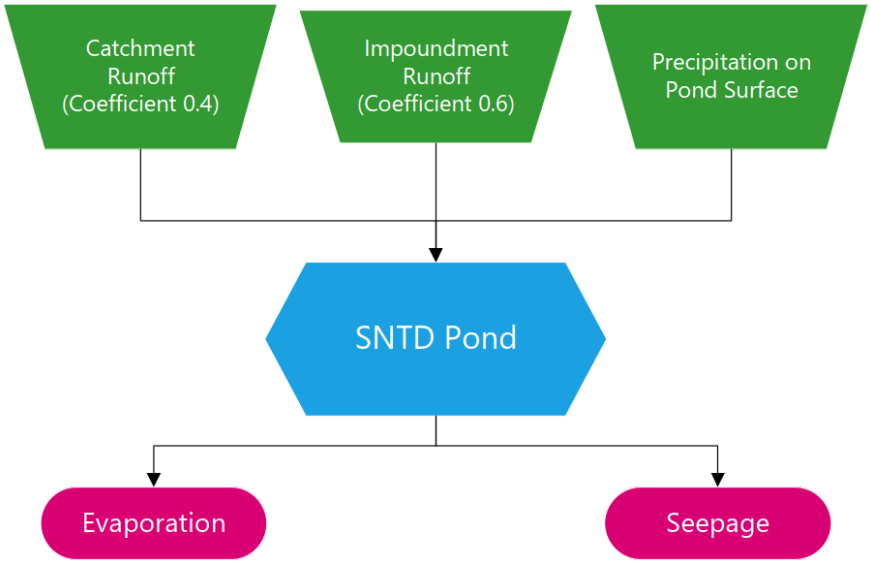
Notes:

1. Monthly precipitation values are based on the mean annual precipitation-elevation relationship and monthly distribution outlined in the 2013 Baseline Hydrology and Design Basis Report (Teck 2013).
2. September 2018 to April 2019 precipitation values were interpreted from Chetwynd Airport climate station (station No. 1181508; elevation 610 masl; and 86 km north of QCO) data, with mean annual precipitation and elevation correction from Teck 2013 Baseline Hydrology and Design Basis Report (2013).
3. May 2019 to August 2019 precipitation values were interpreted from Plantsite climate station data with mean annual precipitation-elevation correction from the Teck 2013 Baseline Hydrology and Design Basis Report (2013).
4. Average monthly temperatures are from the Quintette Plantsite as outlined in the 2013 Baseline Hydrology and Design Basis Report (Teck 2013).
5. Daily maximum, minimum, and average temperatures are based on daily temperature readings that were taken at the Lower Met climate station.

3.3 Water Accounting

Under existing conditions, inflows to the impoundment are predominantly from surface water runoff with limited observed contribution from pit wall seepage. Outflows from the impoundment are predominately seepage through the "flow-through" dam and evaporation from the pond. The size of the pond has been observed to change seasonally indicating there is some retention time in the impoundment. However, total water that enters the impoundment leaves the impoundment and does not accumulate on an annual basis. A simplified water accounting schematic is shown in Figure 3.1.

Figure 3.1 SNTD Water Accounting Diagram



A simplified water accounting calculation for the SNTD impoundment from September 1, 2018 to August 31, 2019 is summarized below:

- Inflows:
  - Precipitation on pond surface = 7,000 m^3 (assumed average pond elevation of 797 masl);
  - Runoff from tailings impoundment (including impoundment slopes and tailings beach, excluding pond area) = 93,000 m^3 (assumed average runoff coefficient of 0.6); and
  - Runoff from upstream catchment = 140,000 m^3 (assumed average runoff coefficient of 0.4).
- Outflows:
  - Evaporation from pond surface = 6,000 m^3 (evaporation rate for this site is 548 mm/yr based on evaporation-elevation relationship from Teck (2013)); and
  - Seepage losses from the impoundment = 234,000 m^3 (estimated from inflows minus evaporation).

Seepage losses from the impoundment are estimated at an average flow rate of 7 L/s over the 12-month period. The flow rate during the 2019 DSI inspection was estimated 8 L/s, similar to the average annual flow and flow rates observed during previous DSI inspections. The average flow estimate includes the winter period when flows are likely zero. The seepage rate is within the expected performance range for the "flow-through" design and there are no planned changes to surface water management that would alter this observation.

3.4 Flood Routing

During flood events, runoff accumulates on the tailings surface. Because of the large freeboard (approximately 32 m) when operations were suspended, a spillway was not constructed and the inflow is stored rather than being routed through the impoundment and discharged. The SNTD hydrotechnical assessment indicates that SNTD has the capacity to store the PMF of 336,200 m^3 with approximately 25 m of freeboard (KCB 2016c).

The minimum inflow design flood (IDF) specified in the Code for the SNTD, based on a "Significant" dam consequence classification, is 1/3 between 1000-year and PMF. As the SNTD stores, rather than routes the IDF, the minimum storm duration required by the Code is 72-hours. A conservative estimate of storing the 72-hour PMF resulted in 18 m of freeboard. The minimum freeboard, based on maximum wind setup and wave runup above the design flood, per the CDA guidelines, is 0.5 m.

4 REVIEW OF MONITORING RECORDS AND DOCUMENTS

4.1 Operations, Maintenance and Surveillance Manual

The Operations, Maintenance and Surveillance (OMS) manual was updated by Teck in March 2019. The OMS manual specifies monitoring programs for the structure that include routine and event driven inspections, and reviews of instrumentation readings (piezometers and survey monuments).

Piezometer, survey monument and freeboard threshold values (i.e., Quantifiable Performance Objectives (QPOs)) and response actions are defined in the updated OMS manual. KCB recommends that during the next update, the OMS manual structure be revised to follow the updated Mining Association of Canada (MAC) Guidelines, if they become available.

4.2 Emergency Preparedness and Response Plan

The Emergency Preparedness and Response Plan (EPRP) was developed for the SNTD in March 2019.

4.3 Monitoring Program

4.3.1 Visual Inspections

The SNTD monitoring program includes the following visual inspections (Teck 2018):

- Annual DSI (this report) – completed by the EoR.
- Routine – monthly inspections of the downstream slope area when visiting the area for S3 Pond water sampling and flow monitoring. Inspections of the SNTD are completed three times per year by Teck's Dam Inspector: spring (after snowmelt), mid-summer, and fall (before first snowfall). Routine inspections were completed three times in 2019 (May 27, July 3, and September 4). The DSI inspection was counted as the spring inspection. Teck's inspection checklists (Appendix III) did not indicate any dam safety issues.
- Event-driven – completed by Teck staff following:
  - A 24-hour rainfall event either greater than the 10-year return period (52 mm – "Warning Level") or the 50-year return period (67 mm – "Alarming Level"). Follow up inspections are to occur within 36 hours for a 50-year return period event, or within 3 days for a 10-year return period event; or
  - An earthquake event either magnitude 5 or greater within 100 km of the site, or a smaller event but significant enough to be felt on site and/or in Tumbler Ridge.
  - No event-driven inspections were triggered in 2019. The largest precipitation event measured at the Lower Met climate station was 29.6 mm of rain on June 6, 2019.

Given the long performance history of the SNTD, flow-through design and large freeboard, the current inspection program is appropriate for the existing conditions.

4.3.2 Survey

In 2018, Teck retained UAViation of Coquitlam, BC, to complete a drone LiDAR topographic survey of SNTD to monitor sinkholes, in response to a KCB recommendation made in 2017. As a secondary objective, the data are being reviewed as to whether they may be a suitable alternative to the survey monument pins to monitor embankment deformations. The 2018 survey was completed in October 2018 and the data was sent to KCB in December 2018. The second such survey was completed in October, 2019, and the data provided to KCB in November, 2019.

A comparison of the 2018 and 2019 surveys showed the following:

- There were no significant differences in crest elevation or the downstream slope between the two surveys, with the difference on average being less than the accuracy of the survey equipment (+/- 5 cm) (UAViation 2019). There was a discrepancy of approximately 0.3 m to 0.6 m between the elevation at each crest survey monument and those measured from the LiDAR. The survey datums and source of discrepancy should be reviewed for consistency and appropriate key elevations be confirmed (e.g. crest, downstream slope, etc.).
- The survey appears to have been sufficient to resolve gradual changes in the sinkholes.

Overall, the drone surveys appear adequate to monitor changes in the sinkholes, and, provided the survey datum discrepancies can be resolved, the surveys may turn out to be a potential alternative to monitor embankment deformations moving forward. Further confidence in the data will be gained as additional surveys are completed.

4.3.3 Piezometers

Of the 16 piezometers installed at SNTD, 10 are functional, (refer to Figure 3). Annual readings of the functioning pneumatic piezometers are taken once a year by Teck's Dam Inspector. 2019 pore pressure readings were collected on May 27, 2019 and are plotted on Figures 5 and 6.

Piezometric levels measured since operations were suspended have not exceeded the thresholds. Threshold Level 1 – "Warning Level" are summarized in Table 4.1. Threshold Level – 2 "Alarming Level" is triggered if there are Threshold Level 1 exceedance of two or more piezometers in the same instrumentation section, or if there are two instrumentation sections with observed exceedance of one or more piezometers. Recommended threshold responses are summarized in Table 4.2. These threshold values and responses are included in the OMS manual.

The following observations are made based on the 2019 piezometer readings:

- All piezometer readings are below the established threshold levels. No significant changes in established trends were observed.
- Instruments are accessible and functioning with the exceptions of those noted in Table 4.1.
- P96-6 measured water level has been slightly lower than other upstream piezometers installed below the current tailings level, but it has been consistent since 2014. This may be due to blockage in the instrument cable, or leakage in the instrument fitting.

- Similar to previous years, P96-9 continues to read a small pressure head and the elevation is above the current pond and tailings level. The reason for this is not known but its readings have been consistent since 2013. There is no visible seepage from the upstream face of the dam and P96-4 historical readings indicate the water level in the dam fill is below tailings level. Instrument error or locally entrained water around the instrument tip is the most likely cause for the readings. This is not a dam safety concern and no follow up action is required.
- P96-10 historical readings showed similar trend to that of P96-9; however, the May 2018 reading indicates the instrument was dry.
- The pore pressure measured for piezometers at the same elevation upstream of the filter zones generally show a downward gradient in the upstream rockfill zone, as expected.

Based on the review of the available instrumentation data, the suite of instruments is sufficient for the existing condition of the SNTD. The EMPR permit for the restart of operations at the QCO site includes a requirement to assess the adequacy of the existing instrumentation prior to reactivation of the facility, and installing replacement or additional instrumentation as appropriate. EMPR also requires the assessment to be submitted to the Chief Inspector for review within 3 months of re-activation of the facility.

Table 4.1 Piezometer Threshold Values and 2018 Versus 2019 Piezometer Readings

Piezometer	Status	Tip Elevation (masl)	Threshold Level 1 "Warning Level" Elevation (masl)	May 31, 2018		May 27, 2019	
				Pressure Readings (psi)	Piezometric Level (masl)	Pressure Readings (psi)	Piezometric Level (masl)
P96-1	Not Functional	767.2	-	No measurement taken, noted as leaking in 2016.			
P96-2	Not Functional	777.2	-	No measurement taken, noted as plugged in historical readings (KC 1999a).			
P96-3	Not Functional[1]	770.0	786.0	34 psi measured; unable to stabilize.			
P96-4	Operational	780.1	-	No measurement taken, fitting was leaking		0	780.1
P96-5	Operational	780.0	797.0	9.4	780.0	6.2	784.4
P96-6	Operational	780.0	797.0	3.1	780.0	2.1	781.5
P96-7	Operational	790.1	803.0	0.5	790.1	0.8	790.7
P96-8	Operational	790.2	803.0	2.9	790.2	1.1	791.0
P96-9	Operational	800.0	805.0	0.1	800.0	0.3	800.2
P96-10	Operational	800.0	805.0	0	Dry	0.9	800.6
P95KC-2A	Operational	755.4	790.0	0	Dry	0.4	755.7
P95KC-2B	Operational	776.2	790.0	0.6	776.2	0.1	776.3
P95KC-3A	Not Functional	762.8	790.0	Readings unable to stabilize, <35 psi			
P95KC-3B	Operational	781.3	795.0	0	Dry	0[2]	Dry[2]
P98-1	Unknown	810.5	-	Instrument has not been located.			
P98-2	Unknown	810.5	-	Instrument has not been located.			

Notes:
1. P96-3 instrument cable was noted as plugged in KC (1999a) and the instrument continued to give unreasonable reading (+34 psi) in 2018, so it has been disregarded. Refer to 2017 DSI Report (KCB 2018) for P96-3 and P96-4 piezometer data verification details.
2. Instrument did not build-up pressure when read, and there was no obvious leak detected when reading, which is an indication that the instrument is dry.

Table 4.2 Piezometers Threshold Responses

Thresholds	Threshold Exceedance	Action
Level 1 "Warning Level"	Exceedance of a threshold in an individual piezometer	▪ Notify EoR within 24 hours upon verification of reading exceedance. ▪ EoR to evaluate data for reliability, and review piezometric data (and survey data if available) within the general vicinity of the individual piezometer in question. EoR may recommend repeat measurement and increased on-going monitoring frequency.
Level 2 "Alarming Level"	Trend of threshold exceedances in a group of piezometers	▪ Notify EoR within 24 hours upon verification of reading exceedance. ▪ Repeat reading within 1 week. ▪ EoR to assess dam integrity and may recommend stability analysis, site visit, or other action.

4.3.4 Survey Monument Pins

The monuments consist of steel pins with plates attached to the base, buried 1 m below the crest surface (KC 1999b).

Monitoring pins were originally installed along the SNTD dam crest in 1999 for displacement monitoring and surveyed during operations until the end of 1999. Monitoring of the pins was re-initiated in 2014 and the pins were surveyed 3 times until 2017 (Figure 7). The 2017 DSI report recommended reducing the survey reading frequency from three times a year to once a year due to lack of a trend in observed horizontal movement or crest settlement (KCB 2018). Teck adopted this in the 2018 OMS manual.

Threshold levels, first established in 2016, as defined in the OMS manual are summarized below:

- Threshold Level 1 – "Warning Level" was developed based on the maximum observed survey measurement to date plus 20%. The Threshold is exceeded if:
  - Horizontal movement ≥ 40 mm from the initial reading;
  - Vertical movement ≥ 70 mm from the initial reading; and
  - Vertical movement ≥ 80 mm between successive readings.
- Threshold Level 2 – "Alarming Level" is exceeded if:
  - There is a trend of threshold exceedances in the monitoring pins.

