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February 26, 2021
NewFields Project No. 475.0433.000

Teck Alaska Incorporated
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Anchorage, Alaska 99517

Attention: **Aaron Sangha**
Tailings and Water Geotechnical Lead

RE: **2020 Periodic Safety Inspection**
Tailings Back Dam (NID ID#AK00303)
Red Dog Mine

Transmitted herewith is the final report for the August 2020 Periodic Safety Inspection for the Tailings Back Dam (NID ID#AK00303. If you have any questions or require additional information, please contact the undersigned.

Sincerely,

NewFields Mining Design & Technical Services

Ryan T. Baker, P.E.
Principal Engineer

Reviewed by:

Keith C. Williams, P.E.
Principal Engineer

RTB/KCW/ng

Addressee: electronic

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2020 Periodic Safety Inspection
Tailings Back Dam (NID ID#AK00303)
Red Dog Mine
Northwest Arctic Borough, Alaska

Prepared for:

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NewFields Project No. 475.0433.000
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1. INTRODUCTION

This report presents the results of the 2020 Periodic Safety Inspection (PSI) of the Tailings Back Dam (TBD) at the Red Dog Mine. Mr. Steve Anderson of Golder Associates (Golder) is the Engineer of Record (EOR) for the facility and has been responsible for the engineering designs, site investigations, instrumentation monitoring, construction Quality Assurance/Quality Control (QA/QC) and annual reviews. NewFields Mining Design & Technical Services, LLC (NewFields) has been retained by Teck Alaska Incorporated (TAK) to complete the 2020 PSI for the facility. PSI are performed on the TBD on a three-year interval as required by 11 AAC 93.159 for Class I and II dams.

At the time of the site inspection the TBD was being operated under the "Certificate of Approval to Operate a Dam" Certificate No. FY2018-14-AK00303 (ADNR, 2018). The requirement for the performance of this PSI was stipulated within the Special Conditions for this certificate and the guidance for performance of the PSI is provided in the Alaska Dam Safety Program guidelines (ADNR, 2017). After the site inspection was complete a new temporary "Certificate of Approval to Operate a Dam" Certificate No. FY2021-4-AK00303 (ADNR, 2020) was issued.

1.1. Project Description

Red Dog Mine is a zinc-lead mine located in northwest Alaska within the Northwest Arctic Borough of Alaska near the southwestern end of the DeLong Mountains. The mine is owned and operated through a partnership between TAK and the Northwest Alaska Native Association (NANA) Regional Corporation.

The main components of the mine are multiple open pits, a Main Waste Stockpile (MWS), mineral processing facility, Tailings Storage Facility (TSF), water supply dam (WSD), and additional ancillary facilities to support the mining process and associated workforce. The WSD, also referred to as the freshwater dam, forms Bons Reservoir and was developed to provide a consistent clean water supply for the mine. The TSF includes the Back Dam and Main Dam, of which the Wing Wall is a component.

1.2. Location

The TSF is located on the South Fork of Red Dog Creek, adjacent to the Red Dog mine complex. The TBD forms the southern extent of the TSF while the Tailings Main Dam (TMD) forms the northern extent. The latitude and longitude along the center of the TBD embankment are 68.047° and -162.877°, respectively.

1.3. Hazard Potential Review

The Hazard Potential Classification is a parameter assigned to a dam which establishes the standards to which a dam is designed and operated. These standards not only apply to design criteria but extend to other elements associated with the dam, such as the need for an Operating and Maintenance (O&M) manual, Emergency Action Plan (EAP), and the schedule for conducting PSIs. The hazard classifications for dams in Alaska are defined in the Alaska Administrative Code, Title 11, Chapter 93, Section 157 (11 AAC 93.157) and summarized in the Alaska Dam Safety Program guidelines (ADNR, 2017).

Both the operating permit in effect at the time of the site inspection and the temporary operating permit issued after the site inspection was completed for the TBD lists the hazard classification for the structure as Class II (Significant) (ADNR 2018, ADNR 2020). The previously completed PSI notes agreement with this classification (KCB, 2017) although the Stage IV design report identifies the hazard classification as Class I (High) (Golder 2018a). NewFields has reviewed the design, inundation study, and operation of the TBD and prepared a Hazard Potential Classification and Jurisdictional Review form as part of this PSI (Appendix A). It is our recommendation that the TBD hazard classification be maintained as Class II (Significant).

2. FACILITY HISTORY

Documentation of the TBD design, construction and inspections are well presented in previous reports and summarized in the following sections. Those facility specific documents should be referenced for a more detailed summary of facility history. A general arrangement of the TSF is shown in Figure 1 with the location of the TBD identified. Figure 2 presents the plan view of the TBD.

2.1. Facility Design

The TBD is a cross-valley embankment at the southern side of the TSF and adjacent to the Overburden Stockpile. The TBD is a zoned gravel and rockfill embankment with a plastic concrete cut-off wall positioned along the centerline of the embankment and extended into the underlying bedrock. The main components of the TBD are the embankment, dewatering system at the downstream toe of the dam and the cut-off wall. The overburden stockpile south of the dam, although not a structural part of the dam structure, acts as an additional seepage barrier (Golder 2016).

The Stage IV embankment has a crest width of approximately 100 feet. The embankment fill provides the mass for the TBD structure and supports the installation of the cut-off wall. The center portion of embankment fill consists of compacted well-graded sand and gravel select fill

materials from the on-site DD2 Quarry. This zone provides the structural support for the cut-off wall and was constructed over native soil and bedrock after ice-rich and organic materials had been removed to reduce thaw settlement potential. The upstream and downstream shells of the embankment are constructed out of 24-inch minus compacted rockfill materials that are intended to provide support to the select fill zone and mass to the overall structure. Portions of the rockfill are constructed over existing fill and native soils without surface preparation, including the Overburden Stockpile on the downstream side and against a rockfill cofferdam on the upstream side, and as a result cracks have been seen in the rockfill. TAK has improved inspection forms being used and staff training to identify and monitor cracks should they appear and the EOR is reviewing monitoring data and inspection reports.

Seepage is controlled through a combination of the plastic concrete cut-off wall and the seepage sump and pumpback system. The cut-off wall is the principal element for seepage containment and is a vertical barrier installed from the embankment crest down into the underlying low permeability bedrock. Target depth of the wall is determined through geotechnical drilling performed in support of the design and actual depths are based upon observations and monitoring during construction by CQA personnel. The cut-off wall was constructed into frozen bedrock (warm permafrost) and extends over 170 feet below the current crest elevation at its deepest point (to an approximate elevation of 820 feet). The cut-off wall was designed to terminate in rock with a thawed hydraulic conductivity of $1x10^{-6}$ centimeters per second (cm/s) or lower. Due to the complications of performing downhole permeability tests in frozen ground, rock was considered to meet the low-permeability criteria once a three-foot interval of rock with one or less fracture per foot was intercepted (Golder 2018b).

Another element of seepage containment is a sump installed at the downstream crest of the embankment near the topographic low point. The seepage sump is intended to control the water level within the downstream shell of the TBD and to prevent flow downstream towards the WSD (Golder 2016). This sump collects seepage flows and returns collected solution to the TSF directly upstream of the TBD. Surface and subsurface flow contributions from side drainages downstream (i.e., south) of the TBD also report to the sump pump which make it difficult to quantify the actual rate of seepage captured by the system. The existence of permafrost below the TBD and within the downstream overburden stockpile significantly contribute to the seepage control at the dam.

Tailings are discharged into the TSF at multiple locations around the impoundment. Currently none of these locations are near the TBD and the tailings beach is not present adjacent to the embankment.

Reclamation of supernatant water from the impoundment is from two floating barges positioned along the eastern limit of the TSF. Comments regarding this equipment is presented in the TMD PSI inspection report (NewFields 2020).

2.2. Construction History

The construction of the TBD began in 2007 with the initial excavation activities for Stage I. This initial stage was completed in 2011 and two subsequent raises, through Stage III have been completed. At the time of the inspection, Stage IV construction was in progress. This expansion will raise the TBD crest elevation to 996 feet and was completed in September 2020. Table 1 below presents the TBD as-built crest elevations and year(s) of construction (Golder 2018c).

