TAILINGS STORAGE FACILITY
NID ID# AK00212
OPERATIONS & MAINTENANCE MANUAL Rev. 8

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August 2019

Tailings Storage Facility
Operations & Maintenance Manual

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Preface

This document is the Operations & Maintenance Manual (O&M Manual) for the Fairbanks Gold Mining, Inc. (FGMI) Tailings Storage Facility (TSF) located near Fairbanks, Alaska in the North Star Borough. This O&M Manual has been prepared to facilitate both effective and efficient practices for the operation, maintenance, surveillance, and documentation of the facility. This document contains information and instructions that will assist FGMI operations and maintenance personnel in the performance of their duties; as well as contribute to their training in recommended procedures. Included in this manual is an organizational chart showing key personnel, and a remedial action contingency plan that covers general emergency response and communication procedures.

Proper O&M is crucial for the TSF to operate safely and efficiently, of which this manual is an essential component of the O&M program. This manual presents the procedures for operation of the TSF under normal or extreme conditions and provides technical guidance and procedures for monitoring, inspection, and long-term maintenance programs. Also contained are descriptions of unusual conditions that might occur at the dam and the operating procedures and inspections that should be followed under those conditions.

As with any structure of this complexity, the operations manual may not foresee every potential problem. However, with a well-conducted training program, careful observation, and regular inspection, unusual circumstances will be identified and brought to management's attention to be appropriately addressed.

Take note that the majority of the time over the life of the TSF, the inspection and monitoring program is routine and encounter no surprises. However, close attention and continued diligence on the part of the operation is required so that potential problems will be identified early and remediated prior to becoming significant. This can only be achieved with the ongoing commitment and support of operating personnel and management at all levels of the operation

Monitoring equipment, procedures, and instrumentation are required to accomplish the following:

- Confirm that the structure is performing in accordance with the design
- Determine if a problem exists that may require remediation
- Provide timely notice of an adverse change in the state of the dam

The facility descriptions presented in this manual are summary descriptions designed to serve as a basis for presenting the O&M and monitoring procedures. The reader should refer to the more detailed descriptions presented in the design and record of construction reports as situations warrant.

Section 1.0 - INTRODUCTION

1.1 Purpose and Objective

This O&M Manual exits to provide a descriptions of the Tailings Storage Facility (TSF) facility and related methods and procedures that will help to ensure that each component of the facility is performing as designed and constructed. In addition, it will help to provide for early detection of component damage, degeneration and/or performance outside the limits of the design intent so that appropriate remedial measures and actions can be implemented.

1.2 Scope

This O&M Manual describes the roles of responsible parties and the procedures that will be used for the operation, maintenance, inspection, and monitoring of the TSF. It specifically addresses components of the facility including: the tailings storage embankment, tailing discharge lines, the barge and pipeline, Pearl Creek Causeway, seepage, collection pump and pipeline, interceptor wells, monitoring wells and the Fish Creek dump. . Also included within the manual is an emergency response plan that outlines responses for various emergency scenarios.

1.3 Overview of the Tailings Storage Facility

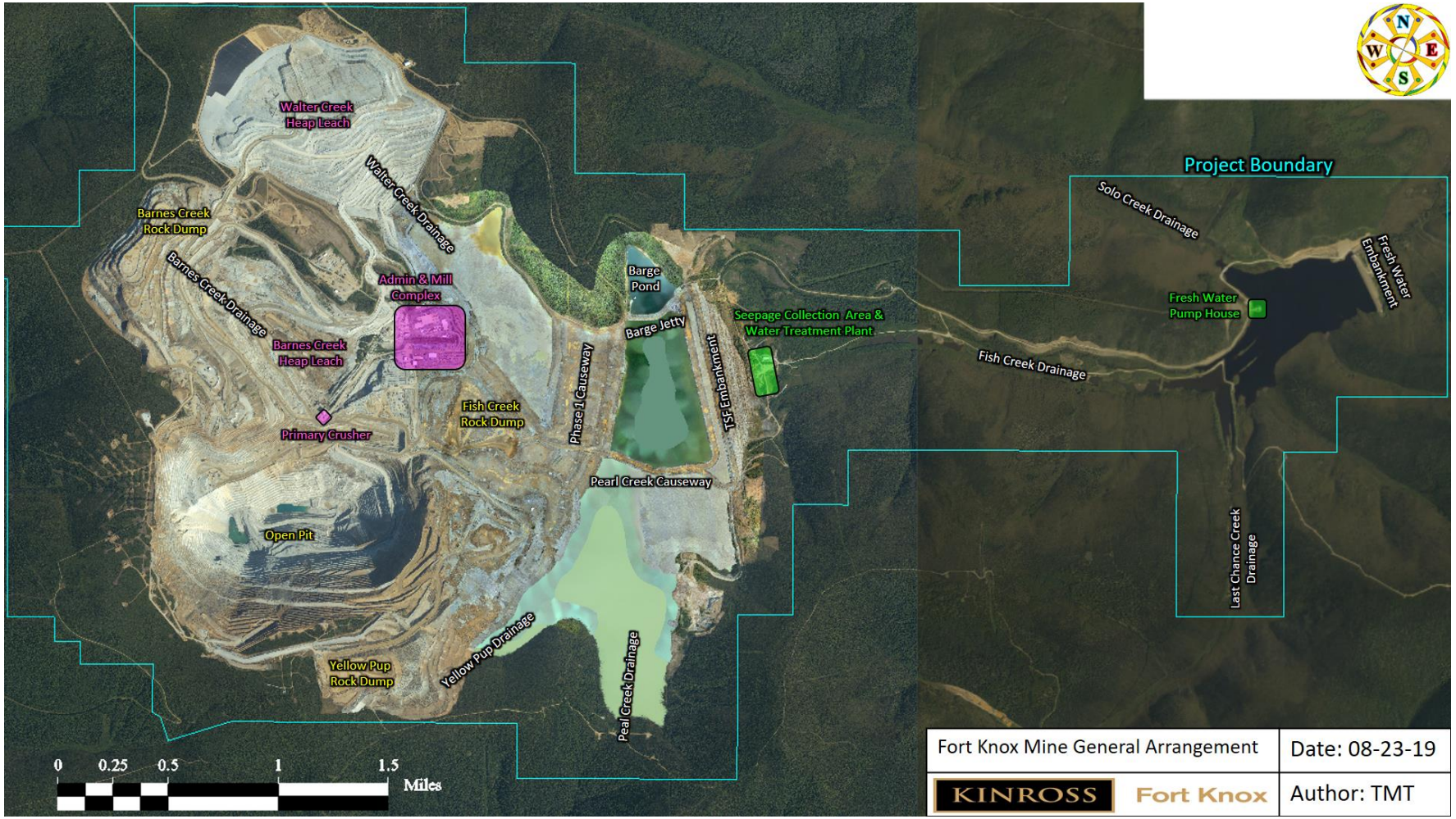
The TSF is located within the Fish Creek drainage and the embankment is downstream from the open pit mine and its associated facilities. With exceptions for the two Fort Knox heap leaches and some localized diversion channels, all upstream water flows are impounded within the facility. Water is captured by intercepting subsurface seepage and ground water flows along the downstream side of the dam and pumping them back into the tailing pond. Process water within the TSF is recycled from the tailing pond to the mill via pumps on a floating barge located near the north abutment of the dam. An overview of the TSF and associated structures can be seen in Figure 1-1**Error! Reference source not found.** on the following page.

The current TSF embankment is at elevation 1557’ fmsl. However, the original embankment was planned and constructed to an ultimate crest elevation of 1488.0 fmsl. As the mine continued to discover millable ore beyond its initial reserves, the need for additional tailings storage capacity was identified. This need triggered a tailing storage study in which a 52’ modified centerline raise to the original TSF embankment was selected for proving additional tailing storage. Subsequent to the construction of the first two of three stages of the 52’ raise, the design of the third stage was revised to allow for an additional 17’ modified centerline raise to crest elevation 1,557 fmsl.

Construction of the modified centerline raise was predicated on the design and construction of a base working platform along the upstream face of the existing embankment, which was permitted under the Alaska Dam Safety Program and successfully completed in the fall of 2009. A general timeline of dam raising activities is below.

- 2006: Original embankment completed to elevation 1488’
- 2009: First base working platform constructed for modified centerline design
- 2010: Original embankment partially excavated and rebuilt on modified centerline back to 1488’
- 2011: Modified centerline raise completed to elevation 1515’
- 2012: Second base working platform constructed
- 2014 - 2015: Modified centerline raise completed to elevation 1540’ and third platform constructed
- 2016 - 2017: Modified centerline raise completed to elevation 1557’

Figure 1-1 – Fort Knox General Arrangement



1.4 Operator Training Program

An ongoing operator-training program and refresher is held annually at a minimum. The program intent is to provide the employees who are responsible for the implementation of the O&M procedures with the expertise required for them to perform their respective duties. New employees are trained prior to them starting any duties.

1.5 Assignment of Responsibilities and Procedures

A partial organization chart outlining relationships between personnel who are involved with operation of the TSF is shown below in Figure 1-2. General responsibilities for positions can be seen below in Table 1-1

Figure 1-2 – FGMI Organizational Chart

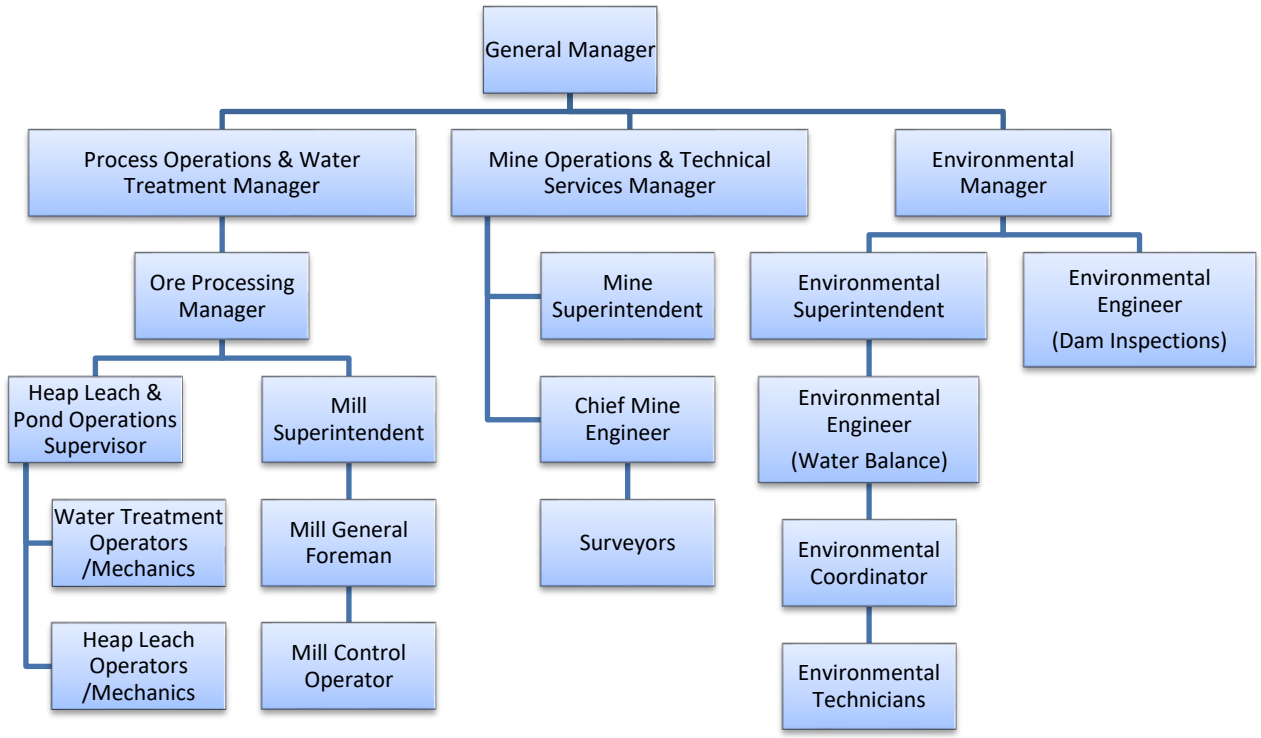


Table 1-1 – TSF O&M Responsibilities

TITLE	RESPONSIBILITY
General Manager	Overall Responsibility for Project
Environmental Manager	Environmental Compliance and Permitting
Engineers	TSF Water Balance Modeling & Inspection
Technicians	Read/Record Monitoring Data & Inspection
Process Operations & W.T. Manager	Water Inventory & Tailings Op
Operators/Mechanics	Routine Maintenance & Inspections
Mill Control Operator	Real Time Operations/Alerts
Mine Operations & T.S. Manager	Tailings Production Planning
Surveyors	Collect Monitoring/Stability Data
FGMI and Consultants as Needed	Data Reduction/Interpretation & Inspections

Water Treatment and/or Heap Leach Operators/Mechanics are responsible for conducting daily inspections as well as general monitoring of the TSF.

The Environmental Department Technicians are responsible for collecting and filing monitoring data.

The Environmental Department Engineers will review the operator's daily inspection logs on a weekly basis.

Additionally, the environmental department will ensure that collected data and operator logs are electronically filed and maintained. Agency requests for data will be met and provided for in the fashion requested.

Emergency event detection, evaluation and mitigation are described in Section 4.

Any variances from the design basis such as higher than design water levels, signs of instability, cyanide in monitoring locations, or other items with the potential to adversely affect facility performance shall be reported daily to the Process Operations/W.T. Manger, Mine Operations/T.S. Manager, and Environmental Manager so corrective actions can be taken. Process Operations/W.T. Manger, Mine Operations/T.S. Manager, and/or Environmental Manager shall advise the General Manager of any deviations and corrective actions.

Any event that has the potential to affect overall safety, integrity, could lead to the release of solutions, or present a threat to the health and/or safety of workers and/or persons offsite shall be reported to either: the General Manager and/or Environmental Manager or acting site manager. The informed manger shall initiate notifications and corrective actions. Additionally the informed manager will initiate the emergency response plan, as appropriate.

Section 2.0 - Description

2.1 General

Major components of the TSF consist of the tailings storage embankment, tailing discharge lines, barge and pipeline, seepage collection pump and pipeline, pearl creek causeway, interceptor wells and monitoring wells. The following sections provide descriptions of these components to help understand the necessary operation and maintenance requirements.

2.2 Design Criteria

The below Table 2-1 shows the general TSF design criteria.

