2022 Annual Facility Performance Report

Red Dog Tailings Storage Facility

Red Dog Mine, Alaska

Submitted to:

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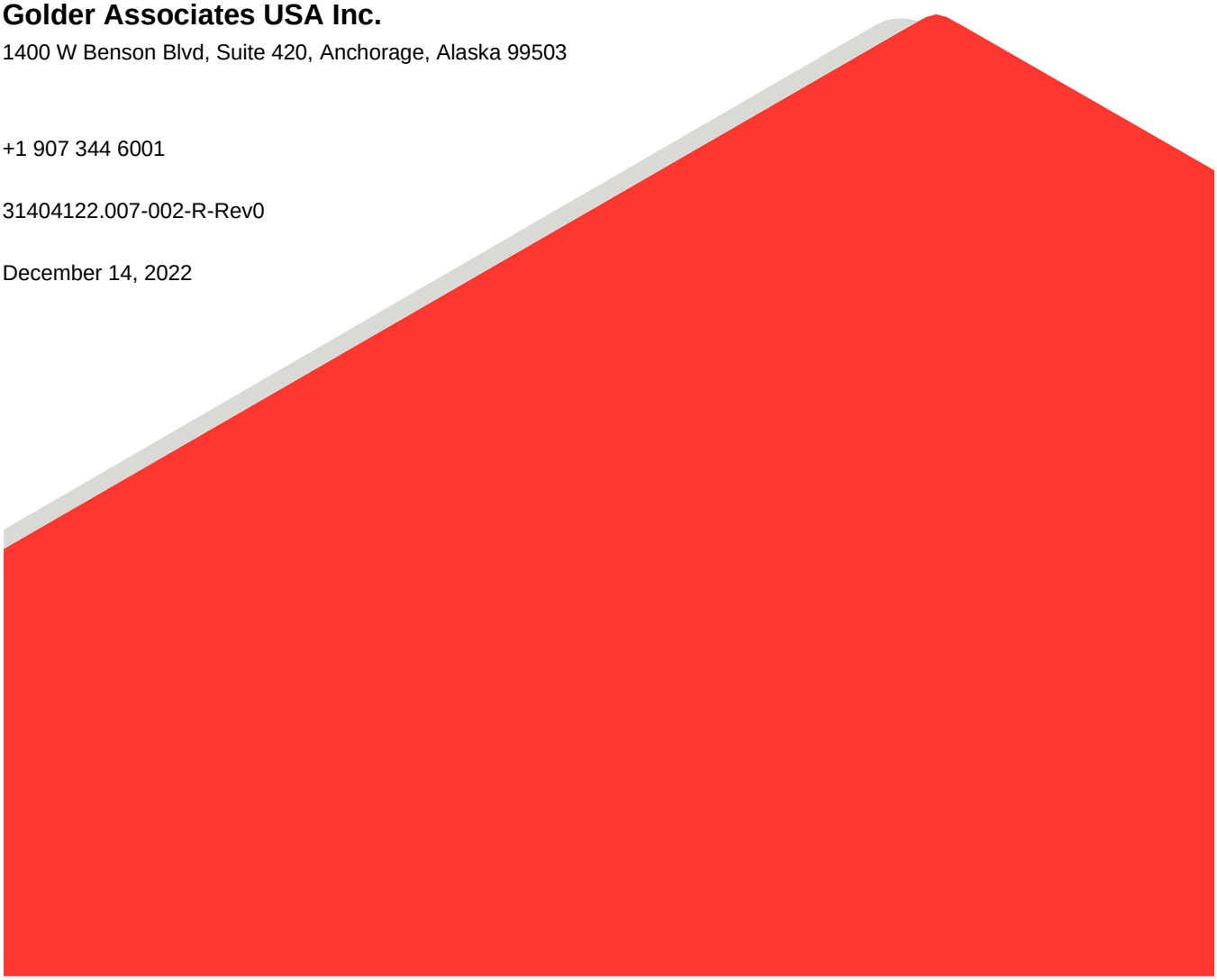

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Executive Summary

Golder Associates USA Inc. (Golder), a member of WSP, was contracted by Teck Alaska Incorporated (TAK) to complete the 2022 Annual Facility Performance Report (AFPR) for the Tailings Storage Facility (TSF) located at the Red Dog Mine, Alaska. The Red Dog TSF is an active facility, located above the Arctic Circle and about 90 miles north of Kotzebue, Alaska, that was initially constructed and operational beginning in 1988. The AFPR includes review of the Tailings Main Dam (TMD) and Tailings Back Dam (TBD) and their associated components for the period from June 2021 through August 2022. The site visit to inspect the Red Dog TSF was performed by Golder with accompaniment by TAK Dam Safety personnel on August 3, 2022.

A description of the dams including their National Inventory of Dams (NID) numbers is summarized in Table E-1. The TMD and TBD are currently permitted to operate through the Alaskan agencies at their respective Stage XI and Stage IV configurations.

Table E-1: Summary of Dam Descriptions

Retaining Dam	NID Number	Description
TMD	AK00201	Zoned gravel and rockfill embankment dam constructed using downstream methods with upstream geomembrane liner seepage barrier that lies over or is keyed into bedrock
TBD	AK00303	Gravel and rockfill embankment dam constructed using centerline method with central plastic (ductile) concrete seepage barrier that is keyed into bedrock

Performance of the Red Dog TSF dams is assessed based on compliance with design criteria, comparison of actual conditions to design assumptions, consistency between measured response and expected behavior, and the presence or absence of potential dam safety concern indictors. Measured response refers to instrumentation readings and visual observations during inspections, and expected response is based on interpretation of historic measured response. On this basis, the performance of the dams during the review period was satisfactory and acceptable, meeting the design intent.

The significant changes that have occurred for the Red Dog TSF over the review period included completion of the TMD Stage XI raise construction and update of the associated TMD Operations and Maintenance (O&M) Manual, initiation of the TMD Stage XII raise and TBD Stage V raise construction, adoption of a new Low Distortion Projection (LDP) coordinate system that has replaced the previous local mine grid system, and completion of the Operation, Maintenance & Surveillance (OMS) Manual (TAK 2021) and the Emergency Preparedness & Response Plan (EPRP).

The surveillance program described in the current OMS and O&M Manuals is appropriate for the facility. The surveillance program includes routine visual inspection and maintenance, measured behavior, routine performance reviews, and a trigger-action-response-plan (TARP). The TARP includes three levels that represent potentially increasing levels of concern that would be initiated as a result of an unusual visual or qualitative

indicator and potentially lead to routine engineering review, design assumption deviation up to initiation of the emergency response plan (ERP).

The recently completed EPRP is appropriate for the Red Dog TSF. The annual EPRP orientation exercise was completed on November 26, 2022.

Key observations from the 2022 AFPR, both visual and through review of instrumentation data, included:

- The TSF is being appropriately operated and maintained.
- Visual inspections have been appropriately carried out in accordance with the OMS.
- The tailings beach at the TMD was at or beyond the targeted widths during the site inspection.
- The tailings pond level during the review period did not exceed the maximum operating level with a maximum that was 2.8 ft below the maximum operating level and 7.8 ft below that permitted seal elevation.
- Monitoring instrument levels were similar to historic readings and mainly remained below their TARP thresholds. The only exceedance of TARP thresholds occurred at the TBD but none of these incidents posed a dam safety concern following review and two of these thresholds are being evaluated for revision.

Recommendations from the 2022 AFPR included only best management practice improvements that were not related to dam safety and performance deficiencies.

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1.0 INTRODUCTION

Golder Associates USA Inc. (Golder), a member of WSP, was contracted by Teck Alaska Incorporated (TAK) to complete the 2022 Annual Facility Performance Report (AFPR) for the Tailings Storage Facility (TSF) located at the Red Dog Mine, Alaska. The Red Dog TSF is an active facility, located above the Arctic Circle and about 90 miles north of Kotzebue, Alaska, that was initially constructed and operational beginning in 1988 and is currently impounded by the Tailings Main Dam (TMD) to the north and Tailings Back Dam (TBD) to the south. The AFPR includes review of the TMD and TBD for the period from June 2021 through August 2022. Table 1.1 summarizes the dams' national identification numbers (NIDs) and their relative TSF locations. A layout of the facility is shown in Figure 1.1.

Table 1.1: Red Dog TSF Structures

Retaining Dam	NID	Location
TMD	AK00201	North Side of TSF
TBD	AK00303	South Side of TSF

Figure 1.1: TSF Configuration – July 10, 2022

The 2022 AFPR scope of work consisted of:

- Visual inspection of the physical condition of the dams and their associated components.
- Review of monthly and quarterly instrumentation monitoring reports prepared by TAK for the review period.
- Review of climate and water balance data for the site provided by TAK.
- Review of the TBD and TMD Operations and Maintenance (O&M) Manuals prepared by Golder (2020 and 2021, respectively), the TSF Operations, Maintenance, and Surveillance (OMS) Manual prepared by TAK (2021), and the TSF Emergency Preparedness and Response Plan (EPRP) prepared by TAK (2022) to confirm they are appropriate for the facility.
- Review of the most recent risk assessment that is relevant to the TSF (TAK 2022c).
- Review of additional activities (construction, tailings deposition, maintenance, etc.) completed at the site during the review period.

The inspection and this report were performed to comply with the guidelines from the Alaska Department of Natural Resources, Dam Safety and Construction Unit (ADNR Dam Safety 2017), the guidelines from Teck Resources Limited (Teck 2019), the guidelines and associated technical bulletins from the Canadian Dam Association (CDA 2007, 2013), and the guidelines from the Mining Association of Canada (MAC 2019).

The inspection was completed on August 3, 2022 by Golder representatives Mr. Steven L. Anderson, PE and Mr. Benjamin Schmidt, PE, who are the Engineer of Record (EoR) and deputy EoR, respectively, for the Red Dog TSF. The Golder team was accompanied by TAK's Dam Safety Engineers Mr. Bryce Hiles, EIT and Mr. Tenaya Brown, along with Mr. Tom Krzewinski, PE who is the Senior Technical Reviewer for the Golder design team. During the inspection the weather was sunny as was the weather the day before the inspection. Designated roles related to tailings management for the Red Dog TSF at the end of the review period as outlined in the OMS and EPRP were filled by:

- Responsible Tailings Facility Engineer (RTFE) – Mr. Tyler Oester, TAK Senior Lead Sustainability
- Responsible Person (RP) – Mr. Mike Gonzales, TAK Manager, Concentrator, Tailings & Environment

The State of Alaska presides as the primary government regulatory body for the Red Dog TSF. Conditions for operation of the TSF structures listed in Table 1.1 are defined by a "Certificate of Approval to Operate a Dam" that contains the pertinent requirements unique to each dam including special conditions that must be adhered to for ensuring the dam is compliant within the bounds of applicable Alaska laws and regulations. A summary of the permits related to the TSF are presented below in Table 1.2.

Table 1.2: Permit Requirements

Agency	Title	Description
Alaska Department of Natural Resources (ADNR)	Certificate of Approval to Operate a Dam	Authorization for operation of the dams
	Certificate of Approval to Modify a Dam	Authorization for modifications in design, operations, maintenance, and surveillance of the dams during the modification process (such as a dam raise)
	Red Dog Mine Reclamation and Closure Plan Approval	Covers Red Dog Closure and Reclamation and all supporting documents listed in approval

Agency	Title	Description
Alaska Department of Environmental Conservation (ADEC)	Waste Management Permit	- Regulates disposal of tailings to TSF, waste rock, and municipal solid waste - Regulates groundwater and surface water collection, treatment, and monitoring systems

2.0 FACILITY DESCRIPTION

The Red Dog TSF is located along the South Fork of Red Dog Creek, lying southwest of the Mill facilities and extending southward. The TMD forms the northern containment of the TSF, and the TBD forms the southern containment. The TSF has a normal storage capacity of approximately 17,600 million gallons (Mgal) at its permitted freeboard limit and a maximum storage capacity of approximately 18,800 Mgal at the permitted seal elevation. Typical geometry and dimensions of the dams and their associated structures are summarized in Table 1.3.

Table 2.1: Summary of Approximate Dam or Dam Component Geometry

Dam or Dam Component	Dam Construction Raise Method	Current Permitted Dam Stage	Permitted Crest Elevation [1] (ft)	Maximum Height (ft)	Crest Length (ft)	Crest Width (ft)	Downstream Slope	Upstream Slope
TMD Embankment	Downstream	Stage XI	997.4	207	3,010	42	2.5H:1V (above buttress) 2H:1V (below buttress)	1.8H:1V and flatter
TMD Wing Wall	Downstream	Stage XI	997.4	36	3,040	58 to >100	2.5H:1V	1.8H:1V and flatter
TMD Seepage Collection Dam (associated component)	Downstream	N/A	806.4	25	380	20	2.5H:1V	2.5H:1V
TBD	Centerline	Stage IV	997.4	36 [2]	5,275 [2]	67.5 [2]	3H:1V	2.5H:1V

Notes:

1. Elevations refer to Low Distortion Projection (LDP) coordinate system and a NAVD 88 elevation datum.
2. TBD Stage V-A dimensions during site inspection.

Tailings are deposited into the TSF using both subaqueous and subaerial methods, with subaerial methods generally used for development of the tailings beach at the TMD. The TMD tailings beach is intended to reduce seepage through the Embankment Stage I Starter Dam and provide upstream seismic stability along the southern leg of the Wing Wall.

2.1 Overview and Design Basis

An overview of the two tailings and water retaining structures at either end of the TSF are provided below. The dams are designed to comply with applicable State of Alaska Administrative Codes and Statutes and TAKs internal standards (Teck 2019). The maximum design earthquake and inflow design flood comply with the Global Industry Standards on Tailings Management (GISTM) (GTR 2020).

2.1.1 Tailings Main Dam

The TMD is a downstream construction zoned gravel and rockfill dam with a 100-mil high-density polyethylene (HDPE) geomembrane-lined upstream face that lies over or is tied into bedrock. The TMD is composed of the Embankment and the Wing Wall. The Embankment is primarily a valley fill structure located in the South Fork of Red Dog Creek (Figure 2.1). The Wing Wall is an extension of the Embankment along the northeastern (north leg) and eastern sides (south leg) of the TSF (Figure 2.2). Typical sections through the Embankment and Wing Wall are shown in Figure 2.3. Monitoring instrument locations are shown in Figures 2.1 and 2.2.

A Seepage Collection Pond (SCP) and associated rock drain and pumping chambers is located along the downstream toe of the Embankment. A shear key and a buttress were added to the Stage X Embankment to improve stability, which has been extended downstream with additional stages. Potentially liquefiable soils within the Wing Wall foundation have been mitigated through construction of a series of cutter soil mixer (CSM) barrettes along the north leg of the Wing Wall and with buttressing and infilling along the Wing Wall southern leg.

2.1.2 Tailings Back Dam

The TBD is located north of the Kivalina Overburden Stockpile (KOB), which lies across the watershed divide between the South Fork of Red Dog Creek and the Bons Creek drainages. The TBD is a centerline construction gravel fill and rockfill embankment dam with a plastic (ductile) concrete cut-off wall (COW) through the center of the embankment and keyed into bedrock. The Stage I TBD was initially constructed from 2007 to 2010. A 28-ft wide insulated section composed of gravel fill and board insulation lies over the COW to protect it from freeze-thaw degradation. An aerial view of the TBD is shown in Figure 2.4 that also shows location of monitoring instruments, and a typical section is shown in Figure 2.5.

The TBD seepage collection system is located on the downstream side of the COW and is composed of a vertical sump and pump to capture seepage so that it does not cross over the watershed divide and enter the Bons Creek drainage. Aggraded permafrost within the KOB forms the secondary seepage barrier for the seepage collection system.

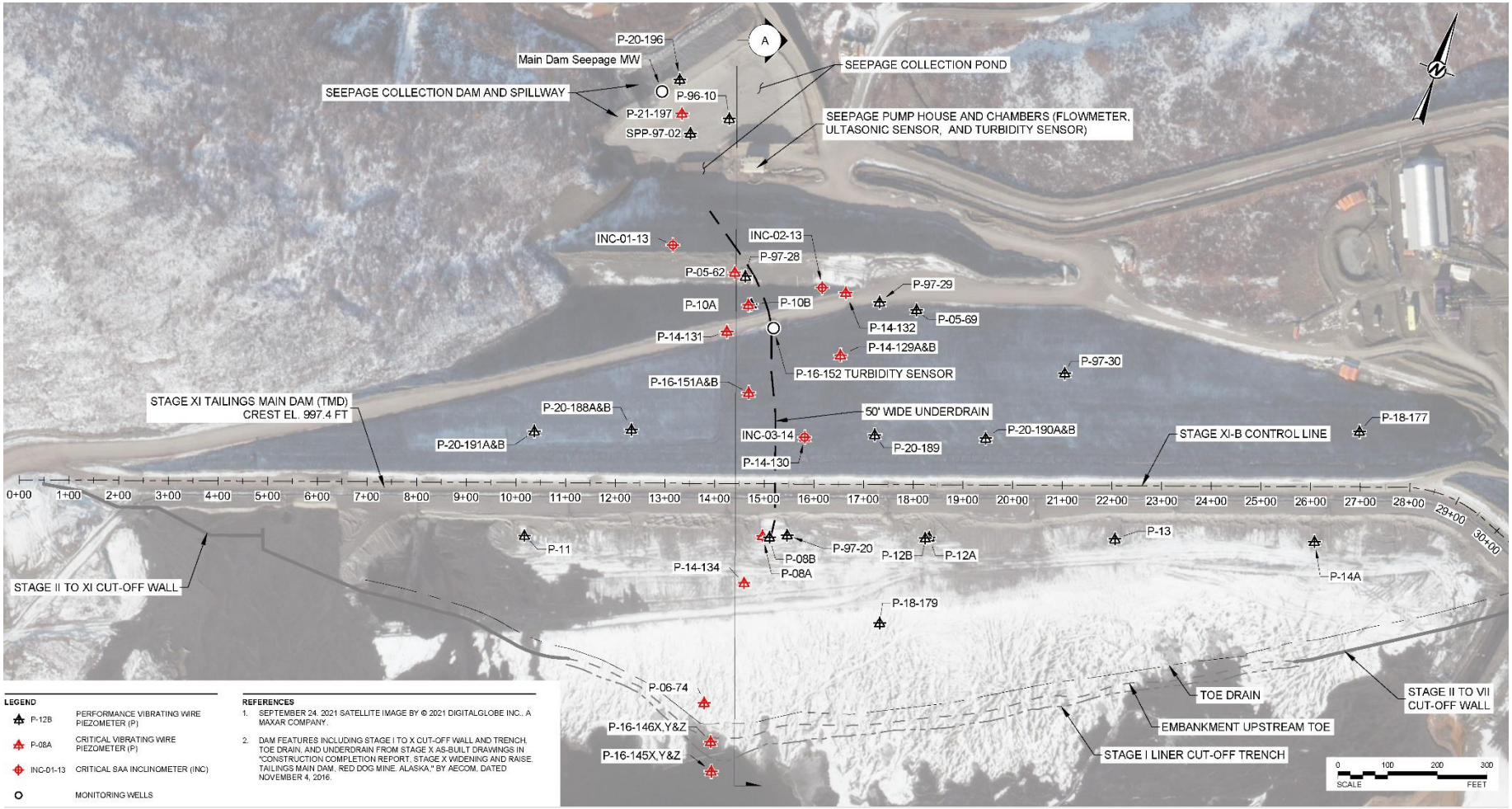

Figure 2.1: TMD Embankment - Plan View

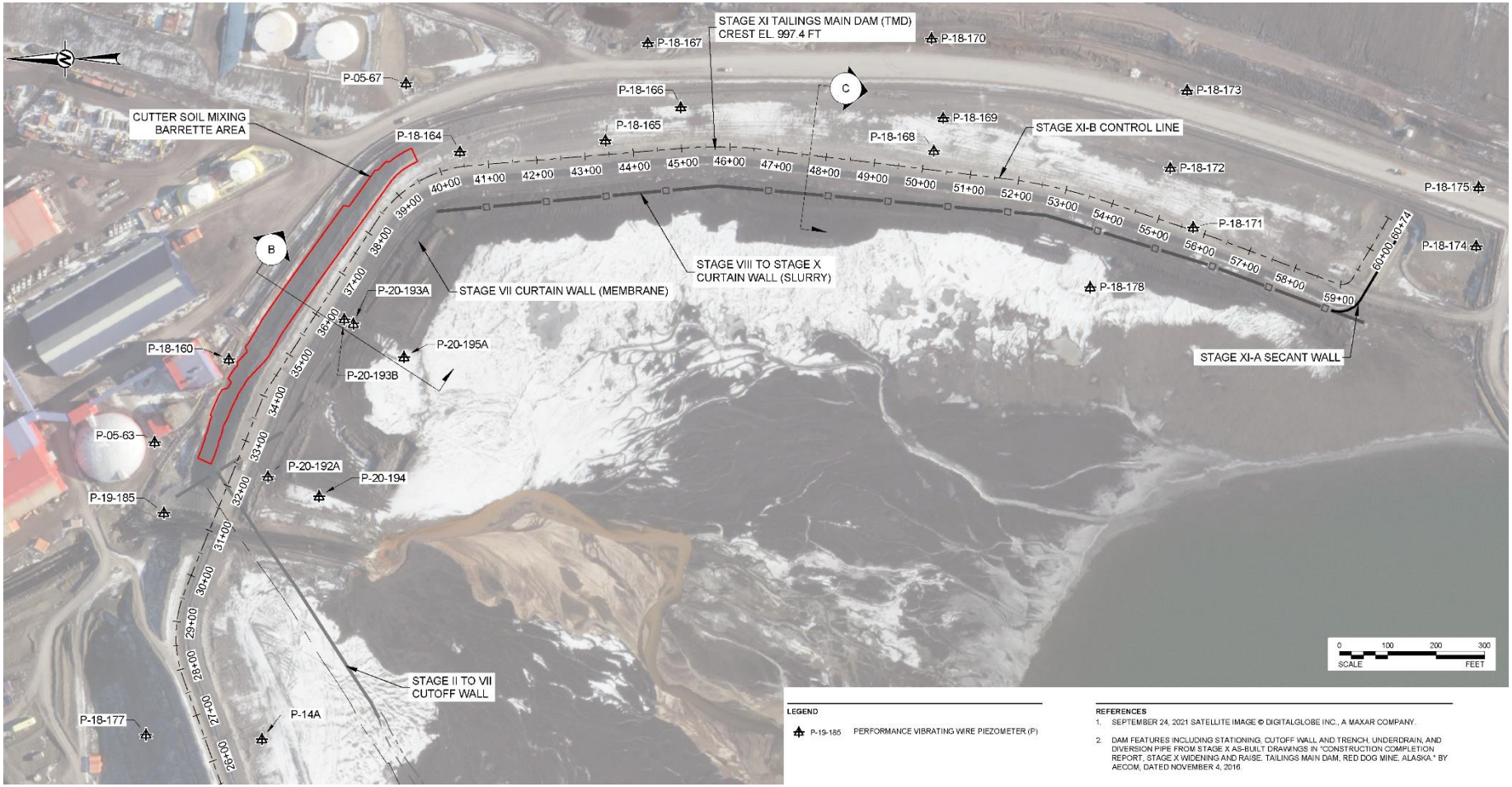

Figure 2.2: TMD Wing Wall - Plan View

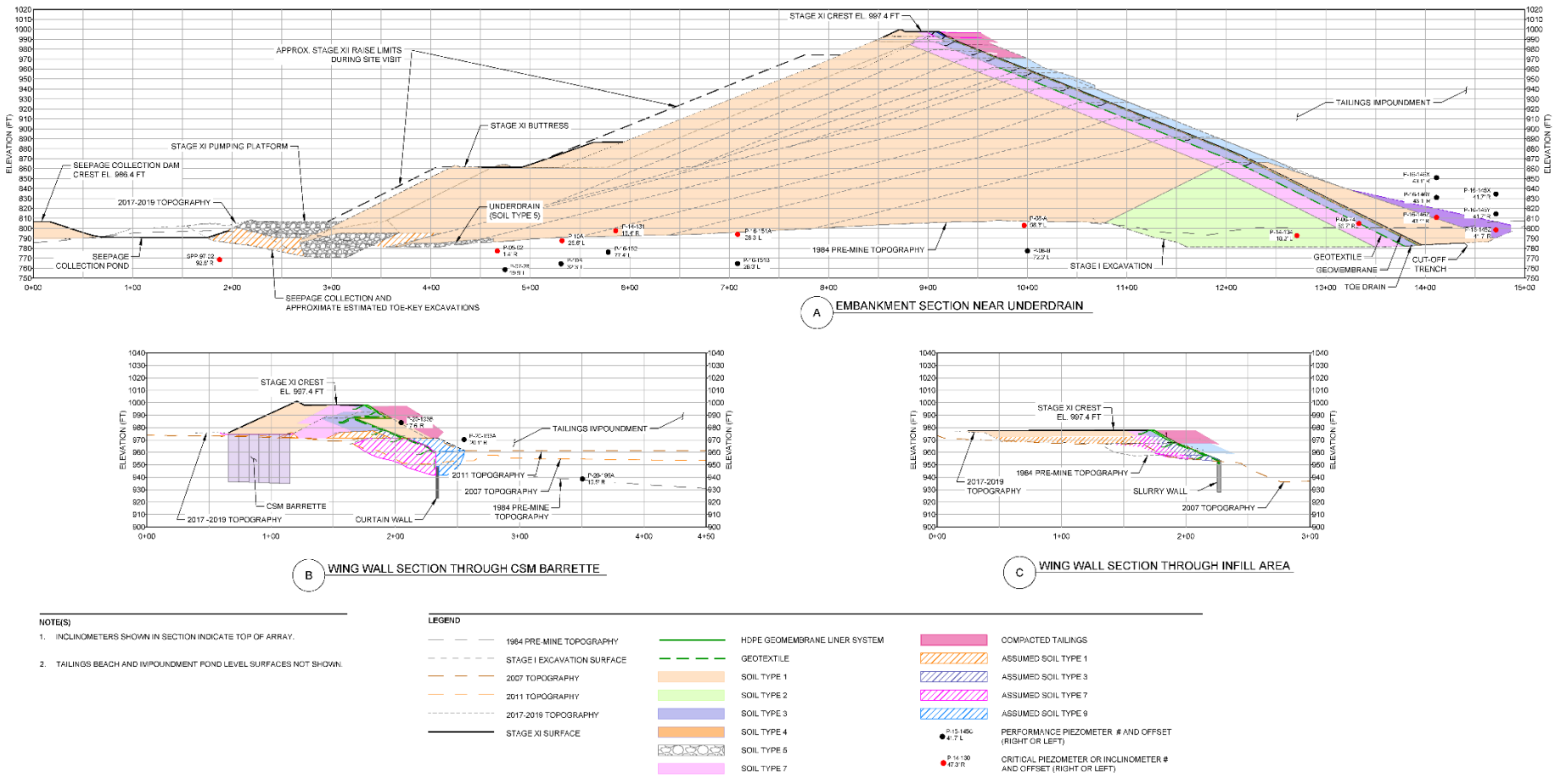

Figure 2.3: Typical TMD Sections at Embankment (A) and Wing Wall (B and C)

