CONFIDENTIAL

REPORT

2022 ANNUAL FACILITY PERFORMANCE REPORT - LOUVICOURT

TECK RESOURCES LTD.

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Executive Summary

This document presents the 2022 annual facility performance report (AFPR) for the tailings storage facility (TSF) and polishing pond at the closed Louvicourt Mine site located near Val-d'Or, Quebec. This report was prepared based on a site visit carried out on September 20, 2022, by Laurent Gareau and Simon Chapuis of Golder Associates Ltd. (Golder; amalgamated under WSP Canada Inc. [WSP] in January 2023), Jason McBain, Jonathan Charland, and Luc Tellier of Teck Resources Ltd. (Teck, Owner), as well as on a review of available data representative of conditions over the period since the previous AFPR. Golder are the original designer of the facility and have been the provider of the Engineer of Record (EOR) since 2017. Golder performed an inspection in 2009, and has performed annual inspections of the facilities since 2014. Laurent Gareau assumed the role of EOR for the Louvicourt TSF in 2018. The objective of the site visit component of an AFPR for any such facility is to observe the physical condition of the structures of the facility and look for any signs of changing geotechnical performance such as settlement, bulging, cracking, erosion, seepage, or piping. The review of monitoring data supplements the visual observations and provides a historic perspective on the annual performance of a facility.

The AFPR is supplemented by routine observations, instrumentation monitoring, and water quality monitoring carried out at the facility by Teck throughout the year.

Summary of Facility Description

The Louvicourt Mine is a closed base-metal mine (primarily copper and zinc, with some gold and silver) located approximately 20 kilometres (km) east of Val-d'Or, Quebec, north of Highway 117. The TSF is located some 8.5 km northwest of the former mine site. The Louvicourt property is currently owned by Teck (55%) and Glencore Canada Corporation (45%). The TSF and polishing pond facilities are managed by Teck.

Infrastructure at the site comprises a tailings pond juxtaposed to a polishing pond. The polishing pond is located immediately downstream (east) of the tailings pond. The tailings pond is bounded by Dams 1A, 1B and 1C to the north and by Dams 1D and 1E to the east, Dams 2A and 2B to the west, and natural topography to the south. An operational spillway and two emergency spillways are located to the east at Dam 1E, at the northeast corner of the facility.

The polishing pond is bounded by Dam 4A, 4B and high ground to the north, Dam 1D (acting as a boundary between the polishing pond and the tailings pond) to the west and by high ground to the south and east. An operational spillway and an emergency spillway are located at the north end of the pond, on the east end of Dam 4B.

The facility is inspected by Teck weekly during the summer period and monthly through the winter months.

Summary of Key Potential Hazards and Hypothetical Consequences

As a required component of the AFPR, a review was completed of the instrumentation data and the September 2022 site observations relative to the potential hazards. There was no significant change to the key potential hazards based on the conditions observed in 2022 compared to previous reporting periods and no safety concerns with the existing facilities were identified. Tailings facilities can have three broad areas of catastrophic failure modes and those were reviewed as part of this annual summary – namely internal erosion, slope instability, and overtopping. The design basis relevant to each of the potential failure modes was reviewed. WSP understands that Teck's long-term goal for all tailings facilities is to reach landform status with all potential failure modes that could result in catastrophic release of tailings and/or water being reduced to non-credible. Where it is not possible to reduce all credible catastrophic failure[1] modes to non-credible, the as-low-as-reasonably-practical (ALARP) principle will be pursued, with redundant safety measures in place to remove the risk of any clear triggers for failure. Non-credible failure modes refer to a state where, under the applicable extreme loading condition, there is negligible likelihood of triggering the given failure mode so that it results in a flow of tailings from the facility. A credible failure mode assessment is underway for the facility. Presently, evaluations of two of the three broad areas of potential failure mechanisms are underway and these will inform WSP's recommendation on the status of credible failure modes for this facility. Following are updates on the status of that work for end of the 2022 reporting period.

Internal Erosion

Flow rates at the V-notch weirs and seepage locations around the TSF are estimated or measured by Teck during monthly observations in the snow-free seasons. The observable flow and/or water accumulation areas are observed for suspended solids, or cloudy discharge, which could be indicative of internal erosion. At the time of the September 20, 2022 site visit, the monitoring results from the previous year were reviewed and it was observed that measured flow rates were within normal historical operating ranges, and there was no evidence of suspended solids in the flows, nor residues indicative of such solids in the flow during the past year. Although the V-notch weir flows fluctuate in response to rainfall and snowmelt events, the historical data does not suggest a trend of increasing seepage flows. The observed flows have consistently been noted to be clear and free of suspended sediments under normal flow conditions. Intermittently, heavy rainfall events result in the accumulation of limited amounts of sediment from surficial washing in the weirs. No zones of recent subsidence or sink holes, which could be indicative of internal erosion, were observed anywhere within the overall facility. In conclusion, no evidence of internal erosion was observed during the formal AFPR inspection nor indicated by the flow monitoring. This has been the case throughout operation and through the mine closure period.

Studies to eliminate this hazard as a credible failure mode for the facility are ongoing or planned and include:

- review of historic construction records to assess filter compatibility between natural soils and construction materials
- piezometric monitoring to measure gradients across potential erosional transitions
- seepage modelling to validate measured gradients
- assessment of potential frost effects on core integrity

Instability

Best management practices for water-retaining structures include using appropriately placed instrumentation to supplement the regular visual assessment of dam performance relative to potential failure modes. For the Louvicourt TSF, piezometers, thermistors, and survey monuments comprise the instrumentation used for performance monitoring.

The groundwater monitoring network consists of eight standpipe piezometers and 11 vibrating wire piezometers (VWPs) installed on the berms of the three different dams (1, 2 and 4). These instruments indicate stable piezometric levels with no significant trend of increasing or decreasing levels.

Survey monuments were surveyed between July 18 and 22, 2022 by Corriveau J.L. & Assoc. (Corriveau), a surveyor based in Val-d'Or. The data (Appendix C) indicates that in many cases, incremental vertical and horizontal

[1] A tailings facility failure that results in material disruption to social, environmental, and local economic systems (ICMM, 2020).

movements are below the stated range of accuracy of the survey – this suggests that within the range of survey accuracy, these instruments are not undergoing any significant displacements. Where instruments show displacement greater than the stated survey accuracy, total displacements since installation are relatively low and some seasonal movements may be occurring. The following general observations were made:

- Total cumulative settlements for all the survey monuments do not exceed 36 mm since 2008.
- Incremental settlements in the past year (2021 to 2022) were all less than or equal 3 mm. The maximal incremental settlement was 3 mm for one instrument (SP-2 at Dam 1D).
- There is no sign of accelerating settlements.
- The horizontal data show that the survey instruments exhibited horizontal movements within the range of annual variability and, in all cases, less than or equal to 9 mm from 2021 to 2022, and total horizontal movements since installation of less than or equal to 21 mm. The data suggest that no significant horizontal movements are occurring.

Based upon the monitoring results, deformation and potential instability were not concerns for the facility in 2022. Studies to eliminate this hazard as a credible failure mode for the facility are ongoing or planned and include:

- Site-specific seismic hazard assessment coupled with an update of seismic stability, including undrained loading, for a 1:10,000-year return period seismic event.

Overtopping

The dams of the tailings pond and polishing pond were originally designed with a 2.0 m freeboard and a 1.5 m freeboard, respectively. *Dam Safety Guidelines* (CDA, 2007) provided updated guidance for freeboard allowance. Klohn Crippen Berger (KCB, 2011) reviewed the freeboard assessment for the tailings pond against the requirements of CDA (2007) in the 2010 independent Dam Safety Review (DSR) (KCB, 2011) and concluded that for a normal operating pond level of 316.15 m, freeboard was adequate under extreme precipitation events. The polishing pond freeboard was judged to be more than adequate as the polishing pond level is currently maintained significantly lower than was intended in the original design, such that freeboard exceeds 3 m. In 2022, the available freeboard was always greater than the minimum requirement of the CDA. These conditions do not present a concern with overtopping.

A consolidated hydrology study (Golder, 2021b) determined that both the TSF pond and the polishing pond had adequate capacity to safely pass the probable maximum flood (PMF) event, with significant contingency and without potential for overtopping, as long as the operational spillways are maintained free of obstructions. Teck has demonstrated diligence in the maintenance of the spillway structures. Under active closure care, it is concluded that overtopping is not a credible failure mode.

Consequence of Failure

Teck are aligned with the most conservative interpretation of the *Global Industry Standard on Tailings Management* (GISTM; ICMM, 2020) which, in turn, is consistent with their safety culture. Commensurately, Teck has advised that consequence classification is not a part of their tailings management governance and has asked that it not be reported in this AFPR. Instead, Teck will adopt the extreme consequence case design loading for any facility with a credible catastrophic flow failure mode. For facilities without a credible failure mode in terms of a life safety issue, Teck will reduce credible risks to ALARP. This consequence case applies for both earthquake and flood scenarios for all tailings facilities, consistent with the GISTM. Adopting this approach meets or exceeds any regulatory requirements, aligns with Teck's goal to eliminate risk for loss of life, and is consistent with the GISTM. This approach is consistent with industry-leading best practices and has an added benefit of providing accurate narratives to communities about the safety of tailings facilities that could impact them and who share Teck's approach of one life is one too many to be at risk.

Summary of Key Observations

Summary of Field Observations

The principal following observations were made at the time of the AFPR inspection:

- All embankments were in good condition without evidence of deteriorating geotechnical conditions.
- The spillways at Dams 4B and 1D were in good condition and functional.
- The broken trash rack upstream of the tailings pond spillway has been replaced.
- Ponding water or seepage with low flows was observed at the toe of several dams, generally at the locations indicated in previous years. In general, the ponding and seepage were similar to previous years. The seepage and ponding features do not represent any dam safety concerns.
- Minor erosion was observed on the dam crests from weather (freeze-thaw and wind activity). This should continue to be monitored, and maintenance efforts may be required in the future.

Climate and Water Balance Summary

The total precipitation over the hydrological year (November 2021 to October 2022) was 955 mm or 4.8% higher than the long-term average of 911 mm. Based on the consolidated hydrology study for the Louvicourt site (Golder, 2021b), this corresponds to a 1:2-year to 1:5-year wet precipitation year.

Based on a high-level water balance analysis, it was estimated that 410,000 cubic metres (m^3) of water were discharged to the polishing pond via the operational spillway. This discharge corresponds to average and maximum spillway discharges much less than the spillway capacity. The annual discharge was transferred without any flow in either the primary or second emergency spillways and does not present a risk to the facility.

Summary of Significant Changes

The only significant construction at the facility in 2022 was the addition of riprap to the interior slope of Dams 1A and 1C. Subsequent to the annual inspection, a significant silviculture program was implemented to remove large trees from the various dams, to clear vegetation in the second emergency spillway channels and to remove vegetation at the toe of Dams 1 and 2 to enable better observation of geotechnical conditions at the toes of the structures.

Summary of Review of OMS and ERP Manuals

The Operations, Maintenance and Surveillance (OMS) manual was updated in 2020. It is also reviewed annually. At the time of preparation of this report, a further update of the OMS is in progress to ensure the format is compliant with the Teck Tailings and Water Retaining Structures guideline (Teck, 2019), which is fully aligned with the Mining Association of Canada's (MAC 2021) guidance on OMS manual best practices. Anticipated completion of the update is Q2 of 2023.

A Mine Emergency Response Plan (MERP) for the site was most recently updated in March 2022. The MERP incorporates response procedures for the tailings and polishing pond components with input from the EOR, and has replaced the previous emergency preparedness and response plan. The most recent MERP test for the facility was conducted in April 2022 (desktop exercise test).

Dam Safety Review

The field inspection portion of an independent DSR of the TSF and polishing pond was conducted on July 29, 2021, by Dixie Ann Simon of John Wood Group PLC. The report of the DSR is outstanding.

Status of Annual Facility Performance Inspection Key Recommended Actions

The status of the deficiencies and non-conformances are presented in the following tables.

Table E1: Status of Annual Facility Performance Inspection Key Recommended Actions

Structure	ID	Deficiency or Non-conformance	Applicable Regulation or OMS Reference	Recommended Action	Priority	Recommended Deadline/Status
Previous Recommendations Closed / Superseded						
Dam 4B	2019-02	Granular fill has been placed east of the main spillway, in an area designed as an emergency spillway.	CDA 2013 Section 3.5.5	Assess whether the current configuration can pass the design storm. Preliminary indications are that the current configuration does not pose any overtopping issues.	2	Analyses completed; report submitted for Teck review. No remedial measures are anticipated to be required to address this issue. Can be closed out immediately upon completion of the report review.
Dam 1D	2020-02	Larger diameter (>4-inch trunk) vegetation exists on the downstream stability berm of Dam 1D	OMS Manual Section 6.2	Consider tree removal		Completed in 2022.
TSF Spillway	*2021-01*	*Beaver activity in TSF Operational Spillway.*	*OMS Manual Section 6.2*	*Remove debris.*	*3*	*Debris removed in 2021. Completed.*
Dam 1A Dam 1C	*2020-01*	*Replacement of riprap on the interior slopes of Dams 1A and 1C is required.*	*CDA 2013 Section 3.5.3*	*Place new riprap as was done for Dams 1B and 1D.*	*3*	*Complete.*
TSF and Polishing Ponds	2021-05	Multiple potential erroneous entries in the pond water level database.	CDA 2013 Section 3.6.3	Implement a QA/QC system for the data collection and entry.	3	Implemented in 2022, but further QA/QC will applied, and validated by new pond piezometers.
Dam 4B	*2021-03*	*Significant beaver blockage downstream of Dam 4B.*	*CDA 2013 Section 3.5.3*	*Engage beaver control contractor and then remove the blockage.*	*2*	*Completed in 2021.*

Table E1: Status of Annual Facility Performance Inspection Key Recommended Actions

Structure	ID	Deficiency or Non-conformance	Applicable Regulation or OMS Reference	Recommended Action	Priority	Recommended Deadline/Status
Previous Recommendations Ongoing						
All	2015-06	Perform a review of dam's seismic stability and undrained behaviour.	Directive 019 Section 2.9.3	Perform a review of dam's seismic stability and undrained behaviour of potentially contractive soils.	3	IN PROGRESS- Undrained stability analysis completed, and deformation analysis is in progress. Q2 2023.
TSF Spillway	2021-02	Beaver access under trash rack leading to increased activity in spillway.	OMS Manual Section 6.2	Survey trash rack and re-assess the adequacy of design and the hydraulic capacity.	3	Survey performed; data analysis is ongoing. Q2 2023.
Dam 1C	2021-04	Irregular slope on toe berm of Dam 1C leading to preferential infiltration.	CDA 2013 Section 3.5.3	Engage a detailed survey of this area and use the data to refine facility integrity analyses.	3	Survey completed in 2021. Data analysis is ongoing. Integrate into stability analysis. Q2 2023.
2022 Recommendations						
General	2022-01	Gaps in the rain gauge records	*CDA 2013 Section 3.2*	Download the rain gauge records monthly during the open-water season and verify the data for equipment errors Verify the equipment calibration	4	To be implemented in 2023

CDA = Canadian Dam Association; OMS = Operations, Maintenance and Surveillance; TSF = tailings storage facility; QA/QC = quality assurance/quality control.

Priority (defined by Teck Resources)	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.
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.

Note: Priority description categories are consistent with Mining Association of Canada (MAC) guidelines.

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Definitions

Abbreviation	Definition
AFPR	Annual facility performance report
CDA	Canadian Dam Association
DSR	Dam Safety Review
EOR	Engineer of Record
Golder	Golder Associates Ltd.
GPS	Global Positioning System
MAC	Mining Association of Canada
MERP	Mine Emergency Response Plan
OMS	Operation, Maintenance and Surveillance
PGA	Peak Ground Accelerations
Teck	Teck Resources Ltd.
TSF	tailings storage facility
WSP	WSP Canada Inc.

Unit	Definition
%	percent
+/-	plus or minus
°C	degrees Celsius
cm	centimetre
ha	hectare
km	kilometre
kN/m^3	kilonewtons per cubic metre
kPa	kilopascal
L/s	litres per second
m	metre
m^2	square metre
m^3	cubic meter
t	tonne
tpd	tonnes per day

Term	Definition
Dam Safety Review (DSR)	A systematic review and evaluation of all aspects of design, construction, maintenance, operation, process, and system affecting a dam's safety, including the dam safety management system (CDA 2013).
Downstream	The side of the embankment furthest away from the reservoir, pond or stored tailings.
Tailings	Fine-grained residual material remaining after the valuable resources have been separated.
Freeboard	The vertical distance between the still water surface elevation in the reservoir and the lowest elevation at the top of the containment structure (CDA 2013).
Upstream	The side of the embankment nearest to the reservoir, pond or stored tailings.
Waste Rock	Coarse-grained (gravel to boulder sized) mineral rockfill. Also referred to as rockfill.

1.0 INTRODUCTION

1.1 Purpose, Scope of Work and Methodology

At the request of Teck Resources Ltd. (Teck), WSP Canada Inc. (WSP, formerly Golder) has completed the 2022 annual performance review inspection at the Louvicourt Mine tailings storage facility (TSF) and polishing pond located near Val-d'Or, Quebec. The facility includes the tailings pond and the polishing pond and associated appurtenant structures. The report is based on a site visit carried out on September 20, and the review of available surveillance data for the reporting period (September 2021 to September 2022) by the Engineer of Record (EOR), Laurent Gareau of WSP. The previous annual inspection for the tailings facility dams was carried out in July 2021, and is reported in the 2021 annual facility performance report (AFPR[2]) (Golder, 2022).

The 2022 inspection included the inspection of the polishing and tailings facility dams:

- Dams 1A through 1E
- Dams 2A and 2B
- Dams 4A and 4B

This report has been prepared in accordance with the Teck Guideline for Tailings and Water Retaining Structures (Teck, 2019). Sections that are no longer applicable due to the facility being closed or because of the particular nature of the Louvicourt tailings facility have been identified as “not applicable”, or are not included in the report. The reader is encouraged to read the limitations and intended uses of the report, following the text, as they are an integral part of the report.

1.2 Regulatory Requirements and Guidelines

In addition to Teck's requirements noted above, the AFPR has also been performed in accordance with the following:

- *Guide de préparation du plan de réaménagement et de restauration des sites miniers au Québec*, MRNF[3] (Ministère de l'Énergie et des Ressources naturelles du Québec) et MDDELCC Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques), 2022.
- Directive 019 sur l'industrie minière, MELCCFP, March 2012.
- Canadian Dam Association *Dam Safety Guidelines*. Original dated 2007, Revised 2013.
- Canadian Dam Association Application of Dam Safety Guidelines to Mining Dams. Original dated 2014. Revised 2019.

The annual field inspection is a requirement of the certificate of authorization no. 7610-08-01-70141-52 issued by MELCCFP in October 2010.

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[2] The annual performance report includes results of visual field inspection, instrumentation monitoring and assessment (ICMM, 2020).

[3] MRNF : ministère des Ressources naturelles et des Forêts depuis octobre 2022; anciennement connu sous les appellations de, ministère de l'Énergie et des Ressources naturelles (MERN, 2014 à 2022), ministère des Ressources naturelles (2012 à 2014), ministère des Ressources naturelles et de la Faune (2005 à 2012), ministère des Ressources naturelles, de la Faune et Parcs (MRNFP, de 2003 à 2005).

1.3 Facility Description

Louvicourt Mine is a closed base-metal mine (primarily copper and zinc, with some gold and silver) located approximately 20 km east of Val-d'Or, Quebec, north of Highway 117. A facility data sheet is included as Appendix A.

The Louvicourt property surface lease is currently owned by Teck (55%) and Glencore Canada Corporation (45%). The site was managed with the support of and monitored by Golder from closure until the end of 2016. From 2017 to the end of 2018, the site was managed by Teck's Supervisor, Water Treatment & Maintenance, Eric Gingras. Since the beginning of 2019, the site has been managed by Kathleen Willman and Morgan Lypka of Teck Legacy Properties. Routine observations of the facility are undertaken by site staff of Teck (Jonathan Charland and Luc Tellier).

Dam infrastructure at the site comprises a tailings pond with a polishing pond located immediately downstream to the east of the tailings pond. The tailings pond is contained by Dam 1 to the north and east, Dam 2 to the west and natural topography to the south. For reference purposes, the main dams have been divided into several sub dams designated Dam 1A to Dam 1E and Dam 2A to Dam 2B, typically linear segments separated by local bedrock outcrops located along the alignment of the dams.

The polishing pond is contained by Dam 4 to the north, the tailings pond to the west and natural topography to south and east. For reference purposes, Dam 4 comprises two segments designated Dam 4A and Dam 4B, separated by a bedrock outcrop.

1.4 Background Information and History

The Louvicourt mine began operations around 1994 and had a nominal milling rate of 4,000 tpd, with a peak estimated rate of 5,000 tpd. Mining operations effectively ceased around July 2005.

Figure 1 shows a plan view of the Louvicourt TSF and polishing pond facilities. Figure 2 shows a typical dam cross-section of the facilities.

Approximately one third of the tailings from the milling process were pumped to the tailings facility, located approximately 8.5 km northwest of the mine/mill. The remainder of the tailings was used as paste backfill for the underground mine. Tailings generated from the milling process have high sulphide content (30% to 45%) and are potentially acid generating. The tailings within the basin are covered with a water cover, approximately 1 m deep, to prevent oxidation and generation of acid rock drainage.

Tailings were deposited within the tailings facility using floating pipelines extending from the dams into the basin. The pipeline was moved laterally as required to keep the tailings solids below elevation 315 m. During operations, regular bathymetric surveys were performed to provide information to allow adjustment of the deposition plan to fill low spots and prevent overfilling in high areas. Local high tailings areas above elevation 315 m generated during deposition were generally spread using a barge-mounted dredge or a rotary harrow device.

The original design of the tailings dams and polishing pond dams was carried out by Golder in 1993. Golder performed an inspection in 2009, and has performed annual inspections of the facilities since 2014. Mayana Kissiova of Golder became the EOR for the tailings facility in 2017 and Laurent Gareau succeeded Mayana Kissiova in 2018.

2.0 CONSTRUCTION, OPERATION, MAINTENANCE, AND SURVEILLANCE

The maintenance and surveillance activities performed in 2022 included the following:

- removal of beaver obstructions
- routine observations of the structures
- survey of monuments
- monitoring of piezometers, V-notch weirs and ponds water levels
- continuing integration of new instrumentation network (pond level loggers and data acquisition system)
- removal of vegetation and debris in the tailings pond and polishing pond active spillway canals
- replacement of riprap on Dams 1A and 1C

3.0 CLIMATE DATA AND WATER BALANCE

3.1 Review and Summary of Climatic Information

Table 2 and Figure 3 summarize the Val-d'Or total monthly precipitation data over the period from November 1, 2021, to October 31, 2022. The data originates from the Environment and Climate Change Canada climate stations (Table 1), which are located about 15 km from the mine site. The available data from the stations presented in Table 1 were combined to form a continuous-time series over the period 1951-2022, which was used for the precipitation analysis and water balance presented in this section.

For comparative purposes, the monthly multi-annual averages calculated from the combined precipitation record over the period 1951-2022 are also provided in Table 2.

Table 1: Information of the Selected Environment and Climate Change Canada Stations

Station Name, ID	Latitude, Longitude (degrees)	Station Elevation (m)	Available Data Record	Notes
VAL-D'OR A, 7098600	48.06, -77.79	337.4	1951 – 2022	Main station since 1951
VAL-D'OR, 7098603	48.06, -77.79	338.9	2008 – 2022	Used for missing data
VAL-D'OR A, 7098605	48.05, -77.78	337.4	2011 – 2022	Used for missing data

The total precipitation over the hydrological year (November 2021 to October 2022) was 955 mm or 4.8% higher than the long-term average of 911 mm. Based on the consolidated hydrology study for the Louvicourt site (Golder, 2021b), this corresponds to a 1:2 to 1:5-year wet precipitation year. The months of March (112 mm vs 57 mm long-term average), June (131 mm vs 90 mm long-term average) and July (124 mm vs 100 mm long-term average) were particularly wet. The months of November (49 mm vs 82 mm long-term average) and August (56 mm vs 93 mm long-term average) were particularly dry.

Table 2: Monthly Precipitation Data from November 2021 to October 2022

Month – Year	Total Precipitation Recorded at Val-d'Or (mm) between Nov. 2021 and Oct. 2022 *	Monthly Multi-Annual Average at Val-d'Or (mm) *	Difference (%) **
November 2020	49	82	-68%↓
December 2020	78	68	14%↑
January 2021	47	59	-26%↓
February 2021	66	47	40%↑
March 2021	112	57	97%↑
April 2021	54	60	-11%↓
May 2021	61	70	-14%↓
June 2021	131	90	45%↑
July 2021	124	100	25%↑
August 2021	56	93	-65%↓
September 2021	108	102	5%↑
October 2021	71	84	-19%↓
Total over the hydrological year	**955**	**911**	+5%↑

*: Values are based on records from Environment and Climate Change Canada climate stations ID 7098600, ID 7098603, ID and 7098605, from 1951 to 2021 (Environment Canada 2019).

**: Difference between Val-d'Or current year precipitation and the multi-annual average precipitation: Difference = $(x-x_{ave}) / x_{ave}$

(↑) (↓): Current year precipitation higher (lower) than the multi-annual average precipitation.

Since July 2021, Teck has operated a rain gauge at the Louvicourt site. Teck shared the collected data with WSP; there are 107 days with valid rainfall data collected between July 30, 2021 and July 4, 2022. On the other days during this period, the instrument failed to record any data. WSP is not aware of the reasons for the data gaps. Figures E-1 and E-2 of Appendix E present the collected data and compare it with the Val-d'Or A records. As expected, there are differences in the daily intensities, but the cumulative rainfall depths are very well correlated. Over the 107 days, the local rain gauge recorded 15% less rainfall than the Val-d'Or A rain gauge. The period of record is too short to draw any conclusion on local trends. WSP recommendations are:

- Continue to operate the local rain gauge and minimize data gaps.
- Calibrate the local rain gauge to limit the risk of instrumentation error.
- Review differences to Val-d'Or A rain gauge once several years (e.g., three years) of complete data are available.
- Continue to use Val-d'Or A climate statistics until sufficient local data has been collected to draw reliable conclusions.

3.2 Review and Summary Water Balance

A water balance of the Louvicourt TSF was compiled based on the recent climate data:

- The runoff from the external watershed area was estimated using a constant, volumetric average annual runoff coefficient of 0.42 based on the approach proposed by Golder (2021b) hydrology study. The value is based on available regional hydrometric records but has not been verified by local measurements. An on-going water balance study calibrated the runoff model to local pond water level records, but the results of this study have not been used for the preparation of this report.

- The long-term mean pond evaporation was calculated using the Morton model (Morton, 1983), with historical climate data from climate stations at Val-d'Or (air temperature, dew point temperature, precipitation, bright sunshine (1969-1999) and Rouyn-Noranda (solar radiation (2000-2016). Solar radiation data from Rouyn-Noranda climate station was available up to 2016 inclusively; the monthly average long-term (1969 to 2016) solar radiation was used for the 2021/2022 hydrological year.
- Constant seepage flow rates were predicted by finite element seepage analyses performed by Golder (1993) prior to construction. They have not been updated since the 1993 study, nor have any formal calibrations been undertaken based on V-notch weir data. Revised seepage analyses are scheduled for 2023.
- The spillway discharge is estimated based on a mass balance, assuming zero net flows for the facility and no volumes of water accumulating over time in the pond.

Table 3 summarizes the yearly flows resulting from the water balance for the considered year, namely from November 1, 2021, to October 31, 2022, and for a typical year (average climate conditions). Higher precipitation for the 2021-2022 year led to higher estimated volume of water discharged at the spillway.

