REPORT

2022 Annual Facility Performance Report for Turnbull Tailings Storage Facility

Teck Coal Limited, Fording River Operations

Submitted to:

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Executive Summary

This report presents the 2022 annual facility performance report (AFPR) for the Turnbull Tailings Storage Facility (Turnbull TSF) at the Teck Coal Limited, Fording River Operations (FRO) site, located near Elkford, British Columbia. The reporting period for the data review is from 1 September 2021 through 31 August 2022, unless otherwise noted.

Review of Key Hazards

The key hazard and existing controls are described below considering the current conditions of the Turnbull TSF.

- Highwall failure leading to water and tailings overtopping the low point of the Turnbull Pit.
  - The highwall continues to exhibit adequate overall slope stability performance. The deposition of water and tailings is not impacting stability conditions and the highwall is expected to continue to perform well (WSP 2023). A large-scale highwall failure into the Turnbull TSF has the potential for a large wave to be generated that overtops the low point of the pit. This event could impact the Upper Fording River ecosystem, FRO infrastructure, and potentially FRO staff in the area. A risk assessment should be completed to further characterize this hazard and evaluate the existing control measures.
  - Existing controls include monitoring the highwall instrumentation and comparing the data with quantifiable performance objective values, annually reviewing the performance with a geotechnical designer, and completing frequent inspections. Response plans should be developed and integrated into the next update of the emergency preparedness plan (EPP) and emergency response plan (ERP) as part of the mitigation to the consequences of a potential highwall failure.

Other potential credible failure modes without life safety concerns for the Turnbull TSF are discussed in the detailed text of this AFPR.

Consequence of Failure

The Turnbull TSF consequence of failure is High, considering the guidelines for consequence classification in Section 3.4 of the Health, Safety and Reclamation Code Guidance Document (Ministry of Energy and Mines 2016b). The Turnbull TSF design has met or exceeded the requirements for such classification.

Summary of Significant Changes

The 2022 dredging season was between 14 April and 21 October 2022. A total of 1.86 million dry metric tonnes of tailings was reported by the dredge contractor to have been dredged from the South Tailings Pond (STP) and sent to the Turnbull TSF.

Significant Changes in Instrumentation or Visual Monitoring Records

There were no significant changes in instrumentation or visual monitoring records, highwall stability, or surface water control for the Turnbull TSF since the 2021 annual inspection for this facility.

Significant Changes in Stability and/or Surface Water Control

As of 31 August 2022, the TSF pond elevation was 1,669.4 m and 11.6 m below the bedrock low point of elevation 1,681 m. A larger than planned volume of water is stored in the Turnbull pit pond and FRO are working on plans to reduce this pond volume.

Operation, Maintenance, and Surveillance Manual and Emergency Preparedness and Response Plan

FRO last completed an update of the OMS manual for the Turnbull TSF in November 2022 (FRO 2022). A review of this version of the OMS manual was completed by as part of this AFPR.

FRO last completed an update of the ERP for the tailings facilities at FRO in 2020 (EP.009.R1; FRO 2020a).

The current EPP for tailings facilities is dated 25 May 2020 (EP.008.R2; FRO 2020b).

Teck personnel at FRO carry out regular testing of the ERP, with the most recent internal tabletop exercise carried out on 15 June 2022, as part of the ERP for flood response. The ERP tabletop considered a flood condition on site where the Flood Response TARP had been triggered.

Dam Safety Review

FRO engaged an independent Professional Engineer to carry out the first dam safety review of the Turnbull TSF in 2022 and reporting is in progress.

Recommendations

Table E-1 summarizes the status of previous priority level 1 and 2 recommended actions from the 2021 Turnbull TSF annual report (Golder 2022). There are no new priority level 1 or 2 recommended actions from the 2022 AFPR. Recommendations of other priorities are presented in the report body.

Table E-1: Current Status of Previously Recommended Priority 1 and 2 Actions for the Turnbull Tailings Storage Facility

ID Number	Deficiency or Non-conformance	Applicable Regulation, Guideline or OMS Manual Reference	Recommended Action	Priority Level	Recommended Timing for the Action	Status as of March 2023
2016-04	Risk of water or tailings exiting the facility via wave generated from pit wall and/or spoil failure not quantified.	As input to satisfy Permit conditions 2-a-i and 2-b-i (Ministry of Energy and Mines 2013). HSRC §10.1.11.	Complete an update to the risk assessment. Use results of assessment from a wave exiting the facility to inform updates to the OMS manual, EPP and ERP to meet permit conditions.	2	Q3 2023	In Progress – OMS manual updated, ERP and EPP updates in progress

HSRC = Health, Safety and Reclamation Code; OMS = operation, maintenance, and surveillance; EPP = emergency preparedness plan; ERP = emergency response plan.

Priority Level	Description
1	A high probability or actual 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 safety issues leading to injury, environmental impact or significant regulatory enforcement; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.

Source: HSRC Guidance Document, Section 4.2 (Ministry of Energy and Mines 2016b).

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1.0 INTRODUCTION

1.1 Purpose, Scope of Work, and Method

WSP Canada Inc. (WSP), has completed an annual facility performance report (AFPR) for the for the Turnbull Tailings Storage Facility (Turnbull TSF) at the Teck Coal Limited, Fording River Operations (FRO) site, located near Elkford, BC. The reporting period for the data review is from 1 September 2021 to 31 August 2022, unless otherwise noted. The Turnbull TSF has also been referred to as the Turnbull South (TBS) Pit TSF and the TBS TSF in some documents and permits.

The report is based on a site visit carried out by Golder Associates Ltd. (now known as WSP Canada Inc.) on 7 September 2022 and on discussions with FRO staff. This report consists of the following and was prepared with consideration of the Teck Resources Limited Guideline for Tailings and Water Retaining Structures (Teck Resources 2019):

- a summary of the site conditions and background information for the facility
- a summary of the construction, operating, and/or maintenance activities for the reporting period
- facility consequence of failure and review of required documentation
- site photographs and records of routine facility visual inspections
- review of dredging data
- review of potential hazards and failure modes, design basis, and facility performance
- recommended actions

Photographs of the Turnbull TSF site inspection are presented in Appendix A, and the inspection report is included as Appendix B.

An inspection to review the TBS Pit walls' stability and performance was completed by Ms. J. Kelly Hood, P.Eng., and Ms. Sharon Ross, E.I.T., of Golder on 12 September 2022. WSP (2023) presents a summary of the observations from the pit wall inspection site visit.

All coordinates presented in this report are in Universal Transverse Mercator (UTM) with elevations referenced to the Elk Valley Elevation Datum.

The previous annual inspection for this facility was carried out in May 2021 and is reported in the 2021 annual report (Golder 2022).

1.2 Regulatory Requirements

1.2.1 BC Health, Safety and Reclamation Code

This AFPR was prepared in accordance with Part 10.5.3 of the Health, Safety and Reclamation Code (HSRC) for Mines in British Columbia (EMLI 2022), which sets out the minimum frequency for inspection of tailings storage facilities and associated dams. It is understood that this report will be submitted by FRO to the Chief Inspector of Mines.

The guidelines for annual reports provided in the HSRC Guidance Document (Ministry of Energy and Mines 2016b, Section 4.2) were considered where applicable during the preparation of this report.

1.2.2 Permits and Licences

Specific sections and amendments to the permits concerning the Turnbull TSF include the following:

- Permit C-3 Amendment Approving Turnbull South Pit Tailings Storage Facility. Issued by the Ministry of Energy and Mines. 14 November 2013. (Ministry of Energy and Mines 2013).
- Permit C-3 Amendment to Approving Turnbull South Pit Tailings Storage Facility East Pipeline Route. Issued by the Ministry of Energy and Mines. 6 May 2015. (Ministry of Energy and Mines 2015).
- Permit C-3 Amendment Approving Deferment of Permit Conditions – South Tailings Pond Dredging – Turnbull Pit. Issued by the Ministry of Energy and Mines. 1 June 2016. (Ministry of Energy and Mines 2016a).
- Permit C-3: Amendment Approving Disposal of Active Water Treatment Facility Liquids. Issued by the Ministry of Energy, Mines and Low Carbon Innovation. 22 October 2021. (EMLI 2021).
- Permit 424 Amendment to authorize discharges – amendment to discharges to the North Tailings Pond and South Tailings Pond (STP) from authorized sources. Issued by the Ministry of Environment. 6 December 2016.
- Permit 424 Amendment to Authorize Discharges – Disposal of Liquids from the West Line Creek Active Water Treatment Facility to the Fording River Operation Turnbull South Tailings Storage Facility. A permit amendment update is under review by the Ministry of Environment at the time of writing of this report.

2.0 BACKGROUND

2.1 Fording River Operations Tailings Storage

The FRO site is an active open pit coal mine located near Elkford, BC, which currently has two tailings pond facilities on site along the Fording River: the inactive North Tailings Pond and the active STP. FRO currently has two permitted destinations for in-pit tailings storage: the 2P-3P tailings storage area and the Turnbull TSF. These pits, combined with their associated ponds, pumps, and pipeline infrastructure, constitute the in-pit tailings management systems that are in place at FRO. The Turnbull TSF is the only active in-pit tailings facility at this time; dredging operations to the 2P-3P tailings storage area ceased in October 2015. FRO continues to deposit tailings into the STP and since 2016 has transferred tailings from the STP to the Turnbull TSF via dredging operations.

FRO continues to deposit tailings into the STP, and tailings are transferred seasonally via dredging operations from the STP to the Turnbull TSF, which started in 2016. Seasonal dredging from the STP to the Turnbull TSF is planned to continue until it reaches capacity (expected in 2028 based on an average annual dredged tailings transfer rate of 1.8 million dry metric tonnes (DMT), however this may be sooner depending on the FRO operations water management actions to reduce the Turnbull TSF pond volume.

The FRO site plan and the location of the Turnbull TSF are shown in Figure 1.

2.2 Overview of Design, Construction, and Previous Operation

2.2.1 Turnbull South Pit Design and Development

The TBS Pit is located on the east side of the Fording River (Figure 1). It is approximately 3.5 km north of the FRO plant facility. The pit was excavated into the west side of the east–west trending Turnbull Ridge.
The configuration of the TBS Pit upon completion of mining in early 2016 is described below and is shown in plan in Figure 2 and in section in Figure 3:

- The pit consists of a west-facing highwall slope along the east side of the pit, a north-facing endwall slope along the south side, southeast-facing and south-facing endwall slopes along the northwest and north sides, respectively, and an east-facing footwall and low wall slopes along the west side.
- The crest of the as-built pit ranges between approximately elev. 2,020 and 1,680 m. The highest crest elevation is located in the southern portions of the highwall. The lowest mined-out crest elevation is on the west side of the pit. The pit floor ranges between approximately elev. 1,690 m on the west side of the pit and approximately elev. 1,580 m on the east side.
- A footwall slope has been excavated along the west side of the pit and is generally 100 m in height. The footwall follows the dip of bedding, which is inclined at approximately 5° to 25° within the pit.
- The highwall excavated along the east side of the pit ranges in height between approximately 250 and 380 m.
- The endwalls excavated along the north and northwest sides of the pit range in height between approximately 80 and 110 m.
- The endwall excavated along the south side of the pit ranges in height between approximately 60 and 200 m, with an average height of 140 m.
- The low wall excavated along the southwest portion of the pit, above the footwall slope, ranges in height between approximately 40 and 55 m.