The responses for each of the threshold levels are summarized in Table 4.3.

Table 4.3 Survey Monument Threshold Response

Threshold Level	Exceedance Threshold	Action
1 "Warning Level"	Exceedance of established threshold in an individual survey pin	▪ Inspect the area around the pin. ▪ Measure again within 1 week and increase monitoring frequency to weekly. ▪ Notify EoR within 24 hours of second reading. ▪ EoR to evaluate data for reliability, and review survey data within the general vicinity of the individual survey pin in question.
2 "Alarming Level"	Common trend of threshold exceedances in a group of pins	▪ Increase monitoring frequency of the survey pins as needed based on assessment of common trend. ▪ EoR to assess stability, stability analysis may be initiated.

Comparison of the June 2018 and July 2019 survey measurements is summarized in Figure 7. The observed movements are plotted on Figures 8 and 9.

From a review of the available data since 2014, none of the monuments indicate a trend of horizontal movement or significant crest settlement. Incremental movement is more likely attributed to survey accuracy than dam movement. There was no exceedance of thresholds in 2018 (Figures 8 and 9).

There are discrepancies between the historical and recent survey data of the SNTD:

- the as-built dam crest elevation was stated as 829 masl (KC 1999b);
- the 2010 LiDAR shows the dam crest elevation at 827.5 masl; and
- the crest ranges from 827.7 masl to 828.5 masl based on the most recent monitoring pin survey data (adjusting the data to account for stick-up), which are consistent with LiDAR crest elevations at these monitoring pin locations (i.e., 827.9 masl to 828.4 masl).

The SNTD is a rockfill dam founded on bedrock, limited to no post-closure settlement is expected. As discussed in Section 2.1, the discrepancy in crest elevation could be the result of survey accuracy, datum changes or settlement. This is not a dam safety concern given the large existing freeboard (>30 m).

Based on the review of the available instrumentation data, the suite of instruments is sufficient for the existing condition of the SNTD.

4.3.5 Freeboard

Although the SNTD has significant flood storage, changes in pond size/level which may indicate a change in dam condition or performance, should be monitored, as required. A physical indicator is installed at the location where tailings beach meets the upstream rock fill zone. The physical indicator has a minimum of 1.5 m stickup above tailings surface. The distance of 1 m above tailings surface was clearly marked such that it is visible when looking from the top of the dam, or from the abutments. Freeboard QPOs, as defined in the OMS manual, for the SNTD under existing conditions and are summarized below:

- Threshold Level 1 – “Warning Level” is exceeded if the water level reaches the contact between dam upstream face and tailings beach.
- Threshold Level 2 – “Alarming Level” is exceeded when pond level reaches 1 m mark on the physical indicator.

The recommended responses for the Threshold Levels are summarized in Table 4.4. The pond level indicator is adequate for the existing condition of the SNTD.

Table 4.4 Response to Freeboard Threshold Exceedances

Response Level	Exceedance Threshold	Action
1 “Warning Level”	Pond level reaches the bottom of the Physical Indicator	▪ Notify EoR within 1 week upon verification of pond level exceedance. ▪ EoR may recommend increased monitoring of pond level.
2 “Alarming Level”	Pond level reaches 1 m mark on the Physical Indicator	▪ Notify EoR within 24 hours upon pond level exceedance. ▪ Increased monitoring frequency as directed by the EoR. ▪ EoR to investigate the increase of the pond level.

4.3.6 Sinkholes

Refer for Figure 3 for sinkholes general location. There was no visually obvious change in the sinkholes between the 2018 and 2019 inspections (Photos I-10, I-11, I-12, and I-13).

- A cluster of 3 sinkholes (Sinkhole 6) were noted to have merged into a single large sinkhole in 2018 (KCB 2019) (Photo I-13). The sinkhole is approximately 9.4 m by 7.4 m and 0.5 m deep and there was no visually obvious change observed in 2019. The bottom of the sinkhole was dry in 2019.
- Sinkholes 2 and 3 were first documented in 2015 (KCB 2016a). There was no visually obvious change observed between the 2018 and 2019 inspections.
- Sinkhole 1 was first documented in 2016. There was no visually obvious change observed between the 2018 and 2019 inspections.
- Smaller sinkholes 4, 5, and 7 through 10 were first documented during the 2017 DSI site visit and appear to be unchanged in 2019. Sinkholes 7 through 10 are located between SNTD-2018-07 and SNTD-2018-08, refer to Figure 3. No photos taken for Sinkholes 7 to 11.
- Sinkhole 11 was first documented during the 2018 inspection (KCB 2019) and is the first sinkhole where apparent flowing of water into the coarse rockfill overlying filters and geotextile was observed. Inspection of the downstream seepage indicated flow was clear (Photo I-14) (i.e., no indication of internal erosion). No photos were taken for Sinkhole 11.

The cause of these features is most likely the migration of tailings into the upstream coarse rockfill shell and “windows” of high permeability gravel (Figure 5) which are upstream of the filters. Sinkholes are considered a local condition and not a risk to the SNTD integrity.

4.4 Water Quality

A water quality monitoring point included in MoE Permit No. PE-06739 is the outflow from S3 Pond downstream of the SNTD. Monitoring at S3 Pond includes:

- Weekly: Flow rate (April 1 to October 31); and
- Quarterly: Field turbidity; lab turbidity and total suspended solids; and metal and non-metal parameters as defined by the permit.

Water quality monitoring data is submitted to MoE for compliance reporting and will be summarized in a Teck prepared annual report in March 2019. The water quality of the S3 Pond outflow is not representative of SNTD seepage because surface water from other catchments also report to S3 Pond. Teck have confirmed that there have been no non-conformances and that monitoring frequency meets permit requirements.

5 VISUAL OBSERVATIONS AND PHOTOGRAPHS

No significant changes related to dam safety were observed between the 2019 and 2018 DSI observations. The following observations were made during the 2019 inspection:

- **Historic Slumping of Pit Wall:** A historic slumping failure is present on the eastern side of the impoundment (Photo I-16) in the old pit wall (approximately 480 m southeast from the upstream face of the dam). No significant changes were observed in the area since the 2012 DSI.
- **Dam Crest**: Good condition. No signs of lateral movement, significant differential settlement or cracking of the dam crest (Photo I-2).
- **Downstream Slope**: Good condition. No signs of significant erosion or displacement and no vegetation cover (Photos I-3, I-4, I-5, and I-8).
- **Upstream Slope**: Good condition. No signs of significant erosion or displacement and no vegetation cover (Photos I-1, I-6, and I-7).
- **West Abutment**: Abutment appears stable and in good condition. Ravelling of the exposed rock face upstream of the west abutment caused by weathering of alternating beds of sandstone and shale. No significant changes since first noted in the 2014 DSI report. No signs of displacement of the pit wall (Photo I-6). Ravelling of upstream rock face does not pose a dam safety concern to the SNTD; no action is required.
- **East Abutment**: Good condition. Minor ravelling of pit wall above the crest, appears predominantly surficial. No signs of significant erosion or displacement of the pit wall (Photo I-5). Ravelling of the pit wall does not pose a dam safety concern to the SNTD; no action is required.
- **Tailings Impoundment**: The impoundment area was sparsely vegetated near the pond and dam. Away from the pond the tailings surface is well drained and supports human traffic (Photo I-7). The 2019 pond area appears to be similar to that of the 2018 inspection, and the pond level was well below the pond threshold levels (Photo I-9).

6 ASSESSMENT OF DAM SAFETY

The potential failure modes included in the CDA Dam Safety Guidelines (2013) were reviewed based on the inspection observations and review of available documents. No significant changes to 2018 assessment were observed in 2019.

- **Overtopping:** Given the large freeboard available in the dam (approximately 18 m after a 72-hour PMF event) and "flow-through" design, the likelihood of overtopping failure is negligible.
- **Internal Erosion and Piping:** The dam is a "flow-through" design with a rockfill core, two upstream filter zones and a geotextile. Filter performance has been demonstrated by clear seepage and retention of fine tailings in the impoundment during operations and care and maintenance periods. Sinkholes observed in the tailings beach will continue to be monitored for changing conditions during annual inspections. They are most likely a local condition where tailings are migrating into the upstream coarse rockfill shell and "windows" of high permeability fill, not the internal filters. If some piping of tailings were to occur, the likelihood of it triggering a dam failure is very low.
- **Slope Instability:** The dam is a coarse rockfill structure founded on bedrock at the base and abutments. The downstream slope of the dam is 2H:1V. Slope stability analysis in the design had factor of safety (FoS) greater than 1.6 under the full pond and tailings levels (KC 1996) which complies with the Code. 2019 piezometer readings indicate that the pore pressures in the dam are below design levels. The safety factor under the current tailings and pond levels will be greater than the ultimate design condition and the likelihood of failure due to slope instability is very low.
- **Foundation Failure:** The dam is constructed across an old open pit and is founded on rock. In the design, a risk of failure along weak planes in the abutment rock was identified and slope inclinometers were installed to monitor for movement. No significant movement was observed in the inclinometers which were monitored until 1998. The likelihood of failure due to foundation failure is negligible.
- **Surface Erosion:** Both the upstream and downstream slopes of the dam are covered with a coarse rockfill to protect against surface erosion. A small erosion gully was observed during the 2017 inspection on the upstream slope and west abutment wall contact. 2019 observations show no significant changes in the gully conditions (Photo I-23). This feature is not a dam safety concern. The likelihood of failure due to surface erosion is very low.
- **Rockfill Degradation:** The SNTD upstream and downstream rockfill shells were constructed with selected competent rock material from Shikano South Pit (KC 1996). Signs of rock degradation were observed during DSI inspections. Based on visual assessment, the degradation is limited to surficial materials that are subjected to freeze and thaw cycles. Degradation of surficial rockfill on the dam embankment would have no impact on the overall dam safety.

- **Earthquakes:** Stability of the dam under seismic loading was reviewed as part of the design (KC 1996) for a seismic acceleration of 0.15g, which is greater than the Code's recommended earthquake design ground motion (EDGM), 2475-year return period event (i.e., 0.082g), based on National Building Code of Canada (NBCC) (2015). The design analysis and lower EDGM relative to design assumptions indicate the likelihood of a failure during the EDGM is very low.

The SNTD appears in good condition and the observed performance is consistent with design requirements. Comparison of available annual inspection reports and piezometer measurements indicate there have been no significant changes to the condition of the structure since 2000.

Recommendations from previously DSI inspections are summarized in Table 6.1. Recommendations resulting from the 2019 DSI are summarized in Table 6.2. Closed recommendations are shown in grey italics and will be removed from the table in the next DSI report.

KCB have assigned priority to the various recommendations using the 2016 HSRC Guidance Document priority definitions, which are as follows:

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

Table 6.1 Previous Recommendations

ID Number	Deficiency or Non-Conformance	Applicable Regulation or OMS Manual Reference	Recommended Action	Priority	Recommended Deadline (Status)
SNTD-2016-01	*Sinkhole Monitoring Program*	*OMS Manual*	*Establish a monitoring program (i.e. stakes) for the sinkholes within the tailings beach to determine if new ones are forming and/or if current ones are getting larger. To be conducted by Teck during the visual inspections and procedure included in the OMS manual. KCB to provide guidance on monitoring program.*	*3*	*(CLOSED – incorporated in LiDAR review)*
SNTD-2017-01	*Lack of an Emergency Preparedness and Response Plan (EPRP)*	*HSRC Code*	*Prepare an EPRP for the SNTD.*	*3*	*(CLOSED)*
SNTD-2018-01	Upper and Lower Met rain gauges unreliable in winter	n/a	Repair or improve the Upper and Lower Met climate station rain gauges to improve reliability of precipitation measurements during the winter months.	4	December 2020 (OPEN - Teck plan to establish a heated rain gauge on site to allow precipitation readings to be taken in the winter, Upper Met station may be excluded due to difficult winter access. Teck have indicated this work has been deferred into 2020)

Table 6.2 2019 Recommendations

ID Number	Deficiency or Non-Conformance	Applicable Regulation or OMS Manual Reference	Recommended Action	Priority	Recommended Deadline (Status)
SNTD-2019-01	Piezometers	n/a	Re-label the piezometers at the toe of the dam.	4	June 2020
SNTD-2019-02	Survey Datum	n/a	Confirm that the drone LiDAR and crest monument surveys are being done using the same survey datums, and confirm key facility metrics (e.g., crest, downstream slope, etc.).	4	December 2020

7 CLOSING

This report is an instrument of service of Klohn Crippen Berger (KCB). The report has been prepared for the exclusive use of Teck Coal Ltd. (Client) and the applicable regulatory authorities for the specific application to the 2019 Dam Safety Inspections, and it may not be relied upon by any other party without KCB's written consent.