Table 3: November 2021 to October 2022 Water Balance for the TSF

Component	Typical Year Flows (Based on an average climate year) (m^3/year)	Current Year Flows* (m^3/year)	Difference (%)	Comment/Source
Total precipitation over the basin	955,000	1,003,000	5% ↑	Basin area = 105 ha Mean annual precipitation = 911 mm Current year precipitation = 955 mm
Surface runoff over the external watershed area	400,000	420,000	5% ↑	Watershed area = 104.6 ha ** Runoff coefficient = 0.42
Total of inflows	**1,355,000**	**1,423,000**	**5% ↑**	-
Pond evaporation	666,000	650,000	2% ↓	Based on Morton (1983) Mean annual pond evaporation = 634 mm Current year pond evaporation = 618 mm
Seepage losses	363,000	363,000	0%	Based on analysis made prior to construction, Golder (1993) Seepage flow rates = 41.4 m^3/h
Spillway discharge to the polishing pond	326,000	410,000	26% ↑	Estimated based on mass balance
Total of outflows	**1,355,000**	**1,423,000**	**5% ↑**	-

* Current year extends from November 2021 to October 2022.
** The watershed area has been updated in Louvicourt Consolidated Hydrological Report (Golder, 2021b)
(↑) (↓): Current year value higher (lower) than the long-term average value.

3.3 Freeboard and Storage

Freeboard and storage are addressed in Section 5.2.3.

3.4 Water Discharge Volumes

Based on a high-level water balance analysis, it is estimated that 410 thousand m^3 of water were discharged to the polishing pond via the operational spillway.

3.5 Water Discharge Quality

Water discharge quality is presented in the Louvicourt annual environmental report (Suivi environnemental post-restauration) submitted by March 31 of each year to le Ministère de l'Environnement et de la Lutte contre les changements climatiques des Forêts et des Parcs du Québec (MELCCFP[4]).

4.0 SITE OBSERVATIONS

A site inspection was carried out on September 20, 2022, by Simon Chapuis, Eng. and Laurent Gareau, Eng. (EOR) from Golder. They were accompanied by Mr. Jason McBain of Teck Resources, and Jonathan Charland and Luc Tellier, from Teck. Ms. Morgan Lypka, the tailings responsible person for the Louvicourt facility was unable to attend the 2022 inspection. The temperature during the visit was approximately 15°C under overcast skies.

4.1 Visual Observations

The following observations were made during this inspection:

- The water level at the tailings pond was 316.09 m.
- The water level at the polishing pond was 307.20 m.

Dams 1A through 1E

- The riprap on the upstream berms of Dams 1B and 1D, which was repaired with new riprap in 2019 (Photograph 1) was unchanged from the previous inspection.
- The riprap on Dams 1A and 1C was replaced in 2022, with the addition of traffic gravel on the crest (Photograph 2).
- Ponding water was observed at the toe of Dams 1A to 1E at the same locations as last year. At several locations, flowing water was either visible or audible near the toe of Dams 1A to 1C and 2B (Photograph 3). The apparent increase of seepage at the toe areas is attributed to a significant rainfall event which occurred on September 19 2022. The locations of current and historic seepage points are presented on Figure 1.
- The emergency spillway located between Dams 1D and 1E (denoted as the second emergency spillway of the TSF) was in good condition but exhibited significant vegetation growth. Vegetation in the downstream channel was cleared in 2020 (Photographs 4 and 5). Historically, vegetation is cleared every other year. It is noted that the spillway was cleared in 2022, after the site inspection.

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[4] MELCCFP : ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (du Québec) depuis octobre 2022; anciennement connu sous les appellations ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC, de 2018 à 2022), ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC, de 2014 à 2018), ministère du Développement durable, de l'Environnement de la Faune et des Parcs (MDDEFP, de 2012 à 2014), ministère du Développement durable, de l'Environnement et des Parcs (MDDEP, de 2005 à 2012), ministère de l'Environnement (MENV, de 1998 à 2005) et ministère de l'Environnement et de la Faune du Québec (MEF, de 1994 à 1998).

- The access bridge close to the TSF spillway was rehabilitated in 2018 and appears in good condition, although the edge blocks appear to be suffering some scraping, presumably by snow removal equipment (Photograph 6). Other than the signs of recent scraping, the condition in 2022 is similar to conditions observed in 2020 and 2021. If this scraping issue worsens, it may be advisable to protect the timber blocks with metal covering to improve durability, or to replace the timbers.
- Crest erosion was nominal, similar to 2021 conditions, and evidence of crest erosion repair was observed (Photograph 7).
- Vegetation is present at the downstream toe of Dams 1A, 1B and 1C (Photograph 8). This is not a stability concern. Removal of vegetation at the toe could be considered to assist the visual observations during routine inspections.

Dams 2A and 2B

- Some stagnant water and low seepage were observed at the toe of Dam 2B representing the seepage points labelled 10 thru 13, and reporting to V-notch 1 and V-notch 2, exhibiting low flow similar to previous years. The seepage water was clear.
- Stagnant water is observed at the toe of Dam 2A (Photograph 9). The extent of ponding appeared similar to 2021; it is noted that this area represents a zone where the natural topography drains towards the dam toe, such that some accumulation at this location is expected.
- The culverts, which are located across Unnamed Creek, just north and west of the tailings pond, and which were cleared of debris in 2019, remain unaffected by beaver activity but exhibited much higher flows during the September 22 2022 inspection than in 2021 with the culverts flowing nearly full (Photograph 10). It is very likely that this high flow was triggered by the 77 mm of rainfall between September 17 and September 19, including the 28 mm measured on September 19 (values at ECCC Val-d'Or-A climate station, approx. 15 km away from the site).

Dams 4A, 4B and Final Effluent Point

- Dam 4A is a structure that is sited at higher ground and is no longer in contact with water. The structure was in good condition with no evidence of settlement, cracking, bulging or other deformation that would be indicative of geotechnical performance issues.
- Trees are continuing to encroach on the side slopes and crest of the Dam 4A embankment (Photograph 11). These trees do not represent an issue of geotechnical concern, since the structure is not currently impounding water, and is not likely to impound water in the future.
- The main spillway at Dam 4B showed evidence of significant debris accumulation (Photograph 12). It is noted that this debris was removed in 2022 subsequent to the site inspection.
- The seepage area on the north shoulder of the Dam 4B service spillway was unchanged from prior years' inspections (visible on Photograph 12). No remedial measures are required. However, this seepage area should be monitored regularly, similar to other seepage features on the dams.
- The outflow channel from the spillway to the Parshall flume contains significant vegetation (Photograph 13). This does not represent a performance issue for the channel; however, some vegetation removal may eventually be required in the future.

- Culverts at the final effluent point were clear although some limited vegetation is present upstream of these culverts (Photograph 14). There was no significant flow through the outflow culverts.
- The Dam 4B crest was generally in good condition and unchanged from 2020. Survey monuments are visible. No noticeable changes were visually apparent (i.e., damage) to the survey monuments.
- Beaver activity observed at the toe of Dam 4B during the 2021 site inspection was removed in 2021 and no recurrence of beaver blockage has occurred at the time of the 2022 inspection (Photograph 15).

4.2 Photographs

Key photographs of the inspection are presented in Appendix B with many being referenced in Section 4.1 relating to specific observations from the field portion of the review.

4.3 Instrumentation and Data Review

The following information was available for this review:

- Yearly monitoring data of survey monuments.
- Records of weekly and monthly visual facility observations.
- Measurement of flow at V-notches and groundwater elevations of existing piezometers since their installation to June 2022.
- Measurements of the water levels for the tailings and polishing ponds.

Thermistor data is not currently available and will be integrated into the monitoring program in 2023.

The monitoring program is consistent with the site OMS manual, and it is felt that the number of instruments, monitoring frequency, and threshold levels are appropriate for the observed performance of the facility.

4.3.1 Water Levels

Figure 4 presents groundwater levels for the polishing pond and tailings facility embankments for a total of eight standpipe piezometers and 11 vibrating wire piezometers installed on the berms of the three different embankments (1, 2 and 4).

The following piezometers are located on the berms of the TSF embankments:

- LOU-D1B-VWP-2020-02A (LOWER VWP) and LOU-D1B-VWP-2020-02B (UPPER VWP)
- LOU-D1B-VWP-2020-03
- LOU-D1C-P-2020-04
- LOU-D1C-P-2020-05
- LOU-D1C-VWP-2020-07A (LOWER VWP) and LOU-D1C-VWP-2020-07B (UPPER VWP)
- LOU-D2B-P-2020-09
- LOU-D2B-P-2020-10
- LOU-D2B-VWP-2020-11A (LOWER VWP) and LOU-D2B-VWP-2020-11B (UPPER VWP)
- D2A

- D2B

The following piezometers are located on the berms of the polishing pond dams:

- LOU-D1D-VWP-2020-08A (LOWER VWP) and LOU-D1D-VWP-2020-08B (UPPER VWP)
- LOU-D4B-VWP-2020-12A (LOWER VWP) and LOU-D4B-VWP-2020-12B (UPPER VWP)
- PZ-02-04
- PZ-04-04

Six other standpipe piezometers (PBR-4, PBR-6, PBR-7, PBR-8, PO-06-30, PO-06-31) are located on natural ground, some distance away from the toe of the dams. The position of these piezometers is shown in Figure 1.

Data for 2022 were provided by Teck (Figure 4). Recent values are quite stable for all standpipe piezometers and consistent with previous trends; historical trends for VWPs will be better defined in the coming years with more data collected.

Standpipe piezometer PZ-02-04 and VWPs LOU-D1D-VWP-2020-08A and B are located within Dam 1D downstream berm. Groundwater at this location corresponds to seepage through Dam 1D and drains toward the polishing pond. It is therefore normal that the trend line for this well is slightly higher than the level of the polishing pond.

Teck measures TSF pond and polishing pond water levels on staff gauges installed near the operational spillways. The measurements are done weekly and are typically limited to the open-water season (it is more difficult to get accurate flow readings throughout the winter with ice buildup and ice cover). For the 2021/2022 winter, measurements stopped on November 25, 2021, and restarted on March 2, 2022. The data are presented in Figures 9 and 10 and are described in Section 5.2.3.

4.3.2 Displacements

A series of 15 movement monitoring monuments exists along the crest and berms of the tailings pond dams and four additional monuments are located along Dam 4B of the polishing pond. Some of these monuments were installed after the 1993 construction and are identified B-1 to B-11 in Appendix C and SP-1 to SP-11 in Figure 1. Other monuments, identified as SP-11-1 to SP-11-8 in Figure 1 and as 2011-1 to 2011-8 in Appendix C, were installed in September and October 2011. All monuments were surveyed between July 18 and 22, 2022, by Corriveau J.L. & Assoc. (Corriveau), a surveyor based in Val-d'Or. The Corriveau survey report is included in Appendix C. The annual survey includes a total station survey and a differential GPS survey of the monitoring points. Table 4 presents horizontal displacement and total settlement of all monuments based on differential GPS and total station survey, respectively. The stated precision of these results is 10 mm for horizontal movements and 2 mm for vertical movements (settlement).

Table 4: Settlement and Horizontal Displacement

Monument	Install Year	Horizontal Movements (total)		Settlement (Negative #s = upward movement)		
		Install to 2021	Install to 2022	Up to 2021	2021-2022	Up to present
Dam 1D (crest)						
B-1 (SP-1)	2008	7 mm	9 mm	1 mm	1 mm	2 mm
B-2 (SP-2)	2008	21 mm	31 mm	31 mm	1 mm	32 mm
B-3 (SP-3)	2008	7 mm	12 mm	3 mm	0 mm	3 mm
Dam 1D (berm)						
2011-2 (SP-11-2)	2011	2 mm	10 mm	16 mm	0 mm	16 mm
Dam 1C (crest)						
B-4 (SP-4)	2008	8 mm	16 mm	-1 mm	0 mm	-1 mm
B-5 (SP-5)	2008	6 mm	11 mm	-2 mm	-1 mm	-3 mm
Dam 1C (berm)						
2011-8 (SP-11-8)	2011	12 mm	9 mm	11 mm	0 mm	11 mm
Dam 1B (crest)						
B-6 (SP-6)	2008	6 mm	12 mm	-1 mm	-1 mm	-2 mm
Dam 1A (crest)						
B-7 (SP-7)	2008	1 mm	6 mm	-26 mm	-3 mm	-29 mm
Dam 2B (crest)						
B-8 (SP-8)	2008	7 mm	4 mm	-2 mm	1 mm	-1 mm
B-9 (SP-9)	2008	8 mm	7 mm	0 mm	0 mm	0 mm
B-10 (SP-10)	2008	18 mm	10 mm	-10 mm	-1 mm	-11 mm
Dam 2B (berm)						
B-11 (SP-11)	2011	4 mm	3 mm	10 mm	-2 mm	8 mm
2011-6 (SP-11-6)	2011	11 mm	11 mm	15 mm	-1 mm	14 mm
2011-7 (SP-11-7)	2011	9 mm	20 mm	-13 mm	-2 mm	-15 mm
Dam 4B (crest)						
2011-1 (SP-11-1)	2011	20 mm	21 mm	24 mm	1 mm	25 mm
2011-3 (SP-11-3)	2011	10 mm	9 mm	29 mm	7 mm	36 mm
2011-4 (SP-11-4)	2011	13 mm	18 mm	5 mm	-4 mm	1 mm
Dam 4B (berm)						
2011-5 (SP-11-5)	2011	11 mm	11 mm	13 mm	-2 mm	11 mm

4.3.2.1 Settlements

Since the previous year, the vertical data shows that 13 monuments indicated minor vertical movements of +/- 1 mm or less, 4 monuments had vertical movements between plus or minus (+/-) 1 mm and +/- 3 mm (which is the stated survey accuracy) and 2 monuments had vertical movements between +/- 3 mm +/- 7 mm. All monuments show total settlement since installation of 31 mm or less, although, the survey data record suggests a pattern of continuing, minor settlement in some instruments. To better assess the settlement data, plots of historical settlement have been prepared as Figures 5 to 7.

From the data, the following general observations are made:

- SP-2 (crest), located in the center part of Dam 1D, shows the maximum downward total displacement along Dam 1, i.e., 32 mm, and an incremental movement of 1 mm relative to 2021. This settlement point shows consistent minor downward displacement. This settlement point shows a pattern of annual downward displacement of about 2 to 3 mm per year since 2008. Historical data indicates that total settlement since installation of this settlement point in 1993 are in the order of 0.7 m and that the ongoing settlements are likely caused by secondary consolidation (KCB, 2011).
- SP-11-6 (berm), located in the centre of the south half of Dam 2B, shows the maximum downward total displacement along Dam 2 (i.e., 14 mm). No historical data prior to 2011 exist for this monitoring point. The settlement point does not show a pattern of annual downward displacement.
- SP-11-3 (crest), located in the north-central part of Dam 4B, shows the maximum downward total displacement along Dam 4 (i.e., 36 mm). This settlement point shows a pattern of annual downward displacement of about 3 mm per year since 2011. No historical data exist for this monitoring point prior to 2011.

The data suggest that minor consolidation settlement may be occurring in the foundations of embankments 1D and 4B. These embankments have the greatest thickness of foundation clays and silts, which are susceptible to secondary consolidation (creep). Consolidation settlements are normal under embankments. The measured values of settlement do not represent a dam safety concern, but annual monitoring should continue.

4.3.2.2 Lateral Displacements

Table 4 above presents a summary of total settlement and horizontal (lateral) displacement for all monuments.

The historic horizontal displacement data is presented as “point-of-origin” plots in Appendix D. Point-of-origin plots show the data points on a year-by-year basis, relative to the point of origin – that is the measured coordinates of the monuments at the time of installation. This type of plot allows the determination of the actual variability of the data and the visual assessment of trends that may be indicative of lateral deformation.

Point-of-origin plots in Appendix D shows that the survey instruments exhibited horizontal movements within the range of annual variability and, in all cases, less than or equal to 11 mm from 2021 to 2022. The instrument, which showed the largest incremental horizontal movement, 11 mm for SP-11-7 at Dam 2B, was within the range of lateral displacements observed in the past years at that location. For all monuments, the total horizontal displacements are less than or equal to 31 mm (SP-2 at Dam 1D). Historic data for SP-2 indicate that total movement for this monitoring point is in the order of 10 cm.

Dam 1D, between the TSF and the polishing pond, presents the greatest total displacements (settlement, and horizontal towards east), in its central part, compared to the other dams. However, displacements at Dam 1D remain low.

Overall, the observed movements are low and do not indicate continuous lateral progression, which indicates there is no significant embankment movement. The observed movements are not an issue of geotechnical concern.

The measured values of lateral displacement do not represent a dam safety concern, but annual monitoring should continue.

4.3.3 Discharge Flows

Seepage flows are measured through a series of 4 V-notch weirs that were installed at the toe of the dams between 1997 and 2003. Table 5 presents measured flow rates at V-notch weirs as provided by Teck in 2022.

Table 5: Measured Flow Rates at V-notch Weirs and Estimated Seepage Rates in 2022

Location	Dam	Flow (point measurements)
V-notch 1	2B	0.1 – 0.4 L/s (provided by Teck). Water was clear
V-notch 2	2B	0.3 – 1.4 L/s (provided by Teck). Water was clear
V-notch 3	1A	0.0 – 0.7 L/s (provided by Teck). Water was clear
V-notch 4	1C	0.5 – 2.4 L/s (provided by Teck). Water was clear

Figure 8 shows the historical trend of seepage flow measurements at these V-notch weirs since their installation. The figure indicates that seepage flows measured during 2022 were generally consistent with previous historical trends. Seepage flows measured during 2022 were also of the same order as those measured during 2021.

V-notch 4, located about 70 m north of the junction of Dams 1C, 1D and 4B, still presents the highest flow rates, as in past years.

The sum of the measurable flows reflects both seepage from the dam and surface water runoff due to rainfall events. The peaks shown on Figure 8 likely reflect impacts of surface runoff, whereas the lower bound values more likely represent base flows derived primarily from seepage. The lower bound range (0 to 1.5 L/s) and upper bound range (1.5 to 3.3 L/s) are lower than the expected seepage rate from the 1993 design studies and as assumed in the water balance (11.5 L/s), suggesting that the water balance may overestimate seepage losses. It is noted however that some of the seepage flows from the embankment are not captured in the V-notch weir network. The seepage rates remain low and no pattern of increasing seepage flow is discernable. This is therefore considered to be within the expected range and does not indicate a dam safety concern.

Other historic observation points of seepage noted during the TSF annual inspections are identified by locations 1 to 18 and shown in Figure 1.

4.4 Pond and Discharge Water Quality

Water discharge quality is presented in the Louvicourt annual environmental report (Suivi environnemental post-restauration) submitted within 90 days of the start of each year to the Ministère de l'Environnement et Lutte contre les changements climatiques du Québec (MELCC).

4.5 Site Observation Forms

The routine observation forms completed by site field staff were reviewed by the EOR. No significant performance issues were identified with the structures as part of the regular observations.

5.0 DAM CONDITION ASSESSMENT

5.1 Design Basis Review

5.1.1 General

The Dams 1A through 1E, and 2A and 2B are comprised of a till core with rockfill/sand and gravel shoulders, a filter zone along the downstream face of the core and a drain along the base of the dam. Geotextile was placed beneath the shoulders and riprap protection layer. Dam height varies along the length of the alignment and ranges from a couple of metres near the abutments up to approximately 18 m in the deeper valleys of Dam 1 and Dam 2. The upper upstream and downstream faces are typically sloped at 2.5H to 1V and 2H to 1V respectively, with upstream and downstream stability berms constructed to approximately the mid height of the dams within the deeper valley sections. The stability berms reduce the overall slope to between about 3.5H:1 and 7H:1V.

The tailings pond level is controlled by a concrete overflow weir located at the south abutment of Dam 1E. Stoplogs were initially used during mine operations to control the pond level. These stoplogs were replaced after closure with mass concrete to form the weir at elevation 316.1 m, including an extra 0.1 m provided by a wood plank. Flood inflows into the tailings facility could be routed through a 5 m wide concrete spillway located adjacent to the overflow weir and set at elevation 316.3 m (referred to as the first emergency spillway). In case of blockages of the weir and first emergency spillway, flood inflows would passively be routed through a second emergency spillway located approximately 170 m north of the concrete overflow weir spillway. The second emergency spillway has a single 5 m wide trapezoidal shaped concrete sill at elevation 316.5 m with 2H:1V side slopes. All flows through the overflow weir and either of the spillways report to the downstream polishing pond.

The polishing pond was built in the fall of 1995 and completed in the spring of 1996. The design of Dam 4B is similar to Dams 1 and 2. Dam 4A is built on higher ground and currently does not retain any water – it was designed to provide adequate freeboard during operations, when the polishing pond was operated at a much higher ponding elevation. Outflow from the polishing pond passes over aluminium stoplogs embedded into a concrete structure. The water level is currently controlled at elevation 307.2 m.

Information concerning the geology, stratigraphy, and groundwater conditions is presented in Golder's design report (Golder, 1993). The tailings facility has not been raised since its original construction. More recently, in January 2020, a geotechnical instrumentation campaign including borehole drilling made it possible to collect additional information on the geotechnical conditions of the site (Golder, 2021a). Golder also prepared in 2020 a study on the characterization of the foundation materials at the TSF (Golder, 2020a) based on Golder's design report (Golder 1993), to help consolidate the original design information and evaluate potential foundational failure modes and ongoing assessments for the TSF.

Routine observations have been carried out since closure in 2005. Monthly observations are performed by walking the crest of the dams, while weekly observations are done by driving the dams at low speed and reconnoitering the spillways. Cameras have been installed at both spillways, and the photos are reviewed regularly by several qualified personnel. It is noted that the camera at the TSF spillway was vandalized in 2021 and did not yield consistent photos for an extended period. Weekly and monthly observations were utilized to mitigate the effect of this reduced performance monitoring at the TSF location. The camera was repaired in 2022.

Inspection of the TSF is performed yearly as part of the facility performance report, and Dam Safety Review (DSR) is performed every 5 years in conformance with CDA recommendations and Teck corporate guidelines. The site inspection for the 2021 DSR was performed at the same time as the 2021 site inspection for the AFPR. The analysis and reporting for the 2021 DSR is in preparation.

5.1.2 Tailings Pond Dams (Dams 1 and 2)

The combined length of all five segments of Dam 1 is 1,650 m. Dam 1 has an average height of 8 m and a maximum height of 18 m. The combined length of the two segments of Dam 2 is 880 m. Dam 2 has an average height of 10 m and a maximum height of 18 m. A typical cross-section of the dams is shown in Figure 2. Dam crests within the central portion of Dam 1D and part of Dam 2B were intentionally built 1 m higher than the design elevation to compensate for anticipated settlement at these locations.

Vibrating wire piezometers and an inclinometer were used to monitor dam behaviour during construction and shortly after. These instruments are no longer operational. Current instrumentation at the tailings pond dams consists of 17 piezometers, 2 thermistor strings, 4 V-notch weirs, and 19 survey monuments. Other observation wells (5) are located further downstream from the dams and are used to monitor water quality. The locations of the instruments are shown in Figure 1.

5.1.3 Polishing Pond Dam (Dam 4B)

The polishing pond was operated until 2011 at an elevation consistently lower than the design pond elevation of 309.0 m. The pond was then operated at elevation 306.54 m until 2018, and at a spillway elevation of 307.2 m since then.

Current instrumentation at the polishing pond consists of 6 piezometers, 1 observation well and 4 survey monuments located on the crest and toe berm of the dam. The locations of the instruments are shown in Figure 1.

5.1.4 Dam Design Parameters

The design geometry of the dams is summarized in Table 6.

Table 6: Design Geometry

Item	Design Value
Upstream Slope	2.5 H:1V
Crest Width	8 m
Downstream Slope	2.0 H:1V (inter bench, without considering downstream berms)
Minimum freeboard (from dam crest)	2.0 m at tailings pond 1.5 m at polishing pond
Maximum level of tailings (below dam crest)	3.0 m
Minimum crest elevation of Dams 1 and 2 at the tailings area	318.0 m with parts of Dams 1D and 2B at 319.0 m
Minimum crest elevation of Dam 4B at the polishing pond	310.5 m

5.1.5 Subsurface Conditions

The dams of the tailings facility are located in a valley between bedrock outcrops of relatively high elevation. The tailings pond dams were constructed between the local bedrock outcrops to reduce overall fill requirements.

Geotechnical investigations indicate that subsurface conditions at the site typically include the following layers:

- Surficial layer of topsoil/peat typically 100 mm to 300 mm thick.

- Overburden soils comprising layers of alluvial/lacustrine silty clay to clayey silt with consistencies ranging from soft to very stiff. A weathered upper crust of stiff clay was observed in most of the profiles, underneath which the consistency of the soils generally significantly decreases. Silty clay and clayey silt materials typically grade to a silt material with depth and in some cases to silty sand.
- A basal glacial till layer typically ranging from silt to silty/gravelly sand in a medium dense to dense state.
- Underlain by granodiorite bedrock.

5.1.6 Embankment Fill Materials

The tailings dams and polishing pond dam are zoned earth fill embankment structures, constructed of compacted till core with a filter zone along the downstream face of the core and a drain along the base of the dams and rockfill/sand and gravel shoulders, as shown in the typical section presented in Figure 2.

Updated material properties for the tailings, the embankment fill materials and subsurface materials were used in the 2005 DSR (SNC-Lavalin, 2005). These material properties are listed in Table 7.

Table 7: Updated Design Material Properties (SNC-Lavalin, 2005)

Material	Unit Weight (kN/m^3)	Total Stress Strength		Effective Stress Strength	
		Cohesion (kPa)	Friction Angle (degrees)	Cohesion (kPa)	Friction Angle (degrees)
Sand and gravel (Dams 1 and 2)	23 - 24*	-	-	0	35
Sand and gravel (Dam 4)	20.8 - 22.6*	-	-	0	35
Sand filter	20	-	-	0	35
Till (Core)	22 - 22.7*	-	-	0	35
Clay	15 – 16.5	30 – 85	0	0	26 – 29
Till (Foundation)	18.5 – 19	-	-	0	30 – 35
Tailings within the tailings pond	16	-	-	0	30

* Saturated Unit Weight.

Based on a reassessment of the tailings density (Golder, 2018), the saturated unit weight for the tailings was revised to 21.3 kN/m^3. Stability analyses confirmed that this change resulted in nominal reduction of the calculated factors of safety.

5.1.7 Seismicity

The most recent assessment of the seismicity values for the site was performed by Golder in 2019 (Golder, 2019), and site-specific seismic shear wave velocity measurements were obtained in 2021. The evaluations were based on the 2015 version of the National Building Code of Canada. The predicted peak ground accelerations (PGA) on hard rock (soil Site Class A) at the corresponding return period are summarized in the following table.

Table 8: Site Seismic Hazard Values from Site-Specific Seismic Hazard Assessment (Golder, 2019)

Structure	Return Period (Years)	PGA[1] (g)
Tailings Pond Dams	1 in 10,000	0.127
Polishing Pond Dam	1 in 2,475	0.065

Note: [1] For ground Site Class A: hard rock foundation.

5.2 Hazards and Failure Modes Review (Assessment of Dam Safety Relative to Potential Failure Modes)

As a required component of the AFPR, the key hazards and failure modes have been identified and assessed.

This section reviews the dam safety implications of the instrumentation data and the September 20, 2022, site observations relative to potential failure modes. The design basis relevant to each of the typical potential failure modes is also presented.

5.2.1 Internal Erosion

Dam internal instability can be caused by materials migrating out of a dam via seepage, 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 caused by regressive erosion of particles towards an outside environment until a continuous pipe is formed.

Design Basis

Filter compatibility was established by Golder during the initial design phase of the structures (Golder, 1993). The initial design considered piping criteria based on grain size distributions of the till core and adjacent sand drain, and between the sand drain and the gravel located at the toe drain. Filter compatibility was briefly commented upon in Section 3.4 of the SNC-Lavalin (2005) dam safety review and was described to have been set with "*conservative limits*".

Instrumentation and Observed Performance

The position of the V-notch weirs and seepage locations is shown on Figure 1. Table 5 presented measured flow rates. Water flowing from the toe drains, the seepage points, and the V-notch weirs was clear and did not contain visible suspended particles. Flow rates were generally low and within the expected range. Additional V-notch weirs are being considered to augment the monitoring network and these are scheduled for installation in 2023.

No zones of subsidence or any sink holes were observed, the presence of which would indicate voids due to piping. No evidence of internal erosion was observed. It was concluded that no internal erosion was occurring that could threaten the integrity of the structures.

Planned and Ongoing Studies

Studies to eliminate this hazard as a credible failure mode for the facility are ongoing or planned and include:

- Review of historic construction records to assess filter compatibility between natural soils and construction materials.
- Piezometric monitoring to measure gradients across potential erosional transitions.
- Seepage modelling to validate measured gradients.
- Assessment of potential frost effects on core integrity.