The pit is accessed from the west side, and access ramps were developed on the easterly dipping footwall slope. For further details regarding previous operation as a pit, refer to WSP (2023).

In 2012, Golder undertook assessments for the TBS Pit as a potential area to store tailings (Golder 2012) to support Teck in obtaining a corresponding amendment to the C-3 Permit. The following assessments were carried out by Golder to support development of the Turnbull TSF:

- pit slope stability assessment
- geotechnical assessment for the tailings facility
- hydrogeological assessment
- water quality assessment

Mining ceased in the TBS Pit in early 2016. A geotechnical stability review was completed in 2016 to assess the validity of previous Golder stability assessments against the mined-out ultimate pit (Golder 2016b). It was determined that the ultimate design pit shell used in previous stability analyses is comparable to the as-built ultimate pit shell. Pit wall stability continues to be monitored and its performance is reviewed annually.

For background information related to the TBS Pit and its development into a TSF, refer to Golder (2012).

2.2.1.1 Tailings Transfer Summary

Tailings started being transferred to the Turnbull TSF in June 2016 via dredging from STP. A summary of annual dredging and water transfer totals (from the FRO dredge contractor) is summarized in Table 1.

Table 1: Summary of Tailings Transfer from South Tailings Pond to the Turnbull Tailings Storage Facility

Year	Dry Metric Tonnes of Tailings Dredged from the STP from Annual Dredging Records	% Solids by Weight in Dredge Slurry	Water in Dredge Slurry, Discharged into the Turnbull TSF (m^3)
2016	215,892	30	503,748
2017	850,076	38.9	1,335,209
2018	1,635,590	41	2,353,654
2019	1,655,032	41	2,381,631
2020	1,648,701	40.7	2,402,161
2021	1,809,721	40.7	2,765,387
2022	1,855,049	40.5	2,802,785
Total to October 2022	**9,670,061**	**39.0% (average)**	**14,544,575**

Note: Some of the numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

Source: FRO dredge contractor annual dredging records.

STP = South Tailings Pond; TSF = tailings storage facility.

2.2.1.2 Changes in Turnbull Tailings Storage Facility Operations Since 2012 Design

Golder (2012) presents the assessments undertaken to support permitting of the Turnbull TSF. FRO received a C-3 Permit Amendment on 14 November 2013, approving the Turnbull South Pit TSF (Ministry of Energy and Mines 2013). Tailings were first deposited into the Turnbull TSF in June 2016. FRO has since adjusted facility operations, some of which deviate from the assumptions used in the Golder (2012) design report. This section presents a summary of key changes and comments on the impact of these deviations.

Table 2 presents key tailings geotechnical assumptions used to support the 2012 design (Golder 2012) compared to the currently understood values and includes comments on how the deviations, if any, impact the TSF's operations.

Table 2: Summary of Key Changes in Turnbull Tailings Storage Facility Design and Operations Since 2012

Design Parameter or Assumption	Considered in Golder (2012)	Considered as of November 2022	Source of Current Value	Impact of Change to the TSF
Low point in mined-out bedrock	Elevation 1,682.5 (EVED) (1,683 m in Mine Grid)	Elevation 1,681 m (EVED)	Confirmed by geophysics survey (FRO 2018)	A decrease in water and tailings storage volume is available in the TSF compared to the 2012 design.
Porosity of in-pit waste rock backfill spoils	30%	20% to 40%	Considered in the Golder (2018b) deposition plan based on volume and geometry of waste rock in final pit	Small; the value should be confirmed, possibly through regular bathymetry surveys.
Available facility tailings storage volume	19.6 to 20.2 million m^3	9.5 million m^3	Golder (2018b) deposition plan, total available volume is consistent with 2022 bathymetric survey data	A decrease in tailings storage volume is available compared to the 2012 design. The available storage presented in Golder (2018b) was based on interim low point in bedrock at elev. 1,679.89 (EVED); the available remaining volume in the facility should be updated using the current low point and an updated deposition plan based on measured in situ conditions.
Annual tailings transferred from STP	1 million DMT over six months each year	Ranges from 216,000 to 1.86 million DMT over 6 to 7 months each year	Dredging records from FRO	There is a decrease in the overall lifetime of the facility with an average of 1.38 million DMT per year over the seven years of operations; this is about 2.7 million DMT ahead of the schedule considered in the 2012 design.
Slurry density of dredge tailings transported to the TSF (solids content in pipeline)	22% by weight	30% to 41% by weight	Dredging records from FRO	Less water is being transferred with the dredged tailings that have higher slurry solids content; therefore, there is a lower annual reclaim water requirement back to the STP.
In situ dry density for tailings	1 t/m^3	1 t/m^3	Estimated	No change; the estimate should be checked using an annual bathymetry surveys.
Reclaim pond	250,000 m^3 pond volume with minimum 5 m depth to operate reclaim barge	7.8 million m^3 pond volume with 30 m to 33 m water depth at north end of tailings deposit	Based on the August 2022 pond elevation using the October 2022 volume by elevation curve	A significantly higher quantity of water is currently stored in the facility compared to the 2012 design.
Annual reclaim water quantity to STP	3.5 million m^3 returned to STP each six-month dredge season, reducing to 3.2 million m^3 returned to STP every six months in later years of operations	3.0 million m^3 returned to STP over 12 months between September 2021 and August 2022	Pumping records from FRO	Small; the annual transfer volume for reclaim water from Turnbull to STP is now similar to the 2012 design assumption.
Tailings beach slope	0.3% for beach above water and 2% for beach below water	Generally, 1% to 4% beach below water, with upwards of 11% in the beach above water below the low point outlet.	Measured from 2022 bathymetry survey	Continue to track tailings beach slopes with annual bathymetry surveys; update deposition plans as required.
Deposition plan and life of facility	From Golder (2012), 20 years from start of deposition, i.e., 2036	Last updated in 2018 deposition study (Golder 2018b); facility estimated to be at capacity in 2028 based on 1.8 million DMT per year, provided pond volume can be lowered	Golder (2018b)	A decrease in TSF life is available compared to the design; the deposition study should be updated with the bedrock low point, the beach slopes, in situ density from bathymetry surveys and operating reclaim pond volume to develop an updated date to reach the life of the facility.
Additional water inflows	None considered	Added 238,000 m^3 of water from Eagle 4 SRF since August 2020	Pumping records from FRO	Small; there is an increase to pond volume stored.
Groundwater flows	150 to 450 m^3/day inflow to pit; 300 m^3/day outflow when pond at final elevation	784 m^3/day inflow to pit in 2018 decreasing to 473 m^3/day in 2034, as used in the deposition study (Golder 2018b) and water balance (Golder 2018a)	Estimated	Small; there is an increase in volume to be stored based on updated groundwater rates.

TSF = tailings storage facility; EVED = Elk Valley Elevation Datum; FRO = Fording River Operations; DMT = dry metric tonnes; STP = South Tailings Pond; SRF = saturated rock fill.

One of the main changes in the Turnbull TSF operations compared to the 2012 design is the large quantity of stored water currently in the facility. This stored volume of water is mainly a result of the decision to delay initial construction of the reclaim pump and pipeline system in 2016 due to the high cost of construction and not requiring make-up water in the STP facility in 2016 and 2017 as well as Shandley and Swift Pit dewatering activities.

This additional stored water volume will not impact the total tailings storage volume of the facility, provided that this water can be pumped out in the future before the tailings storage capacity is required to support dredging from the STP facility. FRO should continue executing plans to reduce stored water in the Turnbull TSF over the next year.

Assumptions for the deposited tailings density, tailings deposit slopes, and the portion of tailings stored within the voids of the waste rock dumps located in the pit were made in the 2012 design. The intention was to confirm these estimates through a comparison of design parameters with results from ongoing annual bathymetry surveys and through tracking the total tonnage of tailings transferred based on STP facility dredge records. A facility bathymetric survey was completed in October 2021 and 2022 and FRO should continue with plans to obtain annual bathymetry surveys as part of tracking these parameters.

The summary of deviations listed in Table 2 should be documented outside of this AFPR.

2.2.1.3 Wave Generation in Tailings Storage Facility

A study was undertaken in November 2019 to assess the potential for wave generation in the Turnbull TSF due to a theoretical failure of the TBS Pit highwall and whether the waves would be able to overtop the facility and reach the Fording River. The study considered a phased approach, with Phase 1 analysis considering an empirical subaerial landslide-generated wave equation. The draft report was prepared and discussed with FRO and will be used to inform updates to the facility operational and emergency documents (recommendation 2016-04).

2.2.1.4 Inflow Design Flood Assessment

An updated inflow design flood (IDF) assessment for the Turnbull TSF was completed and reported in Golder (2021a). The results indicated the following:

- The volume of water from an IDF event is 1,243,200 m³.

The maximum operating pond level of the TSF is elev. 1,677.0 m to store the IDF volume plus the permitted freeboard of 1.2 m below the bedrock low point. FRO is considering updating the design basis for the Turnbull TSF considering operational performance to date and then applying for a permit amendment to update the permit required freeboard below the bedrock low point.

Quantifiable performance objective (QPO) values for pond elevation are provided in Table 6.

Based on a stage storage curve generated from bathymetric data obtained in October 2022, the pond elevation in the TSF is expected to rise to 1,672.6 m when the IDF volume is added to the 31 August 2022 pond level of elev. 1,669.4 m.

2.3 Site Seismicity

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

Probabilistic analysis results from site-specific hazard model are listed in Table 3. All site-specific peak ground acceleration values were evaluated for a soil Site Class C as described in the 2010 National Building Code of Canada (NRCC 2010) as this represents WSP's understanding of the general foundation conditions at the dam locations. Note the NRCC 2015 description for Site Class was not published at the time of writing the site-specific seismic hazard model report.