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

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1. The report is to be read in full, with sections or parts of the report relied upon in the context of the whole report.
2. The Executive Summary is a selection of key elements of the report. It does not include details needed for the proper application of the findings and recommendations in the report.
3. The observations, findings and conclusions in this report are based on observed factual data and conditions that existed at the time of the work and should not be relied upon to precisely represent conditions at any other time.
4. The report is based on information provided to KCB by the Client or by other parties on behalf of the client (Client-supplied information). KCB has not verified the correctness or accuracy of such information and makes no representations regarding its correctness or accuracy. KCB shall not be responsible to the Client for the consequences of any error or omission contained in Client-supplied information.
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Yours truly,
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12 MAR 2020

MC:jc

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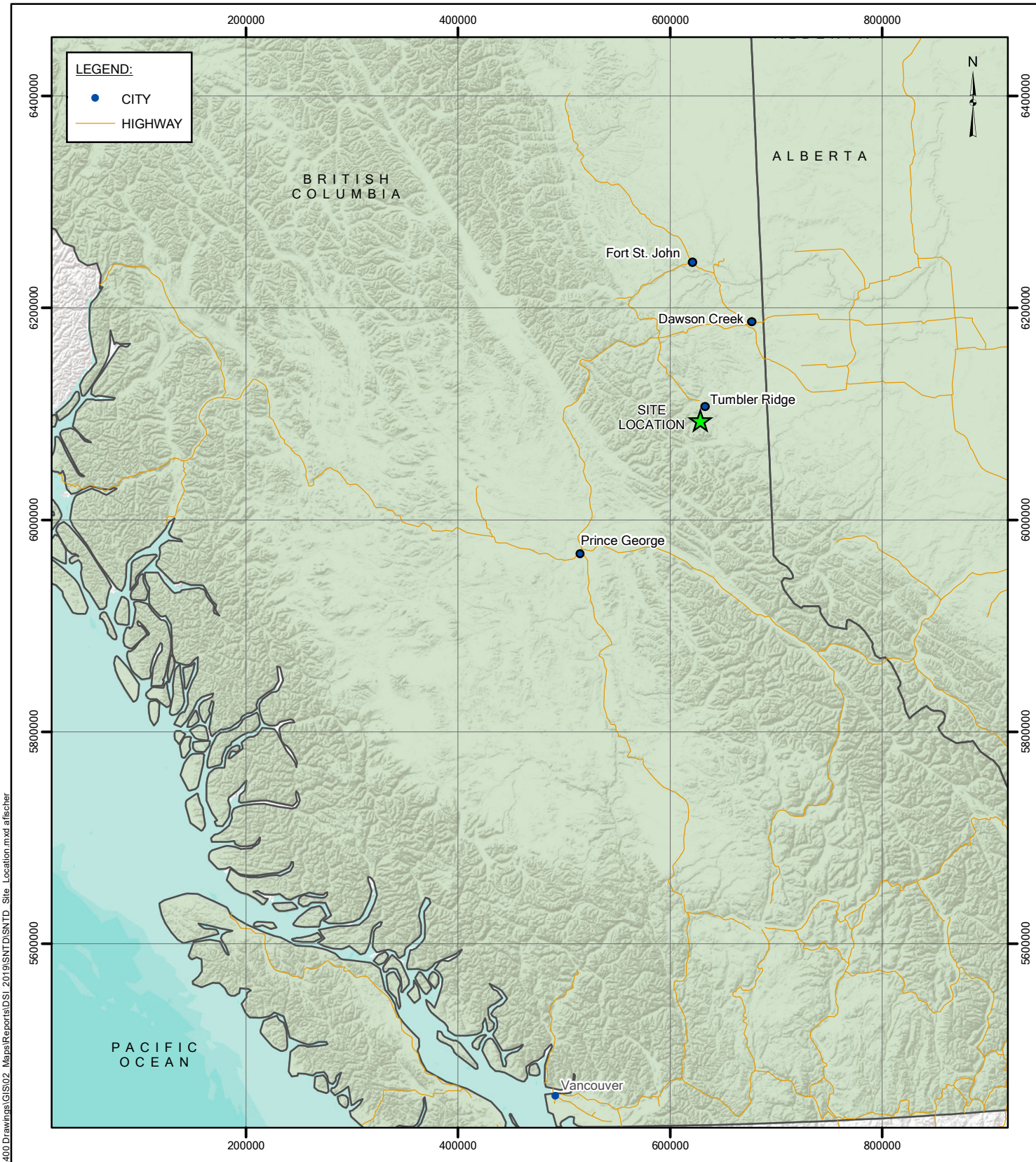
FIGURES



NOTES:
1. PROJECTION: NAD83 UTM ZONE 10N.
2. BASE DATA: ESRI.

SCALE 0 100,000 m

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CLIENT: Teck

Klohn Crippen Berger

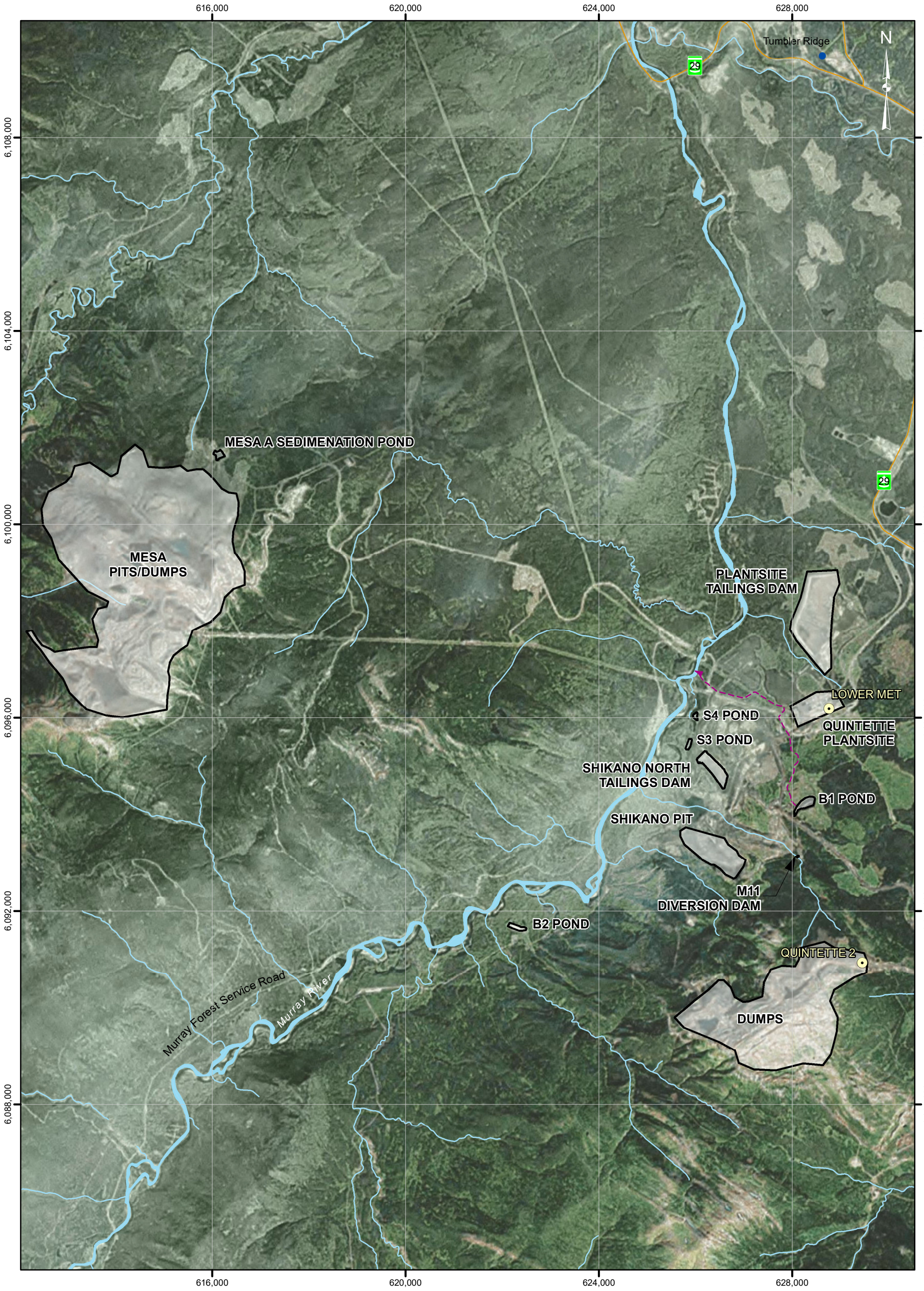
PROJECT: QUINTETTE COAL OPERATIONS
2019 DAM SAFETY INSPECTION

TITLE: SITE LOCATION

PROJECT No. M09684A16

FIG No. 1

Path: Z:\MVCR\M09684A16 - TCL-Quintette 2019 Services\400 Drawings\GIS\02_Maps\Reports\DSI_2019\SNTD\SNTD_Site_Location.mxd afischer



NOTES:
1. PROJECTION: NAD83 UTM ZONE 10N.
2. BASE DATA: ESRI.

LEGEND:

- STRUCTURE BOUNDARY
- CLIMATE STATION
- M11/M15 CHANNEL

SCALE 0 2,500 m

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CLIENT: Teck

Klohn Crippen Berger

PROJECT: QUINTETTE COAL OPERATIONS
2019 DAM SAFETY INSPECTION

TITLE: GENERAL SITE PLAN

PROJECT No. M09684A16

FIG No. 2

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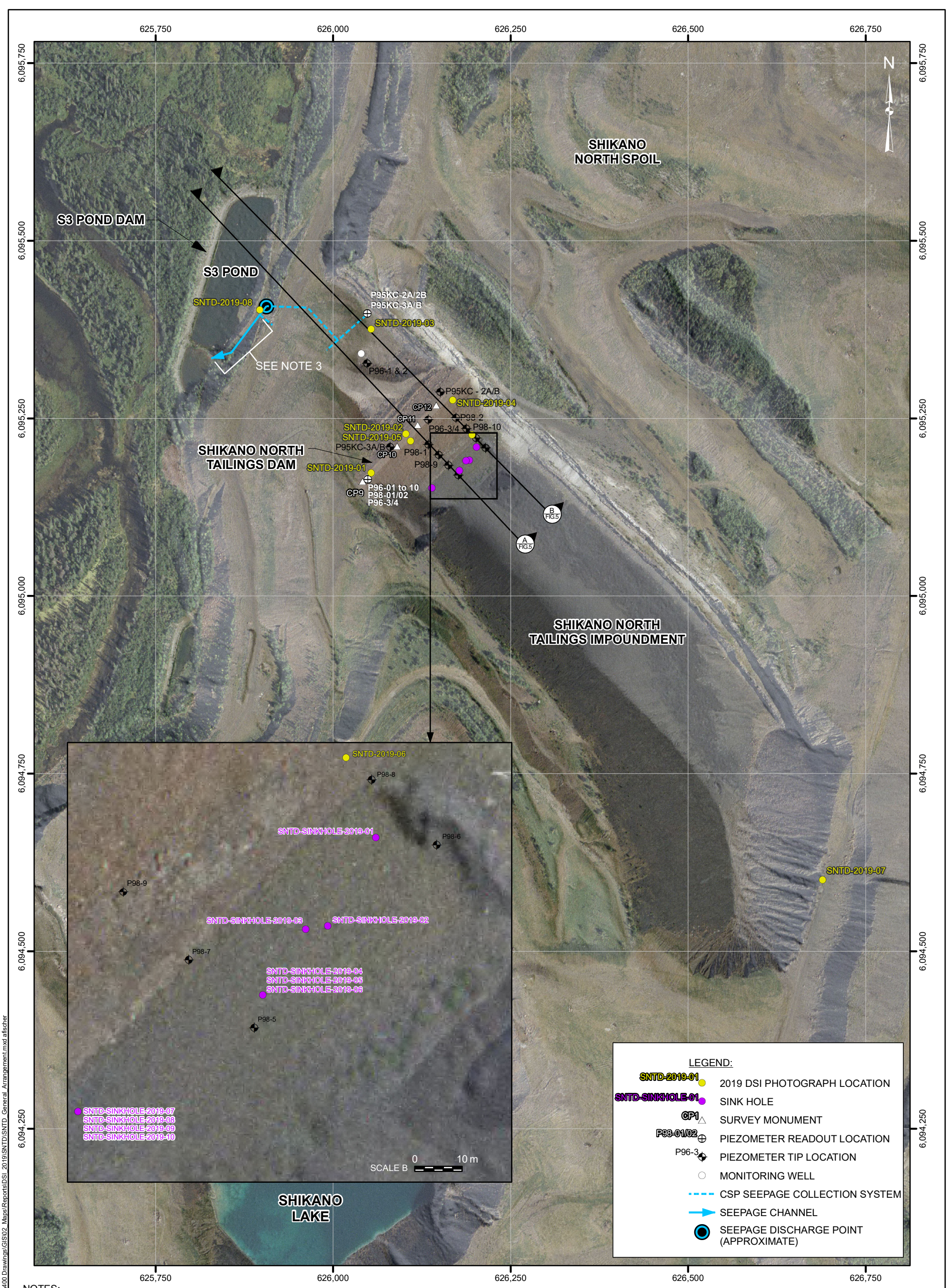

NOTES:
1. PROJECTION: NAD83 UTM ZONE 10N.
2. 2010 ORTHOPHOTO PROVIDED BY TECK.
3. THIS PART OF SEEPAGE COLLECTION PIPE WAS LIKELY REPLACED WITH OPEN CHANNEL.

0 150 m
SCALE A

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CLIENT: Teck

Klohn Crippen Berger

PROJECT: QUINTETTE COAL OPERATIONS 2019 DAM SAFETY INSPECTION

TITLE: SHIKANO NORTH TAILINGS DAM GENERAL ARRANGEMENT

PROJECT No. M09684A16

FIG No. 3

Path: Z:\MIVCR\M09684A16 - TCL-Quintette 2019 Services\400 Drawings\GIS\02_Maps\Reports\DSI_2019\SNTD\SNTD_General_Arrangement.mxd afischer

626,000 626,250 626,500 626,750 627,000

6,095,500 6,095,250 6,095,000 6,094,750 6,094,500 6,094,250 6,094,000

N

SHIKANO NORTH
TAILINGS DAM

SHIKANO NORTH
TAILINGS IMPOUNDMENT

76.4 ha

LEGEND:
CATCHMENT AREA

626,000 626,250 626,500 626,750 627,000

NOTES:
1. PROJECTION: NAD83 UTM ZONE 10N.
2. 2010 ORTHOPHOTO PROVIDED BY TECK.