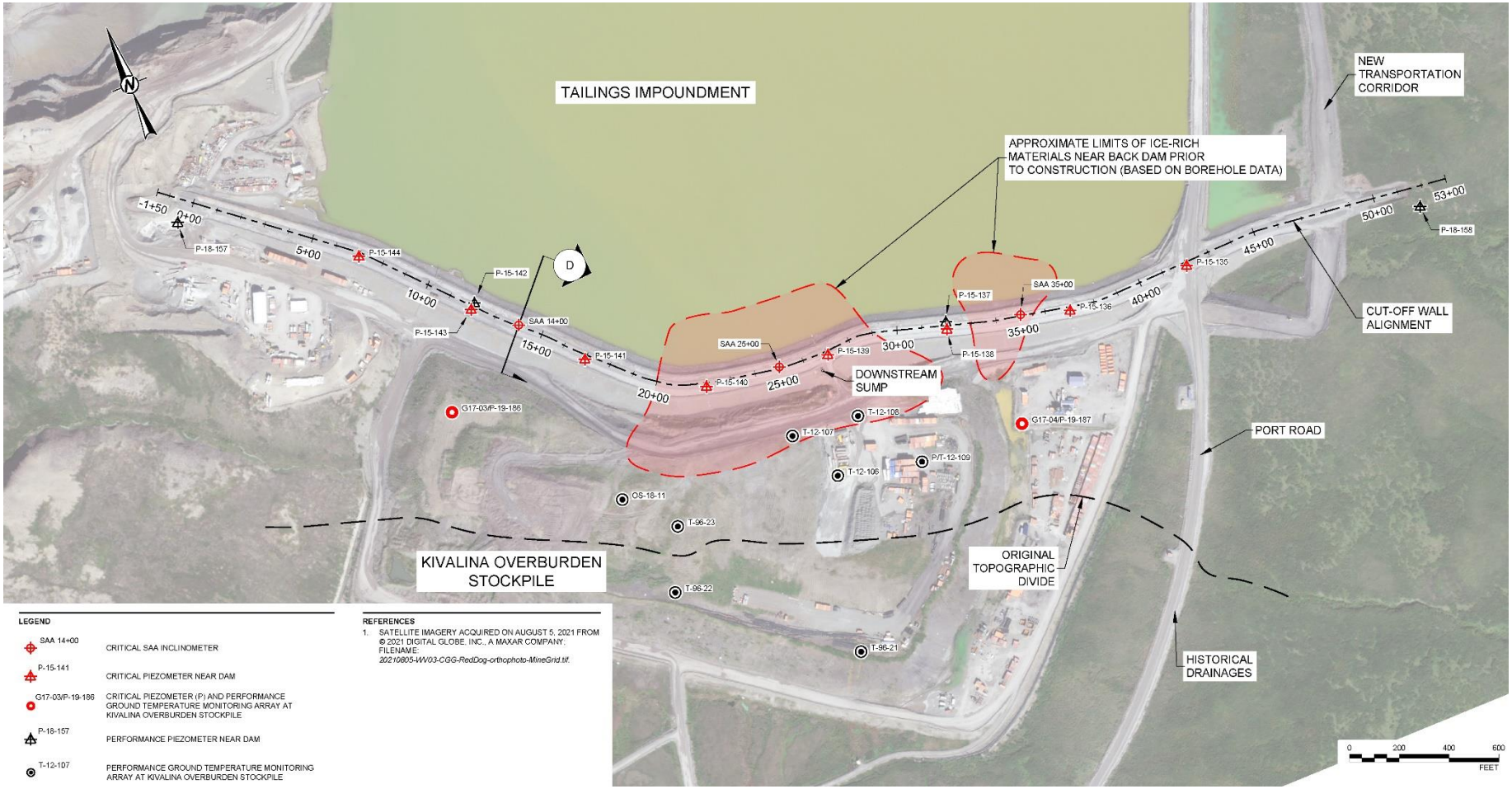

Figure 2.4: TBD - Plan View

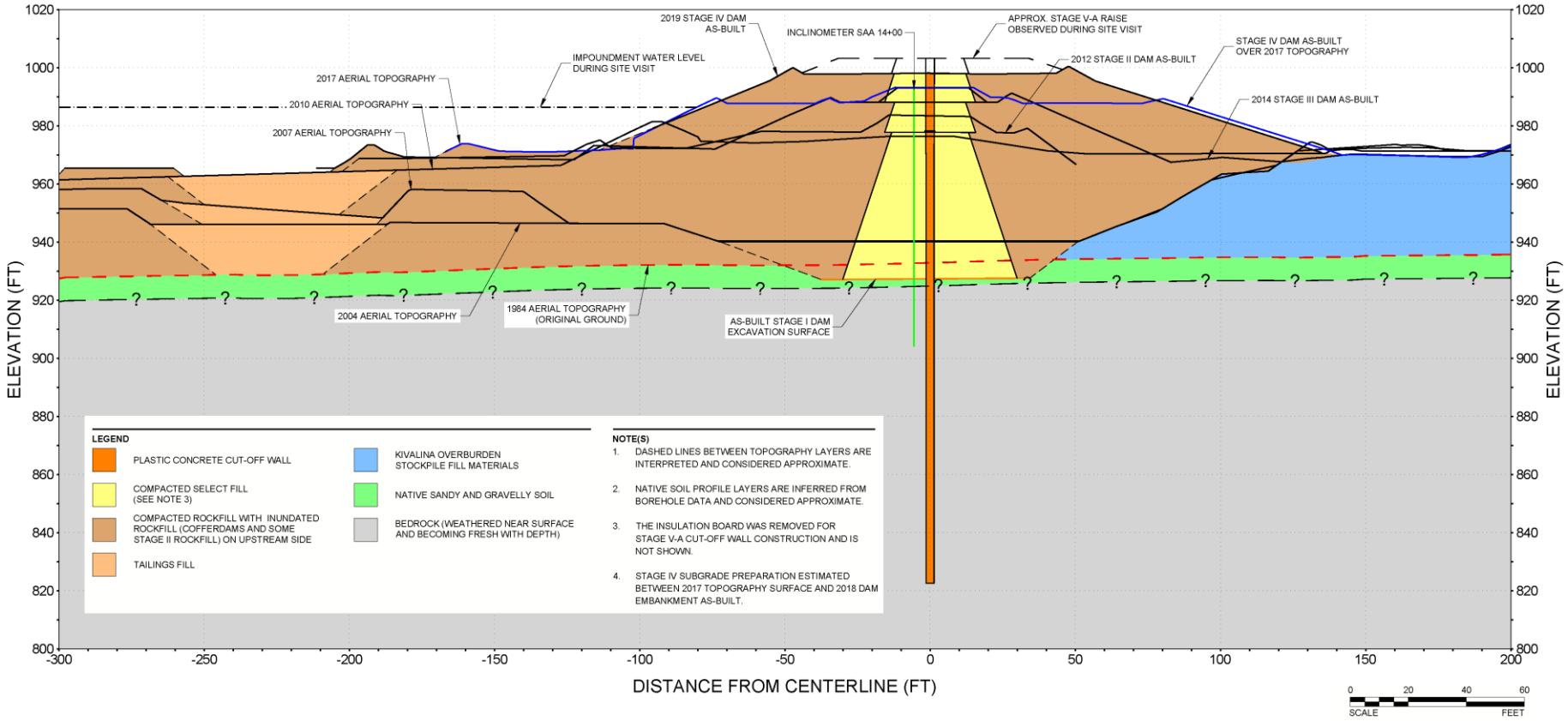

Figure 2.5: Typical TBD Section (D)

2.2 Construction Activities

Construction activities that occurred over the review period included the following:

- Completion of the TMD Stage XI-B raise construction (current crest elevation) that began in May 2021 and finished in October 2021. Construction included raising the dam to its current permitted crest elevation of 997.4 ft and expansion of the SCP to its current configuration.
- Completion of the TBD embankment raise to its Stage V-A crest elevation of 1,002.9 ft that began in May 2021 and finished in September 2021. Construction included raising of the dam fill materials and replacement of the insulation layer only, but not construction of the COW.
- Construction of the TMD Stage XII Embankment widening that was on going at the time of inspection.
- Construction of the Stage V-A COW to a minimum elevation of 1,002.4 ft that was ongoing at the time of inspection. Construction includes extension of the east abutment to the Stage V-B configuration and completion of the new transportation corridor that also crosses the east part of the TBD.

3.0 WATER MANAGEMENT

3.1 Climate Data Summary and Review

TAK provided climate data from the Bons Creek Weather Station near the site airport. A comparison of the 2022 monthly air temperature and precipitation data with historic data is shown in Appendix A, Figures A-1 and A-2. Maximum and mean monthly air temperatures in 2022 were warmer than historic averages for March and April, but otherwise were near historic averages. Monthly cumulative precipitation in 2021 met or exceeded maximum historical precipitation in June and July and were above average in August and December. Monthly cumulative precipitation in 2022 has typically been below historical averages, but April and June 2022 were wetter than average.

3.2 Freeboard and Storage

Since there is no spillway, precipitation from flood events that are not diverted enter and must be contained within the TSF. A minimum freeboard of 5 ft below the dam's permitted crest elevation (currently at 997.4 ft) is required through permit to contain the inflow design flood (IDF), which is the 24-hr rain-on-snow probable maximum precipitation (PMP) event, plus wind setup and wave runup (Golder 2019). The IDF meets the criteria established by the Alaska Dam Safety Program (ADNR Dam Safety 2017) and the GISTM (GTR 2020). The minimum 5 ft of freeboard from the permitted dam crest elevation sets the maximum operating level to an elevation of 992.4 ft.

During our site inspection on August 3rd the tailings pond elevation was about 986 ft, which would provide approximately 6.4 ft or 1,400 Mgal of available storage between the pond elevation and the maximum operating level of 992.4 ft.

3.3 Water Balance Summary and Review

A simplified flow schematic for the Red Dog TSF is shown in Figure 3.1. TAK manages and tracks the water balance for the TSF through a robust Goldsim water balance model. Over the monitoring period there was a net increase of 3,179,667 tonnes of tailings deposited in the TSF (approximately 3,309,621 cubic yards), and a net decrease of 758 million gallons of water.

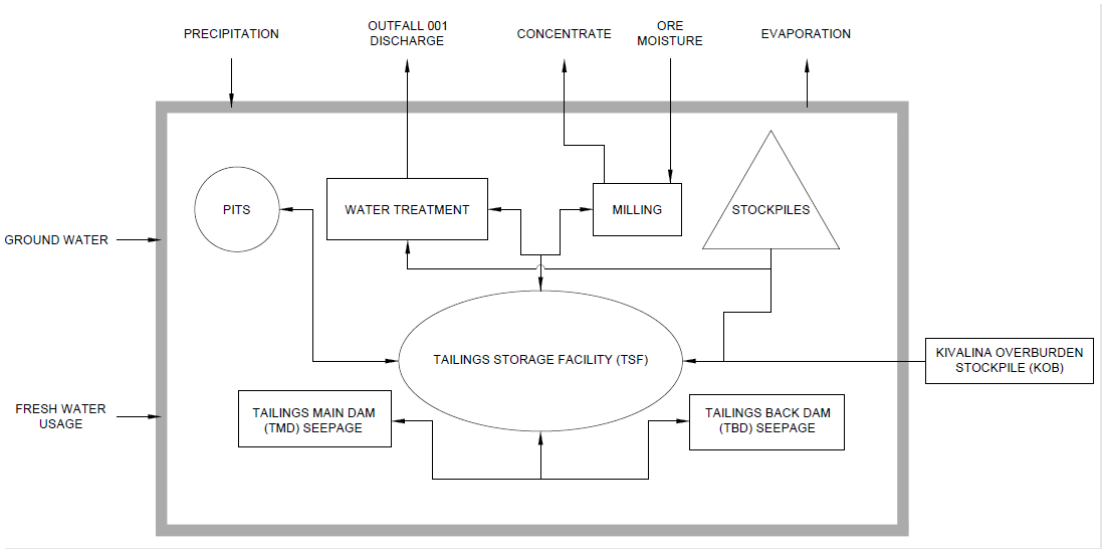

Figure 3.1: Simplified Water Flow Schematic

4.0 REVIEW OF MONITORING RECORDS AND DOCUMENTS

4.1 Surveillance/Monitoring Plan

The TSF OMS Manual prepared by TAK (2021) was reviewed as well as the O&M Manuals for the TMD and TBD prepared by Golder (2021 and 2020, respectively). The OMS is the primary surveillance document that incorporates the TSF as a whole with input from and reference to the O&M manuals that are specific to the dams. The OMS Manual is updated regularly. The surveillance program is appropriate for this operating facility that includes routine visual inspection and maintenance, measured behavior, routine performance reviews, and a trigger-action-response-plan (TARP).

An assessment of performance is completed by the EoR on a monthly basis, and as part of the AFPR as summarized in Table 4.1 based on compliance with design criteria, comparison of actual conditions to design assumptions, consistency between measured response and expected behavior, and the presence or absence of potential dam safety concern indicators. Measured response refers to instrumentation readings and visual observations during inspections, and expected response is based on interpretation of historic measured response. On this basis, the performance of the dams during the review period was satisfactory and acceptable.

Table 4.1: Monitoring Activities

TSF Monitoring	Facility	Minimum Frequency	Documentation	Frequency Compliance	Notes for Review Period
INSPECTIONS					
Routine Visual Inspection [1]	TMD and TBD	Daily, Weekly, and Semi-Annual [2]	TAK Inspection Reports	Yes	
Event-Driven Inspection	TMD and TBD	Event-Driven [3]	TAK Inspection Reports	N/A	One event-driven inspection was triggered over review period
Annual Facility Performance	TMD and TBD	Annually	AFPR prepared by engineer qualified in accordance with	Yes	This report that was prepared by Golder

TSF Monitoring	Facility	Minimum Frequency	Documentation	Frequency Compliance	Notes for Review Period
Report / Dam Safety Inspection (DSI)			Alaska Administrative Code 11 AAC 93.193(b)		
Periodic Safety Inspection (PSI) / Dam Safety Review (DSR)	TMD and TBD	Every 3 years	PSI Report as required by Alaska Administrative Code 11 AAC 93.159 by an engineer qualified in accordance with 11 AAC 93.193(b)	N/A	Last PSI was done in 2020 and next PSI due in 2023
INSTRUMENTATION MONITORING PERFORMED BY TAK					
Pond Level	TSF	Weekly	AFPR	Yes	
Seepage Collection Pumping Rates	TMD and TBD	Daily	AFPR	Yes	-
Piezometers	TMD and TBD	Daily	AFPR	Yes	Some gaps in data due to communication issues, construction, and loss of functionality
Turbidity	TMD	Daily	AFPR	Yes	One of the turbidity meters went down in June 2022
SAA Inclinometers	TMD and TBD	Weekly	AFPR	Yes	
Water Quality Sampling	TMD and Tailings Pond	Monthly	AFPR	Yes	Some gaps in data from sampling locations at TMD due to no safe access in winter or during construction
Ground Temperature Arrays	KOB at TBD	Annually	AFPR	Yes	

Notes:
1. Visual inspections include observations of unusual conditions and/or dam safety concerns (e.g., settlement, sinkholes, seepage, erosion, slope sloughing, piping, etc.)
2. The more comprehensive routine inspections are done semi-annually (spring and fall) at the TMD and TBD due to safe access limitations in the winter.
3. TAK staff are to complete an event-driven inspection in response to one of the following events:
    - Storms and floods (made at discretion of Responsible Party as supplemented by surveillance records and/or monitoring data)
    - Earthquakes with at least Richter Magnitude 5.0 near the mine or that has measured peak ground acceleration greater than 0.08g
    - Observed seepage or wet area along downstream dam embankment
    - Landslide having capability to rapidly displace large volumes that could generate large waves across TSF
    - Human interference (terrorism, vandalism, or accident)
    - unexpected or unexplainable changes in water quality/chemistry

4.2 Pond Level

The tailings pond level is surveyed at least weekly, is monitored daily through a pressure transducer at the reclaim barge, and is visually checked during routine inspections. The pond level measurements since 2020 is shown in Appendix A, Figure A-3. Over the review period, the pond level decreased by about 0.5 ft with a maximum elevation of 989.6 ft reached during the freshet and decreasing with discharge of treated effluents.

4.3 Seepage Collection Pumping Rates

Seepage collection pumping rates are collected daily from the pumping systems at the TBD and TMD. These rates indicate potential seepage through the dams' containment systems from the TSF but are also heavily influenced by stormwater and groundwater downstream of the containment systems. All collected water is pumped back into the TSF. Seepage collection rates typically are the highest during the freshet and following storm events and decrease during the winter but can also spike when pumps are restarted after they have been down. The seepage collection rates, precipitation, and tailings pond levels since 2020 are shown in Appendix A, Figures A-4 and A-15 for the TMD and TBD, respectively.

Seepage collection rates over the review period were similar to historic levels with higher rates impacted by precipitation and TBD construction during the summer of 2021. The rates indicate the dams are performing as expected. The 80 gallons per minute (gpm) TARP threshold for the TBD before the freshet was exceeded in 2022 but this is attributed to the high precipitation during the previous year and will be updated in the OMS Manual.

4.4 Piezometers

The piezometers monitored at the Red Dog TSF consist of critical instruments with notification levels tied to TARPS and other instruments that provide background information for further analysis of TSF performance. The current suite of instruments is considered sufficient for the Red Dog TSF. Piezometric levels over the review period are summarized for the TMD in Appendix A, Figures A-5 to A-11 that also show tailings beach development periods and downstream critical gradients. Piezometric levels and related gradients at the TBD are respectively presented in Appendix A, Figures 16 and 17.

Piezometric levels during the review period show similar patterns as past years with expected performance. Except for TBD piezometers P-15-138 and -139 exceeding their trigger levels in August 2021 as a result of pump shut-downs, there were no piezometric threshold exceedances over the review period. Gradients at the TBD always indicated flows toward the sump verifying that no potential seepage crossed over the historic watershed divide and into the Bons Creek drainage. Gradients at the TMD remained below their trigger alert thresholds.

4.5 SAA Inclinometers

There are a total of three shape acceleration array (SAA) inclinometers at each dam, and the monitoring data for the inclinometers at the TMD and TBD are respectively summarized in Appendix A, Figures A-12 to A-14 and Figures A-18 to A-20.

The SAA inclinometers indicate expected performance. Except for SAA inclinometer SAA 25+00 located at the TBD, none of these instruments exceeded their threshold levels. The current threshold level at SAA 25+00, which is based on the results of deformation modeling (Golder 2018a), did not consider cumulative movements and will be revised based on ongoing design studies by Golder.

4.6 Water Quality Data

Water quality monitoring was performed monthly with samples collected from reclaim, at well P-16-152 in the underdrain upstream of the SCP, at the SCP from the one of the seepage pumpback chambers, and from a well downstream of the SCP. Water quality sampling could not be done at well P-16-152 during periods when there was no safe access due to winter snow accumulation or during construction. No water quality samples were collected from the well downstream of the SCP as it has remained dry.

4.7 Ground Temperature Arrays

Ground temperature data from the arrays located within the KOB downstream of the TBD were collected in October 2021 and were provided for review, as presented in Appendix A, Figures A-22 to A-25. The ground temperature data indicates permafrost levels remain above their trigger exceedance levels. Some warming and permafrost degradation is indicated in OS-18-11.

5.0 INSPECTION OBSERVATIONS AND PHOTOGRAPHS

Copies of the field inspection forms (both ADNR Dam Safety's and TAK's) including photographs and summary of observations made during the AFPR site visit are included in Appendix B. No issues in terms of dam safety were observed and some best management practice improvements were identified. A summary of general observations and comments during the 2022 AFPR site visit follows:

- TMD: The Embankment, Wing Wall, and associated components SCP and SCD appeared to be in satisfactory physical condition with no potential problem indicators noted. The tailings beach appeared to be at or beyond its target widths. Ongoing Stage XII widening construction was observed at the Embankment and had reached an elevation about 20 ft below the Stage XI dam crest.
- TBD: The dam appeared to be in satisfactory physical condition with no potential problem indicators noted. There is no tailings beach at the TBD and subaqueous tailings deposition was observed upstream of the dam. As part of the Stage V-A cut-off wall construction, the insulation layer had been removed and the recently installed plastic concrete cut-off wall was exposed except at the port road crossing where construction was incomplete.

6.0 DAM SAFETY ASSESSMENT

6.1 Design Basis Review

Teck has advised that they are aligned with the most conservative interpretation of the GISTM and will adopt the extreme consequence case design flood and earthquake loading or reduce credible risks to ALARP (as low as reasonably practicable) for any facility with a credible flow failure mode 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. The TSF meets current industry standards and will be reviewed against the extreme loading scenarios. 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 new GISTM that supports evolving beyond the conventional consequence classification system. 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.

The dam consequence classifications for both the TBD and TMD as defined by Alaska Administrative Code 11 AAC 93.157 remain appropriate and do not need to be changed.

Over the review period, the coordinate system was changed from a local mine grid to a Low Distortion Projection (LDP) based on NAD83 (2011) horizontal control datum and a NAVD88 (GEOID12B) vertical datum. This new coordinate system has been incorporated for the new dam raise construction (TMD Stage XII and TBD Stage V) and increases the stated dam elevations by 1.4 ft over the previous mine grid system. All elevations presented in this report utilize the new LDP coordinate system.

6.2 Failure Modes Review

Golder understands Teck's long-term goal for all of their tailings facilities is to reach landform status with all potential failure modes that could result in catastrophic release of tailings and/or water being either reduced to non-credible or not present. Teck's long-term goal for the Red Dog TSF is for all potential failure modes to be non-credible based on extreme loading conditions or loading conditions appropriate using the principles of ALARP when it is not practical to consider extreme loading conditions. Evaluation of failure modes with respect to this goal is ongoing.

All potential failure modes were reviewed and characterized in a recent facility risk assessment based on associated worksheets (TAK 2022c). The facility risk assessment update is ongoing and anticipated to be completed in 2023. Management and status of physically possible and credible failure modes, and related controls, that have the greatest influence on design and performance are summarized herein.

6.2.1 Tailings Main Dam

The Tailings Main Dam has one physically possible and credible failure mode that is considered to have an extremely rare likelihood of occurrence:

- Internal Erosion and Piping (Embankment): The minimum tailings beach width along the Embankment and Wing Wall control the potential for high gradients exceeding 0.17 to develop that could lead to piping and internal erosion in the Embankment resulting in an uncontrolled release of impounded tailings and/or water. Other key design controls are the underdrain, the highly permeable rockfill materials, and the geotextile filters immediately downstream of the liner.

6.2.2 Tailings Back Dam

The Tailings Back Dam has physically possible failure modes but they are deemed not credible based on engineering analyses.

6.3 Physical and Operations Performance

Based on our site inspection in August 2022 and review of the monitoring instrument data over the review period, as described in Sections 4 and 5, the TSF and associated dams are performing as expected and in a satisfactory manner. Operation of the Red Dog TSF is being satisfactorily performed in accordance with the OMS Manual with development of the targeted tailings beach widths, management of water within the TSF below permitted operating levels, and performing routine inspections and maintenance.

6.4 OMS/O&M Manuals Review

The surveillance programs described in the current OMS and O&M Manuals are appropriate for the Red Dog TSF.

6.5 Emergency Preparedness and Response Review

The EPRP for the Red Dog TSF was recently completed in January 2022 (TAK 2022) and is appropriate for the facility. The EPRP is separate from but integrated with the OMS Manual and is appropriate for the current facility. The EPRP is reviewed and updated as necessary to incorporate changes in the OMS Manual and site emergency response procedures.

Minimum periodic training and exercises are scheduled to meet regulatory requirements. The annual EPRP orientation exercise was completed on November 26, 2022.

6.6 Status of Previous Recommendations

The last PSI was completed by NewFields Mining Design & Technical Services (NewFields) in August 2020 and the associated respective reports for the TBD and TMD completed in February and March 2021 (NewFields 2022A, 2022B). The results of the PSI noted that the dams are in satisfactory condition with no recognizable dam safety deficiencies, acceptable performance under normal and extreme loading conditions, and applicable hydrologic and seismic regulatory criteria.

7.0 SUMMARY AND RECOMMENDATIONS

The performance of the Red Dog TSF is satisfactory and consistent with expected performance and within design requirements. The significant changes that have occurred over the review period include the dam raise construction activities described in Section 2.2, the new LDP coordinate system that has replaced the previous local mine grid system, completion of the OMS Manual and EPRP by TAK, and revision of the TMD O&M Manual by Golder.

There were no recommendations related to dam safety and performance deficiencies identified as part of the 2022 AFPR.

8.0 CLOSING

The work program followed the standard of care expected of professionals undertaking similar work in the State of Alaska under similar conditions. No warranty expressed or implied is made. Please contact us if you have any questions or comments regarding this report.

Golder Associates USA Inc.