Table 2-1 – General Design Criteria

Tailings		
Permitted average daily tailing production rate	50,000 tons	
Average daily tailing productions rate	39,500 tons	
Average In-situ tailing dry density	85.9 lbs/ft^3	
Solid content at discharge	40%	
Total storage capacity	308.45 Mtons	
Water Storage Volumes		
Maximum operating pond volume	Variable – must not encroach into reserved space for precipitation events	
Required Storage Capacity Greater of either criteria:	A: 100 yr/24 hr storm event and 3 feet of freeboard Maximum 100 yr/24 hr = 944 ac-ft 3' Freeboard = 1,850 ac-ft **Total Required = 2,794 ac-ft** B: Probable Maximum Flood and 1 foot of freeboard Maximum PMP = 3,632 ac-ft 1' Freeboard = 590 ac-ft **Total Required = 4,222 ac-ft** See Table 2-2 Below For Storm Volume By Month	
Required Storage Capacity for Walter Creek Heap Leach in-heap pond	331 ac-ft ; space required in addition to above events	
Earthquakes – peak horizontal acceleration		
Operational Basis Event M=6.5	0.27g	(expected to occur every 1,000 years)
Maximum Credible Event M=7.5	0.63g	(expected to occur every 10,000 years)
General		
Permitted raise elevation and top of seal zone	1,557 fmsl	
Alaska Dam Safety Hazard Classification (designed to a Class I)	Class II	

Table 2-2 – Design Precipitation Event Volumes

Parameter	Jan	Feb	Mar	Apr [5]	May	Jun	Jul	Aug	Sep [7]	Oct	Nov	Dec
	Rain-on-Snow (CN = 100) [4]				Rain (CN = 85 for 100-yr [ARCII], CN = 93 for PMP [ARCIII]) [6]					Rain-on-Snow (CN = 100) [4]		
100-yr/24-hr Rainfall (in)	1.5	0.9	0.8	1.2	1.6	3.8	3.4	2.7	2.3	1.1	1.5	1.0
10-yr Snow Accumulation (SWE in)	5.8	6.2	6.3	0.0	0.0	0.0	0.0	0.0	1.6	2.2	4.1	4.6
10-yr Warm Temperature (°F)	49.9	37.2	37.6	54.8	69.2	73.9	74.0	72.2	61.5	54.9	39.9	38.1
100-yr/24-hr Snowmelt (SWE in)	1.2	0.4	0.5	0.0	0.0	0.0	0.0	0.0	1.6	1.4	0.6	0.4
100-yr/24-hr Runoff (in)	**2.7**	1.2	1.2	1.2	0.5	2.3	2.0	1.3	2.5	2.5	2.1	1.4
100-yr/24-hr Runoff Volume (ac-ft)	**944**	439	431	410	187	813	694	471	863	885	751	488
PMP/24-hr Rainfall (in)	5.1	3.2	3.3	5.5	6.4	11.2	11.2	10.5	8.8	4.7	6.6	4.3
10-yr Snow Accumulation (SWE in)	5.8	6.2	6.3	0.0	0.0	0.0	0.0	0.0	1.6	2.2	4.1	4.6
10-yr Warm Temperature (°F)	49.9	37.2	37.6	54.8	69.2	73.9	74.0	72.2	61.5	54.9	39.9	38.1
PMP/24-hr Snowmelt (SWE in)	1.6	0.5	0.6	0.0	0.0	0.0	0.0	0.0	1.6	2.0	0.9	0.5
PMP/24-hr Runoff (in)	6.7	3.7	3.8	5.5	5.6	**10.3**	**10.3**	9.7	9.6	6.7	7.6	4.8
PMP/24-hr Runoff Volume (ac-ft)	2,367	1,308	1,346	1,931	1,965	**3,632**	**3,632**	3,417	3,384	2,342	2,657	1,690

Notes:

1) Based on disturbed areas received from FGMI in April 2015 and undisturbed areas estimated by Knight Piésold in June 2015.
2) Assumed frozen ground curve number (CN).
3) Antecedent Runoff Condition.
4) It was assumed that frozen ground conditions are present from October through April. Rain-on-snow runoff values include 100% runoff from rain and snowmelt.
5) April has insignificant snow accumulation values and thus, its runoff values include 100% rain only.
6) It was assumed that unfrozen ground conditions are present from May through September. Rain runoff values take into account infiltration losses, per the stated CNs.
7) September has snow accumulation values and thus, its runoff values include rain and snowmelt and take into account infiltration losses, per the stated CNs.

2.3 Embankment

The TSF dam is a zoned, earthfill, and rockfill embankment founded on competent fractured schist bedrock with some areas of weathered granite bedrock high on the south abutment. It contains a low permeability sloping Seal Zone behind the upstream face that is protected by upstream and downstream Filter Zones. Below elevation 1,488 fmsl, a Transition Zone separates the downstream filter from the downstream Random Fill Shell; which provides structural support to the embankment. Above elevation 1,466 fmsl, a Random Fill Shell provides upstream support and erosion protection from tailing deposition off the embankment.

The embankment contains a relatively impervious seal zone constructed of highly weathered schist. Sand filter zones are located upstream and downstream of the seal zone, followed by a downstream transition zone constructed of weathered schist. Upstream and downstream random rock fill zones complete the embankment cross section seen in the following Figure 2-1 and Typical Construction in Figure 2-2. The random fill comprising this is coarse enough to function as riprap for wave erosion protection. Borrow materials came from the reservoir basin and the surrounding area.

Additional features constructed with the embankment include a gravel drain incorporated into the downstream toe, a geosynthetic liner downstream from that drain, and seepage reclaim sump and pump system to return seepage to the tailing pond.

Dam construction initially started with a starter dam where the first seal zone was at elevation 1,323 feet. The subsequent staged raises for the original downstream constructed dam followed the timeline below.

- 1997: raised seal zone to 1,341 fmsl
- 1998: raised seal zone to 1,389 fmsl
- 2001: raised seal zone to 1,407 fmsl
- 2002: raised seal zone to 1,428 fmsl
- 2004: raised seal zone to 1,453 fmsl
- 2006: Original dam design construction completed - seal zone at 1,488 fmsl
- 2008/2009: A Base Working Platform (BWP) was constructed on tailing to elevation 1,466 fmsl
- 2010: Excavated part of the original dam to elevation 1,466 fmsl and reconstructed the zones in a modified centerline orientation back up to a seal zone elevation at 1,488 fmsl.
- 2011: Raised seal zone to 1,515 fmsl
- 2012: Second BWP constructed on tailing to elevation 1,502 fmsl. Random fill placed and compacted over the BWP to elevation 1,515 fmsl.
- 2014: Raised seal zone to 1,526 fmsl
- 2015: Third BWP constructed to 1525 fmsl and seal zone raised to 1540.
- 2016: raised seal zone to 1,550 fmsl.
- 2017: Construction of the TSF to 1,557 fmsl with a 3’ high overbuild at the maximum section of the embankment to camber the crest and 6 feet of frost protection for a top of frost protection crest elevation of 1,566’ fmsl at the maximum section.
- 2019: Construction of the TSF to seal elevation 1560 fmsl, frost protection cap to elevation 1566.

Figure 2-1- Embankment Section Detail

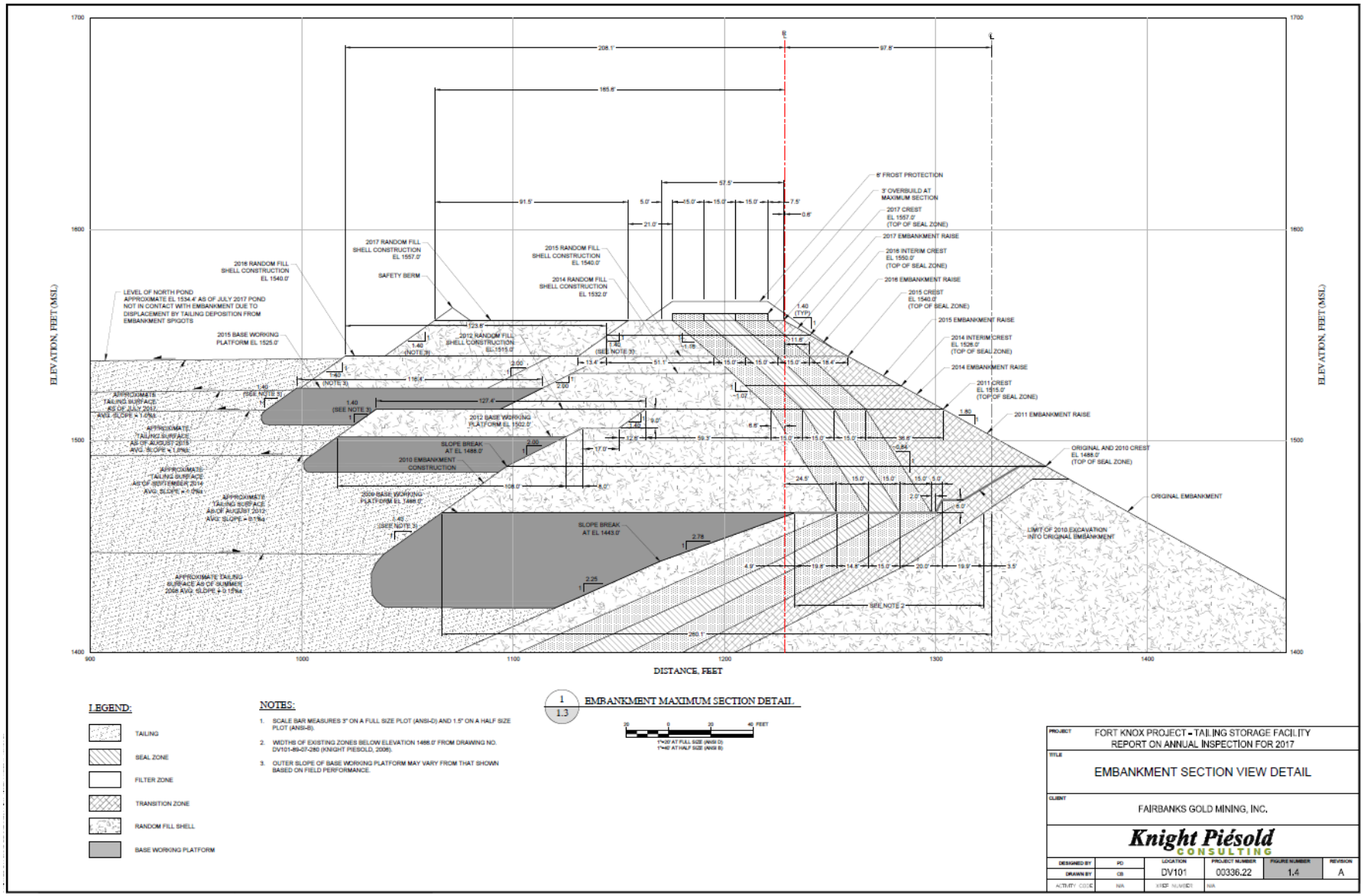
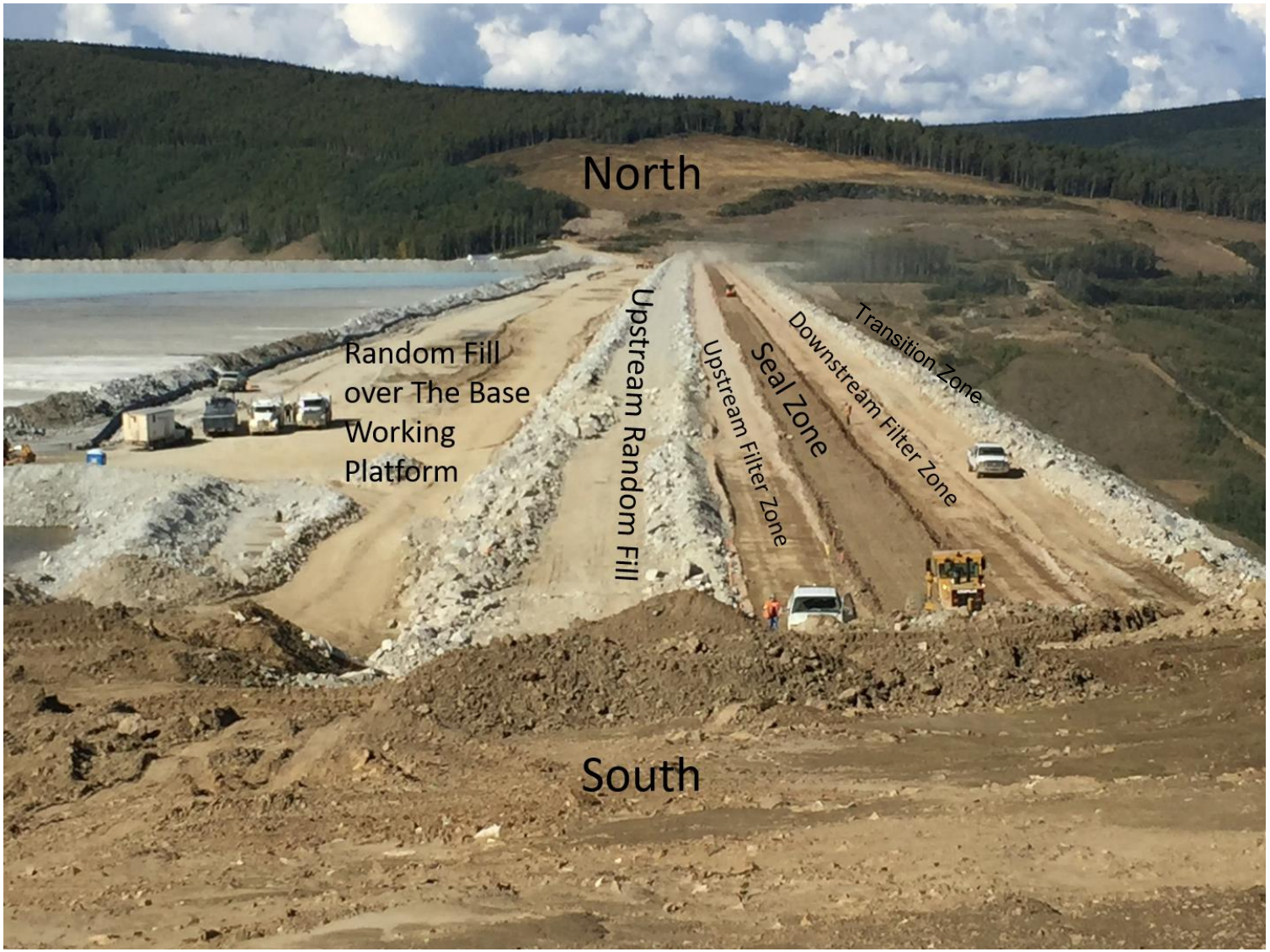


Figure 2-2 - Typical Embankment Construction



2.4 Instrumentation

Instrumentation in and around the dam is designed and constructed to evaluate the performance of the dam the instrumentation is found on Figure 2-3 and Figure 2-4,.

- Vibrating wire piezometers (VWPs) located on two vertical planes through the dam were installed on to planes during initial construction of the starter dam. See the following Figure 2-3 for the plane locations and instruments. Their purpose is to monitor pore pressures, gradients, and head losses across the Seal Zone and in the downstream Random Fill Zone. When construction transitioned to the modified centerline design, additional VWPs were installed in the Seal and Filter The purpose of these instruments is likewise
- VWPs are installed within the tailing under the BWPs. These instruments were initially used to monitor for the development of excess pore pressures under the BWPs during construction. After construction, these instruments allows for monitoring of piezometric head at the upstream face of the dam
- Standpipe piezometers were installed into the foundation with transducres below the upper south side of the dam. Three of the wells are installed to the foundation contact at the base of the dam and three are installed just below the contact in the foundation. Their purpose is to investigate the region where a prominent discontinuity in the foundation is considered responsible for transmitting seepage to a point downstream of the dam, termed Seep 501. This seep has subsequently been intercepted by an extension of the foundation drain system.
- Piezometers were installed into boreholes at the south abutment. At the time, these were above the TSF footprint at crest elevation 1540 fmsl.
- Piezometers were installed with transducers grouted in place and the remaining two are open standpipe with transducers. Their purpose is to track head loss within the pearl creek causeway and hydraulic connectivity between the barge pond and the north abutment. In addition to the four piezometers, three legacy wells are being monitored to provide supplemental data.

