SUBMITTED TO:
Mr. Roger Burggraf
830 Sheep Creek Road
Fairbanks, Alaska 99709

BY:
Shannon & Wilson
2355 Hill Road
Fairbanks, Alaska 99709

(907) 479-0600
www.shannonwilson.com

CONTAMINATED SITE CLOSURE REPORT

Grant Mine Primary Mine Tailings Impoundment

ESTER DOME, ALASKA

SHANNON & WILSON

January 2023

Shannon & Wilson No: 31-1-20094-010

PAGE INTENTIONALLY LEFT BLANK FOR DOUBLE-SIDED PRINTING

Submitted To: Mr. Roger Burggraf
830 Sheep Creek Road
Fairbanks, Alaska 99709

Subject: CONTAMINATED SITE CLOSURE REPORT, GRANT MINE PRIMARY MINE TAILINGS IMPOUNDMENT, ESTER DOME, ALASKA

Shannon & Wilson prepared this report and participated in this project as a consultant to Mr. Roger Burggraf. Our scope of services was specified in our proposal dated June 2, 2022. This report presents the results of the primary tailings impoundment capping and abandonment and was prepared by the undersigned.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON

Andrew Frick
Environmental Scientist

MSL:ALF:CBD/msl

CONTENTS

Exhibits

CONTENTS

Figures

Appendices

ACRONYMS

ACRONYMS

18 AAC 75	18 Alaska Administrative Code 75
18 AAC 60	18 Alaska Administrative Code 60
AWR	AWR Engineering, LLC
BLM	Bureau of Land Management
C&A Plan	Capping and Abandonment Plan
CSM	conceptual site model
Dam Safety	DNR Dam Safety and Construction Unit
DEC	Alaska Department of Environmental Conservation
DNR	Alaska Department of Natural Resources
EPA	Environmental Protection Agency
MCL	maximum contaminant level
mg/L	milligrams per liter
Silverado	Silverado Gold Mines, Inc.
Stutzmann	Stutzmann Engineering Associates, Inc.
TCM	TriCon Mining, Inc.
ug/L	micrograms per liter
WAD	weak-acid-dissociable

1 INTRODUCTION

This report documents the capping/abandonment of the primary mine-tailings impoundment at the Grant Mine located on Ester Dome, northwest of Fairbanks, Alaska (Figure 1). The claim holder, Mr. Roger Burggraf, secured our services for the purpose of pursuing closure of the tailings impoundment through the Alaska Department of Environmental Conservation (ADEC) contaminated sites program and the Alaska Department of Natural Resources (DNR) Dam Safety and Construction Unit (Dam Safety) without the assistance of the former operators. The contaminated sites database file number for the Grant Mine site is 100.38.182, Hazard ID 731; the Nation Inventory of Dams (NID) number is AK00409. The contaminated site comprises the primary tailings impoundment, the former secondary tailings area, and a cyanide release to groundwater.

ADEC approved the *Final R2 Capping and Abandonment Plan, Grant Mine Primary Mine Tailings Impoundment, Ester Dome, Alaska* (C&A Plan) in a letter dated June 11, 2021. Dam Safety issued a *Certificate of Approval to Abandon a Dam, Grant Mine Tailings Dam (NID# AK00409)* on June 28, 2021.

2 SITE DESCRIPTION

The Grant Mine is located along St. Patrick Road approximately 1.2 miles from the intersection with Ester Dome Road, near Fairbanks, Alaska; latitude 64.8802 north, longitude 147.9602 west. The former mine facility and tailings impoundment are located on the eastern flank of Ester Dome, approximately 780 feet above mean sea level. The area around the mine slopes gently to the east and is vegetated with spruce, hardwoods, and shrubs.