SCALE 0 150 m

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CLIENT
Teck
Klohn Crippen Berger

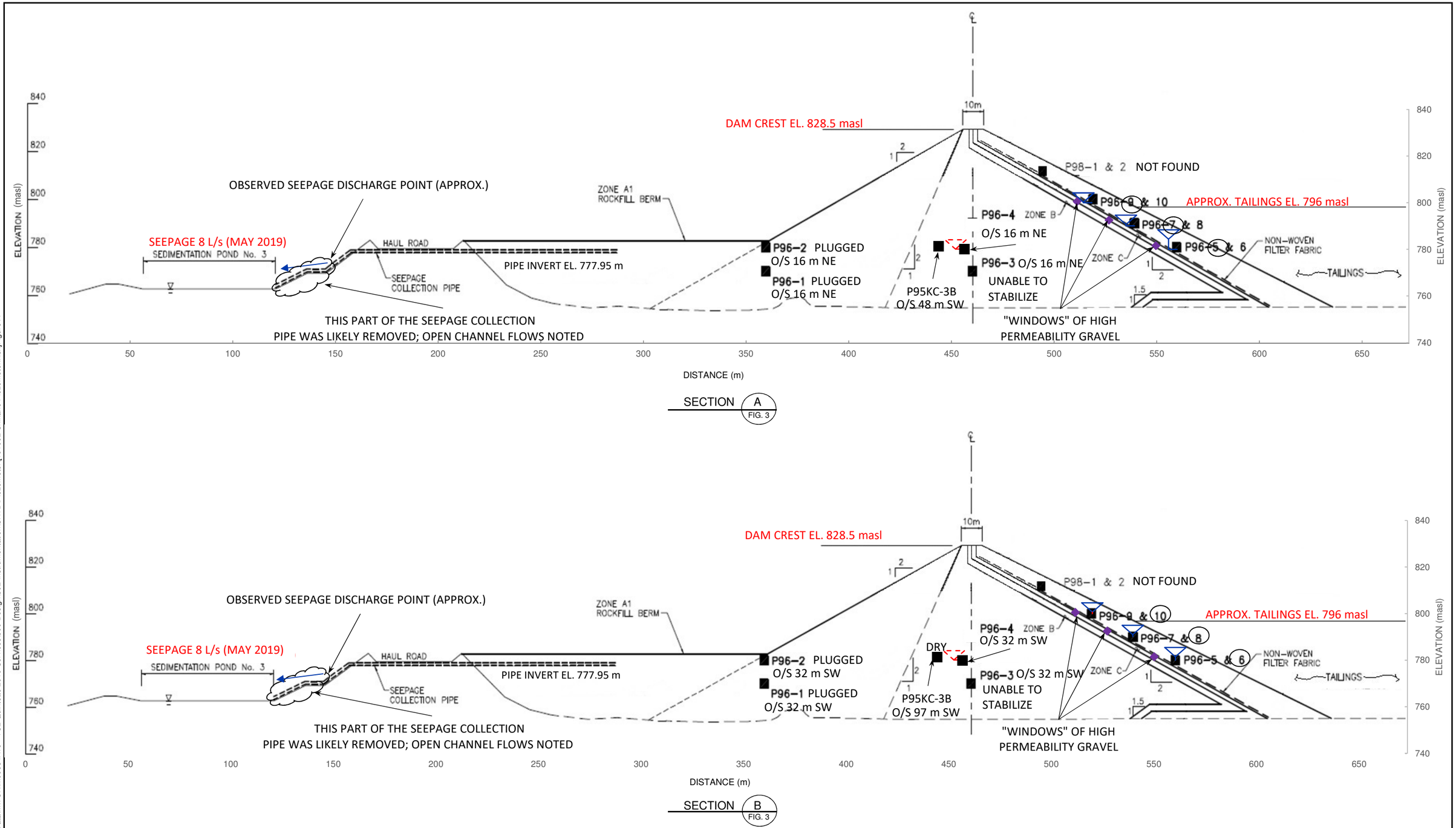
PROJECT
QUINTETTE COAL OPERATIONS
2019 DAM SAFETY INSPECTION

TITLE
SHIKANO NORTH TAILINGS DAM
CATCHMENT

PROJECT No. M09684A16

FIG No. 4

Path: Z:\M\VCR\M09684A16 - TCL-Quintette 2019 Services\400 Drawings\GIS\02_Maps\Reports\DSI_2019\SNTD\SNTD_Catchment.mxd TSchoenhals



SECTION A
FIG. 3

SECTION B
FIG. 3

NOTES:

THRESHOLD VALUES WERE ADJUSTED BASED ON RECOMMENDATIONS FROM 1990 ANNUAL REVIEW (KC 1990).

LEGEND:

MAY 27, 2019 WATER LEVEL

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CLIENT: Teck

Klohn Crippen Berger

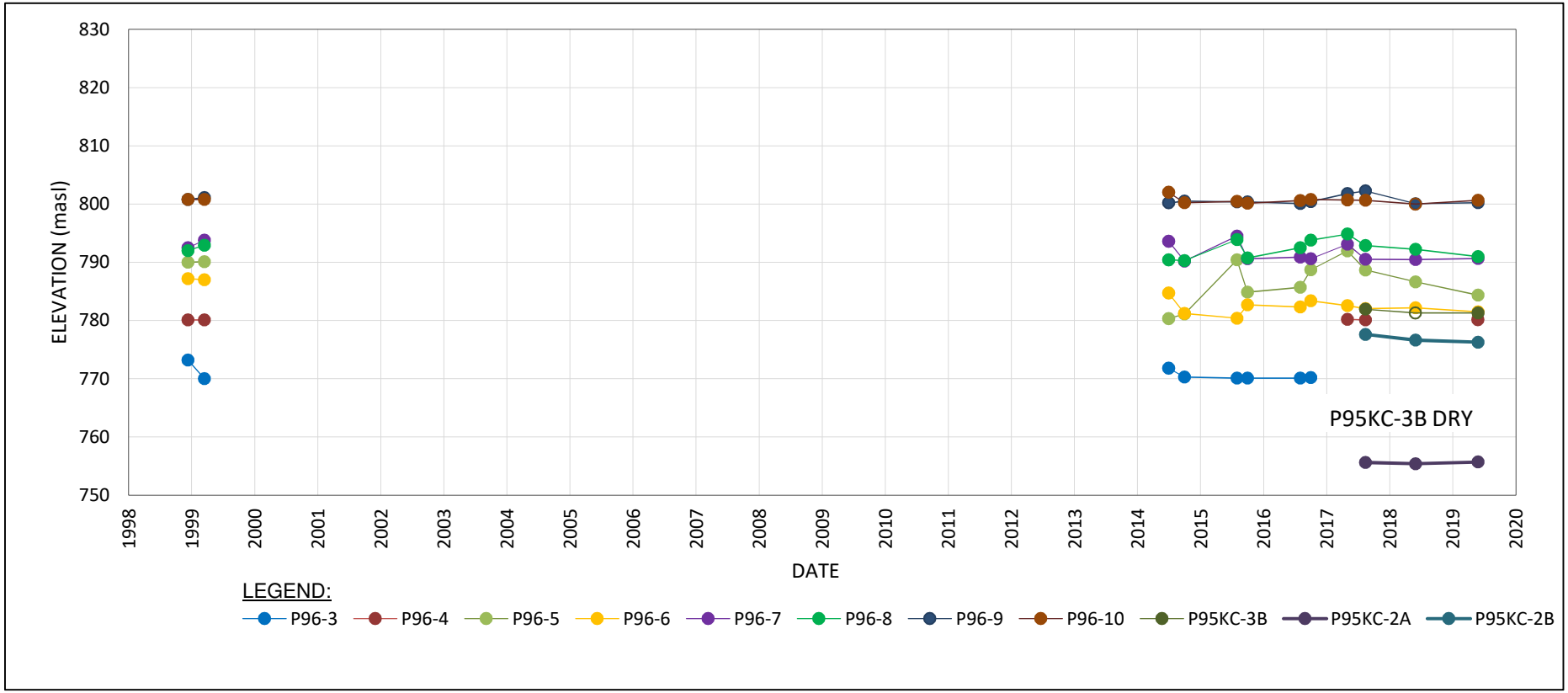
PROJECT: QUINTETTE COAL OPERATIONS
2019 DAM SAFETY INSPECTION

TITLE: SHIKANO NORTH TAILINGS DAM
SCHEMATIC SECTIONS A AND B
WITH 2019 PIEZOMETER READINGS

PROJECT No. M09684A16

FIG. No. 5

Date & Time: 2020-01-15 16:39
Figure File: \\int.klohn.com\ProjData\MVCR\M09684A16 - TCL-Quintette 2019 Services\300 Design\302 Instrumentation\SNTD\Piezometer\[191002 Shikano Piezometer.xlsx]Figure A



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CLIENT: Teck

Klohn Crippen Berger

PROJECT: QUINTETTE COAL OPERATIONS
2019 DAM SAFETY INSPECTION

TITLE: SHIKANO NORTH TAILINGS DAM
HISTORICAL PIEZOMETER DATA

PROJECT No. M09684A16

FIG. No. 6

Date & Time: 2020-01-15 16:39
Figure File: \\int.klohn.com\ProjData\M\VCR\M09684A16 - TCL-Quintette 2019 Services\300 Design\302 Instrumentation\SNTD\Piezometer\[191002 Shikano Piezometer.xlsx]Figure A

MONUMENT	NORTHING (m)		CHANGES BETWEEN READINGS AND PREVIOUS YEAR (mm)
	June 21, 2018	July 11, 2019	July 11, 2019
CP9	6095161.126	6095161.126	0
CP10	6095210.857	6095210.871	14
CP11	6095240.662	6095240.674	12
CP12	6095268.258	6095268.254	-4

MONUMENT	EASTING (m)		CHANGES BETWEEN READINGS AND PREVIOUS YEAR (mm)
	June 21, 2018	July 11, 2019	July 11, 2019
CP9	626041.797	626041.793	-4
CP10	626090.131	626090.103	-28
CP11	626119.210	626119.196	-14
CP12	626145.435	626145.410	-25

MONUMENT	ELEVATION (masl)		CHANGES BETWEEN READINGS AND PREVIOUS YEAR (mm)
	June 21, 2018	July 11, 2019	July 11, 2019
CP9	828.515	828.483	-32
CP10	828.069	828.042	-27
CP11	828.107	828.101	-6
CP12	827.974	827.985	11

NOTES:

1. LATEST SURVEY DATA PROVIDED BY QUINTETTE COAL OPERATIONS ON JULY 11, 2019.

SURVEY ACCURACY:
HORIZONTAL: +/- 5 mm to 10 mm
VERTICAL: +/- 8 mm to 15 mm

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CLIENT: Teck

Klohn Crippen Berger

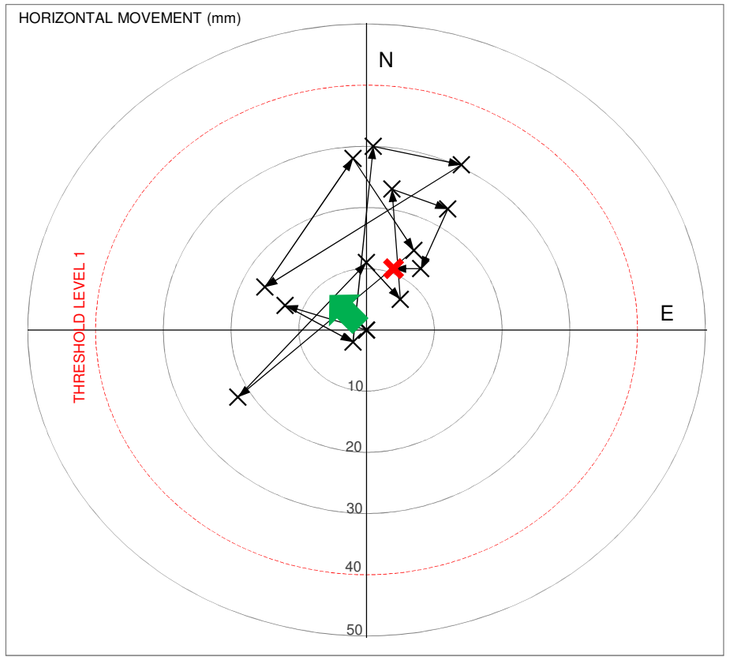
PROJECT: QUINTETTE COAL OPERATIONS
2019 DAM SAFETY INSPECTION

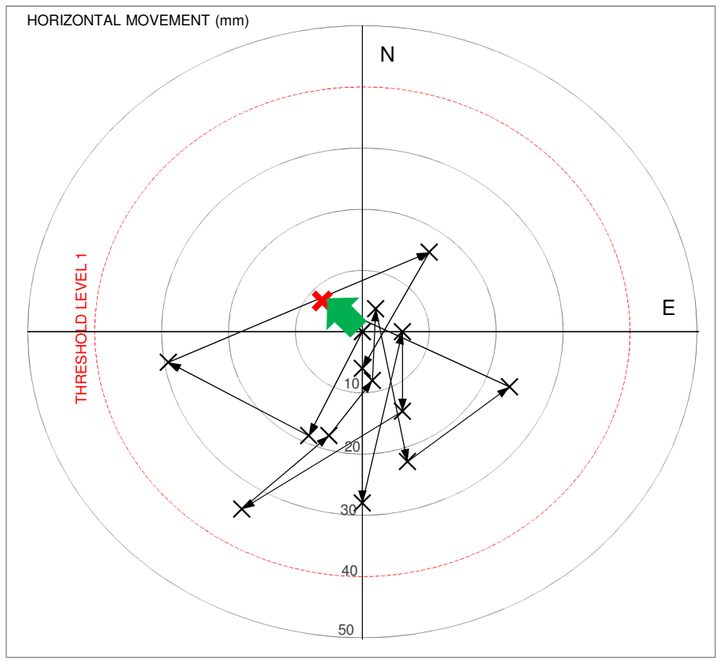
TITLE: SHIKANO NORTH TAILINGS DAM
2019 SURVEY MONUMENT DATA

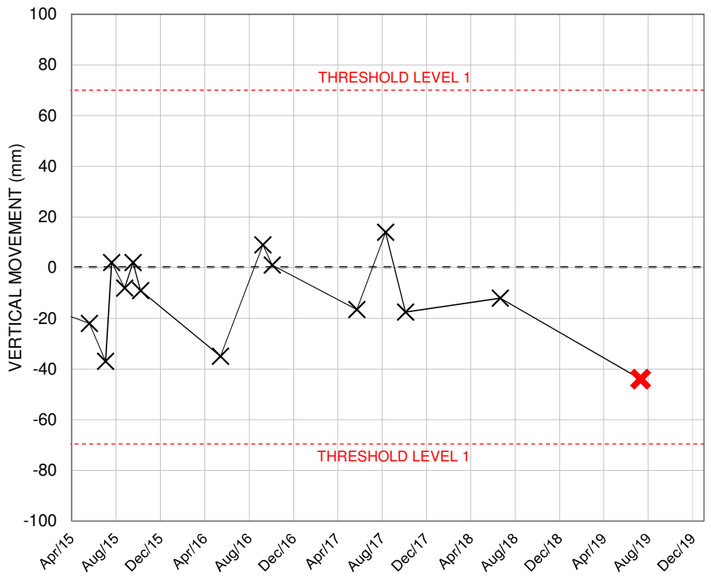
PROJECT No. M09684A16

FIG. No. 7

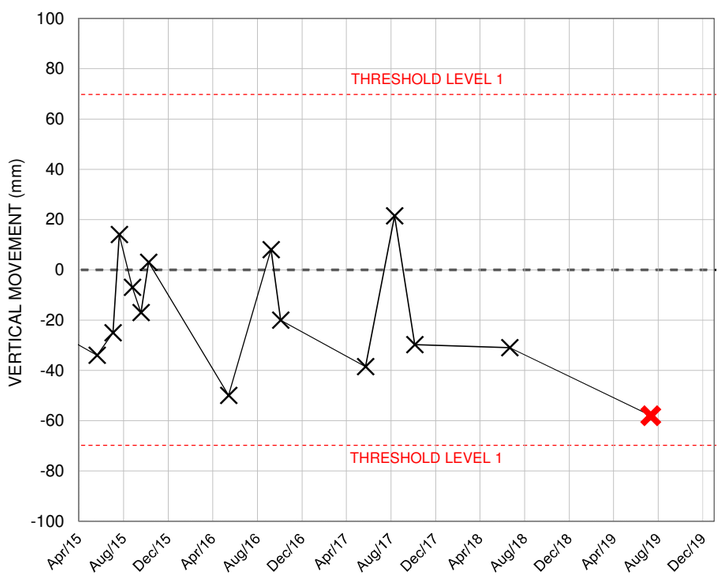
Date & Time: 2020-01-15 16:31
Figure File: \\int.klohn.com\ProjData\MVCR\M09684A16 - TCL-Quintette 2019 Services\300 Design\302 Instrumentation\SNTD\Survey Monument\[190819 Shikano Survey.xlsx]Figure B







CP9 SURVEY RECORDS



CP10 SURVEY RECORDS

NOTES:

1. LATEST SURVEY DATA PROVIDED BY QUINTETTE COAL OPERATIONS ON JULY 11, 2019.

LEGEND:

DOWNSTREAM DIRECTION

LATEST SURVEY READING

SURVEY ACCURACY:
HORIZONTAL: +/- 5 mm to 10 mm
VERTICAL: +/- 8 mm to 15 mm

THRESHOLD VALUES:
THRESHOLD LEVEL 1: ≥ 40 mm OF HORIZONTAL MOVEMENT FROM INITIAL READING;
≥ 70 mm OF VERTICAL MOVEMENT FROM INITIAL READING; OR
IF VERITICAL MOVEMENT ≥ 80 mm BETWEEN SUCCESSIVE READINGS
THRESHOLD LEVEL 2: IF THERE IS A TREND OF THRESHOLD EXEEDANCE IN THE MONITORING MONUMENTS.