Fort Knox is subscribed to Knight Piésold's web-based data management system called FULCRUM. Historical instrumentation data has been loaded into this database and new readings are added by the environmental techs and/or the environmental engineer as the data is collected. As data is entered, it is automatically populated and evaluated.

Figure 2-3 – TSF Instrumentation Plan View

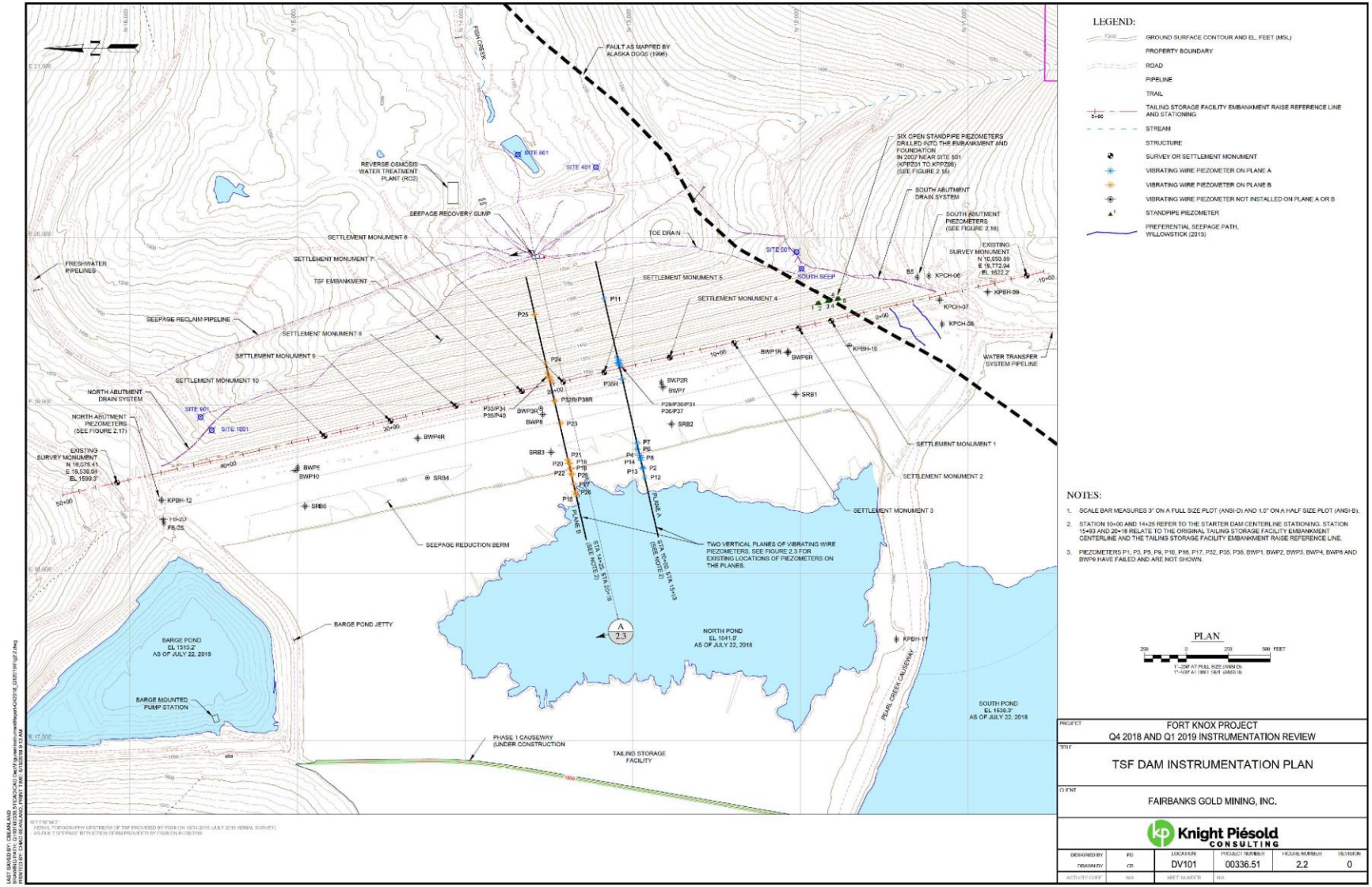
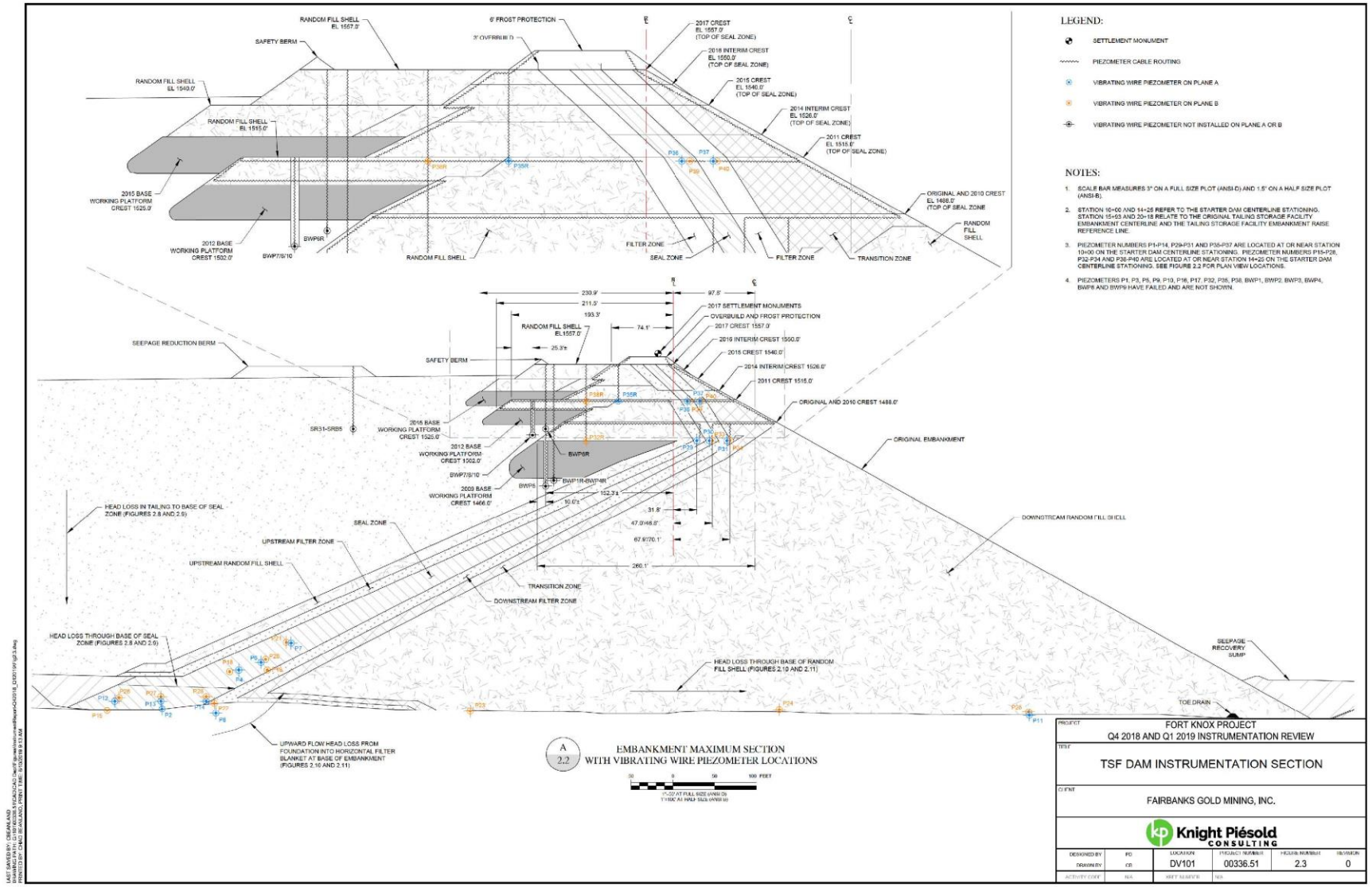


Figure 2-4 – TSF Instrumentation Cross-Section



2.5 Tailing Discharge Line

Three, 24-inch diameter, HDPE, tailing discharge lines, each designed to handle 50,000 tons per day of solids have been installed to carry tailing material from the mill to the impoundment. Tailing slurry from the cyanide detox building can be directed to any one of these lines, depending on maintenance requirements, season, and depositional objectives. When available the water transfer system will be utilized to keep adequate water depth at the barge.

In the event of water encroaching on the TSF freeboard FGMI has installed a critical events pipeline that can be connected to the mill tailings discharge line. The critical events pipeline can pull water from the barge to the mill then would transfer water from the tailings discharge line to the pit.

The deposition of tailings to the TSF and management of the supernatant water changes month to month and year to year

2.6 Barge and Pipeline

A floating barge located in the northeast corner of the tailing pond is used to pump water from the tailing pond to the mill (Figure 2-5). The barge is equipped with four 350 to 400 hp pumps with a pumping capacity of approximately 9,000 gpm. Pumping is on an as need basis with the pumping controlled either by radio telemetry from the mill or manually by the pond operator. Additionally, the barge is equipped with a flow meter, pressure gauges, a surge anticipator It also has deicing system that allows high-pressure water to be released through jets around the barge. The barge is a heated enclosed structure.

Reclaim water is pumped to the process water tank at the mill through a 24-inch HDPE pipeline. Automatic and manual drain valves allow the entire reclaim pipeline to be drained during power outages, maintenance, and barge relocations.

Figure 2-5 - Floating Barge

2.7 Seepage Collection System

The original 1994 design of the toe drain and seepage sump was designed to accommodate up to 12,200 gpm of seepage. The design flow rate was based on the largest flow rate that could be expected during the start-up of the TSF. Start-up conditions were based on the initial filling of the TSF with tailings. Since no tailings were present to blanket the basin or the along the length of the upstream face of the dam a large flow rate was a result of the analysis.

During 2018 the toe drain seepage rate was evaluated for the interim closure configuration of the TSF with the embankment at crest elevation 1557.0 fmsl, and the pond separated from the embankment by the seepage reduction berm. The modelled toe drain flow is 1,493 gpm.

The main TSF embankment has 12-inch diameter, perforated HDPE drain pipes set horizontally in gravel along its toe to collect seepage and divert it to a collection sump. Additionally, water collected from the interceptor wells and the monitoring wells equipped with pumps, is pumped to the collection sump. Water collected in the sump is pumped back to the tailing impoundment. The seepage collection sump is located at the base of the tailings dam and consists of two 63-inch diameter by 50-feet long, perforated HDPE pipes set vertically. A vertical turbine pump is installed to return seepage back to the tailing pond from the sump. The pump is turned on and off by a water level controller. The seepage reclaim building (Figure 2-6) houses the electrical and mechanical components for the seepage collection system.

Figure 2-6 - Seepage Reclaim Building

2.8 Interceptor and Monitoring Wells

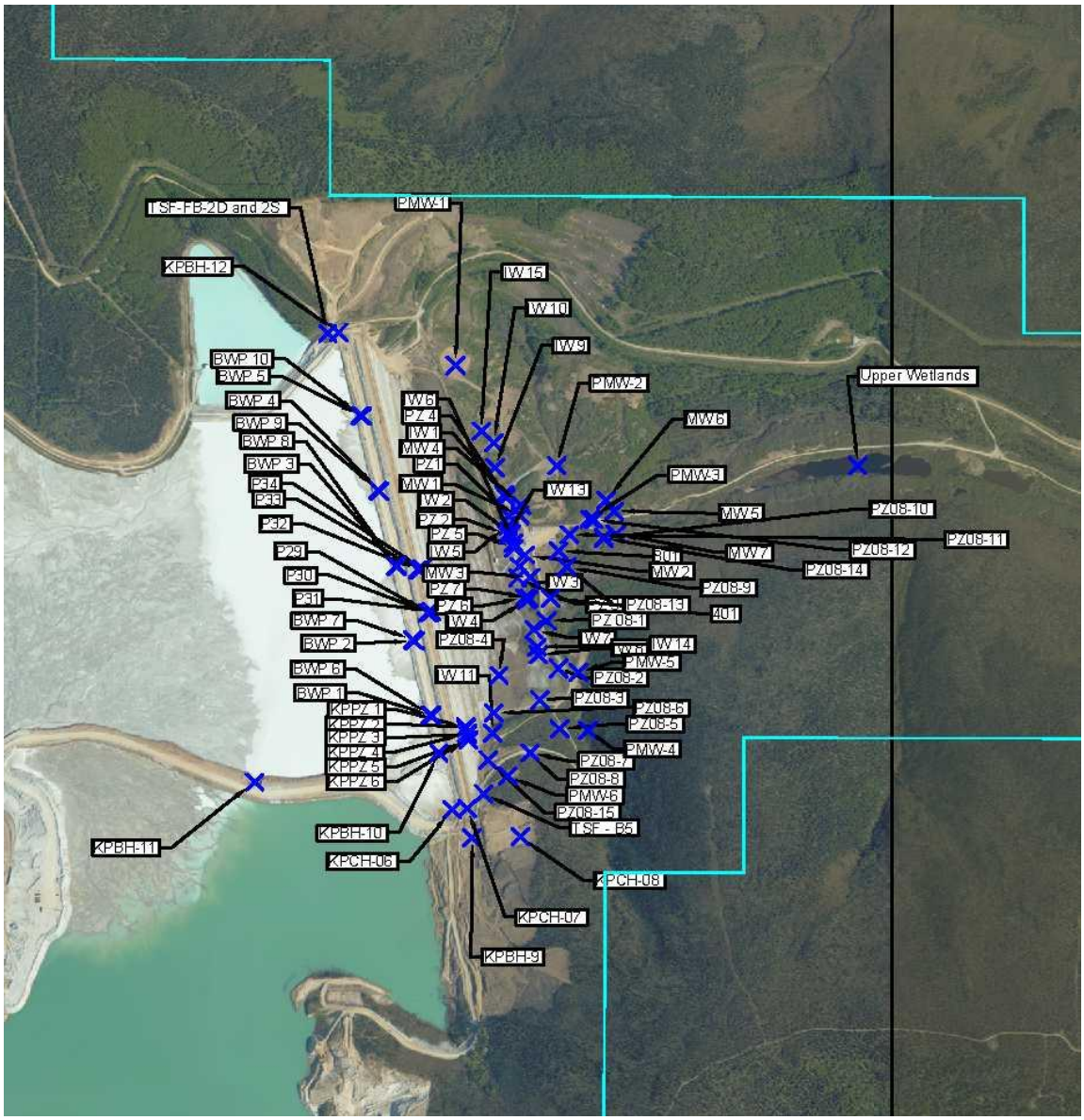
A series of wells that function as either monitoring, interception or compliance are located across the Fish Creek valley downstream from the TSF. The wells are constructed with blank and slotted casing ranging between 6 and 14 inches in diameter, the depth ranges between 120 and 480 feet.