5.2.2 Instability

Design Basis and Subsequent Reviews

Stability analyses were conducted during the original design phase of confinement dams (Golder, 1993). The original dam geometry was established to meet a minimum factor of safety of 1.5 under end of construction conditions and operational conditions. Seismic analysis of the dams was performed at that time using a 1:1,000-year seismic acceleration. The seismic value was modulated based on a one-dimensional soil response analysis of the soil column. The resulting horizontal ground acceleration was used in a pseudo-static stability analysis. Results showed factors of safety slightly greater than 1.1 for all dams. It is noted that the original stability analyses used Bishop's method of analysis, which was common at the time. Bishop's method is not as rigorous as currently used methods and it is therefore not valid to compare these results to modern compliance criteria.

Based on the results of the original 1992 field investigation, the 2005 DSR (SNC-Lavalin, 2005) confirmed a minimum factor of safety value of 1.3 for long-term operational conditions, except for Dam 1D. This led to the widening of Dam 1D downstream berm in 2005. The 1.3 factor of safety was considered adequate for the long-term operational condition. A post-closure target factor of safety of 1.5 was recommended. The seismic analysis contained in the 2005 DSR used seismic values for a 1:10,000-year seismic event and also performed a one-dimensional soil response analysis to account for the presence of a soil column. The resulting horizontal ground acceleration was used in a pseudo-static stability analysis. Results confirmed factors of safety slightly greater than unity for all dams. The liquefaction potential analysis indicated that localized zones of relatively low density till present in dam foundations could potentially be liquefiable in the case of the design earthquake. Post-liquefaction analyses have confirmed that if these zones should liquefy, the dams would remain stable.

The 2010 DSR (KCB, 2011) included a preliminary liquefaction and cyclic softening screening assessment based on the results of the original 1992 field investigation. The 2010 DSR concluded a more extensive presence of potentially liquefiable materials than estimated previously by SNC-Lavalin in 2005. A preliminary stability assessment concluded that post-liquefaction factors of safety for a typical section of the tailings dam did not meet current recommended guidelines in all areas. Further field and laboratory studies were recommended.

Golder performed a supplemental liquefaction assessment and post-liquefaction stability analyses in 2013 (Golder 2013). Based on the 1992 geotechnical field data, the analysis indicated that there was a potential for the silt stratum below Dam 1C and Dam 2B to contract and to have large portions liquefy under the 1:4,975 year seismic event. For a low-bound shear strength value of the liquefied silt layer, Dam 2B was predicted to have factors of safety below the target. However, these analyses did not account for consolidation that may have occurred subsequent to dam construction, and it was noted that the field investigation data did not include current techniques that did not exist in 1992. It was recommended that a focused geotechnical investigation program using current investigation methods be undertaken to update the analyses. The new field investigation was conducted in the fall of 2017 and subsequent analyses were underway while this report was being compiled. To support the stability analyses, a revised site-specific seismic hazard assessment has been completed (draft under review). Further, additional instrumentation was installed in 2020 to validate the piezometric assumptions for the analyses and additional drilling was performed to validate foundation conditions in Dams 1D and 4B in 2022. There is also ongoing work to be concluded along with the site-specific seismic hazard work using stress-deformation modeling which is the state-of-practice for addressing undrained loadings and materials susceptible to liquefaction. This work is expected to be completed within 2023.

Movement Monitoring Instrumentation

Detailed analysis of monitoring data is included in Section 4.3.

The *Dam Safety Guidelines* (CDA 2013) Section 3.6.3 recommends use of dam instrumentation to supplement the ongoing visual assessment of dam performance relative to potential failure modes. Section 4.3.2 presents a summary of settlement and horizontal movements measured and observed at the TSF.

Horizontal and vertical movements of the monuments listed in Table 4 remain relatively limited. Some trends and observations have been noticed and are commented on below:

- Monuments present movement with amplitudes similar to the survey of 2021
- Incremental settlements (2021 to 2022) were generally less than 3 mm (which is the stated survey accuracy). The maximal incremental settlement was 3 mm for one instrument (SP-2) located on the crest of Dam 1D.
- SP-11-1, SP-11-3 and SP-11-5 show patterns of annual settlement equal to a few millimetres per year. However, there is no sign of accelerating settlements. The other survey monuments present total settlements that have stabilized or are variable (minor up and down movements) through the years.
- The largest total movement (settlement of 36 mm, since year 2008) occurs at SP-11-3 located on Dam 4B. The magnitude of deformations indicated by the monitoring instrumentation is within accepted ranges do not present a dam safety concern but do warrant continued monitoring as a best practice.
- None of the monitoring points show patterns of horizontal movement indicative of mass movement of the embankments.

Observed Performance

Longitudinal cracks were reported to develop along the crest of Dam 1 during the last few winter seasons. A general observation was that the severity of crest cracking in 2019 thru 2022 was less pronounced than previous years. Golder (2015) inspected and analyzed the cracks and concluded that they were caused by frost action, exacerbated by eolian removal of snow on the upstream shoulder of the dam. No evidence to the contrary was observed at the time of the inspection.

It is likely that annual longitudinal cracking will continue. It may be necessary to undertake investigations to confirm that there is no associated risk to the integrity of the core. Continued monitoring of the cracks is required.

Planned and Ongoing Studies

Studies to eliminate this hazard as a credible failure mode for the facility are ongoing or planned and include:

- Site specific seismic hazard assessment coupled with an update of seismic stability and liquefaction susceptibility for a 1:10,000-year return period seismic event.

5.2.3 Overtopping

Design Basis

The dams of the tailings pond and polishing pond were originally designed with a 2.0 m freeboard and a 1.5 m freeboard respectively. Both freeboards are relative to the crest of the dams; they are 1.0 m smaller when relative to the crest of the low permeability dam cores. During 2022, the minimum observed freeboard relative to the crest of the dams was 1.8 m for the tailings pond dams and 2.6 m for the polishing pond dams. It is noted that the polishing pond is operated at a significantly lower level than anticipated during the original design. Observed high water levels in both cases were associated with the spring freshet.

A review of freeboard was performed in the 2010 DSR (KCB, 2011) in accordance with CDA (2007) guidelines. Results indicated that wave run-up could reach an elevation less than or equal to 316.89 m in the TSF under normal and probably maximum flood (PMF) conditions. Since this is below the existing crest elevation of nominally 318.0 m, it was concluded that protection against a wave overtopping condition was adequate for the tailings pond. For the polishing pond the current freeboard was considered to be more than adequate.

Golder (2021b) updated the previous estimates and proposed extreme flood water levels combined with wave run-ups for three separate scenarios:

- Historical climate conditions and with non-obstructed spillways.
- 20% increased rainstorm intensities (for climate change impact) and unobstructed spillways.
- 20% increased rainstorm intensities (for climate change impact) and obstructed operational spillways.

For the purpose of the current management philosophy for the facility (active maintenance), only the first two scenarios are relevant. Flood events ranging from a 2-year event to the probable maximum flood (summer and two spring events, as per CDA (2007) were studied. The study concluded that (quotation from Golder, 2021b):

- *Under historical climate conditions and with non-obstructed spillways, the combination of the maximum flood water level, the wind set-up and the wave run-up would not overtop any of the TSF or Polishing Pond dams for any of the studied scenarios. The TSF dams core elevations would be exceeded by up to 0.19 m depending on the dam during the PMF events combined with 2-Year wind speed effects. These exceedances are smaller than the magnitude of the wind effects, which means that the peak pond water levels would remain, in the absence of the wind effects, below the dam core elevations.*
- *Climate change drive increases to the intensities of extreme rainstorms increased the maximum water level for the different flood events by 0.02 m to 0.13 m for the TSF Pond and by 0.04 to 0.29 m for the Polishing Pond. The largest increases occur during a summer PMF. These increases do not change the conclusions of the previous paragraph as the results indicate no dam overtopping. PMF exceedances of the TSF dams core elevation increase to a maximum of 0.31 m, still entirely due to the magnitude of the wind effects.*

Instrumentation Data

The tailings pond water level was measured weekly via staff gauge during the open water season (see Figure 9). In 2022, the recorded pond water levels varied between 316.0 m (0.1 m below the spillway invert) at the end of the August to 316.2 m (0.1 m above the spillway invert) during the freshet month. Higher water levels are likely to have occurred during the spring months, but they were not captured by the weekly measurements.

The polishing pond water level was measured weekly via staff gauge during the open water season (see Figure 10). In 2022, the recorded pond water levels varied between 307.16 m (0.04 m below the spillway invert) at the end of the August to 307.39 m (0.19 m above the spillway invert) during the freshet month. As for the tailings pond, higher water levels are likely to have occurred during the spring months, but they were not captured by the weekly measurements.

For both ponds, the 2022 water levels respected the minimum required freeboards (see KCB, 2011, and Golder, 2021b).

Observed Performance

The water level within the tailings pond was 316.09 m during the site visit on September 20, 2022. The freeboard at the time of the site inspection was greater than the minimum CDA freeboard requirements (KCB, 2011) and therefore did not present a safety concern. The presence of three spillways at the tailings pond and two spillways at the polishing pond provides a significant mitigation against overtopping potential.

Planned and Ongoing Studies

Golder (2021b) determined that both the TSF pond and the polishing pond had adequate capacity to safely pass the PMF event, with significant contingency as long the spillways are maintained free of obstructions. Teck has demonstrated diligence in the maintenance of the spillway structures. Under active closure care, it is concluded that overtopping is not a credible failure mode. Results of this study will be used to update Trigger Action Response Plans related to pond levels.

5.3 Review of Downstream and Upstream Conditions

The unnamed creek to the west of Dam 2B was operating at a significantly higher flow than in previous years, nonetheless the creek remained at a significant distance from the toe of the dam, such that erosion is not realistic. Otherwise, no changes to the overall conditions downstream of the tailings and polishing ponds have been reported to WSP, and observations made in the toe regions of the embankments support this conclusion. No changes to the watershed conditions have been reported to Golder.

5.4 Consequence of Failure

5.4.1 Consequence of Failure Assessment

Teck are aligned with the most conservative interpretation of the GISTM which, in turn, is consistent with their safety culture. Commensurately, Teck has advised that consequence classification is not a part of their tailings management governance and has asked that it not be reported in this AFPR. Instead, Teck will adopt the extreme consequence case design loading for any facility with a credible catastrophic flow failure mode. For facilities without a credible failure mode in terms of a life safety issue, Teck will reduce credible risks to ALARP. This consequence case applies for both earthquake and flood scenarios for all tailings facilities, consistent with the GISTM. Adopting this approach meets or exceeds any regulatory requirements, aligns with Teck's goal to eliminate risk for loss of life, and is consistent with the GISTM. This approach is consistent with industry-leading best practices and has an added benefit of providing accurate narratives to communities about the safety of tailings facilities that could impact them and who share Teck's approach of one life is one too many to be at risk.

5.4.2 Review

No new elements are available to support dam classification modification; however, Teck has directed WSP-Golder to assess the stability and physical performance of the various structures of the TSF and polishing pond against extreme loading conditions, those being a probable maximum flood event and a 1:10,000-year return period seismic event. These design basis loading conditions would be applicable to an extreme consequence classification – the highest consequence level considered in the CDA guidance. If the performance of the structures against extreme loading conditions is verified, Teck may opt to discontinue the periodic review of consequence classification. Future consequence evaluation may be required if the guidance for classification of structures evolves or if the magnitude of the extreme loading events changes but as they currently exist to drive design criteria, Teck no longer needs these reviews.

5.5 Physical Performance

The overall performance of the Louvicourt TSF and polishing pond is good. The observations made during the inspection are consistent with good geotechnical performance, regular monitoring, and periodic maintenance in conformance with the OMS manual for the site. The review of the instrumentation readings presented in Section 4.3 did not show displacement or settlement that could indicate a deterioration of physical stability.

Section 4.1 summarizes the observations made at the site and section 6.4 presents the identified recommended actions in view of supporting the facility performance in the longer term. It is recommended that the outcome of the stability analyses at Dams 1C, 1D, 2B and 4B should be considered in the ongoing assessment of physical performance.

5.6 Operational Performance

The Louvicourt tailings facility is closed and there are no activities related to tailings disposal or regularly scheduled activities related to operation of the ponds. Stop logs are added and removed at the polishing pond spillway as needed to control effluent pH, and caustic soda is added at the TSF on an as-needed basis, to control effluent pH.

5.7 OMS Manual Review

The OMS manual was updated in 2020. It is also reviewed annually. At the time of preparation of this report, a further update of the OMS manual is in progress to ensure the format is compliant with the Teck Tailings and Water Retaining Structures guideline (Teck, 2019), which is fully aligned with the MAC guidance on OMS manual best practices. Anticipated completion of the update is Q2 of 2023.

5.8 Emergency Preparedness and Response Review

A Mine Emergency Response Plan (MERP) for the site was most recently updated in March 2022. The MERP incorporates response procedures for the tailings and polishing pond components with input from the EOR, and has replaced the previous emergency preparedness and response plan. The most recent MERP test for the facility was conducted in April 2022 (desktop exercise test).

6.0 SUMMARY AND RECOMMENDATIONS

6.1 Summary of Construction and Operation/Maintenance Activities

The riprap on Dams 1A and 1C was upgraded at the TSF in 2022. The maintenance and surveillance activities performed in 2021-2022 included the following:

- routine observations
- survey of monuments
- removal of vegetation and debris (beaver activity) in the TSF and polishing pond active spillway canals
- removal of beaver obstructions downstream of the embankments
- monitoring of piezometers, V-notch weirs and ponds water levels
- continuing integration of new instrumentation network (pond level loggers and data acquisition system)
- replacement of riprap on Dams 1A and 1C

6.2 Summary of Climate and Water Balance

The total precipitation over the hydrological year (November 2021 to October 2022) was 955 mm or 4.8% higher than the long-term average of 911 mm. Based on the consolidated hydrology study for the Louvicourt site (Golder, 2021b), this corresponds to a 1:2-year to 1:5-year wet precipitation year.

Based on a high-level water balance analysis, it was estimated that 410 thousand m^3 of water were discharged to the polishing pond via the operational spillway.

6.3 Summary of Performance

The overall performance of the Louvicourt TSF and polishing pond is good and does not require major works or corrections. Minor works to be considered are summarized in Section 6.4. All actions recommended in Section 6.4 aim at obtaining a good long-term performance or improving the overall understanding of potential long-term stability issues.

6.4 Table of Deficiencies and Non-Conformances

Review of Previous Deficiencies and Non-Conformances

The Dams at the tailings pond and polishing pond were observed to be in a good condition at the time of the 2022 site visit. No significant changes were noted in the condition of the dams since the 2021 AFPR. Deficiencies and non-conformances noted during the annual inspections and their status are presented in Table 9. Table 10 provides a description of the priority levels referenced in Table 9.

Table 9 : Status of Annual Facility Performance Inspection Key Recommended Actions

Structure	ID	Deficiency or Non-conformance	Applicable Regulation or OMS Reference	Recommended Action	Priority	Recommended Deadline/Status
Previous Recommendations Closed / Superseded						
Dam 4B	2019-02	Granular fill has been placed east of the main spillway, in an area designed as an emergency spillway.	CDA 2013 Section 3.5.5	Assess whether the current configuration can pass the design storm. Preliminary indications are that the current configuration does not pose any overtopping issues.	2	Analyses completed; report submitted for Teck review. No remedial measures are anticipated to be required to address this issue. Can be closed out immediately upon completion of the report review.
Dam 1D	2020-02	Larger diameter (>4-inch trunk) vegetation exists on the downstream stability berm of Dam 1D	OMS Manual Section 6.2	Consider tree removal		Completed in 2022.
TSF Spillway	*2021-01*	*Beaver activity in TSF Operational Spillway.*	*OMS Manual Section 6.2*	*Remove debris.*	*3*	*Debris removed in 2021. Completed.*

Table 9 : Status of Annual Facility Performance Inspection Key Recommended Actions

Structure	ID	Deficiency or Non-conformance	Applicable Regulation or OMS Reference	Recommended Action	Priority	Recommended Deadline/Status
Dam 1A Dam 1C	*2020-01*	*Replacement of riprap on the interior slopes of Dams 1A and 1C is required.*	*CDA 2013 Section 3.5.3*	*Place new riprap as was done for Dams 1B and 1D.*	*3*	*Complete.*
TSF and Polishing Ponds	2021-05	Multiple potential erroneous entries in the pond water level database.	CDA 2013 Section 3.6.3	Implement a QA/QC system for the data collection and entry.	3	Implemented in 2022, but further QA/QC will applied, and validated by new pond piezometers.
Dam 4B	*2021-03*	*Significant beaver blockage downstream of Dam 4B.*	*CDA 2013 Section 3.5.3*	*Engage beaver control contractor and then remove the blockage.*	*2*	*Completed in 2021.*
Previous Recommendations Ongoing						
All	2015-06	Perform a review of dam's seismic stability and undrained behaviour.	Directive 019 Section 2.9.3	Perform a review of dam's seismic stability and undrained behaviour of potentially contractive soils.	3	IN PROGRESS- Undrained stability analysis completed, and deformation analysis is in progress. Q2 2023.
TSF Spillway	2021-02	Beaver access under trash rack leading to increased activity in spillway.	OMS Manual Section 6.2	Survey trash rack and re-assess the adequacy of design and the hydraulic capacity.	3	Survey performed; data analysis is ongoing. Q2 2023.
Dam 1C	2021-04	Irregular slope on toe berm of Dam 1C leading to preferential infiltration.	CDA 2013 Section 3.5.3	Engage a detailed survey of this area and use the data to refine facility integrity analyses.	3	Survey completed in 2021. Data analysis is ongoing. Integrate into stability analysis. Q2 2023.
2022 Recommendations						
General	2022-01	Gaps in the rain gauge records	*CDA 2013 Section 3.2*	Download the rain gauge records monthly during the open-water season and verify the data for equipment errors Verify the equipment calibration	4	To be implemented in 2023

CDA = Canadian Dam Association; OMS = Operations, Maintenance and Surveillance; TSF = tailings storage facility; QA/QC = quality assurance/quality control.

Table 10: Priorities and Level of risks

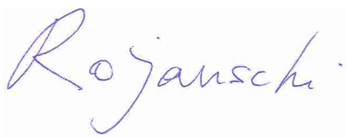
Priority (defined by Teck Resources)	Description
1	A high probability or actual dam safety issue considered immediately dangerous to life, health or the environment, or a significant risk of regulatory enforcement.
2	If not corrected could likely result in dam safety issues leading to injury, environmental impact or significant regulatory enforcement.
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.

Note: Priority description categories are consistent with Mining Association of Canada (MAC) guidelines.

CLOSURE

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

WSP Canada Inc.



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Laurent Gareau, ing.
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LGA/LG/cd

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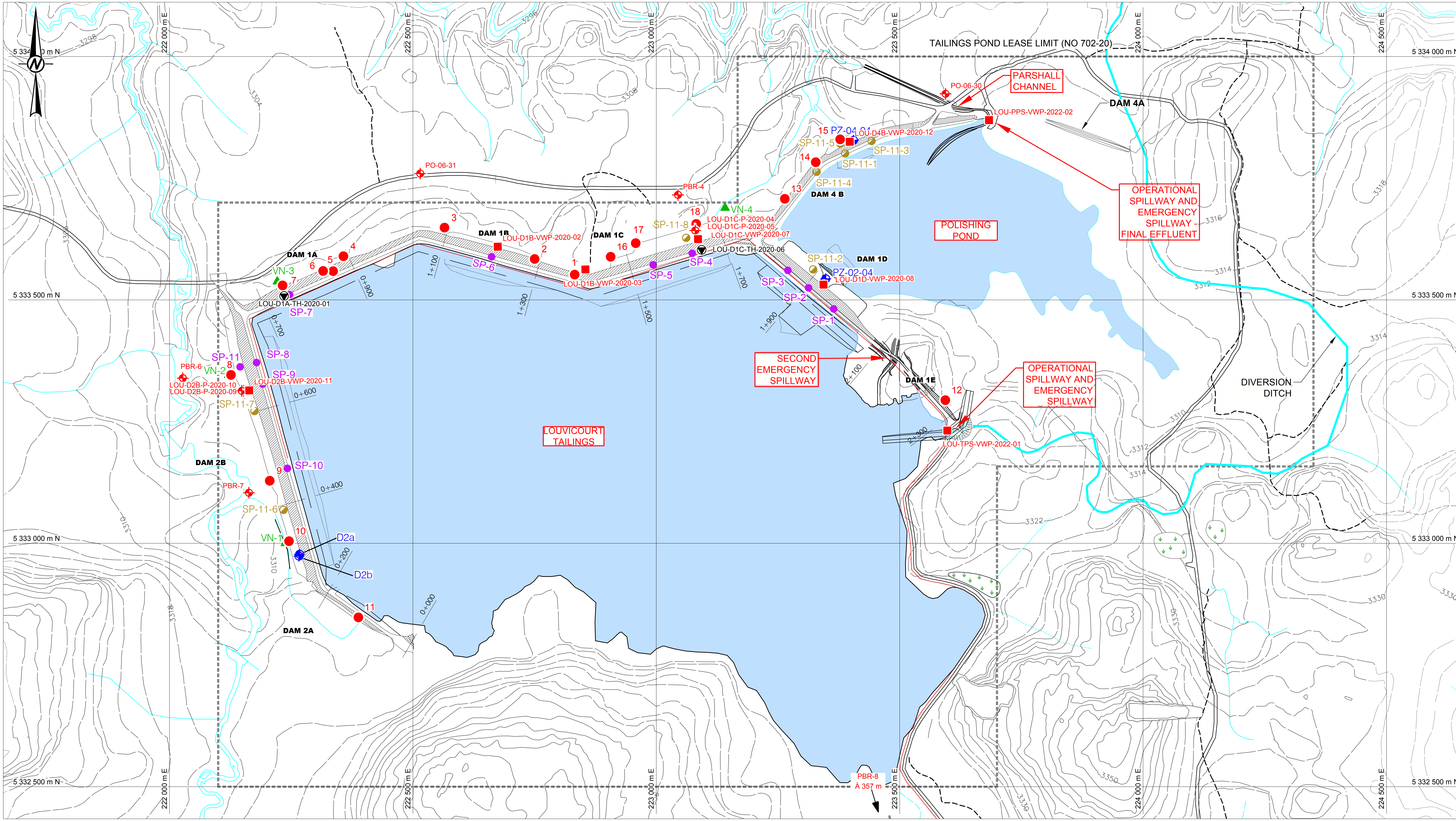
Figures



LEGEND

	PIEZOMETER		SETTLEMENT POINT (GOLDER, 2011)
	V-NOTCH WEIR		OBSERVATION WELLS
	SEEPAGE AREA		VIBRATING WIRE PIEZOMETER(S)
	SETTLEMENT POINT		THERMISTOR STRING

0 125 250
1:7 500 METRES

CLIENT
TECK
MINE LOUVICOURT

PROJECT
LOUVICOURT MINE TAILING AND POLISHING PONDS - TAILINGS STORAGE FACILITY ANNUAL INSPECTION 2022

CONSULTANT
wsp

YYYY-MM-DD	2022-10-31
DESIGNED	S. Betnesky
PREPARED	S. Chapuis
REVIEWED	L. Gareau
APPROVED	L. Gareau

TITLE
GENERAL SITE PLAN

PROJECT NO.	PHASE	REV.	FIGURE
22521237	2000	0	1

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

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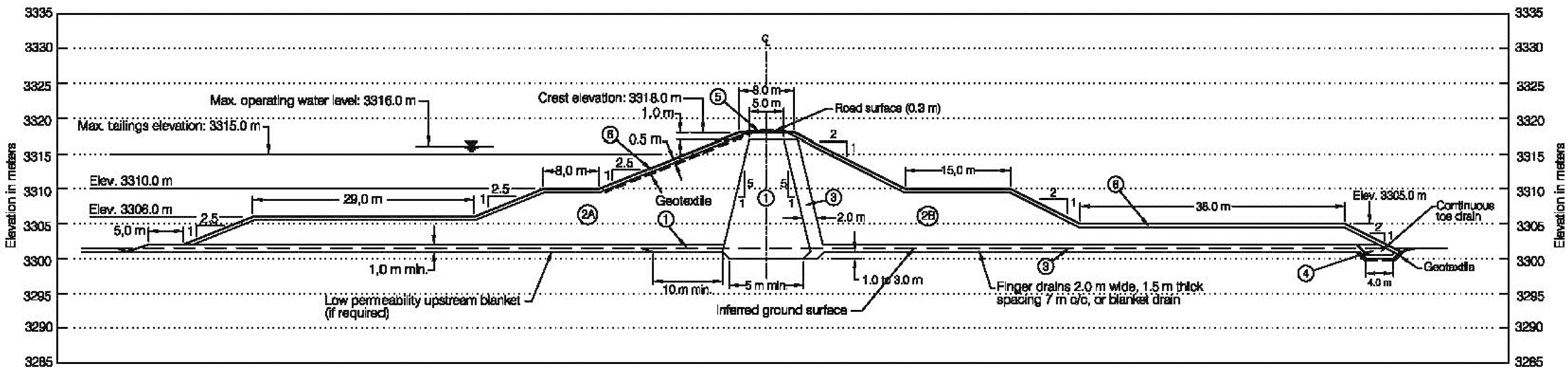
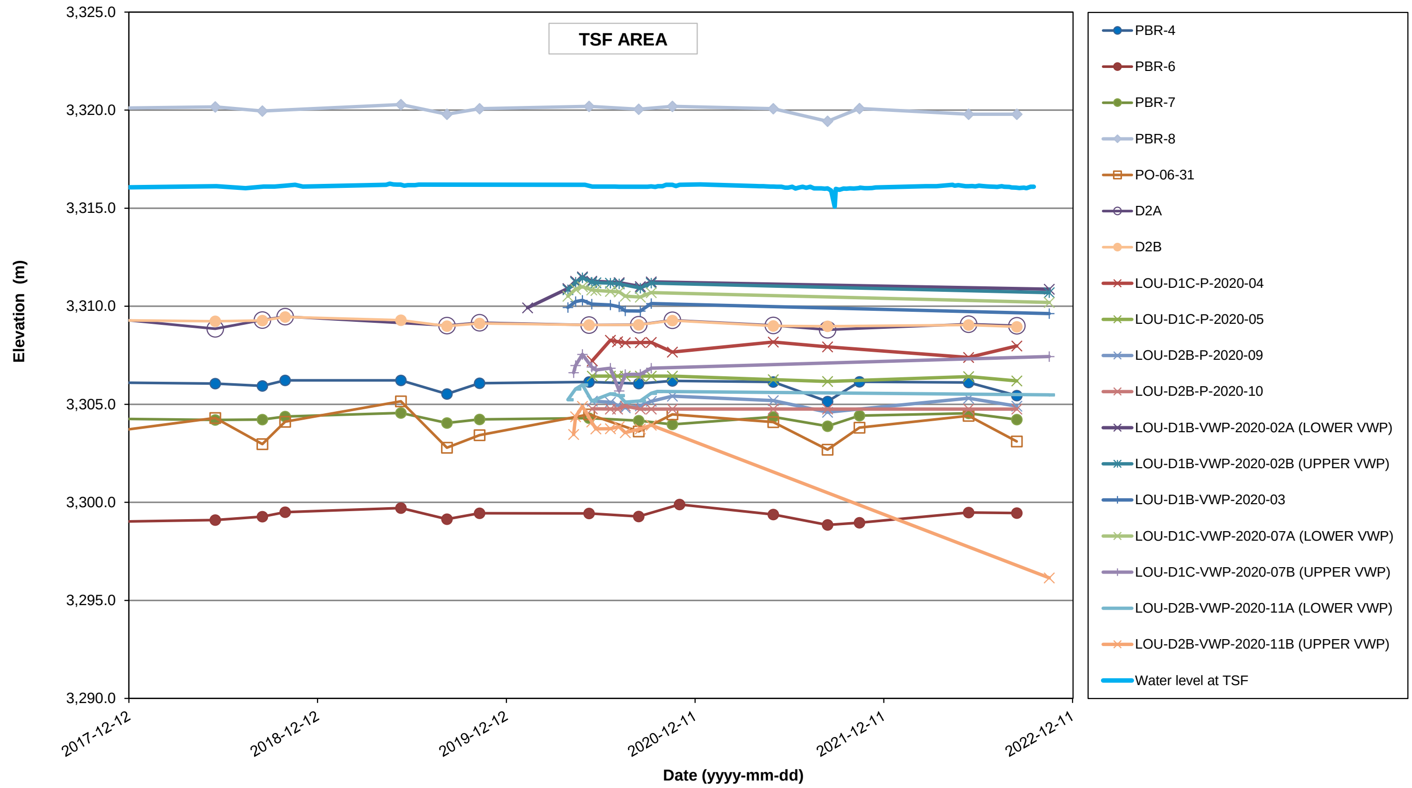