Table 3: Fording River Operations Site Seismic Hazard Values

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

Note(s): Source Golder 2016a. For firm ground site class C, very dense soil and soft rock foundation, as defined by 2010 National Building Code of Canada (NRCC 2010). Return periods are not exact representations of annual exceedance probabilities; rounding per Canadian Dam Association guidelines (CDA 2013, 2019) is shown. FRO site coordinates: 50.202°N, 114.876°W.

2.4 Key Operational Components

Key components of the Turnbull TSF are as follows:

- TBS Pit (described in Section 2.2.1)
- in-pit spoils
- dredge pipeline from the STP
- reclaim water lines and associated infrastructure
- geotechnical instrumentation
- IDF
- signage

In-pit spoil areas are noted in Figure 2 and consist of waste rock that was end-dumped into the pit during mining operations, portions of which buttress a portion of the south endwall and cover much of the footwall and low wall.

A pipeline to convey dredged tailings from the STP to the Turnbull TSF was constructed from late 2015 through mid-2016. Deposition of dredged tailings from the STP started in June 2016. Dredged tailings from the STP can be discharged along the southwest side of the pit at one of the two locations shown in Figure 2. Dredging from the STP to the Turnbull TSF is planned for the life of the facility, to be completed seasonally between approximately April and October.

In May 2018, a temporary reclaim pipeline was installed, and in June 2018 it began to transfer water from the Turnbull TSF pond to the STP. The non-winterized temporary pipeline was used until freeze-up in 2018. The temporary pipeline was not in use following the 2018 freeze-up until use resumed in early 2020.

In July 2019, construction was completed on a permanent reclaim pipeline to be used during dredging operations, which began to transfer water from the Turnbull TSF pond to the STP.

All instrumentation locations are shown in Figure 2. GPS units are installed on the highwall and north endwall of the TBS Pit and on the in-pit spoils to monitor movement in the facility. The south endwall GPS (unit TBL_WD_Turnbull R4_03) was installed in September 2018 on the spoils above the TBS Pit and above TB05. Prisms were installed on the highwall during mining and there is a total station on the footwall as well as two backsights (one on the highwall and one on the northwest endwall). Piezometers were installed at eight locations in the highwall to monitor pore pressures behind the wall: three were installed in 2012, two were installed in 2017, and an additional three were installed in 2018.

The Turnbull TSF does not include any engineered fills as part of tailings containment. The design of the Turnbull TSF is for the tailings to be contained by the bedrock of the mined-out pit. An area of a backfill spoil over the footwall forms a low point along the west side of the facility at elev. 1,690 m. The ponded water is to be maintained below the lowest point of bedrock along the mined-out pit crest. The lowest point of bedrock is located on the west side of the pit and has been established to be at elev. 1,681 m following discussions between the Engineer of Record (EoR) team and FRO based on results from a ground-penetrating radar survey conducted on 10 September 2018 (FRO 2018). The bedrock low point is used to establish the TSF maximum pond elevation.

Signage has been placed at the facility crest, before the pond, and in the vicinity of the Turnbull TSF to notify passersby that the structure contains tailings and to provide direction and contact information to report any issues observed or any proposed work in the vicinity.

2.5 Key Personnel

The EoR for the Turnbull TSF is John Cunning, P.Eng., an employee of WSP Canada Inc. The Pit Slope Geotechnical Engineer (PSGE) for the Turnbull pit slopes is J. Kelly Hood, also an employee of WSP Canada Inc.

The Qualified Person (QP) for the Turnbull TSF is James Campbell, P.Eng., Senior Tailings Engineer, who is an employee of Teck. Mr. Campbell became the QP on 4 May 2021.

2.6 Quantifiable Performance Objectives

Table 4 summarizes the QPOs or trigger levels in place for GPS and prism displacement monitoring instrumentation at the Turnbull TSF, which were recommended by the pit wall Designer of Record and reviewed by a Qualified Person and are discussed in WSP (2023). These values have been included in the most recent Turnbull TSF OMS manual (FRO 2022). The GPS and prism data are to be reviewed on a monthly basis to check for movements or trends of concern.

Table 4: GPS and Prism Displacement Trigger Levels for the Turnbull Tailings Storage Facility

Monitoring Instrument	Displacement Trigger Levels	Warning	Alarm
Highwall GPS units	3D point velocity with 12-point averaging	100 mm/day	150 mm/day
GPS units on spoils	3D point velocity with 12-point averaging	150 mm/day	300 mm/day
Prisms on highwall	Change in slope distance[(a)]	n/a	>25 mm[(a)]
	3D displacement[(a)]	n/a	>50 mm[(a)]

(a) The slope distance alarm trigger and 3D displacement trigger levels for the highwall prisms are based on an assumed three-month average time period between readings. The trigger levels should be adjusted accordingly for the first reading following the winter months.

n/a = not applicable.

The trigger level for water quality monitoring in the vicinity of the Turnbull TSF is presented in Table 5.

Table 5: Quantifiable Performance Objective for Water Quality Monitoring near the Turnbull Tailings Storage Facility

Monitoring Requirement	Trigger Level	Action
Water quality monitoring in vicinity of the Turnbull TSF	Elevation of tailings reaches 1,675 m above sea level (1,674.5 m Elk Valley Elevation Datum) (Ministry of Energy and Mines 2013).	Monitoring water quality as required by the C-3 permit amendment condition C-1-a (Ministry of Energy and Mines 2013).

TSF = tailings storage facility.

QPOs for the pond elevation in the Turnbull TSF are shown in Table 6. The maximum operating pond elevation is 1,677.0 m (4.0 m below the low point in bedrock elevation), which was updated to allow the IDF volume (Golder 2021a) plus the 1.2 m freeboard requirement from the C-3 Permit Amendment (condition 2-c, Ministry of Energy and Mines 2013).

The design intent for Turnbull TSF did not include storage of the IDF plus 1.2 m freeboard as is currently worded in the C-3 Permit Amendment (condition 2-c, Ministry of Energy and Mines 2013), and it is recommended to review and update the required freeboard for the facility during the IDF event and modify the permit as required.

Table 6: Quantifiable Performance Objective Response Framework for Pond Elevation in the Turnbull Tailings Storage Facility

Frequency of Inspection	Threshold Criteria		
	Acceptable	Warning	Alarm
Monthly – visual inspection and survey of pond elevation. Surveys are not to be completed when conditions are unsafe (e.g., excess snow preventing access or avalanche hazards).	Pond elevation is located more than 5 m below the low point in bedrock on the west side of the pit **(pond below elev. 1,676.0 m).**	Pond elevation is located between 4 and 5 m below the low point in bedrock on the west side of the pit **(between elev. 1,676.0 and 1,677.0 m).**	Pond elevation is within 4 m of the low point in bedrock on the west side of the pit **(above elev. 1,677.0 m).**

Note: Elevations presented in Elk Valley Elevation Datum.

Alarm and warning trigger levels for the highwall piezometers are provided in the most recent version of the Turnbull TSF OMS manual (FRO 2022) as shown in Table 7.

Table 7: Quantifiable Performance Objectives for the Turnbull Storage Facility Highwall Piezometers

Borehole ID	Piezometer Number	Total Head Trigger Elevation[(a)]	Severity	Instrument Priority[(b)]
PZ12-01	3	1,839.7	Warning	3
	2	1,819.5		
	1	1,922.6		
PZ12-02	3	1,810.7	Warning	3
	2	1,794.4		
	1	1,893.4		
PZ12-03	3	1,827.3	Warning	3
	2	1,806.7		
	1	1,910.6		
GTF17-07	2	1,921.1	Warning	3
	1	1,899.1		
GTF17-08	4	1,830.3	Warning	3
	3	1,812.4		
	2	1,800.2		
	1	1,887.0		

(a) The recommended total head trigger level has been calculated based on the recommended ru trigger level from Golder (2021b), where ru is a pore water pressure coefficient and ru = pore water pressure / total vertical stress.

(b) Priority level is based on the information provided by the unit. Priority level 3 = medium priority (address within 1 to 3 months). Manually download data bi-weekly if data communication is an issue.

Source: FRO 2022.

3.0 OPERATIONS, MAINTENANCE, AND CONSTRUCTION DURING 2021/2022 REPORTING PERIOD

3.1 Operations

The 2022 dredging season was between 14 April and 21 October 2022. A total of 1,855,050 dry metric tonnes of tailings was dredged from the STP and sent to the Turnbull TSF based on the dredging contractor records. The total tonnage of tailings transferred from the STP to the Turnbull TSF to date is 9,670,061 dry metric tonnes. Tailings were deposited from the end-of-pipe outlet location (Figure 2) throughout the 2022 reporting period. The low point outlet had previously been used as the deposition location from 2019 to August 2021 to accommodate for potential spoils at the south end of Turnbull Pit. A tailings beach above water area has developed below the end-of-pipe outlet.

As of 31 August 2022, the TSF pond elevation was 1,669.4 m and 11.6 m below the bedrock low point of elev. 1,681 m.

In May 2022, FRO installed a water level GPS monitor on the reclaim barge to measure pond elevation in real time. The pond elevation GPS monitor reports to Teck's GeoExplorer remote data collection system.

The Turnbull TSF was inspected by qualified FRO tailings personnel once per month during the reporting period. During active discharge of dredged tailings, the tailings discharge location is inspected by the dredge crew.

During winter, the routine TSF inspections are carried out from the causeway due to concerns over the safety of FRO personnel from snow and avalanche hazards in the pit area. The inspections were completed at the required frequency, and the EoR team has reviewed them as part of this annual review.

3.2 Maintenance

There was no maintenance completed at the Turnbull TSF over the reporting period. There is an outstanding recommendation to the remove debris from behind the berm above the tailings dredge pipeline (recommended action 2020-01 in Table 11).

3.3 Construction

Issued for construction drawings for the SRF Intake from the Turnbull TSF to the Clode Pond area were issued on 24 June 2022 by Wood Canada Limited (Walker 2022). The design consists of three intake pipelines and a pump pad at the north endwall as well as pipeline that runs along the haul road of the northwest endwall that directs water to the Clode Pond area. Construction activities began in August 2022 and were ongoing at the time of the AFPR site visit. A trench excavation was observed through the waste rockfill haul road of the northwest endwall at approximately elev. 1,705 m. The design low point of the drainage pipeline is elev. 1,689.1 m along the northwest endwall, north of the bedrock low point. The as-built record surveyed elevations of the trench and pipeline should be checked once construction is complete.

4.0 REVIEW OF CLIMATE DATA AND WATER BALANCE

4.1 Climatic Review

Three local climate monitoring stations exist at FRO: waste water treatment plant, A Spoil, and Brownie Spoil. Records were available from the waste treatment plant and Brownie Spoil weather stations during the reporting period of 1 September 2021 to 31 August 2022. Only limited precipitation data were available for the A Spoil station; it has therefore been excluded from the climate data review.