Submersible pumps up to 30 hp are installed in the interceptor wells. The water from these wells flow and discharges in to seepage collection sump. Adjustment of the valves controls the ground water table draw down to the recommended target depth to achieve containment.

Smaller submersible pumps, used for ground water sampling, are installed in the monitoring wells. Figure 2-7 includes the locations of the interceptor wells and instrumentation associated with the monitoring of the system.

An optimization study conducted in June 2016 evaluated the seepage containment efficiency. This resulted in updates to the water elevations and pumping rates for the interceptor wells. As indicated on the weekly well pump log in Appendix F.

Figure 2-7 - TSF Interceptor System



2.9 Barge Pond Jetty

The jetty, Figure 2-8, is intended to isolate the barge from areas of active tailing deposition and provide a pool of water that is deep enough to accommodate the barge mounted pumps. Reclaim water will enter the barge pond through the open graded mine waste rock comprising the jetty or be pumped to the barge pond from the south pond via the water transfer system. Should flows through the jetty not provide the 8,500 gpm of reclaim water required, a channel could be excavated at its northwest end at a point furthest from the tailing deposition points along the crest of the raised embankment. The resultant flow path should be long enough to allow for adequate clarification of the reclaim water prior to its return to the mill. At closure, the jetty may need to be breached, to allow flow through the barge pond from the TSF supernatant pond to the closure spillway that will be excavated into the north side of the Fish Creek valley. At that time, it may be necessary to stabilize the surface of the tailing within the barge pond with mine waste to prevent erosion of the tailing surface by storm water flows entering the spillway.

Figure 2-8 - Barge Pond Jetty

2.10 Pearl Creek Causeway

The pearl creek causeway is a continuous bottom to top vertical rockfill structure. Consequently, it provides a hydraulic connection between the north and south supernatant ponds and the upstream face of the TSF dam when the pond(s) are in contact with the causeway even if the north pond is not in contact with the TSF embankment itself. Although this is not a safety concern since the TSF is designed to withstand full hydraulic loading up to the crest of the embankment. It is considered good practice to isolate the pond(s) from the front face of the dam and the causeway to reduce the head on the dam, the resultant hydraulic gradients and the seepage flow rates through the embankment. The current tailing deposition plan prioritizes the development of beaches in these key areas to facilitate this goal. In addition, FGMI has placed lower permeability rockfill along both sides of the causeway to increase the head loss upstream of the embankment when the pond(s) are in contact of the causeway. In addition, FGMI relocated the current raise to the causeway in 2016 (Figure 2-9) such that it terminates against natural ground at the south abutment rather than the upstream face of the dam. This will have some effect by further increasing the head loss between the supernatant ponds and the upstream face of the embankment. During 2018, the causeway was raised to 1555 in various locations, which is two feet below the engineered zones.

Figure 2-9 - Pearl Creek Causeway Realignment 2016

2.11 Phase 1 Causeway

The Phase 1 Causeway (P1C) is a rockfill embankment structure that is constructed from north to south over the north basin. The P1C is approximately 40 feet high with a crest elevation of 1582 fmsl and width of 1093 feet, with an overall width of 1730 feet at its base from toe to toe. It extends in an arc from the

natural ridge on the north side of the TSF just west of the barge-mounted pump station to the natural ridge at the west end of the Pearl Creek causeway that is partially covered by the Yellow Pup waste rock dump (YPWRD).

Construction of the P1C was completed using mine waste rock, including both general and coarse rockfill. Tailing will be deposited from points remote from, and opposite to, the causeway such that a low point on the tailing deposit will develop against the upstream face of the P1C. Direct precipitation run-off and supernatant water will report to this face and be conveyed through the P1C to the north pond via a coarse rockfill upstream face drain that extends over the entire crest length of the P1C, and four coarse rockfill drain outlet fingers that will extend from the face drain through the P1C to its downstream side.

Section 3.0 - OPERATION AND MAINTENANCE PROCEDURES

3.1 General

The O&M program includes a description of the parameters by which the TSF is to be operated and a monitoring program conducted by FGMI to confirm that the storage pond, embankment, and related systems are performing in accordance with the design. The monitoring program will include both informal routine inspections by operations personnel and formal inspection monitoring for the ultimate operation of the TSF.

As discussed in Section 2.0, major components of the TSF consist of the tailings storage embankment, tailing discharge lines, barge and pipeline, pearl creek causeway, seepage collection pump and pipeline, interceptor wells and monitoring wells. This section outlines the operation and maintenance procedures and corresponding monitoring requirements for each of these components.

3.2 Embankment

3.2.1 Operation and Maintenance - Embankment

An important aspect of protecting the embankment is maintaining an appropriate freeboard. A stage-storage curve was developed by Knight Piésold for both the north and south ponds (Appendix H). A maximum water surface elevation and freeboard requirements, related to the storage capacity, were developed for the dam and is incorporated into the water balance. The water balance is calculated and evaluated by the environmental engineer monthly to confirm the minimum required volume for the extreme event containment with adequate freeboard is available above the tailings and average operations pond levels. Design Criteria and climatic parameters used for the TSF water balance model are listed below:

- Current seal zone elevation input is 1557 fmsl
- Freeboard allowance of 3 feet above the water elevation associated with the combined average operations pond volume from the water balance, maximum volume of pregnant solution in the WCHLF in-heap pond (331 ac-ft), and the 100-year/24-hour storm water volume (1,119 ac-ft)
- Freeboard allowance of 1 foot above the water elevation associated with the combined average operations pond volume from the water balance, maximum volume of pregnant solution in the WCHLF in-heap pond (331 ac-ft), and the PMF (4,304 ac-ft)
- Precipitation both rain and snow
- Temperature
- Snow accumulations
- Evaporation
- Runoff
- Infiltration
- Ice
- Operations timeline

The stability of the TSF embankment also depends on the effectiveness of the seal zone and filter zone limiting the development of an elevated phreatic surface within the downstream random fill shell.

Piezometers installed in the dam are maintained as required to keep them functional; however, since they are buried deep within the embankment, the primary maintenance item is to protect the exposed wires and the readout-panel located in the seepage reclaim pump building.

3.2.2 Inspections and Monitoring - Embankment

Daily inspections of the embankment include observations for settlements, heaving, deflections, and lateral movement as well as increased or decreased seepage, new seepage areas, or erosion. Inspections are conducted along the exposed abutment contacts, upstream and downstream faces of the dam, crest, and the toe of the dam. These observations and measurements are reported on the form “Tailings Dam Inspection Form - Daily” attached in Appendix C.

Changes in the appearance or behavior of the embankment must be reported immediately to the supervisor. An investigation will be conducted to determine the frequency of inspections, instrumentation analysis and stability monument surveys.

Piezometer monitoring is done on a weekly basis by the environmental technicians. Data from the piezometers are recorded (including the temperature at the piezometer) from a digital readout box, and entered into Fulcrum. All data will be accessible to the environmental department and others as appropriate.

Typically, prior to a construction season, the settlement monuments are removed to accommodate construction activities. Settlement monument monitoring is then continued on a monthly basis by the surveyors, once the monuments are reinstalled. Data that is obtained is uploaded to FULCRUM where it is accessible to the engineers and the environmental department. The data is compared to the original location of the monuments as well as the previous months reading. The environmental department reviews the horizontal movement and the vertical settlement data as it is uploaded. The settling monument installation will occur after construction of the seal zone to 1560 fmsl is complete, similar to Figure 3-1.

Figure 3-1 - TSF Survey Monuments

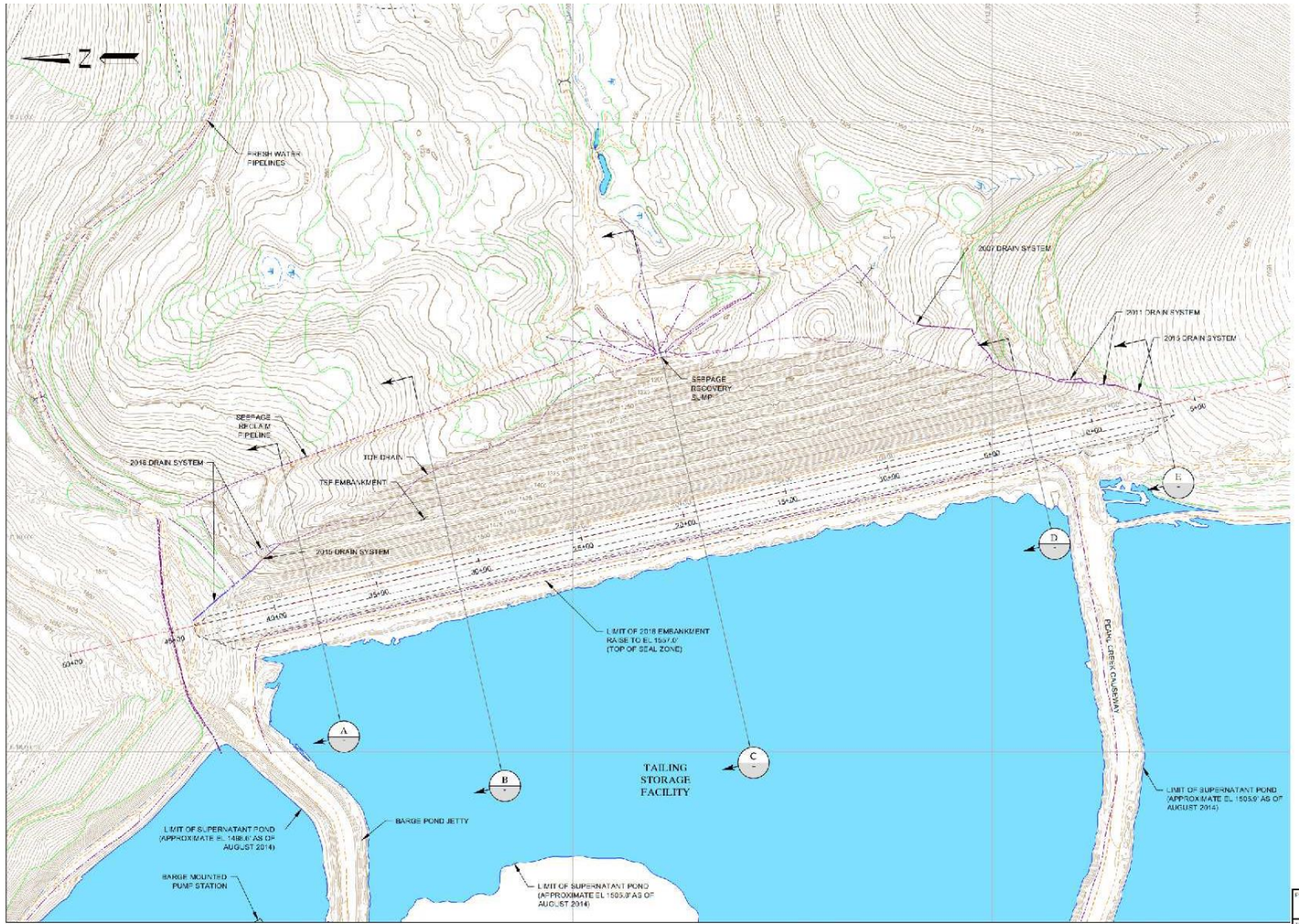
3.3 Site 901 and Site 1001

During the dam safety inspection in July 2015, two areas of seepage were noted at, and downstream of, the embankment toe along the north abutment. The locations of the seepage have been designed as Site 901 and Site 1001 (Figure 3-2).

The locations of the two seeps were surveyed and water samples collected for chemical analysis. Once the source of the seeps was confirmed to be the TSF based on water chemistry, ADNR and the Alaska Department of Environmental Conservation (ADEC) were notified of the existence of the two seeps as required by the TSF permitting. An initial plan for corrective action was submitted to ADEC, which included for completion of a "review of available geotechnical data and geologic information relevant to the north abutment area in the vicinity of 901 and 1001. Knight Piésold has completed the required review of available geotechnical data and geological information to include completion of confirmatory geotechnical analyses of the TSF embankment in the vicinity of the two seeps. The occurrence of seepage at Sites 1001 and 901 is similar to the seepage that occurred at Site 501 in late 2006, which was successfully mitigated by installation of the south abutment drain system.

When noticed, the north abutment seepage flowed overland from Sites 1001 and 901, parallel to the downstream toe of the embankment, until it infiltrated into the subsurface about 50 feet above the end of the original toe drain, indicating the toe drain is still operational and could be extended. The extension of the north abutment drain system was completed in October 2016. Seepage at Sites 1001 and 901 have not recurred to date

Figure 3-2 - Sites 901 and 1001



PLAN

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI D) AND 1.5" ON A HALF SIZE PLOT (ANSI B).
2. THE STATIONING SHOWN ON THE ORIGINAL TAILING STORAGE FACILITY EMBANKMENT CENTERLINE HAS BEEN TRANSPOSED TO THE TAILING STORAGE FACILITY RAISE REFERENCE LINE

PROJECT	FORT KNOX PROJECT TAILING STORAGE FACILITY EXPANSION				
TITLE	TAILING STORAGE FACILITY PLAN VIEW				
CLIENT	FAIRBANKS GOLD MINING, INC.				
	Knight Piésold CONSULTING				
DESIGNED BY	JS	LOCATION	PROJECT NUMBER	FIGURE NUMBER	REVISION
DRAWN BY	DB	DV101	00089.83	1.3	0

3.4 Tailings Discharge Lines

3.4.1 Operation and Maintenance – Tailings Discharge Lines

Tailing discharge lines designed to handle 50,000 tons per day of solids, have been installed to carry tailing slurry from the mill to the impoundment. Tailing slurry from the cyanide detox building can be directed to any line, depending on maintenance requirements, season, and depositional objectives. The lines may be incorporated into the water transfer system when necessary to maintain freeboard and provide adequate water depth at the barge. The tailings will be managed by single discharge points according to operational requirements, and final closure topography.

At no time is a pipeline to be left with all off-takes closed. Discharge into a closed pipe could result in sanding or high pressures that could lead to pipeline failures, especially at off-takes and valves. When discharge is redirected to a different pipeline or off-take, the off-take valves in the new area of discharge must first be opened and flow established through them before the valves to the previous active area are closed. Prior to any prolonged shutdown, a pipeline will be flushed of solids to all off-takes and then allowed to drain.

3.4.2 Inspections and Monitoring – Tailings Discharge Lines

The tailing discharge line is inspected daily for leaks, erosion, and settlement. Leaks are most likely to occur at saddle off-takes, valves, fabricated bends, drop boxes, and along steep downgrades. Hence, daily visual inspections focus on these areas. Pond operators perform operations, maintenance, inspections and record activities on a daily basis unless otherwise specified.

Visual inspection of the discharge point into the tailing pond is made daily. Items checked include excessive movement or vibration of the HDPE pipe, excessive erosion, reduction or loss of flow, etc.

The tailing discharge point is noted on the “Barge Inspection Form - Daily” (Appendix D). The daily shift log kept by Mill Control provides a record of the tons of tailing discharged, percent solids in the tailing discharged, and the duration of any shutdowns.