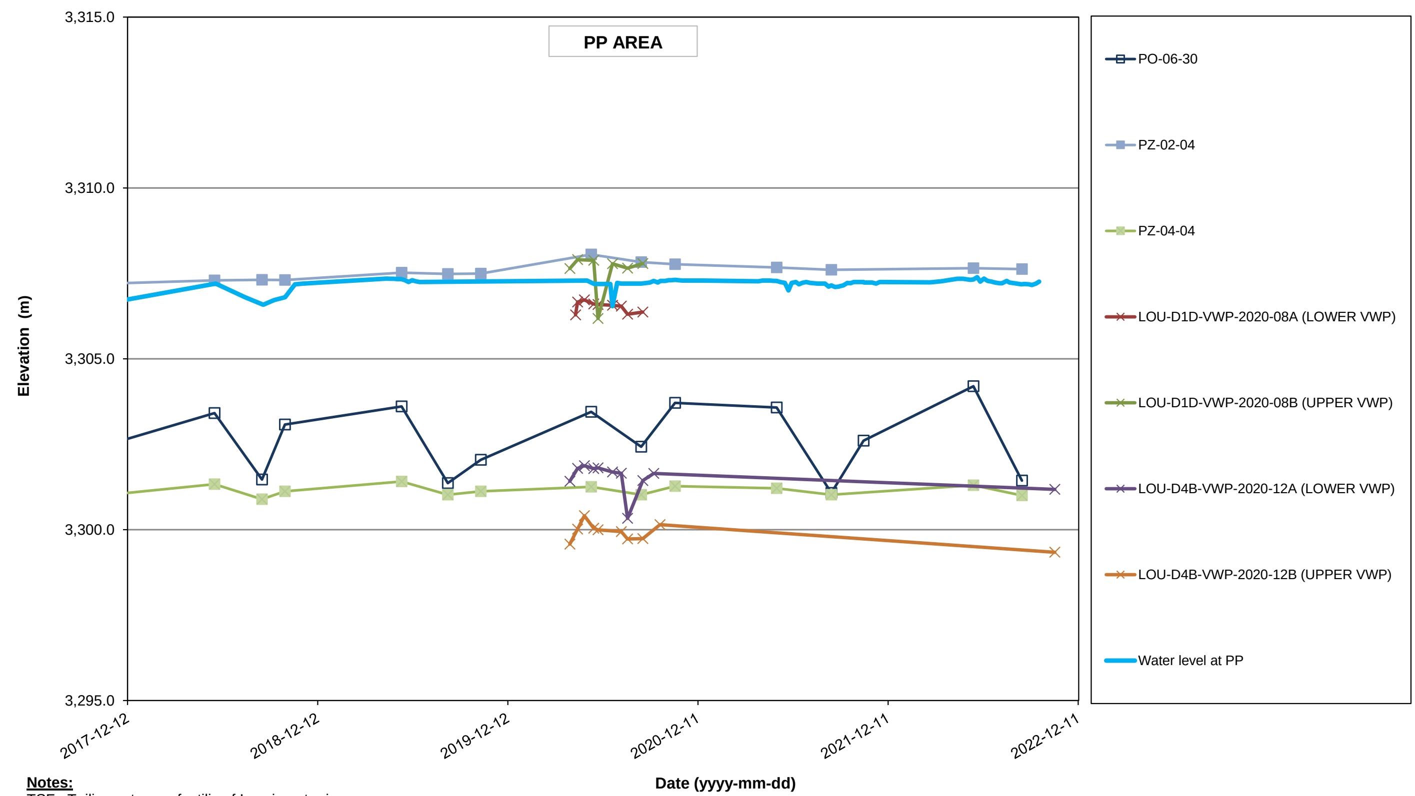
Legend:

- ① Till core
- (2A) Pit-run sand or sand and gravel upstream shell
- (2B) Sand or sand and gravel downstream shell
- ③ Processed filter sand
- ④ Toe drain - processed gravel
- ⑤ Road surface
- ⑥ Quarried rock

CLIENT TECK MINE LOUVICOURT		PROJECT LOUVICOURT MINE TAILING AND POLISHING PONDS - TAILINGS STORAGE FACILITY ANNUAL INSPECTION 2022	
CONSULTANT	YYYY-MM-DD: 2022-10-31 DESIGNED: S. Betnesky PREPARED: S. Chapuis REVIEWED: L. Gareau APPROVED: L. Gareau	TITLE TYPICAL DIKE CROSS-SECTION	
		PROJECT NO. 22521237 · PHASE 2000 · REV. 0	FIGURE 2

Figure 3: Monthly Precipitation Data from November 2021 to October 2022





Notes:
TSF : Tailings storage factiliy of Louvicourt mine
PP : Polishing pound of the Louvicour mine
PBR-8 : This well is located in the upstream of the TSF

Tailings Storage Facility Annual Facility Performance Assessment - 2022	**Water level measurements - piezometers (provided by Teck)**	
Louvicourt TSF Teck Resources Ltd	PROJECT NO.	22521237-2000
	REV	0
	FIGURE	**4**

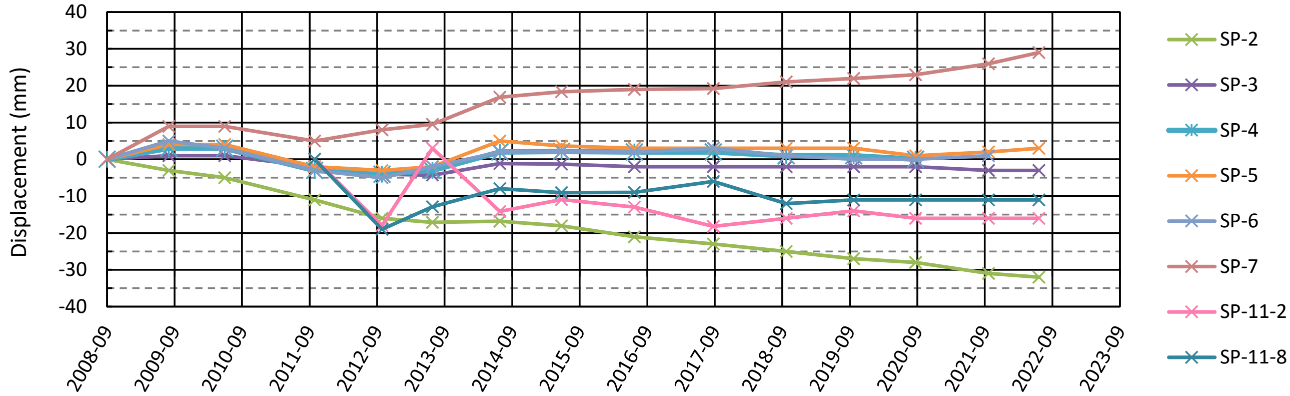


Figure 5 : Vertical Displacement of the Survey Monuments at Dam 1

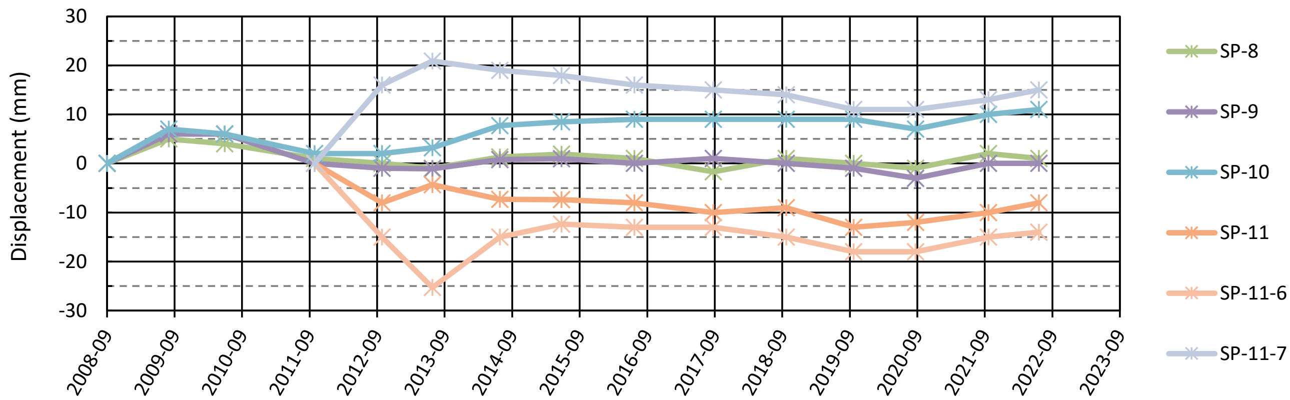


Figure 6 : Vertical Displacement of the Survey Monuments at Dam 2

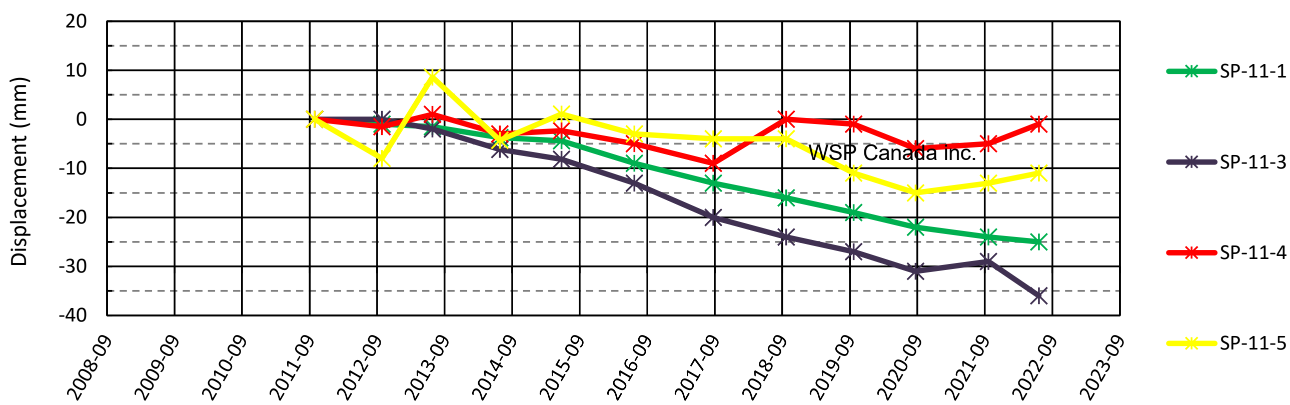
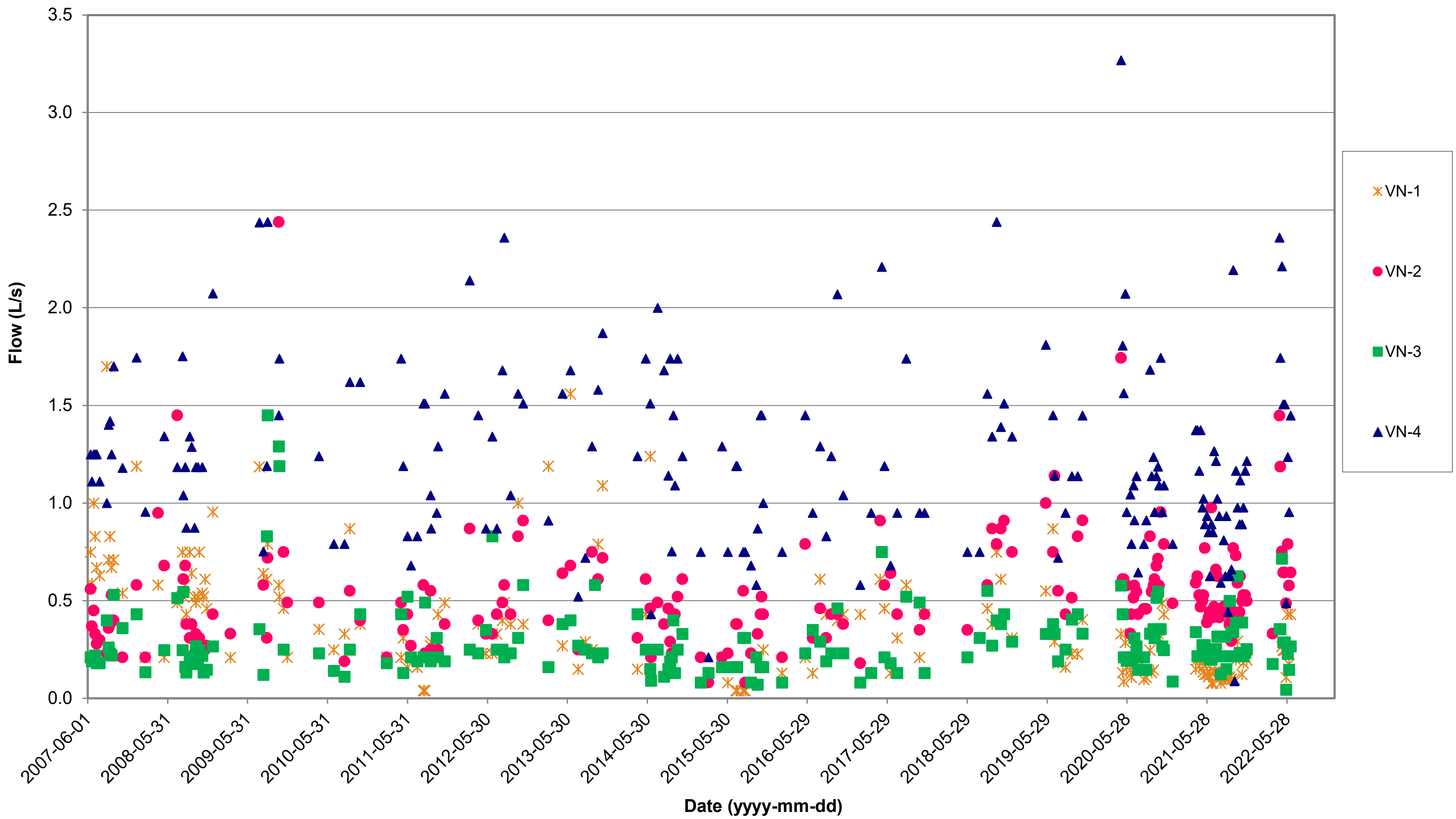


Figure 7 : Vertical Displacement of the Survey Monuments at Dam 4

Note: positive = upward displacement



Tailings Storage Facility Annual Facility Performance Assessment - 2022	**Louvicourt Mine Tailings Pond - historical trend of seepage flow measured at the V-notch weirs (provided by Teck)**	
Louvicourt TSF Teck Resources Ltd	PROJECT NO.	22521237-2000
	REV	A0
	FIGURE	**8**

APPENDIX A

Facility Data Sheet

Facility Data Sheet

Mine TSF and Polishing Pond Dams

Dam 1

Dam Type	Till core, rock shell
Maximum Dam Height	13 m
Dam Crest Width	5 m
Impoundment Area	~1,000,000 m^2
Volume of Tailings	~6,500,000 t
Reservoir Capacity	~1,700,000 m^3 (to max spring pond elevation)
Inflow Design Flood (IDF)	PMF
Design Earthquake	1:10,000
Spillway Capacity	Combined 12.7 m^3/s at 317.0 m water level
Catchment Area	~2,100,000 m^2
Access to Dam	From crest of dam

Dam 2

Dam Type	Till core, rock shell
Maximum Dam Height	15 m
Dam Crest Width	5 m
Impoundment Area	~1,000,000 m^2
Volume of Tailings	~6,500,000 t
Reservoir Capacity	~1,700,000 m^3 (to max spring pond elevation)
Inflow Design Flood (IDF)	PMF
Design Earthquake	1:10,000
Spillway Capacity	N/A – See Dam 1
Catchment Area	~2,100,000 m^2
Access to Dam	From crest of dam

Dam 4 – Polishing Pond

Dam Type	Till core, rock shell
Maximum Dam Height	12.5 m
Dam Crest Width	5 m
Impoundment Area	150,000 m^2
Volume of Tailings	N/A
Reservoir Capacity	150,000 m^3 (to spillway crest elevation + 0.1 m)
Inflow Design Flood (IDF)	PMF
Design Earthquake	1:10,000
Spillway Capacity	Combined 22.0 m^3/s at 309.5 m water level
Catchment Area	1,150,000 m^2
Access to Dam	From crest of dam, or northeast access.

APPENDIX B :

Photographs

Photo 1 : Dams 1D – View of the upstream slope with riprap replaced.

Photo 3 : Flowing water near downstream toe of Dam 1C. Similar flows occur on Dams 1A and 1B.

Photo 2 : Dam 1C - Rip rap was recently replaced and traffic gravel was placed on the crest.

Photo 4 : Emergency spillway located between Dams 1D and 1E was in good condition but exhibited significant vegetation growth. Vegetation in the upstream channel was cleared later in 2022, after this inspection.

Photo 5 :Emergency spillway located between Dams 1D and 1E was in good condition but exhibited significant vegetation growth. Vegetation in the downstream channel was cleared later in 2022, after this inspection.

Photo 7 : Crest erosion was nominal, with conditions similar to 2021 when repair was performed.

Photo 6 : Access bridge close to the TSF spillway. Bridge appears in good condition, although the edge blocks appear to be suffering some scraping, presumably by snow removal equipment.

Photo 8 : Typical view of vegetation which is present at the downstream toe of Dams 1 and 2.

Photo 9 : Dam 2A – View of the water accumulation at the toe of the dyke, essentially unchanged since 2021.

Photo 11 : Dam 4A which does not currently retain water.
Note: limited vegetation on slopes and ridge.

Photo 10 : Culverts on the unnamed creek, northwest of the tailings pond.
Water levels were higher than flow in 2021, a possible reflection of significant rainfall on 19 September. No evidence of recent beaver activity in the culverts.

Photo 12 : Dam 4B main spillway – accumulation of debris showing beaver activity in the spillway. It is noted that this debris was removed later in 2022, subsequent to the site inspection.

Photo 13 : Dam 4B – Downstream view of the spillway. Outflow channel from the spillway to the Parshall flume contains significant vegetation

Photo 15 : Foot of dam 4B. Beaver blockage of 2021 removed, with no recurrence of the blockage at the time of 2022 inspection.

Photo 14 : Outlet channel of the site. Note the limited vegetation upstream of the channel.

APPENDIX C

Movement Monitoring Survey

LEVÉ EN XYZ
DE DIX-NEUF (19) REPÈRES DE TASSEMENT
EXISTANTS

PAR MÉTHODE GPS TEMPS RÉEL,
NIVELLEMENT GÉOMÉTRIQUE
ET
TRIGONOMÉTRIQUE
EN 2022

MINE LOUVICOURT
TECK RESOURCES LIMITED

CANTON LOUVICOURT

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LEVÉ EN XYZ DE DIX-NEUF (19) REPÈRES (PLAQUES) DE TASSEMENT EXISTANTS PAR MÉTHODE GPS TEMPS RÉEL, NIVELLEMENT GÉOMÉTRIQUE ET TRIGONOMÉTRIQUE

RAPPORT D'OPÉRATION

1) INTRODUCTION :

À la demande de madame Morgan Lypka de la compagnie Teck Resources, nous nous sommes rendus sur le site du parc à résidus de la Mine Louvicourt situé dans le canton de Louvicourt pour y effectuer le levé de dix-neuf (19) plaques de tassement en XYZ afin de contrôler leur déplacement en horizontal et en vertical, à l'aide de la méthode GPS temps réel, les méthodes de nivellement géométrique et trigonométrique.

2) TRAVAUX TERRAIN EXÉCUTÉS :

Description des travaux :

En premier lieu, les travaux consistaient à lever par GPS temps réel haute précision (± 1cm) la position XYZ de toutes les plaques de tassement. Nous avons utilisé un jalon calé avec un trépied « tripode » pour maintenir l'antenne GPS en stabilité parfaite et ainsi obtenir une meilleure précision de nos observations. De plus, chacune des plaques de tassement a fait l'objet de trois (3) séquences d'observation différentes à environ quinze (15) minutes d'intervalle ou plus pour avoir des géométries différentes de la position des satellites. Chaque séquence d'observation comptait trois (3) moyennes de dix (10) lectures chacune avec une rotation de 120° du jalon à chaque moyenne pour une plus grande justesse et annuler l'erreur de verticalité du jalon porteur du récepteur GPS. Tous les travaux ont été réalisés dans le système SCOPQ (projection MTM) fuseau 9, NAD83, mais appuyés ou comparés sur les points du « *tableau des Points d'appui et de contrôle levés au GPS Temps réel – Système SCOPQ Fuseau 9 NAD83* » (voir le point 6 du rapport), soit les mêmes points de référence ancrés dans le roc que les années précédentes.

Comme à chaque année, nous avons gardé le point **94-257** comme point de référence principal, alors que cinq (5) autres points d'appui secondaires servent de validation du point d'appui principal ainsi que de témoin de la bonne opération et de la justesse de nos méthodes de levé au GPS RTK. Notez que lors du levé effectué en juillet 2022, les points d'appui **94-260**, **94-262** et **94-263** n'ont fait l'objet que d'une seule séquence d'observation.

La deuxième partie des travaux consistait à faire le cheminement vertical avec un niveau géométrique électronique de haute précision et une mire code-barres en fibre de verre pour obtenir une précision verticale de quelques millimètres de toutes les plaques de tassement placées sur le sommet des digues. Le point de départ du cheminement est le repère **94-257** (ancré dans le roc) d'une élévation fixe de **3316.707m (Mine)** ou **316.707m (altitude N.M.M)**. Nous avons effectué dix (10) cheminements en boucle obtenant des écarts de fermeture de 0.1mm, 0.0mm, 0.4mm, 0.5mm, 0.1mm, 0.5mm, 0.0mm, 0.6mm, 0.4mm et 0.4mm.

Le premier cheminement en boucle s'étend sur une distance totale (incluant aller et retour) de 518m entre le repère **94-257** et le moniteur **B-1** avec une erreur de fermeture de 0.1mm. Le deuxième cheminement en boucle s'étend sur une distance de 672m totale (incluant aller et retour) entre le repère **94-257** et le moniteur **JLC-2011-3** avec une erreur de fermeture de 0.0mm. Le troisième cheminement en boucle s'étend sur une distance totale (incluant aller et retour) de 1105m entre le repère **94-257** et le moniteur **B-6** avec une erreur de fermeture de 0.4 mm. Le quatrième cheminement liant le moniteur **JLC-2011-8** (départ) et le point d'appui **94-257** (arrivée) s'étend sur une distance totale (incluant aller et retour) de 250m avec une erreur de fermeture globale de 0.5mm. Le cinquième cheminement liant le moniteur **B6** (départ) et le moniteur **B7** (arrivée) s'étend sur une distance totale (incluant aller et retour) de 888m avec une erreur de fermeture globale de 0.1mm. Le sixième cheminement liant le moniteur **B7** (départ) et le moniteur **B10** (arrivée) s'étend sur une distance totale (incluant aller et retour) de 826m avec une erreur de fermeture globale de 0.5mm. Le septième cheminement liant le moniteur **B10** (départ) et le point d'appui **94-263** (arrivée) s'étend sur une distance totale (incluant aller et retour) de 652m avec une erreur de fermeture globale de 0.0mm. Le huitième cheminement liant le point d'appui **94-263** (départ) et le moniteur **B11** (arrivée) s'étend sur une distance totale (incluant aller et retour) de 1136m avec une erreur de fermeture globale de 0.6mm. Enfin, le neuvième cheminement liant le moniteur **B1** (départ) et le moniteur **JLC-2011-2** (arrivée) s'étend sur une distance totale (incluant aller et retour) de 750m avec une erreur de fermeture globale de 0.4mm. Finalement, le dixième cheminement liant le moniteur **JLC-2011-4** (départ) et le moniteur **JLC-2011-5** (arrivée) s'étend sur une distance totale (incluant aller et retour) de 152m avec une erreur de fermeture globale de 0.4mm. Les plaques de tassement ont été mesurées à l'aller et au retour, soit deux (2) déterminations différentes utilisant chacune des plaques comme des « points tournant ». Nous avons ensuite fait la moyenne de ces deux (2) déterminations pour obtenir les valeurs du « *tableau des Élévations précises des plaques de tassement »* (voir le point 8 du rapport).

La troisième partie des travaux consistait à lever les plaques de tassement placées sur les bermes. La méthode consistant à stationner une station totale sur le sommet des digues, a été abandonnée au profit du nivellement géométrique, ce dernier étant plus précis en élévation. Les cheminements permettant la mesure des plaques sur les bernes ont été décrits au paragraphe précédent.

3) COMMENTAIRES SUR LES OBSERVATIONS DE 2008 :

Comme déjà mentionné dans les rapports des années passées, il est possible qu'il y ait un cassé en déplacement entre les données de 2008 et les années précédentes qui ne soit pas nécessairement dû au déplacement des plaques de tassement, mais plutôt à un choix différent des points d'origine et l'incohérence des repères d'appui ou de référence. De plus, il y a sûrement une différence entre la procédure que nous utilisons pour faire les levés et celle qu'utilisait la compagnie minière, laquelle procédure ne nous a pas été indiquée, on aurait pu alors assurer une continuité plus rigoureuse dans les résultats par une même méthodologie de levé.

4) TRAVAUX BUREAU EXÉCUTÉS :

Nous avons calculé les coordonnées des points mesurés en XYZ par GPS temps réel en faisant les moyennes des répétitions, avons complété le « *tableau des Différences des coordonnées XYZ »* et avons calculé les déplacements (voir le point 7 du rapport). Il est à noter que les coordonnées XYZ obtenues par méthode GPS temps réel sont estimées avoir une précision de ± 1cm avec 1 sigma en horizontal, tandis qu'en élévation par GPS la précision n'est qu'environ 2cm.

Nous avons fait la moyenne des deux (2) lectures d'élévation obtenues par nivellement géométrique (aller et retour) de toutes les plaques de tassement des sommets de digues. Nous avons compensé les cheminements aller-retour même si l'erreur de fermeture des boucles n'était que de quelques fractions de millimètres et n'avait que peu d'incidence significative sur le résultat obtenu.

5) GÉNÉRALITÉS :

Les travaux ont été effectués les 18, 19, 20, 21 et 22 juillet 2022 par une équipe de trois hommes. Les travaux ont été supervisés par Jean-Luc Corriveau, arpenteur-géomètre.

Instruments utilisés :

- Un (1) niveau électronique DNA 3 compagnie Leica avec deux mires à code-barres précision en nivellement double de 1 mm/km.
- Un (1) système GNSS comprenant :

  deux (2) récepteurs GNSS modèle GS14 et GS18i de la compagnie Leica. La précision du système GNSS ou GPS est de ± 0,01m horizontalement et ± 0,02m verticalement à un niveau de confiance de 1σ, selon les spécifications du fabricant; cependant, par la répétition, la proximité des points d'appui et la méthodologie, ces précisions ont pu être largement améliorées.

6) REMARQUES:

Contrairement aux mesures de nivellement géométrique, les mesures GNSS temps réel de certains points montrent des écarts d'environ 3 cm par rapport aux mesures antécédentes, ce qui semble anormal, bien que les mesures aient été prises parfaitement selon les normes (3 mesures prises à une quinzaine de minutes d'espacement donc 3 installations indépendantes) ayant chacune d'excellentes statistiques et que de plus les autres points pris dans la même période ne présentent pas de biais. Ces données GPS pour le vertical sont à plus ou moins 1 à 2 cm de précision, des valeurs près de 3 centimètres s'expliqueraient par des inexactitudes normales de 1 à 2 cm s'additionnant sur les 2 ans au lieu de s'annuler ou se soustraire.

Ces données verticales du GPS ne sont qu'à titre indicatif et ne saurait remplacer les altitudes obtenues par nivellement géométrique.

Suite au levé effectué en 2021, on remarque que l'élévation de l'ensemble des plaques de tassements est stable hormis certaines dont **B-2**, **JLC-2011-1** et qui semblent s'enfoncer, alors que **B-7** s'élèvent légèrement confirmant la tendance déjà observée lors des années précédentes en ce point.

Suite au levé effectué en 2022, on remarque que l'élévation de l'ensemble des plaques de tassements est stable hormis certaines dont **B-2**, **JLC-2011-1 et JLC-2011-3** et qui semblent s'enfoncer, alors que **B-7** s'élèvent légèrement confirmant la tendance déjà observée lors des années précédentes en ces points. Cependant ces écarts sont très faibles, soit de l'ordre de quelques millimètres.