Steven L. Anderson, PE
Geotechnical Engineering Director

Benjamin N. Schmidt, PE
Senior Lead Consultant

SLA/MSG/BNS/sla

https://golderassociates.sharepoint.com/sites/158140/project files/5 technical work/2022 afpr/final-rev0/31404122.007-002-r-rev0_rdo tsf annual review_20221214.docx

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APPENDIX A

Annual Performance Monitoring Data

2022 ANNUAL FACILITY PERFORMANCE MONITORING TABULATED DATA

Table A-1 Tailings Storage Facility Pond Elevation 2021 Year			
Date	**Survey (ft asl)**	**Operating Freeboard Limit**	**Max/Min**
1/1/2021	984.6	987.4	Min
12/29/2021	988.2	992.4	Max
2022 Year (to-date September 4)			
Date	**Survey (ft asl)**	**Operating Freeboard Limit**	**Max/Min**
5/9/2022	989.6	992.4	Max
9/4/2022	985.1	992.4	Min

Table A-2 Tailings Storage Facility Summarized Water Volume	
Time	**Volume (Mgal)**
July 2021	4,766
August 2022	4,008

Table A-3 Tailings Storage Facility Pumpback Rates 2021 Year					
TMD Seepage			TBD Sump		
Date	Rate (gpm)	Max/Min	Date	Rate (gpm)	Max/Min
4/11/2021	511.8	Min	4/8/2021	80.7	Min
8/3/2021	1350.0	Max	7/31/2021	610.4	Max
2022 Year (to-date September 4)					
TMD Seepage			TBD Sump		
Date	Rate (gpm)	Max/Min	Date	Rate (gpm)	Max/Min
3/20/2022	568.3	Min	4/17/2022	95.8	Min
5/29/2022	1074.2	Max	5/28/2022	370.6	Max

Table A-4
Tailings Main Dam
Embankment and Seepage Dam Piezometers - Review Period June 2021 through August 2022

Borehole ID	Instrument	Priority	Status	Monitoring Location		Soil Description	Tip Elevation (ft asl)	Period Min W.L.	Period Max W.L.	Trigger Level	Failure Mode
P-08A	P-08A	Critical	Working	Downstream	Underdrain	Underdrain Rockfill	805.7	818.1	823.2	WL ≥ El. 852.4 feet	2, 3, 4
P-08B	P-08B	Performance	Working	Downstream	Below Underdrain	Mod. Weathered shale	780.3	819.5	824.7		
P-10A	P-10A	Critical	Working	Downstream	Underdrain	Underdrain Rockfill	790.5	807.8	812.0	WL ≥ El. 824.4 feet	2, 3, 4
P-10B	P-10B	Performance	Working	Downstream	Below Underdrain	Mod. Weathered shale	767.0	800.8	804.4		
P 11	P 11	Performance	Down	Downstream	Foundation	Highly Weather Shale	901.6	899.9	900.4		
P 12A	P 12A	Performance	Down	Downstream	Dam Fill	Soil Type 1 / Select Shale	831.3	834.3	837.1		
P 12B	P 12B	Performance	Down	Downstream	Foundation	Mod. Weathered shale	809.6	818.1	822.0		
P 13	P 13	Performance	Working	Downstream	Foundation	Mod. Weathered shale	832.3	831.8	836.2		
P 14A	P 14A	Performance	Working	Downstream	Foundation	Highly Weather Shale	882.6	916.9	919.2		
P-97-20	P-97-20	Performance	Working	Downstream	Deep Foundation	Shale	539.2	799.4	811.7		
P-97-28	P-97-28	Performance	Working	Downstream	Below Underdrain	Mod. Weathered shale	762.3	792.6	813.4		
P-97-29	P-97-29	Performance	Working	Downstream	Dam Fill	Soil Type 1 / Select Shale	795.3	809.1	815.7		
P-97-30	P-97-30	Performance	Working	Downstream	Foundation	Bedrock - Shale	810.4	831.5	850.1		
SS-05-05	P-05-62	Critical	Working	Downstream	Underdrain	Underdrain Rockfill	780.2	803.4	807.2	WL ≥ El. 821.4 feet	2, 3, 4
SS-17-05	P-05-69	Performance	Working	Downstream	Foundation	F-C SAND with Gravel (SM)	825.0	824.3	825.2		
P-06-74	P-06-74	Critical	Working	Downstream	Starter Dam Toe Drain	Toe Drain Riser	807.6	830.7	847.2	WL ≥ El. 896.4 feet	2, 3, 4
SS-05-14	P-14-129A	Performance	Working	Downstream	Dam Fill	Soil Type 1 / Select Shale	823.4	823.7	823.8		
SS-05-14	P-14-129B	Critical	Working	Downstream	Dam Fill	Kivalina Waste Fill	809.4	809.8	815.1	WL ≥ El. 818.4 feet	2, 3, 4
SS-01-14	P-14-130	Critical	Working	Downstream	Above Underdrain	Rockfill	802.0	815.4	819.7	WL ≥ El. 831.4 feet	2, 3, 4
SS-03-14	P-14-131	Critical	Working	Downstream	Above Underdrain	Rockfill	800.4	809.4	813.9	WL ≥ El. 827.4 feet	2, 3, 4
SS-04-14	P-14-132	Critical	Working	Downstream	Dam Fill	Rockfill	815.4	818.1	822.6	WL ≥ El. 827.4 feet	2, 3, 4
SS-12-14	P-14-134	Critical	Working	Downstream	Above Underdrain	Rockfill	795.7	830.6	835.5	WL ≥ El. 860 feet	2, 3, 4
SS-10-16	P-16-145X	Performance	Working	Upstream	Tailings	Tailings	837.3	909.6	930.5		
SS-10-16	P-16-145Y	Performance	Working	Upstream	Tailings	Tailings	817.3	895.6	918.2		
SS-10-16	P-16-145Z	Critical	Working	Upstream	Kivalina Waste Fill	Kivalina Waste Fill	802.3	895.2	916.7	N/A	5
SS-05-16	P-16-146X	Performance	Working	Upstream	Tailings	Tailings	853.8	912.8	930.9		
SS-05-16	P-16-146Y	Performance	Working	Upstream	Tailings	Tailings	833.8	906.2	925.9		
SS-05-16	P-16-146Z	Critical	Working	Upstream	Kivalina Waste Fill	Kivalina Waste Fill	813.8	893.7	916.5	N/A	5
SS-09-16	P-16-151A	Critical	Working	Downstream	Underdrain	Underdrain Rockfill	796.9	814.4	819.5	WL ≥ El. 833.4 feet	2, 3, 4
SS-09-16	P-16-151B	Performance	Working	Downstream	Below Underdrain	Shale	767.5	812.3	818.0		
TMD-18-33	P-18-177	Performance	Working	Downstream	Foundation	ML with Gravel	909.9	911.4	911.7		
TMD-18-40	P-18-179	Performance	Down	Upstream	Tailings	Tailings	946.4	967.1	967.9		
TMD-20-04	P-20-188A	Performance	Down	Downstream	Foundation	Bedrock	855.3	854.4	854.9		
TMD-20-04	P-20-188B	Performance	Down	Downstream	Dam Fill	Select Shale	865.3	864.1	864.9		
TMD-20-01	P-20-189	Performance	Down	Downstream	Foundation	Bedrock	808.9	814.6	818.6		
TMD-20-02	P-20-190A	Performance	Down	Downstream	Foundation	Bedrock	829.9	842.3	845.2		
TMD-20-02	P-20-190B	Performance	Down	Downstream	Dam Fill	Rockfill	839.9	843.5	845.9		
TMD-20-03	P-20-191A	Performance	Working	Downstream	Foundation	Bedrock	897.9	896.0	901.7		
TMD-20-03	P-20-191B	Performance	Working	Downstream	Dam Fill	Rockfill	911.9	909.9	912.1		
N/A	P-96-10	Performance	Working	Seepage Dam	Sub-permafrost aquifer	Shaly to silty Sandstone Bedrock	605.4	786.8	794.7		
N/A	SPP-97-02	Performance	Working	Seepage Dam	Foundation of SCD	Shale Bedrock	771.5	782.9	786.3		
TMD-20-07	P-20-196	Performance	Working	Seepage Dam	Downstream of SCD	HW to CW Bedrock	781.9	781.1	786.7		
TMD-21-01	P-21-197	Critical	Working	Seepage Dam	Foundation of SCD	HW to CW Bedrock	786.9	786.0	788.3	WL ≥ El. 789.4 feet	N/A

Failure Mode Event 1	Overtopping
Failure Mode Event 2	Global Stability
Failure Mode Event 3	Earthquake Global Stability
Failure Mode Event 4	Earthquake Deformation
Failure Mode Event 5	Internal Erosion

Table A-5
Tailings Main Dam
Wing Wall Piezometers - Review Period June 2021 through August 2022

Borehole ID	Instrument	Priority	Status	Monitoring Location		Soil Description \ Unit	Tip Elevation (ft asl)	Period Min W.L.	Period Max W.L.
SS-07-05	P-05-63	Performance	Working	Downstream	Foundation - North	Moderately Weathered Shale	931.0	944.6	957.9
SS-15-05	P-05-67	Performance	Working	Downstream	Foundation - North	Highly Weathered Shale	956.3	971.6	981.6
TMD-18-32	P-18-160	Performance	Working	Downstream	Foundation - North	Site Development Fill \ GM	958.8	959.4	964.0
TMD-18-25	P-18-164	Performance	Working	Downstream	Foundation - South	Site Development Fill \ SM	964.6	968.3	980.9
TMD-18-26	P-18-165	Performance	Working	Downstream	Foundation - South	Native Coarse Soils \ SC	948.2	970.3	983.3
TMD-18-24	P-18-166	Performance	Working	Downstream	Foundation - South	Native Coarse Soils \ SC	960.4	971.8	984.6
TMD-18-27	P-18-167	Performance	Working	Downstream	Foundation - South	Native Coarse Soils \ SC	970.9	975.0	984.8
TMD-18-38	P-18-168	Performance	Working	Downstream	Foundation - South	Native Fine Soils \ CL	969.3	980.7	986.8
TMD-18-36	P-18-169	Performance	Working	Downstream	Foundation - South	Site Development Fill \ GM	976.6	982.2	985.7
TMD-18-23	P-18-170	Performance	Down	Downstream	Foundation - South	HW to CW Bedrock	992.4	994.3	994.7
TMD-18-37	P-18-171	Performance	Working	Downstream	Foundation - South	Native Fine Soils \ CL	975.9	977.7	989.0
TMD-18-35	P-18-172	Performance	Working	Downstream	Foundation - South	Site Development Fill	979.2	984.4	989.0
TMD-18-22	P-18-173	Performance	Working	Downstream	Foundation - South	HW to CW Bedrock	998.2	1000.3	1003.9
TMD-18-20	P-18-174	Performance	Working	Downstream	Foundation - South	HW to CW Bedrock	972.9	986.4	991.8
TMD-18-21	P-18-175	Performance	Down	Downstream	Foundation - South	Native Coarse Soils \ SC	990.5	989.4	989.9
TMD-18-39	P-18-178	Performance	Working	Downstream	Foundation - South	Native Coarse Soils \ SC	948.6	977.7	983.3
TMD-19-06	P-19-185	Performance	Working	Downstream	Foundation - North	HW to CW Bedrock	941.5	940.5	947.3
N/A	P-20-192A	Performance	Working	Upstream	Foundation - North	Rockfill \ Mineralized	969.9	967.7	969.9
N/A	P-20-193A	Performance	Working	Upstream	Foundation - North	Rockfill \ Mineralized	970.4	966.9	969.1
N/A	P-20-193B	Performance	Working	Upstream	Foundation - North	Rockfill \ Mineralized	984.0	982.2	984.5
N/A	P-20-194	Performance	Working	Upstream	Foundation - North	HW to CW Bedrock	959.6	958.2	959.7
N/A	P-20-195A	Performance	Down	Upstream	Foundation - North	Tailings	938.7	954.6	964.9

Table A-6 Tailings Main Dam Inclinometers										
Borehole ID	**Instrument**	**Serial No.**	**Status**	**Monitoring Location**	**Material**	**Top Elevation (ft asl)**	**Bottom Elevation (ft asl)**	**Trigger Level**	**Failure Mode**	**Azimuth**
SS-04-05	INC-01-13	57335	Working	DS Dam and Foundation	Rockfill/Native Soil/Bedrock	810.1	731.4	Cumulative movement ≥ 1.5-inches Displacement rate ≥ 0.2 inches/month	2, 3	-23 degrees
SS-06-05	INC-02-13	57900	Working	DS Dam and Foundation	Rockfill/Kivalina Shale/Native Soil/Bedrock	823.6	665.4	Cumulative movement ≥ 0.5-inches Displacement rate ≥ 0.2 inches/month	2, 3	-23 degrees
SS-01-14	INC-03-14	61014	Working	DS Foundation Movement	Bedrock	784.7	635.4	Cumulative movement ≥ 0.25-inches Displacement rate ≥ 0.1 inches/month	2, 3	-23 degrees

Failure Mode Event 1	Overtopping
Failure Mode Event 2	Global Stability
Failure Mode Event 3	Earthquake Global Stability
Failure Mode Event 4	Earthquake Deformation
Failure Mode Event 5	Internal Erosion

Table A-7 Tailings Main Dam Tailings Amount Deposited 2021 Year	
Volume Deposited	**Tonnage Deposited**
3,251,381 yd3 (2,485,859 m3)	3,381,480 tonnes (t)
2022 Year (to-date September 4)	
Volume Deposited	**Tonnage Deposited**
1,816,962 yd3 (1,389,167 m3)	2,042,075 tonnes (t)

Table A-8 Tailings Main Dam Beach Deposition Data 2021 Year			
Location	**Start Date**	**End Date**	**Duration (days)**
Embankment	1/1/2021	1/15/2021	14
Wing Wall	1/15/2021	3/9/2021	53
Embankment	3/9/2021	3/20/2021	11
Wing Wall	6/8/2021	7/4/2021	26
Embankment	9/18/2021	10/15/2021	27
2022 Year			
Location	**Start Date**	**End Date**	**Duration (days)**
Embankment	4/11/2022	5/12/2022	31
Wing Wall	5/12/2022	7/11/2022	60
Embankment	7/11/2022	8/1/2022	21

Table A-9 Tailings Main Dam Tailings Beach Length 2021 Year		
Location	**Date**	**Minimum Beach Length (ft.)**
Embankment	5/26/2021	532
North Wing Wall		1,588
South Wing Wall		0
Embankment	8/5/2021	387
North Wing Wall		966
South Wing Wall		302
Embankment	9/27/2021	482
North Wing Wall		1,593
South Wing Wall		377
2022 Year		
Location	**Date**	**Minimum Beach Length (ft.)**
Embankment	4/12/2022	511
North Wing Wall		325
South Wing Wall		82
Embankment	5/9/2022	481
North Wing Wall		684
South Wing Wall		41
Embankment	6/18/2022	807
North Wing Wall		1,564
South Wing Wall		381
Embankment	8/25/2022	905
North Wing Wall		1,825
South Wing Wall		500

Table A-10
Tailings Back Dam
Piezometers - Review Period June 2021 through August 2022

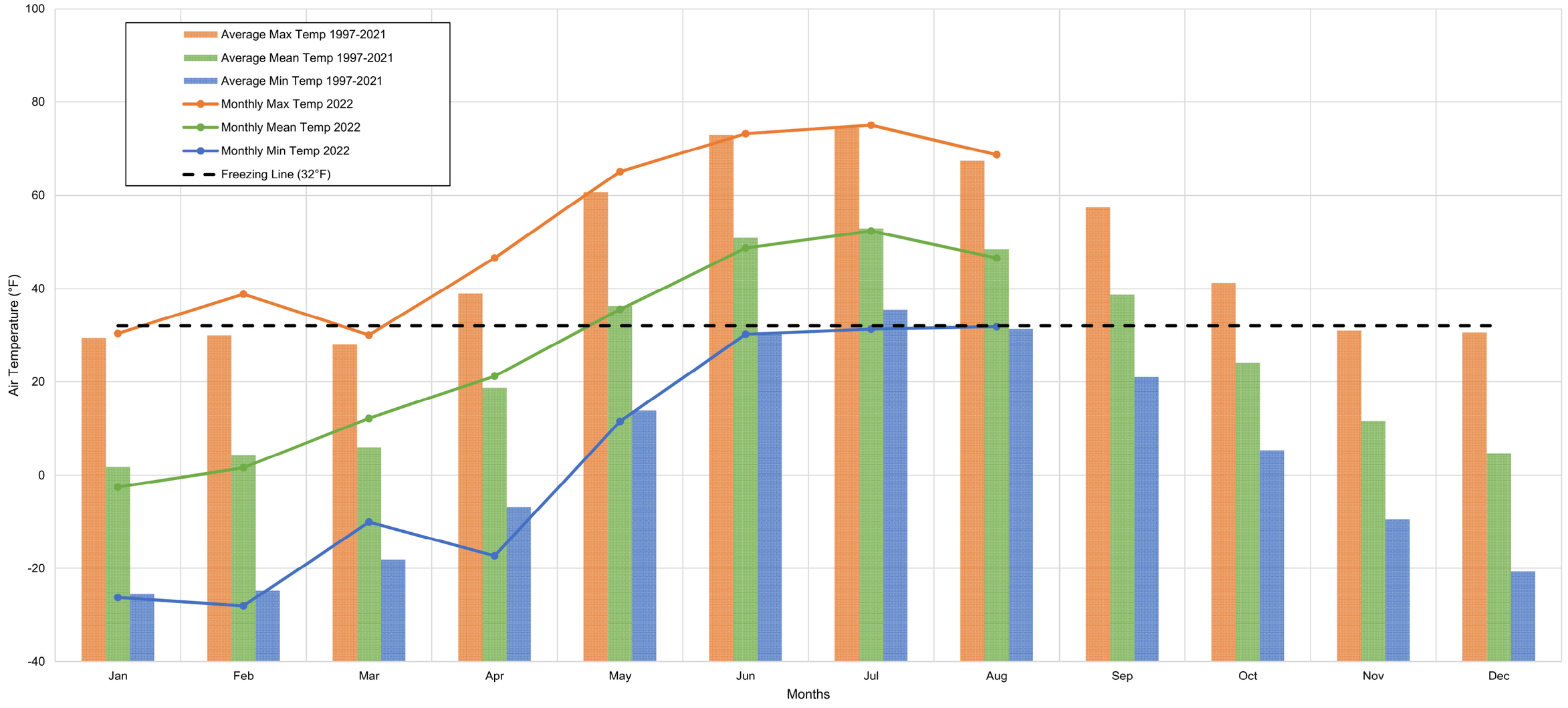
Borehole ID	Instrument	Priority	Status	Monitoring Location		Soil Description	Tip Elevation (ft asl)	Period Min W.L.	Period Max W.L.	Trigger	Failure Mode
N/A	P-15-135	Performance	Working	Downstream	42+00	Rockfill	952.6	965.5	971.3	N/A	
N/A	P-15-136	Critical	Working	Downstream	37+00	Rockfill	950.2	939.8	950.0	< P-15-138 and > 955-ft	2, 3
N/A	P-15-137	Performance	Working	Upstream	32+00	Rockfill	953.8	984.8	989.2	Freeboard	1
N/A	P-15-138	Critical	Working	Downstream	32+00	Rockfill	921.4	939.3	950.5	≥ El. 946.4 feet and >P-19-187	3
N/A	P-15-139	Critical	Working	Downstream	37+00	Rockfill	921.4	938.4	957.0	≥ El. 946.4 feet and >P-19-187	3
N/A	P-15-140	Critical	Working	Downstream	22+00	Rockfill	921.4	945.9	957.8	< P-15-139	3
N/A	P-15-141	Critical	Working	Downstream	17+00	Rockfill	936.4	951.9	963.2	< P-15-140	3
N/A	P-15-142	Performance	Working	Upstream	12+00	Rockfill	956.4	984.9	989.4	Freeboard	1
N/A	P-15-143	Critical	Working	Downstream	12+00	Rockfill	936.4	953.2	965.1	< P-15-141	3
N/A	P-15-144	Critical	Working	Downstream	7+00	Rockfill	956.4	977.2	979.4	< P-15-143	3
G17-03	P-19-186	Critical	Working	Downstream	KOB	OVB	944.3	956.2	965.7	< P-15-141 or P-15-143	3
G17-04	P-19-187	Critical	Working	Downstream	KOB	OVB	948.8	948.7	957.5	< P-15-138, P-15-139, or P-15-136	3

Failure Mode Event 1 Global Stability
Failure Mode Event 2 Earthquake Failure
Failure Mode Event 3 Excessive Seepage
Failure Mode Event 4 Changes in Downstream Hydrological Regime

Table A-11 Tailings Back Dam Inclinometers										
Borehole ID	**Instrument**	**Serial No.**	**Status**	**Monitoring Location**	**Material**	**Top Elevation (ft asl)**	**Bottom Elevation (ft asl)**	**Trigger Level**	**Failure Mode**	**Azimuth**
N/A	STA 14+00	77809	Working	Cut-off Wall Horiz. Movement	Rockfill/Native Soil/Bedrock	987.5	903.9	1.9 inches max. cumulative movement	3	-189 degrees
N/A	STA 25+00	76690	Working	Cut-off Wall Horiz. Movement	Rockfill/Native Soil/Bedrock	988.0	902.7	1.4 inches max. cumulative movement	3	-179 degrees
N/A	STA 35+00	76691	Working	Cut-off Wall Horiz. Movement	Rockfill/Native Soil/Bedrock	986.8	883.5	1.4 inches max. cumulative movement 0.2 inches per month	1, 3	-182 degrees

Failure Mode Event 1 Global Stability
Failure Mode Event 2 Earthquake Failure
Failure Mode Event 3 Excessive Seepage
Failure Mode Event 4 Changes in Downstream Hydrological Regime

2022 ANNUAL FACILITY PERFORMANCE MONITORING PLOTTED DATA



RED DOG TEMPERATURE DATA
COMPARISON OF 2022 WITH HISTORIC DATA

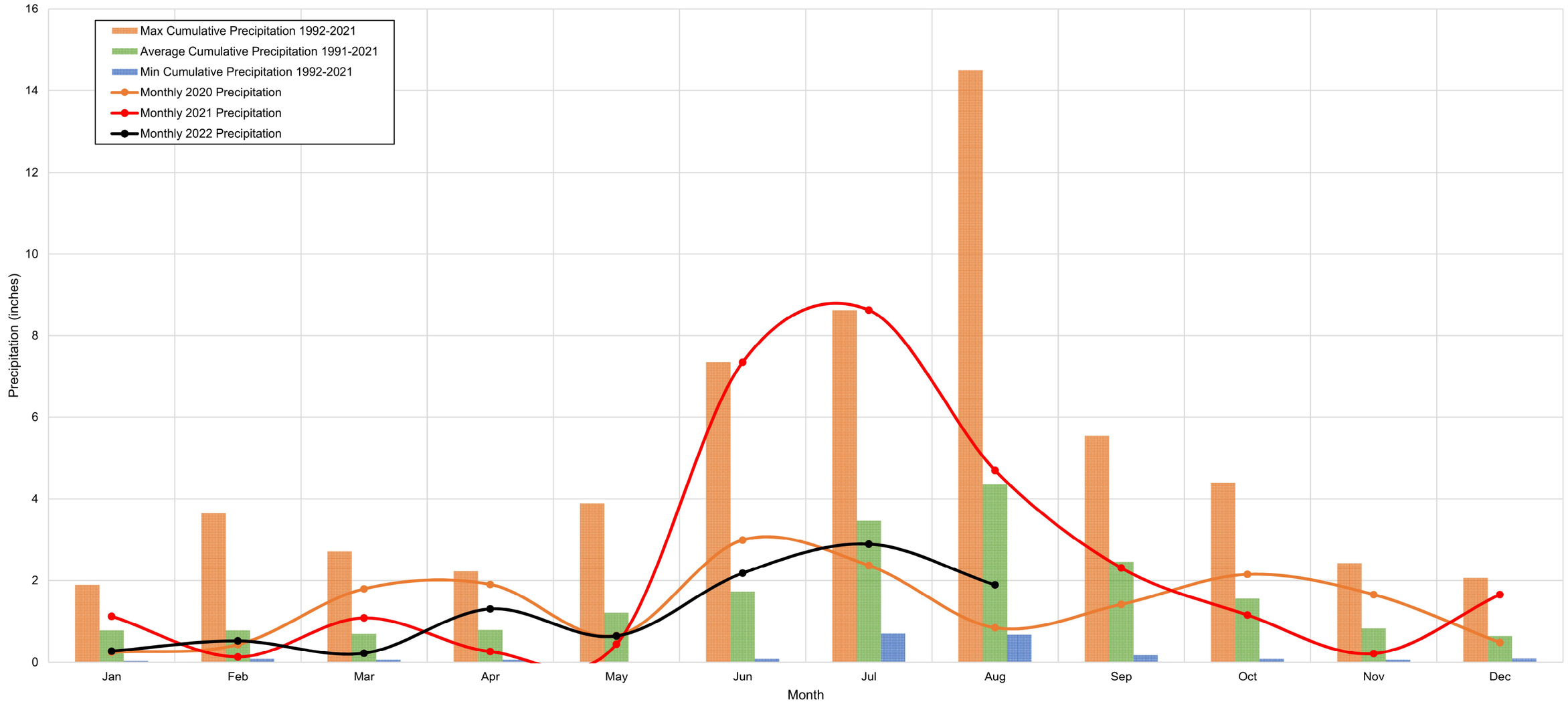
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

Teck

Figure A-1



RED DOG PRECIPITATION DATA
COMPARISON OF 2022 WITH HISTORIC DATA

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DRAWN BY:	BAH
CHECKED BY:	NT
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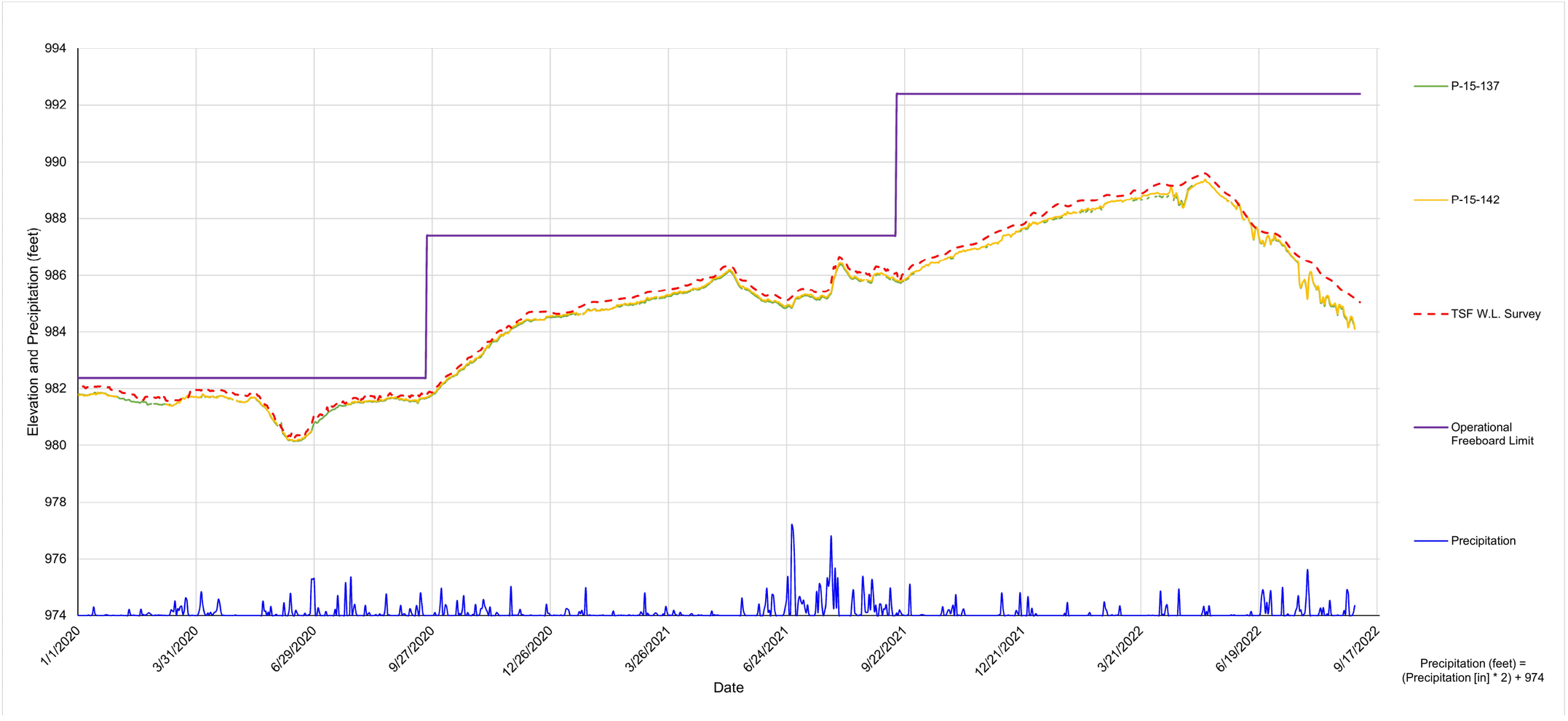
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

Teck

Figure A-2



TAILINGS STORAGE FACILITY
POND ELEVATION AND FREEBOARD LIMIT

PROJECT #	2022 AFPR
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CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