Periodic inspections of sub-aerial and sub-aqueous deposition are performed as directed to verify the desired depositional patterns are being achieved. Sub-aerial deposition is inspected visually. Additionally, the environmental technicians along with the surveyors conduct a bathymetric survey to measure the sub-aqueous deposition using a depth sounder. This is done a minimum twice per year and generally corresponds to the yearly aerial survey and prior to freeze up. The water balance is calibrated with the new bathometry data and the deposition plan is checked to verify predicted vs actual calculations.

3.5 Barge and Pipeline

3.5.1 Operation and Maintenance – Barge and Pipeline

The reclaim water system, including the barge and pipeline, are critical to operation of the mill. Since the barge is a floating vessel, any listing or change in its waterline should be reported to superiors immediately. Such changes will trigger more frequent inspections and a complete investigation to identify and rectify the cause.

Each flotation and ballast compartment on the barge has been fitted with a 2-inch diameter discharge pipe and a 1-inch diameter air inlet fitting so that water can be expelled when necessary. It is critical to limit air pressure to less than 2 psi on these compartments. (Consider that on the 8-foot by 8-foot side of each compartment every 1 psi exerts 9,216 lbs of force pushing the side outwards. This total force must be contained by the compartment bracing and the corner welds. Too much pressure will cause the compartment to bulge and possibly rupture.)

If any welding is done on a compartment, the compartment shall be pressure tested to make certain no pinholes or leaks exist. Pressure testing is conducted with an accurate pressure gauge (one that reads 0 to 5 psi) and is attached to piping on the compartment prior to applying the 2 psi air pressure. The pressure is observed for 12 to 24 hours. If no pressure drop is observed, then the compartment is sound. Otherwise, it is necessary to investigate further.

When the process water pipeline is empty, it takes almost one hour for water to reach the process water tank after the barge pumps start. Consequently, good planning and coordination with pond operator is required when starting up after a prolonged shutdown.

The barge is anchored in place at each corner. Each day the tension in the mooring cables is checked and adjusted as necessary. A walkway from the shore is connected to the barge that also carries a 24-inch, flexible pipeline and electrical cables. Each day these are checked and propped or adjusted as necessary. As the water elevation in the pond rises, the barge must be relocated. The pond operators keep their supervisors advised of an upcoming need to relocate the barge, well in advance of the need for relocation. This is especially important during breakup, significant storm events and the winter months when the jetty is blinded off and may not be transferring enough water.

Pump lubrication, alignment checks, impeller adjustments, seal replacements, etc. are scheduled by the mill maintenance planners according to manufacturers' recommendations and operator experience at the Fort Knox Mine. Mill maintenance mechanics normally perform this service however; the pond operators should be mindful of items that may have been overlooked or may need more frequent attention than anticipated.

3.5.2 Inspections and Monitoring – Barge and Pipeline

The barge and process water pipeline are inspected daily by the pond operator. The pond operator inspects for any unusual noises from the pumps, excessive snow loads on the barge, etc. Fire extinguishers, life preservers, and other safety equipment are inspected regularly and serviced or replaced as required Other critical items include indications or signs of leaks or excessive movement, particularly at the connection between the barge and the shore. If any adverse conditions are observed, the pond operator takes appropriate corrective action.

Observations and measurements such as the depth of water under the barge, pontoon condition, deicing system performance, condition of the valves, total barge pump time, instantaneous flows for each pump, and monthly totalizer flow, are recorded on the "Barge Inspection Form - Daily" (Appendix D) and the "Daily Pond Operators Log" (Appendix E).

During inspection the inspectors look for any signs of corrosion, grounding problems, and general wear and tear at the barge.

3.6 Seepage Collection System

3.6.1 Operation and Maintenance – Seepage Collection System

Operation of the seepage reclaim pump is controlled remotely by the Mill Control Operator. The automatic level controller activates a pump when the water rises within 20 feet below the floor grate; the pump deactivates when the water level drops to 35 feet below the grate. The l elevation of the floor grate is 1175 fmsl During periods of automatic control, operators must verify that the pumps are starting and stopping when they should. During periods when the automatic level controller is not functioning properly, the pond operator must control the pump manually. To insure prompt response to water level changes, an electronic data recorder measures the depth-to-water in the sump every two seconds and immediately transmits the measurement to the Mill Data Collection System where it is monitored on a continuous basis. An associated automatic alarm alerts Mill Control when the sump rises above or below the target pumping depth.

The seepage pump arrangement has been modified to accommodate the operations of the Reverse Osmosis Plant 2 (RO 2).The pump located in the north well casing is replaced with pumps that report to RO-2 . The south pump remains installed with the capacity to pump 2,600 gpm. In the event the south pump is down and the RO2 plant is offline the brine pump valve to the TSF must be opened to accommodate the flow.

When the pumps are shutdown, the pipeline will slowly drain back into the sump. The surge anticipator should be operated regularly to be certain it is functioning properly.

Pump lubrication, alignment checks, impeller adjustments, seal replacements, etc. are scheduled by the mill maintenance planners according to manufacturers' recommendations and experience at the Fort Knox Mine. Mill maintenance mechanics normally perform this service however; the pond operators should be mindful of items that may have been overlooked or may need more frequent attention than anticipated.

3.6.2 Inspections and Monitoring – Seepage Collection System

The environmental engineer reviews the electronic seepage sump depth and total seepage flow data transmitted to the Mill Data Collection System (PI) weekly. PI also collects and records totalizer, run hour, and instantaneous flow rate for the seepage collection sump these data are maintained on the mill server.

3.7 Interceptor and Monitoring Wells

3.7.1 Operation and Maintenance – Interceptor and Monitoring Wells

Seepage that bypasses the seepage collection sump located in the embankment foundation is collected by 10 deep ground water interceptor wells, one surface pond (801), one shallow ground well (401) and the 501 seep drain all are located downstream from the embankment. Routine operation of the deep interceptor wells includes observing that each of the wells is producing water and adjusting the flow rates as needed to maintain the desired drawdown in each well. In addition, each year roughly three wells are rehabilitated by the mill. Starting in 2017 the mill is responsible for this activity. Prior to 2017 the environmental held the responsibility.

To prevent wellhead and line freezing during cold weather the wellheads will be wrapped with a heating blanket and the heat trace is turned on.

Pond operators will maintain pond 801 water level as to not allow it to overflow.

3.7.2 Inspections and Monitoring – Interceptor and Monitoring Wells

Daily inspections of the interceptor and monitoring wells include observations of the integrity of the pipelines from the interceptor wells to the seepage collection sump. Totalizer, instantaneous flow rate and water depth readings for each interceptor well are recorded weekly by the Pond Operator on the “Well Pump Log Sheet - Weekly form. (Appendix F). Electronic copies are archived in the environmental department files. This data is monitored weekly by the responsible environmental engineer.

The interceptor wells are also used for ground water sampling. Sampling is conducted with the use of submersible pumps installed in the wells. Ground water sampling is currently being done quarterly and is electronically archived in the environmental department files.

3.8 Phase 1 Causeway

3.8.1 Inspections and Monitoring Phase 1 Causeway

Monitoring of the causeway’s performance will be conducted both visually through field observations and analytically through review of collected instrument data. The goal of the proposed plan below is to allow for adequate data collection and inspection of the facility so as to alert the operation to any signs of potential problems or unexpected behavior.

FGMI will notify Knight Piésold (KP) if at any point inspections and or observations show concerning and/or unexpected behavior of the structure. KP will instruct FGMI as needed on any necessary remedial actions beyond those already specified in the above monitoring plan.

1. On a daily basis while active deposition is occurring behind the causeway
    a. Visual inspection of the active tailings surface will occur. Inspections will note the general direction of the tailings stream and look for signs of decant water being actively ponded or impounded behind the causeway. Note: It is recognized that small areas of localized ponding may occur, and are expected as the tailings stream propagates out from the deposition point.
        i. Remedial Actions: Areas of ponding that occur as a result of slow/reduced drainage through the causeway will be addressed through deployment of a pumping system to augment flows over the top of the causeway.
        ii. Remedial Actions: Areas of ponding that occur as a result of tailings beach formation will be addressed through creation and/or activation of another deposition point located such that the new beach will displace impounded water towards the causeway.

b. Visual inspection of the downstream conditions along the causeway will occur. Inspections will look for any obvious signs of tailings solids being piped through the causeway and accumulating along the downstream toe. In addition, inspections will look for any obvious signs of cracking, sinkholes, or springs/seepage developing in the rock fill.

    i. Remedial Actions: In the event that piping of tailings solids is identified, the entry point into the upstream face of the causeway will be surveyed. At this location there is likely a localized area of nested course particles in the fill. After the area is surveyed, the mine will dump a thin cover of finer-grained material over the causeway face to disrupt any preferential flow paths.

    ii. Remedial Actions: If inspections identify cracking in the causeway fill, the locations will be surveyed and the area visually monitored to determine if active propagation and expansion is occurring. If after three days minimal changes are observed, then the area will be scarified and re-compacted to limit meteoric water infiltration.

2. On a weekly basis while active deposition is occurring behind the causeway

    a. Surveys of available settlement monuments will be completed at least twice per week with Wednesday and Sunday being preferred days. In the event weather conditions do not allow for surveys to be completed it will be logged in the site survey sheet as “no-read: weather”.

    b. Survey of the tailings beach elevation at designated “Survey Points” numbered 1 through 4 on drawing 1000 will be completed at least once per week, preferably Wednesday. In the event that the location is below the decant water elevation, then no reading will be taken. No reading will be required for survey point 5 due to its location on the South side of the Pearl Creek causeway.

    c. Tailings elevation measurements at all accessible standpipe locations will be taken with a weighted tape and recorded at least once per week, preferably Wednesday.

    d. Readings of assessable vibrating wire piezometer (VWP) instruments installed during causeway construction will be recorded at least three times per week, preferably on Monday, Wednesday, and Friday.

Review and analysis of recorded information will be conducted at least once per week by FGMI staff.

3.9 TSF Inspection Program

As discussed in the previous sections, inspections are conducted on the TSF associated structures. The TSF inspection schedule is summarized in Table 3.1.

In addition to the TSF Inspection Program, water quality monitoring is conducted at various locations below the tailings impoundment by the environmental technicians. The current seepage monitoring program is summarized in Table 3.2.

Table 3-1: Inspection Schedule for the TSF

TSF Associated Structure	Inspection Activity	Document	Schedule	Responsible Person / Group
Embankment	Tailings Dam Inspection Form	Appendix C	Daily	Pond Operator
	Update Water Balance	GoldSim Model	Quarterly and as needed	Environmental Engineer
	Piezometer Monitoring	1.1 Monitoring Data (Internal Server M:\Enviromental)	Weekly	Environmental Technician
	Stability Monuments	Survey Slope spreadsheet	Monthly	Surveyors
Tailing Discharge Lines	Barge Inspection Form	Appendix D	Daily	Pond Operator
	Shift Log	Mill Control System	Daily	Mill Control
	Deposition	Spot survey according to deposition plan	Quarterly (minimum)	Surveyors
	Sub-Aqueous Deposition	Bathymetric Survey	Twice a year	Environmental Technicians and Surveyors
Barge and Pipeline	Barge Inspection Form	Appendix D	Daily	Pond Operator
	Pond operators Daily Report	Appendix E	Daily	Pond Operator
Seepage Collection System	Seepage Monitoring	Appendix F	Weekly	Pond Operator
Interceptor and Monitoring Wells	Seepage Monitoring	Appendix F	Weekly	Pond Operator
Periodic Safety Inspection	Annual Inspection	Report on Annual Inspection	Annual	Engineer of Record
	Safety Inspection	Appendix G	Every Three Years	Engineer of Record

Table 3-2: Seepage Monitoring Locations

Location	Sample and Analysis	Schedule
Site 501 Site 801 Upper Wetlands Lower Wetlands Pond C Pond D TSF Decant Tailings Filtrate Tailings Solids TSF Seepage Fresh Water Reservoir Fresh Water Dam Seepage IW – 1, 2, 3, 4, 5, 6, 7, 8, 11, 13 MW – 1, 3, 5, 6, 7 PMW – 1, 2, 3S, 3D, 4, 5,6	Full Profile (Appendix B)	Quarterly

3.10 Photographs

Taking photographs of conditions needing repair and of the repairs are encouraged to provide a visual record of the conditions and the repair. This is especially important when design of the repair may involve personnel who are offsite. It also provides a visual record of areas that are taking more than routine maintenance that could reduce the maintenance costs by revising the design. The photographic record is many times a real value in showing the designer the problem to be addressed.

3.11 Data Interpretation

This manual provides the guidelines for a consistent method for monitoring and inspecting the facilities including trigger cases that initiates actions based on the results of the monitoring and inspection. Any unexpected change in data is reported to management, Knight Piésold and the appropriate personnel of the specific area effected.

The data collected and reviewed by the environmental department. Knight Piésold analyzes and prepares a quarterly geotechnical and instrumentation report to confirm the TSF is performing to design standards. The report includes an executive summary, recommendations and graphical representations of the data on a time basis. This includes piezometric elevations, water elevations, flow rates and stability movements.

3.12 Internal and External Reviews

The EOR conducts an annual inspection of the TSF. The The EOR conducts a PSI every 3 years in accordance with the Class II ranking of the TSF dam under the Alaska Dam Safety Program. The next PSI is scheduled for 2021.The TSF is included in the State required third-party environmental audit The next third-party audit is required in 2023.

Section 4.0 - Event Detection

This section is a tool to identify potential situations before they become critical events. The majority of this material is taken from the Fort Knox Emergency Action Plan is coordinated with the Fort Knox Emergency Management Plan. Refer to those plans for additional information.

4.1 Event Detection

This step describes the detection of an unusual or emergency event and provides information to assist the Dam Operator in determining the appropriate emergency level for the event. Unusual or emergency events may be detected by:

- Observations by FGMI personnel or contractors
- Observations at or near the dam by government personnel (Local, State, or Federal), landowners, visitors to the dam, or the public
- Evaluation of instrumentation data
- Earthquakes felt or reported in the vicinity of the dam
- Forewarning of conditions that may cause an unusual event or emergency event at the dam (for example, a severe weather or flash flood forecast)

4.1.1 Level 1 Non-Failure

A non-failure emergency is an unusual condition. They are conditions or situations that differ from the normal or expected condition of the dam and impoundment. These unusual conditions may indicate problems needing investigation or corrective measures.

4.1.2 Level 2 Potential Failure

A potential failure emergency level indicates that conditions are developing at the dam and could lead to a failure. A potential failure should convey that time is available for analyses, decisions and actions prior to a failure. A failure may occur but predetermined response action may moderate or alleviate the failure. This also includes water at the WCHL spillway invert and a release to the tailings storage in imminent.