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CLIENT: Teck

Klohn Crippen Berger

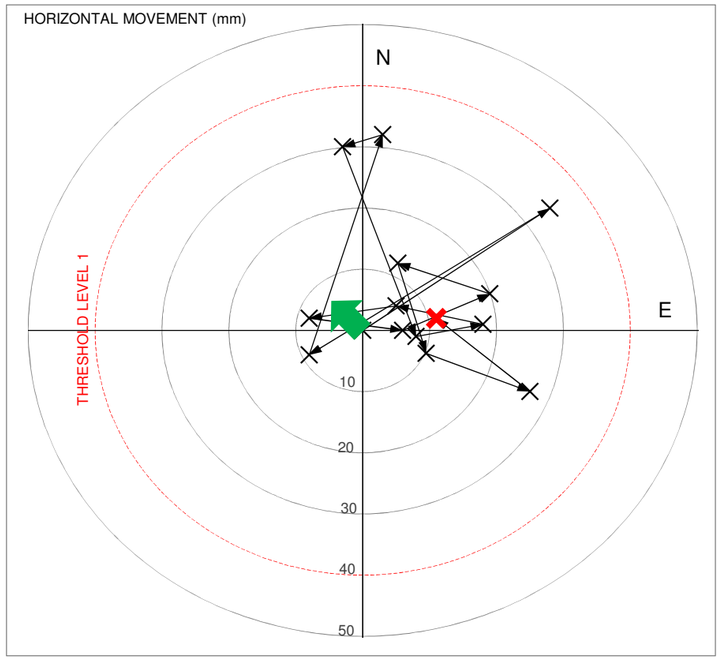
PROJECT: QUINTETTE COAL OPERATIONS
2019 DAM SAFETY INSPECTION

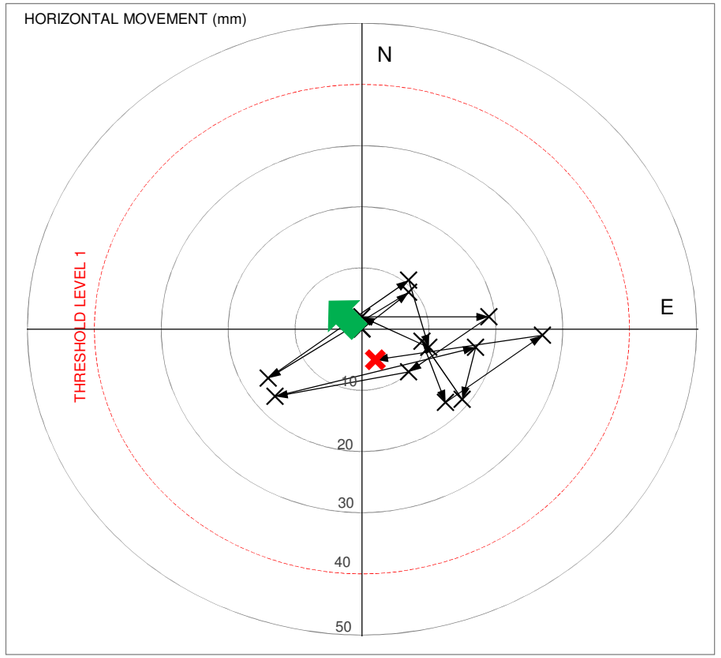
TITLE: SHIKANO NORTH TAILINGS DAM
2019 SURVEY MONUMENT PLOTS
CP9 AND CP10

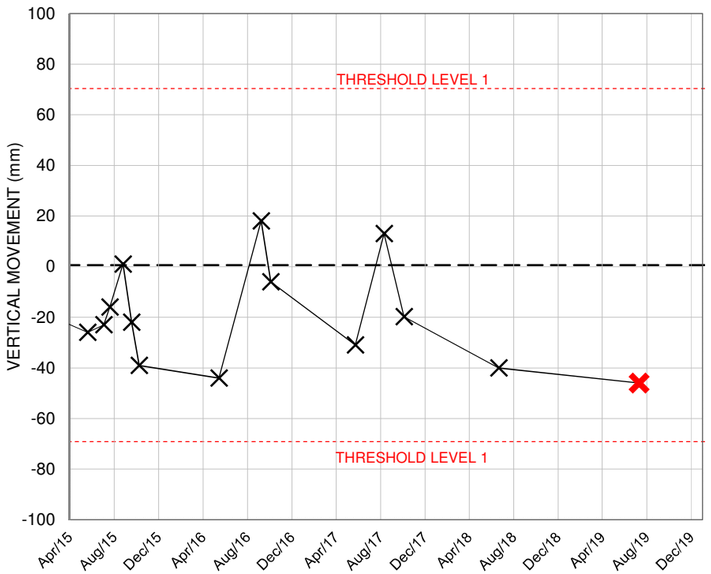
PROJECT No. M09684A16

FIG. No. 8

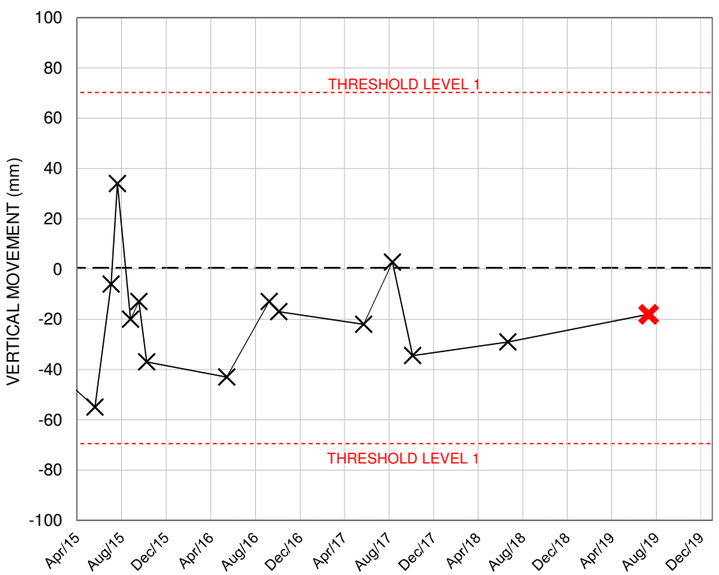
Date & Time: 2020-01-15 16:31
Figure File: \\int.klohn.com\Proj\Data\M\VCR\M09684A16 - TCL-Quintette 2019 Services\300 Design\302 Instrumentation\SNTD\Survey Monument\[190819 Shikano Survey.xlsx]Figure B







CP11 SURVEY RECORDS



CP12 SURVEY RECORDS

NOTES:

1. LATEST SURVEY DATA PROVIDED BY QUINTETTE COAL OPERATIONS ON JULY 11, 2019.

LEGEND:

DOWNSTREAM DIRECTION

LATEST SURVEY READING

SURVEY ACCURACY:
HORIZONTAL: +/- 5 mm to 10 mm
VERTICAL: +/- 8 mm to 15 mm

THRESHOLD VALUES:
THRESHOLD LEVEL 1: ≥ 40 mm OF HORIZONTAL MOVEMENT FROM INITIAL READING;
≥ 70 mm OF VERTICAL MOVEMENT FROM INITIAL READING; OR
IF VERITICAL MOVEMENT ≥ 80 mm BETWEEN SUCCESSIVE READINGS
THRESHOLD LEVEL 2: IF THERE IS A TREND OF THRESHOLD EXEEDANCE IN THE MONITORING MONUMENTS.

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CLIENT: Teck

Klohn Crippen Berger

PROJECT: QUINTETTE COAL OPERATIONS
2019 DAM SAFETY INSPECTION

TITLE: SHIKANO NORTH TAILINGS DAM
2019 SURVEY MONUMENT PLOTS
CP11 AND CP12

PROJECT No. M09684A16

FIG. No. 9

Date & Time: 2020-01-15 16:31
Figure File: \\int.klohn.com\ProjData\M\VCR\M09684A16 - TCL-Quintette 2019 Services\300 Design\302 Instrumentation\SNTD\Survey Monument\[190819 Shikano Survey.xlsx]Figure B

APPENDIX I

Inspection Photographs

Appendix I
Inspection Photographs

LEGEND:

- SNTD = Shikano North Tailings Dam
- SNTD-2019-## refers to 2019 DSI photograph location, as shown on Figure 3

Photographs were taken during site inspection on May 27, 2019.

Photo I-1 Upstream slope from the left abutment with pit wall in the background – looking northeast (SNTD-2019-01)

Photo I-2 Dam crest from left abutment – looking northeast (SNTD-2019-01)

Photo I-3 Downstream slope – looking northwest (SNTD-2019-02)

Photo I-4 Downstream slope – looking east (SNTD-2019-03)

Photo I-5 Downstream right abutment – looking east (SNTD-2019-03)

Photo I-6 **Ravelling of shale slope upstream of the left abutment – looking southwest (SNTD-2019-04)**

Photo I-7 **Upstream slope and impoundment (general area where sinkholes are observed is shown in red box) – looking southeast (SNTD-2019-02)**

Photo I-8 Downstream slope – looking northwest (SNTD-2019-04)

Photo I-9 Freeboard water level stake (SNTD-2019-05)

Photo I-10 Sinkhole 11, water level indicator visible in the background (SNTD-SINKHOLE-2019-11)

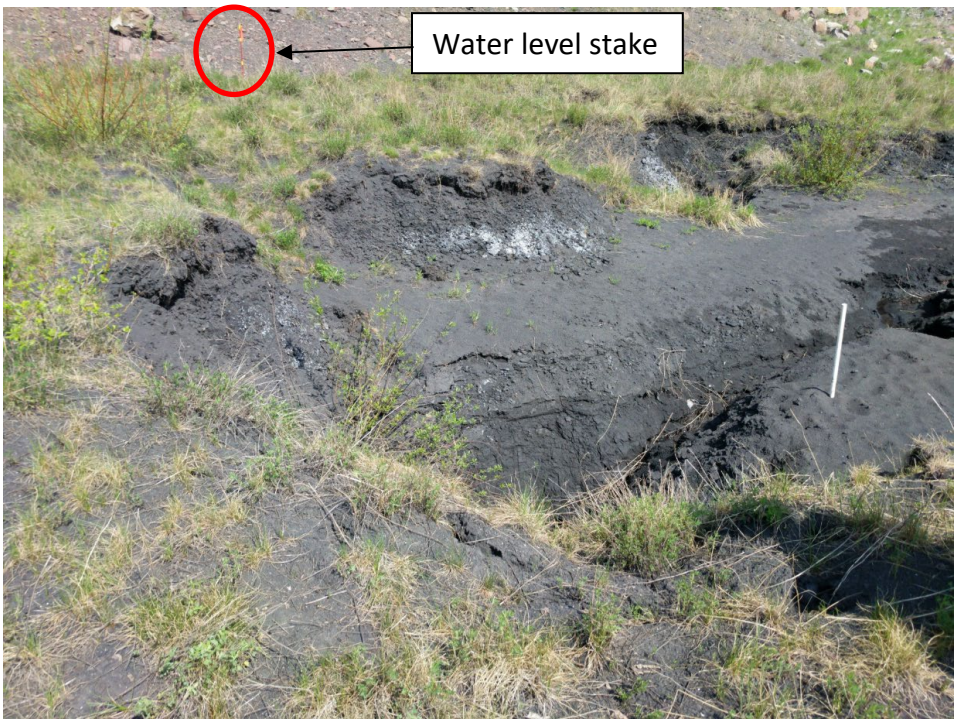


Photo I-11 Sinkhole 2 (SNTD-SINKHOLE-2019-02)

Photo I-12 Sinkhole 3 (SNTD-SINKHOLE-2019-03)

Photo I-13 Sinkhole 6, formerly a cluster of three sinkholes that were observed to have merged in 2018 (SNTD-SINKHOLE-2019-06)