Table 1: As-Built TBD Crest Elevation and Year(s) of Construction per Stage

Stage	Crest Elevation (feet)	Year(s) of Construction
I	970	2007-2010
II	976	2013
III	986	2014-2016
IV	996	2018-2020

2.3. Inspection History

Previous PSIs were completed in 2014 by Golder Associates and in 2017 by Klohn Crippen Berger (KCB). The PSIs have been completed on a 3-year schedule which is consistent with the current Class II hazard classification requirement. Dam safety inspections by the EOR are conducted annually except for years when a PSI is completed.

As part of the current PSI, a review of key issues and recommendations from previous PSIs and annual inspections was completed with TAK. A summary of the outstanding items is included in the Table 3 (appended).

3. CURRENT FACILITY INSPECTION

The inspection was completed on August 2, 2020 by Ryan Baker and Nick Rocco of NewFields, and Troy Thompson of ERC. Ryan was the PSI lead, Nick was the geotechnical reviewer, and Troy was the hydrology and hydraulics reviewer for the inspection.

The work items involved the following: visual inspection of the facility, document review, and interviews with appropriate TAK personnel who operate, maintain, and monitor the facility.

- A site visit and visual inspection were completed.

- The management and operational surveillance programs were discussed with site personnel and relevant documents were reviewed.
- A closeout meeting was held on the last day of the site visit to present preliminary findings. The meeting was attended by Mark Smith (Operating Manager), Mike Gonzalez (Tailings & Water Superintendent), Aaron Sangha (Tailings & Water, Geotechnical), Tanna DeRuyter (Tailings Dam Operation Engineer), Matt Gee (Maintenance Superintendent), Simon Yu (Principal Metallurgist, Mill Operations), Matt Kzewinski (Construction Manager), and Kevin Palmer (Chief Geologist, Mine Operations).
- Instrumentation records were obtained and reviewed.
- Design, construction, and engineering analyses documents were obtained and reviewed.
- The O&M manual was obtained and reviewed.
- Photographs were taken of typical and key features noted during the inspection.
- Inspection tables and hazard classification forms were completed to document the PSI, and
- This report was prepared.

Appendix A includes the Hazard Classification and Jurisdictional Review Form, Appendix B includes the Photograph Log, and Appendix C includes the Visual Inspection Form completed for the current PSI. Figure 1 provides an overall view of the tailings impoundment and mine facilities. Figure 2 presents a general site plan of the TBD.

3.1. Visual Inspection Highlights

Visual inspection of the facility was conducted in one day. Aaron Sangha of TAK accompanied our team throughout the visual inspection. No parts of the visual inspection were impeded by weather conditions, which were generally dry and sunny. As previously indicated, at the time of the inspection the Stage IV construction was in progress. While the construction activities did not impede the inspection, some items such as cracks in the embankment as were identified during the 2019 Annual Inspection (Golder 2019) were not visible due to new fill placement or recent ground disturbance.

3.2. Embankment

Similar to previous inspections, the embankment is in good condition. The crest and upstream slope were generally smooth and relatively uniform or under construction at the time of the inspection (Photos 01 through 06). Although there were minor amounts of ponded water on the crest of the embankment as a result of recent rainfall, these pools and general grading of the area are not a concern. Wave erosion of the upstream slope was minimal (Photo 07), and no areas of concern were identified. The downstream slope of the embankment was smooth and uniform with no signs of slope deformation or instability (Photos 08 through 10). Ponding of

water was noted in several areas along the downstream toe (Photo 08), these areas were inspected and they appear to be the result of stormwater runoff and not seepage.

Excavation at both the east (Photo 11) and west (Photo 12) abutments had been performed as a part of the Stage IV construction activities.

General housekeeping practices around and within the facility were good, especially considering the ongoing construction activities.

3.3. Cut-Off Wall

Active construction of the cut-off wall was not in progress during the inspection, but it was evident that recent activities had occurred. Cracks were noted at a few areas adjacent to the cut-off wall (Photo 17) as a result of the cut-off wall excavation. Based on our field observations of the cracks and on-going construction activities, we determined these features were construction related and not a result of a structural issue. There were cracks noted within the cut-off wall, perpendicular to the wall alignment, at several of the joints between primary and secondary wall panels (Photo 18). Based on discussions with Golder field personnel these are addressed during construction by excavating/removing the upper portion of the wall joint down to a depth where the crack is no longer visible and then backfilling with the plastic concrete. At the location where utilities and access road cross the embankment, the installation of the insulation layer was in progress during the inspection (Photo 19).

3.4. Pumping System

The seepage sump pump (Photo 14) was operating intermittently during the inspection as water levels within the sump triggered the level control switch. The discharge location of the seepage pump outfall was inspected, and no erosion of the upstream slope was noted. Similarly, no erosion was noted at the discharge location of the overburden stockpile pumpback discharge (Photo 13).

4. OPERATIONS AND MAINTENANCE MANUAL REVIEW

4.1. O&M Manual Review

The O&M Manual (Golder 2020) was reviewed as part of the PSI. Revision 4 of the manual was published in 2020 after the completion of the site inspection. Recommended updates to the O&M Manual as presented in the 2017 PSI by KCB and the 2019 Annual Inspection by Golder were also reviewed. NewFields is in agreement with these recommendations and believe they have been addressed by the current version. It is noted that the O&M Manual now identifies a performance trigger level on the daily sump pump flow rate for both before and after the spring

freshet. Based on the review of pumping rates from the sump, it is likely that the before freshet trigger flow rate of 80 gpm is likely to be exceeded on a regular basis as it appears it is common for flows to be upwards of 100 gpm. It should also be noted that the revised O&M Manual does not currently contain a catalog of surface monuments to monitor deformation and associated trigger levels for the monuments. It is noted in the Manual that it will be updated after the surface monuments are re-established on the TBD.

The O&M Manual describes procedures necessary for safe operation of the TBD along with requirements for monitoring and inspection of the facility performance. Daily, weekly, and quarterly inspections are outlined, and example checklists and forms are included. It is our understanding that daily and weekly inspections forms have recently been transitioned to a digital format, and according to TAK, the transition has led to more robust record keeping and operational efficiencies. Examples of the digital format and quarterly summaries were reviewed as part of the PSI. The O&M Manual meets the requirements provided in the Alaska Dam Safety Program guidelines (ADNR 2017).

4.2. O&M Inspections

Monitoring and inspection requirements for the TBD that are required in addition to the PSI and annual inspections are identified in the O&M Manual. These inspections are summarized in Table 2.

Table 2: O&M Required Inspections

Inspection Type	Inspection Activity
Daily	Document temperature and general weather conditions
	Visually inspect dam and surrounding areas for unexpected behavior
	Visually observe any operational activities at or near dam
Weekly	Document temperature and general weather conditions including wave action
	Visually inspect dam and surrounding areas for unusual behavior
	Inspect embankment, crest, toe, east buttress, west buttress, upstream slope, and downstream slope for signs of cracks, slumps, seepage, vegetation that impairs visibility, and changes in any of these conditions if already present
	Inspect sump pump and discharge pipelines for normal operation and notable leaks
	Document operations activities occurring at or in the vicinity of the dam
Quarterly	Visually inspect all exposed dam surface (crest and slopes) for evidence of deformation, displacement, cracks, settlement, slumping, sliding, frost heaving, etc., and changes in these if they already exist
	Inspect toe, abutments and downstream area for springs, seeps, boils or other wet spots and changes in these if they already exist. Record location, pattern, discharge, variation with tailings pond water level, turbidity, temperature, and duration.
	Inspect exposed surfaces of the upstream buttress for evidence of slope cutting caused by waves, slumping, and sliding or erosion caused by tailings or water discharge.
	Inspect instrument installations for physical damage, malfunction, or maintenance needs.
	Inspect condition of pipelines for physical damage, cracking, separation or needed maintenance.
	Review recent instrumentation readings for trends that could be related to observed conditions.
Annual	Evaluation of weekly and quarterly inspection documents.
	Evaluate instrumentation monitoring data.
	Visual site inspection similar to weekly and quarterly inspections.
Periodic Safety Inspection (PSI)	In accordance with current Alaska Dam Safety regulations.

4.3. Water Management Review

The discussion regarding the water management and water balance for the TSF is presented in the PSI report prepared for the TMD (NewFields 2020). One item worth noting is the recommendation to consider the 72-hour PMP as the design storm in lieu of the current criteria of the 24-hour PMP event. This recommendation is presented in the TMD PSI report.