7) TABLEAU DES POINTS D'APPUI ET DE CONTRÔLE LEVÉS AU GPS TEMPS RÉEL SYSTÈME SCOPQ FUSEAU 9 NAD83

Numéro		NORD (m)	EST (m)	ALTITUDE (m)***
94-257**	**Théorique***	**5333644.982**	**223183.100**	**316.707**
Point de base	Terrain	5333644.982	223183.100	316.707
	Différence	**0.000**	**0.000**	**0.000**

94-258**	**Théorique***	**5333566.954**	**222891.729**	**311.677**
	Terrain 2010	5333567.016	222891.730	311.661
Contrôle 1	Terrain 2011	5333567.027	222891.729	311.682
	Terrain 2012	5333567.011	222891.724	311.681
	Terrain 2013	5333567.022	222891.723	311.685
	Terrain 2014	5333567.020	222891.730	311.676
	Terrain 2015	5333567.019	222891.728	311.680
	Terrain 2016	5333567.028	222891.729	311.699
	Terrain 2017	5333567.015	222891.735	311.688
	Terrain 2018	5333567.020	222891.726	311.674
	Terrain 2019	5333567.021	222891.727	311.681
	Terrain 2020	5333567.021	222891.734	311.688
	Terrain 2021	5333567.014	222891.729	311.680
	Terrain 2022	5333567.019	222891.733	311.672
	Diff. Théo-2010.	**-0.062**	**-0.001**	**0.016**
	Diff. Théo-2011.	**-0.073**	**0.000**	**-0.005**
	Diff. Théo-2012.	**-0.057**	**0.005**	**-0.004**
	Diff. Théo-2013	**-0.068**	**0.006**	**-0.008**
	Diff. Théo-2014	**-0.066**	**-0.001**	**0.001**
	Diff. Théo-2015	**-0.065**	**0.001**	**-0.003**
	Diff. Théo-2016	**-0.074**	**0.000**	**-0.022**
	Diff. Théo-2017	**-0.061**	**-0.006**	**-0.011**
	Diff. Théo-2018	**-0.066**	**0.003**	**0.003**
	Diff. Théo-2019	**-0.067**	**0.002**	**-0.004**
	Diff. Théo-2020	**-0.067**	**-0.005**	**-0.011**
	Diff. Théo-2021	**-0.060**	**0.000**	**-0.003**
	Diff. Théo-2022	**-0.065**	**-0.004**	**0.005**
	2011-2010	**0.011**	**-0.001**	**0.021**
	2012-2011	**-0.016**	**-0.005**	**-0.001**
	2013-2012	**0.011**	**-0.001**	**0.004**
	2014-2013	**-0.002**	**0.007**	**-0.009**
	2015-2014	**-0.001**	**-0.002**	**0.004**
	2016-2015	**0.009**	**0.001**	**0.019**
	2017-2016	**-0.013**	**0.006**	**-0.011**
	2018-2017	**0.005**	**-0.009**	**-0.014**
	2019-2018	**0.001**	**0.001**	**0.007**
	2020-2019	**0.000**	**0.007**	**0.008**
	2021-2020	**-0.006**	**-0.005**	**-0.008**
	2022-2021	**0.005**	**0.004**	**-0.008**

94-256**	**Théorique***	**5333408.957**	**223515.007**	**317.777**
	Terrain 2010	5333408.888	223514.937	317.774
Contrôle 2	Terrain 2011	5333408.896	223514.929	317.784
	Terrain 2012	5333408.900	223514.927	317.782
	Terrain 2013	5333408.899	223514.929	317.786
	Terrain 2014	5333408.887	223514.932	317.772
	Terrain 2015	5333408.894	223514.932	317.773
	Terrain 2016	5333408.899	223514.929	317.792
	Terrain 2017	5333408.907	223514.939	317.801
	Terrain 2018	Trop boisé pour observation		
	Terrain 2019	Trop boisé pour observation		
	Terrain 2020	5333408.900	223514.926	317.767
	Terrain 2021	5333408.896	223514.934	317.788
	Terrain 2022	5333408.903	223514.928	317.788
	Diff. Théo-2010.	**0.069**	**0.070**	**0.003**
	Diff. Théo-2011.	**0.061**	**0.078**	**-0.007**
	Diff. Théo-2012.	**0.057**	**0.080**	**-0.005**
	Diff. Théo-2013	**0.058**	**0.078**	**-0.009**
	Diff. Théo-2014	**0.070**	**0.075**	**0.005**
	Diff. Théo-2015	**0.063**	**0.076**	**0.004**
	Diff. Théo-2016	**0.059**	**0.079**	**-0.015**
	Diff. Théo-2017	**0.050**	**0.068**	**-0.024**
	Diff. Théo-2020	**0.057**	**0.081**	**0.010**
	Diff. Théo-2021	**0.061**	**0.073**	**-0.011**
	Diff. Théo-2022	**0.054**	**0.080**	**-0.011**
	2011-2010	**0.008**	**-0.008**	**0.010**
	2012-2011	**0.004**	**-0.002**	**-0.002**
	2013-2012	**-0.001**	**0.002**	**0.005**
	2014-2013	**-0.012**	**0.003**	**-0.014**
	2015-2014	**0.007**	**0.000**	**0.001**
	2016-2015	**0.004**	**-0.003**	**0.019**
	2017-2016	**0.008**	**0.010**	**0.010**
	2020-2017	**-0.007**	**-0.013**	**-0.034**
	2021-2020	**-0.004**	**0.008**	**0.021**
	2022-2021	**0.008**	**-0.007**	**0.000**

94-260**	**Théorique***	**5333495.201**	**222157.718**	**312.345**
	Terrain 2010	5333495.447	222157.739	312.333
Contrôle 3	Terrain 2011	5333495.453	222157.733	312.360
	Terrain 2012	5333495.443	222157.735	312.350
	Terrain 2013	5333495.453	222157.735	312.369
	Terrain 2014	5333495.451	222157.737	312.345
	Terrain 2015	5333495.447	222157.738	312.354
	Terrain 2016	5333495.453	222157.731	312.368
	Terrain 2017	5333495.435	222157.742	312.385
	Terrain 2018	5333495.441	222157.743	312.371
	Terrain 2020	5333495.449	222157.734	312.347
	Terrain 2021	5333495.440	222157.731	312.366
	Terrain 2022	5333495.455	222157.737	312.377
	Diff. Théo-2010	**-0.246**	**-0.021**	**0.012**
	Diff. Théo-2011	**-0.252**	**-0.015**	**-0.015**
	Diff. Théo-2012	**-0.242**	**-0.017**	**-0.005**
	Diff. Théo-2013	**-0.252**	**-0.017**	**-0.024**
	Diff. Théo-2014	**-0.250**	**-0.019**	**0.000**
	Diff. Théo-2015	**-0.246**	**-0.020**	**-0.009**
	Diff. Théo-2016	**-0.252**	**-0.013**	**-0.023**
	Diff. Théo-2017	**-0.234**	**-0.024**	**-0.040**
	Diff. Théo-2018	**-0.240**	**-0.025**	**-0.026**
	Diff. Théo-2020	**-0.248**	**-0.016**	**-0.002**
	Diff. Théo-2021	**-0.239**	**-0.013**	**-0.020**
	Diff. Théo-2022	**-0.254**	**-0.019**	**-0.032**
	2011-2010	**0.006**	**-0.006**	**0.027**
	2012-2011	**-0.010**	**0.002**	**-0.010**
	2013-2012	**0.010**	**0.000**	**0.019**
	2014-2013	**-0.002**	**0.002**	**-0.024**
	2015-2014	**-0.004**	**0.001**	**0.009**
	2016-2015	**0.006**	**-0.007**	**0.014**
	2017-2016	**-0.018**	**0.011**	**0.017**
	2018-2017	**0.006**	**0.001**	**-0.014**
	2020-2018	**0.007**	**-0.009**	**-0.023**
	2021-2020	**-0.008**	**-0.002**	**0.018**
	2022-2021	**0.015**	**0.005**	**0.011**

Numéro		NORD (m)	EST (m)	ALTITUDE (m)***
94-262**	**Théorique***	**5332897.066**	**222292.513**	**315.842**
	Terrain 2010	5332897.303	222292.387	315.827
Contrôle 4	Terrain 2011	5332897.306	222292.381	315.840
	Terrain 2012	5332897.307	222292.382	315.856
	Terrain 2013	5332897.304	222292.381	315.859
	Terrain 2014	5332897.311	222292.390	315.840
	Terrain 2015	5332897.313	222292.386	315.851
	Terrain 2016	5332897.325	222292.386	315.870
	Terrain 2017	5332897.307	222292.386	315.878
	Terrain 2018	5332897.311	222292.388	315.861
	Terrain 2019	5332897.302	222292.385	315.835
	Terrain 2020	5332897.310	222292.384	315.865
	Terrain 2021	5332897.304	222292.392	315.852
	Terrain 2022	5332897.313	222292.392	315.868
	Diff. Théo-2010.	**-0.237**	**0.126**	**0.015**
	Diff. Théo-2011.	**-0.240**	**0.132**	**0.002**
	Diff. Théo-2012.	**-0.241**	**0.131**	**-0.014**
	Diff. Théo-2013	**-0.238**	**0.132**	**-0.017**
	Diff. Théo-2014	**-0.245**	**0.123**	**0.002**
	Diff. Théo-2015	**-0.247**	**0.127**	**-0.009**
	Diff. Théo-2016	**-0.259**	**0.128**	**-0.028**
	Diff. Théo-2017	**-0.241**	**0.127**	**-0.036**
	Diff. Théo-2018	**-0.245**	**0.125**	**-0.019**
	Diff. Théo-2019	**-0.236**	**0.128**	**0.007**
	Diff. Théo-2020	**-0.244**	**0.129**	**-0.023**
	Diff. Théo-2021	**-0.238**	**0.121**	**-0.010**
	Diff. Théo-2022	**-0.247**	**0.121**	**-0.026**
	2011-2010	**0.003**	**-0.006**	**0.013**
	2012-2011	**0.001**	**0.001**	**0.016**
	2013-2012	**-0.003**	**-0.001**	**0.003**
	2014-2013	**0.007**	**0.009**	**-0.019**
	2015-2014	**0.002**	**-0.004**	**0.011**
	2016-2015	**0.012**	**0.000**	**0.019**
	2017-2016	**-0.018**	**0.000**	**0.008**
	2018-2017	**0.004**	**0.002**	**-0.017**
	2019-2018	**-0.009**	**-0.004**	**-0.026**
	2020-2019	**0.008**	**0.000**	**0.030**
	2021-2020	**-0.006**	**0.007**	**-0.013**
	2022-2021	**0.009**	**0.000**	**0.016**

94-263**	**Théorique***	**5332858.918**	**222355.630**	**317.471**
	Terrain 2010	5332859.145	222355.493	317.465
Contrôle 5	Terrain 2011	5332859.147	222355.487	317.467
	Terrain 2012	5332859.140	222355.487	317.485
	Terrain 2013	5332859.142	222355.485	317.488
	Terrain 2014	5332859.139	222355.491	317.468
	Terrain 2015	5332859.140	222355.492	317.478
	Terrain 2016	5332859.138	222355.487	317.495
	Terrain 2017	5332859.135	222355.488	317.524
	Terrain 2018	Trop boisé pour observation		
	Terrain 2019	5332859.136	222355.488	317.477
	Terrain 2020	5332859.141	222355.489	317.487
	Terrain 2021	5332859.138	222355.494	317.478
	Terrain 2022	5332859.116	222355.469	317.523
	Diff. Théo-2010.	**-0.227**	**0.137**	**0.006**
	Diff. Théo-2011.	**-0.229**	**0.143**	**0.004**
	Diff. Théo-2012.	**-0.222**	**0.143**	**-0.014**
	Diff. Théo-2013	**-0.224**	**0.145**	**-0.017**
	Diff. Théo-2014	**-0.221**	**0.139**	**0.003**
	Diff. Théo-2015	**-0.222**	**0.138**	**-0.007**
	Diff. Théo-2016	**-0.220**	**0.143**	**-0.024**
	Diff. Théo-2017	**-0.217**	**0.142**	**-0.053**
	Diff. Théo-2018	**-**	**-**	**-**
	Diff. Théo-2019	**-0.218**	**0.142**	**-0.006**
	Diff. Théo-2020	**-0.223**	**0.141**	**-0.016**
	Diff. Théo-2021	**-0.220**	**0.136**	**-0.007**
	Diff. Théo-2022	**-0.198**	**0.161**	**-0.052**
	2011-2010	**0.002**	**-0.006**	**0.002**
	2012-2011	**-0.007**	**0.000**	**0.018**
	2013-2012	**0.002**	**-0.002**	**0.003**
	2014-2013	**-0.003**	**0.006**	**-0.020**
	2015-2014	**0.001**	**0.001**	**0.010**
	2016-2015	**-0.002**	**-0.005**	**0.017**
	2017-2016	**-0.003**	**0.001**	**0.029**
	2018-2017	**-**	**-**	**-**
	2019-2017	**0.001**	**0.000**	**-0.047**
	2020-2019	**0.006**	**0.000**	**0.010**
	2021-2020	**-0.004**	**0.006**	**-0.009**
	2022-2021	**-0.021**	**-0.026**	**0.045**

■ SCOPQ (MTM) NAD83 FUSEAU 9 MÉRIDIEN CENTRAL : 76°30' OUEST

* Coordonnées théoriques fournies par la mine dont on a ajouté 5 300 000m en Nord et 200 000m en Est et soustrait 3 000m en élévation

Note : On doit considérer les inscriptions au mm significatives qu'au 10mm près en horizontal et qu'au 2 cm près en vertical pour les données venant des levés GPS ou GNSS.

Légende :

** Point existant ancré dans le roc avec trépied témoin.

*** Précision insuffisante en vertical, se référer au nivellement géométrique pour une meilleure

8) TABLEAU DES DIFFÉRENCES DES COORDONNÉES XYZ DES PLAQUES DE TASSEMENT OBTENUES PAR MÉTHODE GPS TEMPS RÉEL (voir annexe 1)

9) TABLEAU DES ÉLÉVATIONS PRÉCISES DES PLAQUES DE TASSEMENT (voir annexe 2)

10) RÉSUMÉ :

En résumé, notre travail contient :

Nombre de plaques de tassement levées par GPS (±1cm) :	19
Nombre de plaques de tassement nivelées (± 2mm) :	19
Nombre de plaques levées par st. totale pour le vertical :	0
Nombre de plaques nivelées à partir du niveau géométrique :	19
Nombre de points d'appui localisés/contrôlés en horizontal :	5
Nombre de points d'appui en vertical (cheminement géométrique) :	2
Longueur totale des cheminements altimétriques :	7.079 Km

Fait à Val d'Or, le 5 Août 2022, sous le dossier C-16117/817 et le numéro 16120 de mes minutes en référence aux dossiers : C-15686/817 (2021), C-15304/817 (2020), C-14891/442.18-19 (2019), C-14421/442.18-19 (2018), C-13907/442.18-19 (2017), C-13282/442.18 (2016), C-12762/442.18 (2015), C-12486/442.17 (2014), C-12102/442.17 (2013), C-11735/442.17 (2012), C-11471/442.17 (2011), C-10945/442.17 (2010), C-10558/442.16 (2009) et C-10178/442.15 (2008) du soussigné.

Val-d'Or, le 29 août 2022

PRÉLIMINAIRE

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Jean-Luc Corriveau, A.-G., A.T.C.
CORRIVEAU J.L. & ASSOC. INC.

Annexes

Annexe 1 Tableau des différences des coordonnées xyz des plaques de tassement obtenues par méthode GPS temps réel.

Annexe 2 Tableau des élévations précises des plaques de tassement.

Annexe 3 Plan de localisation des plaques de tassement révision du 20/10/2011 minute C-10945/442.17 du soussigné.

Annexe 1

Tableau des différences des coordonnées XYZ des plaques de tassement obtenues par méthode GPS Temps réel

Plaque de tassement		Coordonnées théoriques	Arpentage Sept. 2008	Différence 2008-Théo		Arpentage Juin 2010	Différence 2010-2008		Arpentage Octobre 2011	Différence 2011-2010		Arpentage Octobre 2012	Différence 2012-2011	
B-1	Nord	5333481.600	5333481.572	-0.028	S	5333481.588	0.016	N	5333481.573	-0.015	S	5333481.567	-0.006	S
	Est	223364.365	223364.319	-0.046	O	223364.310	-0.009	O	223364.316	0.006	E	223364.317	0.001	E
	Elev.	319.120	319.085	-0.035	B	319.085	0.000	-	319.097	0.012	H	319.089	-0.008	B
B-2	Nord	5333524.849	5333524.834	-0.015	S	5333524.840	0.006	N	5333524.842	0.002	N	5333524.839	-0.003	S
	Est	223312.799	223312.758	-0.041	O	223312.754	-0.004	O	223312.766	0.012	E	223312.765	-0.001	O
	Elev.	318.489	318.450	-0.039	B	318.452	0.002	H	318.454	0.002	H	318.448	-0.006	B
B-3	Nord	5333560.718	5333560.716	-0.002	S	5333560.721	0.005	N	5333560.721	0.000	-	5333560.720	-0.001	S
	Est	223270.316	223270.298	-0.018	O	223270.294	-0.004	O	223270.298	0.004	E	223270.292	-0.006	O
	Elev.	319.122	319.090	-0.032	B	319.093	0.003	H	319.101	0.008	H	319.098	-0.003	B
B-4	Nord	5333595.764	5333595.789	0.025	N	5333595.793	0.004	N	5333595.798	0.005	N	5333595.802	0.004	N
	Est	223073.887	223073.882	-0.005	O	223073.899	0.017	E	223073.888	-0.011	O	223073.881	-0.007	O
	Elev.	318.136	318.111	-0.025	B	318.134	0.023	H	318.140	0.006	H	318.141	0.001	H
B-5	Nord	5333572.172	5333572.224	0.052	N	5333572.230	0.006	N	5333572.233	0.003	N	5333572.227	-0.006	S
	Est	222993.640	222993.630	-0.010	O	222993.641	0.011	E	222993.631	-0.010	O	222993.632	0.001	E
	Elev.	318.157	318.151	-0.006	B	318.158	0.007	H	318.166	0.008	H	318.164	-0.002	B
B-6	Nord	5333588.639	5333588.744	0.105	N	5333588.757	0.013	N	5333588.748	-0.009	S	5333588.747	-0.001	S
	Est	222661.587	222661.604	0.017	E	222661.649	0.045	E	222661.613	-0.036	O	222661.609	-0.004	O
	Elev.	318.176	318.139	-0.037	B	318.141	0.002	H	318.150	0.009	H	318.139	-0.011	B
B-7	Nord	5333510.829	5333511.090	0.261	N	5333511.091	0.001	N	5333511.093	0.002	N	5333511.087	-0.007	S
	Est	222246.790	222246.804	0.014	E	222246.868	0.064	E	222246.809	-0.059	O	222246.807	-0.003	O
	Elev.	318.176	318.185	0.009	H	318.190	0.005	H	318.203	0.013	H	318.186	-0.017	B
B-8	Nord	5333371.342	5333371.603	0.261	N	5333371.609	0.006	N	5333371.606	-0.003	S	5333371.607	0.001	N
	Est	222178.864	222178.871	0.007	E	222178.944	0.073	E	222178.876	-0.068	O	222178.872	-0.004	O
	Elev.	319.031	319.022	-0.009	B	319.020	-0.002	B	319.035	0.015	B	319.031	-0.004	B
B-9	Nord	5333326.921	5333327.178	0.257	N	5333327.189	0.011	N	5333327.187	-0.002	S	5333327.193	0.006	N
	Est	222191.523	222191.531	0.008	E	222191.610	0.079	E	222191.543	-0.067	O	222191.531	-0.012	O
	Elev.	319.181	319.161	-0.020	B	319.171	0.010	H	319.180	0.009	H	319.186	0.006	H
B-10	Nord	5333154.032	5333154.277	0.245	N	5333154.279	0.002	N	5333154.282	0.003	N	5333154.278	-0.004	S
	Est	222242.232	222242.203	-0.029	O	222242.271	0.068	E	222242.254	-0.017	O	222242.192	-0.062	O
	Elev.	318.244	318.220	-0.024	B	318.226	0.006	H	318.234	0.008	H	318.233	-0.001	B
B-11	Nord								5333362.842	N/A		5333362.840	-0.002	S
	Est								222145.004	N/A		222145.006	0.002	E
	Elev.								307.277	N/A		307.241	-0.036	B
2011-1 L	Nord								5333800.878	N/A		5333800.873	-0.005	S
	Est								223387.811	N/A		223387.817	0.006	E
	Elev.								310.020	N/A		310.018	-0.002	B
2011-2 C	Nord								5333562.623	N/A		5333562.637	0.014	N
	Est								223322.116	N/A		223322.109	-0.007	O
	Elev.								309.270	N/A		309.252	-0.018	B
2011-3 L	Nord								5333826.347	N/A		5333826.349	0.002	N
	Est								223442.150	N/A		223442.150	0.000	-
	Elev.								310.354	N/A		310.345	-0.009	B
2011-4 L	Nord								5333763.037	N/A		5333763.041	0.004	N
	Est								223329.455	N/A		223329.455	0.000	-
	Elev.								310.371	N/A		310.359	-0.012	B
2011-5 C	Nord								5333821.228	N/A		5333821.227	-0.001	S
	Est								223378.028	N/A		223378.028	0.000	-
	Elev.								303.984	N/A		303.978	-0.006	B
2011-6 C	Nord								5333068.318	N/A		5333068.305	-0.013	S
	Est								222236.094	N/A		222236.095	0.001	E
	Elev.								309.338	N/A		309.334	-0.004	B
2011-7 C	Nord								5333271.670	N/A		5333271.658	-0.012	N
	Est								222174.469	N/A		222174.459	-0.010	O
	Elev.								309.156	N/A		309.159	0.003	H
2011-8 C	Nord								5333627.581	N/A		5333627.573	-0.008	S
	Est								223061.472	N/A		223061.471	-0.001	O
	Elev.								310.383	N/A		310.369	-0.014	B

Plaque de tassement		Arpentage Juillet 2013	Différence 2013-2012		Arpentage Juin 2014	Différence 2014-2013		Arpentage Juin 2015	Différence 2015-2014		Arpentage Juin 2016	Différence 2016-2015	
B-1	Nord	5333481.574	0.007	N	5333481.565	-0.009	S	5333481.569	0.004	N	5333481.576	0.007	N
	Est	223364.319	0.002	E	223364.324	0.005	E	223364.321	-0.003	O	223364.317	-0.004	O
	Elev.	319.087	-0.002	B	319.082	-0.005	B	319.080	-0.002	B	319.098	0.018	H
B-2	Nord	5333524.843	0.004	N	5333524.841	-0.002	S	5333524.836	-0.005	S	5333524.846	0.010	N
	Est	223312.764	-0.001	O	223312.774	0.010	E	223312.774	0.000	-	223312.771	-0.003	O
	Elev.	318.439	-0.009	B	318.430	-0.009	B	318.428	-0.002	B	318.441	0.013	H
B-3	Nord	5333560.718	-0.002	S	5333560.713	-0.005	S	5333560.717	0.004	N	5333560.730	0.014	N
	Est	223270.294	0.002	E	223270.302	0.008	E	223270.297	-0.005	O	223270.295	-0.002	O
	Elev.	319.096	-0.002	B	319.086	-0.010	B	319.087	0.001	H	319.099	0.001	H
B-4	Nord	5333595.802	0.000	N/A	5333595.797	-0.005	S	5333595.803	0.006	N	5333595.808	0.005	N
	Est	223073.879	-0.002	O	223073.885	0.006	E	223073.879	-0.006	O	223073.877	-0.002	O
	Elev.	318.141	0.000	N/A	318.127	-0.014	B	318.134	0.007	H	318.146	0.012	H
B-5	Nord	5333572.231	0.004	N	5333572.233	0.002	N	5333572.232	-0.001	S	5333572.233	0.001	N
	Est	222993.625	-0.007	O	222993.633	0.008	E	222993.633	0.000	-	222993.626	-0.007	O
	Elev.	318.165	0.001	H	318.160	-0.005	B	318.163	0.003	H	318.172	0.009	H
B-6	Nord	5333588.753	0.006	N	5333588.751	-0.002	S	5333588.753	0.002	N	5333588.754	0.001	N
	Est	222661.604	-0.005	O	222661.610	0.006	E	222661.608	-0.002	O	222661.609	0.001	E
	Elev.	318.143	0.004	H	318.132	-0.011	B	318.148	0.016	H	318.160	0.012	H
B-7	Nord	5333511.096	0.009	N	5333511.093	-0.003	S	5333511.096	0.003	N	5333511.098	0.002	N
	Est	222246.802	-0.005	O	222246.805	0.003	E	222246.803	-0.002	O	222246.804	0.001	E
	Elev.	318.203	0.018	H	318.196	-0.007	B	318.204	0.008	H	318.221	0.017	H
B-8	Nord	5333371.610	0.003	N	5333371.606	-0.004	S	5333371.607	0.001	N	5333371.610	0.003	N
	Est	222178.867	-0.005	O	222178.872	0.005	E	222178.876	0.004	E	222178.866	-0.010	O
	Elev.	319.035	0.004	H	319.012	-0.023	B	319.033	0.021	H	319.028	-0.005	B
B-9	Nord	5333327.189	-0.004	S	5333327.179	-0.010	S	5333327.182	0.003	N	5333327.191	0.009	N
	Est	222191.528	-0.003	O	222191.533	0.005	E	222191.536	0.003	E	222191.524	-0.012	O
	Elev.	319.177	-0.009	B	319.154	-0.023	B	319.173	0.019	H	319.175	0.002	H
B-10	Nord	5333154.275	-0.003	S	5333154.276	0.001	N	5333154.268	-0.008	S	5333154.280	0.012	S
	Est	222242.189	-0.003	O	222242.196	0.007	E	222242.196	0.000	-	222242.186	-0.010	O
	Elev.	318.231	-0.002	B	318.226	-0.005	B	318.232	0.006	H	318.243	0.011	H
B-11	Nord	5333362.842	0.002	N	5333362.843	0.001	N	5333362.849	0.006	N	5333362.854	0.005	N
	Est	222145.000	-0.006	O	222145.004	0.004	E	222145.004	0.000	-	222144.996	-0.008	O
	Elev.	307.266	0.025	H	307.251	-0.015	B	307.255	0.004	H	307.273	0.018	H
2011-1 L	Nord	5333800.871	-0.002	S	5333800.866	-0.005	S	5333800.873	0.007	N	5333800.859	-0.014	S
	Est	223387.815	-0.002	O	223387.819	0.004	E	223387.817	-0.002	O	223387.818	0.001	E
	Elev.	310.018	0.000	N/A	310.001	-0.017	B	310.003	0.002	H	309.987	-0.016	B
2011-2 C	Nord	5333562.632	-0.005	S	5333562.627	-0.005	S	5333562.627	0.000	-	5333562.629	0.002	N
	Est	223322.107	-0.002	O	223322.116	0.009	E	223322.110	-0.006	O	223322.107	-0.003	O
	Elev.	309.242	-0.010	B	309.240	-0.002	B	309.235	-0.005	B	309.247	0.012	H
2011-3 L	Nord	5333826.347	-0.002	S	5333826.343	-0.004	S	5333826.350	0.007	N	5333826.338	-0.012	S
	Est	223442.153	0.003	E	223442.157	0.004	E	223442.154	-0.003	O	223442.161	0.007	E
	Elev.	310.344	-0.001	B	310.332	-0.012	B	310.333	0.001	H	310.307	-0.026	H
2011-4 L	Nord	5333763.040	-0.001	S	5333763.036	-0.004	S	5333763.040	0.004	N	5333763.033	-0.007	S
	Est	223329.456	0.001	E	223329.465	0.009	E	223329.460	-0.005	O	223329.458	-0.002	O
	Elev.	310.365	0.006	H	310.349	-0.016	B	310.353	0.004	H	310.341	-0.012	B
2011-5 C	Nord	5333821.221	-0.006	S	5333821.222	0.001	N	5333821.227	0.005	N	5333821.220	-0.007	S
	Est	223378.028	0.000	-	223378.034	0.006	E	223378.031	-0.003	O	223378.030	-0.001	O
	Elev.	303.980	0.001	H	303.967	-0.013	B	303.970	0.003	H	303.963	-0.007	B
2011-6 C	Nord	5333068.308	0.003	N	5333068.307	-0.001	S	5333068.308	0.001	N	5333068.313	0.005	N
	Est	222236.096	0.001	E	222236.100	0.004	E	222236.096	-0.004	O	222236.093	-0.003	O
	Elev.	309.337	0.003	H	309.324	-0.013	B	309.334	0.010	H	309.349	0.015	H
2011-7 C	Nord	5333271.660	0.002	N	5333271.666	0.006	N	5333271.661	-0.005	S	5333271.669	0.008	N
	Est	222174.458	-0.001	O	222174.459	0.001	E	222174.457	-0.002	O	222174.447	-0.010	O
	Elev.	309.161	0.001	H	309.149	-0.012	B	309.172	0.023	H	309.170	-0.002	B
2011-8 C	Nord	5333627.577	0.004	N	5333627.571	-0.006	S	5333627.574	0.003	N	5333627.574	0.000	-
	Est	223061.467	-0.004	O	223061.476	0.009	E	223061.475	-0.001	O	223061.469	-0.006	O
	Elev.	310.370	0.001	H	310.355	-0.015	B	310.368	0.013	H	310.383	0.015	H