Teck

Figure A-3

TAILINGS MAIN DAM

POND ELEVATION, SEEPAGE RATE, AND PRECIPITATION

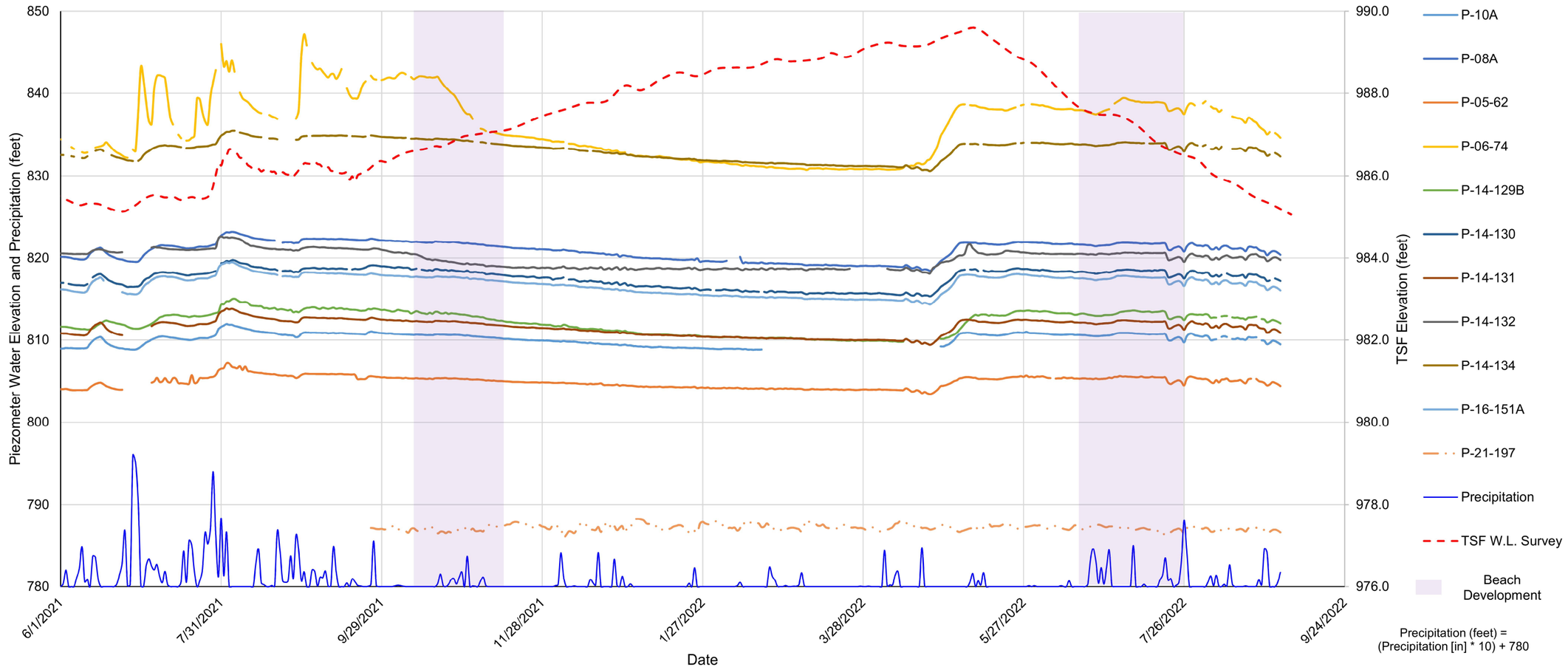
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

Teck

Figure A-4



TAILINGS MAIN DAM
EMBANKMENT DOWNSTREAM CRITICAL PIEZOMETERS

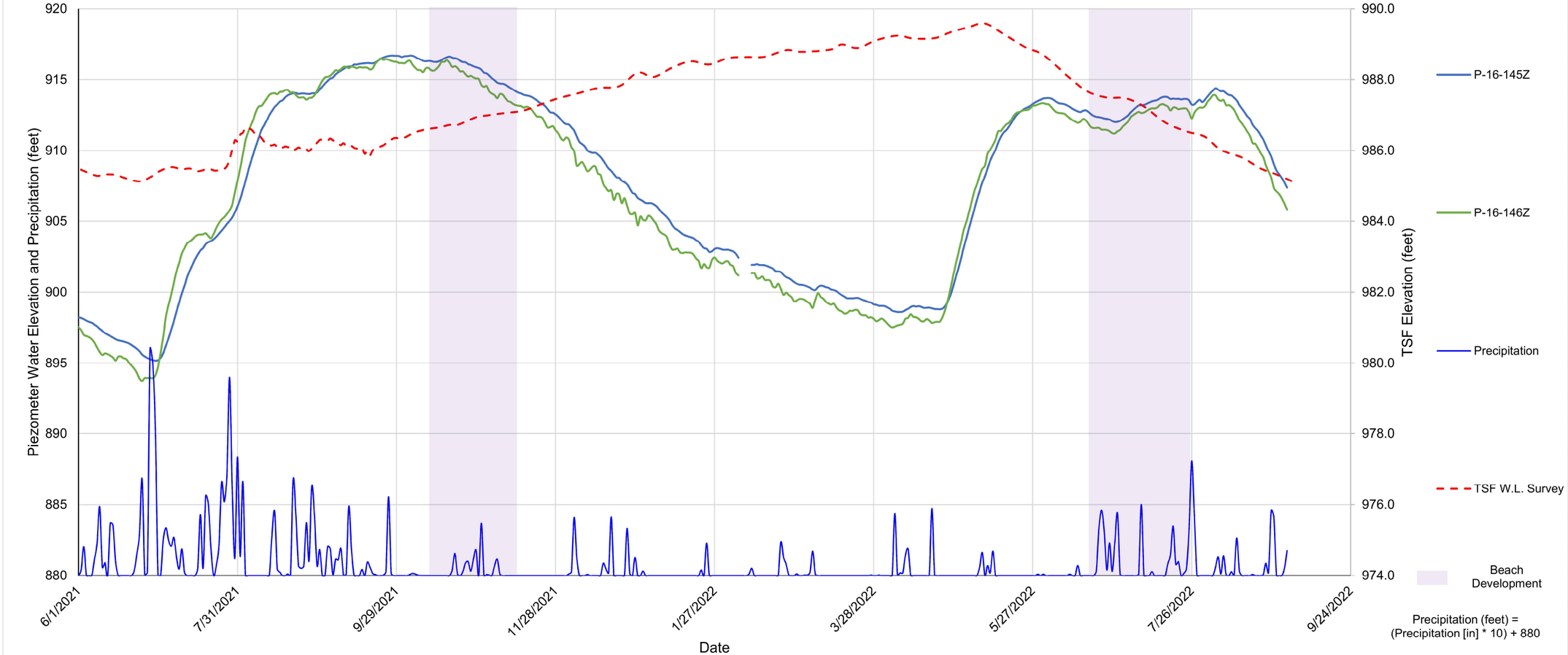
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

Teck

Figure A-5



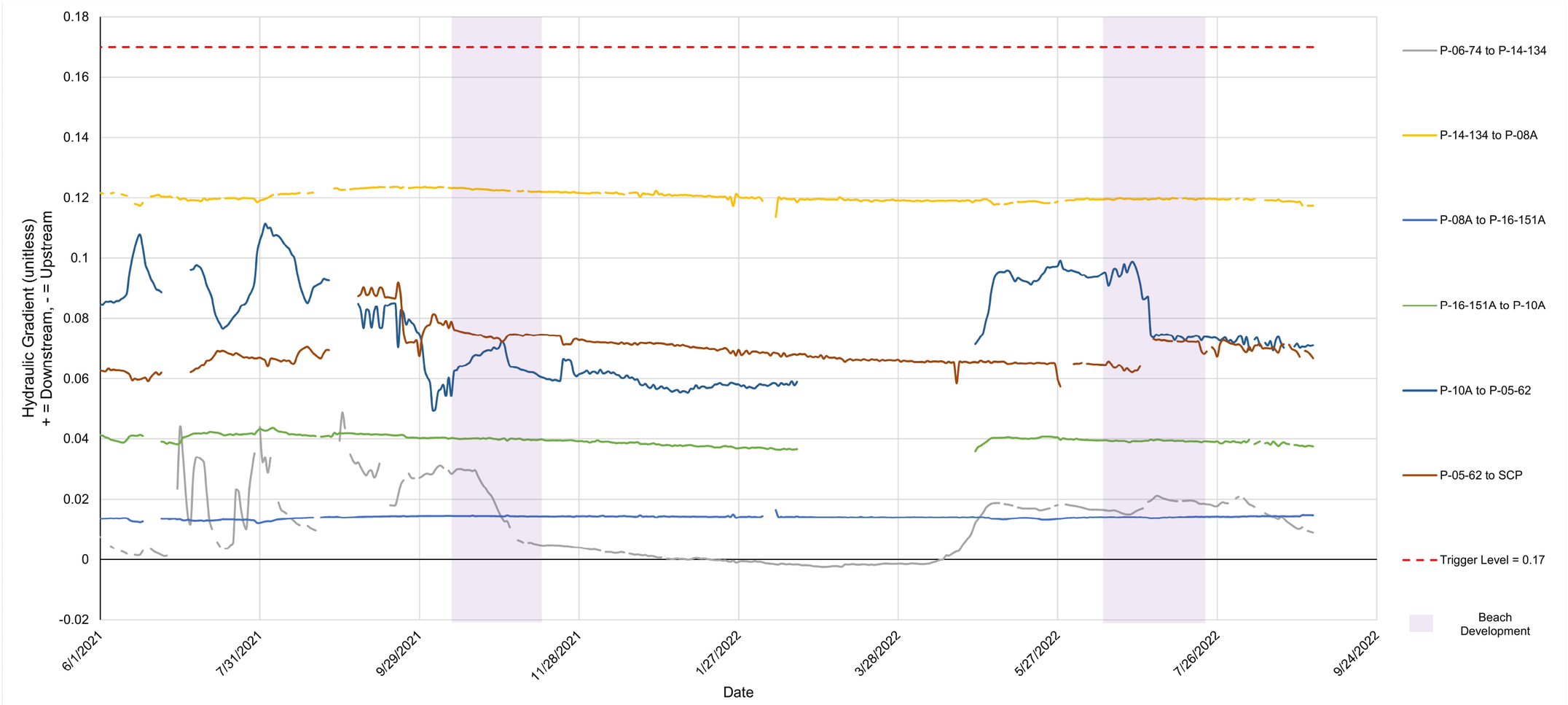
TAILINGS MAIN DAM
EMBANKMENT UPSTREAM CRITICAL PIEZOMETERS

PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations
Teck

Figure A-6



TAILINGS MAIN DAM
EMBANKMENT DOWNSTREAM CRITICAL GRADIENTS

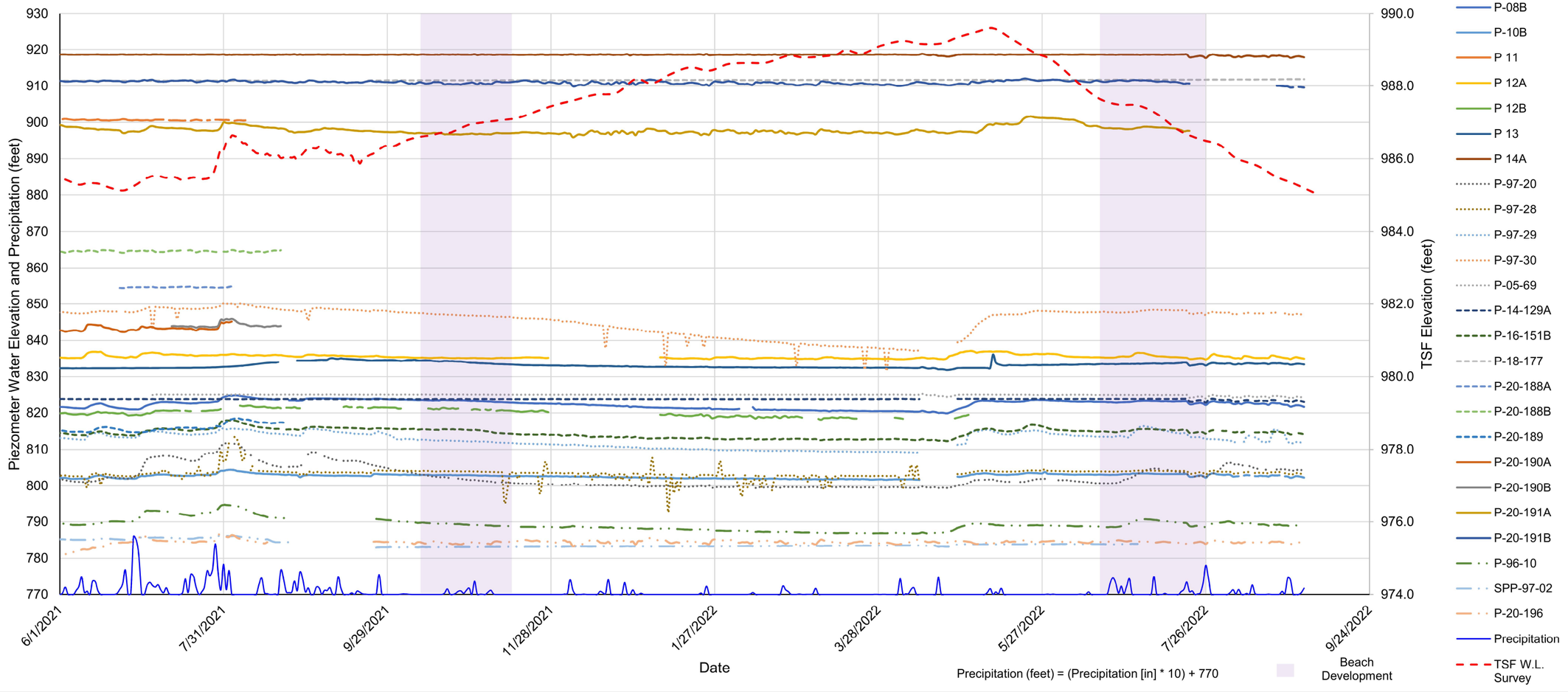
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

Teck

Figure A-7



TAILINGS MAIN DAM

EMBANKMENT DOWNSTREAM PERFORMANCE PIEZOMETERS

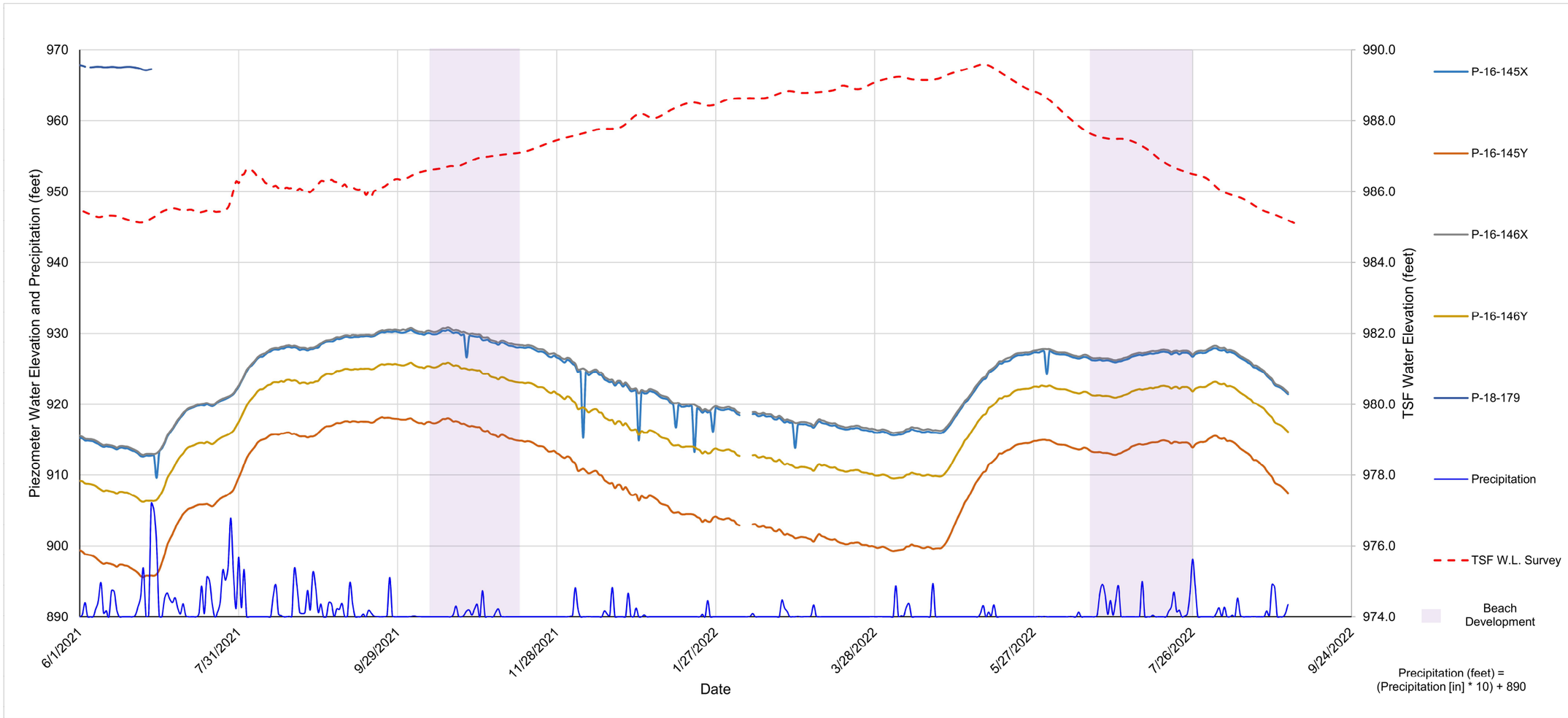
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

Teck

Figure A-8



TAILINGS MAIN DAM

EMBANKMENT UPSTREAM PERFORMANCE PIEZOMETERS

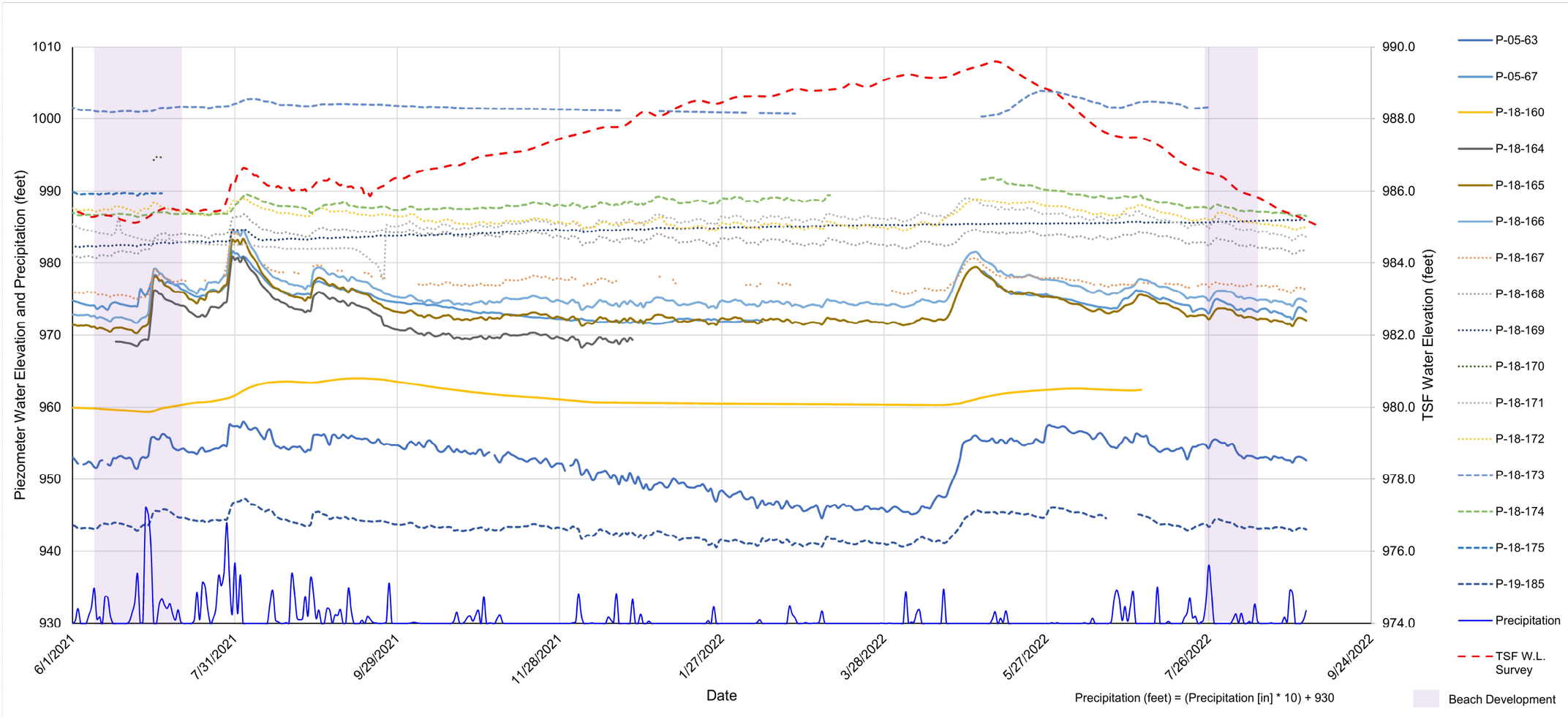
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	OF

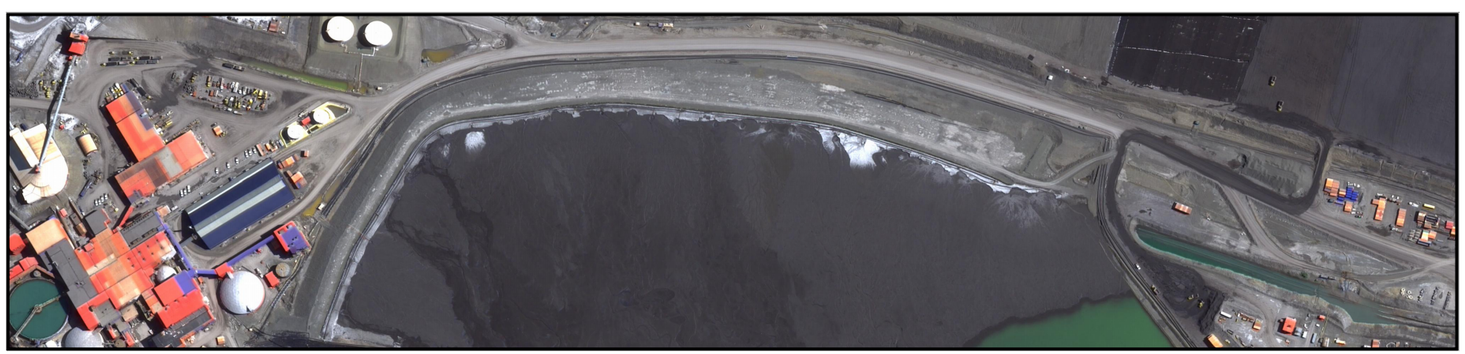
RED DOG MINE

Red Dog Operations

Teck

Figure A-9





TAILINGS MAIN DAM

WING WALL DOWNSTREAM PERFORMANCE PIEZOMETERS

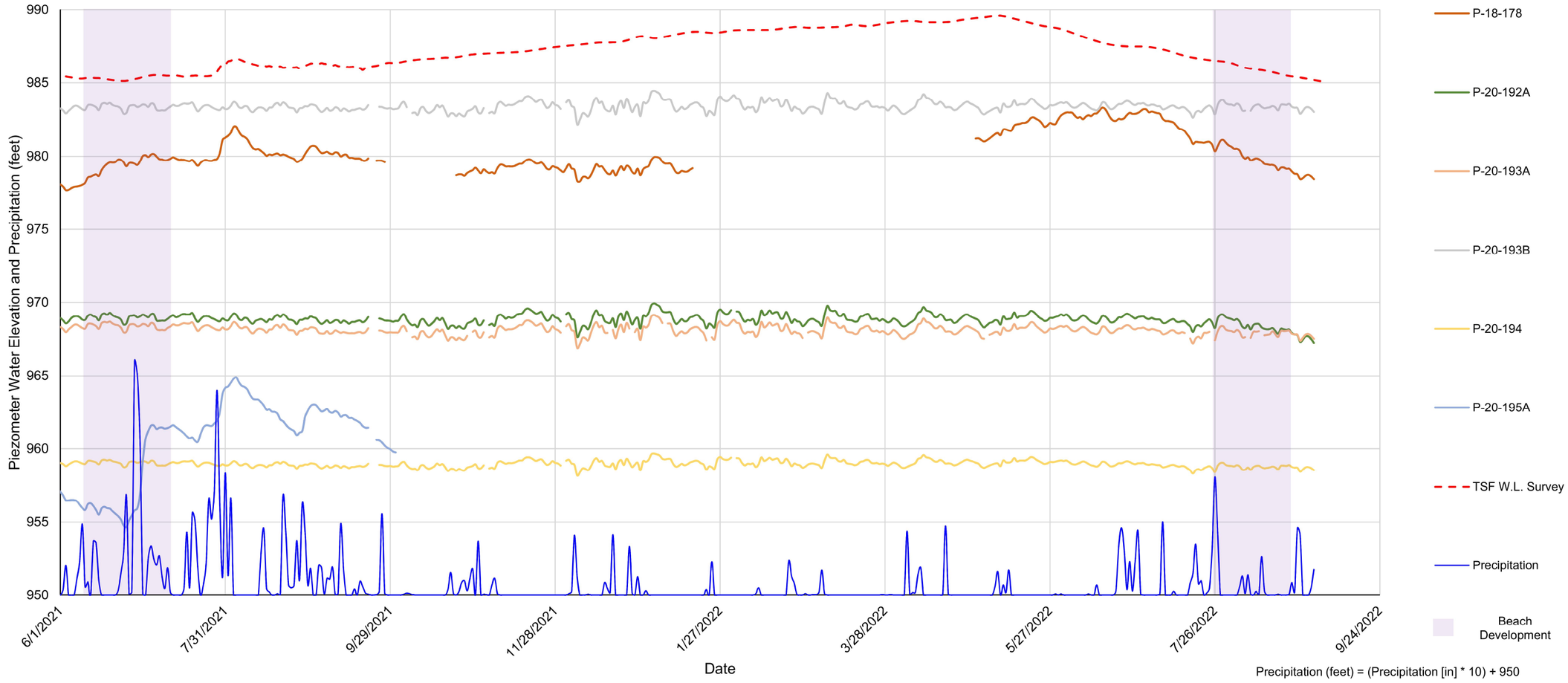
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

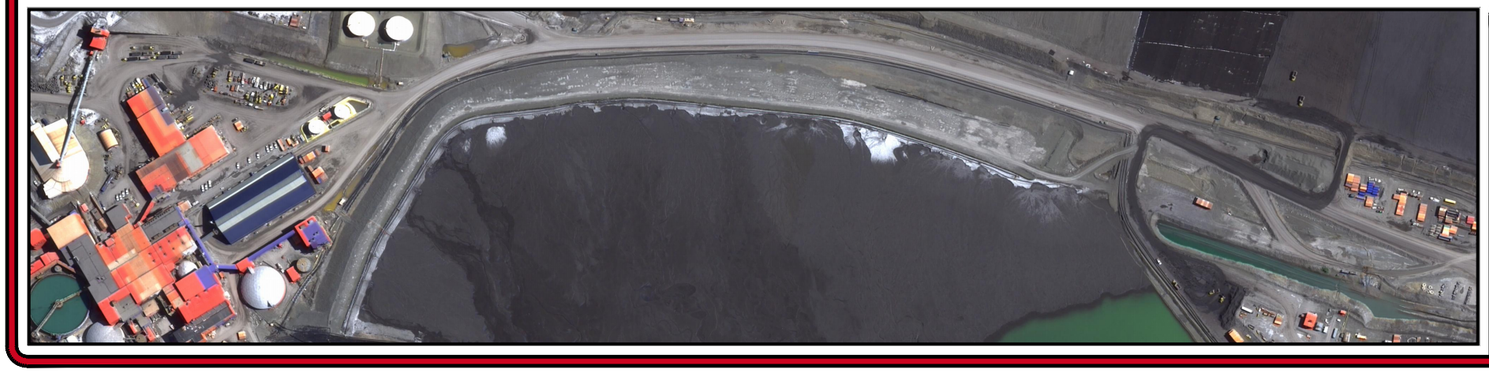
RED DOG MINE

Red Dog Operations

Teck

Figure A-10





TAILINGS MAIN DAM

WING WALL UPSTREAM PERFORMANCE PIEZOMETERS

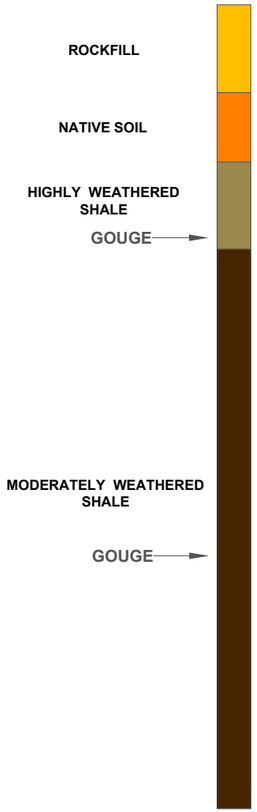
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