4.4. Operations Review and Interviews

Based upon discussions with TAK personnel it is evident that progress has continued with respect to operational stewardship and management of the TSF, including the TBD. The tailings, water

and environmental personnel met during the PSI were able to provide in-depth responses to queries, as well as provide access to the necessary documents and data with little delay. Operational personnel are well coordinated with engineering personnel and the means and methods for collection, review, and management of large amounts of monitoring data are sufficient. Historic facility documents have been organized for quick access and design basis documents are available for reference and updating as needed.

5. MONITORING DATA REVIEW AND PERFORMANCE

The performance of the TBD is monitored with instrumentation, survey methods, and visual inspection by Operations. Performance of the seepage control systems are monitored with the piezometers network and flow meter on the seepage pumpback system. Ground temperature measured by the thermistors are also used to determine the performance of the seepage control systems and provide an indication to what is or may occur with the embankment movements. Structural performance of the embankment is monitored visually and by the inclinometers and surface monuments that are systematically surveyed. The review of monitoring data provided by TAK included vibrating wire piezometers, sump pump flows, thermistors, survey monuments, inclinometers, and visual monitoring (field inspection reports and photos).

5.1. Pore Pressure Monitoring

Piezometer data is available from two (2) instruments installed upstream of the cut-off wall and eight (8) instruments installed downstream of the cut-off wall. Additionally, one piezometer is installed near each abutment for future monitoring purposes (Golder 2020). Data is collected daily and readily available to TAK personnel. Piezometers located upstream of the cut-off wall are primarily influenced by the tailings pond elevation. Piezometer readings show minimal variation between the tailings pond elevation and the piezometer instruments within the upstream zones of the TBD embankment. Piezometers located downstream of the cut-off wall are influenced by the sump pump flow rate, seasonal variations in precipitation, tailings pond elevation, and air temperature. The data indicates that the operation of the sump pump has the greatest impact with spikes in phreatic levels being recorded after the pump has been shut off or malfunctioned and decreases in levels during pump operation. As expected, the piezometers closest to the sump (P-15-138, P-15-139 and P-15-140) show the most response to the sump pump operation. The response of both the upstream and downstream piezometers indicates high permeability of the embankment rockfill and select fill materials.

5.2. Seepage Monitoring

The seepage collection sump is located at the downstream crest of the embankment with the pump intake positioned in a topographic low point near the center of TBD. The volume of water pumped is measured by a flow meter attached to the sump pump system (Photo 14) and the data is readily available to TAK personnel. There are data gaps noted in the historic records due to mechanical issues with the pump system. The sump pump flow data reflect the impact of seasonal influences on the groundwater collected by the system. Previous inspections have noted the cyclic trend in flow rates with peaks in the spring as a result of the freshet and in the late summer due to precipitation events (KCB 2017). Short duration peaks are noted to occur after precipitation events during the summer months. Pump rates decrease during the winter season when average air temperatures fall below freezing and groundwater recharge from precipitation declines. The lowest sump pumping rates generally occur during January through May and pumping rates increase during the spring. The monitoring data collected indicates this seasonal trend will continue and flow rates will continue to rise as the tailings pond elevation and subsequently the phreatic levels upstream of the concrete cut-off wall also rise.

While the actual seepage rate from the TBD cannot be determined from the sump pump data, based on the analyses that have been performed it is reasonable to infer that the base seepage is in the range of the winter values when precipitation and ground thawing effects are minimized. It was determined that there was a direct correlation between the TSF pool level and base seepage rates, such that increases in the pool elevation result in increases in the base seepage rates. Given the noted responses by the piezometers with the operation of the sump pump, and the fact that seepage rates are increasing over time, it is important to have the pump available to operate consistently. Monitoring of the system reliability will determine if recent improvements to the sump pumphouse and controls made as part of the Stage IV construction are sufficient or if additional measures and improvements are required.

5.3. Thermal Monitoring

Ground temperature monitoring data is available from ground temperature monitoring arrays within both the TBD and the overburden stockpile. Ground temperature monitoring is performed at the piezometer and inclinometer locations. Thermistors within the TBD can provide an early indication of performance issues with the seepage control systems or the structural integrity of the embankment. Depending on the location and temperature change, rising temperature readings could indicate increased seepage rates and hydraulic gradients which could lead to thawing of ice rich materials and the potential for thaw-settlement and the appearance of cracking on the embankment. The thermistors continue to indicate relatively stable and consistent readings year over year. There is a slight warming trend near the base of the cut-off

wall, as noted in thermistor T-15-140 and the 2019 Annual Inspection (Golder 2019). There is no indication of a rise in phreatic levels in the piezometer P-15-140 but this may be a function of the positioning of the instruments relative to the seepage sump. The 2017 PSI recommended an analysis of the effect on the cut-off wall from freeze-thaw cycles being recorded by the thermistors. It is our understanding that this study, by others, is nearing completion.

5.4. Deformation Monitoring

Three inclinometers are positioned within the TBD, downstream of the cut-off wall, in the center portion of the embankment. The inclinometers are monitored weekly. A total of 11 settlement monuments were previously installed along the upstream and downstream crests of the TBD but these were removed during the construction of Stage IV. When the settlement monuments were operational readings were collected monthly. The inclinometers monitor the horizontal movement of the dam embankment, rate, and direction of horizontal movement while the settlement monuments are utilized to monitor vertical strain and horizontal movement of the dam embankment. Prior to being removed for the 2020 construction season, three of the survey monuments did show signs of horizontal movement worth noting and one location (Mon-15-05) exceeded the trigger level established by the previous version of the O&M manual. All three of these monuments are within the approximate aerial extend of ice-rich materials within the foundation in which surface cracks were noted in the 2019 Annual Inspection (Golder 2019).

The inclinometer data indicates the TBD is performing as designed and within the monitoring threshold limits established by the O&M manual. It is noted that all inclinometer readings are within the trigger limits identified in the current O&M manual. New settlement monuments will be installed as part of the Stage IV construction after annual fill placement has been completed. The 2019 Annual Inspection (Golder 2019) identified movement in settlement monuments that were likely the result of thaw settlement within the foundation. This movement was noted as being well within the anticipated magnitude of settlement predicted by numeric modeling (Golder, 2018d).

6. REVIEW OF PERFORMANCE PARAMETERS

Based on our understanding of the facility location, design and construction, control of seepage is considered the key performance parameter. Since the TBD is well buttressed from topography and the existing overburden storage area, global stability of the embankment during steady-state loading conditions is not considered a significant concern.

The piezometer data show hydraulic gradients exist toward the seepage pumpback system, indicating the seepage pumpback system is performing as intended and capturing seepage moving through the TBD. Trigger levels identified in the O&M Manual alert TAK personnel in the

event that hydraulic gradients change or the seepage pumpback system cannot maintain the phreatic surface at designated levels. It is our opinion that the number and location of the existing piezometers, and the trigger levels identified, are appropriate for monitoring the performance of the cut-off wall and the seepage control systems.

One element that will contribute to seepage control, once in place, is the development of a tailings beach along the TBD embankment. This is part of the long-term tailings deposition plan. It is anticipated that once a beach is developed and the tailings pond is moved away from the TBD embankment, seepage rates will decrease.

Prior to the decommissioning of the survey monuments, the performance of the embankment was being adequately monitored through the use of ground survey and NewFields agrees with the current plan to reinstall and re-establish trigger limits on survey monuments as soon as reasonably possible. It is critical to combine this monitoring with the upgraded documentation of surface conditions through visual inspections to understand the performance of the embankment.

Of the three inclinometers installed within the TBD, two of them are in close proximity of the settlement monuments which showed horizontal movement. There is a plan to install a future inclinometer in the general vicinity of where settlement monument Mon-15-05 was located, although it may be located near the downstream toe to allow for measurement of foundation movements. NewFields agrees with the recommendation in the 2017 PSI to install additional inclinometers (PSI-R-10) and to expand the monitoring of this portion of the embankment which in which surface cracks have been noted and survey monuments have recorded movement.

The installed thermistors provide an indication of the ground temperature conditions within the TBD footprint and in the overburden stockpile located downstream. The existence of permafrost and location of permafrost is a key element in the performance of the seepage control system an stability of the embankment. Based upon our review, the number and extend of the thermistors is adequate particularly given the fact that replacement of old and failing instruments is part of the plan and additional monitoring of the overburden stockpile has recently commenced. The use of thermistors in conjunction with the other monitoring devices should continue.