4.1.3 Level 3 Imminent Failure

The imminent failure emergency level indicates that time has run out, and the dam, is failing or about to fail

Table 4-1 Event Detection

Event	Situation	Emergency Level Notification
Spillway flow	Water Supply Reservoir water is obstructed Walter Creek Heap Leach any amount is reportable to DEC	1
	Water Supply Reservoir water surface elevation at 1027.5 (2.5 feet above spillway crest) Spillway flow could contribute to downstream flooding if the reservoir level continues to rise	2
	Water Supply Reservoir water surface elevation at 1033 (8 feet above spillway) flow could continue to contribute to flooding downstream	3
Embankment overtopping	Water level is encroaching on the freeboard TSF 1552. amsl (5 feet below seal zone) WCHL 1648 amsl (5 feet below dam crest) WSRD 1030 amsl; (5 feet above spillway)	1
	TSF Mitigation efforts for Level 1 are not working or water elevation is at or above 1554 (3 feet below seal zone) WCHL 1650.5 Water is at the spillway invert and a release to the tailings is imminent WSRD 1033 amsl; (8 feet above spillway)	2
	TSF, WCHL, WSRD Water level has exceeded the freeboard and water is flowing over the dam failure is imminent.	3
Seepage	New seepage areas in or near the dam	1
	Increase in new or existing seepage rates. New or existing seepage have a cloudy discharge or increasing flow rate.	2
	Is the new or existing seepage cloudy and the discharge flow rate is rapidly increasing. Surface cracks are developing. Notable and unusual conditions are occurring.	3
Earthquake	Minor Earthquake as defined in Figure 4.1 and Tables 4.2 and 4.3	1
	Major Earthquake as defined in Figure 4.1 and Tables 4.2 and 4.3	2
	Earthquake resulting in uncontrolled release of water from the dam	3
Embankment cracking	New cracks in the embankment less than ¼-inch wide without seepage	1
	New cracks in the embankment greater than ¼-inch wide without seepage	2
	Cracks in the embankment with seepage	3
Embankment movement	Small movement detectable by instruments	1
	Slightly larger movements/slippage that are visually observable	2
	Sudden or rapidly proceeding slides of the embankment slopes	3
Instruments	Increase in instrument readings	1

Event	Situation	Emergency Level Notification
	Instrumentation readings beyond predetermined values Instrument readings that continue to increase from the expected norm	2
	Elevated instrument readings in conjunction with other elevated event detection situations	3
Boils and Sinkholes	Observation of new sinkhole in reservoir area or on embankment. Observation of a boil down stream of the toe	1
	A boil is noticed with the formation of a silty soil cone around the outlet of the boil Enlarging sinkhole	2
	Rapidly enlarging sinkhole with a whirlpool on the lake surface with or without a drop in water elevation	3
Security threat	Vague or unverified bomb threat	1
	Verified bomb threat that, if carried out, could result in damage to the dam	2
	Detonated bomb that has resulted in damage to the dam or appurtenances	3
Sabotage/ vandalism	Damage to dam or appurtenance with no impacts to the functioning of the dam	1
	Modification to the dam or appurtenances that could adversely impact the functioning of the dam	2
	Damage to dam or appurtenances that has resulted in a dam safety issue	3

4.2 Conditions and Evaluation

The potential emergency conditions or unusual occurrences are reviewed in this section. Measures to mitigate the effects of the emergency condition are in Section 4.3.

4.2.1 Extreme Runoff from Rainfall or Snowmelt

On a heavy rain warning from the National Weather Service, the water level in the impoundment and reservoir will be monitored closely and facilities will be maintained as necessary during the event.

After any major storm or thaw runoff event, a thorough inspection of all ditches, culverts, ponds, and other water-related facilities will be completed. Necessary repairs will be completed as soon as is reasonably possible to reduce the chance of additional damage during subsequent storm events.

4.2.2 Increase in Seepage

Observations of water levels and flow rates on the piezometers, seepage reclaim sump, and interceptor and monitoring wells should be evaluated to determine if there are any significant changes in seepage rates associated with any of the dams. If an increase in seepage is detected, the flow will be examined to see if it is cloudy or clear and a determination of the reason for the increase in seepage will be made. Water quality analyses must also be performed to help determine the source of the water.

The identification of unanticipated seepage from the abutments or toe will be investigated, monitored, evaluated, and steps taken to control it. Monitoring will be conducted daily and will include visual inspection to determine if the water is clear or cloudy. Quantity measurements and water quality samples will be taken as required provided conditions are not prohibitive.

The engineer of record will be advised of new seeps, significant or sudden increases in seepage rates, changes in seepage color or cloudiness, or identification of new surface seeps.

Measures to control the seepage will be based on planned investigations and studies. Investigations will be carefully designed to provide information that can be used to analyze and evaluate the nature of the seepage.

4.2.3 Earthquakes

Earthquakes are classified as insignificant, minor, or major, with regard to the Fort Knox dams. An inspection of the dams should be conducted by FGMI environmental and designated operators following any seismic event that produces a Peak Ground Horizontal Acceleration (PGHA) greater than 0.05g. Reference Figure 4.1 and Table 4.2 All geotechnical instruments will be read or surveyed. The Engineer of Record will be contacted and made aware of the occurrence and brought out to site if the situation is warranted. Instrumentation data will be entered into FULCRUM (web based instrumentation data collection program). Heightened attention should be given the normal daily inspection. Any necessary repairs will be completed as soon as practical.

In order to provide real-time seismic monitoring and a more effective early warning system, FGMI has installed two accelerometers in the TSF area. These accelerometers were installed along the dam to work in tandem to monitor seismic events and any movement of the TSF dam. One analog triaxial accelerometer, model 147A-01/3, was installed on the crest of the dam while the other a triaxial accelerograph, model 130-SMHR/6, was installed on the north abutment. Both models are made for continuous monitoring of earthquakes and other seismic events. Once the data from the instruments is continuously recorded and sent through the FGMI network to a computer and data storage on-site. In case of major events (PGHA ≥ 0.05g) FGMI designated team and EOR are immediately notified via email and above mentioned inspection will be performed. The data can also be downloaded manually then taken back to the office and analyzed. Until this system is fully automated with email notifications Figure 4.1 Earthquake Attenuation Plot and Table 4.3 will continue to be used as the basis for inspections. Once the data from the accelerometer has been manually downloaded or and analyzed the inspections may change in accordance with resulting PGHA.

Figure 4-1 - Earthquake Attenuation Plot

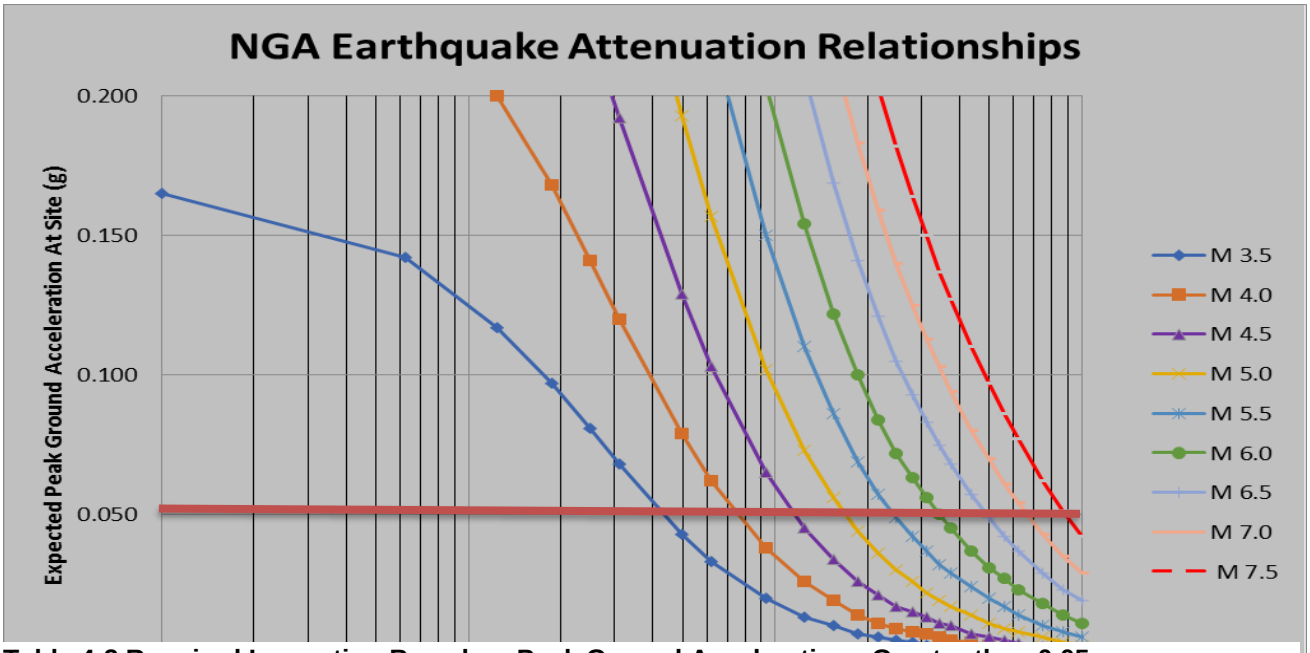


Table 4-2 Required Inspection Based on Peak Ground Accelerations Greater than 0.05g

Table 4-3 Recognition and Action for Seismic Event

Insignificant	Action	They require no special actions or inspections. Continue daily inspections and report any deformation or movement (cracking, slump, seep, etc.).
Minor Earthquakes Magnitude producing less than a 0.05 peak horizontal ground acceleration. Reference Figure 5.1 if the accelerometer is not functioning	Action	They require no special actions or inspections. Continue daily inspections and report any deformation or movement (cracking, slump, seep, etc.).
Major Earthquakes Magnitude producing greater than 0.05 peak horizontal ground acceleration Reference Figure 5.1 if the accelerometer is not functioning	Action	Immediately stop the pumping of reclaim water and all process solutions if problems are discovered during the inspections. If safe to do so, immediately inspect the main embankments (Heap Leach, Freshwater Reservoir and TSF), for obvious deformation or movement (cracking, slump, seep, etc.). If safe to do so, immediately inspect all pipelines and the pump barge for rupture, leakage, or other obvious damage. For a two-week period after an earthquake classified as major, the piezometers should be read daily by an Environmental Technician or Engineer. After data reduction, water levels should be graphically displayed on a summary graph to track any unusual changes piezometer readings. Check the interceptor and monitoring wells for any indication of changes in ground water elevations. **Arrange for an immediate inspection by the Engineer of Record**

4.2.4 Slumping of the Embankment

Any slumping or abnormal deformation of the embankment or areas adjacent too at any time is to be reported to the ore processing manager and the environmental manager. The location, extent, and size of the slump are to be reported, as well as the pond level and any flow or seepage associated with the slump. The Engineer of Record must also be contacted.

4.2.5 Unusual Instrument Readings

Initial instrument readings from piezometers and survey monuments must be compared with design limits to see any variation. Instrument readings when obtained will be compared with previous readings of the same instrument, as well as design limits. If the current readings differ significantly from previous readings taken under similar circumstances and conditions an additional reading to verify the results will be taken as soon as possible.

4.2.6 Avalanche or Debris Slide

No indications exist that natural avalanches or debris slides are of concern within the TSF, HLP or Fresh water reservoir. However, operating personnel will always be alert to indications of slide movement such

as the development of tension cracks or scarp faces on slopes, downhill movement of roads, pipelines, or other constructed elements, and the development of seepage at the base of slopes. In addition to debris slides, be alert of the potential sliding of the overliner on the LLDPE primary geomembrane of the heap leach.

4.3 Mitigation measures

The following actions describe some of the steps that could be taken at the dam to prevent or delay failure after an emergency is first discovered. These actions should be performed with consultation from of the Dam Safety Office, or other qualified engineers. It will be necessary to stop tailings deposition if any of the emergency events listed below were to occur.

4.3.1 Overtopping by Flood Waters

- Reduce the volume of water stored in the impoundment, if possible
- Run critical events pipeline.
- Provide erosion-resistant protection to the downstream slope by placing plastic sheets or other materials over eroding areas
- Divert flood waters around the reservoir basin if possible
- Provide emergency siphons or pumps

4.3.2 Reduction in Freeboard and/or Loss of Dam Crest Width

- Place additional rip rap or sandbags in damaged areas to prevent further embankment erosion
- Lower the water level to an elevation below the damaged area
- Restore freeboard with sandbags or earth and rock fill
- Continue close inspection of the damaged area until the storm is over
- Provide emergency siphons or pumps

4.3.3 Slide on the Upstream or Downstream Slope of the Embankment

- Lower the water level at a rate, and to an elevation, that is considered safe given the slide condition. If the barge pumps are damaged or blocked, pumping, siphoning, or a controlled breach may be required
- Restore lost freeboard if required by placing sandbags or filling in the top of the slide.
- Stabilize slides on the downstream slope by weighting the toe area with additional soil, rock, or gravel
- Provide emergency siphons or pumps

4.3.4 Erosional Seepage or Leakage (Piping)

- Plug the flow with whatever material is available (hay bales, bentonite, or plastic sheeting if the entrance to the leak is in the reservoir)
- Lower the water level until the flow decreases to a non-erosive velocity or until it stops.
- Place a reverse filter directly against the soil from which the leakage is exiting.
- Deposit tailings in a manner that moves the operating pool in the impoundment away from the embankment area where the seepage and/or piping is occurring
- Provide emergency siphons or pumps

4.3.5 Failure of an Appurtenant Structure such as Inlet or Outlet Piping

- Discontinue pumping
- Identify cause of leak (pipe penetration, landslide, etc.)
- Repair damaged pipe and attended areas
- Provide emergency siphons or pumps

4.3.6 Mass Movement of the Dam on its Foundation

- Immediately lower the water level until excessive movement stops
- Continue lowering the water level until a safe level is reached
- Continue operation at a reduced level until repairs are made
- Place fill at the base of the movement
- Provide emergency siphons or pumps

4.3.7 Excessive Seepage and High Level Saturation of the Embankment

- Lower the water to a safe level
- Continue frequent monitoring for signs of slides, cracking, or concentrated seepage
- Continue operations at a reduced level until repairs are made

4.3.8 Excessive Settlement of the Embankment

- Lower the water level by releasing it by pumping, or siphoning
- If necessary, restore freeboard, preferably by placing sandbags
- Lower water to a safe level
- Continue operating at a reduced level until repairs can be made

Section 5.0 - REFERENCES

[1] Fort Knox Project, Design of Tailing Storage Facility and Water Reservoir, Design Report, August 1993.

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[3] Surface and Groundwater Hydrology for the Fort Knox Project, J. C. Halepaska and Associates, December 1992.

[4] Fort Knox Mine Emergency Action Plan Rev 6, Fairbanks Gold Mining, Inc., January 2016.

[5] Fort Knox Mine Monitoring Plan, Fairbanks Gold Mining, Inc., Jan, 2011.

[6] Fairbanks Gold Mining Inc, Fort Knox Mine, Periodic Safety Inspection, Knight Piésold, Ltd., August 2009.

[7] Fairbanks Gold Mining Inc, Fort Knox Mine, Tailings Storage Facility Expansion, Geotechnical and Hydrological Evaluation Report, November 13, 2009, Knights Piésold and Co. Denver, Colorado.

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[9] Fairbanks Gold Mining, Inc. Fort Knox Project Tailing Storage Facility Expansion 2011 Construction Completion Report, January 31, 2012 Knight Piésold and Co. Denver Colorado.