The Fording River Cominco station is the closest regional Environment and Climate Change Canada station to the FRO site; however, the station has not published precipitation data since 2017. The waste water treatment plant station has been used as the main precipitation station for the Fording River Cominco infilling gap process since December 2013 and now makes up the majority of the dataset. As a result, a new combined dataset, hereafter referred to as the Fording River (infilled) dataset, has been used for the climate review. The waste water treatment plant station precipitation data were used over the entire reporting period.

The total precipitation recorded at the Fording River (infilled) and Brownie Spoil stations over the reporting period is shown in Table 8 with their monthly total precipitation presented in Chart 1. For comparison purposes, the long-term (1970 to 2021) average monthly precipitation at FRO (from the Fording River Cominco infilled dataset) is also presented in Chart 1. The long-term (1970 to 2021) average annual precipitation at the mine site is estimated to be 631 mm.

Note that data presented in Table 8 and Chart 1 for the Fording River (infilled) and Brownie Spoil stations are raw data; no adjustments for station elevation or undercatch were made.

Table 8: Total Precipitation from 1 September 2021 to 31 August 2022

Weather Station	Total Precipitation (mm)
Fording River (infilled)	669
Brownie Spoil	617

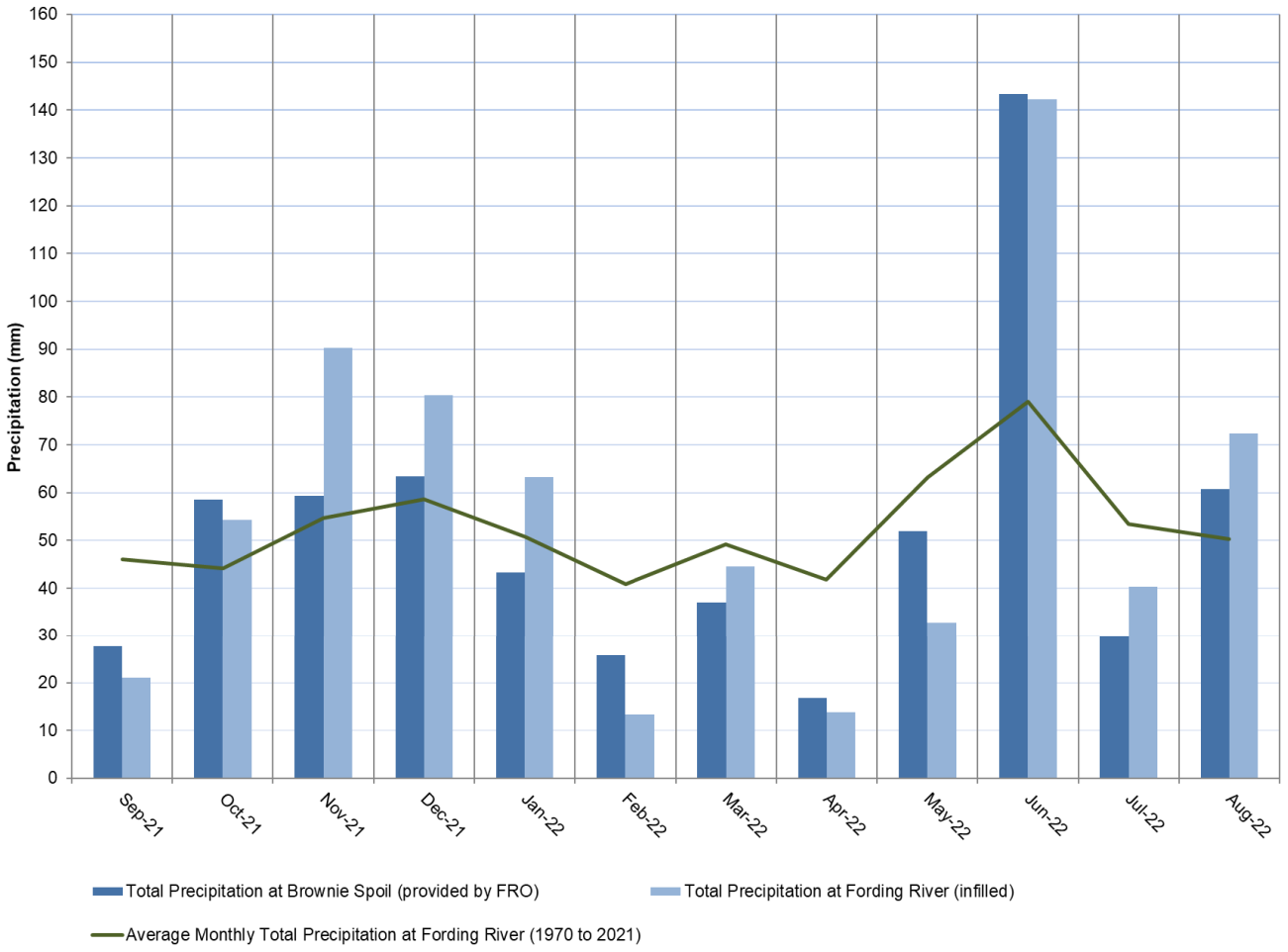


Chart 1: Monthly Precipitation Data from 1 September 2021 to 31 August 2022

The precipitation data in Table 8 indicate that the annual precipitation at FRO was approximately average, with the Fording River (infilled) dataset from 1 September 2021 to 31 August 2022 being a little higher than the long-term annual average of 631 mm and the Brownie Spoil weather station dataset being slightly lower than the long-term annual average. A similar observation could be made from Chart 1.

Freshet typically starts in April to May at FRO with higher runoff flow events expected during those months as a result of combined rainfall and snowmelt.

4.2 Water Balance

The Turnbull TSF water balance from 1 September 2021 to 31 August 2022 is summarized in Table 9 using climate inputs from the waste water treatment plant station.

Table 9: Turnbull Tailings Storage Facility Water Balance (1 September 2021 to 31 August 2022)

In	12-month Volume (m^3)	Out	12-month Volume (m^3)	Total Inventory Change (m^3)
Surface water runoff and precipitation	687,000	Evaporation	192,000	290,000
Groundwater	256,000	Dust suppression	181,000	
Water Eagle 4 SRF	38,000	Reclaim water transferred to STP	3,014,000	
Water in dredged slurry	2,267,000	Water remaining in tailings deposit	653,000	
STP	1,083,000			
Sum	4,328,000	Sum	4,038,000	

Note: 12-month volumes and total inventory change may not exactly equal the sum of inflows and/or outflows due to rounding.
STP = South Tailings Pond; SRF = saturated rock fill.

The total inventory change of 290,000 m^3 represents an increase in the total water volume stored in the Turnbull TSF over the reporting period; however, the year-over-year bathymetry surveys indicated an increase of free water in the pond of 1.4 million m^3. The water balance assessment is based on the flow and water data provided by Teck and the values presented have been interpreted based on the available data provided. Based on the actual observed increase in the volume of water stored from the year-over-year bathymetry surveys, there is low confidence in the interpretation of the water balance. FRO is currently working on a site-wide mass balance model, which should support increased accuracy in the Turnbull TSF water balance.

A total estimated volume of 7.8 million m^3 of water is stored in the Turnbull TSF based on the October 2022 bathymetric survey and the 31 August 2022 pond elevation.

No water was discharged from the Turnbull TSF during the reporting year; discharge from the TSF is not part of the regular operation of the facility.

No facility performance issues were noted associated with the precipitation observed on site during the reporting period. The positive water balance and increase in water observed in the facility from the year over year bathymetry surveys poses an operational risk associated with the design lifespan of the facility. Mitigation measures to reduce the volume of water in the facility are being investigated by FRO.

4.3 Water Quality

It is understood that FRO Environment submits water quality monitoring results to the BC Ministry of Environment and Climate Change Strategy. The assessment of the water quality results is beyond the scope of this AFPR.

5.0 TURNBULL SOUTH TAILINGS STORAGE FACILITY SAFETY ASSESSMENT

This section presents the facility safety assessment for the Turnbull TSF based on observations and data review for each of the failure modes that are most relevant to this facility.

5.1 Site Visit

A site inspection of the Turnbull TSF was carried out on 7 September 2022 by John Cunning, P.Eng., and Colin McGrath, P.Eng., of WSP. Mr. Cunning and Mr. McGrath were accompanied by David Walker, P.Eng., tailings engineer of FRO. The temperature during the visit was approximately 20°C to 25°C and the weather was sunny with moderate winds.

Appendix A presents a summary of photographs of the Turnbull TSF from the site inspection. The location, direction, and number for each photograph are noted in Figure 2.

The backfill spoil and downstream toe area were inspected during the 2022 site inspection. The access road area includes pumping infrastructure and a laydown area (Photographs 8 and 9 in Appendix A). The downstream toe of the access road is located adjacent to the Fording River (Photograph 8 in Appendix A).

A summary of the observations from the site visit is included in the inspection report in Appendix B.

Details of the facility's performance based on observations during the site inspection are discussed in Section 5.5.

5.2 Review of Background Information

FRO provided the following information for this inspection:

- FRO site 2021 LiDAR topographic data and orthophoto
- records of routine visual inspections by FRO qualified personnel
- pond water levels in the Turnbull TSF
- dredging records for the STP to the Turnbull TSF
- site climate data from 1 September 2021 to 31 August 2022

5.3 Consequence of Failure

Teck has advised that they are aligned with the Global Industry Standard on Tailings Management (GISTM; GTR 2020), which, in turn, is consistent with their safety culture. Teck has further advised that they will adopt extreme consequence case design loading for any facility with a credible catastrophic flow-type failure mode. For facilities without a credible catastrophic flow-type failure mode, Teck will reduce credible risks based on the As Low As Reasonably Practicable (ALARP) principle. Adopting this approach meets or exceeds regulatory requirements, aligns with Teck's goal to eliminate any risk for loss of life, and is consistent with the GISTM (GTR 2020).

Considering the guidelines for consequence classification in Section 3.4 of the HSRC Guidance Document (Ministry of Energy and Mines 2016), the Turnbull TSF consequence of failure is High and the Turnbull TSF has met or exceeded the requirements for such classification.

5.4 Review of Operational Documents

5.4.1 Operation, Maintenance, and Surveillance Manual

The OMS manual for the Turnbull TSF is Version 2022.11, dated November 2022 (FRO 2022). A review of this version of the OMS manual was completed by WSP as part of this AFPR.

5.4.2 Emergency Preparedness and Response Plans

FRO last completed an update to the emergency response plan (ERP) for the tailings facilities at FRO in May 2020 (EP.009.R1; FRO 2020a).

The current emergency preparedness plan for tailings facilities is dated 25 May 2020 (EP.008.R2; FRO 2020b).