7. CONDITION ASSESSMENT AND CONCLUSIONS

Based on the visual inspection performed in August 2020, discussion with TAK personnel, and subsequent review of available monitoring data, NewFields concludes the TBD is functioning as the design intended and is well maintained. Additionally, TAK has sufficient external third-party professionals providing technical oversight to the facility in addition to active EOR involvement.

In addition to the outstanding issues and recommended action items identified during previous annual inspections and PSIs, summarized in Table 3, it is recommended that the following items be further reviewed or considered:

- Evaluate the selected PMP storm event and consider selection of the 72-hour PMP storm as the design storm.
- Based on the data review, and as discussed in Section 1.3, maintaining the hazard classification for the TBD as Class II (Significant) is appropriate.

It should be noted that item PSI-18-R from the 2017 PSI is an outstanding/open item that TAK views as not applicable during discussions with NewFields personnel. NewFields is in agreement with this opinion. During the 2017 PSI KCB acknowledges that "the EoR states that the design complies with minimum required criteria" (KCB 2018) and it is unclear why the recommendation is for the EoR to review specific components of the design analysis to confirm the statement provided. NewFields believes PSI action item PSI-18-R should be closed.

Overall, it is the opinion of the PSI team that the TBD, at the time of the inspection, should be considered in *Satisfactory* condition. Per the ADNR Dam Safety Program Guidelines (ADNR 2017), this is defined as:

- No existing or potential dam safety deficiencies are recognized.
- Acceptable performance is expected under normal and extreme loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.
- Meets applicable hydrologic and seismic regulatory criteria.

8. REFERENCES

ADNR, 2017. Guidelines for Cooperation with the Alaska Dam Safety Program – Draft Revision. Prepared by the Dam Safety Construction Unit, Water Resources Section, Division of Mining, Land and Water, Alaska Department of Natural Resources. July 28.

ADNR, 2018. Certificate of Approval to Operate a Dam, Red Dog Tailings Back Dam, Issued to Teck Alaska Incorporated. Certificate No. FY2018-14-AK00303, dated February 12, 2018.

ADNR, 2020. Temporary Certificate of Approval to Operate a Dam, Red Dog Tailings Back Dam, Issued to Teck Alaska Incorporated. Certificate No. FY2021-4-AK00303, dated September 22, 2020.

Golder, 2016. Operations and Maintenance Manual, Revision 3, Tailings Back Dam Red Dog Mine, AK, October 21.

Golder, 2018a. Stage IV Detailed Design Report – Tailings Back Dam at Crest El. 996 feet – Revision 1, Red Dog Mine, Alaska, March 30.

Golder, 2018b. Dam Site Characterization Report, Tailings Back Dam, Red Dog Mine, Alaska, September 20.

Golder, 2018c. Red Dog Tailings Back Dam, 2018 Dam Breach and Inundation Study, December 10.

Golder, 2018d. Static and Seismic Deformation Analysis of the Tailings Back Dam, October 10.

Golder, 2019. 2019 Annual Performance Report for Tailings Back Dam, Red Dog Mine, Alaska, October 24.

Golder, 2020. Operations and Maintenance Manual, Revision 4, Tailings Back Dam Red Dog Mine, AK, September 25.

KCB, 2018. Tailings Back Dam Facility Periodic Safety Inspection Report, Red Dog Tailings Back Dam, AK-00303, January.

NewFields 2020. 2020 Periodic Safety Inspection, Tailings Main Dam (NID ID#AK00201), Red Dog Mine, October.

TABLES

Table 3
Red Dog Mine
Register of Outstanding Key Issues and Recommended Actions
Tailings Back Dam

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

ID	Applicable Regulation or O&M Reference	Deficiency or Non-Conformance	Risk to Structure	Priority	Recommended Action	Recommended Timing for the Action	NewFields Notes
2017-04 (PSI-R-04)	O&M Manual Section 6.0	Monitoring program needs to be updated	Current program may not adequately address all dam failure modes	3	Teck and the EoR are recommended to review and implement, as appropriate, a combination of the following to monitor the permeability performance of the COW: - new surveillance activities or instrumentation; and - additional thresholds and criteria for existing activities. One criteria that should be developed is the allowable horizontal strain (to maintain permeability criteria) which is necessary to relate inclinometer movements to COW performance.	NewFields recommends closing item.	O&M manual update added thresholds and additional isntrumentation has been installed since the 2017 PSI. EOR believes monitoring of permeability is not possible across the COW; permeability will be qualitatively assessed through monitoring of the pumpback system. NewFields agrees with the EOR. Pumpback data for past 4 years was reviewed during 2020 PSI.
PSI-R-07					Complete the recommendations related to the uninsulated pipes through the frost protection layer identified in the 2016 inspection (DSIR10), and compare the location of the cracks perpendicular to the centerline to the COW panel joint locations to confirm whether that may be a factor.		The comment is in regards to pipes from seepage pumpback and Kivalina pumpback systems; for Stage 4 the pipe location was revised to be on top of the insulation, so further problems would not develop. Cracks were monitored for the following season and they never materialized again. Will monitor Stage 4 surface when it is complete to see if similar situation develops this winter. Teck believes these were likely associated with minor ammounts of frozen fill placed at very end of construction.
2017-09 (PSI-R-10)	O&M Manual Section 6.0	Potential movement between Stations 22+00 and 23+00 is not adequately captured in instrumentation	Damage to the TBD could occur without warning from the monitoring array	3	Install additional inclinometers upstream and downstream of the COW where the continuous crack is present in the downstream slope and thickness of ice-rich soils (including ice lenses) is thickest (between Sta. 21+00 and Sta. 23+00). - Inclinometers should be installed at same centerline station. - At least one inclinometer should be installed downstream of the COW in the Select Fill zone. Teck and the EoR may wish to install an additional instrument downstream of the crack, through the Rockfill zone.	Q3/Q4 2021	Plan is to install at least (1) SAA inclinometer at the toe of the Kivalina overburden dump.

Table 3
Red Dog Mine
Register of Outstanding Key Issues and Recommended Actions
Tailings Back Dam

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

ID	Applicable Regulation or O&M Reference	Deficiency or Non-Conformance	Risk to Structure	Priority	Recommended Action	Recommended Timing for the Action	NewFields Notes
2017-15 (PSI-R-16)	n/a	No tailings beach is established at the TBD	The TBD is being subjected to higher seepage gradients and more acidic seepage than if a beach was in place	4	Teck commented that establishing a tailings beach at the TBD is part of their long-term deposition goals which is strongly supported and should be implemented	2020	This continues to be a long-term goal of Teck. There has been questions of how a tailings beach would affect the COW; Golder has reviewed this scenario and is OK with beaching tailings against the dam.
2017-16 (PSI-R-17)	n/a	The COW may have been affected by freeze-thaw cycling	The effects of freeze-thaw cycling on the COW performance are unknown	2	As part of design of the next raise, if completed, the EoR should assess whether freeze-thaw cycles from lateral temperature changes around the insulation layer have impacted the COW performance.	2020	EOR is reviewing this at this time. Teck hopes re-evaluation will show that current insulation design can be scaled back.
PSI-R-18					Recommendations have been made for the EoR to review site specific components of the design analyses. If these reviews indicate that minimum required criteria are not met, the condition assessment should be lowered to FAIR, based on ADNR definitions, until the appropriate remedial activities are completed to bring the TBD back into compliance for all loading conditions.		Teck considers this not applicable.
2019-01	O&M Manual Section 5.0	Monitor for cracking along dam crest	Cracking may indicate areas of instability or identify locations that require higher regiment of observation	3	Continue to monitor for cracking along the dam crest and watch for correlations with monitoring data collected in nearby SAAs and survey monuments. Consider revision of daily inspection forms in regard to observed cracking during the next O&M Manual revision to reduce possible discrepancies between the daily and weekly/quarterly reporting. Collect a survey of any new cracking observed.	Q1 2020	New monitoring forms address this documentation concern. Tech working to be more consistent in documentation; improvements to employee training and O&M guidance (Rev 4 of O&M manual). Documentation is on-going and will continue into the future.