The property is underlain by as much as 60 feet of loess (aeolian silt) that mantles schist bedrock. The schist is cut by gold-bearing quartz veins. The mineral assemblage in the vein consisted of free-milling gold, arsenic and antimony oxides, arsenopyrite, and galena (Bundtzen and Kline; 1981). According to Youcha (2003), the groundwater on Ester Dome is present in unconfined bedrock aquifers, localized by regional faults, fractures, and joints. The Environmental Protection Agency (EPA) found elevated concentrations of arsenic, barium, copper, manganese, selenium, and zinc in background groundwater samples; background arsenic concentrations exceeded 1,000 micrograms per liter (µg/L). According to Verplanck et al., (2007) oxidation of arsenopyrite in sheared gold-bearing quartz veins is the primary source of elevated arsenic concentrations in groundwater at Ester Dome.

The primary tailings impoundment occupies approximately 4 acres (Figure 2). The secondary (initial) tailings impoundment was located about 400 feet to the east and was about one acre.

The land use around the mine is a mix of undeveloped land and low-density residential housing. Residents in the area are not connected to a municipal water system but instead obtain water from deliveries to holding tanks and/or from wells. It is unknown how many wells are used for drinking water; naturally high arsenic and mineral levels render the groundwater non-potable.

3 SITE HISTORY

Roger Burggraf has held the mining claims surrounding the Grant Mine since 1972. The land was previously owned by the Bureau of Land Management and is now owned by the DNR. Silverado Gold Mines (Silverado)/Tri-con Mining Alaska (TCM) leased the claims from Mr. Burggraf from 1978 to 2019. Between 1980 and 1983, Silverado operated a pilot mill for metallurgical testing; the tailings from the pilot mill were placed in the secondary tailings area.

Silverado/TCM submitted an *Application to Construct or Modify a Dam* to Dam Safety on January 11, 1985. Dam Safety issued an *Approval to Construct the Grant Mine Tailings Impoundment* on July 11, 1985. The tailings impoundment, lined with compacted silt and bordered by a 45-foot-high earthen berm, was designed by Shannon & Wilson, Inc. and built by TCM in 1985. The dam was constructed in a single raise. The primary tailings impoundment had a capacity of approximately 130,000 cubic yards. TCM prepared a Solid Waste Disposal Permit Application in 1985; there is no record that the permit was obtained.

TCM/Silverado operated the mill at the Grant Mine from 1985 to 1989 using a cyanide process for gold extraction. The cyanide process involved mixing crushed ore with sodium cyanide and lime solution thereby extracting the gold. This generated a slurry containing waste rock, lime, sodium cyanide, and water. The slurry was piped into primary tailings impoundment; the discharge point of the piping was manually moved to distribute the tailings throughout the impoundment.

The mine came to the attention of ADEC in 1988 when TCM applied for a rezone, and water samples from two water supply wells adjacent to the impoundment contained cyanide concentrations above the federally established maximum contaminant level (MCL) of 0.2 milligrams per liter (mg/L). According to TCM employees, the cyanide-rich tailings slurry was accidentally discharged upslope of the impoundment, allowing the tailings to reach groundwater through the former water supply well. TCM removed the well casing and sealed the boring by pressure grouting in 1989.

Monitoring wells, M-1 and M-2, shown in Figure 2 were installed in 1989 and 1990, respectively, to monitor cyanide in groundwater downgradient of the impoundment. The wells were routinely sampled for total cyanide and/or weak-acid-dissociable (WAD) cyanide concentrations. Mr. Burggraf sampled monitoring wells, M-1 and M-2 until the cyanide concentration did not exceed the ADEC cleanup for three consecutive sampling events.

3.1 1994 EPA Site Investigation

In July of 1994, EPA sampled tailings from the primary and secondary tailings impoundments, groundwater from on-site monitoring wells, and groundwater from off-site domestic wells. Two soil and two groundwater samples were collected from upgradient, off-site sources to represent background analyte concentrations.

Arsenic, cyanide, lead, manganese, mercury, and silver were detected above DEC cleanup levels in groundwater from on-site monitoring wells. Contaminants were detected above background in upgradient domestic wells, suggesting elevated metals concentrations were naturally occurring.