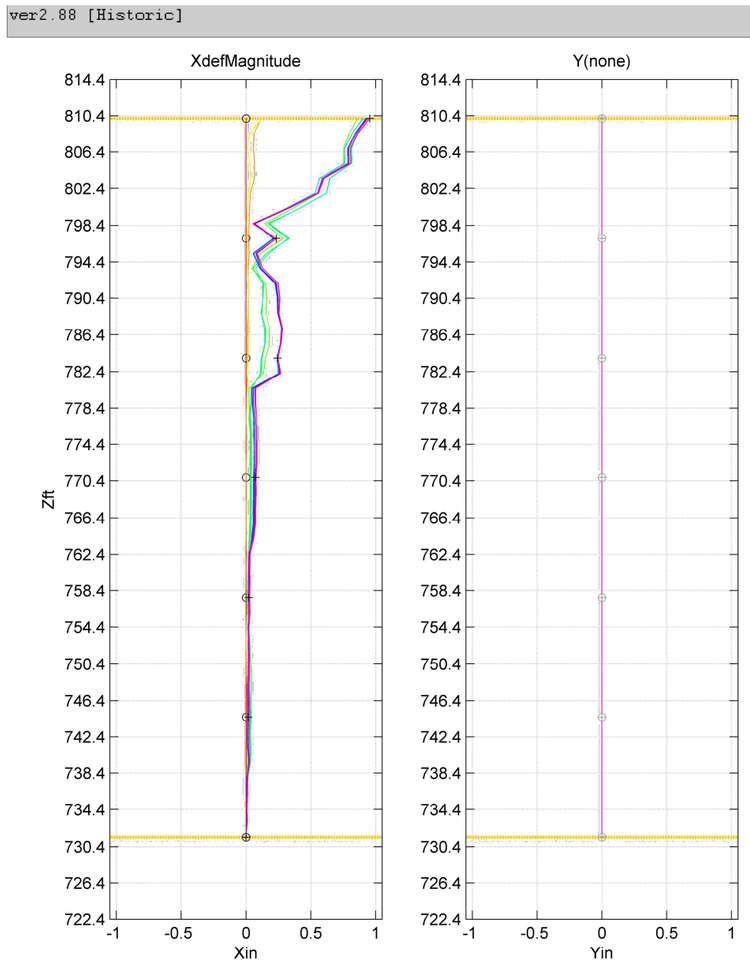
RED DOG MINE

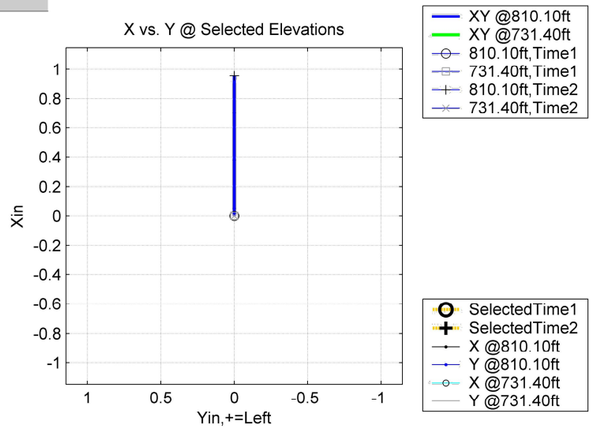
Red Dog Operations

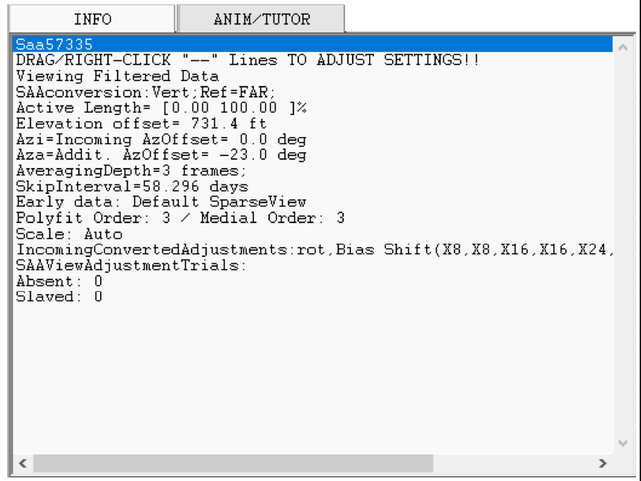
Teck

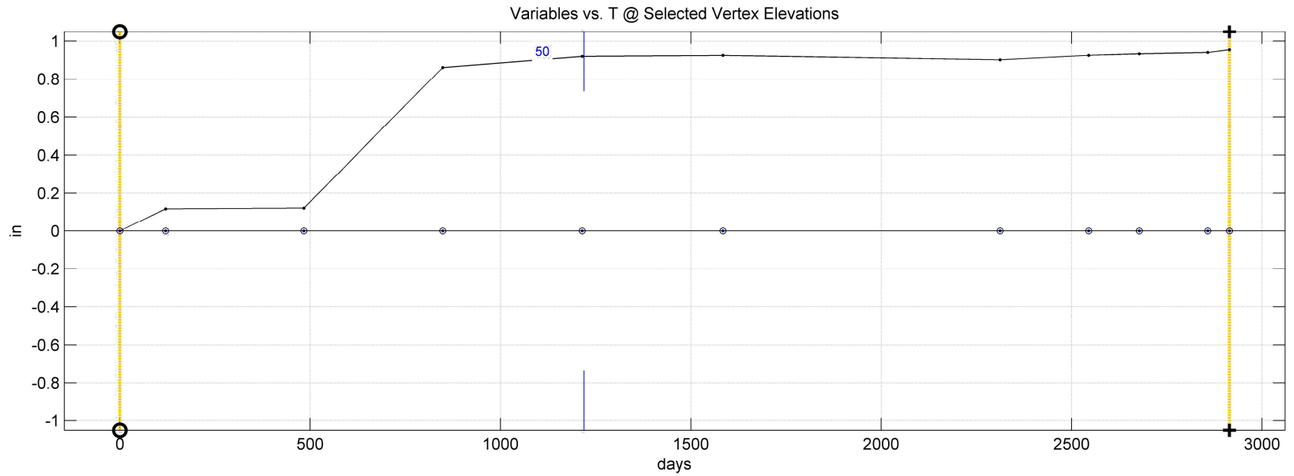
Figure A-11











05-Sep-2014 13:24:16 : 29-Aug-2022 08:22:00 [2914.79 days]

TAILINGS MAIN DAM
INCLINOMETER - INC 01-13

PROJECT #	2022 AFPR
DRAWN BY:	TJB
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

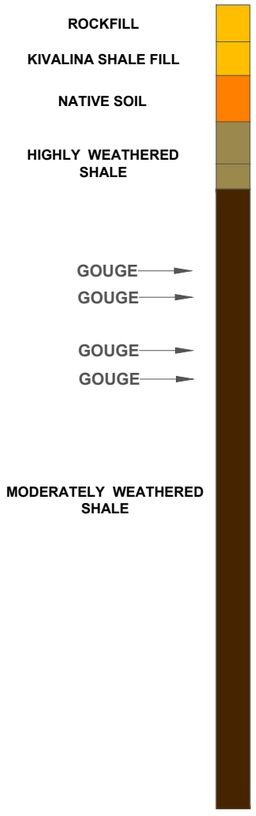
RED DOG MINE

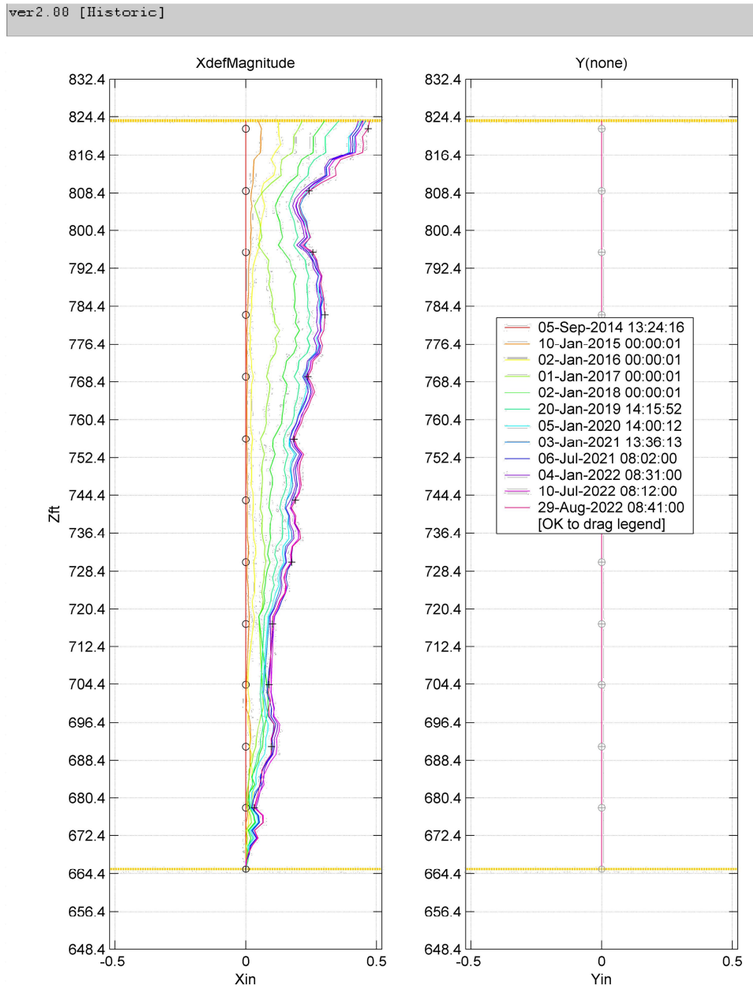
Red Dog Operations

Teck

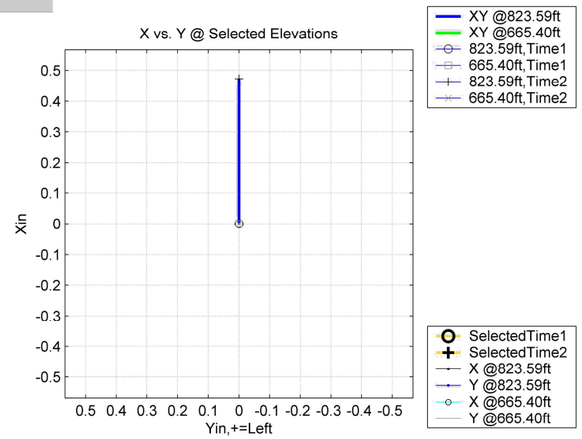
Figure A-12

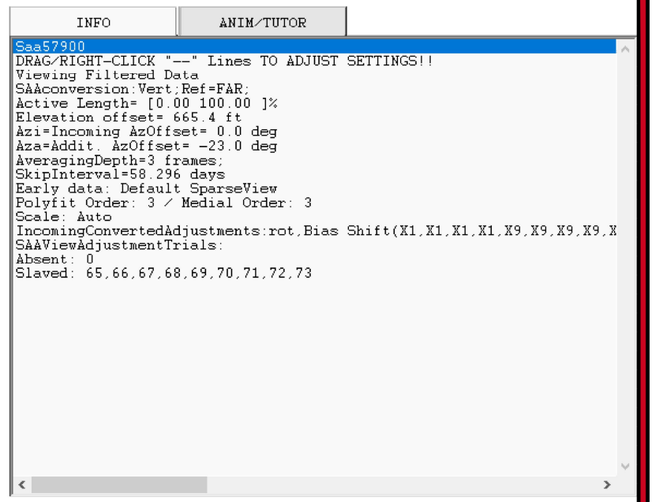
SOIL PROFILE

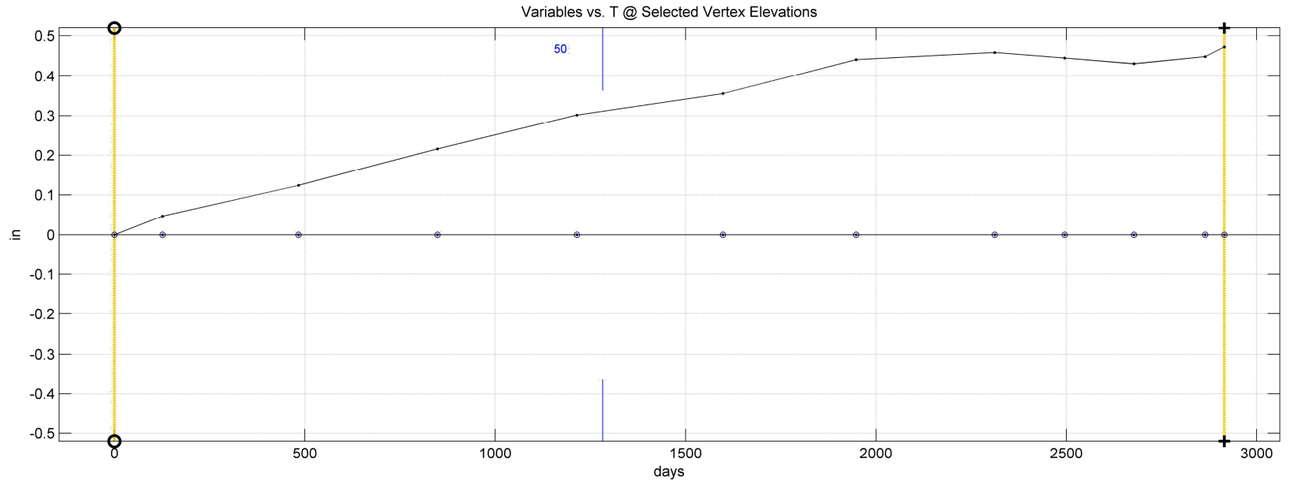




665.40 : 823.59 ft, (vtx = 0 : 97)







05-Sep-2014 13:24:16 : 29-Aug-2022 08:41:00 [2914.80 days]

TAILINGS MAIN DAM
INCLINOMETER - INC 02-13

PROJECT #	2022 AFPR
DRAWN BY:	TJB
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	OF

RED DOG MINE

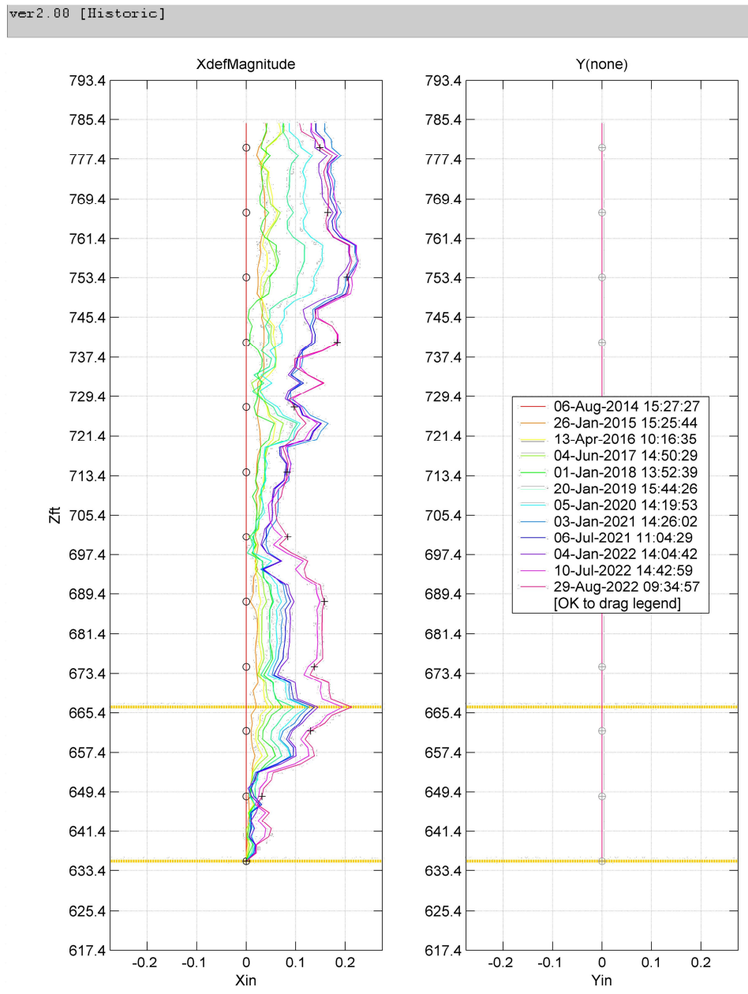
Red Dog Operations

Teck

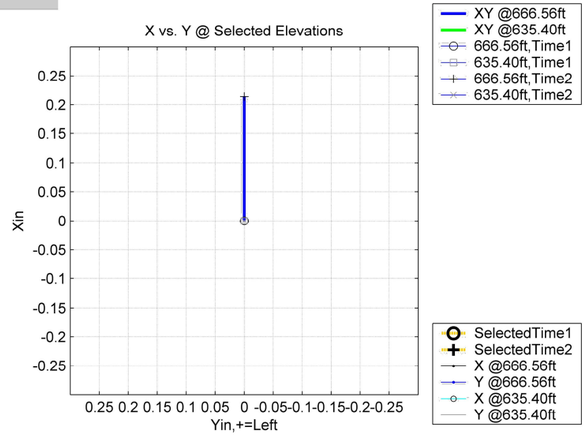
Figure A-13

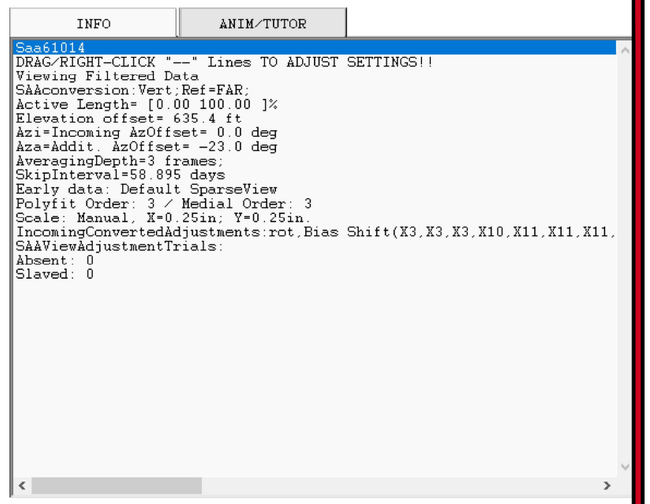
SOIL PROFILE

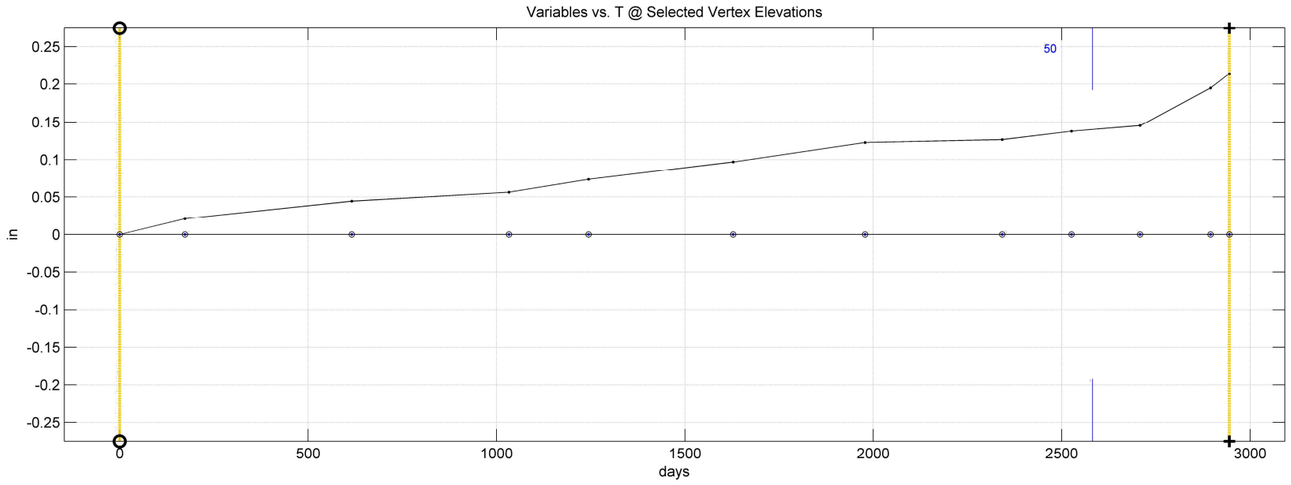
MODERATELY WEATHERED SHALE



635.40 : 666.56 ft, (vtx = 0 : 19)







06-Aug-2014 15:27:27 : 29-Aug-2022 09:34:57 [2944.76 days]

TAILINGS MAIN DAM
INCLINOMETER - INC 03-14

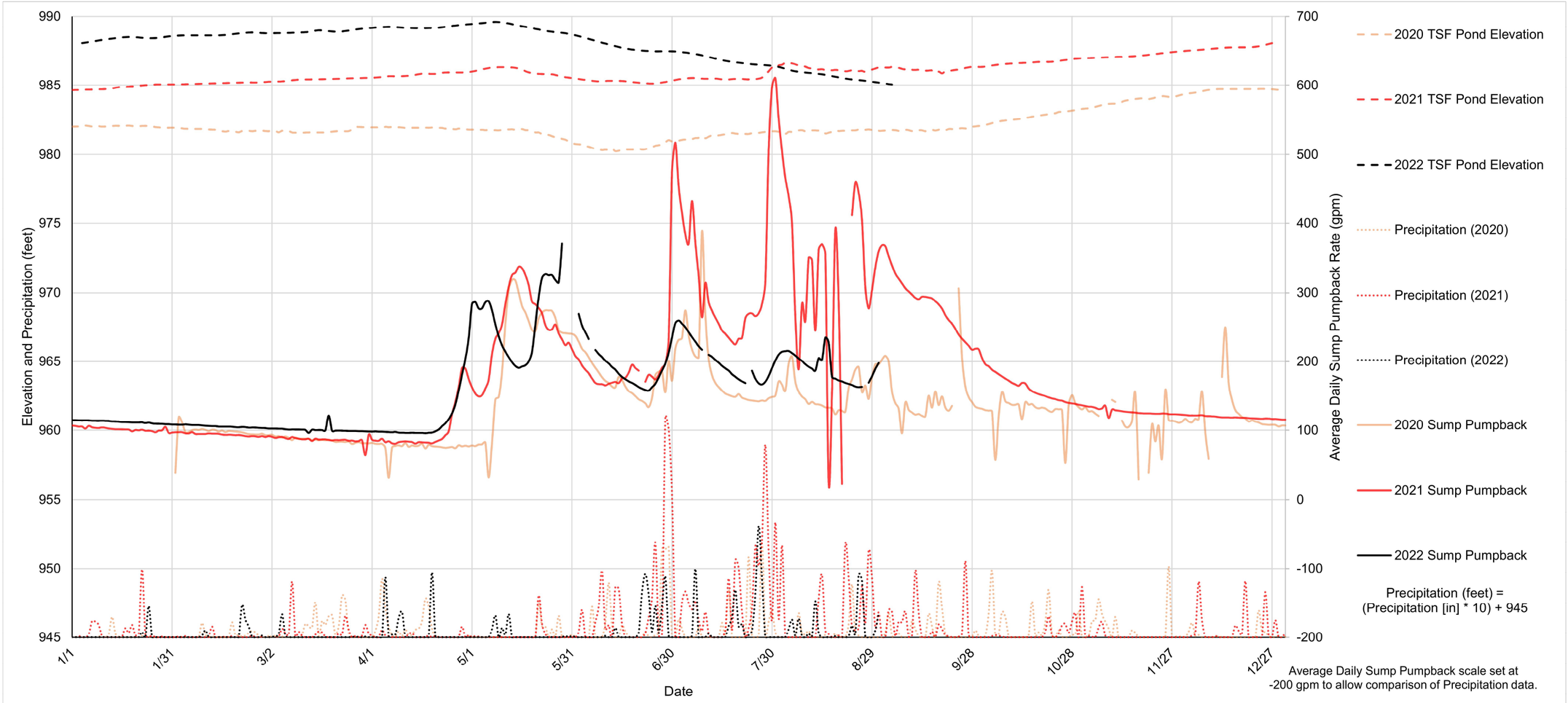
PROJECT #	2022 AFPR
DRAWN BY:	TJB
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET: OF	

RED DOG MINE

Red Dog Operations

Teck

Figure A-14



TAILINGS BACK DAM

POND ELEVATION, SUMP PUMPING RATE, AND PRECIPITATION

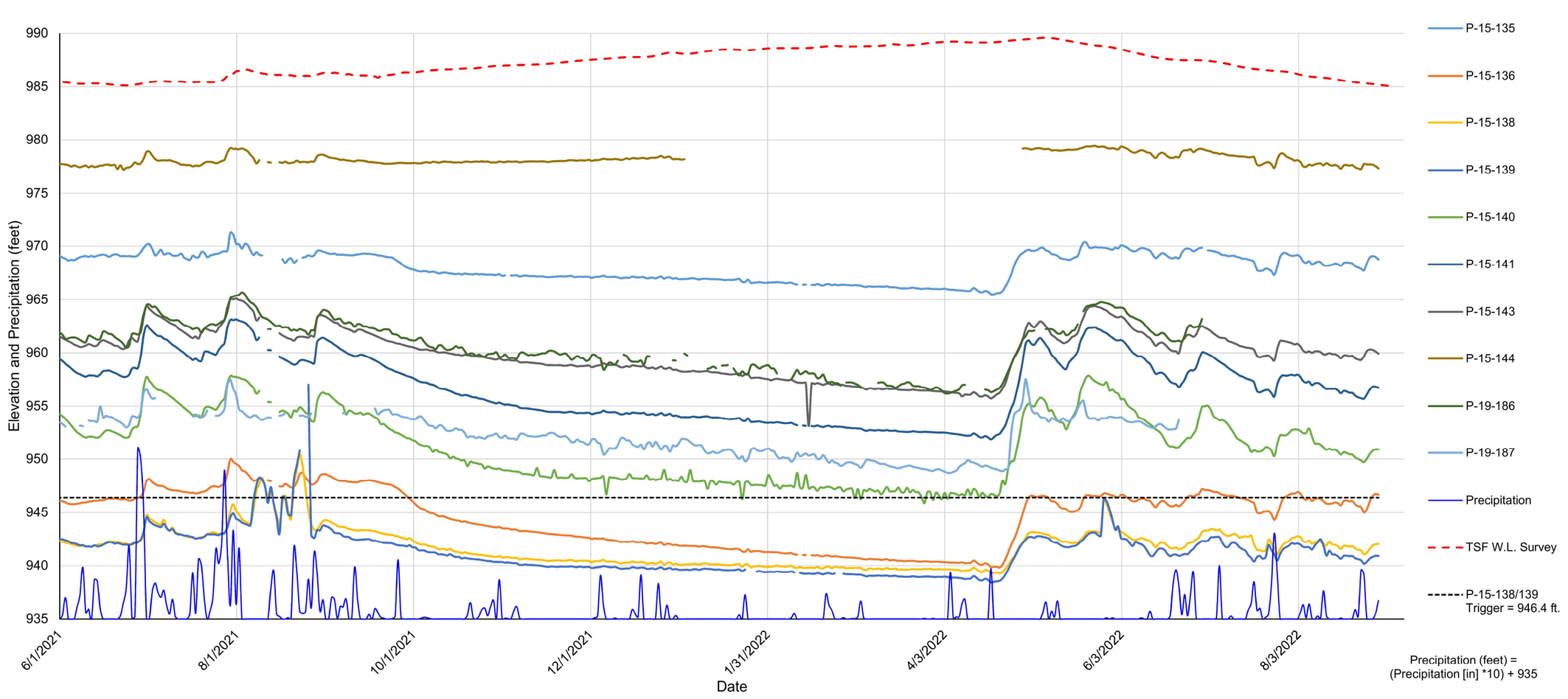
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