Plaque de tassement		Arpentage Septembre 2017	Différence 2017-2016		Arpentage Octobre 2018	Différence 2018-2017		Arpentage Octobre 2019	Différence 2019-2018	
B-1	Nord	5333481.586	0.010	N	5333481.575	-0.011	S	5333481.568	-0.007	S
	Est	223364.321	0.004	O	223364.321	0.000	O	223364.323	0.002	E
	Elev.	319.094	-0.004	B	319.086	-0.007	B	319.083	-0.004	B
B-2	Nord	5333524.853	0.007	N	5333524.839	-0.014	S	5333524.841	0.002	N
	Est	223312.773	0.002	E	223312.775	0.002	E	223312.776	0.001	E
	Elev.	318.436	-0.005	B	318.425	-0.010	B	318.424	-0.001	B
B-3	Nord	5333560.720	-0.010	S	5333560.722	0.002	N	5333560.716	-0.005	S
	Est	223270.299	0.004	E	223270.301	0.002	E	223270.302	0.001	E
	Elev.	319.092	-0.007	B	319.084	-0.008	B	319.083	-0.001	B
B-4	Nord	5333595.807	-0.001	S	5333595.803	-0.004	S	5333595.806	0.003	N
	Est	223073.879	0.002	E	223073.890	0.011	E	223073.878	-0.012	O
	Elev.	318.137	-0.009	B	318.136	-0.002	B	318.143	0.007	H
B-5	Nord	5333572.234	0.001	N	5333572.226	-0.008	S	5333572.237	0.010	N
	Est	222993.629	0.003	E	222993.639	0.010	E	222993.628	-0.010	O
	Elev.	318.160	-0.012	B	318.158	-0.003	B	318.168	0.010	H
B-6	Nord	5333588.759	0.005	N	5333588.749	-0.010	S	5333588.759	0.010	N
	Est	222661.607	-0.002	O	222661.620	0.012	E	222661.608	-0.011	O
	Elev.	318.146	-0.014	B	318.144	-0.001	B	318.155	0.010	H
B-7	Nord	5333511.101	0.003	N	5333511.092	-0.009	S	5333511.096	0.004	N
	Est	222246.797	-0.007	O	222246.812	0.014	E	222246.802	-0.010	O
	Elev.	318.217	-0.004	B	318.222	0.005	H	318.223	0.001	H
B-8	Nord	5333371.607	-0.003	S	5333371.606	-0.001	S	5333371.603	-0.003	S
	Est	222178.868	0.001	E	222178.881	0.014	E	222178.869	-0.012	O
	Elev.	319.032	0.004	H	319.027	-0.005	B	319.030	0.003	H
B-9	Nord	5333327.186	-0.005	S	5333327.181	-0.005	S	5333327.185	0.003	N
	Est	222191.528	0.004	E	222191.542	0.014	E	222191.532	-0.010	O
	Elev.	319.173	-0.002	B	319.172	-0.001	B	319.175	0.003	H
B-10	Nord	5333154.274	-0.006	S	5333154.274	0.000	S	5333154.272	-0.002	S
	Est	222242.185	-0.001	O	222242.207	0.022	E	222242.191	-0.016	O
	Elev.	318.243	0.000	N/A	318.237	-0.005	B	318.234	-0.003	B
B-11	Nord	5333362.834	-0.020	S	5333362.849	0.015	N	5333362.845	-0.004	S
	Est	222144.997	0.001	E	222145.015	0.018	E	222145.002	-0.013	O
	Elev.	307.258	-0.015	B	307.269	0.011	H	307.266	-0.003	B
2011-1 L	Nord	5333800.872	0.013	N	5333800.863	-0.009	S	5333800.865	0.002	N
	Est	223387.812	-0.006	O	223387.813	0.000	-	223387.816	0.004	E
	Elev.	309.999	0.012	H	309.986	-0.013	B	309.986	0.000	-
2011-2 C	Nord	5333562.632	0.003	N	5333562.636	0.004	N	5333562.638	0.002	N
	Est	223322.099	-0.008	O	223322.112	0.013	E	223322.117	0.005	E
	Elev.	309.252	0.005	H	309.240	-0.012	B	309.249	0.009	H
2011-3 L	Nord	5333826.351	0.013	N	5333826.344	-0.007	S	5333826.344	0.000	-
	Est	223442.151	-0.010	O	223442.151	0.000	-	223442.157	0.006	E
	Elev.	310.323	0.016	H	310.309	-0.014	B	310.279	-0.030	B
2011-4 L	Nord	5333763.039	0.006	N	5333763.037	-0.002	S	5333763.030	-0.007	S
	Est	223329.458	0.000	-	223329.458	0.000	-	223329.462	0.004	E
	Elev.	310.347	0.006	H	310.347	0.000	-	310.343	-0.004	B
2011-5 C	Nord	5333821.222	0.002	N	5333821.221	-0.001	S	5333821.223	0.002	N
	Est	223378.030	0.000	E	223378.025	-0.005	O	223378.037	0.012	E
	Elev.	303.973	0.010	H	303.965	-0.008	B	303.958	-0.006	B
2011-6 C	Nord	5333068.302	-0.011	S	5333068.314	0.012	N	5333068.310	-0.003	S
	Est	222236.094	0.001	E	222236.113	0.020	E	222236.095	-0.018	O
	Elev.	309.347	-0.002	B	309.346	-0.001	B	309.334	-0.012	B
2011-7 C	Nord	5333271.658	-0.011	S	5333271.661	0.003	N	5333271.653	-0.008	S
	Est	222174.452		E	222174.472	0.020	E	222174.452	-0.020	O
	Elev.	309.171	0.001	H	309.164	-0.007	B	309.171	0.007	H
2011-8 C	Nord	5333627.568	-0.006	S	5333627.571	0.003	N	pas levé		-
	Est	223061.470	0.001	E	223061.473	0.004	E	pas levé		-
	Elev.	310.369	-0.014	B	310.373	0.004	H	pas levé		-

Plaque de tassement		Arpentage Septembre 2020	Différence 2020-2019		Arpentage Octobre 2021	Différence 2021-2020		Arpentage Juillet 2022	Différence 2022-2021	
B-1	Nord	5333481.571	0.003	N	5333481.569	-0.002	S	5333481.573	0.004	N
	Est	223364.323	-0.001	O	223364.325	0.002	E	223364.328	0.003	E
	Elev.	319.062	-0.020	B	319.089	0.026	H	319.068	-0.021	B
B-2	Nord	5333524.841	0.000	-	5333524.835	-0.006	S	5333524.848	0.013	N
	Est	223312.772	-0.004	O	223312.779	0.007	E	223312.785	0.006	E
	Elev.	318.397	-0.027	B	318.423	0.025	H	318.409	-0.014	B
B-3	Nord	5333560.722	0.006	N	5333560.712	-0.010	S	5333560.722	0.010	N
	Est	223270.301	-0.001	O	223270.304	0.003	E	223270.308	0.004	E
	Elev.	319.091	0.008	H	319.091	0.000	-	319.070	-0.021	B
B-4	Nord	5333595.803	-0.003	S	5333595.797	-0.006	S	5333595.805	0.008	N
	Est	223073.880	0.002	E	223073.882	0.002	E	223073.882	0.001	-
	Elev.	318.122	-0.021	B	318.138	0.016	H	318.119	-0.018	B
B-5	Nord	5333572.234	-0.003	S	5333572.229	-0.005	S	5333572.234	0.005	N
	Est	222993.633	0.004	E	222993.634	0.001	E	222993.633	-0.001	O
	Elev.	318.151	-0.017	B	318.165	0.014	H	318.143	-0.022	B
B-6	Nord	5333588.754	-0.005	S	5333588.747	-0.007	S	5333588.755	0.009	N
	Est	222661.607	-0.001	O	222661.609	0.002	E	222661.610	0.001	O
	Elev.	318.145	-0.010	B	318.147	0.002	H	318.123	-0.023	B
B-7	Nord	5333511.096	0.000	-	5333511.091	-0.006	S	5333511.096	0.006	N
	Est	222246.806	0.004	E	222246.805	-0.001	O	222246.802	-0.003	O
	Elev.	318.219	-0.004	B	318.214	-0.005	B	318.213	-0.001	B
B-8	Nord	5333371.607	0.004	N	5333371.600	-0.007	S	5333371.605	0.005	N
	Est	222178.872	0.003	E	222178.877	0.005	E	222178.867	-0.011	O
	Elev.	319.033	0.003	H	319.025	-0.007	B	319.025	0.000	-
B-9	Nord	5333327.183	-0.001	S	5333327.178	-0.005	S	5333327.185	0.008	N
	Est	222191.534	0.002	E	222191.539	0.004	E	222191.531	-0.008	O
	Elev.	319.174	-0.001	B	319.171	-0.003	B	319.170	-0.001	B
B-10	Nord	5333154.271	-0.001	S	5333154.261	-0.011	S	5333154.277	0.016	N
	Est	222242.193	0.001	E	222242.194	0.001	E	222242.193	-0.001	O
	Elev.	318.232	-0.003	B	318.236	0.004	H	318.227	-0.008	B
B-11	Nord	5333362.842	-0.003	S	5333362.845	0.003	N	5333362.839	-0.006	S
	Est	222145.005	0.003	E	222145.006	0.001	E	222145.003	-0.002	O
	Elev.	307.256	-0.010	B	307.267	0.011	H	307.269	0.002	H
2011-1 L	Nord	5333800.866	0.000	-	5333800.859	-0.007	S	5333800.861	0.002	N
	Est	223387.816	0.000	-	223387.817	0.001	E	223387.823	0.006	E
	Elev.	309.992	0.006	H	309.992	0.000	-	309.971	-0.021	B
2011-2 C	Nord	5333562.634	-0.004	S	5333562.624	-0.010	S	5333562.633	0.009	S
	Est	223322.115	-0.003	O	223322.118	0.003	E	223322.117	-0.001	O
	Elev.	309.218	-0.031	B	309.251	0.033	H	309.235	-0.017	B
2011-3 L	Nord	5333826.347	0.003	N	5333826.341	-0.006	S	5333826.345	0.004	N
	Est	223442.158	0.001	E	223442.158	0.000	-	223442.159	0.001	E
	Elev.	310.313	0.035	H	310.326	0.013	H	310.257	-0.069	B
2011-4 L	Nord	5333763.034	0.004	S	5333763.031	-0.003	S	5333763.033	0.001	N
	Est	223329.465	0.003	E	223329.467	0.001	E	223329.473	0.006	E
	Elev.	310.343	0.000	B	310.347	0.005	H	310.337	-0.010	B
2011-5 C	Nord	5333821.227	0.004	N	5333821.220	-0.007	S	5333821.222	0.002	N
	Est	223378.029	-0.008	E	223378.036	0.006	E	223378.037	0.002	E
	Elev.	303.968	0.010	B	303.974	0.006	H	303.957	-0.017	B
2011-6 C	Nord	5333068.311	0.001	S	5333068.307	-0.005	S	5333068.313	0.006	N
	Est	222236.098	0.003	O	222236.096	-0.002	O	222236.104	0.008	E
	Elev.	309.338	0.003	B	309.337	-0.001	B	309.321	-0.016	B
2011-7 C	Nord	5333271.661	0.009	S	5333271.667	0.005	N	5333271.655	-0.012	S
	Est	222174.455	0.003	O	222174.461	0.005	E	222174.456	-0.005	O
	Elev.	309.169	-0.002	H	309.167	-0.003	B	309.164	-0.003	B
2011-8 C	Nord	5333627.572	0.002	N	5333627.569	-0.004	S	5333627.574	0.005	N
	Est	223061.477	0.004	E	223061.475	-0.002	O	223061.477	0.003	E
	Elev.	310.366	-0.007	B	310.373	0.007	H	310.365	-0.008	B

N.B. Valeurs des différences en "Z" significatives qu'à 2cm près; pour plus de précision, se référer au tableau des élévations prises au niveau électronique.
B-1 à B-11 Tiges existantes avec regard protecteur en métal et tige témoin.

Note: On doit considérer les inscriptions au mm significative qu'aux 5 mm près

N = déplacement vers le Nord **O = déplacement vers l'Ouest** **E = déplacement vers l'Est**
S = déplacement vers le Sud **H = déplacement vers le Haut** **B = déplacement vers le Bas**

Légende
L= Repère médaillon sur longs tuyaux 2.35m x 0.33m extérieur avec 3 ailettes et bout vrillé, regard protecteur et tige témoin 2m
C= Repère médaillon sur tige d'armature de ¾ x 0.9m, regard protecteur et tige témoin de 2m.

Annexe 2

<u>TABLEAU DES *ÉLÉVATIONS PRÉCISES DES PLAQUES DE TASSEMENT*</u>

(Obtenues par nivellement géométrique-électronique et trigonométrique)

Plaque de tassement	Élévation Théorique selon mine	Année Sept. 2008	Diff. (m) 2008-Théo.	Élévation Août 2009	Diff. (m) 2009-2008	Élévation Juin 2010	Diff. (m) 2010-2009	Élévation Oct. 2011	Diff. (m) 2011-2010	Diff. (m) 2011-2008
94-257	3316.707	3316.707	-	3316.707	-	3316.707	-	3316.707	-	-
94-262	3315.842	-	-	-	-	-	-	3315.840	-	-
B1	3319.120	3319.099	-0.021	3319.099	0.000	3319.100	0.001	3319.097	-0.003	-0.002
B2	3318.489	3318.465	-0.024	3318.462	-0.003	3318.460	-0.002	3318.454	-0.006	-0.011
B3	3319.122	3319.103	-0.019	3319.104	0.001	3319.104	0.000	3319.101	-0.003	-0.002
B4	3318.136	3318.143	0.007	3318.146	0.003	3318.146	0.000	3318.140	-0.006	-0.003
B5	3318.157	3318.168	0.011	3318.172	0.004	3318.172	0.000	3318.166	-0.006	-0.002
B6	3318.176	3318.153	-0.023	3318.158	0.005	3318.156	-0.002	3318.150	-0.006	-0.003
B7	3318.176	3318.198	0.022	3318.207	0.009	3318.207	0.000	3318.203	-0.004	0.005
B8	3319.031	3319.034	0.003	3319.039	0.005	3319.038	-0.001	3319.035	-0.003	0.001
B9	3319.181	3319.180	-0.001	3319.186	0.006	3319.186	0.000	3319.180	-0.006	0.000
B10	3318.244	3318.232	-0.012	3318.239	0.007	3318.238	-0.001	3318.234	-0.004	0.002
**B11	3307.253	-	-	-	-	-	-	3307.277	-	-
*2011-1	-	-	-	-	-	-	-	3310.020	-	-
**2011-2	-	-	-	-	-	-	-	3309.270	-	-
*2011-3	-	-	-	-	-	-	-	3310.354	-	-
*2011-4	-	-	-	-	-	-	-	3310.371	-	-
**2011-5	-	-	-	-	-	-	-	3303.984	-	-
**2011-6	-	-	-	-	-	-	-	3309.357	-	-
**2011-7	-	-	-	-	-	-	-	3309.156	-	-
**2011-8	-	-	-	-	-	-	-	3310.383	-	-

Plaque de tassement	Élévation Oct. 2012	Diff. (m) 2012-2011	Diff. (m) 2012-2008	Élévation Juil. 2013	Diff. (m) 2013-2012	Diff. (m) 2013-2008 / 2013-2011	Élévation Juil. 2014	Diff. (m) 2014-2013	Diff. (m) 2014-2008 / 2014-2011
94-257	3316.707	-	-	3316.707	-	-	3316.707	-	-
94-262	3315.839	-0.001	-0.001	3315.859	0.020	0.019	3315.841	-0.018	0.001
B1	3319.097	0.000	-0.002	3319.097	0.000	-0.002	3319.099	0.002	0.000
B2	3318.449	-0.005	-0.016	3318.448	-0.001	-0.017	3318.448	0.000	-0.017
B3	3319.099	-0.002	-0.004	3319.099	0.000	-0.004	3319.102	0.003	-0.001
B4	3318.139	-0.001	-0.004	3318.140	0.001	-0.003	3318.145	0.005	0.002
B5	3318.165	-0.001	-0.003	3318.166	0.001	-0.002	3318.173	0.007	0.005
B6	3318.148	-0.002	-0.005	3318.151	0.003	-0.002	3318.155	0.004	0.002
B7	3318.206	0.003	0.008	3318.208	0.002	0.010	3318.215	0.007	0.017
B8	3319.034	-0.001	0.000	3319.033	-0.001	-0.001	3319.035	0.002	0.001
B9	3319.179	-0.001	-0.001	3319.179	0.000	-0.001	3319.181	0.002	0.001
B10	3318.234	0.000	0.002	3318.235	0.001	0.003	3318.240	0.005	0.008
**B11	3307.269	-0.008	-	3307.273	0.004	-0.004	3307.270	-0.003	-0.007
*2011-1	3310.019	-0.001	-	3310.019	0.000	-0.001	3310.016	-0.002	-0.004
**2011-2	3309.252	-0.018	-	3309.273	0.021	0.003	3309.256	-0.017	-0.014
*2011-3	3310.354	0.000	-	3310.352	-0.002	-0.002	3310.348	-0.004	-0.006
*2011-4	3310.370	-0.002	-	3310.372	0.003	0.001	3310.368	-0.004	-0.003
**2011-5	3303.976	-0.008	-	3303.993	0.017	0.009	3303.980	-0.013	-0.004
**2011-6	3309.342	-0.015	-	3309.332	-0.010	-0.025	3309.342	0.010	-0.015
**2011-7	3309.172	0.016	-	3309.177	0.005	0.021	3309.175	-0.002	0.019
**2011-8	3310.364	-0.019	-	3310.370	0.006	-0.013	3310.375	0.005	-0.008

Plaque de tassement	Élévation Jun-15	Diff. (m) 2015-2014	Diff. (m) 2015-2008 / 2015-2011	Élévation Jun-16	Diff. (m) 2016-2015	Diff. (m) 2016-2008 / 2017-2011	Élévation septembre.17	Diff. (m) 2017-2016	Diff. (m) 2017-2008 / 2017-2011
94-257	3316.707	-	-	3316.707	-	-	3316.707	-	-
94-262	3315.842	0.001	0.002	3315.842	0.000	0.002	3315.878	0.036	0.038
B1	3319.100	0.001	0.001	3319.099	-0.001	0.000	3319.100	0.001	0.001
B2	3318.447	-0.001	-0.018	3318.444	-0.003	-0.021	3318.442	-0.002	-0.023
B3	3319.102	0.000	-0.001	3319.101	-0.001	-0.002	3319.101	0.000	-0.002
B4	3318.145	0.000	0.002	3318.145	0.000	0.002	3318.145	0.000	0.002
B5	3318.172	-0.001	0.004	3318.171	-0.001	0.003	3318.171	0.000	0.003
B6	3318.155	0.000	0.002	3318.155	0.000	0.002	3318.156	0.001	0.003
B7	3318.216	0.001	0.018	3318.217	0.001	0.019	3318.217	0.000	0.019
B8	3319.036	0.001	0.002	3319.035	-0.001	0.001	3319.032	-0.003	-0.002
B9	3319.181	0.000	0.001	3319.180	-0.001	0.000	3319.181	0.001	0.001
B10	3318.240	0.000	0.008	3318.241	0.001	0.009	3318.241	0.000	0.009
**B11	3307.270	0.000	-0.007	3307.269	-0.001	-0.008	3307.267	-0.002	-0.010
*2011-1	3310.016	-0.001	-0.004	3310.011	-0.005	-0.009	3310.007	-0.004	-0.013
**2011-2	3309.259	0.003	-0.011	3309.257	-0.002	-0.013	3309.252	-0.005	-0.018
*2011-3	3310.346	-0.002	-0.008	3310.341	-0.005	-0.013	3310.334	-0.007	-0.020
*2011-4	3310.369	0.001	-0.002	3310.366	-0.003	-0.005	3310.362	-0.004	-0.009
**2011-5	3303.985	0.005	0.001	3303.981	-0.004	-0.003	3303.980	-0.001	-0.004
**2011-6	3309.345	0.003	-0.012	3309.344	-0.001	-0.013	3309.344	0.000	-0.013
**2011-7	3309.174	-0.001	0.018	3309.172	-0.002	0.016	3309.171	-0.001	0.015
**2011-8	3310.374	-0.001	-0.009	3310.374	0.000	-0.009	3310.377	0.003	-0.006

Plaque de tassement	Élévation octobre.18	Diff. (m) 2018-2017	Diff. (m) 2018-2008 / 2018-2011	Élévation octobre.19	Diff. (m) 2019-2018	Diff. (m) 2019-2008 / 2019-2011	Élévation Sept. 2020	Diff. (m) 2020-2019	Diff. (m) 2020-2008 / 2020-2011
94-257	3316.707	-	-	3316.707	-	-	3316.707	-	-
94-262	3315.842	-0.036	0.002	3315.841	-0.001	0.001	3315.840	-0.001	0.000
B1	3319.099	-0.001	0.000	3319.098	-0.002	-0.002	3319.098	0.001	-0.001
B2	3318.440	-0.002	-0.025	3318.438	-0.002	-0.027	3318.437	-0.001	-0.028
B3	3319.101	0.000	-0.002	3319.101	-0.001	-0.003	3319.101	0.000	-0.002
B4	3318.144	-0.001	0.001	3318.144	0.000	0.001	3318.143	-0.001	0.000
B5	3318.171	0.000	0.003	3318.171	0.000	0.003	3318.169	-0.002	0.001
B6	3318.154	-0.002	0.001	3318.153	-0.001	0.000	3318.153	-0.001	0.000
B7	3318.219	0.002	0.021	3318.220	0.001	0.022	3318.221	0.000	0.023
B8	3319.035	0.003	0.001	3319.034	-0.001	0.000	3319.033	-0.002	-0.002
B9	3319.180	-0.001	0.000	3319.179	-0.001	-0.001	3319.177	-0.002	-0.003
B10	3318.241	0.000	0.009	3318.241	0.000	0.009	3318.239	-0.002	0.007
**B11	3307.268	0.001	-0.009	3307.264	-0.004	-0.013	3307.265	0.000	-0.012
*2011-1	3310.004	-0.003	-0.016	3310.001	-0.003	-0.019	3309.998	-0.004	-0.022
**2011-2	3309.254	0.002	-0.016	3309.256	0.002	-0.014	3309.254	-0.002	-0.016
*2011-3	3310.330	-0.004	-0.024	3310.327	-0.003	-0.027	3310.323	-0.004	-0.031
*2011-4	Tige non atteignable avec la règle			3310.370	0.008	-0.001	3310.365	-0.005	-0.006
**2011-5	3303.980	0.000	-0.004	3303.973	-0.007	-0.011	3303.969	-0.004	-0.015
**2011-6	3309.342	-0.002	-0.015	3309.339	-0.003	-0.018	3309.339	0.000	-0.018
**2011-7	3309.170	-0.001	0.014	3309.167	-0.003	0.011	3309.167	0.000	0.011
**2011-8	3310.371	-0.006	-0.012	3310.372	0.001	-0.011	3310.372	0.000	-0.011

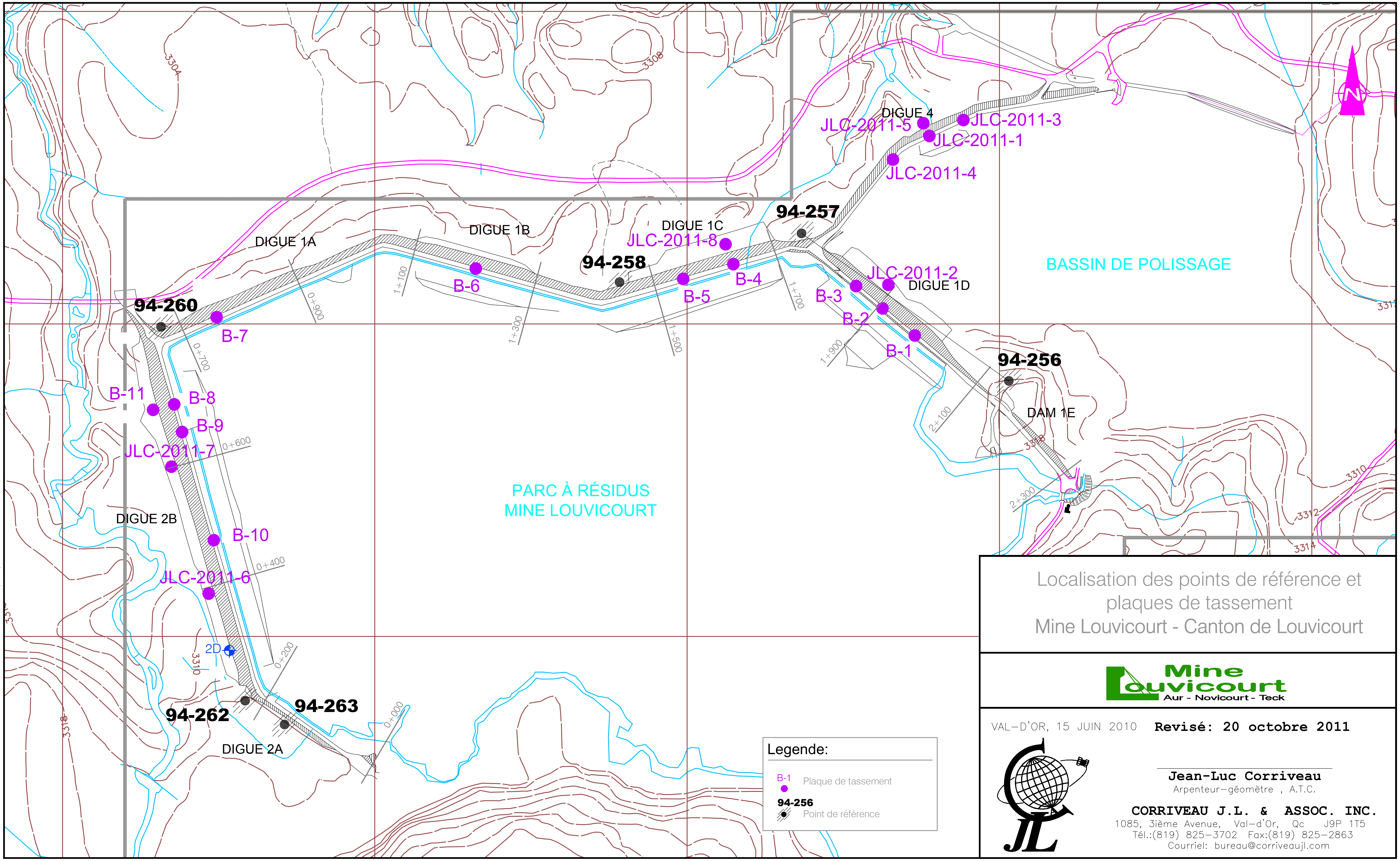
Élévation Oct. 2021	Diff. (m) 2021-2020	Diff. (m) 2021-2008 / 2021-2011	Élévation Juil. 2022	Diff. (m) 2022-2021	Diff. (m) 2022-2008 / 2022-2011	Plaque de tassement
3316.707	-	-	3316.707	-	-	94-257
3315.842	0.002	0.002	3315.843	0.001	0.003	94-262
3319.098	-0.001	-0.002	3319.097	0.000	-0.002	B1
3318.434	-0.003	-0.031	3318.433	-0.001	-0.032	B2
3319.100	-0.001	-0.003	3319.100	0.000	-0.003	B3
3318.144	0.000	0.001	3318.144	0.001	0.001	B4
3318.170	0.001	0.002	3318.171	0.001	0.003	B5
3318.154	0.002	0.001	3318.155	0.001	0.002	B6
3318.224	0.004	0.026	3318.227	0.003	0.029	B7
3319.036	0.003	0.002	3319.035	0.000	0.001	B8
3319.180	0.003	0.000	3319.180	0.000	0.000	B9
3318.242	0.002	0.010	3318.243	0.002	0.011	B10
3307.267	0.002	-0.010	3307.269	0.002	-0.008	**B11
3309.996	-0.002	-0.024	3309.995	0.000	-0.025	*2011-1
3309.254	0.000	-0.016	3309.254	0.000	-0.017	**2011-2
3310.325	0.002	-0.029	3310.318	-0.007	-0.036	*2011-3
3310.366	0.001	-0.005	3310.370	0.005	-0.001	*2011-4
3303.971	0.002	-0.013	3303.973	0.002	-0.011	**2011-5
3309.342	0.002	-0.015	3309.343	0.001	-0.014	**2011-6
3309.169	0.002	0.013	3309.171	0.002	0.015	**2011-7
3310.372	0.000	-0.011	3310.372	0.000	-0.011	**2011-8

*Trait jaune = Repères implantés en 2011

**Nivellement trigonométrique (précision estimé à +/- 5 mm

Note : seul le nivellement géométrique à été utilisé lors du levé des plaques de tassement en octobre 2019.