The EPA site investigation characterized the tailings as a mixture of waste rock, lime, and process wastewater which contained cyanide and identified metals above background concentrations in both the primary and secondary tailings impoundments. The tailings in the primary tailings impoundment contained arsenic, antimony, and mercury exceeding the DEC migration-to-groundwater cleanup levels. Total cyanide was detected at a maximum concentration of 8.6 mg/kg, but free cyanide wasn't analyzed during the investigation. The tailings in the secondary tailings area contained arsenic exceeding the DEC cleanup level.

3.2 1996 TCM Site Investigation

TCM collected samples from the primary tailings impoundment in 1996. Their sampling revealed similar concentrations of metals as found by the 1995 EPA investigation. They analyzed the tailings for total, WAD, and free cyanide. Results indicate concentrations of free cyanide in the tailings exceeded current DEC migration-to-groundwater soil cleanup levels but did not exceed human health cleanup criteria. The sampling also indicated the tailings had a pH ranging from 8.7 to 9.9, likely due to the addition of lime during the ore processing.

3.3 1998 TCM Closure Plan

In 1998, Silverado/TCM prepared a *Mine Tailings Impoundment Closure Plan.* The plan proposed constructing a compacted silt cap over the mine tailings to isolate the tailings from potential receptors and limit infiltration. This plan was not carried out.

4 SITE CLOSURE

4.1 Groundwater

DEC established a 1.5 ug/L groundwater cleanup level for free cyanide with their November 6, 2016 revision of the 18 AAC 75. Additional sampling was required since the previous samples were only analyzed for total and/or WAD cyanide. Free cyanide was not detected in the groundwater samples collected from either M-1 or M-2 in October 2019, June 2021, and September 2021. The limits of detection were below the ADEC cyanide cleanup level in these three sampling events; the results of these samples were presented in Shannon & Wilson's report *Groundwater-Quality Assessment Summary, Grant Mine, Ester Dome, Alaska* dated October 26, 2021. In a letter dated November 29, 2021, DEC accepted this report and concluded that additional sampling of the monitoring wells would not be required.

On September 15, 2022, Mr. Burggraf submitted Shannon & Wilson's *Monitoring Well Decommissioning Work Plan, Grant Mine Site, Ester Dome, Alaska*; DEC approved the plan in a letter dated September 16, 2022. The wells are scheduled to be decommissioned in the spring of 2023.

4.2 Secondary Tailings Area

In October 2019, Mr. Burggraf moved the tailings from secondary tailings area into the primary tailings area prior to capping. Details of the secondary tailing area cleanup and the results of soil sampling at the limits of the excavation are presented in Shannon & Wilson, Inc.'s letter report entitled *Post-Excavation Sampling, Secondary Tailings Impoundment Revision 2, Grant Mine, Ester Dome, Alaska, ADEC File #100.38.182, Hazard ID 731* dated April 13, 2020. In a letter dated April 20, 2020 DEC accepted the closure of the secondary tailings impoundment based on the post-excavation sampling.

4.3 Primary Tailings Impoundment

Mr. Burggraf began the closure construction on July 28, 2021 using his own equipment and staff. Stutzmann Engineering Associates, Inc. (Stutzman) laid out survey control; Mr. Burggraf's crew removed the fence, stripped the berm of vegetation, and contoured the tailings surface to mimic the final cap surface. Once the vegetation was stripped, the operator began dismantling the earthen berm and spreading the silt from the berm over the tailings. Generally, the operator spread the soil in the east to west direction to optimize the compaction with the loaded, rubber-tired loader; compaction testing results are discussion in Section 4.3.1. The capping advanced from the south to the north.

The drainage diversion channel was constructed in accordance with the specifications of the C&A Plan, with only the exception noted in Section 4.3.2. Photos of the closure construction are presented in Appendix A. Stutzmann surveyed the site on September 16, 2022 after the capping and diversion channel was completed and prepared the *Record Drawing As Built* presented in Appendix B. Based on Stutzmann's survey, the thickness of the cap is at least 24 inches.