Table 3
Red Dog Mine
Register of Outstanding Key Issues and Recommended Actions
Tailings Back Dam

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

ID	Applicable Regulation or O&M Reference	Deficiency or Non-Conformance	Risk to Structure	Priority	Recommended Action	Recommended Timing for the Action	NewFields Notes
2019-03	O&M Manual Section 6.0	Monitoring program needs to be updated	Current program may not adequately address all dam failure modes	3	Make the following improvements to the instrumentation in and near the Overburden Stockpile to monitor its performance as a secondary seepage barrier for the system: - Replace the three 96 series ground temperature arrays (T-96-21 to T-96-23), which range in length from 105 to 115 feet, with three of the Beaded Stream temperature monitoring arrays that were used along the TBD alignment. *- Install VWPs within the standpipe piezometers at G17-03 and G17-04 to monitor groundwater levels. Completed.* *- Install two of the Beaded Stream temperature monitoring arrays that were used along the TBD alignment at OS-18-11 and at G17-04. Completed* - Replace the frozen VWP at P-12-109 with another that is installed with the instrument above the permafrost surface. - Drill and install a new ground temperature array between OS-18-11 and G17-03. - Connect the VWPs and if possible the temperature monitoring arrays into the NavStar data collection system, and incorporate them into the O&M Manual scheduled to be updated in 2019.	2020	Teck agrees that upgrades are necessary for thermal monitoring under Kivalina Overburden Stockpile; current instruments are fairly old. They do not consider this an immediate dam safety concern. Teck working with EoR to prioritize these recommendations, and additional instrumentation will be installed over next 1-3years outside of what has already been addressed.

FIGURES

REFERENCE:

AERIAL IMAGERY ACQUIRED BY WORLD IMAGERY BY ArcGIS, FILE NAMES:
overall flyover NAD27 Alaska State Plane Zone 7.tif AND
RedDog Minesite 2ft Ortho.tif

NewFields

CLIENT: TECK ALASKA INCORPORATED

PROJECT: 2020 PERIODIC SAFETY INSPECTION

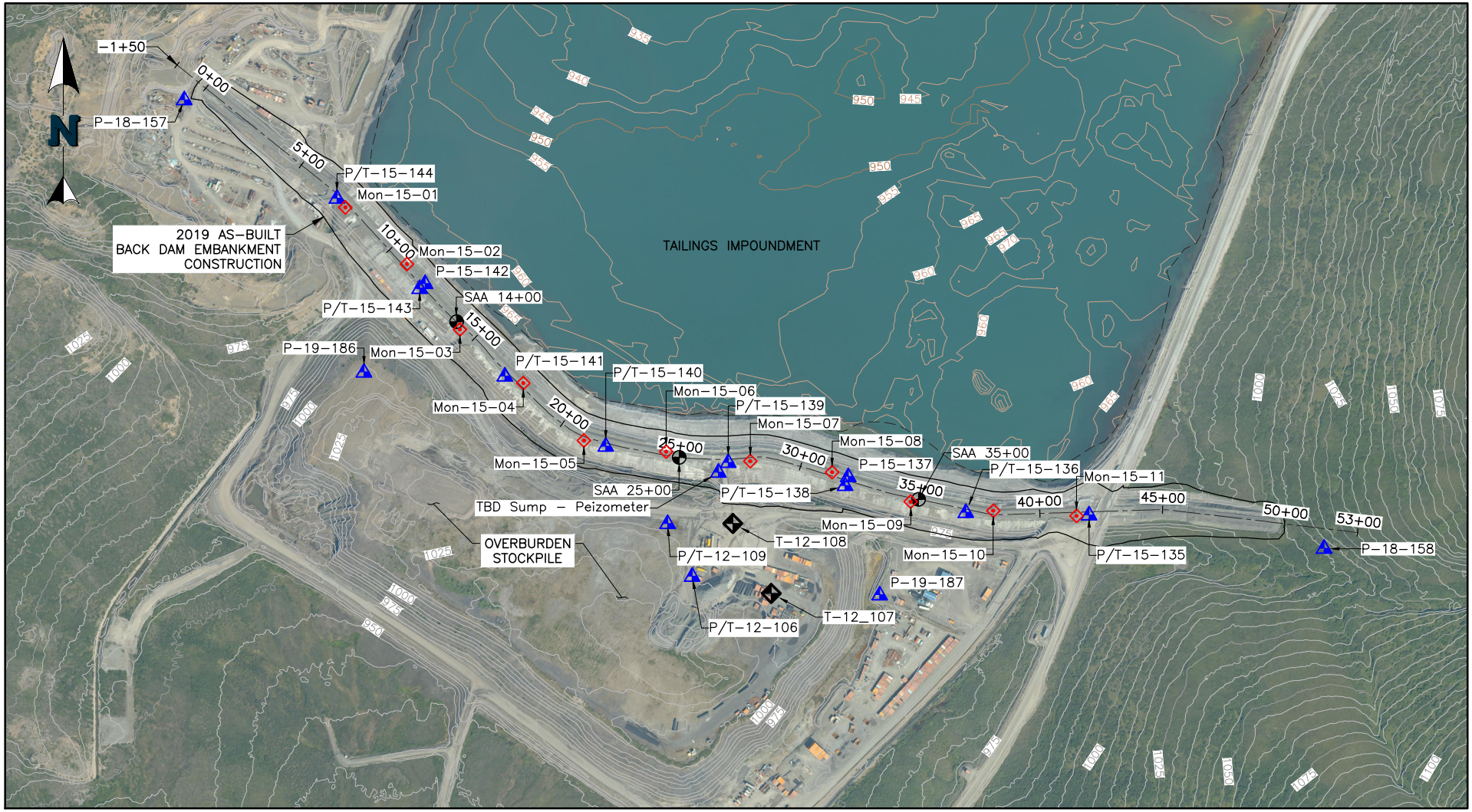
TITLE: TAILINGS IMPOUNDMENT OVERVIEW

FILENAME: 0433.000 FIG 1_R2

FIGURE NO.: 1

REVISION: 0

P:\Projects\0433.000 Red Dog Safety Inspections (PSI)\A-CAD\FIGS\TBD Report\0433.000 FIG 1_R2.dwg-10/28/2020 11:28 AM



LEGEND:

- EXISTING GROUND CONTOURS
- BATHYMETRY CONTOURS
- P-XX-XXX — PIEZOMETER
- SAA XX+00 — SAA INCLINOMETER
- Mon-15-XX — SURVEY MONUMENTS
- T-XX-XXX — THERMISTOR
- P/T-XX-XXX — PIEZOMETER WITH THERMISTOR

0 300 600 FEET

REFERENCE:

AERIAL IMAGERY ACQUIRED BY WORLD IMAGERY BY ArcGIS, FILE NAMES: RedDog Minesite 2ft Ortho.tif

THE CONTOURS LINES AND BATHYMETRY FILE WE RECEIVED FROM TAK, FILE NAME:
TAILINGS BATHY 2019.xml
red_dog_wo4136f_2ft_contours_2020jun20_mine_grid_all.dwg

NewFields

CLIENT: TECK ALASKA INCORPORATED

PROJECT: 2020 PERIODIC SAFETY INSPECTION

TITLE: TAILINGS BACK DAM PLAN VIEW

FILENAME: 0433.000 FIG 2_R2

FIGURE NO.: 2

REVISION: 1

P:\Projects\0433.000 Red Dog Safety Inspections (PSI)\A-CAD\FIGS\TBD Report\0433.000 FIG 2_R2.dwg-2/23/2021 12:03 PM

APPENDIX A – Hazard Classification Review Form

Alaska Dam Safety Program

HAZARD POTENTIAL CLASSIFICATION AND JURISDICTIONAL REVIEW

This form is used to review and indicate the hazard potential classification of an artificial barrier in accordance with 11 AAC 93.157 and to determine if the barrier is a dam under the jurisdiction of the Alaska dam safety regulations, based on the definition articulated under Alaska Statute 46.17.900 (3), and summarized as follows:

"Dam" includes an artificial barrier, and its appurtenant works, which may impound or divert water and which...

- has or will have an impounding capacity at maximum water storage elevation of 50 acre-feet and is at least 10 feet in height measured from the lowest point at either the upstream or downstream toe of the dam to the crest of the dam; or
- is at least 20 feet in height measured from the lowest point at either the upstream or downstream toe of the dam to the crest of the dam; or
- poses a threat to lives and property as determined by the department after an inspection.