Teck personnel at FRO carry out regular testing of the ERP, with the most recent internal tabletop exercise carried out on 15 June 2022, as part of the ERP for flood response. The ERP tabletop considered a flood condition on site where the Flood Response Trigger Action Response Plan had been triggered, which has implications for the facilities downstream, including the STP and North Tailings Pond.

5.4.3 Dam Safety Review

FRO engaged an independent Professional Engineer to carry out the first dam safety review of the Turnbull TSF in 2022 (reporting in progress). It is understood that the next dam safety review would be initiated in 2026 based on the current regulatory requirements or as recommended in the final dam safety review report.

5.5 Assessment of Turnbull South Tailings Storage Facility Safety Relative to Failure Modes and Facility Performance

This section presents a summary of information related to the potential hazards to which the Turnbull TSF is exposed, as well as WSP's opinion as to the credibility of each hazard.

Potential hazards and failure modes were reviewed as part of this AFPR and are summarized in Table 10.

The performance of the facility relative to each failure mode is discussed in the following sections.

Table 10: Assessment of Internal and External Hazards and Potential Failure Modes

Potential Hazard	Area of Concern	Observations/Data	Assessment of Failure Mode
			At Current Conditions (at pond elev. 1,669.4 m on 31 August 2022, average tailings estimated at elev. 1,640 m)
Instability of rock pillar between the pit and Fording River	North and northwest endwalls, low wall and footwall	The orientation of the bedding and the buttressing effect of the spoils are favourable to stability.	**Not credible** based on favourable conditions to physical stability (Golder 2012).
Tailings or contaminated water exiting the facility due to debris from a pit wall failure generating a wave in the TSF	North and northwest endwalls	No significant instability was observed during mining, and the pit wall is now buttressed by spoils. Orientation of these pit walls relative to the low point area leads to a very low likelihood of this potential hazard.	**Not credible** based on current pit wall stability and orientation relative to low point area.
	Highwall and pit low point area	Failure through the poor-quality rock of the 210/220 fault was considered, and slope stability assessment indicated a factor of safety of over 1.5, which is considered to be a low likelihood for a pit wall failure. Failure of the highwall could lead to generation of waves that could overtop the backfill spoil in the pit low point area.	**Credible** based on preliminary assessment from Golder and current pond elevation, which indicated there is a low likelihood of a pit wall failure; existing controls are in place to monitor the pit wall as part of the TSF operations.
	South endwall	In-pit spoils have helped buttress the wall. This buttressing has improved the stability of the endwall. The current tailings beach and pond are located over 200 m from this wall.	**Not credible** based on current pit wall stability and distance from low point area.
Tailings or contaminated water exiting the facility due to debris from a spoil failure generating a wave in the TSF	Spoils in area	In-pit spoils or nearby ex-pit spoils that have the potential to fail towards the TSF are not considered to have enough volume to generate a significant wave.	**Not credible** at current tailings/water elevation.
Tailings or contaminated water exiting the facility due to debris from an external slope failure generating a wave in the TSF	Turnbull Ridge above highwall	Geology in the highwall and drilling done behind the highwall indicate conditions that are favourable to stability.	**Not credible** at current tailings/water elevation.
Inflow flood and/or tailings elevation causing overtopping	n/a	Flood routing for the Turnbull TSF has been completed (Golder 2021a).	**Not credible** at current tailings/water elevation. Facility has capacity to store the IDF volume at the current pond elevation.
Migration of tailings	Through bedrock	Bedrock discontinuities are not sufficiently wide to facilitate transport of tailings sediment.	**Not credible.**
	Through waste rock	Tailings are not intended to be placed such that they could migrate readily through waste rock above the lowest point of bedrock (elevation 1,681 m) along the crest of the pit.	**Not credible** at current tailings elevation.
Migration of contaminated water	Through bedrock	Potential impacts to the Fording River could occur when the tailings pond elevation exceeds the Fording River elevation. Permit amendment condition (Ministry of Energy and Mines 2013) requires groundwater monitoring to begin no later than when tailings within the Turnbull TSF reach an elevation of 1,675 m above sea level (1,674.5 m EVED). This is intended to provide an early warning of an increase in contaminant loadings to the Fording River. Westward flow potential could also develop between the TSF and potable well field when the tailings elevation exceeds 1,673.5 m (Golder 2012). The pond, plus freeboard and IDF volume, is not intended to exceed the lowest point of bedrock (elev. 1,681 m) along the crest of the pit.	**Not credible** at current tailings/water elevation.
Tailings or tailings water pipeline failure	Dredge pipeline, return water pipeline	Failure of dredge or return water pipeline could result in the release of tailings or tailings water. Lines are inspected by a dredging contractor, who reports no leakage issues observed from the pipelines during active dredging.	**Credible**, being managed with routine inspection during active use.

TSF = tailings storage facility; n/a = not applicable; IDF = inflow design flood.

5.5.1 Pit Wall Instability Causing Overtopping

5.5.1.1 Design Basis and Existing Controls

The results of the previous stability analyses indicate that the TBS Pit has exhibited adequate overall stability following the completion of mining and is expected to continue to exhibit adequate stability performance with the development of the Turnbull TSF (Golder 2012).

Ongoing monitoring of the walls is recommended during the operation of the TSF. The frequency of monitoring should be increased when equipment and/or personnel are working near the pond in the TSF or close to the face of the walls. The monitoring procedures are included in Section 5.1 of the OMS manual (FRO 2022).
Further details of pit wall stability are presented in WSP (2023).

Instrumentation – GPS and Prism Monitoring of Spoils and Highwall

There are 26 active prisms installed on the highwall of the TBS Pit. There are five GPS units on the highwall and endwalls of the TBS Pit. The spoils and highwall are monitored due to the potential for a failure to create a subaerial landslide that could result in a wave overtopping the facility via the low point on the west side of the pit. Instrumentation locations are shown in Figure 2.

All of the GPS monitors report to the GeoExplorer monitoring system in real time and readings are taken on an hourly basis.

There are 21 prisms that did not have location data collected over the past year and they are shown in grey in Figure 2. Prisms along the lower portions of the highwall will become inactive as the TSF pond elevation rises.

The highwall prisms are to be manually read three times per year per the OMS manual (FRO 2022).

Instrumentation – Piezometers within Highwall

There are 15 vibrating wire (VW) piezometers at five locations within the highwall of the Turnbull TSF to monitor water levels behind the highwall. Three of the VW piezometers (PZ12-01, PZ12-02, PZ12-03) were installed in 2012 and two were installed in 2017 (GTF17-07 and GTF17-08). Four of these 15 VW piezometers are no longer collecting reliable data, these are detailed below. Three VW piezometers (GTF18-11, GTF18-12, and GTF18-13) were installed in the summer of 2018 and are monitored by Teck for another project unrelated to highwall stability; these piezometers are not included in this report.

Data are to be collected from the piezometers at least three times per year and uploaded to GeoExplorer (FRO 2022).

5.5.1.2 Observed Performance

The pit walls were exhibiting adequate stability during the 2022 annual inspection, and the monitoring data review did not indicate any signs of large-scale slope stability issues. The deposition of water and tailings is not impacting stability conditions and the highwall is expected to continue to perform well (WSP 2023). An overtopping failure of the TSF caused by a large-scale highwall failure could generate a large wave that can overtop the crest of the TSF low point area (elev. 1,690 m). This could lead to potential consequences on FRO staff, the environment, and infrastructure in Fording River valley downstream of the facility. A risk assessment update should be completed for the Turnbull TSF to evaluate the credibility of this failure mode, evaluate the potential consequences, evaluate the existing controls, and inform updates to the facility operational and emergency documents (recommendation 2016-04).

An erosion gulley was observed in the spoils on the west side of the low wall above the dredge pipeline and a new recommendation to divert surface water from this area is included in this report (recommended action 2022-02 in Table 11).

A detailed review of the monitoring instrumentation is provided in WSP (2023). A summary of the instrumentation is provided below.

The displacements exhibited by the GPS units during the reporting period are within the accuracy of the monitoring system and largely below the 3D velocity warning of 100 mm/day. The total displacement values and directions indicate that no deep-seated, large-scale instability is being detected at the locations of the GPS units along the highwall.

FRO collected three prism measurements in the reporting period (November 2021, and April and August 2022). Data from prism monitoring are to be reviewed and interpreted as soon as possible after they are downloaded to allow enough time for additional readings to be collected if needed to meet the pit wall monitoring requirements in the TSF OMS manual.

The total head data in the VW piezometers during the reporting period are relatively consistent with previous seasonal fluctuations except for the following:

- PZ12-01 began reporting total head data again on 8 November 2021.
- PZ12-02 (3) is not functioning correctly and continues to record sudden and sporadic increases in total head.
- PZ12-03 (3) did not record any data during the reporting period.
- GTF17-07 stopped recording total head data on 24 October 2021.

FRO should determine if there are any potential issues with these instruments (WSP 2023).

5.5.2 Pond Level Causing Overtopping

5.5.2.1 Design Basis and Existing Controls

A design memorandum evaluating the disposal of tailings into the Turnbull TSF was previously completed and indicated that the normal operating freeboard be maintained at least 1.2 m below the low point in the bedrock around the pit crest (Golder 2012).

The IDF assessment (Golder 2021a) has updated the IDF volume based on a 72-hour rain and snow event. Based on the pond storage curve from the 2018 tailings deposition study (Golder 2018b), the IDF volume of 1,242,000 m³ (Golder 2021a) plus the minimum freeboard of 1.2 m (permit condition 2-c, Ministry of Energy and Mines 2013), the maximum operating pond elevation is 1,677.0 m.

Instrumentation – Pond Level

The Turnbull TSF pond level was manually surveyed seven times during the reporting period. As of June 2022, the reclaim barge is equipped with a GPS monitor that measures the Turnbull TSF pond level in real time. Manual readings to monitor the freeboard were historically less frequent during the winter months when there is no safe access due to snow cover and avalanche hazards. Since no tailings are deposited during the winter months, postponing the pond level survey until safe access is available is acceptable based on the current freeboard. The Turnbull TSF water level in Chart 2 shows that the pond level was increasing throughout the reporting year.