4.3.1 Compaction

18 AAC 60.455 requires a capped monofill to include an infiltration layer of at least 18 inches of earthen material with a permeability no greater than 1×10^{-5} centimeters per second (cm/sec). In situ permeability testing of undisturbed samples during construction of the tailings impoundment was found to range from 2×10^{-5} to 5.8×10^{-5} cm/sec. Compacted samples of the same material had a permeability of 8.7×10^{-6} cm/sec at a compaction of about 94.5 percent of Standard Proctor. The C&A Plan called for compacting the natural material to 92 percent based on Standard Proctor test, using a wet density of 98.1 pounds per cubic foot (pcf); dry density of 82.6 pcf; and water content of about 19 percent to yield a permeability of less than 1×10^{-5} cm/sec.

On July 22, 2021, Stephen Chase, a laboratory technician with Shannon & Wilson, Inc. used a nuclear densometer to assess the compaction of an eight-inch lift in accordance with the specifications. The results of the compaction testing indicated the density was 106 percent of Standard Proctor, exceeding the 92 percent recommendation. Therefore, the capping density meets or exceeds the infiltration permeability requirement of less than 1×10^{-5} cm/sec. The test result is presented in Appendix C.

The results of the testing indicated the specified compaction was met by rolling of the capping material with a minimum of two passes of the loaded, rubber-tired loader. As the cap was installed, the entire area was subjected to at least two passes of the loader.

4.3.2 Placement of Riprap in Drainage Diversion Channel

In accordance with the C&A Plan specifications, Mr. Burggraf placed 460 cubic yards of Class I riprap in two sections of the drainage diversion channel as specified by AWR Engineering, LLC. The local source of rip rap varied slightly from the specifications; the material was more tabular than blocky. In an e-mailed dated September 22, 2021, Ms. Janie Dusel, PE, with AWR concurred the material was acceptable for use in the diversion ditch.

On August 10, 2021, Shannon & Wilson, Inc. subjected a subsample of the riprap to L.A. abrasion test (ASTM C131/C535 AASHTO T96). The results indicate the material met the soundness requirements set forth in design; the test results are presented in Appendix D.

4.3.3 Seeding

Once the earthwork was complete, Shannon & Wilson staff spread a seed mixture a rate of 1.5 pounds per 1,000 square feet. The seed mixture contained 50-percent Nortran Tufted Hairgrass, 35-percent Arctared Fescue, 10-percent Wainwright Wheatgrass, and 5-percent Annual Rye. The seed was placed in the unlined ditches and the exposed top of the berm in accordance with the specifications. Natural vegetation has begun to populate the disturbed area.

5 CONTAMINANTS OF POTENTIAL CONCERN DISCUSSION

Contaminants of potential concern (COPCs) at the site include metals and cyanide. For the purpose of this proposed site closure and associated institutional controls implemented, we understand that the DEC human health cleanup levels are appropriate for evaluating potential exposure risks from COPCs remaining at the site.

5.1 Metals

Based on our review of historical soil sampling data, only antimony and arsenic were detected at concentrations greater than DEC human health cleanup levels in soil sampled at the site.

5.1.1 Chromium Speciation

Chromium was detected in samples collected by DEC, EPA, and TCM in the 1990s. As a point of clarification, the chromium present in the tailings is assumed to be chromium III; there's no documented source of hexavalent chromium at the site.

5.2 Cyanide

Total cyanide is the sum of free cyanide, weak metal cyanide complexes, and strong metal cyanide complexes. Free cyanide is highly toxic and the most bioavailable of the expected cyanide species, with toxicity moderated through complexation with other compounds (Redman and Santore, 2012). DEC has only established soil or groundwater cleanup levels for free cyanide.

5.2.1 Groundwater

Groundwater samples collected previous to 2009 were analyzed for total cyanide. Groundwater samples collected from 2009 to June 2018 were analyzed for total cyanide and WAD cyanide. Groundwater samples collected after June 2018 were analyzed for free cyanide. Free cyanide was not detected in the last three groundwater sampling events.