[10] Fort Knox Mine Reclamation Plan, Fairbanks Gold Mining, Inc., November 2013 Rev 2

[11] Knight Piésold and Co., 2016, Fort Knox Project Tailing Storage Facility Expansion Report on Design of Embankment Raise to Crest Elevation 1557 Rev 1

[12] Knight Piésold and Co., 2016, Fort Knox Project Tailing Storage Facility Expansion 2016 Construction Completion Report Rev 1

[13] Knight Piésold and Co., 2016, Fort Knox Project Tailing Storage Facility Expansion 2016 Tailing Deposition Plan

[14] Knight Piésold and Co., 2016, Fort Knox Project Report through Q4 2017 on Geotechnical and Hydraulic Instrumentation Records for the Tailing Storage Facility, Water Supply Reservoir and Walter Creek Heap Leach Facility

[15] Knight Piésold and Co., 2017, Fort Knox Project Tailing Storage Facility Expansion 2017 Construction Completion Report Rev 0

[16] Knight Piésold and Co., 2017, Fort Knox Project Tailing Storage Facility Report on Annual Inspection for 2017 Rev 0

[17] Fort Knox Mine Emergency Action Plan Rev 7 Fairbanks Gold Mining, Inc., January 2017

[18] Knight Piésold and Co., 2018, Fort Knox Project Tailing Storage Facility Report on 2018 Periodic Safety Inspection, Rev A.

Section 6.0 - LIST OF REVISIONS

This revision log is included to provide the manual user with a description of the revisions made to the manual. The manual should be reviewed on at least an annual basis. If updates are necessary, they should be made and a revised manual issued.

REVISION LOG	
REVISION NUMBER AND DATE	**DESCRIPTION OF REVISIONS**
Revision - April 2011	Updated to reflect the 2010 construction
Revision 1 – March 2012	Updated to reflect 2011 Construction: Section 2.3 Embankment Section 2.4 and 3.3 – Tailings discharge line Fig 4.1 Emergency Notification – Updated names and numbers Table 3.2 – Updated monitoring locations Appendix A – Updated freeboard added graphical representation of freeboard
Revision 2 – December 2013	Updates incorporated from the 2012 PSI report Dated May 2013
Revision 5 March 2016	Updated to reflect 2016 Embankment Construction and instrumentation. Updated seepage system to account for 2015 and 2016 studies and new 2017 regional wells downstream of the TSF Added pearl creek causeway information Added TSF Steering Committee and TSF Quarterly Scorecard information. Updated Section 4 to Event Detection Updated operating parameters and 2016 Deposition Plan
Revision 6 – March 2017	Updated to reflect 2017 Embankment Construction and instrumentation. Updated seepage system to account for new 2017 regional wells downstream of the TSF and updated toe drain seepage. Incorporated applicable 2017 Annual inspection recommendations
Revision 7 – November 2018	Incorporated 2018 Periodic Safety Inspection recommendations
Revision 8 August 2019	Deleted superfluous information in all sections Added Phase 1 Causeway

Section 7.0 - Acronyms and Abbreviations

ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
AGI	Amax Gold Inc.
AGP	Acid Generation Potential
ANP	Acid Neutralizing Potential
BWP	Base Working Platform
COE	Corps of Engineers
DCS	Data Collection System
EOR	Engineer of Record
EPA	Environmental Protection Agency
FGMI	Fairbanks Gold Mining, Inc.
FWD	Fresh Water Reservoir Dam (Water Supply Reservoir Dam)
INCO	company name-patented cyanide destruction process
MHTLO	Mental Health Trust Land Office
OHMP	Office of Habitat & Permitting
OPT	Ounces per Ton
P1C	Phase 1 Causeway
QA/QC	Quality Assurance/Quality Control
RTD	Resistance Temperature Device
TSF	Tailings Storage Facility
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Service
WAD CN	Weak Acid Dissociable Cyanide
YPWRD	Yellow Pup Waste Rock Dump

Appendix A

Project Data Sheet

ALASKA DAM SAFETY PROGRAM
PROJECT DATA SHEET

NID No. AK 00212

A. GENERAL

Dam Name	Fort Knox Tailing Storage Facility Dam	
NID Number	AK00212	
Hazard Potential Class	II with Class I design criteria	
Purpose	water and tailing storage	
Year Built	starter embankment: 1995	
Year Modified	staged raises: intermittent through 2017	
Location	Latitude 65°00'N Longitude 147°18'W	lat/long (GPS)
Reservoir Name	Tailing Storage Facility Basin	
River or Creek Name	Fish Creek	
Owner	Fairbanks Gold Mining, Inc. (FGMI)	
Contact Name	Ms. Bartly Kleven	
Address	#1 Fort Knox Road (P.O. Box 73726)	
City, State, Zip	Fairbanks, Alaska 99707-3726	
Phone	907 490 2207	
Email	bartly.kleven@kinross.com	

B. DAM

Type	earth and rock fill embankment	
Primary Seepage Control	low permeability seal zone	
Crest Length	approximately 4,800	feet
Crest Width	at top of seal zone: 165.0	feet
Crest Elevation	1,557.0 feet at top of seal zone and 1,566.0	feet with overbuild and frost protection
Crest Height (from d/s toe)	to top of seal zone: 383.0	feet
Hydraulic Height at Normal Pool	as of June 17, 2018: 361.5	feet to elevation of north pond

C. PRIMARY SPILLWAY

Type	N/A (not applicable) - none present	
Location		
Spillway Invert Elevation		feet
Top Width		feet
Bottom Width		feet
Length		feet
Discharge Capacity at Dam Crest Elevation or Maximum Flood Pool		cubic feet/second (cfs)

D. EMERGENCY SPILLWAY

Type	N/A - none present	
Location		
Spillway Invert Elevation		feet
Top Width		feet
Bottom Width		feet
Length		feet
Discharge Capacity at Dam Crest Elevation or Maximum Flood Pool		cfs

ALASKA DAM SAFETY PROGRAM
PROJECT DATA SHEET

(continued)

E. OUTLET WORKS

Type	N/A - none present	
Location		
Inlet Invert Elevation		feet
Outlet Invert Elevation		feet
Diameter		inches
Length		feet
Outlet Type		
Discharge Capacity at Dam Crest Elevation or Maximum Flood Pool		cfs

F. RESERVOIR

Normal Storage Capacity at Spillway Invert Elevation	N/A - none present	acre-feet	
Surface Area at Spillway Invert Elevation	N/A - none present	acres	
Maximum Storage Capacity at Dam Crest or Maximum Flood Pool	at top of seal zone: 27,324	acre-feet	as of June 15, 2018
Maximum Surface Area at Dam Crest or Maximum Flood Pool	at top of seal zone: 1,042	acres	as of June 15, 2018

G. HYDROLOGY

Drainage Basin Area	5,006 acres - 7.8	sq. miles	including open pit
Average Annual Precipitation	17.3	inches	
100 Year/24 Hour Precipitation	rain: 3.8 inches (June) - runoff: 2.7	inches	(January rain-on-snow)
100 Year Flood	1,119 acre-feet (no discharge)	cfs	
Probable Maximum Precipitation	rain: 11.2 inches (June or July) - runoff: 10.3	inches	(June or July)
Probable Maximum Flood	4,304 acre-feet (no discharge)	cfs	
Flood of Record	unknown	cfs	
Inflow Design Flood	100 yr/24 hr plus WCHLF pond with 3.0 feet freeboard 24 hr PMP plus WCHLF pond with 1.0 foot freeboard	cfs	

H. DATA REFERENCES

(use endnotes)

Appendix B

Analytical Profile Chemistry

Analytical Profile I – Surface Water Inorganic Parameters

Major Ion Chemistry	Minor Ion Chemistry	Trace Ion Chemistry
Lab pH	*Arsenic	*Antimony
Lab Conductivity	Cyanide	*Barium
Temperature (field)	Total	*Bismuth
Turbidity	WAD	*Cadmium
Settleable Solids	Fluoride	*Chromium
Total Suspended Solids	*Iron	*Copper
Total Dissolved Solids	*Manganese	*Lead
*Calcium	Nitrogen, Ammonia	*Mercury
*Magnesium	Nitrate as Nitrogen	*Nickel
*Potassium	Nitrite as Nitrogen	*Selenium
*Silicon	Total Phosphorus	*Silver
*Sodium	TPH	*Zinc
Chloride		
Sulfate		
Alkalinity (as CaCO3)		
Bicarbonate		
Total Hardness		

* Dissolved

Analytical Profile II - Groundwater Inorganic Parameters

Major Ion Chemistry	Minor Ion Chemistry	Trace Ion Chemistry
Lab pH	*Arsenic	*Antimony
Lab Conductivity	Cyanide	*Barium
Temperature (field)	Total	*Bismuth
Turbidity	WAD	*Cadmium
Total Suspended Solids	Fluoride	*Chromium
Total Dissolved Solids	*Iron	*Copper
*Calcium	*Manganese	*Lead

*Magnesium	Nitrogen, Ammonia	*Mercury
*Potassium	Nitrate as Nitrogen	*Nickel
*Silicon	Nitrite as Nitrogen	*Selenium
*Sodium	Total Phosphorus	*Silver
Chloride	Sulfide	*Zinc
Sulfate	TPH	
Alkalinity (as CaCO3)		
Bicarbonate		
Total Hardness		
Calcium Hardness		
Magnesium Hardness		

* Dissolved

Appendix C

Tailings Dam Inspection Form - Daily

Tailings Dam Inspection Form – Daily

Look for seepage, movement, subsidence cracking or erosion

Day	Name	Time	Upstream Slope (OK or * and describe in comment section)	Dam Crest	Downstream Slope	Downstream Toe	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							

22							
23							
24							
25							
26							
27							
28							
29							
30							
31							

Month / Year: _____

Appendix D

Barge Inspection Form – Daily

Day	Name	Time	Tails Discharge Point	Barge Housekeeping	Pool Depth Ft.	Instant Flow (gpm) Tag no FIQ1996 Total of all 4 pumps	Totalizer Flow Tag no. FIQ1996 First and last day of the month	Comments
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								

22								
23								
24								
25								
26								
27								
28								
29								
30								
31								

Appendix E

Daily Pond Operators Log

Tailings Barge / Reclaim Pumps

Date _____ Name _____

Water Samples	
Barge	
Seepage	
Initials	

30-pp-055
Amps 1 _____
2 _____
3 _____
Hours M _____
Hours A _____
Line PSI _____
GPM _____
Totalizer _____
Temp _____

30-pp-056
Amps 1 _____
2 _____
3 _____
Hours M _____
Hours A _____

Water Corner
_____
_____ RF
_____ RR
_____ LR
_____ LF
Readings taken facing barge

30-pp-057
Amps 1 _____
2 _____
3 _____
Hours M _____
Hours A _____

Slimes
RF _____
RR _____
LR _____
LF _____

30-pp-058
Amps 1 _____
2 _____
3 _____
Hours M _____
Hours A _____

De-icing Pump 30-pp-078
Running YES / NO
Hours _____

Tails Discharge
Walter Creek _____
Pearl Creek _____
Powder Mag _____
Parking Lot _____

Seepage Pumps

30-pp-062
Amps 1 _____
2 _____
3 _____
Hours M _____
Hours A _____
Line PSI _____
Sump Level _____

30-pp-063
Amps 1 _____
2 _____
3 _____
Hours M _____
Hours A _____
Temp _____
GPM _____

Ballast Readings

Time _____

L1 _____ R1 _____
L2 _____ R2 _____
L3 _____ R3 _____
L4 _____ R4 _____

Readings taken facing barge

Comments:

Fresh Water Pumps

31-pp-068
GPM _____
Totalizer _____
Line PSI (Mill) _____
Line PSI (Tails) _____
Hours _____

31-pp-139
GPM _____
Totalizer _____
Hours _____
Temp _____

31-pp-066
GPM _____
Totalizer _____
Hours M _____
Hours A _____

31-pp-067
GPM _____
Totalizer _____
Hours M _____
Hours A _____

Comments:

Appendix F

Well Pump Log Sheet – Weekly

Well Pump Log Sheet Date: Name:

WELL ID	WELL DEPTH (FT)	PUMP DEPTH (FT)	TARGET RANGE (FT)	WATER DEPTH (FT)	FLOW RATE (GPM)	VALVE POS. (Open)	TOTALIZER	Comments
PZ-1	420							
PZ-2	450							
PZ-3	445							
PZ-4	550							
PZ-5	450							
PZ-6	150							
PZ-7	200							
IW-1	320	252	140-200					
IW-2	329	252	210-230					
IW-3	310	283	250-260					
IW-4	330	295	240-260					
IW-5	380	320	0					
IW-6	380	273	220-240					
IW-7	160	147	130-140					
IW-8	184	171	130-150					
IW-9	197		0					
IW-10	260		0					
IW-11	296	294	180-200					
IW-13	480	440	400-420					
IW-14	400	337	90-120					
IW-15	380		0					
MW-1	305	240	0					
MW-2	279		0					
MW-3	296	253	0					
MW-4	288	231	0					
MW-5	120							
MW-6	150							
MW-7	135							
401								
501								
801								

Signature

Notes:

Appendix G

TSF Annual Inspection Form

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

NID ID# AK00212
SHEET 1 OF 9

GENERAL INFORMATION

NAME OF DAM: **Fort Knox TSF Dam**	POOL ELEVATION: **1515 fmsl**
NATIONAL INVENTORY OF DAMS ID#: **AK00212**	TAILWATER ELEVATION: **Water level in seepage pumpback sump is between 1,132 and 1,140 fmsl.**
OWNER: **Fairbanks Gold Mining Inc.**	CURRENT WEATHER: **Dry, Clean, Sunny**
HAZARD POTENTIAL CLASSIFICATION: **II**	PREVIOUS WEATHER: **Dry, Clean, Sunny**
SIZE CLASSIFICATION: Mine Tailings Dam	INSPECTED BY: **Thomas Kerr, P.E. (Alaska)**
PURPOSE OF DAM: **Tailings storage**	INSPECTION FIRM: **Knight Piésold and Co.**
O & M MANUAL REVIEWED: **Yes**	DATE OF INSPECTION: **July 22, 2015**
EMERGENCY ACTION PLAN REVIEWED: Y**es**	

ITEM	YES	NO	REMARKS
RESERVOIR			
1. Any upstream development?	✓		Mine, Mill, HLP
2. Any upstream impoundments?	✓		HLP
3. Shoreline slide potential?		✓	
4. Significant sedimentation?		✓	Tailing in impoundment
5. Any trash boom?		✓	
6. Any ice boom?		✓	
7. Operating procedure changes?	✓		Priority deposition is spigot discharges from dam in summer and single point discharges from both sides of the causeway and Fish Creek stockpile to control seepage.
DOWNSTREAM CHANNEL			
1. Channel			
a. Eroding or Backcutting		✓	
b. Sloughing?		✓	
c. Obstructions?		✓	
2. Downstream Floodplain			
a. Occupied housing?		✓	
b. Roads or bridges?	✓		Access to Water Reservoir Dam
c. Businesses, mining, utilities?	✓		Water Reservoir Dam
d. Recreation Area?		✓	
e. Rural land?		✓	
f. New development?		✓	
EMERGENCY ACTION PLAN			
1. Class I or Class II Dam?	✓		Class II
2. Emergency Action Plan Available?	✓		
3. Emergency Action Plan current?	✓		June 2015. New dam break study upcoming to replace most recent in 2010.
4. Recent emergency action plan exercise?	✓		Completed in Q2 2014
INSTRUMENTATION			
1. Are there			
a. Piezometers?	✓		
b. Weirs?		✓	
c. Observation wells?	✓		

d. Settlement Monuments?		✓	New monuments to be installed at 1540 fmsl.
e. Horizontal Alignment Monuments?		✓	New monuments to be installed at 1540 fmsl.
f. Thermistors?	✓		With piezometers
2. Are readings			
a. Available?	✓		
b. Plotted?	✓		
c. Taken periodically?	✓		