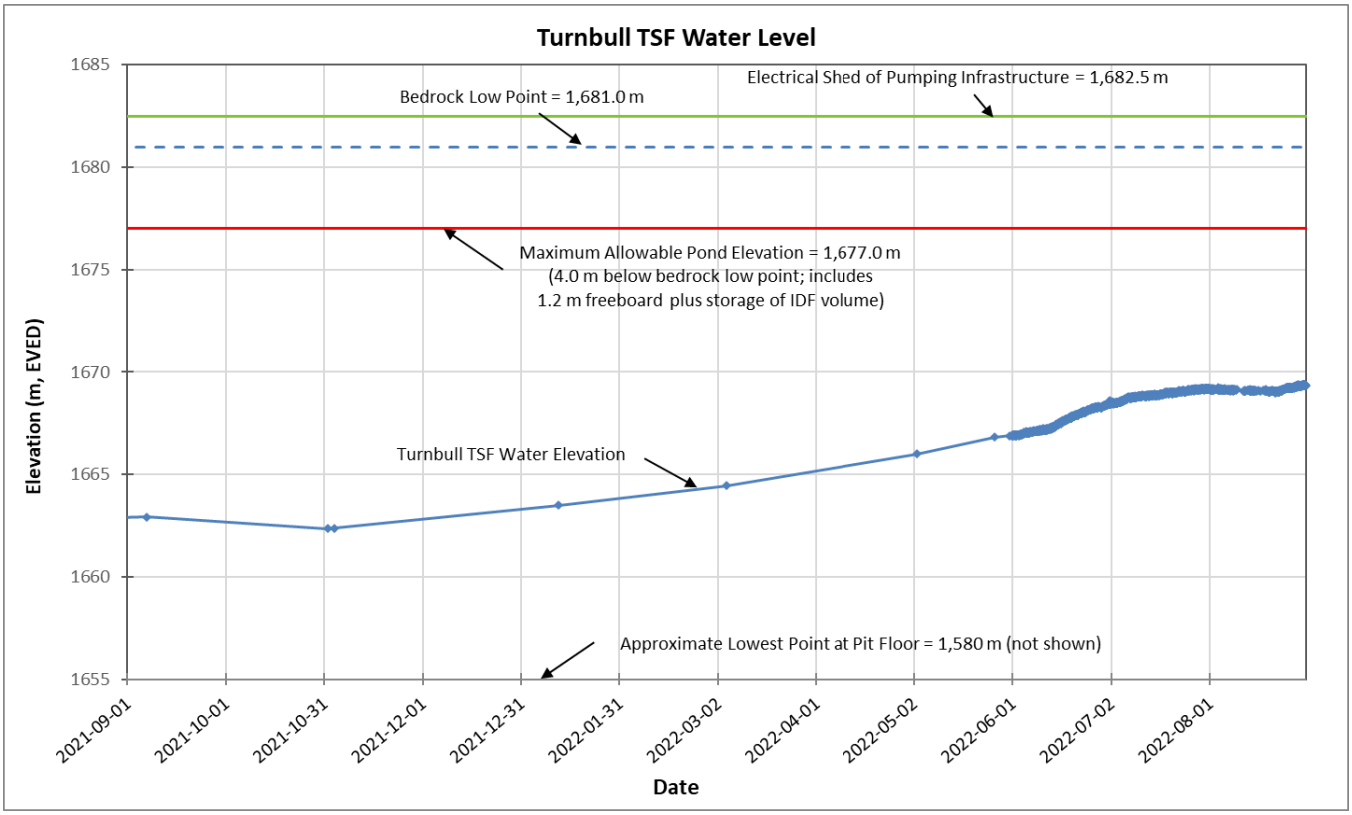


Chart 2: Turnbull Tailings Storage Facility Pond Water Elevation for 1 September 2021 to 31 August 2022

5.5.2.2 Observed Performance

As of 31 August 2022, the TSF pond was at elev. 1,669.4 m, which results in a freeboard of 11.6 m below the low point in the bedrock around the pit on the west side of the facility.

5.5.3 Tailings Migration and Seepage

5.5.3.1 Design Basis and Existing Controls

A water quality model prepared for permitting (Golder 2012) predicted that the maximum potential water quality impacts to the potable wells and the Fording River would occur at the ultimate configuration of tailings in the Turnbull TSF.

Instrumentation – Water Quality Monitoring

There are two water quality monitoring locations in the vicinity of the Turnbull TSF (CC1 and FR1; Figure 2). There is no requirement to monitor water quality as a result of Turnbull TSF operations. Monitoring at an additional location is required by the permit to be in place no later than when the elevation of tailings reaches elev. 1,675 m above sea level (1,674.5 Elk Valley Elevation Datum, Ministry of Energy and Mines 2013).

5.5.3.2 Observed Performance

Migration of water through bedrock is a very unlikely failure mode at the current elevation of tailings and water in the pit. Migration of water or tailings through the bedrock has not historically been observed.

Migration of tailings or seepage through waste rock is not a credible failure mode at the current elevation of tailings and water in the pit.

5.5.4 Release of Tailings and Tailings-Affected Water through Pipeline Failure

5.5.4.1 Design Basis and Existing Controls

The dredged tailings pipeline from the STP facility to the Turnbull TSF is located along spoils northeast of the STP and along a bench of the Turnbull TSF in-pit spoils. The reclaim water pipeline is located along the west side of the Turnbull TSF. A failure of one of these pipelines could release tailings or tailings-affected water into the spoils beneath the pipeline alignment.

5.5.4.2 Observed Performance

This failure mode is managed by routine inspections of the pipeline by the dredging contractor during active dredging. During the 2022 site inspection by the EoR, waste rock debris was observed to be collecting between the tailings dredging pipeline berm and the spoils over the low wall in an area within the TSF. No leakage from this pipeline was observed during the reporting period. The debris is to be cleaned out such that the berm could catch ravelling rocks from the waste rock slope above the pipeline (recommended action 2020-01 in Table 11).

6.0 SUMMARY AND RECOMMENDATIONS FOR THE 2022 ANNUAL FACILITY PERFORMANCE REPORT

6.1 Summary of Activities During Reporting Period

The following activities were completed during the reporting period:

- A total of 1,855,049 dry metric tonnes of tailings was dredged from the STP to the Turnbull TSF between 14 April and 21 October 2022.
- Tailings were deposited from the end-of-pipe outlet location during the 2022 dredging season.
  - A tailings beach above water area has developed at the south end of pond.
- An inspection of the pit wall stability from September 2022 is provided in WSP (2023).
- Construction for the SRF Intake from the Turnbull TSF to the Clode Pond was underway at the time of the AFPR site inspection.
- A bathymetry survey was conducted in October 2022.
- A dam safety review is in progress.

6.2 Summary of Climate and Water Balance

The climate data during the reporting period indicate the annual precipitation received for the Fording River (infilled) dataset was higher than the long-term annual average whereas the annual precipitation received at the Brownie Spoil weather station was lower than the long-term annual average.

Additional water volume is stored in the Turnbull TSF compared to design. This will not impact the total tailings storage volume of the facility, provided that this water can be pumped out in the future before the tailings storage

capacity is required to support dredging from the STP facility. FRO should continue executing plans to reduce stored water in the Turnbull TSF over the next year.

No facility performance issues associated with the precipitation observed on site or considering the water balance were noted during the reporting period.

6.3 Summary of Performance and Changes

Based on the visual observations during the 7 September 2022 site visit, the Turnbull TSF appeared safe with no deficiencies requiring immediate actions.

6.4 Consequence of Failure

The Turnbull TSF consequence of failure is High, considering the guidelines for consequence classification in Section 3.4 of the HSRC Guidance Document (Ministry of Energy and Mines 2016). The Turnbull TSF design has met or exceeded the requirements for such classification.

6.5 Recommendations

Table 11 summarizes the status of recommended actions from the 2021 annual inspection (Golder 2022). Completed actions are shown with grey shading. Items from the 2021 annual report that are incomplete have been brought forward into the 2022 AFPR recommendations. There are two new recommendations for the Turnbull TSF following the 2022 AFPR.

Table 11: Status of 2021 Recommended Actions and New Actions from the 2022 Annual Facility Performance Report for the Turnbull Tailing Storage Facility

ID Number	Deficiency or Non-conformance	Applicable Regulation or Guideline	Recommended Action	Priority Level	Recommended Timing for the Action	Status as of March 2023
2016-04	Risk of tailings exiting the facility via wave generated from pit wall and/or spoil failure not quantified	As input to satisfy permit conditions 2-a-i and 2-b-i (Ministry of Energy and Mines 2013) HSRC §10.1.11	Complete an update to the risk assessment. Use results of assessment from a wave exiting the facility to inform updates to the OMS manual, EPP and ERP to meet permit conditions.	2	Q3 2023	**In Progress**– – OMS manual updated, ERP and EPP updates in progress
2016-09	No dam safety review	HSRC §10.5.4	Complete dam safety review within 5 years of 2016 update to Part 10 of the HSRC.	3	2023	**In Progress**
2019-02	No inundation study completed	HSRC §10.1.11	Perform an inundation study for the TSF or use results of wave assessment to define a downstream inundation zone.	3	2023	**Incomplete** – updated recommended timing from 2022; need for inundation study to be determined following the updated risk assessment
2019-03	Undocumented stability hazard and unknown tailings and pond elevations at which current non-credible failure modes become credible	HSRC Guidance Document §4.4.1	Perform analyses to identify stability hazard for pit walls and tailings and pond elevations at which the current non-credible failure modes will become credible for the potential hazard of tailings or contaminated water exiting the facility due to debris from a pit wall or spoil failure generating a wave in the TSF.	3	2023	**In Progress**– updated recommended timing from 2022
2020-01	Debris collecting behind berm above tailings dredge pipeline	n/a	Remove debris collecting behind berm above tailings dredge pipeline.	4	2023	**Incomplete**– updated recommended timing from 2022
2020-04	OMS manual needs updating	HSRC §10.5.2	Items for the next annual update of the OMS manual should include: a) IDF volume (Golder 2021a). b) updated maximum operating pond level and QPOs from Section 2.6 of this report. c) addition of new QPO for piezometer GTF17-08 (03). d) frequency of bathymetry survey could be changed to once a year (currently twice a year). Description of deviations between design basis in 2012 (Golder 2012) and current operating conditions (from Section 2.2.1.2 of this report).	4	2022	**Complete**
2022-01	OMS manual needs updating	HSRC §10.5.2	Include visual inspections of seepage as part of routine pit slope / TSF monitoring. Update the OMS manual as required with any procedures that are not already documented. Update the OMS manual to include pit slope monitoring recommendations included in the 2022 Pit Slope Stability Review (WSP 2023), with input from the EoR and PSGE.	4	2023	**New Recommendation**
2022-02	Facility maintenance	-	Divert surface water away from the erosion gulley on the west side of the low wall if possible. Monitor the degree of catchment at the toe of the slope and clean out the rock fall roll-out berm beneath the gulley as required.	4	2023	**New Recommendation**

Note: Grey shaded rows indicate completed, superseded, or retracted actions.