5.2.2 Soil

Cyanide analysis was performed on samples collected at the primary tailings impoundment in 1989, 1994, and 1996 by AMAX, EPA, and TCM, respectively. Analysis of free cyanide was only requested for the 1996 samples.

Free cyanide was not detected at concentrations above the DEC human health soil cleanup level in the 1996 soil samples, and the reported free cyanide concentrations were less than 5 percent of total cyanide concentrations. This indicates a low bioavailability potential for cyanide present at the site.

6 CUMULATIVE RISK ASSESSMENT

We performed a cumulative risk assessment using analytical sample results from the primary tailings impoundment, the secondary tailings impoundment, and groundwater at the site. In accordance with the February 2018 DEC *Procedures for Calculating Cumulative Risk* guidance document, we identified COPCs detected at concentrations greater than one-tenth of their human health cleanup level for each dataset; the maximum concentration of each analyte was used for this evaluation.

Data used for our cumulative risk assessment are presented in Exhibit 6-1 below. The analytical results tables from which we sourced this data are included in Appendix E.

Exhibit 6-1: Cumulative Risk Data Summary

Dataset	Cumulative Risk Calculated	Analyte[1]	Result[2]	Sample Date	Sample Name
Primary Tailings Impoundment	Yes	Antimony	1,950 mg/kg	7/19/1994	SS001
		Arsenic	6,310 mg/kg	4/1/1996	SSCP751040196
		Lead	399 mg/kg	4/1/1996	SSCP769040196
		Manganese	393 mg/kg	7/19/1994	SS001
		Mercury	2.11 mg/kg	4/1/1996	SSCP760040196
Secondary Tailings Impoundment[3]	No	Arsenic	110 mg/kg	10/22/2019	GM19-3
Groundwater[4]	Yes	Arsenic	196 µg/L	9/14/2018	M-2
		Mercury	0.249 µg/L	9/14/2018	M-1

NOTES:

1 Only analytes detected at greater than one-tenth of the DEC human health cleanup level are presented.

2 The maximum concentration from each dataset are presented.

3 Post-excavation confirmation sample results were used to evaluate cumulative risk for the Secondary Tailings Impoundment.

4 The most recent analytical groundwater sample results for each analyte were evaluated.

6.1 Exceptions from the Cumulative Risk Assessment

In our April 2020 *Post-Excavation Sampling, Secondary Tailings Impoundment* report, we concluded that concentrations of arsenic detected in the Secondary Tailings Impoundment confirmation samples were comparable to background concentrations expected on Ester Dome. Additionally, the detection of 196 µg/L of arsenic at monitoring well M-2 was less than 20 percent of the 1,040 µg/L and 1,180 µg/L background concentrations reported for arsenic in the 1994 site investigation conducted by EPA.

We consider the arsenic detected in Secondary Tailings Impoundment and groundwater at the site to be attributable to naturally occurring background concentrations. In accordance with the 2018 DEC cumulative risk guidance document, arsenic was not included in our cumulative risk assessment for these datasets. Therefore, a cumulative risk calculation was not necessary for the Secondary Tailings Impoundment dataset because no other analytes were detected at concentrations greater than one-tenth of their DEC human health cleanup level. The cumulative risk calculation for groundwater included only mercury as a COPC.

6.2 Cumulative Risk Assessment Results

The cumulative risk assessment for the primary tailings impoundment indicated concentrations of COPCs exceed the cumulative carcinogenic risk standard of 1 in 100,000 and the cumulative non-carcinogenic hazard index of 1 for a residential land use scenario. The land use restrictions and institutional controls discussed below will eliminate potential exposure pathways and mitigate associated exposure risk.

The cumulative risk assessment for groundwater indicated concentrations of COPCs were below the cumulative carcinogenic risk standard of 1 in 100,000 and the cumulative non-carcinogenic hazard index of 1.

The cumulative risk values are presented in Appendix E.