Teck

Figure A-15



TAILINGS BACK DAM
CRITICAL PIEZOMETERS

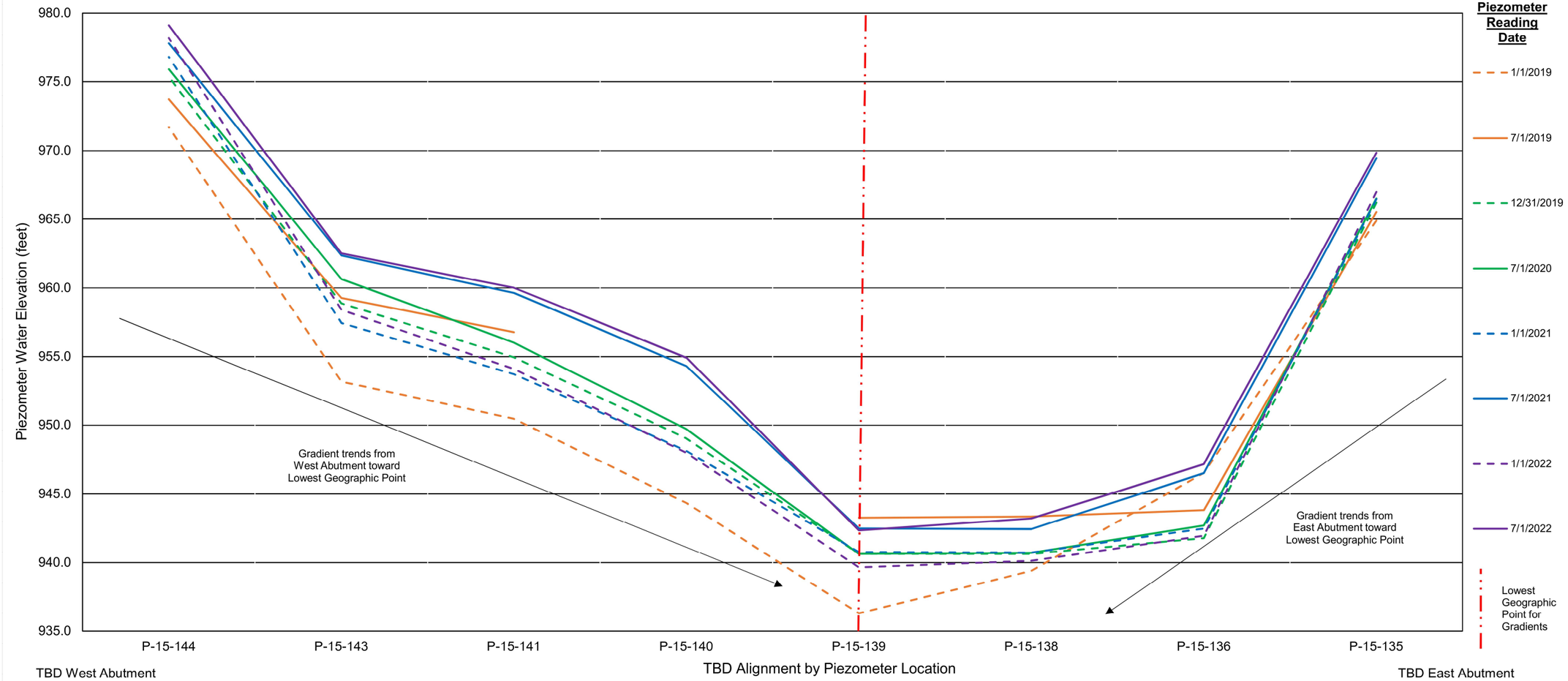
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

Teck

Figure A-16



TAILINGS BACK DAM DOWNSTREAM PIEZOMETER GRADIENTS

PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

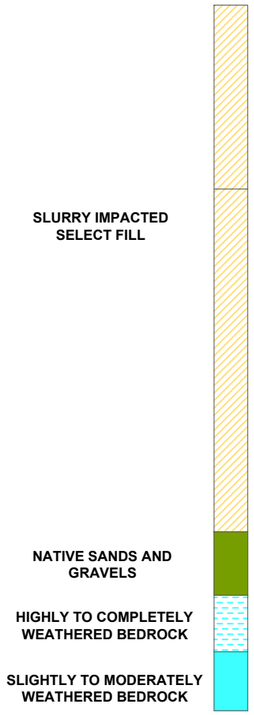
RED DOG MINE

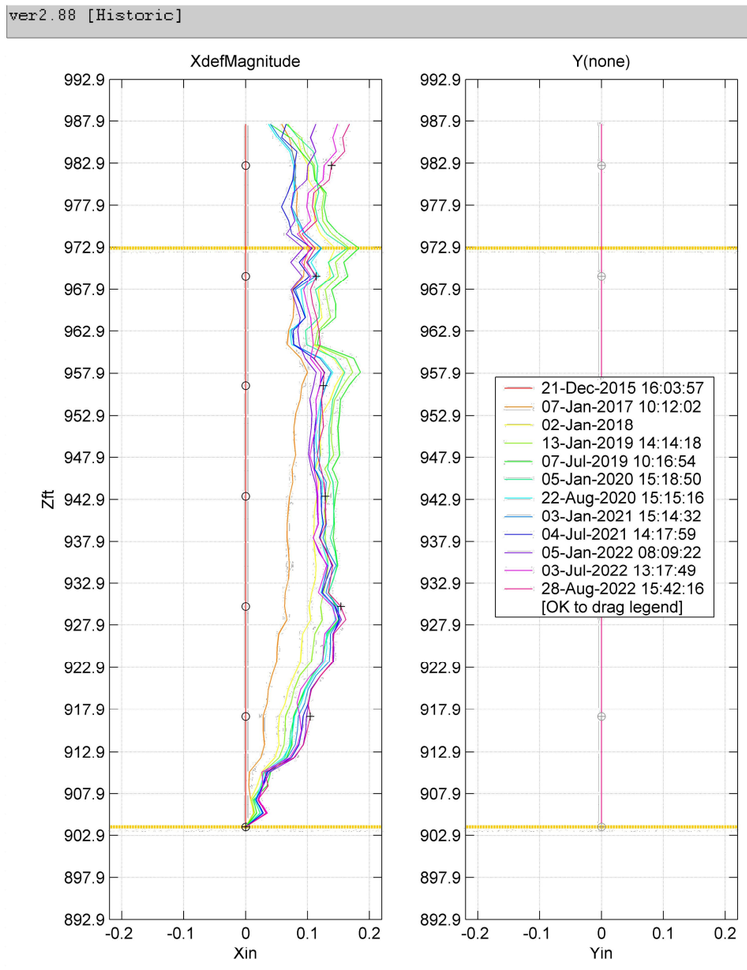
Red Dog Operations

Teck

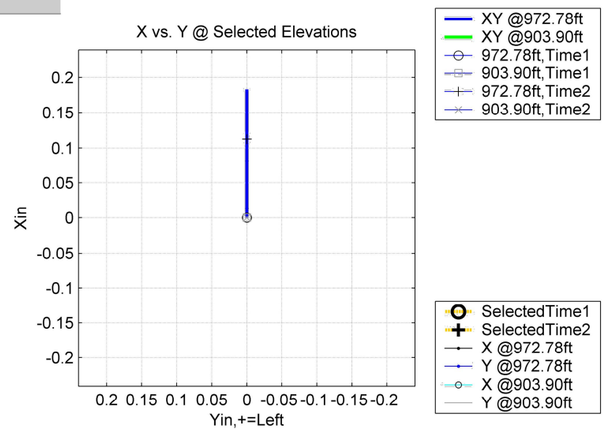
Figure A-17

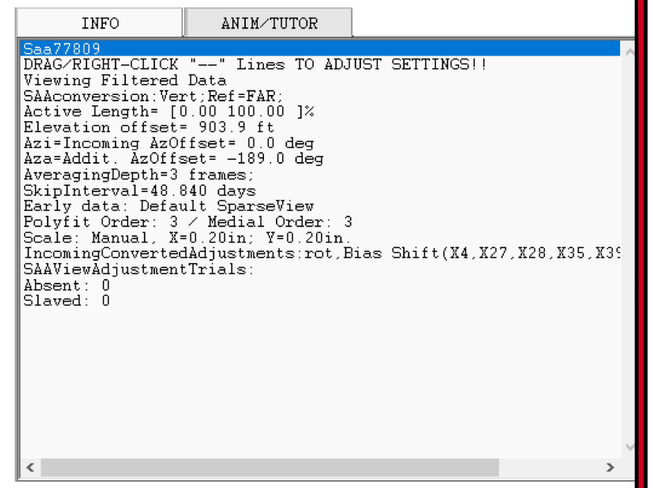
SOIL PROFILE

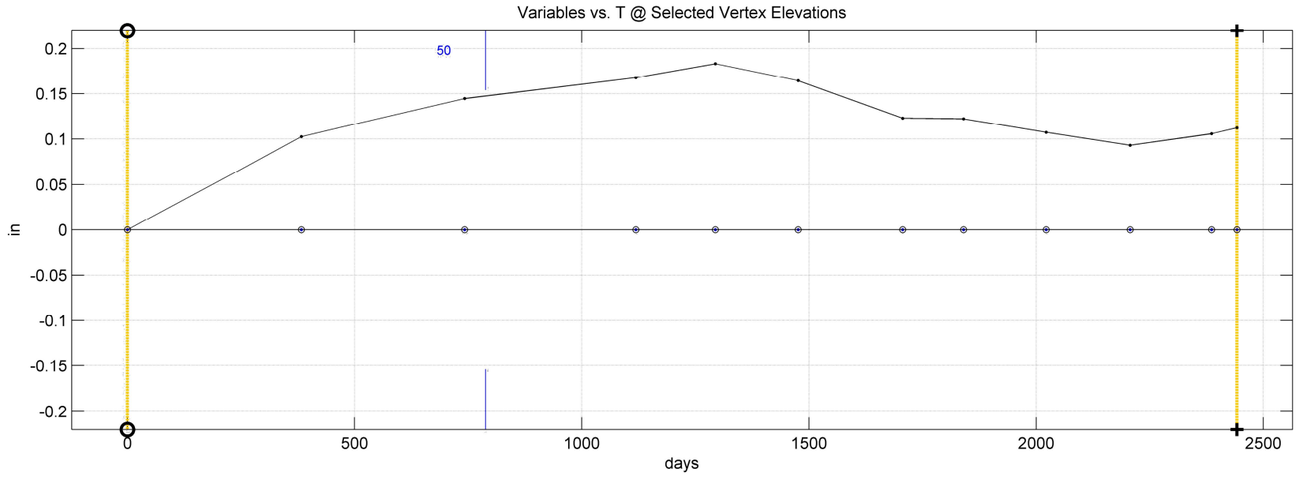




903.90 : 972.78 ft, (vtx = 0 : 42)







21-Dec-2015 16:03:57 : 28-Aug-2022 15:42:16 [2441.98 days]

TAILINGS BACK DAM
INCLINOMETER - SAA 14+00

PROJECT #	2022 AFPR
DRAWN BY:	TJB
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET: OF	

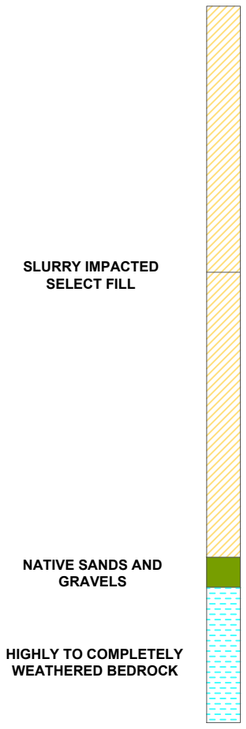
RED DOG MINE

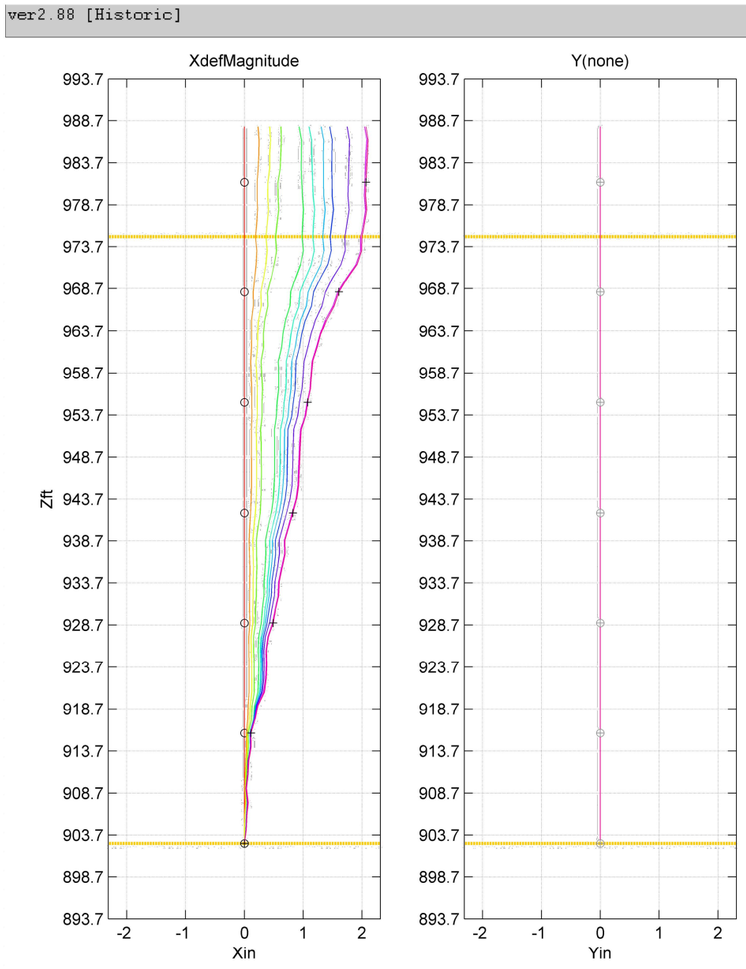
Red Dog Operations

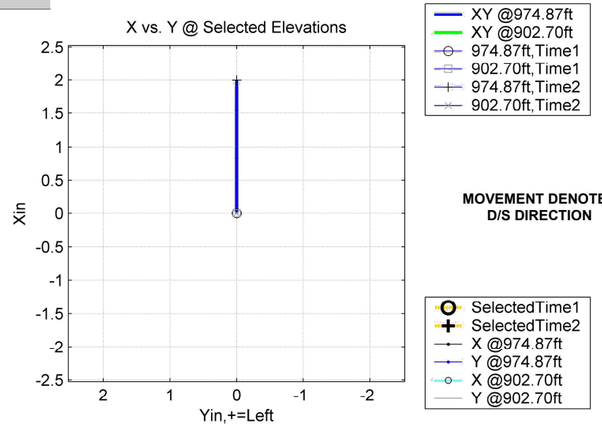
Teck

Figure A-18

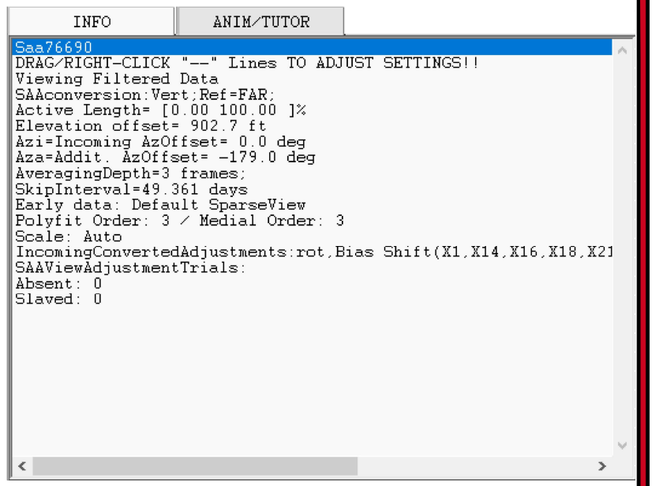
SOIL PROFILE

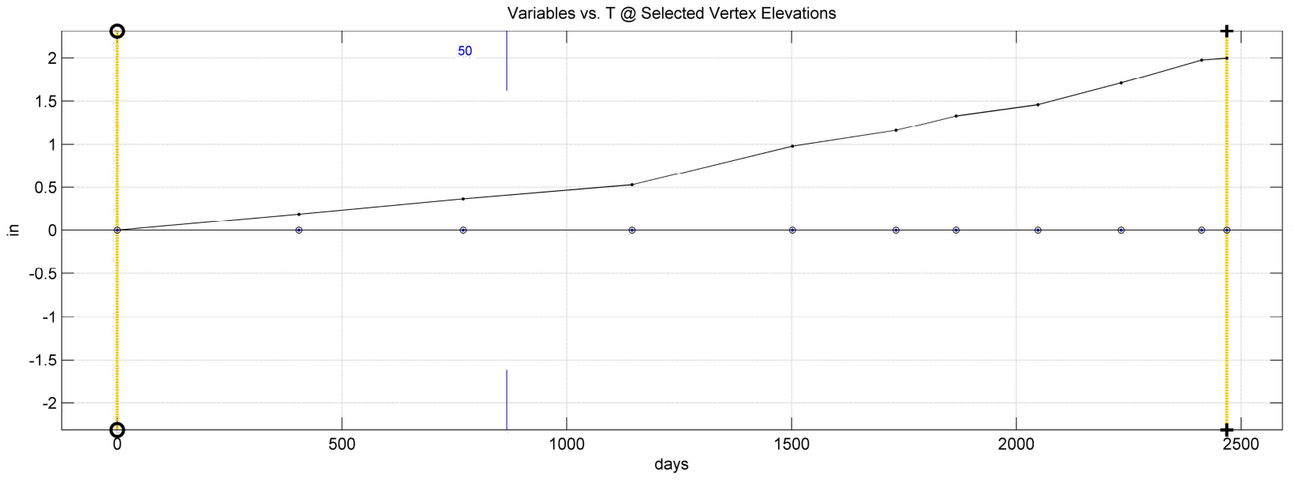






MOVEMENT DENOTES D/S DIRECTION





25-Nov-2015 14:45:56 : 28-Aug-2022 15:48:14 [2468.04 days]

TAILINGS BACK DAM
INCLINOMETER - SAA 25+00

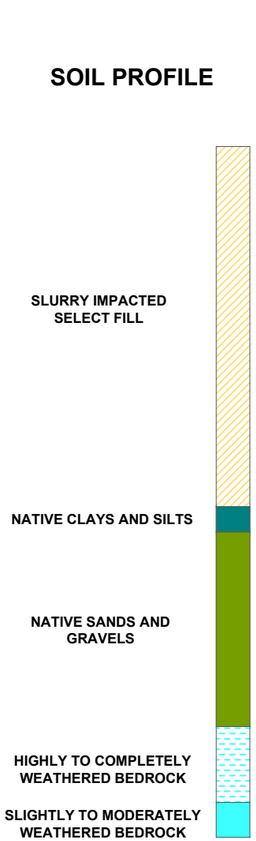
PROJECT #	2022 AFPR
DRAWN BY:	TJB
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

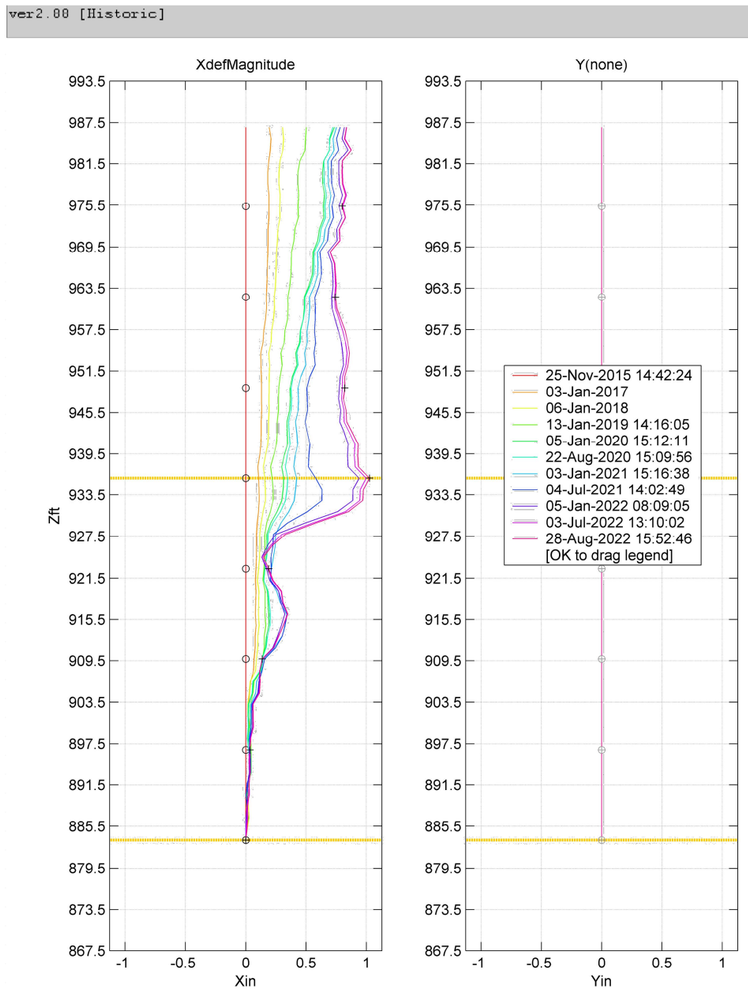
RED DOG MINE

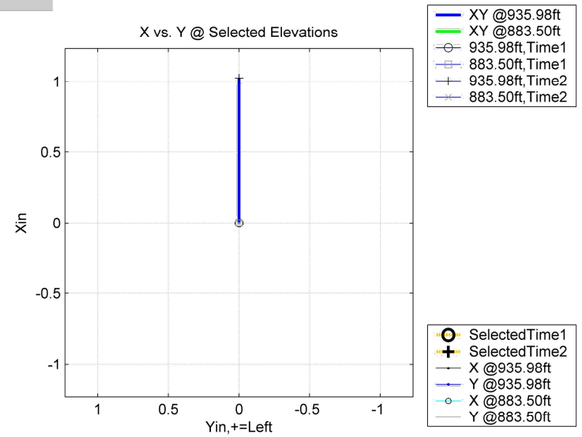
Red Dog Operations

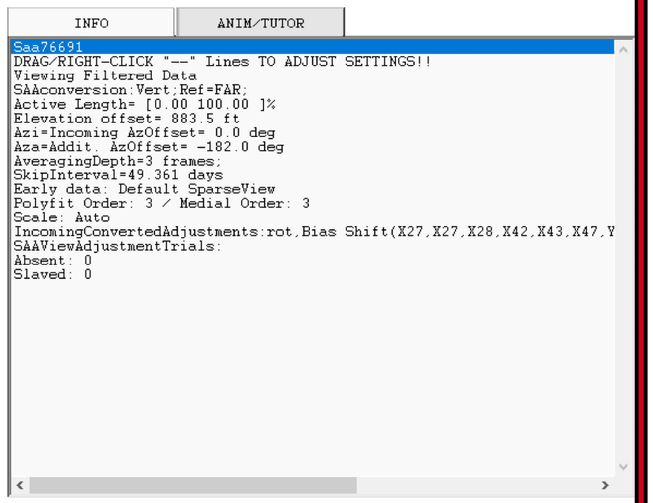
Teck

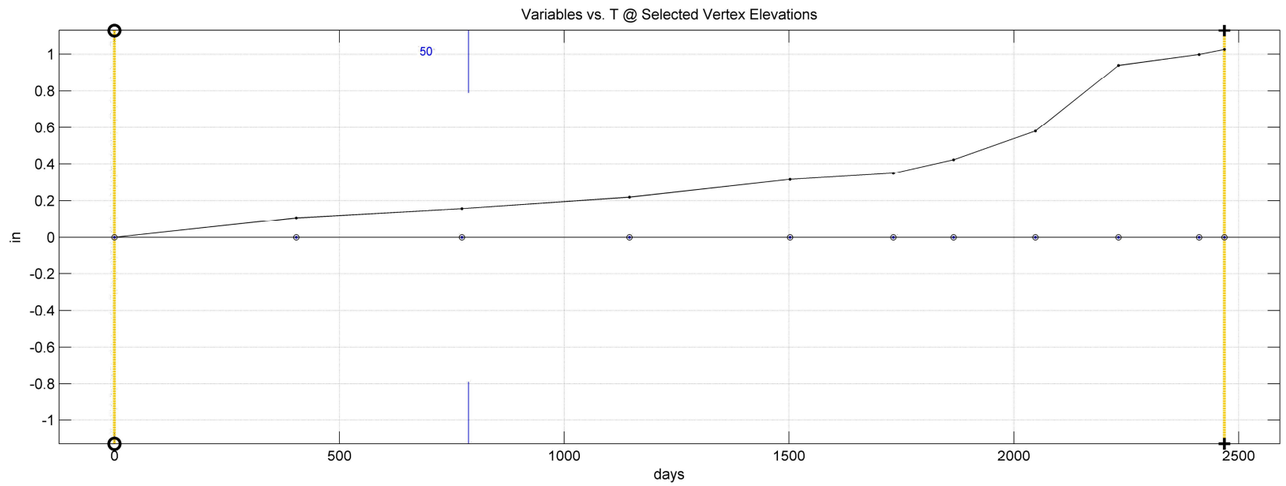
Figure A-19











883.50 : 935.98 ft, (vtx = 0 : 32)

25-Nov-2015 14:42:24 : 28-Aug-2022 15:52:46 [2468.05 days]

TAILINGS BACK DAM
INCLINOMETER - SAA 35+00

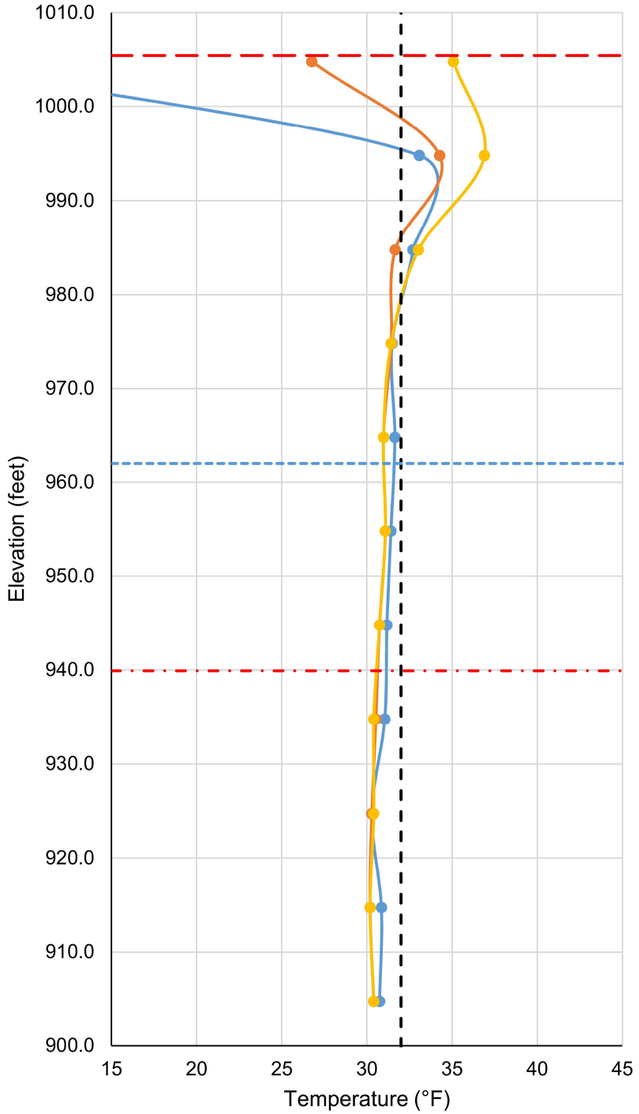
PROJECT #	2022 AFPR
DRAWN BY:	TJB
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