IDF = inflow design flood; HSRC = Health, Safety and Reclamation Code; TSF = tailings storage facility; OMS = operation, maintenance, and surveillance; EPP = emergency preparedness plan; n/a = not applicable; EoR = Engineer of Record; FRO = Fording River Operations; QPO = quantifiable performance objective.

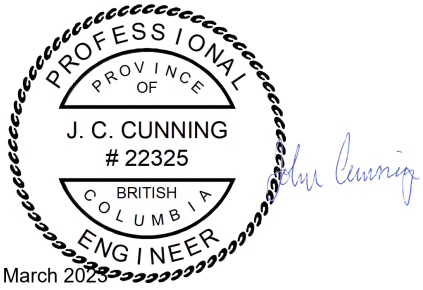
Priority Level	Description
1	A high probability or actual safety issue considered immediately dangerous to life, health or the environment, or a significant risk of regulatory enforcement.
2	If not corrected, could likely result in safety issues leading to injury, environmental impact or significant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

7.0 CLOSURE

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

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

WSP Canada Inc.



24 March 2023

Colin McGrath, B.A.Sc., P.Eng.
Geotechnical Engineer

John Cunning, M.Sc., P.Eng.
Fellow Geotechnical Engineer

CM/JCC/sd/anr/hp

PERMIT TO PRACTICE #1000200
Engineers & Geoscientists BC

https://golderassociates.sharepoint.com/sites/158990/project files/6 deliverables/issued/2022-119-r-rev0-1400- turnbull tsf afpr/22516328-2022-119-r-rev0-1000-turnbull tsf afpr 24mar_23.docx

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STUDY LIMITATIONS

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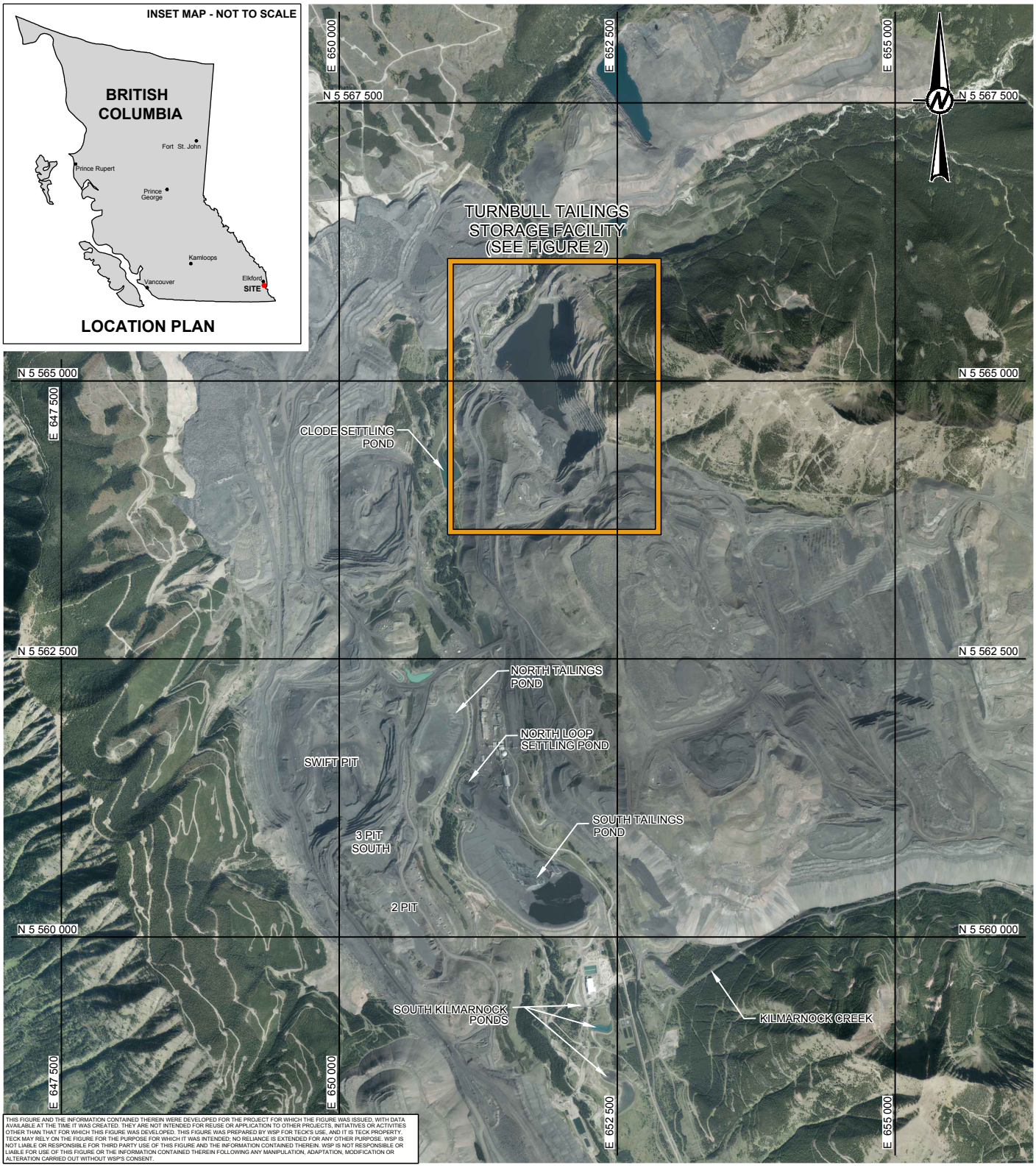
FIGURES



REFERENCE

1. 2021 AERIAL PHOTO PROVIDED BY TECK COAL LIMITED, RECEIVED: 12 OCTOBER 2021, DATE FLOWN: 22 JULY 2021.

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN UTM ZONE 11, ELEVATIONS ARE REFERENCED TO ELK VALLEY ELEVATION DATUM.

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

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
wsp

YYYY-MM-DD	2023-03-08
DESIGNED	P. AMINI-MOTLAGH
PREPARED	A. WANG
REVIEWED	C. MCGRATH
APPROVED	J. CUNNING

PROJECT
2022 ANNUAL FACILITY PERFORMANCE REPORT FOR TURNBULL TAILINGS STORAGE FACILITY

TITLE
FORDING RIVER OPERATIONS PLAN

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
22516328	1000/1400/2022-119	0	1

NOTES

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATES ARE IN UTM ZONE 11, ELEVATIONS ARE REFERENCED TO ELK VALLEY ELEVATION DATUM.
3. TOPOGRAPHIC CONTOURS SHOWN AT 5.0 m MINOR AND 25.0 m MAJOR INTERVAL.
4. BATHYMETRIC CONTOURS SHOWN AT 1.0 m MINOR AND 5.0 m MAJOR INTERVAL.

LEGEND

- TOPOGRAPHIC CONTOURS
- BATHYMETRY CONTOURS (SEE REFERENCE 8)
- DREDGE LINE
- TURNBULL SOUTH PIT LIMIT
- PIEZOMETER LOCATION
- POTABLE WELL LOCATION
- WATER QUALITY MONITORING LOCATION
- GPS MONITORING LOCATION
- ACTIVE PRISM LOCATION
- INACTIVE PRISM LOCATION
- 2022 PHOTOGRAPH LOCATION
- PRISM SURVEY STATION LOCATION
- LOW POINT IN BEDROCK AROUND PIT

REFERENCES

1. 2021 LIDAR TOPOGRAPHY AND AERIAL PHOTO PROVIDED BY TECK COAL LIMITED, RECEIVED: 12 OCTOBER 2021, DATE FLOWN: 22 JULY 2021.
2. GPS LOCATIONS FROM FRO'S GEOEXPLORER PROGRAM. ACCESSED 18 OCTOBER 2019.
3. POTABLE WELL LOCATIONS PROVIDED BY TECK COAL LIMITED, FORDING RIVER OPERATIONS IN 2010.
4. WATER QUALITY STATION LOCATIONS PROVIDED BY TECK COAL LIMITED, FORDING RIVER OPERATIONS ON 17 OCTOBER 2019.
5. 2012 PIEZOMETER LOCATIONS PROVIDED BY TECK COAL LIMITED, FORDING RIVER OPERATIONS IN 2012.
6. BEDROCK LOW POINT PROVIDED BY FRO. 2018. TURNBULL TSF NORTHWEST ENDWALL GPR SURVEY RESULTS FOR BEDROCK DELINEATION. DRAFT RECEIVED 12 DECEMBER 2018.
7. 2017 PIEZOMETER LOCATIONS PROVIDED BY TECK COAL LIMITED, FORDING RIVER OPERATIONS IN 2017.
8. 2022 BATHYMETRY SURVEY CONDUCTED BY GOLDER ON 6-7 OCTOBER 2022.
9. PRISM LOCATIONS WERE PROVIDED BY TECK COAL LIMITED FORDING RIVER OPERATIONS ON 19 OCTOBER 2020.

0 125 250
1:7,500 METRES

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT
wsp

YYYY-MM-DD	2023-03-08
DESIGNED	P. AMINI-MOTLAGH
PREPARED	A. WANG
REVIEWED	C. MCGRATH
APPROVED	J. CUNNING

PROJECT
2022 ANNUAL FACILITY PERFORMANCE REPORT FOR TURNBULL TAILINGS STORAGE FACILITY

TITLE
2022 SITE INSPECTION PHOTOGRAPH AND MONITORING LOCATIONS

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
22516328	1000/1400/2022-119	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
0 25 mm

WEST

EAST

SCALE 1:3,000 m

A
2

TURNBULL SOUTH PIT - CROSS-SECTION

0 50 100
1:3,000 METRES

LEGEND

- 2021 AS-BUILT GROUND SURFACE (SEE REFERENCE 1)
- 2022 BATHYMETRY SURVEY (SEE REFERENCE 4)
- TURNBULL SOUTH PIT AS-BUILT (SEE REFERENCE 3)
- CURRENT WATER LEVEL (SEE REFERENCE 2)

NOTE

1. ALL UNITS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. ELEVATIONS ARE REFERENCED TO ELK VALLEY ELEVATION DATUM.

REFERENCES

1. 2021 LIDAR TOPOGRAPHY PROVIDED BY TECK COAL LIMITED, RECEIVED: 12 OCTOBER 2021, DATE FLOWN: 22 JULY 2021.
2. POND ELEVATION DATA FROM GEOEXPLORER. DOWNLOADED BY WSP GOLDER ON 1 SEPTEMBER 2022.
3. AS-BUILT TURNBULL SOUTH PIT SHELL CREATED USING 3D FACES PROVIDED BY TECK COAL LIMITED, FORDING RIVER OPERATIONS. RECEIVED: 11 APRIL 2018.
4. 2022 BATHYMETRY SURVEY CONDUCTED BY GOLDER ON 6-7 OCTOBER 2022.