7 FUTURE LAND USE RESTRICTIONS

Shannon & Wilson presented an updated conceptual site model (CSM) in our *Revised Site Characterization Report, Grant Mine Tailings Impoundment, 1.2 Mile St. Patrick Road, Fairbanks, Alaska* dated August 2019. The exposure medium of concern at the site described in the CSM was the uncapped mine tailings. With the capping of the tailings and implementation of the future land restrictions discussed below, the potential exposure pathways will be removed along with the risk of exposure to receptors.

Because the capped tailings within the impoundment exceed DEC's human health risk cleanup levels for antimony and arsenic and will not be removed from the site, DEC will require institutional controls (ICs) in the form of a deed notification/environmental covenants to ensure future land use will not adversely affect or disturb the cap. We understand DNR, as the landowner, agrees to comply with the ICs and modify the deed as required by 18 AAC 60 and 18 AAC 75. We understand Mr. Burggraf is seeking a Restricted Use Authorization (RUA) through DNR to be used in conjunction with environmental covenants. The boundaries of the area surrounding the capped tailings are currently being surveyed and will be available for inclusion in the RUA/covenants documents. The proposed area of the RUA is shown in Figure 3.

18 AAC 60.490 (a) outlines the deed notifications required once the closure is complete. The owner/operator will record the modified deed which includes the following:

- the land has been used as a monofill;
- the type of waste that was placed in the monofill;
- the geographical boundaries of the waste management areas; and

- details of any final cover, cap, or other structures or devices installed as part of the dam abandonment/capping.

According to Section 46.04.300 of the Alaska Statues:
(a) An environmental covenant is required if the department makes a remedial decision as part of an environmental response project and that environmental response project results in

(1) residual contamination remaining in the environment in concentrations that are safe for some, but not all, uses; or

(2) an engineered feature or structure that requires monitoring, maintenance, or operation, or that will not function as intended if disturbed.

(b) An environmental covenant may be held by one or more holders. A holder may own an interest in the real property subject to an environmental covenant. The interest of a holder is an interest in real property.

We understand Mr. Burggraf will work with DEC and DNR to develop the appropriate deed notice/environmental covenant for the portion of the property surrounding the impoundment.

8 POST-CAPPING MONITORING AND REPORTING

18 AAC 60.490 (c) outlines the post-closure monitoring requirements for monofills. The owner/operator will conduct visual monitoring, for settlement and erosion, for 60 consecutive months following the completion of the cap. The inspections will also include photographing vegetative growth on berms and unlined ditches to document revegetation. The post-closure inspection form is presented in Appendix F. Mr. Burggraf proposes the monitoring period be between April and October due to the prevalence of freezing conditions during the winter months.

At the end of the post-capping monitoring period, the owner or operator will submit a report to the DEC Contaminated Sites Program that describes site conditions and summarizes the information collected. We understand DNR will then monitor the site yearly for five years, and every five years after.

9 REFERENCES

Alaska Administrative Code 18 AAC 60 *Solid Waste Management,* April 2022.

Alaska Administrative Code 18 AAC 75 *Oil and Other Hazardous Substances Pollution Control*, January 2022.