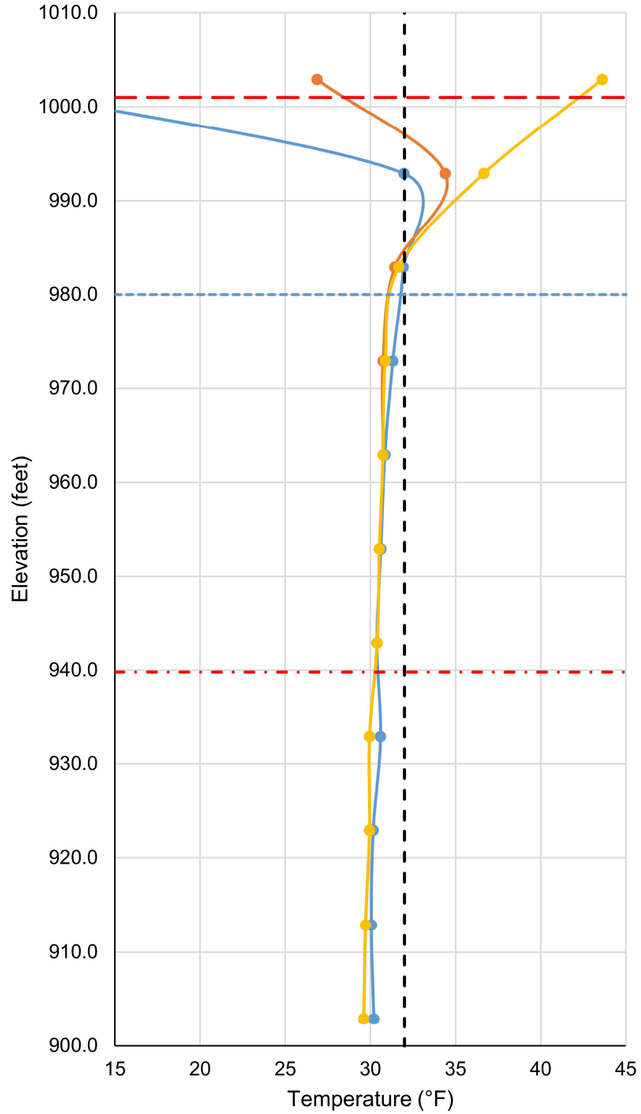
Teck

Figure A-20



T-12-106

- 29-Dec-19
- 24-Oct-20
- 13-Oct-21
- 32°F
- Original Ground Surface
- Top of Casing
- Trigger Elevation



T-12-107

- 29-Dec-19
- 24-Oct-20
- 13-Oct-21
- 32°F
- Original Ground Surface
- Top of Casing
- Trigger Elevation

KIVALINA OVERBURDEN THERMISTORS T-12-106 & T-12-107

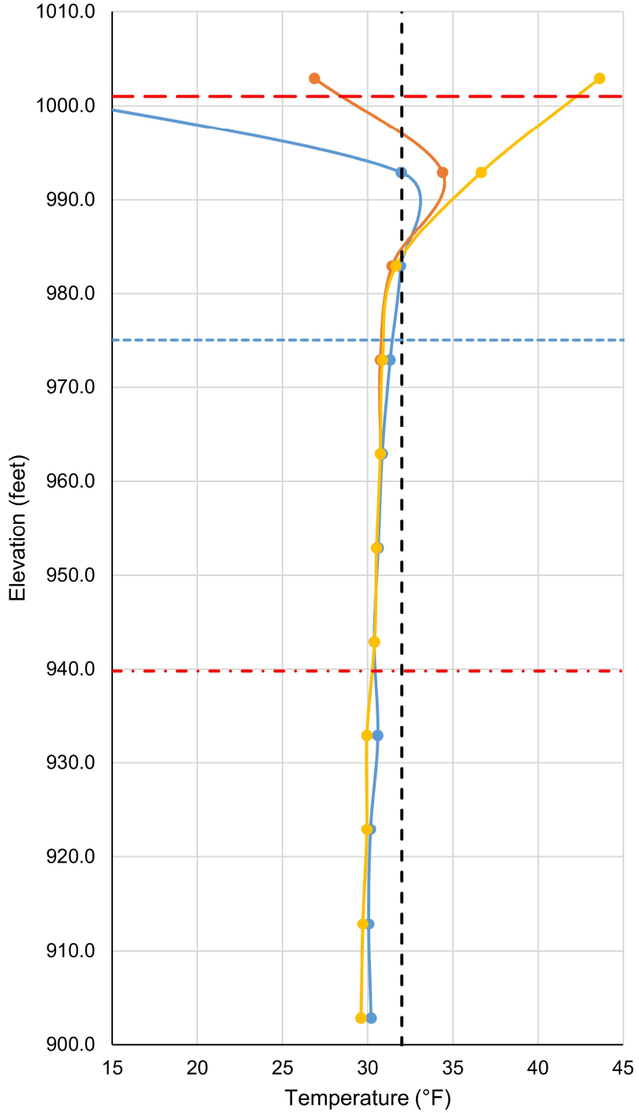
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

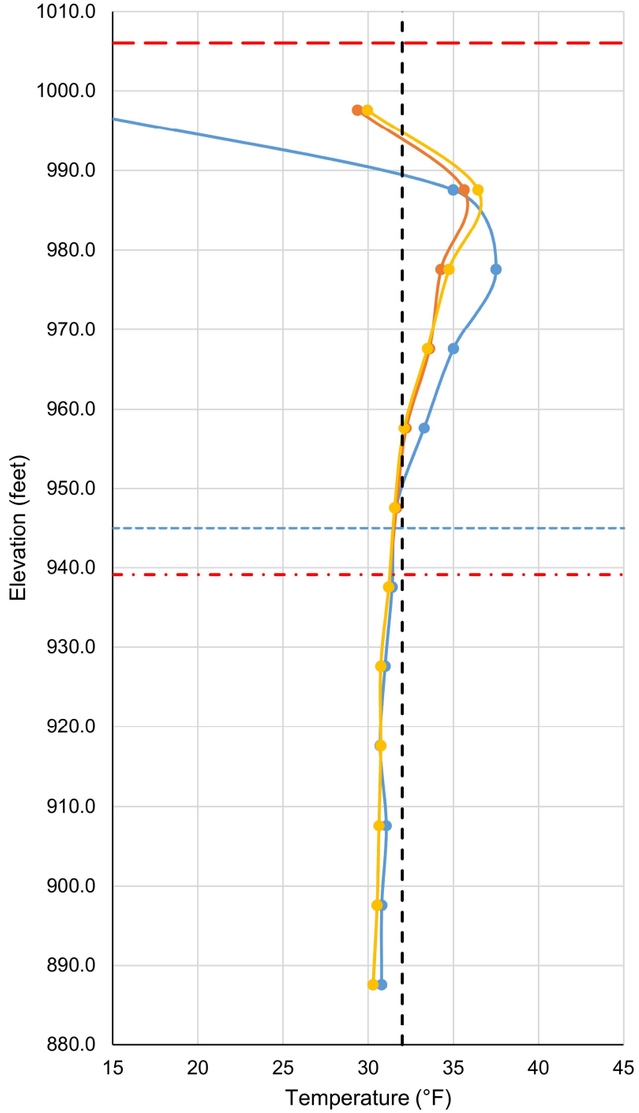
Teck

Figure A-21



T-12-108

- 29-Dec-19
- 24-Oct-20
- 13-Oct-21
- 32°F
- Original Ground Surface
- Top of Casing
- Trigger Elevation



T-12-109

- 29-Dec-19
- 24-Oct-20
- 13-Oct-21
- 32°F
- Original Ground Surface
- Top of Casing
- Trigger Elevation

KIVALINA OVERBURDEN THERMISTORS T-12-108 & T-12-109

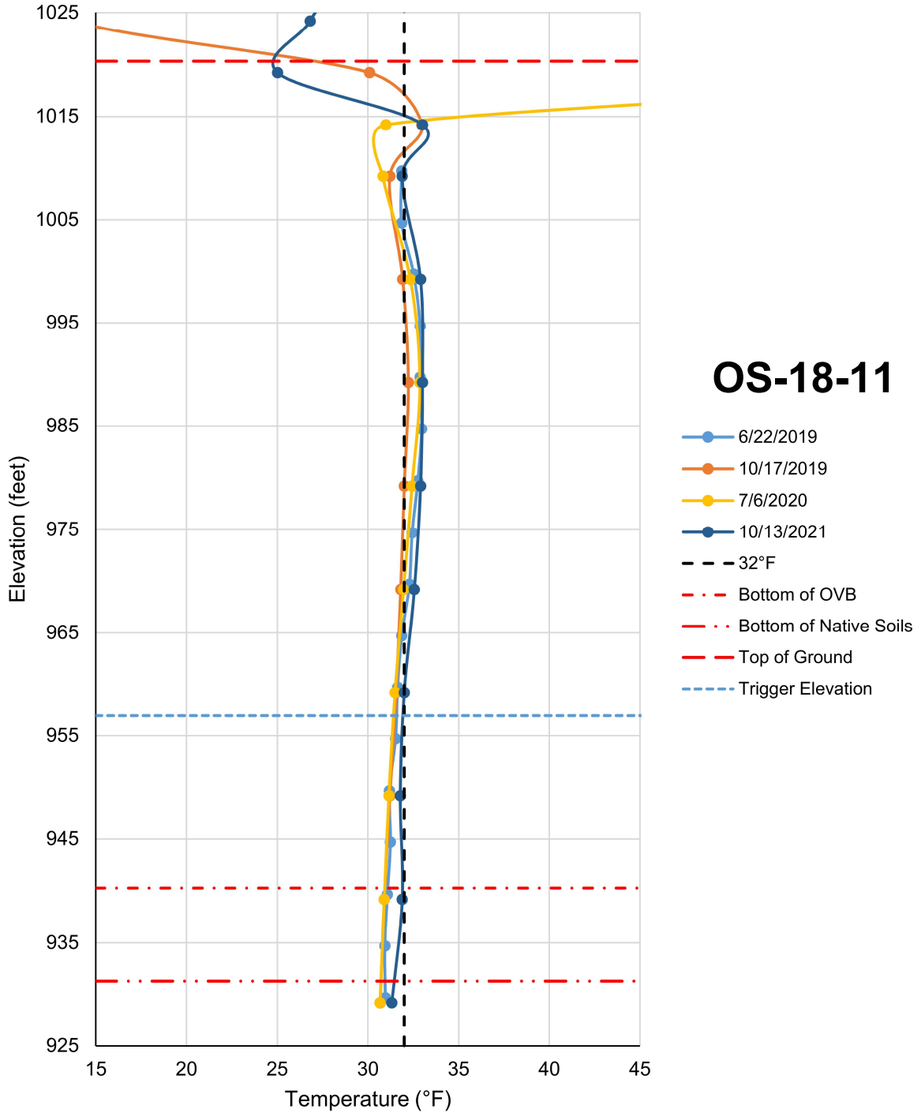
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET: OF	

RED DOG MINE

Red Dog Operations

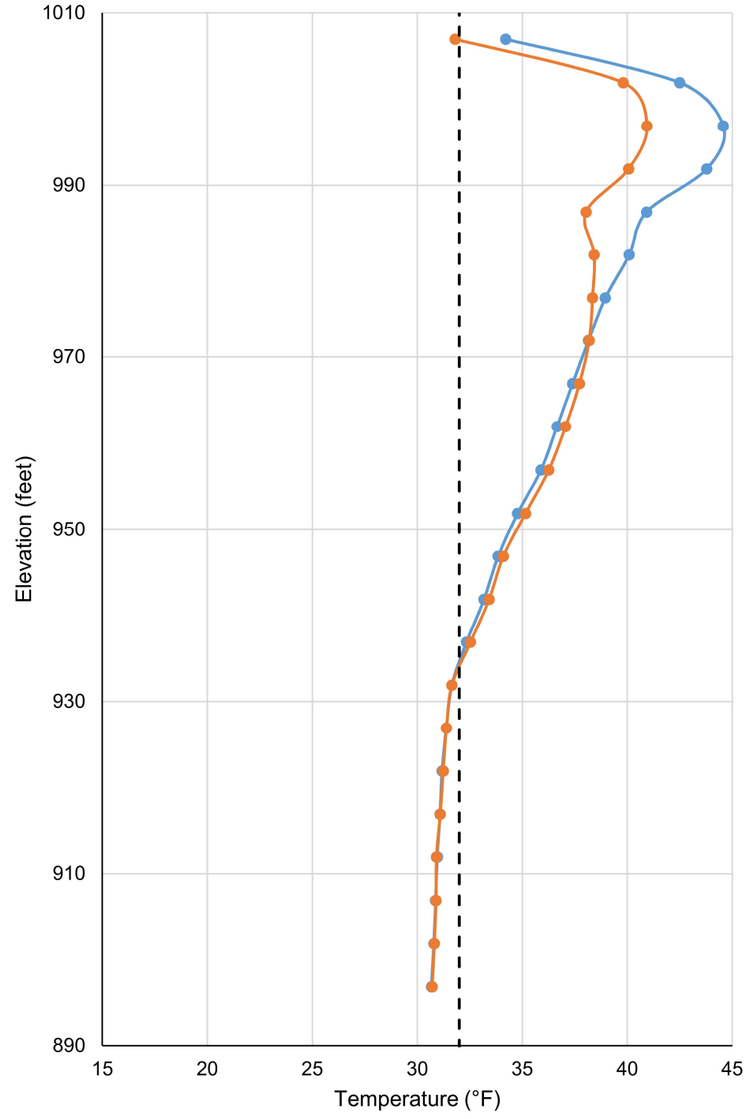
Teck

Figure A-22



OS-18-11

- 6/22/2019
- 10/17/2019
- 7/6/2020
- 10/13/2021
- 32°F
- Bottom of OVB
- Bottom of Native Soils
- Top of Ground
- Trigger Elevation



T-96-21

- 10/16/2019
- 10/19/2020
- 32°F

Reading on 10/31/2021 faulty, all recorded temperatures plot far above freezing line.

KIVALINA OVERBURDEN THERMISTORS OS-18-11 & T-96-21

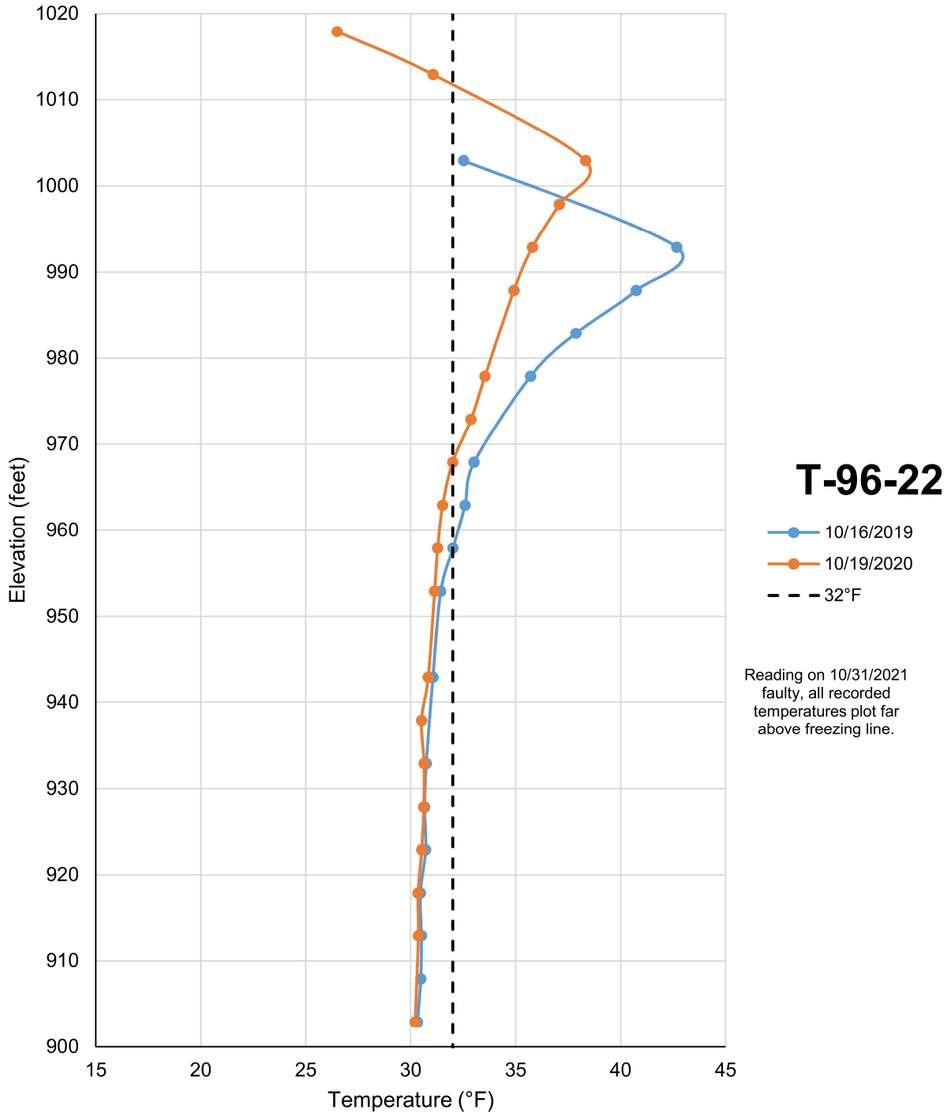
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	**OF**

RED DOG MINE

Red Dog Operations

Teck

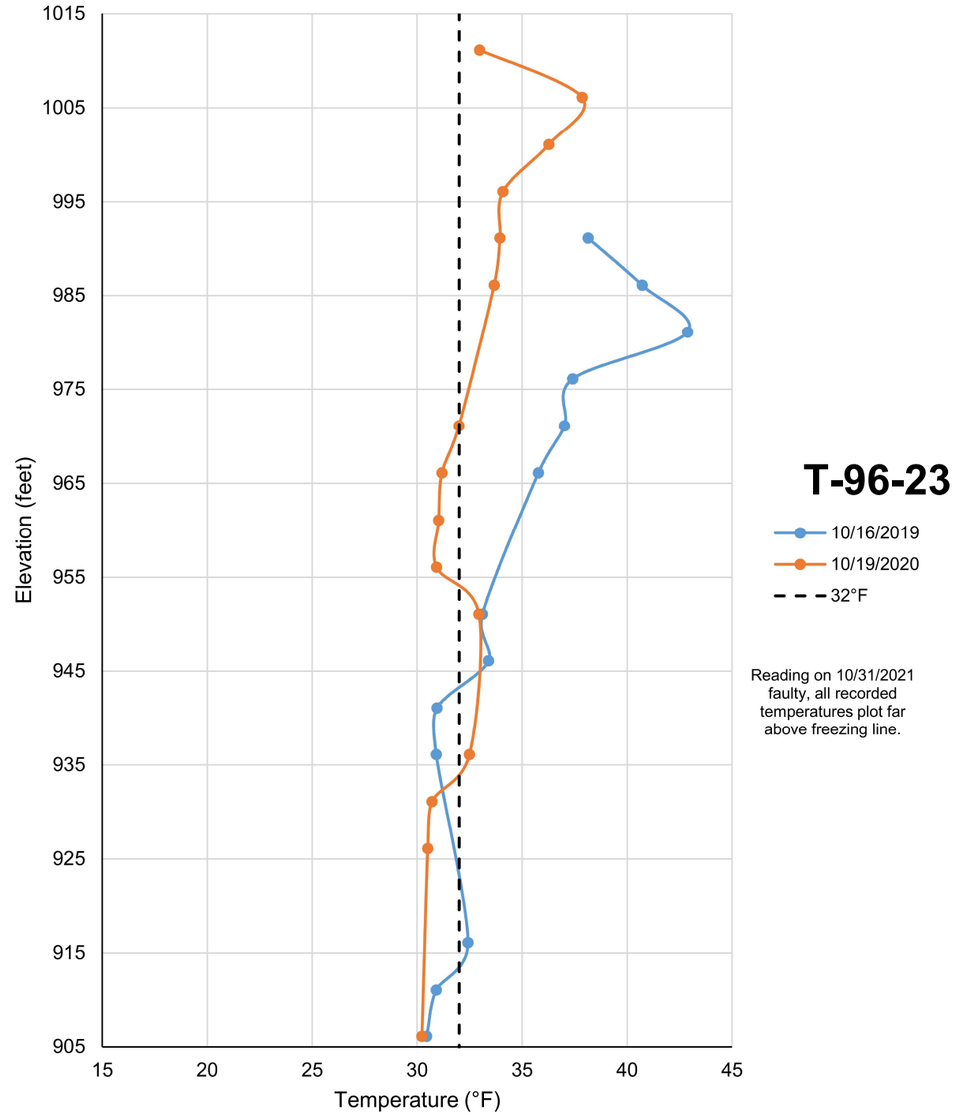
Figure A-23



T-96-22

10/16/2019
10/19/2020
32°F

Reading on 10/31/2021 faulty, all recorded temperatures plot far above freezing line.



T-96-23

10/16/2019
10/19/2020
32°F

Reading on 10/31/2021 faulty, all recorded temperatures plot far above freezing line.

KIVALINA OVERBURDEN THERMISTORS T-96-22 & T-96-23

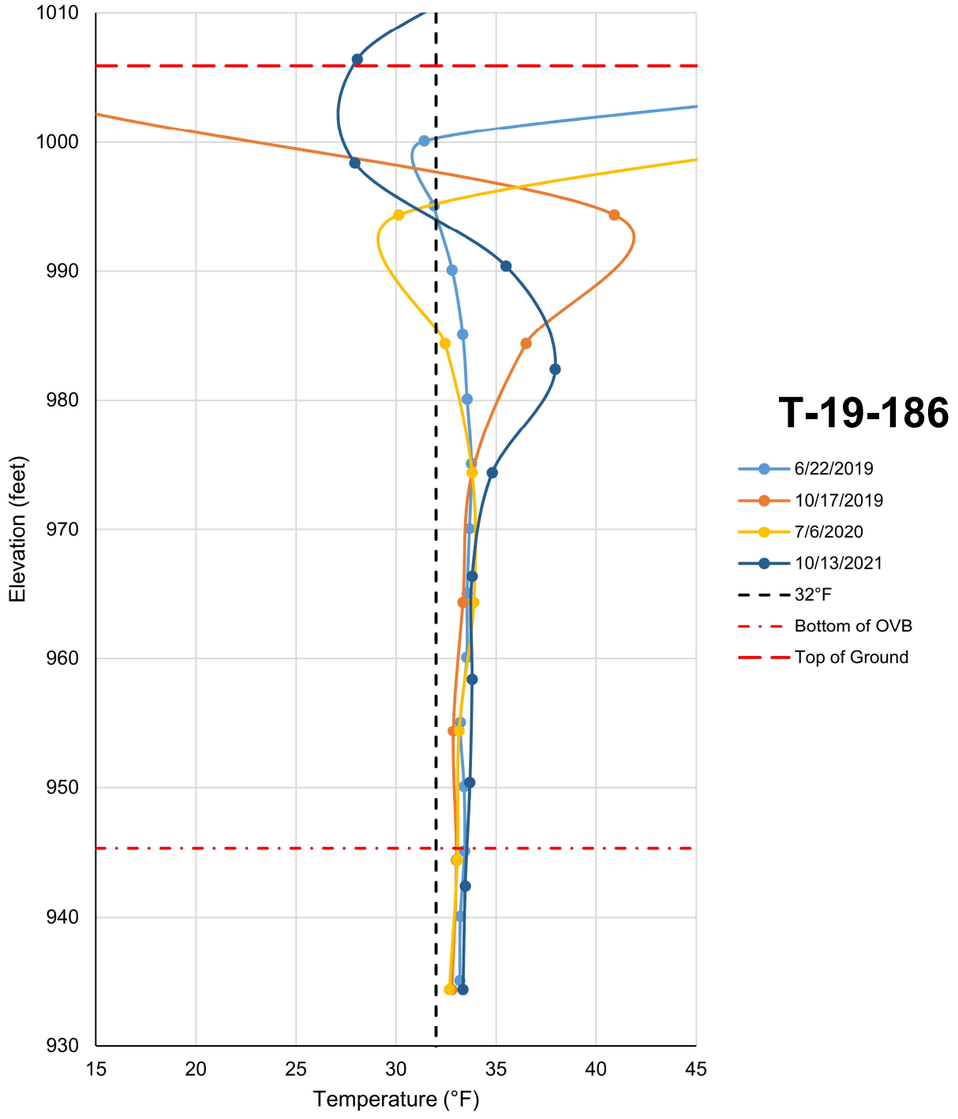
PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	OF

RED DOG MINE

Red Dog Operations

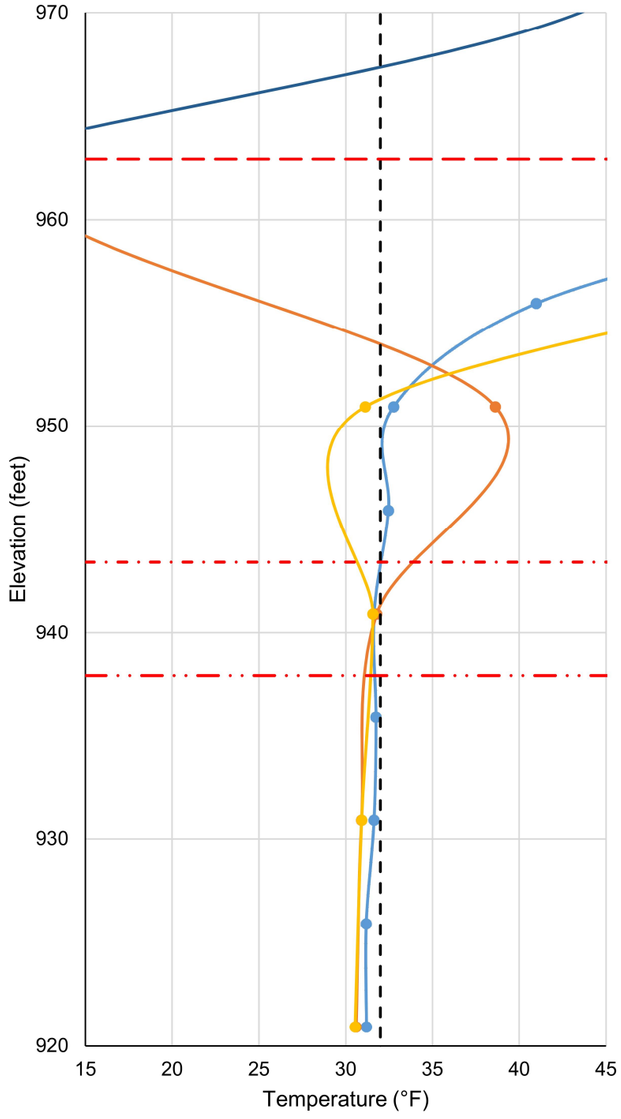
Teck

Figure A-24



T-19-186

- 6/22/2019
- 10/17/2019
- 7/6/2020
- 10/13/2021
- 32°F
- Bottom of OVB
- Top of Ground



T-19-187

- 6/22/2019
- 10/17/2019
- 7/6/2020
- 10/13/2021
- 32°F
- Bottom of Fill
- Bottom of Surface Organic
- Top of Ground

Equipment strike in April 2021 disconnected above-ground nodes from below-ground nodes. Damage to cable identified in October 2021. Data after 7/6/2020 not usable. Attempt to retrieve and replace cable unsuccessful.