CLIENT
TECK COAL LIMITED
FORDING RIVER OPERATIONS
ELKFORD, B.C.

CONSULTANT

YYYY-MM-DD	2023-03-08
DESIGNED	P. AMINI-MOTLAGH
PREPARED	A. WANG
REVIEWED	C. MCGRATH
APPROVED	J. CUNNING

PROJECT
2022 ANNUAL FACILITY PERFORMANCE REPORT FOR
TURNBULL TAILINGS STORAGE FACILITY

TITLE
CROSS-SECTION A

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
22516328	1000/1400/2022-119	0	3

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

0 25 mm

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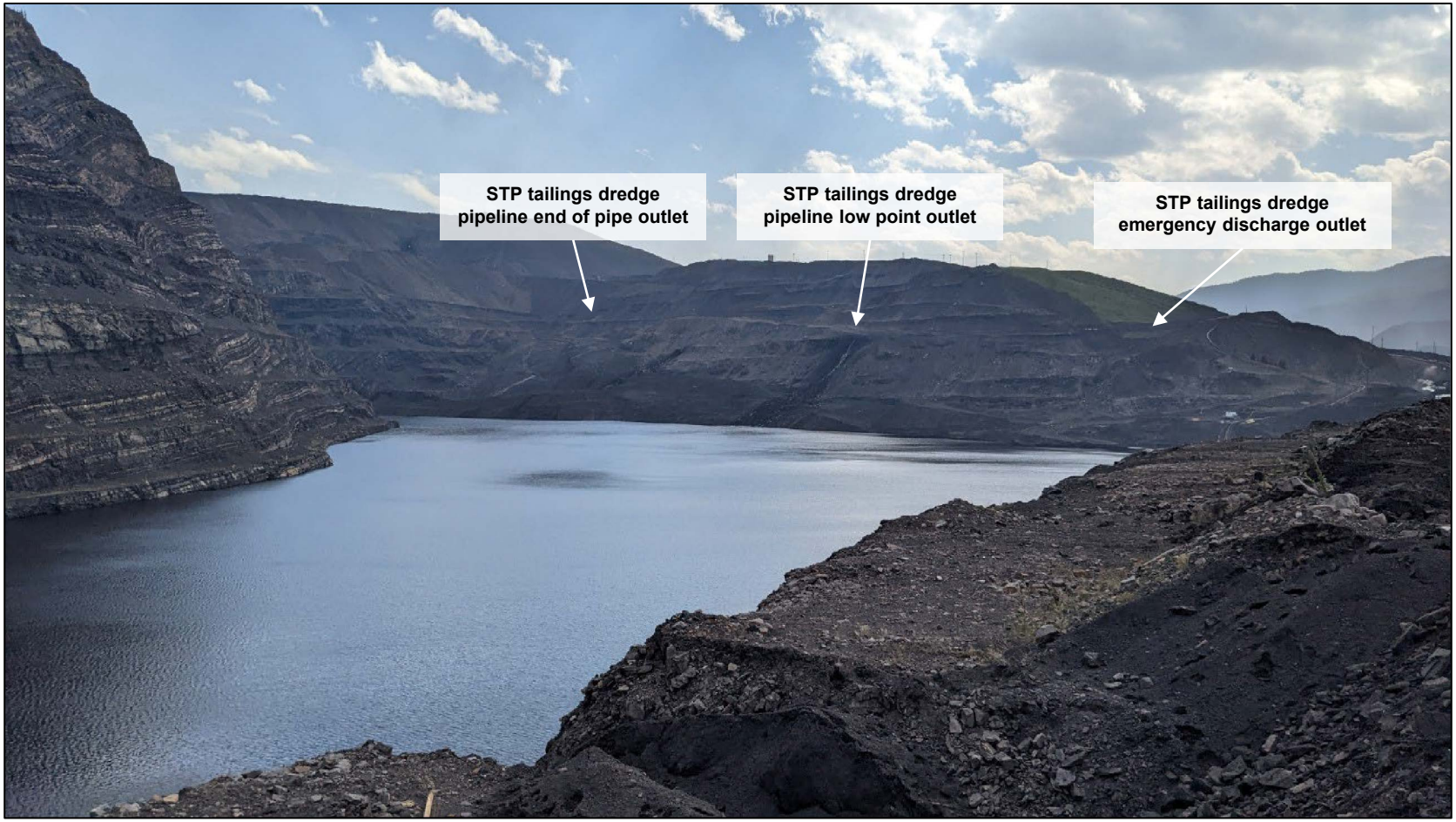
APPENDIX A

Site Photographs

PHOTOGRAPH 1 **7 September 2022**



Turnbull TSF: Overview from north endwall, looking south.

PHOTOGRAPH 2 **7 September 2022**

Turnbull TSF pond, reclaim water intakes, and pipelines, looking north.

PHOTOGRAPH 3 **7 September 2022**

Discharge of tailings from the South Tailings Pond at the tailings dredge pipeline end of the pipe outlet into the Turnbull TSF, looking southeast.

PHOTOGRAPH 4 **7 September 2022**

Tailings deposition and in-pit spoils below the tailings pipeline end of the pipe outlet, looking east.

PHOTOGRAPH 5 **7 September 2022**

Discharge of tailings from the South Tailings Pond through the tailings dredge pipeline low point outlet into the Turnbull TSF, looking southeast.

PHOTOGRAPH 6 **7 September 2022**

Turnbull TSF waste rock benched slope above the tailings pipelines on the low wall, looking northwest.

PHOTOGRAPH 7 **7 September 2022**

Waste rockfill and haul road, which is the topographic low point (saddle area) of the Turnbull TSF, looking southwest.

PHOTOGRAPH 8 **7 September 2022**

Turnbull TSF view of the downstream slope, Fording River, and the toe of the low point area waste rockfill, looking northeast.

PHOTOGRAPH 9 **7 September 2022**

Turnbull TSF: View of the downstream slope and toe of the low point area waste rockfill, looking southwest.

APPENDIX B

Turnbull TSF Inspection Report

Client:	**Teck Coal Limited, Fording River Operations**	**By:**	**Colin McGrath, P.Eng.**
Project:	**22516328 – 2022 Annual Facility Performance Report**	**Date:**	**7 September 2022**
Location:	**Turnbull Tailings Storage Facility**	**Reviewed By:**	**John Cunning, P.Eng.**

GENERAL INFORMATION			
Dam Type:	Waste Rockfill		
Weather:	Sunny, moderate winds	**Temp:**	20-25°C

INSPECTION ITEM		OBSERVATIONS/DATA	PHOTO	COMMENTS & OTHER DATA
1.0	**DAM CREST**			
1.1	Crest Elevation	elev. 1,691 m (2021 LiDAR)		From lowest topography in backfill spoil area.
1.2	Reservoir Level/ Freeboard	Reservoir level at elev. 1,669.4 m (31 August 2022) 11.6 m freeboard		Turnbull TSF maximum pond is controlled by low point of mined out bedrock at elev. 1,681 m; freeboard reported is measured from the bedrock low point.
1.3	Surface Cracking	None		
1.4	Unexpected Settlement	None		
1.5	Lateral Movement	None		
1.6	Other Unusual Conditions	Excavations in rockfill currently being made in the crest area for construction of a new water reclaim line.		Crest area is an old haul road, now access road and a laydown area for equipment and pumping infrastructure.
2.0	**UPSTREAM SLOPE**			
2.1	Slope Angle	1.3H:1V		Backfill spoils over Turnbull pit footwall, safety berm at crest of pit wall.
2.2	Signs of Erosion	None		
2.3	Signs of Movement (Deformation)	None		
2.4	Cracks	None		
2.5	Face Liner Condition (if applicable)	Not applicable		
2.6	Other Unusual Conditions	None		
3.0	**DOWNSTREAM SLOPE**			
3.1	Slope Angle	1.3H:1V		
3.2	Signs of Erosion	None		

3.3	Signs of Movement (Deformation)	None		
3.4	Cracks	None		
3.5	Seepage or Wet Areas	None		
3.6	Vegetation Growth	None		
3.7	Other Unusual Conditions	None		
4.0	**DOWNSTREAM TOE AREA**			Fording River and Turnbull multiplate located in downstream toe area.
4.1	Seepage from Dam	None		
4.2	Signs of Erosion	None		
4.3	Signs of Turbidity in Seepage Water	Not applicable		
4.4	Discoloration/Staining	Not applicable		
4.5	Outlet Operating Problem (if applicable)	Not applicable		
4.6	Other Unusual Conditions	None		
5.0	**ABUTMENTS**			
5.1	Seepage at Contact Zone (Abutment/ Embankment)	None		
5.2	Signs of Erosion	None		
5.3	Vegetation Growth	None		
5.4	Presence of Rodent Burrows	None		
5.5	Other Unusual Conditions	None		
6.0	**RESERVOIR**			
6.1	Stability of Slopes	Good		Monitoring in place
6.2	Distance to Nearest Slide (if applicable)	500 m		Turnbull pit highwall
6.3	Estimate of Slide Volume (if applicable)	7,600,000 m^3		(Golder 2019)
6.4	Floating Debris	None		
6.5	Sediment	Sub-aerial beach forming at south end of facility.		
6.6	Other Unusual Conditions	Floating pipes		
7.0	**EMERGENCY SPILLWAY/ OUTLET STRUCTURE**	None		
8.0	**INSTRUMENTATION**			

8.1	GPS			6 GPS units installed on the in-pit spoils, the highwall, north end wall, and south end wall of the TBS Pit. 5 are active.
8.2	Prisms			26 active prisms and 2 backsights.
8.3	Piezometers			Vibrating wire (VW) piezometers at 5 locations within the highwall of the Turnbull TSF.
9.0	**DOCUMENTATION**			
9.1	Operation, Maintenance and Surveillance (OMS) Manual	Yes		Turnbull Tailings Storage Facility OMS Manual.
9.1.1	OMS Manual Reflects Current Dam Conditions	Yes		
9.1.2	Date of Last Revision	November 2022		Version 2022-11 (FRO 2022).
9.2	Emergency Response Plan (ERP)	Yes		Turnbull TSF included in site tailings facilities ERP. (EP.009.R1) (FRO 2020a).
9.2.1	ERP Reflects Current Conditions	Yes		
9.2.2	Date of Last Revision	25 May 2020		
10.0	**NOTES** • Tailings is being discharged from the dredge pipeline at the end of pipe outlet; small portion of flow is being discharged from the low point outlet. • Construction / excavation being conducted on the crest of the saddle for a new water reclaim line. • Sub-aerial beach forming at south end of facility.			
Inspectors:		Colin McGrath, P.Eng., and John Cunning, P.Eng.	**Date:**	7 September 2022

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