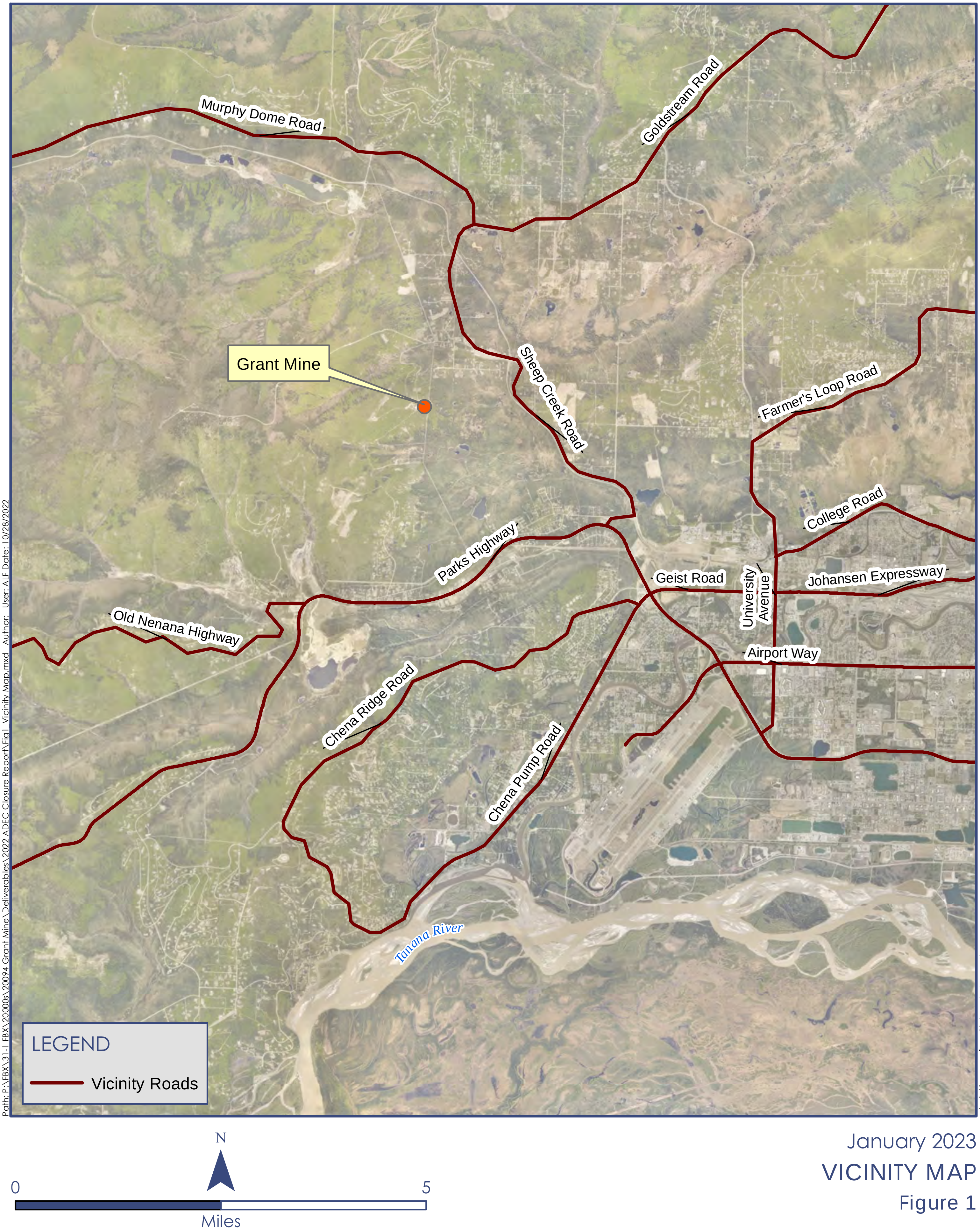
Bundtzen, T.K. and Kline, J.T.; *Geologic mine map, Grant gold mine, Fairbanks mining district: Alaska Division of Geological and Geophysical Surveys Open-File Report 141*, 1981.

Redman, A. and Santore, R.; *Bioavailability of Cyanide and Metal-Cyanide Mixtures to Aquatic Life*; 2012.

Tri-Con Mining, Inc., *Sediment Sampling and Analysis, Ester Dome Project, Former Grant Mine Tailings Pond*, 1996.

Verplanck, P.L., et al., IMWA Symposium, 2007, *Elevated arsenic in groundwater, Ester Dome, Alaska*.

Youcha, E.K., University of Alaska, MSc Thesis, 2003, *A Geohydrologic analysis of an upland-bedrock aquifer system: Application to interior Alaska, Fairbanks, Alaska*.



Path: P:\FBX\31-1 FBX\20000s\20094 Grant Mine\Deliverables\2022 ADEC Closure Report\Fig1 Vicinity Map.mxd Author: User: ALF Date: 10/28/2022

Aerial imagery from Pictometry International 2020, courtesy of Fairbanks North Star Borough GIS Services.