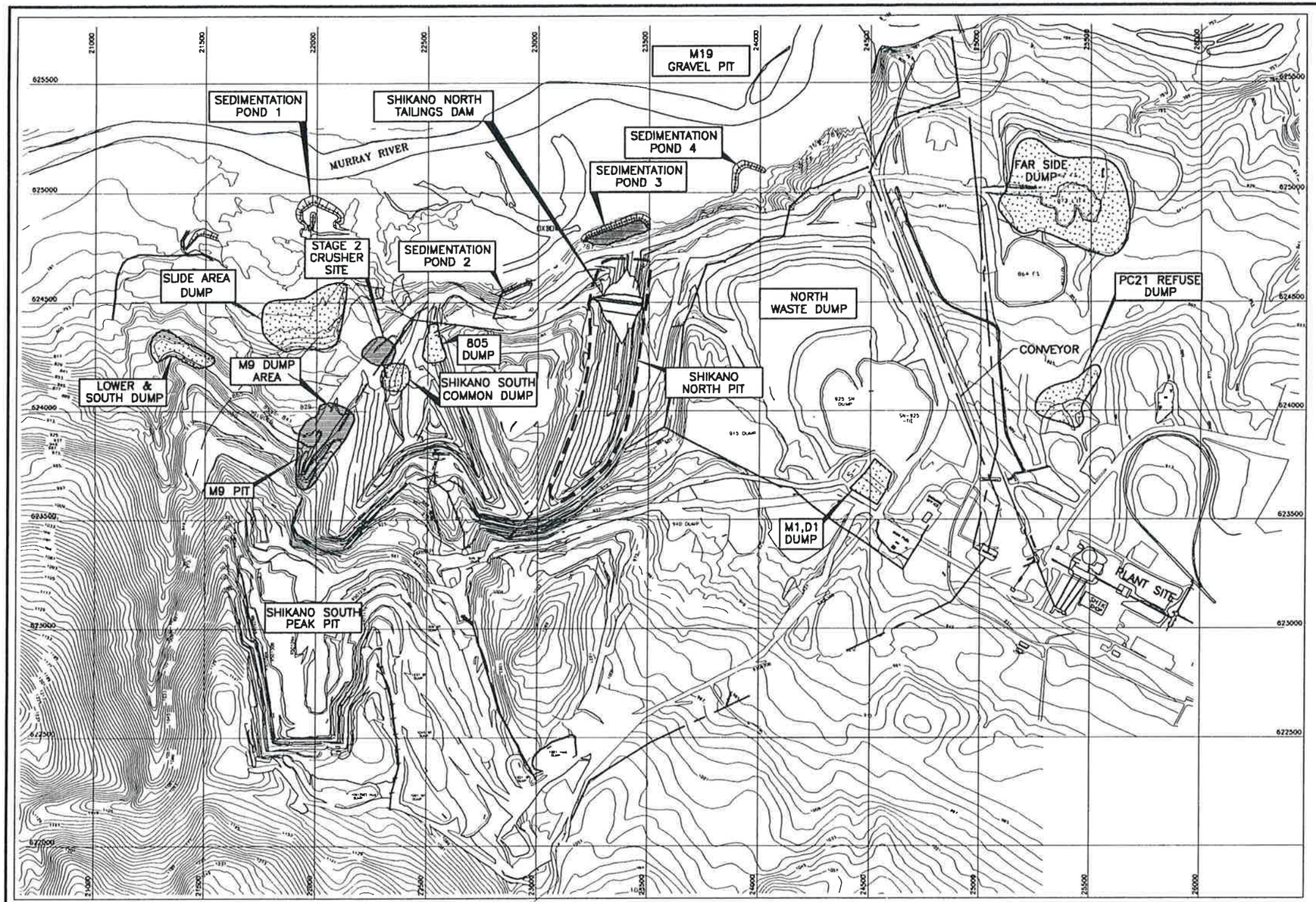
Photo I-14 Seepage channel, which flows into Sediment Pond S3 – looking east (SNTD-2019-07)

Photo I-15 Seepage channel to S3 Pond – looking southwest (SNTD-2019-07)

Photo I-16 Shikano North Tailings Dam – looking northwest. Historic slumping failure circled with red dash line (SNTD-2019-06)

APPENDIX II

Select Dam Record Drawings



LEGEND

SHIKANO NORTH PIT \ WORK AREA

DISPOSAL AREA

ISSUED FOR AS-BUILT

200m 0 600m
SCALE

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
H. D. PLEWES
Jul-7/99

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
2	JULY 99	ISSUED FOR AS-BUILT	ENL	TDP	HDP	HDP
1	OCT 98	ISSUED FOR CONSTRUCTION	PSK	TDP	HDP	HDP
0	OCT 98	ISSUED FOR TENDER	PSK	TDP	HDP	HDP

DRAWING NO. | REFERENCE DRAWING

SEAL

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CLIENT: Quintette Operating Corp.

KLOHN-CRIPPEN

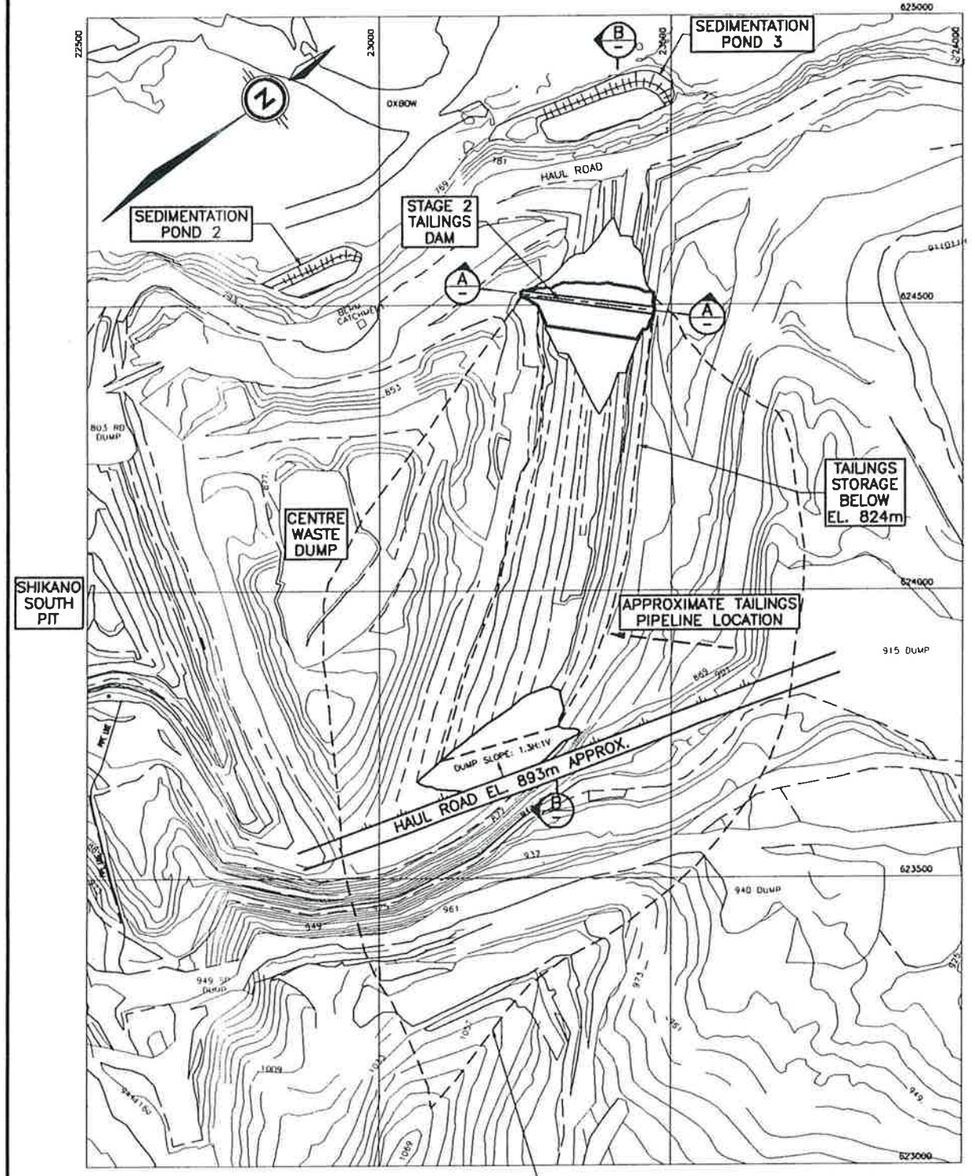
PROJECT: SHIKANO NORTH TAILINGS IMPOUNDMENT

TITLE: GENERAL SITE ARRANGEMENT

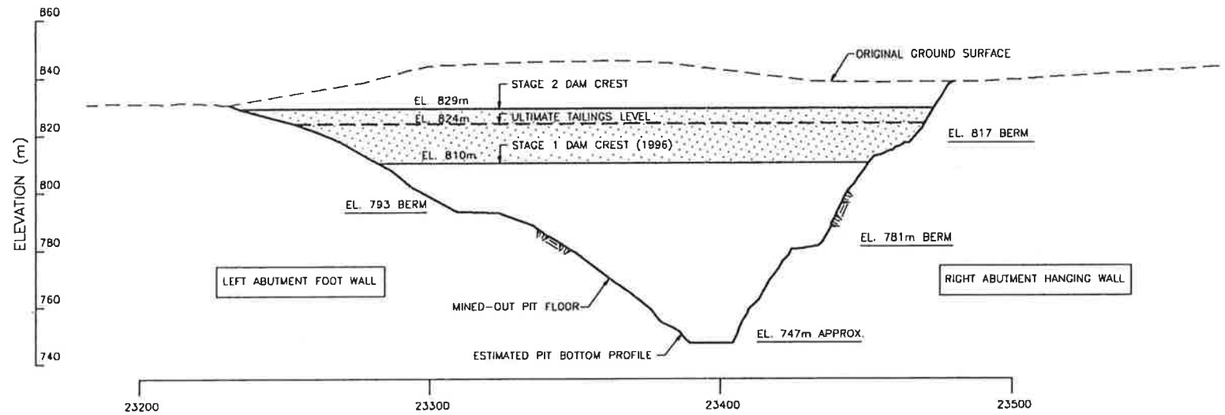
SCALE	PROJECT No.	DWG. No.	REV
AS SHOWN	PM6970 16	D-16000	2

CANCEL PRINTS BEARING PREVIOUS

KCC-A3



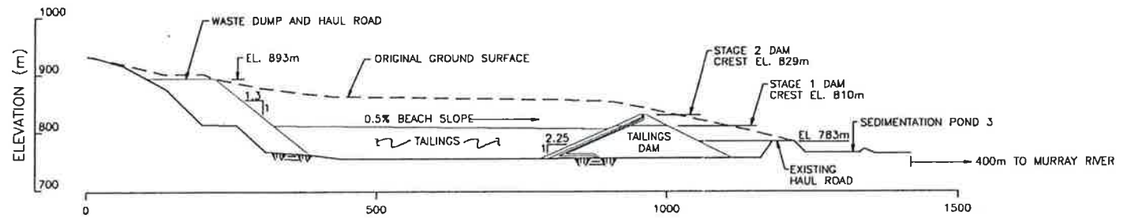
PLAN
SCALE: A



SECTION A
SCALE: B

LEGEND:

STAGE 2 DAM RAISE



SECTION B
SCALE: A

ISSUED FOR AS-BUILT

SCALE B: 20m 0 60m

SCALE A: 100m 0 300m

SCALE

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA H. D. PLEWES 7/99

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
2	JULY 99	ISSUED FOR AS-BUILT	ENL	TDP	HDP	HDP
1	OCT 98	ISSUED FOR CONSTRUCTION	PSK	TDP	HDP	HDP
0	OCT 98	ISSUED FOR TENDER	PSK	TDP	HDP	HDP

DRAWING NO. | REFERENCE DRAWING

SEAL

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CLIENT: Quintette Operating Corp.