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

NID ID# AK00212
SHEET 3 OF 9

SAFETY

ITEM	YES	NO	REMARKS
SAFETY			
1. ACCESS			**TYPE:**
a. Road access?	✓		
b. Trail access?		✓	
c. Boat access?	✓		In surface water pond.
d. Air access?		✓	
e. Access safe?	✓		
f. Security gates and fences?	✓		
g. Restricted access signs?	✓		
2. PERSONNEL SAFETY			
a. Safe access to maintenance and operation areas?	✓		
b. Necessary handrails and ladders available?	✓		Reclaim Pump Barge
c. All ladders and handrails in safe condition?	✓		Reclaim Pump Barge
d. Life rings or poles available?	✓		Reclaim Pump Barge
e. Limited access and warning signs in place?	✓		Reclaim Pump Barge
f. Safe walking surfaces?	✓		Reclaim Pump Barge
3. DAM EMERGENCY WARNING DEVICES			
a. Emergency Action Plan required?	✓		
b. Emergency warning devices required by EAP?	✓		**TYPE(S): Piezometers**
c. Emergency warning devices available?	✓		
d. Emergency warning devices operable?	✓		
e. Emergency warning devices tested?	✓		
f. Emergency warning devices tested by owner?	✓		**WHEN: At times of readings**
g. Emergency procedures available at dam?	✓		
h. Dam operating staff familiar with EAP?	✓		
4. OPERATION AND MAINTENANCE MANUAL			
a. O & M Manual reviewed?	✓		
b. O & M Manual current?	✓		**DATE: June 2015**
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:**
1. CREST			
a. Any settlement?		✓	
b. Any misalignment?		✓	
c. Any cracking?		✓	
d. Adequate freeboard?	✓		
2. UPSTREAM SLOPE			
a. Adequate slope protection?	✓		Coarse rockfill
b. Any erosion or beaching?	✓		Good tailing beach established over most of length, no erosion.
c. Trees or brush growing on slope?		✓	
d. Deteriorating slope protection?		✓	
e. Visual settlement?		✓	
f. Any sinkholes?		✓	
3. DOWNSTREAM SLOPE			**TYPE:**
a. Adequate slope protection?	✓		Coarse rockfill
b. Any erosion?		✓	
c. Trees or brush growing on slope?	✓		Minor, no stability issues but should clear a path along toe of dam.
d. Animal burrows?		✓	
e. Sinkholes?		✓	
f. Visual settlement?		✓	
g. Surface seepage?	✓		3 new, small seeps just downstream of dam, expanded drainage systems being implemented.
h. Toe drains dry?		✓	Drains collecting seepage.
i. Relief wells flowing?	✓		Pumped seepage recovery system
j. Slides or slumps?		✓	
4. ABUTMENT CONTACTS			
a. Any erosion?		✓	
b. Seepage present?	✓		Seepage being collected by drains and wells.
c. Boils or springs downstream?	✓		3 new, small seeps just downstream of dam, expanded drainage systems being implemented.
5. FOUNDATION			**TYPE: Fractured rock**
a. If dam is founded on permafrost		✓	
(1) Is fill frozen?			N/A
(2) Are internal temperatures monitored?			N/A
b. If dam is founded on bedrock	✓		**TYPE: Fairbanks Schist**
(1) Is bedrock adversely bedded?		✓	
(2) Does rock contain gypsum?		✓	
(3) Weak strength beds?		✓	
c. If dam founded on overburden			**TYPE: Dam not on O/B**
(1) Pipeable?			N/A
(2) Compressive?			N/A
(3) Low shear strength?			N/A

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

TIMBER DAMS

ITEM	YES	NO	REMARKS
TIMBER DAMS			**TYPE: Not a timber dam**
1. CREST			N/A
a. Any settlement?			N/A
b. Any misalignment?			N/A
c. Adequate freeboard?			N/A
d. Deck timbers sound?			N/A
2. ABUTMENT AND FOUNDATION CONTACTS			N/A
a. Any erosion?			N/A
b. Seepage present?			N/A
c. Boils or springs downstream?			N/A
d. Exposed bedrock?			N/A
e. Is bedrock deteriorating?			N/A
f. Visible displacements?			N/A
3. STRUCTURAL AND CRIB TIMBERS			**TYPE: Not a timber dam**
a. Any deterioration?			N/A
b. Are ends broomed or checked?			N/A
c. Are timbers preservation treated?			N/A
d. Are timbers pinned or bolted?			N/A
4. CRIBS			
a. Are cribs filled with rock fill?			N/A
b. Is rock fill sound rock?			N/A

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

SPILLWAYS

ITEM	YES	NO	REMARKS
SPILLWAYS			**TYPE(S): No Spillways**
1. CREST			**TYPE(S):**
a. Any settlement?			N/A
b. Any misalignment?			N/A
c. Any cracking?			N/A
d. Any deterioration?			N/A
e: Exposed reinforcement?			N/A
f. Erosion?			N/A
g. Silt deposits upstream?			N/A
2. CONTROL STRUCTURES			
a. Mechanical equipment operable?			N/A
b. Are gates maintained?			N/A
c. Will flashboards trip automatically?			N/A
d. Are stanchions trippable?			N/A
e. Are gates remotely controlled?			N/A
3. CHUTE			
a. Any cracking?			N/A
b. Any deterioration?			N/A
c. Erosion?			N/A
d. Seepage at lines or joints?			N/A
4. ENERGY DISSIPATERS			
a. Any deterioration?			N/A
b. Erosion?			N/A
c. Exposed reinforcement?			N/A
5. METAL APPURTENANCES			
a. Corrosion?			N/A
b. Breakage?			N/A
c. Secure anchorages?			N/A
6. EMERGENCY SPILLWAY			
a. Adequate grass cover?			N/A
b. Clear approach channel?			N/A
c. Erodible downstream channel?			N/A
d. Erodible fuse plug?			N/A
e. Stable side slopes?			N/A
f. Beaver dams present?			N/A

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

LOW LEVEL OUTLET

ITEM	YES	NO	REMARKS
LOW LEVEL OUTLET			**TYPE: No low level outlet**
1. GATES			
a. Mechanical equipment operable?			N/A
b. Are gates remotely operated?			N/A
c. Are gates maintained?			N/A
2. CONCRETE CONDUITS			
a. Any cracking?			N/A
b. Any deterioration?			N/A
c. Erosion?			N/A
d. Exposed reinforcement?			N/A
e. Are joints displayed?			N/A
f. Are joints leaking?			N/A
3. METAL CONDUITS			
a. Is metal corroded?			N/A
b. Is conduit cracked?			N/A
c. Are joints displaced?			N/A
d. Are joints leaking?			N/A
4. ENERGY DISSIPATERS			
a. Any deterioration?			N/A
b. Exposed reinforcement?			N/A
5. METAL APPURTENANCES			
a. Corrosion?			N/A
b. Breakage?			N/A
c. Secure anchorages?			N/A

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

NID ID# AK00212
SHEET 8 OF 9

INTAKES

ITEM	YES	NO	REMARKS
INTAKES			**No Intakes**
1. EQUIPMENT			
a. Trash racks			N/A
b. Trash rake?			N/A
c. Mechanical equipment operable?			N/A
d. Intake gates?			N/A
e. Are racks and gates operable?			N/A
f. Are gate operators operable?			N/A
2. CONCRETE SURFACES			
a. Any cracking?			N/A
b. Any deterioration?			N/A
c. Erosion?			N/A
d. Exposed reinforcement?			N/A
e. Are joints displaced?			N/A
f. Are joints leaking?			N/A
3. CONCRETE CONDUITS			
a. Any cracking?			N/A
b. Any deterioration?			N/A
c. Erosion?			N/A
d. Exposed reinforcement?			N/A
e. Are joints displaced?			N/A
f. Are joints leaking?			N/A
4. METAL CONDUITS			
a. Is metal corroded?			N/A
b. Is conduit damaged?			N/A
c. Are joints displaced?			N/A
d. Are joints leaking?			N/A
5. METAL APPURTENANCES			
a. Corrosion?			N/A
b. Breakage?			N/A
c. Secure anchorages?			N/A
6. PENSTOCKS			**TYPE MATERIAL: No Penstocks**
a. Material deterioration?			N/A
b. Joints leaking?			N/A
c. Supports adequate?			N/A
d. Anchor blocks stable?			N/A

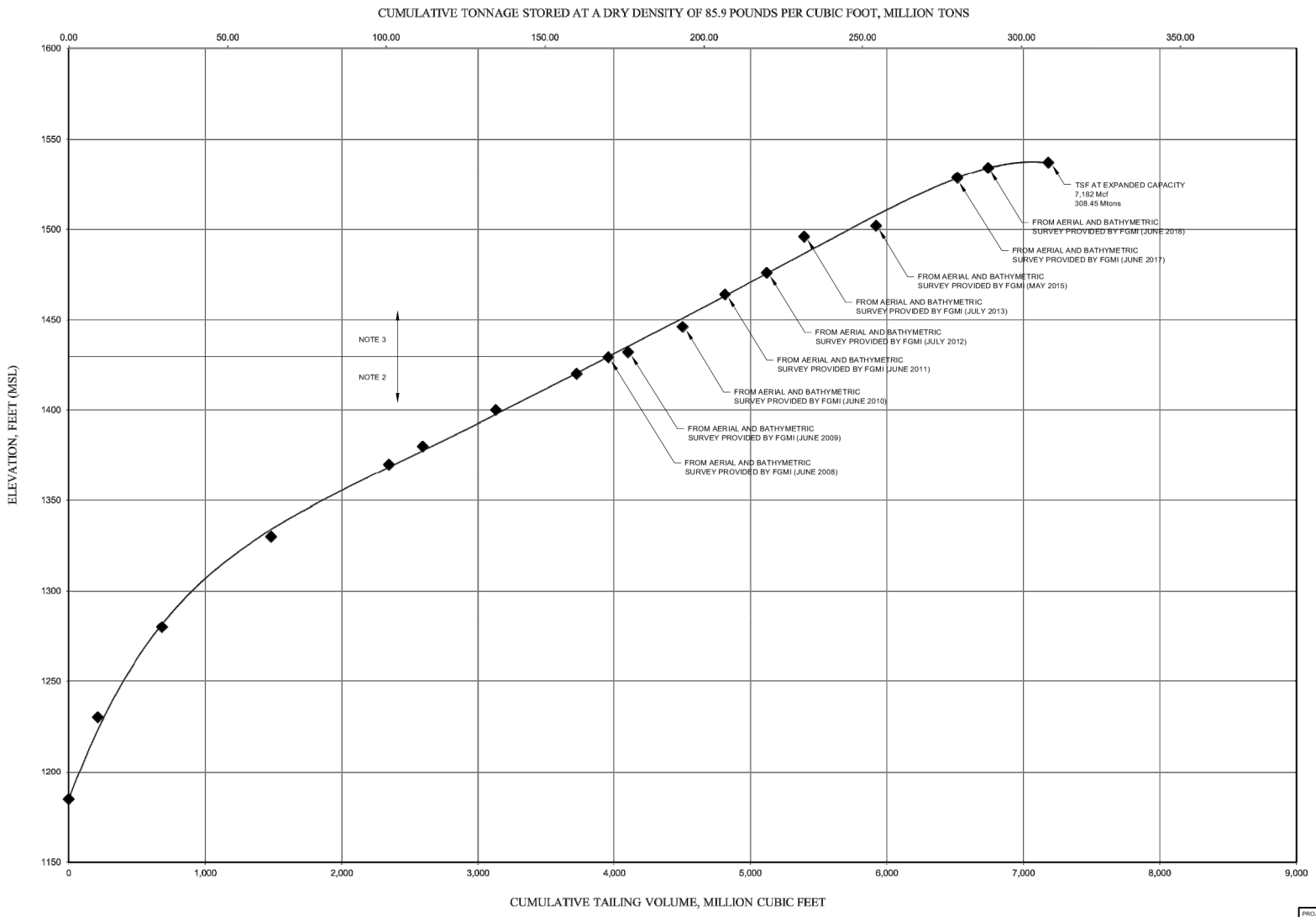
ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

CONCRETE DAMS

ITEM	YES	NO	REMARKS
CONCRETE DAMS			**TYPE OF DAM: Not a concrete dam**
1. CREST			
a. Any settlement?			N/A
b. Any misalignment?			N/A
c. Any cracking?			N/A
d. Any deterioration?			N/A
e. Exposed reinforcement?			N/A
d. Adequate freeboard?			N/A
2. UPSTREAM FACE			
a. Spalling?			N/A
b. Cracking?			N/A
c. Erosion?			N/A
d. Deterioration?			N/A
e. Exposed reinforcement?			N/A
f. Displacement?			N/A
g. Loss of joint fillers?			N/A
h. Damage to membranes?			N/A
i. Silt deposits upstream?			N/A
3. DOWNSTREAM FACE			**TYPE: Not Concrete**
a. Spalling?			N/A
b. Cracking?			N/A
c. Erosion?			N/A
d. Deterioration?			N/A
e. Exposed reinforcement?			N/A
f. Inspection gallery?			N/A
g. Foundation drains?			N/A
h. Foundation drains clear and flowing?			N/A
i. Seepage from joints?			N/A
j. Seepage from lift lines?			N/A
4. ABUTMENT & FOUNDATION CONTACTS			
a. Exposed bedrock?			N/A
b. Erosion?			N/A
c. Visible displacement?			N/A
d. Seepage from contact?			N/A
e. Boils or springs downstream?			N/A

Appendix H

Tailing Facility Stage Storage Curve



NOTES:

1. TYPICAL BEACH CONFIGURATION COMPRISES A 0.50% (DEPOSITION POINT) OR 1.00% (SPIGOTS) SLOPE ABOVE THE SUPERNATANT POND, A 2.50% SLOPE UNDER WATER AT THE POND EDGE AND A 0.10% SLOPE UNDER WATER ALONG THE POND BOTTOM.
2. TAILING VOLUMES BELOW ELEVATION 1430 FMSL BASED ON DEPOSITION TOWARD THE EMBANKMENT.
3. TAILING VOLUMES ABOVE ELEVATION 1430 FMSL INCORPORATE DEPOSITION FROM THE EMBANKMENT RAISE CREST AS WELL AS FROM THE MILL AREA, WALTER, BARNES AND YELLOW PUP CREEKS; YELLOW PUP WASTE ROCK DUMP AND DESIGNATED POINTS ALONG PEARL CREEK CAUSEWAY.

PROJECT	FORT KNOX PROJECT - TAILING STORAGE FACILITY REPORT ON 2018 PERIODIC SAFETY INSPECTION
TITLE	TAILING STORAGE ELEVATION CURVE
CLIENT	FAIRBANKS GOLD MINING, INC.

Knight Piésold CONSULTING

DESIGNED BY	PD	LOCATION	PROJECT NUMBER	FIGURE NUMBER	REVISION
DRAWN BY	CB	DV101	00336.32	5.1	A
ACTIVITY CODE	N/A	XREF NUMBER	N/A		