Légende des écarts : pas de signe s'élève, signe négatif (-) s'enfonce



Localisation des points de référence et plaques de tassement
Mine Louvicourt - Canton de Louvicourt

Mine Louvicourt
Aur - Novicourt - Teck

VAL–D'OR, 15 JUIN 2010 **Revisé: 20 octobre 2011**

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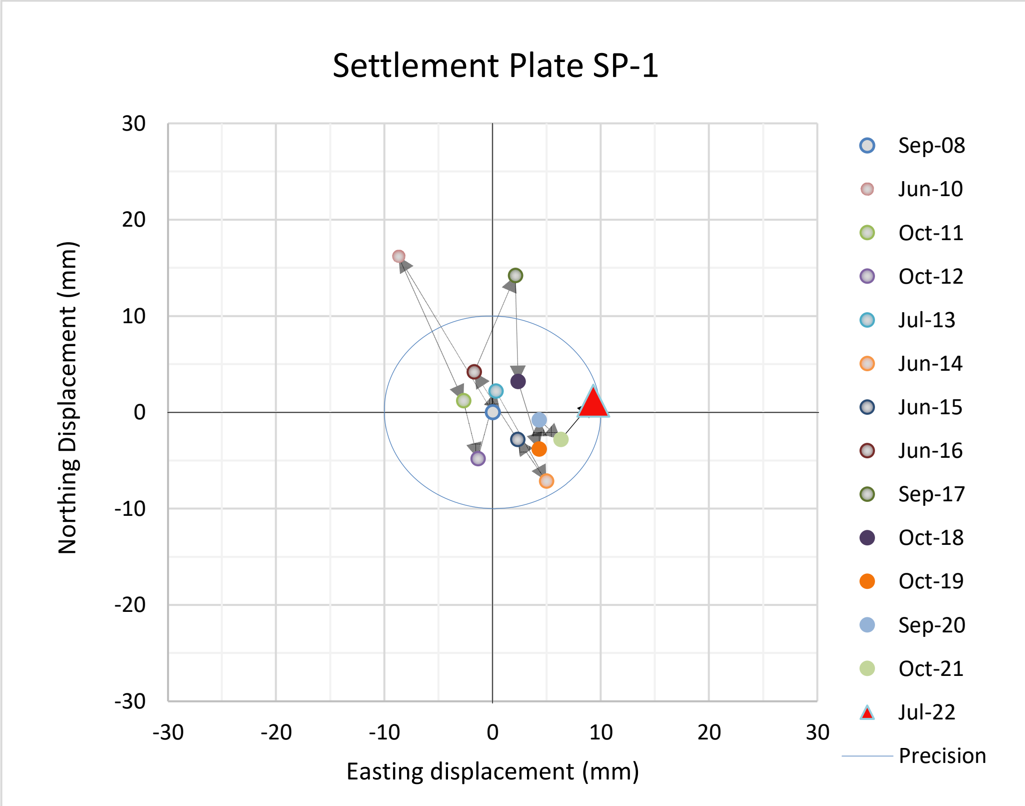
1085, 3ième Avenue, Val–d'Or, Qc J9P 1T5
Tél.:(819) 825–3702 Fax:(819) 825–2863
Courriel: bureau@corriveaujl.com

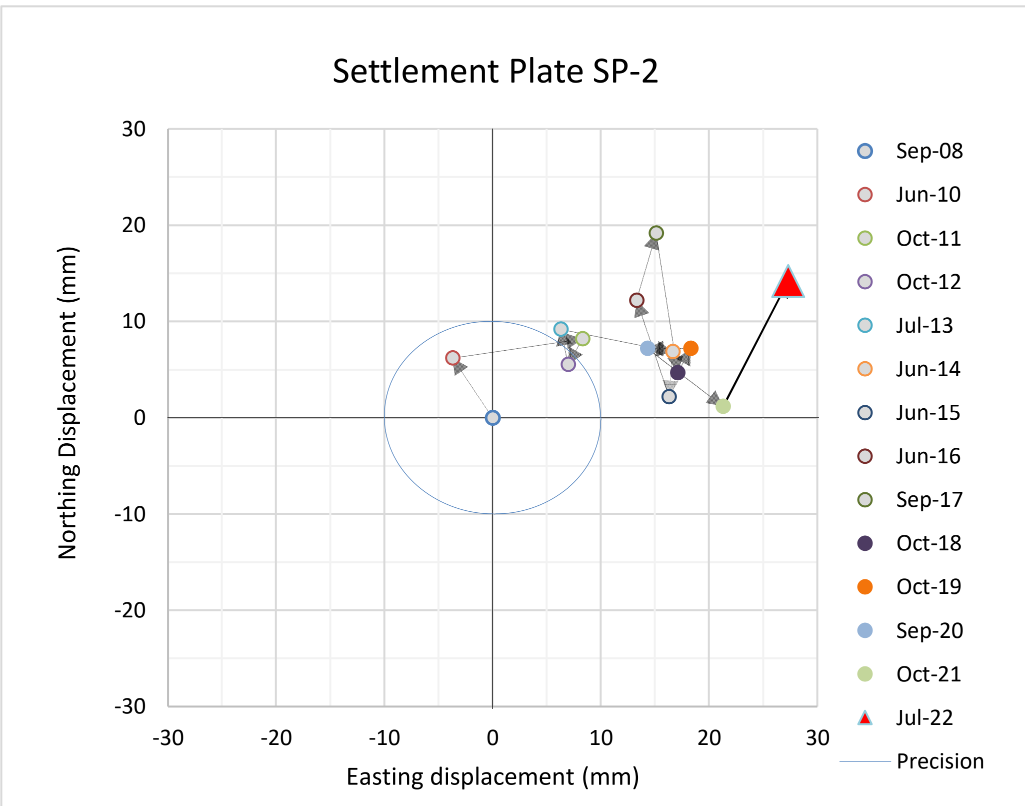
Réf. DAO: J:\C15304\6. Dessin\C10945_Plaques.dwg/ISMAEL

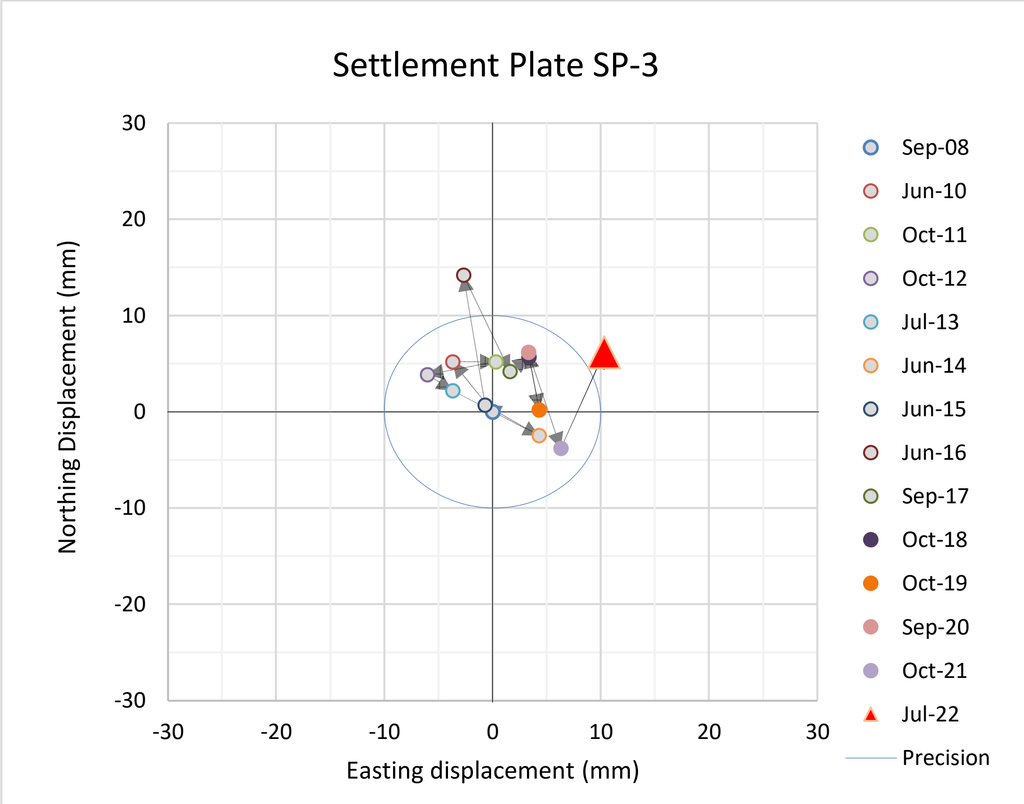
C10945/442.17

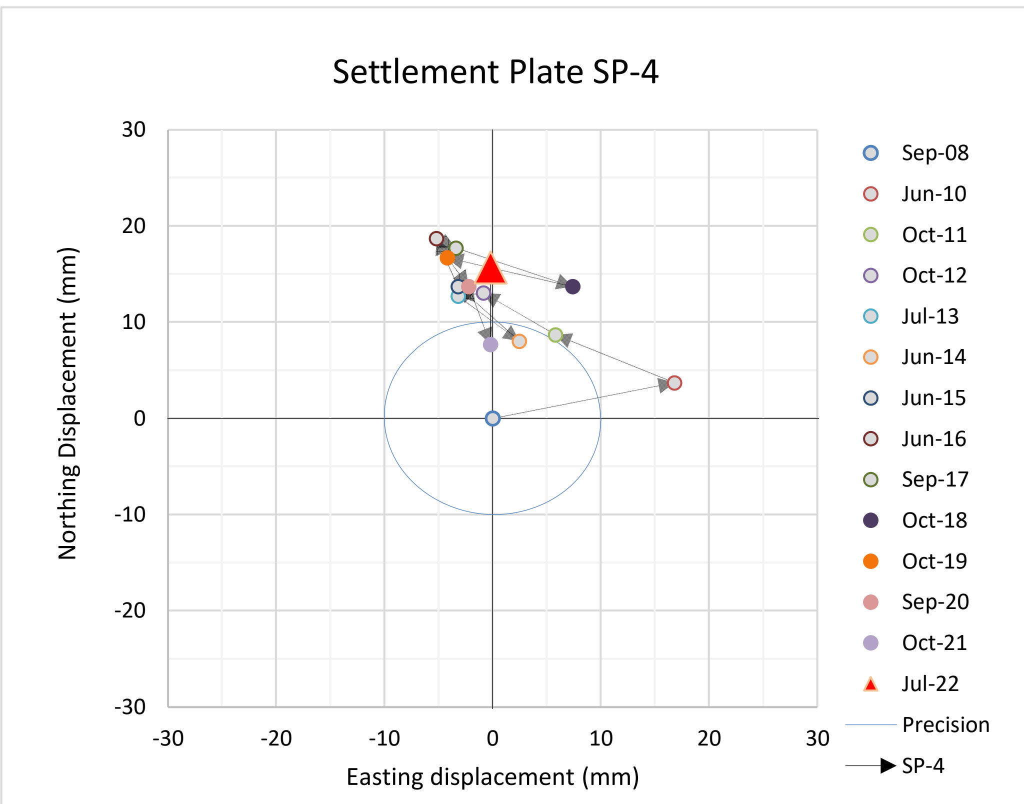
APPENDIX D

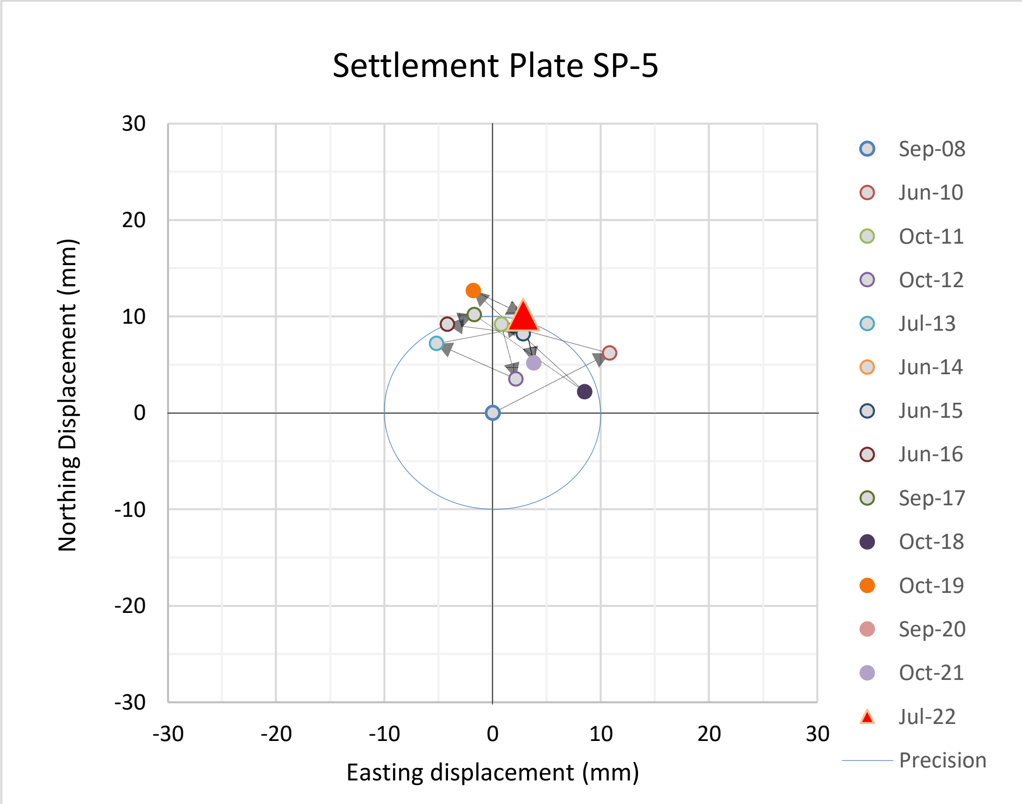
Point of Origin Plots

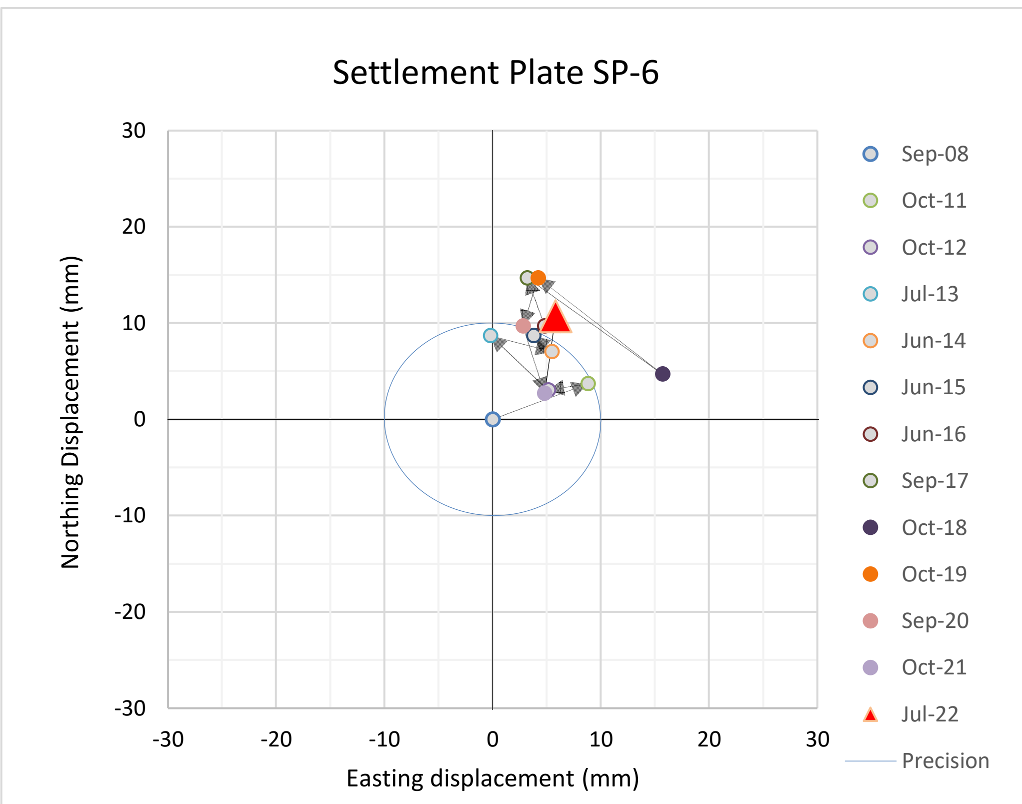

Settlement Plate SP-1
Northing Displacement (mm)
30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
20
30
Easting displacement (mm)
Sep-08
Jun-10
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision

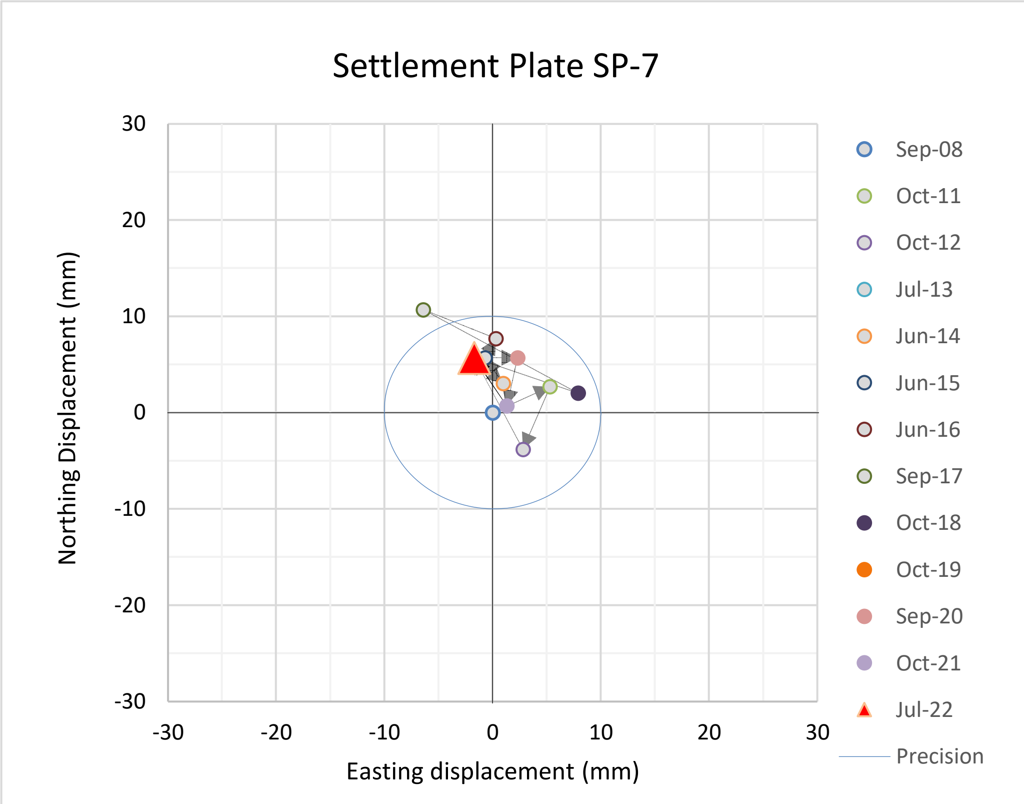

Settlement Plate SP-2
Northing Displacement (mm)
30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
20
30
Easting displacement (mm)
Sep-08
Jun-10
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision

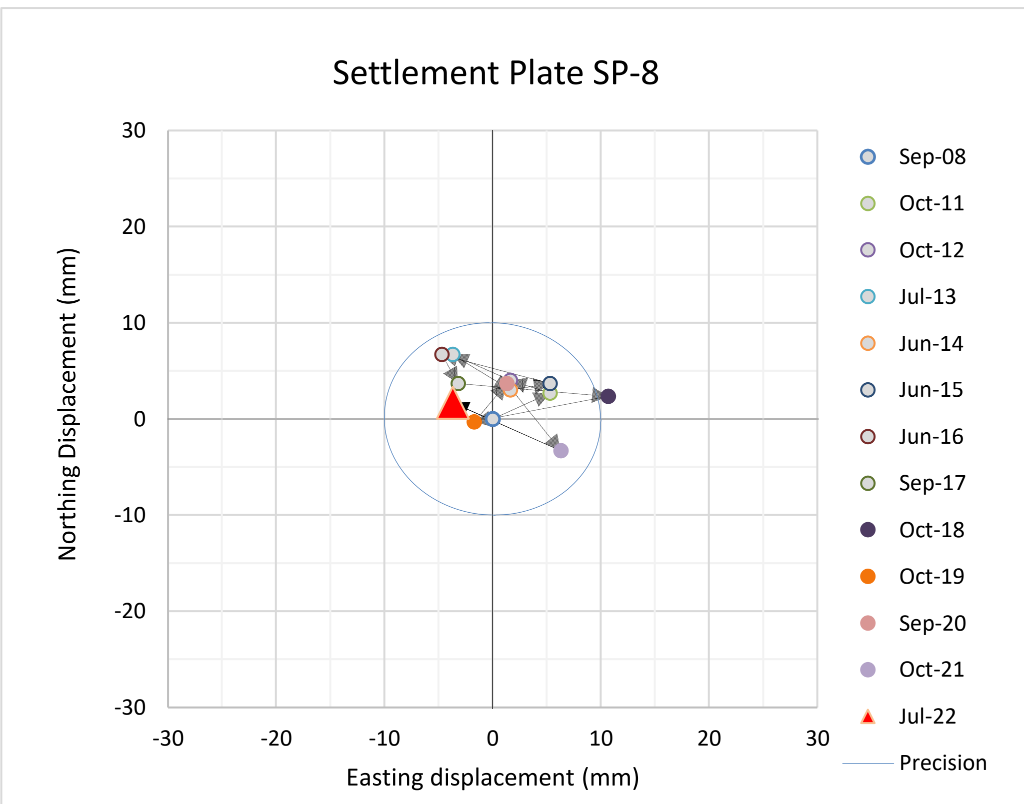

Settlement Plate SP-3
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
Sep-08
Jun-10
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision

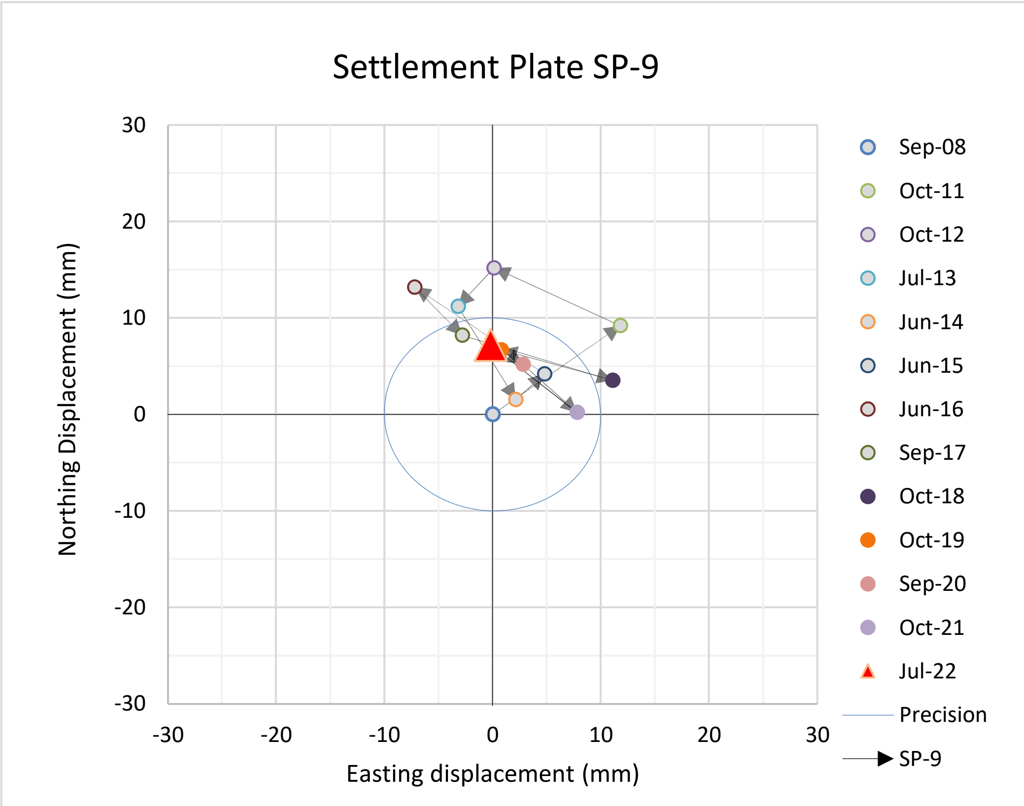

Settlement Plate SP-4
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
Sep-08
Jun-10
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision
SP-4


Settlement Plate SP-5
Northing Displacement (mm)
30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
20
30
Easting displacement (mm)
Sep-08
Jun-10
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision

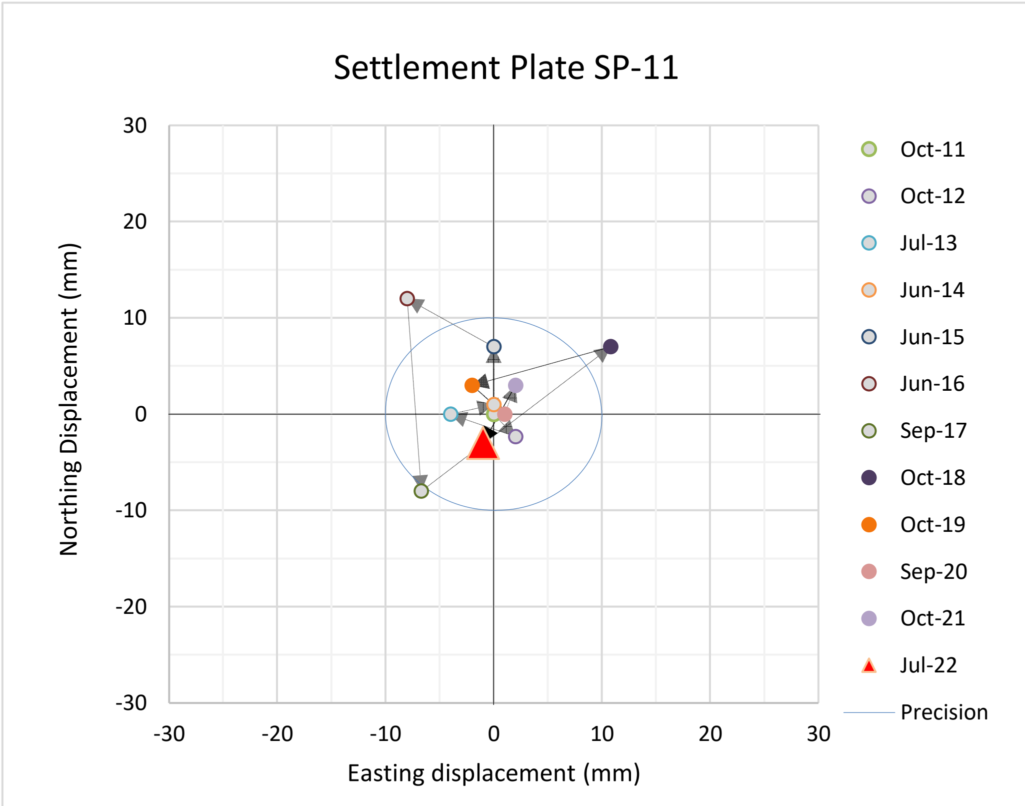

Settlement Plate SP-6
Northing Displacement (mm)
30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
20
30
Easting displacement (mm)
Sep-08
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision

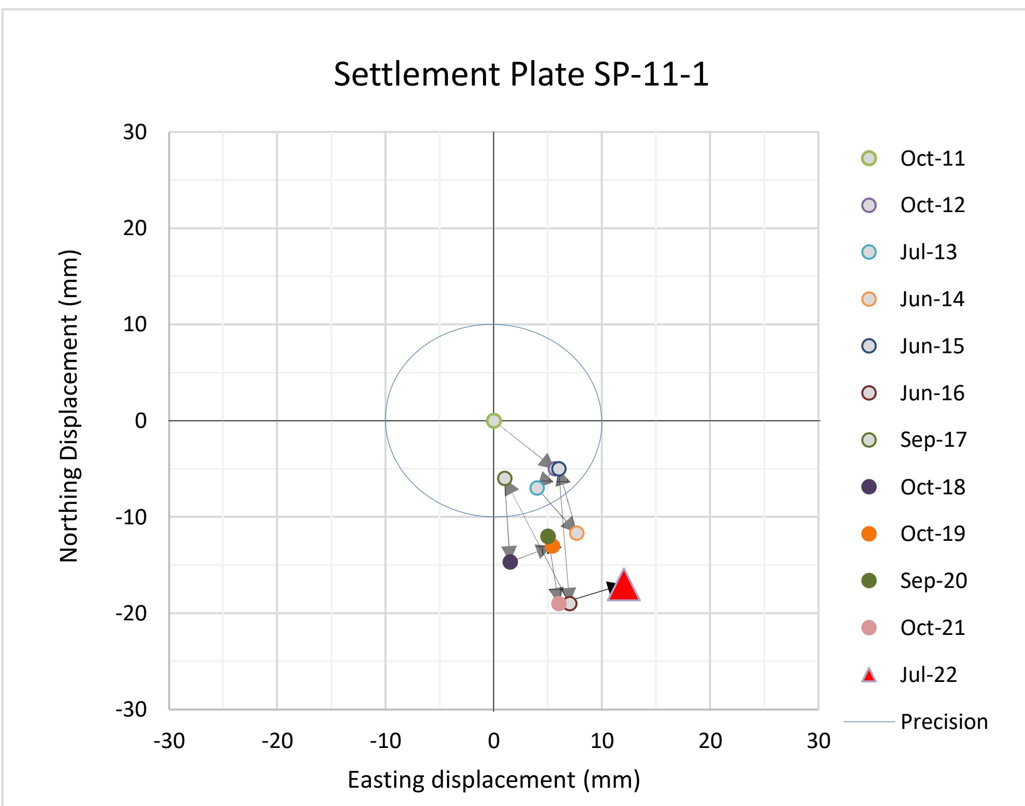

Settlement Plate SP-7
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
Sep-08
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision

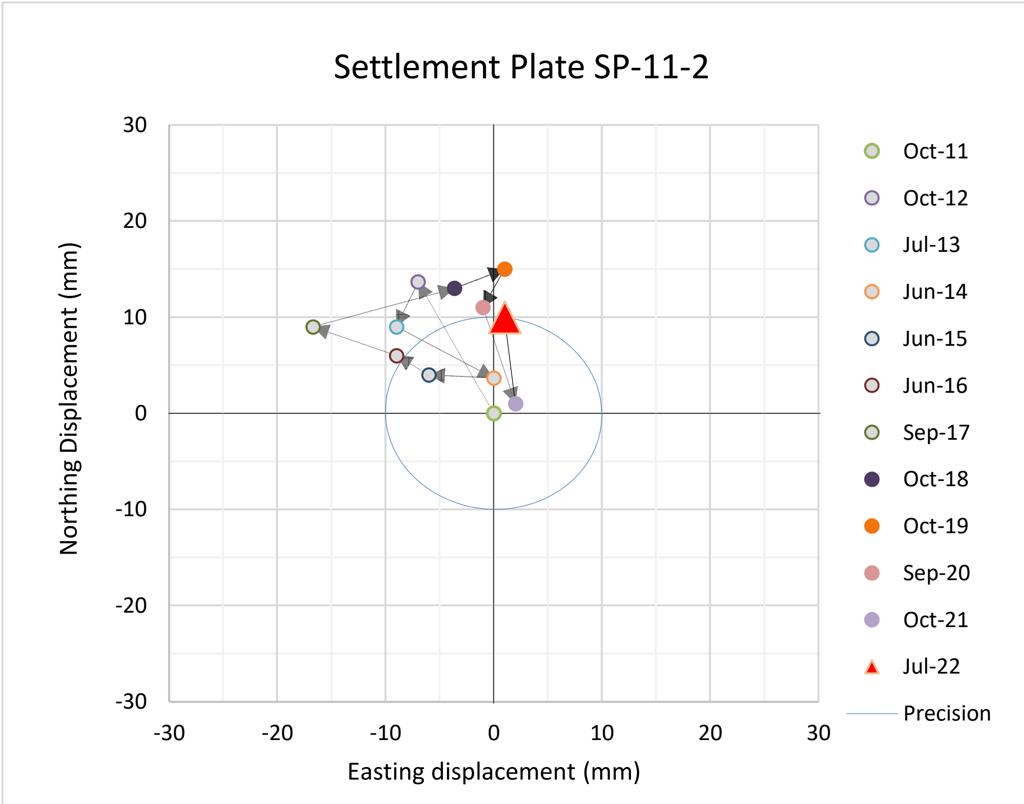

Settlement Plate SP-8
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
Sep-08
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision

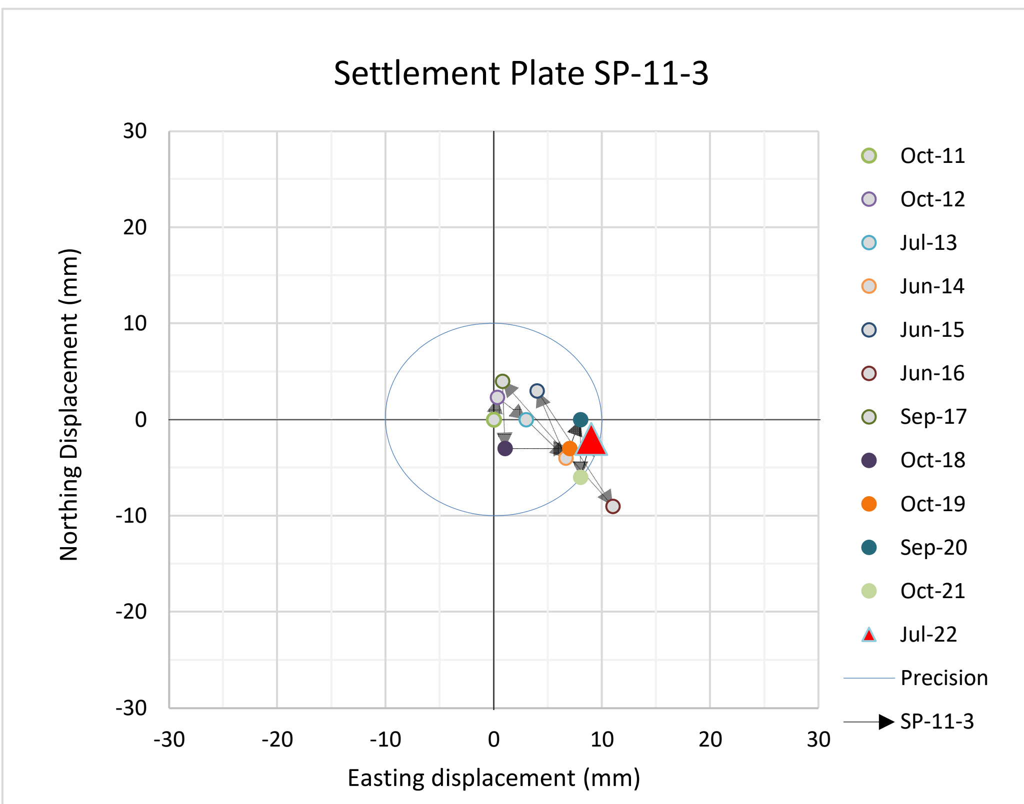

Settlement Plate SP-9
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
Sep-08
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision
SP-9

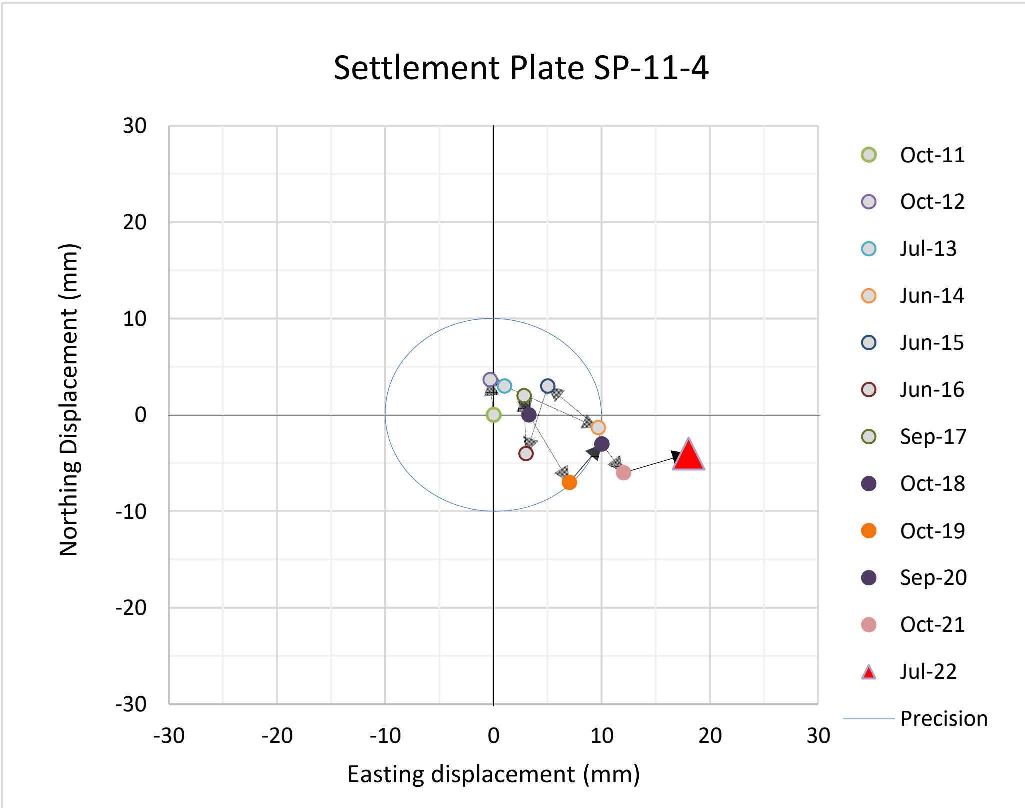

Settlement Plate SP-10
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
Sep-08
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision
SP-10


Settlement Plate SP-11
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
20
30
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision

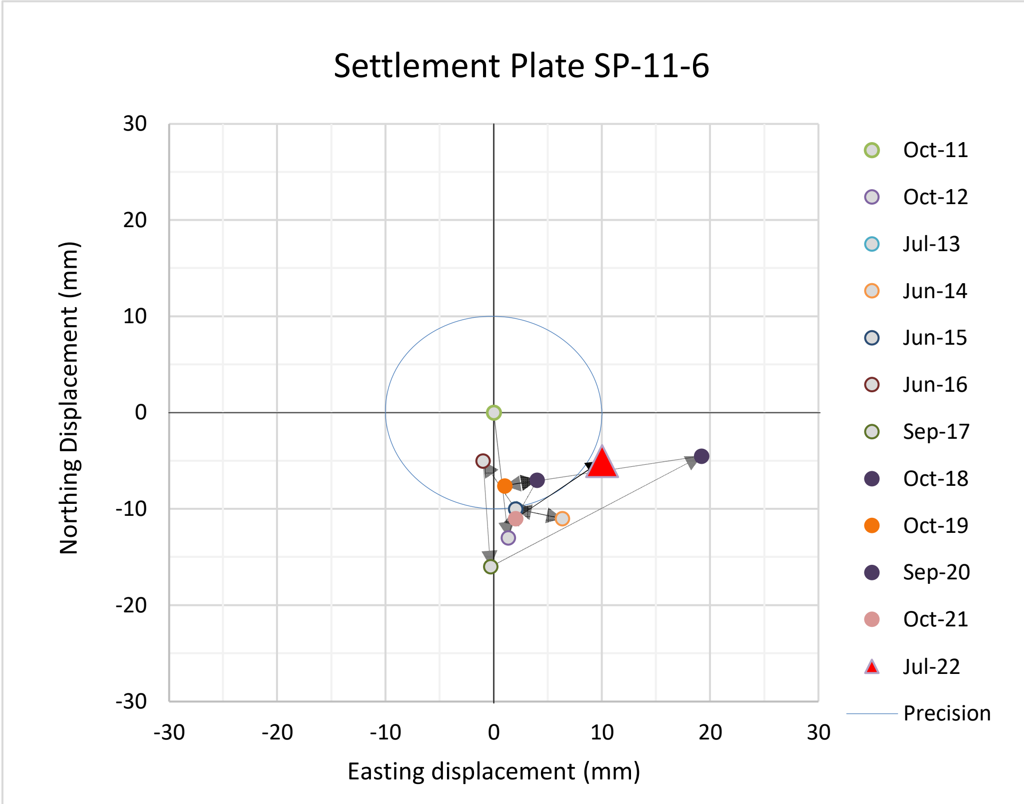

Settlement Plate SP-11-1
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
20
30
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision

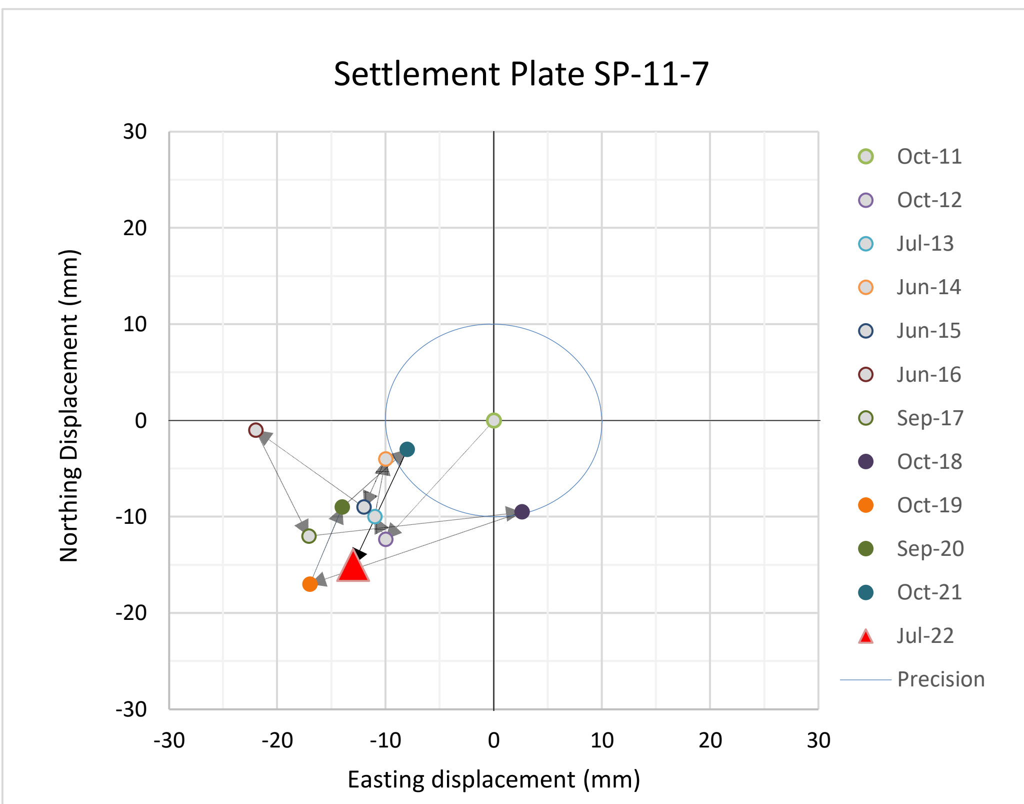

Settlement Plate SP-11-2
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
-30 -20 -10 0 10 20 30
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision

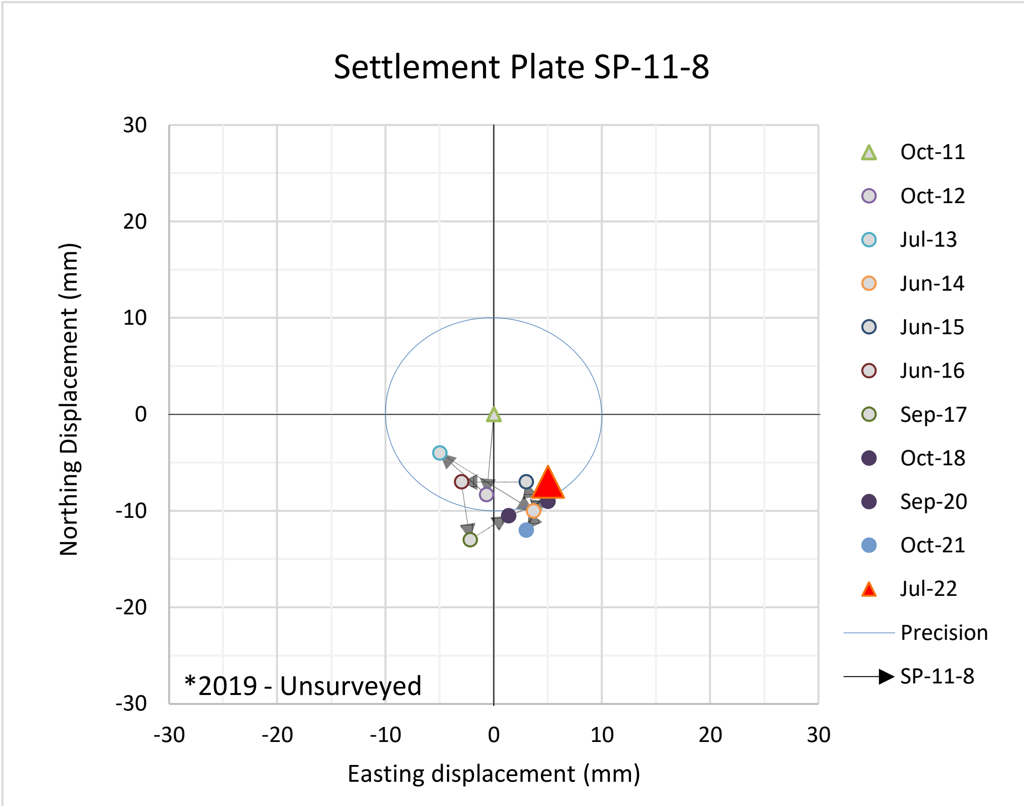

Settlement Plate SP-11-3
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
-30 -20 -10 0 10 20 30
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision
SP-11-3


Settlement Plate SP-11-4
Northing Displacement (mm)
30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
20
30
Easting displacement (mm)
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision


Settlement Plate SP-11-5
Northing Displacement (mm)
30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
20
30
Easting displacement (mm)
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision


Settlement Plate SP-11-6
30
20
10
0
-10
-20
-30
Northing Displacement (mm)
-30
-20
-10
0
10
20
30
Easting displacement (mm)
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision


Settlement Plate SP-11-7
30
20
10
0
-10
-20
-30
Northing Displacement (mm)
-30
-20
-10
0
10
20
30
Easting displacement (mm)
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Oct-19
Sep-20
Oct-21
Jul-22
Precision


Settlement Plate SP-11-8
Northing Displacement (mm)
Easting displacement (mm)
30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
20
30
*2019 - Unsurveyed
Oct-11
Oct-12
Jul-13
Jun-14
Jun-15
Jun-16
Sep-17
Oct-18
Sep-20
Oct-21
Jul-22
Precision
SP-11-8

APPENDIX E

Rainfall Data

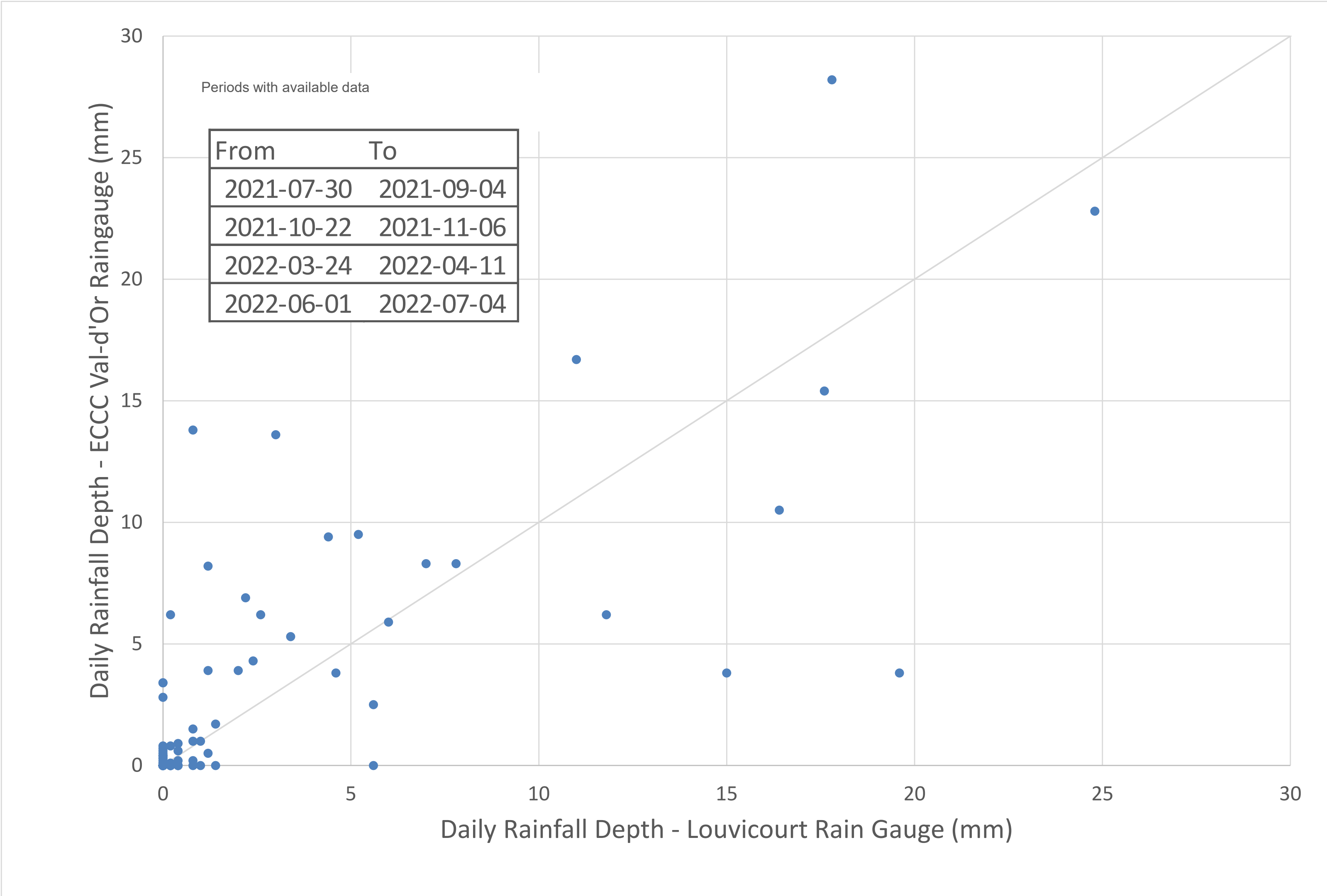


Figure E-1 : Comparison of Concurrent Daily Rainfall Depths between the Louvicourt and the Val-d'Or A Rain Gauges

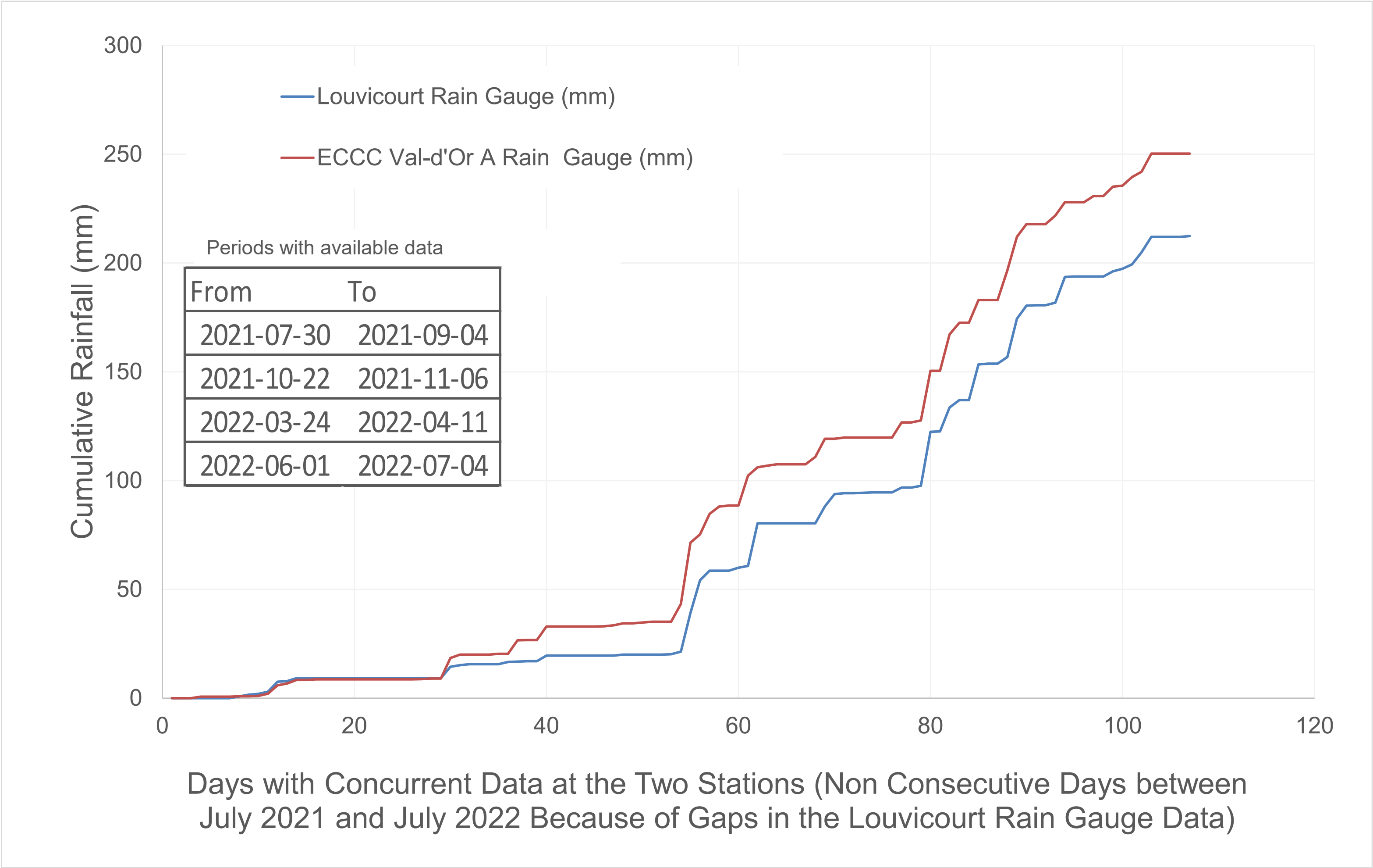


Figure E-2 : Comparison of Cumulative Daily Rainfall Depths between the Louvicourt and the Val-d'Or A Rain Gauges

WSP Canada Inc.