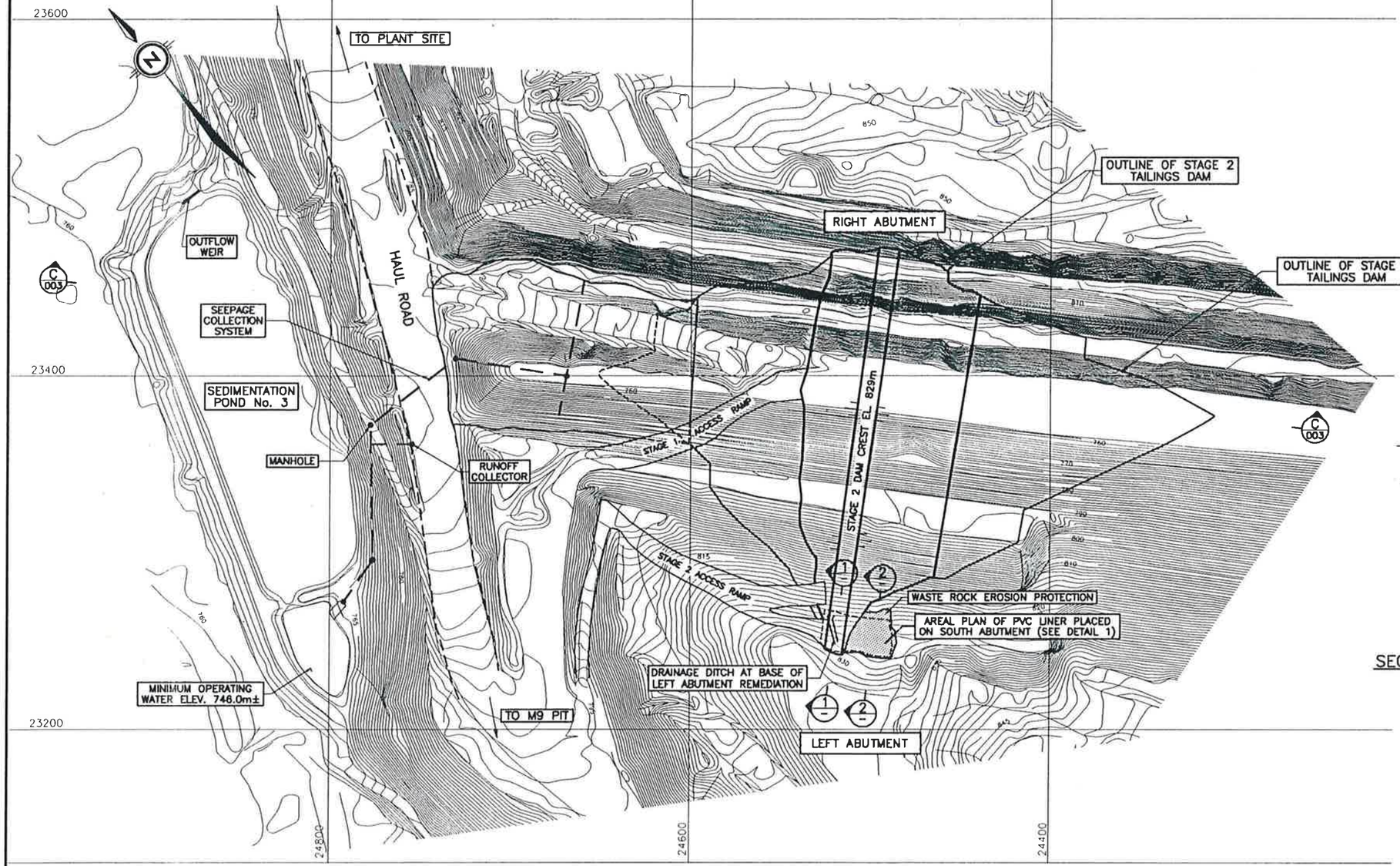
KLOHN-CRIPPEN

PROJECT: SHIKANO NORTH TAILINGS IMPOUNDMENT

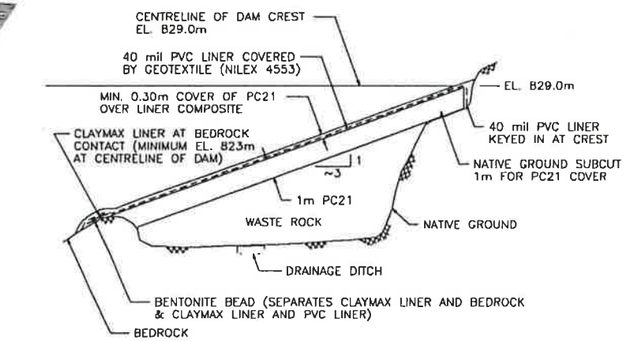
TITLE: ARRANGEMENT PLAN AND SECTIONS OF TAILINGS IMPOUNDMENT SITE

SCALE	PROJECT No.	DWG. No.	REV.
AS SHOWN	PM6970 16	D-16001	2

CANCEL PRINTS BEARING PREVIOUS



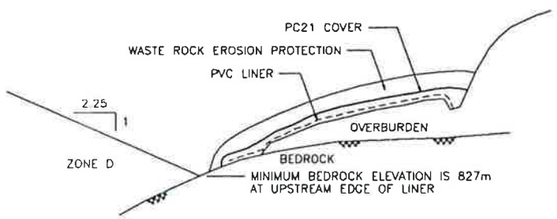
PLAN



SECTION (1) TYPICAL LEFT ABUTMENT REMEDIATION
N.T.S.

NOTES:

1. TOPOGRAPHY ACQUIRED FROM AERIAL PHOTOGRAPHY TAKEN SEPT.8, 1995 AND SUPPLIED BY QUINTETTE OPERATING CORPORATION.
2. TOPOGRAPHY FOR LEFT ABUTMENT REMEDIATION SUPPLIED BY CONTRACTOR.



SECTION (2) TYPICAL LEFT ABUTMENT LINER EXTENSION
N.T.S.

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — H. D. PLEWES — 7/99

ISSUED FOR AS-BUILT

0 100m
SCALE

NO	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
2	JULY 99	ISSUED FOR AS-BUILT	ENL	TDP	HDP	HDP
1	OCT 98	ISSUED FOR CONSTRUCTION	PSK	TDP	HDP	KDP
0	OCT 98	ISSUED FOR TENDER	PSK	TDP	HDP	KDP

DRAWING NO. | REFERENCE DRAWING

SEAL

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CLIENT: Quintette Operating Corp.

KLOHN-CRIPPEN

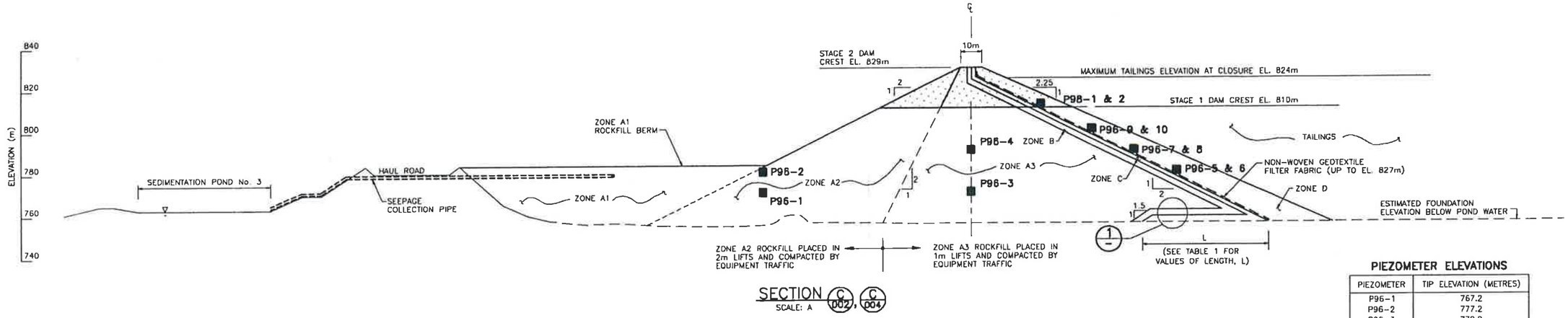
PROJECT: SHIKANO NORTH TAILINGS IMPOUNDMENT

TITLE: STAGES 1 AND 2 TAILINGS DAM PLAN

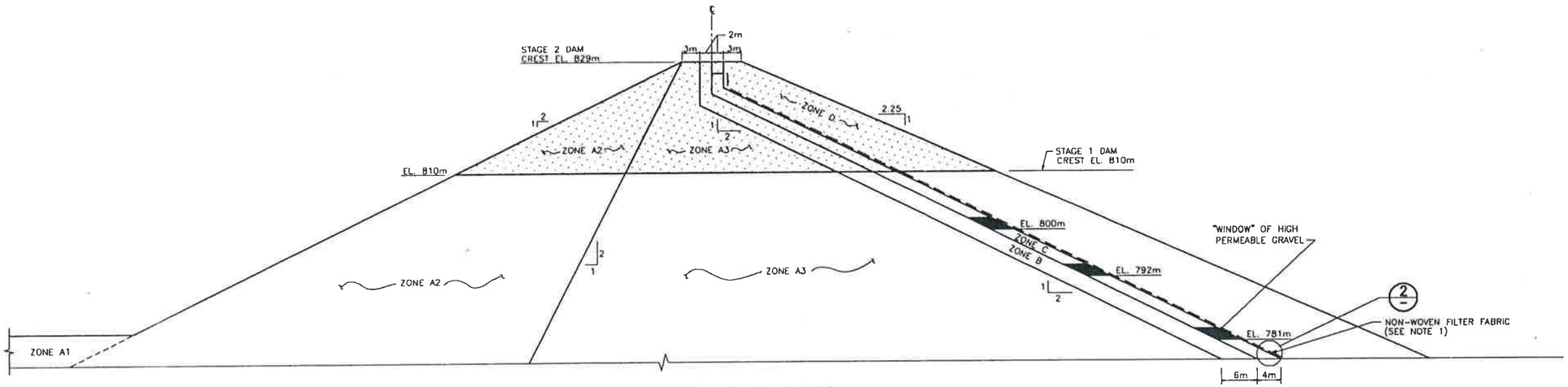
SCALE	PROJECT No.	DWG No.	REV
AS SHOWN	PM6970 16	D-16002	2

CANCEL PRINTS BEARING PREVIOUS

KCC-A3



SECTION ℄ (C/002, C/004)
SCALE: A



DETAIL OF DAM CREST
SCALE: B

PIEZOMETER ELEVATIONS

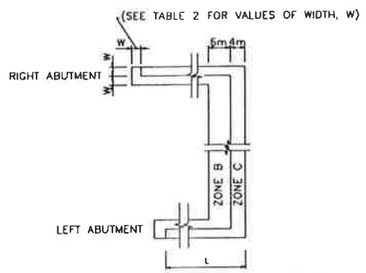
PIEZOMETER	TIP ELEVATION (METRES)
P96-1	767.2
P96-2	777.2
P96-3	770.0
P96-4	780.1
P96-5	780.0
P96-6	780.0
P96-7	790.1
P96-8	790.2
P96-9	800.0
P96-10	800.0
P98-1	810.5
P98-2	810.5

LEGEND:

96-10
■ PIEZOMETERS INSTALLED IN TAILINGS DAM

NOTES:

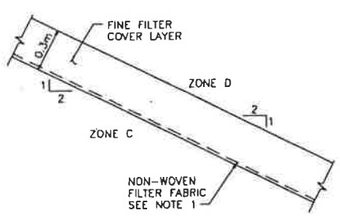
1. FILTER FABRIC LAID ON THE UPSTREAM SIDE OF ZONE C FINE FILTER. FILTER FABRIC OVERLAP > 0.3m ON DAM FACE, AND EXTENDS 1m UP DAM ABUTMENTS. FILTER FABRIC COVERED BY 0.3m OF ZONE C FINE FILTER.
2. PIEZOMETER LEADS FOR P96-3 AND 4 AND P98-1 AND 2 EXTENDED TO LOCATION OF PIEZOMETER LEADS FOR P96-5 TO 10.
3. PIEZOMETER LEADS FOR P96-3 TO P96-10 AND P98-1 AND 2 ARE EXTENDED IN A PVC CONDUIT UP THE LEFT ABUTMENT TO THE STAGE 2 DAM CREST.



(SEE TABLE 1 FOR VALUES OF LENGTH, L)

DETAIL (1) (C)
SCALE: C

PLAN VIEW OF FILTER ZONES AGAINST ABUTMENT WALLS



DETAIL (2) (-)
SCALE: D

GEOTEXTILE PROTECTIVE COVER

TABLE 1
FILTER ARM EXTENSION LENGTHS

FOUNDATION ELEVATION (m)	LENGTH, L (METRES) RIGHT ABUTMENT	LENGTH, L (METRES) LEFT ABUTMENT
810.0 - 815.5	30	20
815.5 - 816.5	28	20
816.5 - 817.5	26	20
817.5 - 818.5	24	20
818.5 - 819.5	22	20
819.5 - 820.5	20	20
820.5 - 821.5	18	18
821.5 - 821.6	15	15
821.6 - 822.5	13	13
822.5 - 823.5	11	11
823.5 - 824.5	9	9
824.5 - 825.5	9	9
825.5 - 825.6	7	7
825.6 - 826.5	7	7
826.5 - 827.5	7	7
827.5 - 828.5	7	7
828.5 - 829.0	6	6

TABLE 2
FILTER ARM WIDTHS

FOUNDATION ELEVATION (m)	WIDTH , W (METRES)* LEFT ABUTMENT	WIDTH , W (METRES)* RIGHT ABUTMENT
810.0-829.0	2.5	1.677

* EQUIVALENT HORIZONTAL THICKNESS. PERPENDICULAR THICKNESS TO ABUTMENT WALL IS 1.5m

STAGE 2 DAM RAISE MATERIAL ZONES

ZONE	DESCRIPTION	MATERIAL DESCRIPTION
A2	DOWNSTREAM SHELL	WASTE ROCK < 2m
A3	ROCKFILL SELECT	WASTE ROCK < 1m
B	COARSE FILTER	150mm MINUS
C	FINE FILTER	38mm MINUS
D	UPSTREAM SHELL	WASTE ROCK < 2m

ISSUED FOR AS-BUILT

SCALE D: 0 2m
SCALE C: 0 80m
SCALE B: 0 40m
SCALE A: 0 100m
SCALE

NO	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
2	JULY 99	ISSUED FOR AS-BUILT	ENL	TDP	HDP	
1	OCT 98	ISSUED FOR CONSTRUCTION	PSK	TDP	HDP	
0	OCT 98	ISSUED FOR TENDER	PSK	TDP	HDP	

DRAWING NO. | REFERENCE DRAWING

SEAL: PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA, H. D. PLEWES, 1999

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CLIENT: Quintette Operating Corp.

KLOHN-CRIPPEN

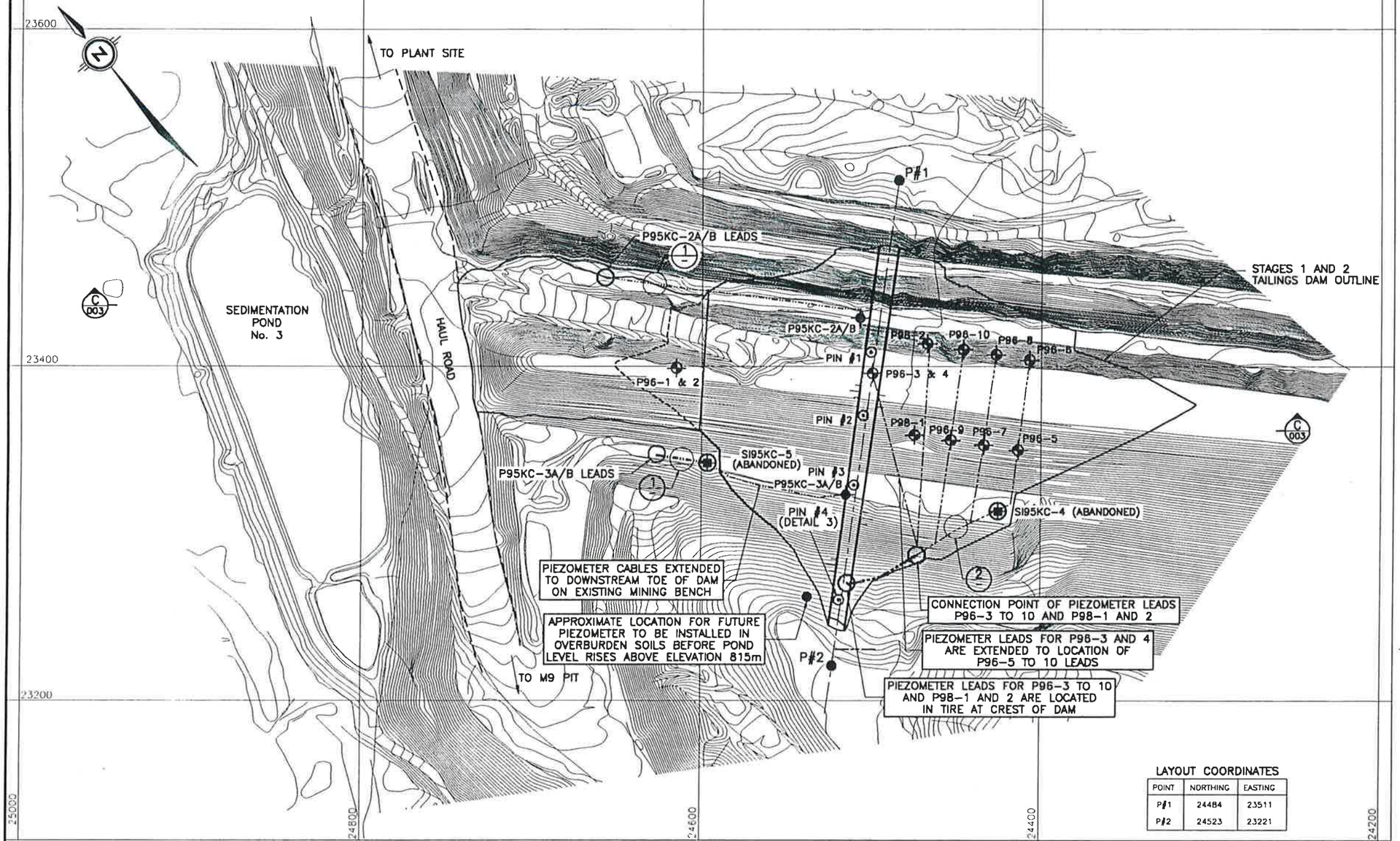
PROJECT: SHIKANO NORTH TAILINGS IMPOUNDMENT