In accordance with 11 AAC 93.151, an artificial barrier with a Class I or Class II designation is determined to meet the third definition of a dam, regardless of its geometry.

Please complete items 1 through 20. Attach additional information as necessary. This form must be certified and stamped on page 3 by an Alaska-registered professional engineer, qualified in accordance with 11 AAC 93.193.

1. Name of barrier: RED DOG MINE - TAILINGS BACK DAM

   National Inventory of Dams (NID) number: AK 00303 (Assigned by Department)

   Name of stream: SOUTH FORK OF RED DOG CREEK

   General location and region: DELONG MOUNTAINS, NANA REGION, NW ARCTIC BOROUGH

   Legal location: Township 31N Range 18W Section 19 Meridian KATEEL RIVER

   Purpose and type of barrier: Tailings, process water, and stormwater storage

   This barrier is: ☑ Existing ☐ Proposed ☐ Under construction

   Current hazard potential classification: ☐ I ☑ II ☐ III ☐ Not assigned

2. Owner: TECK ALASKA INCORPORATED

   Address: 2525 C STREET, SUITE 310

   ANCHORAGE, AK 99503

   Contact name: MIKE GONZALEZ

   Phone: (907) 426-9278

3. Is barrier federally owned, or regulated by the Federal Energy Regulatory Commission?

   ☐ Yes (stop here) ☑ No (complete form)

4. Maximum crest height of barrier: 56 feet
   Measured from: ☐ Upstream toe ☑ Downstream toe ☐ Offstream toe
   Basis of height: ☐ Conceptual design drawing ☑ Detailed design drawing
   ☐ As-built drawing ☐ Field measurement ☐ NID data

5. Maximum impoundment volume: 19,157 acre-feet
   Surface area of reservoir at maximum storage: 700 acres
   Average depth of reservoir above bottom of barrier: 27 feet (live storage)
   Basis of volume estimate:
   ☐ Surface area multiplied by average depth
   ☐ Bathymetry
   ☐ NID data
   ☑ Other: TMD Stage XI Design Report

6. Downstream development: ☑ Yes ☐ No ☐ Unknown
   Type of development (check all that apply):
   ☑ Homes
   ☑ School
   ☑ Community halls, churches, etc.
   ☑ Industrial or commercial property
   ☐ Major highway
   ☐ Primary roads
   ☑ Secondary or rural roads
   ☐ Railroads
   ☐ Power or communication utilities
   ☐ Water or wastewater treatment facilities or lines
   ☐ Overnight campgrounds
   ☐ Public parks or trails
   ☐ Fish hatchery or processor
   ☑ Barrier owner's property or facilities
   ☐ Other utilities:
   ☑ Other development: Seasonal recreational cabins

   Basis of observations: ☑ Ground reconnaissance ☐ Aerial reconnaissance
   ☐ Aerial photo ☑ Other: 2018 TBD Dam Breach (Golder)
   Date of observations:

7. Proximity of development to downstream channel (add maps or other information as necessary):
   Distance downstream from barrier: 52 miles
   Distance from stream bed: 0 feet
   Relative elevation above streambed: 68 feet

8. Is development in the inundation zone of a flood from an uncontrolled release of water from the barrier?
   ☑ Yes ☐ No ☐ Unknown

9. Was a dam break analysis conducted? ☑ Yes ☐ No

   What model was used to determine inundation zone: : HEC-HMS, FLOW-3D, dam at crest elev. 1,006' (Golder 2018)
   (Please attach calculations)

   Maximum depth and velocity of flow through development: 2.9' at Phil Driver cabin, unknown velocity (Golder 2018)

10. Is development at risk from improper operation or a "sunny day" failure?
    ☑ Yes ☐ No ☐ Unknown

11. Is development at risk from an incremental increase in the flood if the barrier fails under flood conditions?
    ☑ Yes ☐ No ☐ Unknown
    Flood condition evaluated: ☐ 100 year ☐ ½ PMF ☐ PMF ☑ Other 746 Mgal (larger than PMF event)

12. Could an uncontrolled release cause other significant property damage or loss?
☑ Yes ☐ No ☐ Unknown
Description: Water Storage Dam (NID No. AK 00200) located downstream could breach.

13. Could an uncontrolled release effect public health? ☐ Yes ☐ No ☑ Unknown
Description: Tailings release estimated to reach Kivalina Lagoon but community of Kivalina not anticipated to experience flooding.

14. Is the reservoir created by the barrier the primary water supply for a community of more than 500 residents? ☐ Yes ☑ No ☐ Unknown

Is a backup water supply available? ☐ Yes ☐ No ☐ Unknown ☑ N/A

15. Is barrier located on waters important to anadromous fish? ☐ Yes ☑ No ☐ Unknown

Are anadromous fish waters at risk of damage or loss if an uncontrolled release occurs?
☑ Yes ☐ No ☐ Unknown ☐ N/A

16. Does the barrier contain mine mill tailings, process water or contact water?
☑ Yes ☐ No

17. Proposed hazard potential classification: ☐ Class I (High) ☑ Class II (Significant) ☐ Class III (Low)

18. Basis of classification:
☐ Quantitative - Numerical dam break analysis conducted
☐ Qualitative - Limited engineering calculations
☑ Preliminary - No engineering calculations

19. Comments: Recommendation is based upon dam breach analysis performed by Golder (2018) for a future Stage V embankment raise. The results indicate Kivali will not likely experience flooding and incremental flow depth and downstream cabins expected to be less than 3 feet.

20. Certified by: Ryan T. Baker, P.E. (Print name)

Date: February 24, 2021

Company: NewFields Mining Design & Technical Services, LLC

Phone: (720) 508-3300

Engineer's Seal and Signature

Notes:
1. *This form must be certified and stamped by an Alaska-registered professional engineer qualified in accordance with 11 AAC 93.193.*
2. *The information presented in this form may be overruled based on current data that reveals a higher level of confidence in the quality of information necessary to make the appropriate determinations.*
3. *Anadromous fish waters are determined in accordance with 11 AAC 195.010 (a).*
4. *Alaska dam safety regulations are articulated under 11 AAC 93.151 through 11 AC 93.291 (Article 3).*

FOR DEPARTMENT USE ONLY

Jurisdictional Status of Barrier:

☐ Dam under state jurisdiction

Reasons:
- ☐ Height
- ☐ Height and storage volume
- ☐ Hazard potential classification
- ☐ Anadromous fish stream
- ☐ Other:_____

☐ Barrier is not a dam under state jurisdiction

Reasons:
- ☐ Height
- ☐ Height and storage volume
- ☐ Hazard potential classification
- ☐ Federal ownership or regulation
- ☐ Other:_____

Concur with proposed hazard potential classification: ☐ Yes ☐ No

Hazard potential classification based on current information: ☐ Yes ☐ No

Official hazard potential classification:

☐ Class I (High) ☐ Class II (Significant) ☐ Class III (Low)

Comments:_____

_____

_____

_____

Reviewed by: _____

Title: _____

Signature: _____

Date: _____

11 AAC 93.157. Hazard classification

(a) In order to determine design, operation, inspection, maintenance, emergency action, and reporting criteria under AS 46.17 and 11 AAC 93.151 - 11 AAC 93.201, the department will periodically review and classify each artificial barrier according to the barrier's potential danger to life or property, and will assign the barrier one of the following hazard potential classifications:

(1) a Class I (high) hazard potential classification, if the department determines that the failure or improper operation of the barrier will result in probable loss of human life;

(2) a Class II (significant) hazard potential classification, if the department determines that the failure or improper operation of the barrier will result in

(A) a significant danger to public health;

(B) the probable loss of or probable significant damage to homes, occupied structures, commercial property, high-value property, major highways, primary roads, railroads, or public utilities, other than losses described in (3)(B) of this subsection;

(C) other probable significant property losses or damage, other than losses described in (3)(B) of this subsection; or

(D) probable loss of or significant damage to waters identified under 11 AAC 195.010(a) as important for the spawning, rearing, or migration of anadromous fish; or

(3) a Class III (low) hazard potential classification if the department determines that the failure or improper operation of the barrier will result in

(A) limited impacts to rural or undeveloped land, rural or secondary roads, and structures;

(B) property losses or damage limited to the owner of the barrier; or

(C) insignificant danger to public health.