KIVALINA OVERBURDEN THERMISTORS T-19-186 & T-19-187

PROJECT #	2022 AFPR
DRAWN BY:	BAH
CHECKED BY:	NT
DATE:	09/19/22
SCALE:	
SHEET:	OF

RED DOG MINE

Red Dog Operations

Teck

Figure A-25

APPENDIX B

Annual Facility Performance Inspection Forms

ANNUAL FACILITY PERFORMANCE INSPECTION CHECKLIST, OBERVATIONS AND PHOTOGRAPHS

Teck Alaska Incorporated
Red Dog Operations
2525 C Street, Suite 310
Anchorage, AK USA 99503

+1 907 754 3800 Tel
www.teck.com

INSPECTION CHECKLISTS

Facility:	Red Dog Tailings Main Dam	**Inspection Date:**	August 3, 2022
Consequence Classification:	Unchanged from previous inspection		
Weather:	Sunny	**Inspector(s):**	Steven L. Anderson, PE and Benjamin Schmidt, PE
Freeboard (pond level to dam crest):	6.4 ft (pond elevation of 986 ft)		

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

EMBANKMENT	Yes/ No
U/S slope	☒ Yes ☐No
Crest	☒ Yes ☐No
D/S Slope	☒ Yes ☐No
D/S Toe	☒ Yes ☐No

Were any of the following ***POTENTIAL PROBLEM INDICATORS* found?**
(check one if applicable)

INDICATOR	EMBANKMENT	INDICATOR	EMBANKMENT
Piping	☐ Yes ☒No	Settlement	☐ Yes ☒No
Sinkholes	☐ Yes ☒No	Sloughing/ Slides	☐ Yes ☒No
Seepage	☐ Yes ☒No	Animal Activity	☐ Yes ☒No
External Erosion	☐ Yes ☒No	Excessive Growth	☐ Yes ☒No
Cracks	☐ Yes ☒No	Excessive Debris	☐ Yes ☒No

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

- *Some divots were noted in the Soil Type 11 materials covering the geomembrane liner along the floor of the Seepage Collection Pond (see Photo 6). The concern is that the divots may have been produced by the dozer during grading of the Soil Type 11 materials and could have damaged the liner. As a best management practice, recommend using care and soft tooling methods to inspect the liner at these locations and make any repairs, as necessary. Following inspection, the minimum 1 ft thickness of Soil Type 11 should be replaced over the liner. This inspection should be accomplished either this year before winter starts and freezing conditions/snow cover or during the continuing Stage XII construction when the geomembrane liner subcontractor is on site.*

- *Some pooling water was noted in the Seepage Collection Pond at the base of the bench fill and the southern end of the pond bottom (see Photo 5). We understand these water pools are related to the operating level of the pumpback system. The minimum 1 ft Soil Type 11 is supposed to be about 790 ft (old Mine Grid coordinate system). Additional Soil Type 11 may be required at these locations. As a best management practice, recommend inspecting the elevation of the Soil Type 11 cover and placing more fill as necessary. Timing to perform this maintenance could be either this year (2022) or next year (2023).*

Comments/ Notes:

- *Golder inspection listed team above accompanied by Bryce Hiles and Tenaya Brown from Teck, and Tom Krzewinski from Golder.*
- *Stage XII Embankment widening construction ongoing at time of inspection.*

INSPECTION OBSERVATIONS

General

Stage XII widening construction was ongoing at the Embankment during the site inspection. This construction had reached a stage where the active construction bench was about 20 ft below the dam crest (see Photo 4). Therefore, the Embankment slope below the construction bench, including the lower buttress slope, was newly constructed in 2022.

Crest

The dam crest appeared to be in satisfactory physical condition with no indications of settlement, cracking, or stability issues (see Photos 2, 3, 5, and 14 to 17). Tire tracks in soft soils were observed along crest of TMD Embankment (see Photo 2) that showed equipment had driven inside of the delimitation markers (either safety candles or reflectors) and came close to the exposed geomembrane liner near the anchor trench at several locations. Driving over the geomembrane liner without protective cover could damage the liner. We understand these occurred during the ongoing Stage XII raise construction and that the contractor had already been notified to stay outside of the delimitation markers. No apparent damage to the geomembrane liner was observed.

West Abutment

West abutment of Embankment appeared to be in satisfactory physical condition with no indications of erosion, deterioration, horizontal displacement, or other instability (see Photos 1 and 6).

East Abutment

East abutment of Embankment appeared to be in satisfactory condition with no indications of erosion, deterioration, horizontal displacement, or other instability (see Photo 7).

Upstream Slope/ Tailings Beach

Upstream slope of Embankment and Wing Wall appeared to be in satisfactory physical condition with no indications of liner damage, displacement, or other signs of instability (see Photos 2, 3, and 15). A satisfactory subaerial tailings beach that appeared to meet the minimum target widths was observed at the Embankment and Wing Wall (see Photos 19 and 20). No piping or sinkholes were observed in the subaerial tailings beach.

Downstream Slope

Downstream slope of Embankment and Wing Wall appeared to be in satisfactory physical condition with no vegetation or indications of instability (see Photos 3, 4, 11, and 12).

Seepage

No seepage was observed along the upstream or downstream slopes.

Seepage Collection Pond and Dam

The Seepage Collection Pond and Dam crest, upstream and downstream slopes, and spillway appeared to be in satisfactory physical condition with no signs of damage, settlement, cracking, or instability (see Photos 8 to 11). The bottom of the Seepage Collection Pond had divots in the protective soils covering the geomembrane liner at the east side of the pond bottom (see Photo 9), which should be inspected to assess there is no damage to the liner and protective cover soil replaced. Ponding water was also observed at the base of the Embankment bench fill (see Photo 8), which may be an indicator that additional protective cover soil may be required in those areas.

INSPECTION PHOTOGRAPHS

Photos were taken on August 3, 2022 during the site inspection.

Photo 1: Upstream West Abutment of Embankment

Photo 2: Embankment Crest, Upstream Slope, and Tailings Pipe Bench

Photo 3: Equipment Tire Tracks near Geomembrane Liner at Embankment Crest

Photo 4: Stage XII Construction Bench and Downstream Embankment Slope

Photo 5: Embankment Crest near Transition to Wing Wall

Photo 6: Downstream Slope and Buttress at West Abutment of Embankment

Photo 7: Downstream Slope at East Abutment of Embankment

Photo 8: Seepage Collection Pond with Visible Ponded Water

Photo 9: Divots in Seepage Collection Pond Cover Soil

Photo 10: Downstream Slope of Seepage Collection Dam

Photo 11: Seepage Collection Dam Spillway

Photo 12: Turbine Pumps inside of Pumphouse

Photo 13: Flow Meter Inside of Pumphouse

Photo 14: Insulation over Secant Wall at South End of Wing Wall

Photo 15: Upstream Slope and Crest at South Leg of Wing Wall

Photo 16: Downstream Slope and Crest at South Leg of TMD Wing Wall

Photo 17: Downstream Slope and Crest at North Leg of TMD Wing Wall

Photo 18: Downstream Slope at Pipeline Corridor

Photo 19: Subaerial Tailings Beach at Embankment

Photo 20: Subaerial Tailings Beach at Wing Wall

Teck Alaska Incorporated
Red Dog Operations
2525 C Street, Suite 310
Anchorage, AK USA 99503

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www.teck.com

INSPECTION CHECKLISTS

Facility:	Red Dog Tailings Back Dam	**Inspection Date:**	August 3, 2022
Consequence Classification:	Unchanged from previous inspection		
Weather:	Sunny	**Inspector(s):**	Steven L. Anderson, PE and Benjamin Schmidt, PE
Freeboard (pond level to dam crest):	6.4 ft (pond elevation of 986 ft)		

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

EMBANKMENT	Yes/ No
U/S slope	☒ Yes ☐No
Crest	☒ Yes ☐No
D/S Slope	☒ Yes ☐No
D/S Toe	☒ Yes ☐No

Were any of the following ***POTENTIAL PROBLEM INDICATORS* found?**
(check one if applicable)

INDICATOR	EMBANKMENT	INDICATOR	EMBANKMENT
Piping	☐ Yes ☒No	Settlement	☐ Yes ☒No
Sinkholes	☐ Yes ☒No	Sloughing/ Slides	☐ Yes ☒No
Seepage	☐ Yes ☒No	Animal Activity	☐ Yes ☒No
External Erosion	☐ Yes ☒No	Excessive Growth	☐ Yes ☒No
Cracks	☐ Yes ☒No	Excessive Debris	☐ Yes ☒No

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

- *Standing water from seepage at east abutment cut slope at the crest tie in was observed that could pool over plastic concrete cut-off wall and saturate the bottom of insulation layer. This has potential to negatively impact the plastic concrete due to freeze-thaw degradation with time. As a best management practice, recommend construction of a shallow trench graded to drain and filled with draining rock along base of cut-slope that daylights into rockfill, which would allow seepage water to drain away from cut-off wall. This could be addressed during ongoing or future construction scheduled to be completed in 2024. Installation of trench during later construction would require removal of the insulation layer.*

Comments/ Notes:

- *Golder inspection listed team above accompanied by Bryce Hiles and Tenaya Brown from Teck, and Tom Krzewinski from Golder*
- *Stage V-A cut-off wall raise, and Transportation Corridor construction was ongoing at time of inspection.*

INSPECTION OBSERVATIONS

General

The dam embankment has already been raised to the Stage V-A crest elevation in 2021 and ongoing construction in 2022 includes installing the associated cut-off wall, extending the east abutment to the Stage V-B elevation, and completing the new transportation corridor crossing near the east abutment. No ongoing construction was observed during the site inspection, but most of the cut-off wall installation and east abutment extension had been completed.

Crest

The dam crest has no thermal protective layer (except at port road crossing) as it is exposed to accommodate Stage V-A cut-off wall construction. Crest and exposed plastic concrete cut-off wall appear to be in satisfactory physical condition with no indications of settlement, cracking, or stability issues (see Photos 1, 4, 6, 10, 11, 16, 20, and 22).

West Abutment

West abutment appears to be in satisfactory physical condition with no indications of displacement, settlement, erosion, or concerning issues (see Photos 1 and 2). Excavation to refusal into bedrock at cut-off wall tie in observed (see Photos 2).

East Abutment

East abutment appears to be in satisfactory physical condition with no indications of displacement, settlement, erosion, or stability issues. Excavation to bedrock and cut-off wall constructed to Stage V-B elevation observed. Standing water from seeps observed at base of Stage V-B cut slope (see Photo 22). If water is not allowed to drain away it could saturate plastic concrete immediately below insulation layer and lead to potential freeze-thaw degradation of plastic concrete with time. This potential can be mitigated during ongoing or future construction scheduled to be completed in 2024.

Upstream Slope/ Tailings Beach

Upstream slope appears to be in satisfactory physical condition with no indications of erosion, displacement, or other signs instability (see Photos 3, 8, 9, 14, 17, and 19). Subaqueous tailings deposition ongoing (see Photo 9) but no tailings beach has been constructed yet.

Downstream Slope

Downstream slope appears to be in satisfactory physical condition with no vegetation or indications of instability (see Photos 5, 7, 15, 18, and 21). Note that water shown in Photo 24 is from Upper Bons Creek and not seepage from the downstream dam embankment.

Seepage

No seepage observed coming from embankment along upstream or downstream slopes. Seep observed at base of east abutment cut slope as noted above. This seep is a result of drainage from upper east abutment area and not from impoundment, so is not a sign of leakage.

INSPECTION PHOTOGRAPHS

Photos were taken on August 3, 2022 during the site inspection.

Photo 1: Stage V-A Dam Crest and Cut-off Wall at West Abutment

Photo 2: Cut-off Wall Tie-In to Bedrock at West Abutment

Photo 3: Upstream Slope near West Abutment

Photo 4: Dam Crest and Cut-off Wall near Station 2+00

Photo 5: Downstream Slope near Station 2+50

Photo 6: Dam Crest, Cut-off Wall, and Pipe Crossing near Station 10+00

Photo 7: Downstream Slope and Kivalina Overburden Stockpile near Station 9+00

Photo 8: Upstream Slope near Station 9+00

Photo 9: Upstream Slope near Station 10+00 and Subaqueous Tailings Discharge in Pond

Photo 10: Dam Crest, Cut-off Wall, and SAA Inclinometer near Station 14+00

Photo 11: Dam Crest and Cut-off Wall near Station 21+50

Photo 12: Sump Pumphouse and Discharge Pipe near Station 26+50

Photo 13: Sump Pump Pipe and Flow Meter Inside Pumphouse

Photo 14: Sump Pump Discharge Pipe and Upstream Slope near Station 27+00

Photo 15: Downstream Slope near Station 27+00

Photo 16: Dam Crest, Cut-off Wall, and Initial Lift of Insulation Layer Fill near Station 28+00

Photo 17: Upstream Slope near Station 30+50

Photo 18: Downstream Slope and Piezometer near Station 39+00

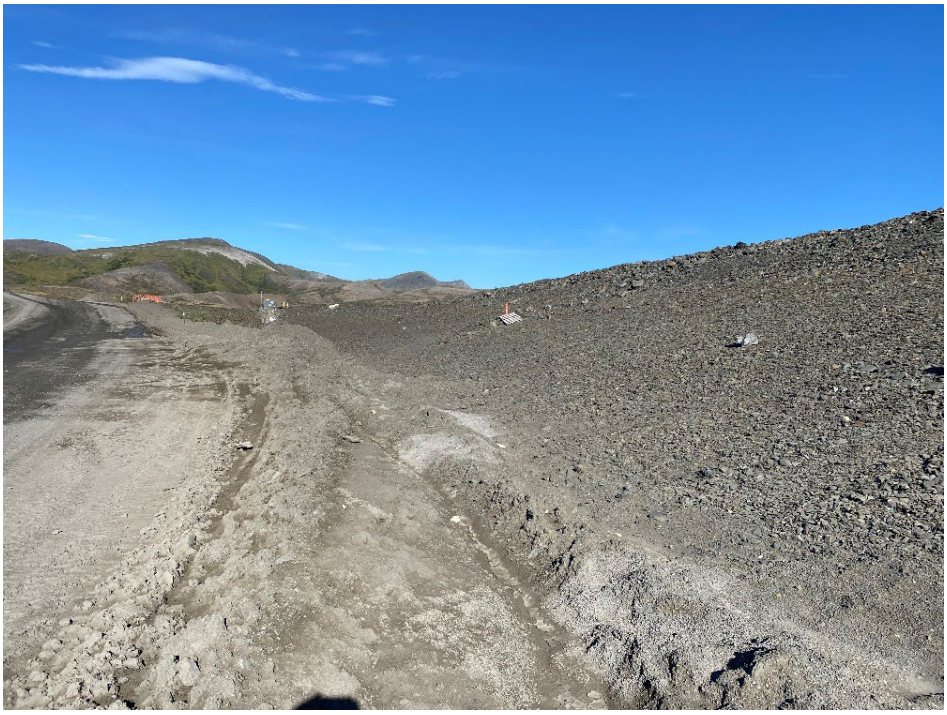

Photo 19: Upstream Slope near Station 43+00

Photo 20: Dam Crest and Cut-off Wall near Station 44+00

Photo 21: Downstream Slope and Transportation Corridor near Station 43+00

Photo 22: East Abutment and Standing Water from Seep

Photo 23: New Transportation Corridor and Upper Bons Creek Culverts Downstream of Back Dam

Photo 24: Close Up of Upper Bons Creek Culvert Inlet Downstream of Back Dam

ADNR DAM SAFETY VISUAL INSPECTION CHECKLIST

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

GENERAL INFORMATION

NAME OF DAM: Red Dog Tailings Main Dam	POOL ELEVATION: ~986 ft
NATIONAL INVENTORY OF DAMS ID#: AK00201	TAILWATER ELEVATION: N/A
OWNER: Teck Alaska Incorporated	CURRENT WEATHER: Sunny
HAZARD POTENTIAL CLASSIFICATION: Unchanged	PREVIOUS WEATHER: Sunny
SIZE CLASSIFICATION:	INSPECTED BY: Steven L. Anderson, PE and Benjamin Schmidt, PE
PURPOSE OF DAM: Tailings Storage Facility	INSPECTION FIRM: Golder Associates USA Inc.
O & M MANUAL REVIEWED: 11/18/2021 (Rev14)	DATE OF INSPECTION: August 3, 2022
EMERGENCY ACTION PLAN REVIEWED: 01/14/2022	

ITEM	YES	NO	REMARKS
RESERVOIR			
1. Any upstream development?		X	
2. Any upstream impoundments?		X	
3. Shoreline slide potential?		X	
4. Significant sedimentation?	X		stored tailings
5. Any trash boom?		X	
6. Any ice boom?		X	
7. Operating procedure changes?	X		Stage XII construction
DOWNSTREAM CHANNEL			
1. Channel			
a. Eroding or Backcutting		X	
b. Sloughing?		X	
c. Obstructions?	X		Seepage Collection Dam and Fish Weir
2. Downstream Floodplain			
a. Occupied housing?	X		Cabins and Kivalina
b. Roads or bridges?	X		Fish Weir Road
c. Businesses, mining, utilities?	X		Mill facilities, Camp, Pit, etc.
d. Recreation Area?	X		Mine staff recreational area
e. Rural land?	X		
f. New development?		X	
EMERGENCY ACTION PLAN			
1. Class I or Class II Dam?	X		
2. Emergency Action Plan Available?	X		
3. Emergency Action Plan current?	X		EPRP dated 01/14/2022
4. Recent emergency action plan exercise?	X		**DATE:** 2/26/2021, exercise planned for 2022
INSTRUMENTATION			
1. Are there			
a. Piezometers?	X		
b. Weirs?		X	
c. Observation wells?	X		
d. Settlement Monuments?		X	
e. Horizontal Alignment Monuments?	X		SAA inclinometers
f. Thermistors?		X	
2. Are readings			
a. Available?	X		
b. Plotted?	X		
c. Taken periodically?	X		in accordance with O&M Manual

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

SAFETY

ITEM	YES	NO	REMARKS
SAFETY			
1. ACCESS			**TYPE:** gravel access road
a. Road access?	X		
b. Trail access?		X	
c. Boat access?		X	
d. Air access?	X		
e. Access safe?	X		
f. Security gates and fences?		X	remote secured site
g. Restricted access signs?		X	
2. PERSONNEL SAFETY			
a. Safe access to maintenance and operation areas?	X		
b. Necessary handrails and ladders available?			N/A
c. All ladders and handrails in safe condition?			N/A
d. Life rings or poles available?	X		Available at mine office, life ring at SCP
e. Limited access and warning signs in place?	X		
f. Safe walking surfaces?	X		
3. DAM EMERGENCY WARNING DEVICES			
a. Emergency Action Plan required?	X		
b. Emergency warning devices required by EAP?	X		**TYPE(S):** Monitoring instruments
c. Emergency warning devices available?	X		
d. Emergency warning devices operable?	X		
e. Emergency warning devices tested?	X		
f. Emergency warning devices tested by owner?	X		**WHEN:** Monthly during instrumentation review
g. Emergency procedures available at dam?	X		Available at mine offices
h. Dam operating staff familiar with EAP?	X		
4. OPERATION AND MAINTENANCE MANUAL			OMS manual too, dated June 2021
a. O & M Manual reviewed?	X		
b. O & M Manual current?	X		**DATE:** 11/18/2021, Rev 14
c. Contains routine inspection schedule?	X		
c. Contains routine inspection checklist?	X		

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

EMBANKMENT DAMS

ITEM	YES	NO	REMARKS
EMBANKMENT DAMS			**TYPE:** Rockfill with upstream geomembrane
1. CREST			
a. Any settlement?		X	
b. Any misalignment?		X	
c. Any cracking?		X	
d. Adequate freeboard?	X		
2. UPSTREAM SLOPE			
a. Adequate slope protection?	X		
b. Any erosion or beaching?	X		Beaching at south end of Wing Wall
c. Trees or brush growing on slope?		X	
d. Deteriorating slope protection?		X	
e. Visual settlement?		X	
f. Any sinkholes?		X	
3. DOWNSTREAM SLOPE			**TYPE:** Rockfill
a. Adequate slope protection?	X		
b. Any erosion?		X	
c. Trees or brush growing on slope?		X	
d. Animal burrows?		X	
e. Sinkholes?		X	
f. Visual settlement?		X	
g. Surface seepage?		X	
h. Toe drains dry?			N/A
i. Relief wells flowing?			N/A
j. Slides or slumps?		X	
4. ABUTMENT CONTACTS			
a. Any erosion?		X	
b. Seepage present?		X	
c. Boils or springs downstream?		X	
5. FOUNDATION			**TYPE:** Bedrock, native soil, and fill
a. If dam is founded on permafrost	X		Permafrost may exist in some areas
(1) Is fill frozen?		X	
(2) Are internal temperatures monitored?	X		Piezometers
b. If dam is founded on bedrock	X		**TYPE:** shales/cherts
(1) Is bedrock adversely bedded?		X	
(2) Does rock contain gypsum?		X	
(3) Weak strength beds?	X		Discontinuous gouge zones
c. If dam founded on overburden			**TYPE:** native coarse and fine soils
(1) Pipeable?	X		addressed in design
(2) Compressive?	X		addressed in design
(3) Low shear strength?	X		addressed in design

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

GENERAL INFORMATION

NAME OF DAM: Red Dog Tailings Back Dam	POOL ELEVATION: ~986 ft
NATIONAL INVENTORY OF DAMS ID#: AK00303	TAILWATER ELEVATION: N/A
OWNER: Teck Alaska Incorporated	CURRENT WEATHER: Sunny
HAZARD POTENTIAL CLASSIFICATION: Unchanged	PREVIOUS WEATHER: Sunny
SIZE CLASSIFICATION:	INSPECTED BY: Steven L. Anderson, PE and Benjamin Schmidt, PE
PURPOSE OF DAM: Tailings Storage Facility	INSPECTION FIRM: Golder Associates USA Inc.
O & M MANUAL REVIEWED: 9/25/2020 (Rev4)	DATE OF INSPECTION: August 3, 2022
EMERGENCY ACTION PLAN REVIEWED: 01/14/2022	

ITEM	YES	NO	REMARKS
RESERVOIR			
1. Any upstream development?		X	
2. Any upstream impoundments?		X	
3. Shoreline slide potential?		X	
4. Significant sedimentation?	X		stored tailings
5. Any trash boom?		X	
6. Any ice boom?		X	
7. Operating procedure changes?	X		Stage V construction
DOWNSTREAM CHANNEL			
1. Channel			
a. Eroding or Backcutting		X	
b. Sloughing?		X	
c. Obstructions?		X	
2. Downstream Floodplain			
a. Occupied housing?	X		emulsion plant
b. Roads or bridges?	X		
c. Businesses, mining, utilities?	X		water supply dam and reservoir
d. Recreation Area?		X	
e. Rural land?	X		
f. New development?		X	
EMERGENCY ACTION PLAN			
1. Class I or Class II Dam?	X		
2. Emergency Action Plan Available?	X		
3. Emergency Action Plan current?	X		EPRP dated 01/14/2022
4. Recent emergency action plan exercise?	X		**DATE:** 2/26/2021, another planned in 2022
INSTRUMENTATION			
1. Are there			
a. Piezometers?	X		
b. Weirs?		X	
c. Observation wells?		X	
d. Settlement Monuments?		X	
e. Horizontal Alignment Monuments?	X		SAA inclinometers
f. Thermistors?	X		SAA inclinometers and KOB
2. Are readings			
a. Available?	X		
b. Plotted?	X		
c. Taken periodically?	X		

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

SAFETY

ITEM	YES	NO	REMARKS
SAFETY			
1. ACCESS			**TYPE:** gravel access road
a. Road access?	X		
b. Trail access?		X	
c. Boat access?		X	
d. Air access?	X		
e. Access safe?	X		
f. Security gates and fences?		X	remote secured site
g. Restricted access signs?		X	
2. PERSONNEL SAFETY			
a. Safe access to maintenance and operation areas?	X		
b. Necessary handrails and ladders available?	X		steps and handrails for pumphouse access
c. All ladders and handrails in safe condition?			N/A
d. Life rings or poles available?	X		Available at mine office
e. Limited access and warning signs in place?	X		
f. Safe walking surfaces?	X		
3. DAM EMERGENCY WARNING DEVICES			
a. Emergency Action Plan required?	X		
b. Emergency warning devices required by EAP?	X		**TYPE(S):** Monitoring instruments
c. Emergency warning devices available?	X		
d. Emergency warning devices operable?	X		
e. Emergency warning devices tested?	X		
f. Emergency warning devices tested by owner?	X		**WHEN:** Monthly during instrumentation review
g. Emergency procedures available at dam?		X	Available at mine offices
h. Dam operating staff familiar with EAP?	X		
4. OPERATION AND MAINTENANCE MANUAL			OMS manual too, dated June 2021
a. O & M Manual reviewed?	X		
b. O & M Manual current?	X		**DATE:** 9/25/2020, Rev 4
c. Contains routine inspection schedule?	X		
c. Contains routine inspection checklist?	X		

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

EMBANKMENT DAMS

ITEM	YES	NO	REMARKS
EMBANKMENT DAMS			**TYPE:** Gravel and rockfill with centerline cut-off wall
1. CREST			
a. Any settlement?		X	
b. Any misalignment?		X	
c. Any cracking?		X	
d. Adequate freeboard?	X		
2. UPSTREAM SLOPE			
a. Adequate slope protection?	X		
b. Any erosion or beaching?		X	
c. Trees or brush growing on slope?		X	
d. Deteriorating slope protection?		X	
e. Visual settlement?		X	
f. Any sinkholes?		X	
3. DOWNSTREAM SLOPE			**TYPE:** Rockfill
a. Adequate slope protection?	X		
b. Any erosion?		X	
c. Trees or brush growing on slope?		X	
d. Animal burrows?		X	
e. Sinkholes?		X	
f. Visual settlement?		X	
g. Surface seepage?			
h. Toe drains dry?		X	N/A
i. Relief wells flowing?			N/A
j. Slides or slumps?		X	
4. ABUTMENT CONTACTS			
a. Any erosion?		X	
b. Seepage present?	X		seepage at east abutment from upstream catchment
c. Boils or springs downstream?		X	
5. FOUNDATION			**TYPE:** Bedrock, native soil, and fill
a. If dam is founded on permafrost	X		
(1) Is fill frozen?	X		In some locations
(2) Are internal temperatures monitored?	X		SAA inclinometers
b. If dam is founded on bedrock	X		**TYPE:** shales/cherts
(1) Is bedrock adversely bedded?		X	
(2) Does rock contain gypsum?		X	
(3) Weak strength beds?		X	
c. If dam founded on overburden			**TYPE:** native coarse and fine soils
(1) Pipeable?		X	
(2) Compressive?	X		fine-grain and thawed soils could consolidate
(3) Low shear strength?	X		KOB and native fines have relatively lower strengths

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