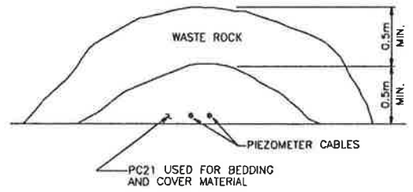
TITLE: STAGES 1 AND 2 TAILINGS DAM SECTIONS AND DETAILS

SCALE	PROJECT No.	DWG No.	REV
AS SHOWN	PM6970 16	D-16003	2

CANCEL PRINTS BEARING PREVIOUS

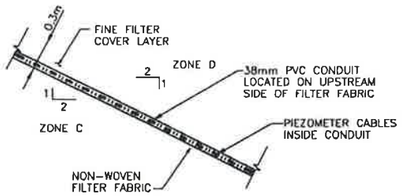
A2C-A3





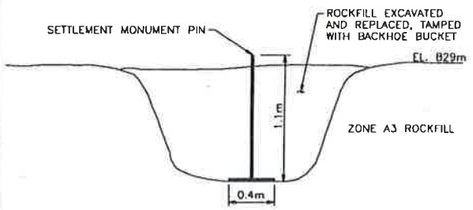
DETAIL 1
SCALE: B

BEDDING AND COVER MATERIAL FOR EXTENSION OF EXISTING PIEZOMETERS P95KC-3A/B



DETAIL 2
SCALE: B

EXTENSION OF PIEZOMTERS UP LEFT ABUTMENT



DETAIL 3
SCALE: N.T.S.

DETAIL OF SURVEY MONUMENTS INSTALLED ON STAGE 2 DAM CREST

LAYOUT COORDINATES

POINT	NORTHING	EASTING
P#1	24484	23511
P#2	24523	23221

NOTES:

1. TOPOGRAPHY ACQUIRED FROM AERIAL PHOTOGRAPHY TAKEN SEPT. 8, 1995 AND SUPPLIED BY QUINTETTE OPERATING CORPORATION (QOC).
2. TOPOGRAPHY FOR LEFT ABUTMENT REMEDIATION SUPPLIED BY CONTRACTOR.

LEGEND:

- P96-5 — LOCATION OF PIEZOMETERS INSTALLED IN STAGE 1
- EXISTING PIEZOMETERS P95KC-2A/B AND P95KC-3A/B
- EXISTING SLOPE INCLINOMETER SIKC95-5
- TIRE LOCATIONS TO PROTECT END OF PIEZOMETER CABLES AND SLOPE INCLINOMETERS.
- PIEZOMETER CABLES
- PIEZOMETER CABLES ENCLOSED IN PVC
- PIN #1 — DAM SETTLEMENT MONUMENTS SURVEY POINTS

ISSUED FOR AS-BUILT

SCALE B: 0 2m
SCALE A: 0 100m
SCALE

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
2	JULY 99	ISSUED FOR AS-BUILT	ENL	TDP	HDP	HDP
1	OCT 98	ISSUED FOR CONSTRUCTION	PSK	TDP	HDP	HDP
0	OCT 98	ISSUED FOR TENDER	PSK	TDP	HDP	HDP

DRAWING NO. | REFERENCE DRAWING

SEAL: PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — H. D. PLEWES

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CLIENT: Quintette Operating Corp.

KLOHN-CRIPPEN

PROJECT: SHIKANO NORTH TAILINGS IMPOUNDMENT

TITLE: STAGES 1 AND 2 TAILINGS DAM INSTRUMENTATION PLAN AND DETAILS

SCALE	PROJECT No.	DWG. No.	REV.
AS SHOWN	PM6970 16	D-16004	2

CANCEL PRINTS BEARING PREVIOUS

APPENDIX III

Teck's Shikano North Tailings Dam
2019 Inspection Checklists

Shikano North Tailings Dam – Overall Inspection

Date:	July 3/2019
Property:	Quintette Coal Operations (QCO)
Structure:	Shikano North Tailings Dam
Function (tailings, water, etc.):	Tailings storage facility
Consequence Classification:	Significant
Inspection Performed By:	Rob Muise
Inspection Type (circle one):	(Routine) Event-Driven (Rainfall) Event-Driven (Earthquake)

Conditions at Time of Inspection	
Conditions	☐Sunny ☐Scattered Clouds ☒Overcast ☐Raining ☐Snowing Comments:
Temperature	12°C
Winds	☐None ☒Light ☐Moderate ☐High From:
Snow Cover	☒None ☐Slight ☐Drifts ☐Melting Comments:
Pond	☐None ☒Open Water ☐Partially Frozen ☐Frozen ☐High Turbidity Comments:
Wave Action:	☐None ☒Light ☐Moderate ☐High ☐Causing Erosion Comments:

Shikano North Tailings Dam – Overall Inspection

DAM STRUCTURE	Visible for Inspection	Cracks	Settlement	Sloughing, Slides or Sinkholes	Surficial Erosion or Rutting	Seepage Breakout, Turbidity or Discoloration	Excessive Vegetation	Excessive Debris	Animal Burrows
Crest	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑		Yes ☐ No ☑		Yes ☐ No ☑
	Comments or Unusual Conditions:								
Upstream Slope	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑		Yes ☐ No ☑		Yes ☐ No ☑
	Comments or Unusual Conditions:								
Downstream Slope	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑		Yes ☐ No ☑
	Comments or Unusual Conditions:								
Freeboard Monitoring	Is there ponded water on the tailings beach? (Circle one)						(Yes)	No	
	If "yes", is the water level at or above the bottom of the reference marker (i.e. the top of the tailings beach)? (Circle one)						Yes	(No)	N/A
	If "yes", is the water level at or above the 1m mark on the reference marker? (Circle one)						Yes	No	
Tailings Beach	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑
	Comments or Unusual Conditions: No change in Sinkholes / Some erosion from recent rain								
Downstream Toe & Area	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑
	Comments or Unusual Conditions:								
Seepage Collection Pipe Outlet	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑
	Approximate flow rate and clarity of discharge: Normal								

LEGEND

- CPs ▲ Survey Monument
- NSTD-2014-## (PZ) ● 2014 Waypoint and Piezometer Location
- NSTD-2014-## ● 2014 Waypoint
- WP-41 ● 2013 Waypoint and Piezometer Readout Location
- —— Existing Road

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED NOVEMBER 2014.

0 125 m

Notes:
1. UTM Zone 10N NAD83
2. 2010 orthophoto from Teck

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CLIENT: Teck

Klohn Crippen Berger

PROJECT: QUINTETTE COAL OPERATIONS
2014 DAM SAFETY INSPECTION

TITLE: SHIKANO NORTH TAILINGS DAM
2014 INSPECTION WAYPOINTS

PROJECT No. M09684A10

FIG No. 1

Shikano North Tailings Dam – Downstream Slope Visual Inspection

	Date: Sept 4/19
Property:	Quintette Coal Operations (QCO)
Structure:	Shikano North Tailings Dam
Function (tailings, water, etc.):	Tailings storage facility
Consequence Classification:	Significant
Inspection Performed By:	Rob Muise
Inspection Type (circle one):	(Routine) Event-Driven (Rainfall) Event-Driven (Earthquake)

Conditions at Time of Inspection			
Conditions	☐Sunny ☐Scattered Clouds ☑Overcast ☐Raining ☐Snowing Comments:		
Temperature	15°C		
Winds	☐None ☑Light ☐Moderate ☐High	From:	

Downstream Slope Condition	
Snow Cover	☑None ☐Slight ☐Drifts ☐Melting Comments:
Vegetation	Any vegetation growth? NONE
Condition	Visible signs of erosion, tension cracking, bulging or movement of the rock fill face? NO
Seepage	If seepage observed, note location, approximate elevation, clarity/turbidity, approximate rate. 0.01253 m^3/s
Animal Burrows	NO
Other	Other comments or unusual conditions.

Shikano North Tailings Dam – Overall Inspection

	Date: Sept 4/19
Property:	Quintette Coal Operations (QCO)
Structure:	Shikano North Tailings Dam
Function (tailings, water, etc.):	Tailings storage facility
Consequence Classification:	Significant
Inspection Performed By:	Rob Muise
Inspection Type (circle one):	Routine ✓ Event-Driven (Rainfall) Event-Driven (Earthquake)

Conditions at Time of Inspection	
Conditions	☐Sunny ☐Scattered Clouds ☒Overcast ☐Raining ☐Snowing Comments:
Temperature	
Winds	☐None ☑Light ☐Moderate ☐High From:
Snow Cover	☑None ☐Slight ☐Drifts ☐Melting Comments:
Pond	☐None ☑Open Water ☐Partially Frozen ☐Frozen ☐High Turbidity Comments:
Wave Action:	☑None ☐Light ☐Moderate ☐High ☐Causing Erosion Comments:

Shikano North Tailings Dam – Overall Inspection

DAM STRUCTURE	Visible for Inspection	Cracks	Settlement	Sloughing, Slides or Sinkholes	Surficial Erosion or Rutting	Seepage Breakout, Turbidity or Discoloration	Excessive Vegetation	Excessive Debris	Animal Burrows
Crest	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑		Yes ☐ No ☑		Yes ☐ No ☑
	Comments or Unusual Conditions:								
Upstream Slope	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑		Yes ☐ No ☑		Yes ☐ No ☑
	Comments or Unusual Conditions:								
Downstream Slope	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑		Yes ☐ No ☑
	Comments or Unusual Conditions:								
Freeboard Monitoring	Is there ponded water on the tailings beach? (Circle one)						Yes	No	
	If "yes", is the water level at or above the bottom of the reference marker (i.e. the top of the tailings beach)? (Circle one)						Yes	No	N/A
	If "yes", is the water level at or above the 1m mark on the reference marker? (Circle one)						Yes	No	
Tailings Beach	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑
	Comments or Unusual Conditions: Sink holes → NO change								
Downstream Toe & Area	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑
	Comments or Unusual Conditions:								
Seepage Collection Pipe Outlet	Yes ☑ No ☐	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑	Yes ☐ No ☑
	Approximate flow rate and clarity of discharge: 0.01253 m³/Sec								

LEGEND

- CP# ▲ Survey Monument
- NSTD-2014-## (P2) ● 2014 Waypoint and Piezometer Location
- NSTD-2014-## ● 2014 Waypoint
- WP-41 ● 2013 Waypoint and Piezometer Readout Location
- —— Existing Road

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED NOVEMBER 2014.

0 125 m

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CLIENT: Teck

Klohn Crippen Berger

PROJECT: QUINTETTE COAL OPERATIONS
2014 DAM SAFETY INSPECTION

TITLE: SHIKANO NORTH TAILINGS DAM
2014 INSPECTION WAYPOINTS

PROJECT No. M09684A00 | FIG No. 1

APPENDIX IV

Register of Reference Documents

Appendix IV
Register of Reference Documents

Document Title	Author	Date of Issue
Shikano Geological Report Text	Quintette Coal Limited	May-85
Shikano North Tailings Impoundment - Design Report	Klohn Crippen	23-Jun-95
Shikano North Tailings Impoundment - Pervious Tailings Dam Option - Design Report	Klohn Crippen	09-Feb-96
Shikano North Tailings Impoundment - 1995 Geotechnical Investigations, Data Report	Klohn Crippen	09-Feb-96
Shikano North Tailings Impoundment 1996 As-Built Report	Klohn Crippen	14-Mar-97
Shikano North Tailings Impoundment 1997 Annual Review	Klohn Crippen	20-Feb-88
Shikano North Tailings Impoundment 1998 Annual Review	Klohn Crippen	05-Mar-99
Shikano North Tailings Impoundment - Stage 2 As-Built Report	Klohn Crippen	09-Jul-99
Shikano North Tailings Impoundment 1999 Annual Review	Klohn Crippen	06-Dec-99
Quintette Project - Baseline Climate & Hydrology Conditions	Clearwater Consultants Ltd.	17-Aug-11
Quintette Coal Project: 2012 Dam Inspections: Plantsite Tailings Dam, M11 Diversion Dam, Shikano North Tailings Dam	Klohn Crippen Berger Ltd.	Dec-12
Tailings Water Balance, Seepage Rates and Preliminary Seepage Reclaim Design	Klohn Crippen Berger Ltd.	30-Apr-13
Shikano North Tailings Dam - 2013 Dam Safety Inspection Report	Klohn Crippen Berger Ltd.	09-Dec-13
Quintette Dam Safety Review Shikano North Tailings Storage Facility	Klohn Crippen Berger Ltd.	27-May-14
Shikano North Tailings Dam – 2014 Dam Safety Inspection Report – Revision 1	Klohn Crippen Berger Ltd.	26-Nov-14
Shikano North Tailings Dam - Response to February 3, 2014 MEM Memorandum	Klohn Crippen Berger Ltd.	29-Jun-15
Shikano North Tailings Dam – 2015 Dam Safety Inspection Report	Klohn Crippen Berger Ltd.	04-Mar-16
Shikano North Tailings Storage Facility Engineer of Record	Klohn Crippen Berger Ltd.	23-Sep-16
Quintette Coal Operations – Shikano North Tailings Dam Water Management, Water Balance and Quantifiable Performance Objectives	Klohn Crippen Berger Ltd.	22-Dec-16
Shikano North Tailings Dam – 2016 Dam Safety Inspection Report	Klohn Crippen Berger Ltd.	22-Dec-16
Shikano North Tailings Dam – 2017 Dam Safety Inspection Report	Klohn Crippen Berger Ltd.	16-Mar-18