(b) As necessary to obtain accurate information for a review and classification under (a) of this section, the department will require the owner of an artificial barrier to submit the following information, on a form provided by the department and sealed by an engineer qualified under 11 AAC 93.193(a) :

(1) the type and height of the barrier and the impounding capacity of the reservoir at the maximum storage elevation;

(2) the name of the water body, the location of the barrier and a description of the area downstream;

(3) a proposed hazard potential classification, and any supporting information for that proposed classification; supporting information may include maps, an inundation map prepared in substantial accordance with 11 AAC 93.195, a dam break analysis, photographs, and engineering calculations.

(c) The department may reject a hazard potential classification proposed under (b)(3) of this section and require the owner to submit additional information if the department determines that the

(1) engineer who sealed that information is not qualified under 11 AAC 93.193(a) ; or

(2) information previously provided is insufficient for the department to assign that hazard potential classification.

(d) The department may assign an artificial barrier a higher hazard potential classification than one proposed under (b)(3) of this section. The department will assign the barrier a hazard potential classification based on the level of information readily available regarding the barrier and its potential hazards.

NOTE: *This excerpt from 11 AAC 93 is for information only and is not an official document. The official version may be viewed at the following address: http://www.legis.state.ak.us/basis/folio.asp).*

APPENDIX B – Photo Log

Photograph 01: TBD crest, near Sta. 25+00 (looking east)

Photograph 02: TBD crest, near Sta. 22+50 (looking northwest)

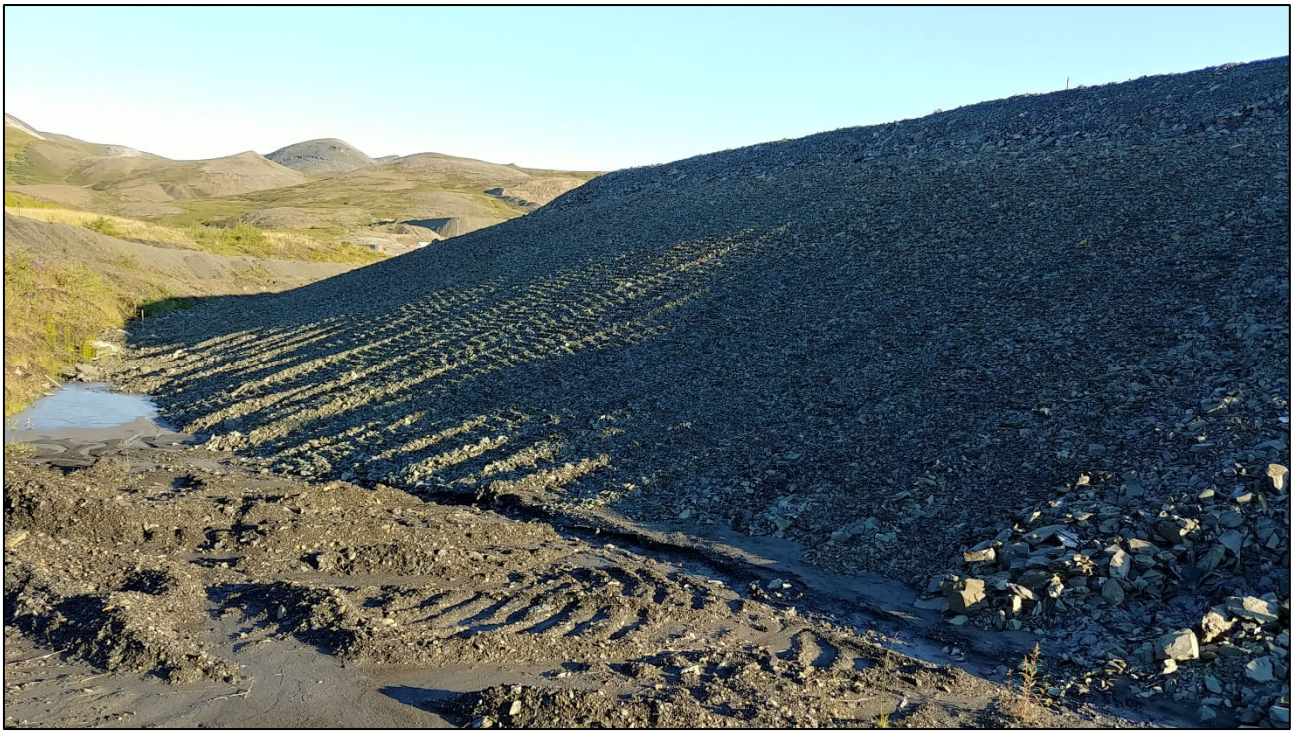
Photograph 03: TBD crest, near Sta. 26+00 (looking west)

Photograph 04: Upstream slope (looking northwest)

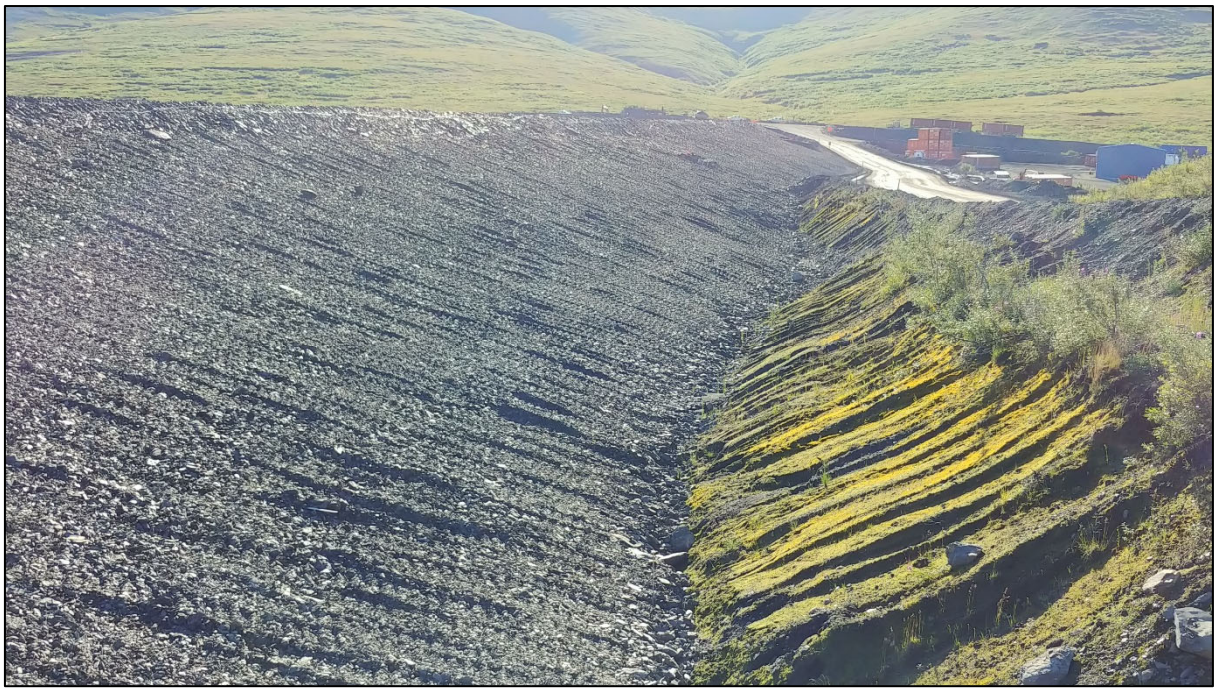
Photograph 05: Upstream slope (looking east)

Photograph 06: Upstream slope near Sta. 6+00 (looking southeast)

Photograph 07: Wave erosion on upstream slope



Photograph 08: Downstream slope near Sta. 22+50 (looking west)



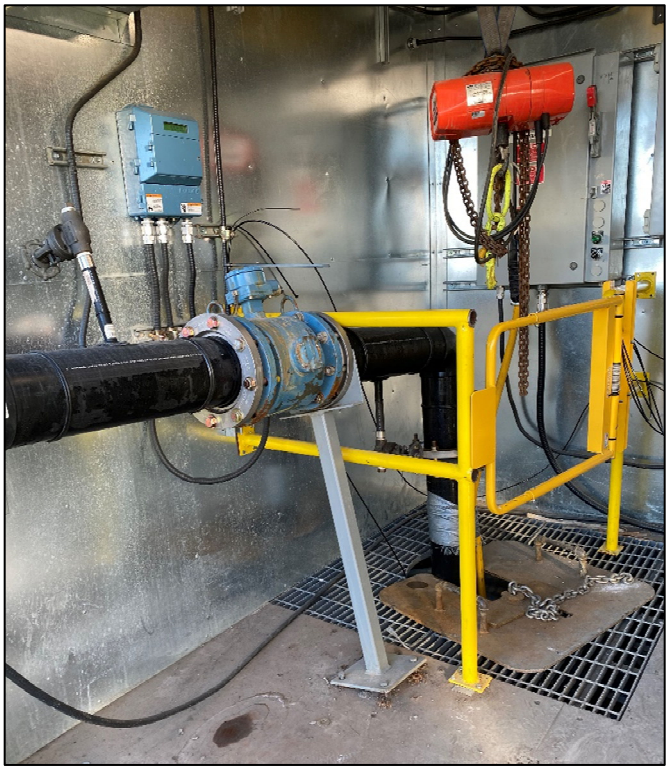
Photograph 09: Downstream slope near Sta. 27+00 (looking east)

Photograph 10: Downstream slope near Sta. 42+50 (looking east)

Photograph 11: East abutment excavation

Photograph 12: West abutment excavation and cutoff wall excavation/construction

Photograph 13: Seepage return discharge pipe



Photograph 14: Seepage collection sump pumphouse

Photograph 15: Piezometer cable extension at upstream slope

Photograph 16: Piezometer cable extension at downstream slope

Photograph 17: Cut-off wall construction

Photograph 18: Panel joint at cut-off wall (under construction)

Photograph 19: Insulation installation at utility and road crossing near Sta. 42+50

APPENDIX C – Visual Inspection Checklist

AK00303
NID ID#_____
SHEET 1 OF 3

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

GENERAL INFORMATION

NAME OF DAM: TAILINGS BACK DAM	POOL ELEVATION: 980 feet
NATIONAL INVENTORY OF DAMS ID#: AK00303	TAILWATER ELEVATION: N/A
OWNER: TECK ALASKA INC.	CURRENT WEATHER: SUNNY, 50 DEGREE FAHRENHEIT
HAZARD POTENTIAL CLASSIFICATION: Class II (Signific	PREVIOUS WEATHER: N/A
SIZE CLASSIFICATION: N/A	INSPECTED BY: RYAN BAKER, NICK ROCCO, TROY THOMPSON
PURPOSE OF DAM: SEE NOTE 1	INSPECTION FIRM: NEWFIELDS
O & M MANUAL REVIEWED: YES	DATE OF INSPECTION: 08/02/2020
EMERGENCY ACTION PLAN REVIEWED: YES	

ITEM	YES	NO	REMARKS
RESERVOIR			
1. Any upstream development?	☐	✓	
2. Any upstream impoundments?	☐	✓	Adjacent waste dump to the east
3. Shoreline slide potential?	☐	✓	
4. Significant sedimentation?	✓	☐	Tailings impoundment
5. Any trash boom?	☐	✓	
6. Any ice boom?	☐	✓	
7. Operating procedure changes?	✓	☐	Temporary due to Stage IV construction activities
DOWNSTREAM CHANNEL			
1. Channel			
a. Eroding or Backcutting	☐	☐	N/A
b. Sloughing?	☐	☐	N/A
c. Obstructions?	☐	☐	N/A
2. Downstream Floodplain			
a. Occupied housing?	✓	☐	Seasonal Cabins
b. Roads or bridges?	✓	☐	Mine Access Road
c. Businesses, mining, utilities?	✓	☐	Mine Water Supply
d. Recreation Area?	✓	☐	Hunting and Fishing Camps
e. Rural land?	✓	☐	
f. New development?	☐	✓	
EMERGENCY ACTION PLAN			
1. Class I or Class II Dam?	✓	☐	
2. Emergency Action Plan Available?	✓	☐	
3. Emergency Action Plan current?	✓	☐	
4. Recent emergency action plan exercise?	✓	☐	**DATE:** 2019 (See Note 3)
INSTRUMENTATION			
1. Are there			
a. Piezometers?	✓	☐	
b. Weirs?	☐	✓	
c. Observation wells?	✓	☐	
d. Settlement Monuments?	☐	✓	
e. Horizontal Alignment Monuments?	✓	☐	
f. Thermistors?	✓	☐	
2. Are readings			
a. Available?	✓	☐	
b. Plotted?	✓	☐	
c. Taken periodically?	✓	☐	

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

SAFETY

ITEM	YES	NO	REMARKS
SAFETY			
1. ACCESS			**TYPE:** gravel road
a. Road access?	✓		
b. Trail access?		✓	
c. Boat access?		✓	
d. Air access?		✓	
e. Access safe?	✓		
f. Security gates and fences?		✓	Remote site, no security fence but mine is monitored by security personnel
g. Restricted access signs?	✓		
2. PERSONNEL SAFETY			
a. Safe access to maintenance and operation areas?	✓		
b. Necessary handrails and ladders available?			N/A
c. All ladders and handrails in safe condition?			N/A
d. Life rings or poles available?	✓		
e. Limited access and warning signs in place?	✓		
f. Safe walking surfaces?	✓		
3. DAM EMERGENCY WARNING DEVICES			
a. Emergency Action Plan required?	✓		
b. Emergency warning devices required by EAP?	✓		**TYPE(S):** Instrumentation
c. Emergency warning devices available?	✓		
d. Emergency warning devices operable?	✓		
e. Emergency warning devices tested?	✓		
f. Emergency warning devices tested by owner?	✓		**WHEN:** During data collection as required by O&M
g. Emergency procedures available at dam?	✓		At Tailings Mine Office
h. Dam operating staff familiar with EAP?	✓		
4. OPERATION AND MAINTENANCE MANUAL			
a. O & M Manual reviewed?	✓		
b. O & M Manual current?	✓		**DATE:** September 25, 2020
c. Contains routine inspection schedule?	✓		
c. Contains routine inspection checklist?	✓		

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

EMBANKMENT DAMS

ITEM	YES	NO	REMARKS
EMBANKMENT DAMS			**TYPE:** See Note 2
1. CREST			
a. Any settlement?		✓	
b. Any misalignment?		✓	
c. Any cracking?	✓		Adjacent and parallel to cut-off wall
d. Adequate freeboard?	✓		
2. UPSTREAM SLOPE			
a. Adequate slope protection?	✓		
b. Any erosion or beaching?		✓	
c. Trees or brush growing on slope?		✓	
d. Deteriorating slope protection?		✓	
e. Visual settlement?		✓	
f. Any sinkholes?		✓	
3. DOWNSTREAM SLOPE			**TYPE:** Exposed Rockfill Slope
a. Adequate slope protection?	✓		
b. Any erosion?		✓	
c. Trees or brush growing on slope?		✓	
d. Animal burrows?		✓	
e. Sinkholes?		✓	
f. Visual settlement?		✓	
g. Surface seepage?		✓	
h. Toe drains dry?		✓	Drain to Seepage Sump
i. Relief wells flowing?			
j. Slides or slumps?		✓	
4. ABUTMENT CONTACTS			
a. Any erosion?		✓	
b. Seepage present?		✓	
c. Boils or springs downstream?		✓	
5. FOUNDATION			**TYPE:** Native soil and bedrock
a. If dam is founded on permafrost			Has been considered in design
(1) Is fill frozen?		✓	
(2) Are internal temperatures monitored?	✓		
b. If dam is founded on bedrock			**TYPE:** Cherts and Shales
(1) Is bedrock adversely bedded?		✓	
(2) Does rock contain gypsum?		✓	
(3) Weak strength beds?		✓	
c. If dam founded on overburden			**TYPE:** sands and gravels, clays and silts
(1) Pipeable?		✓	
(2) Compressive?	✓		potentially
(3) Low shear strength?		✓	

Notes:
1. Tailings, process water, and storm water runoff storage.
2. Compacted granular fill with plastic concrete cut-off wall.
3. EAP exercise although applied to the back dam to meet the regulatory requirements was actually an exercise on the seepage pump-back system of the TMD.