January 2023

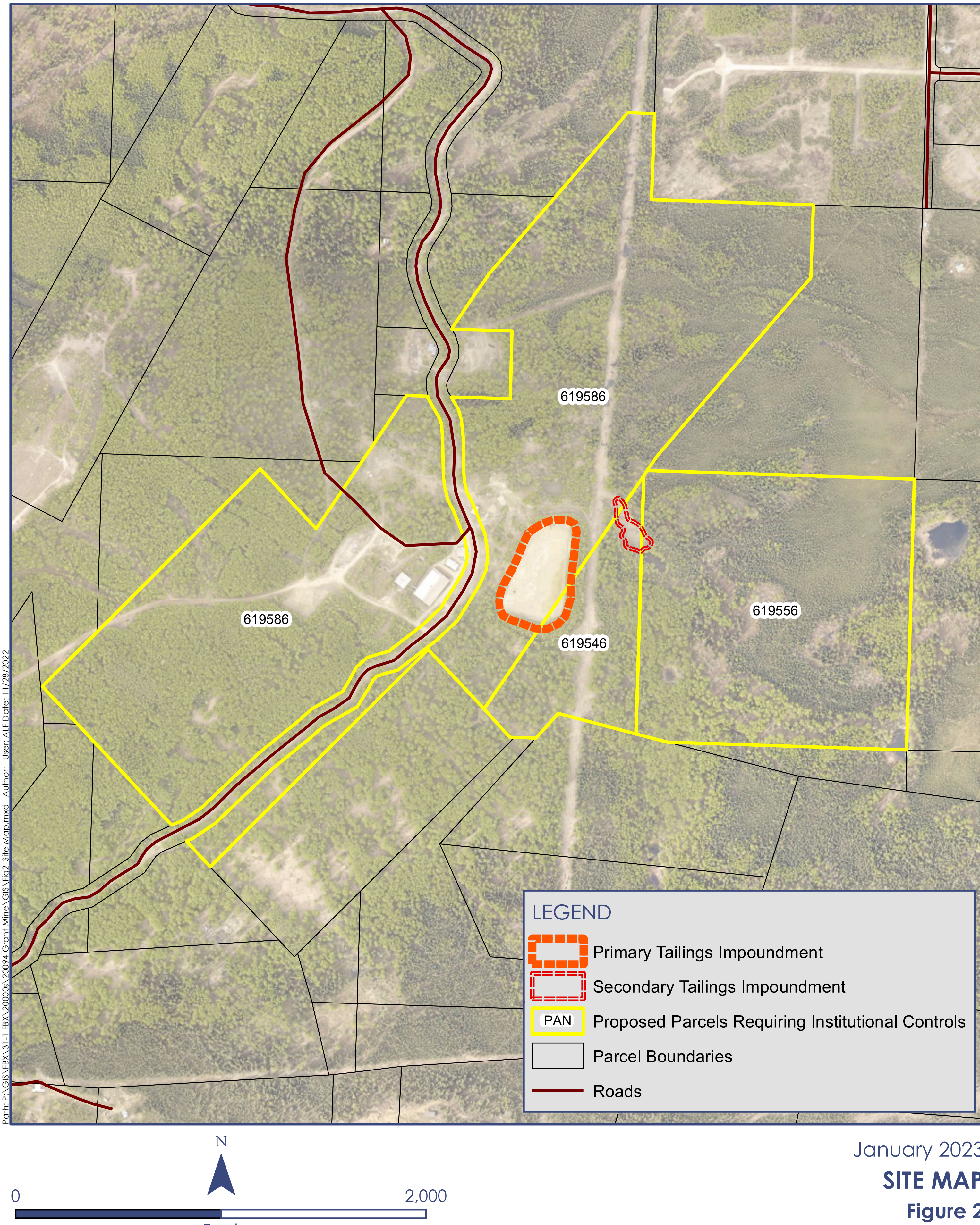
VICINITY MAP

Figure 1

SHANNON & WILSON

31120094

Grant Mine
Primary Tailings Impoundment Closure
Ester Dome, Alaska



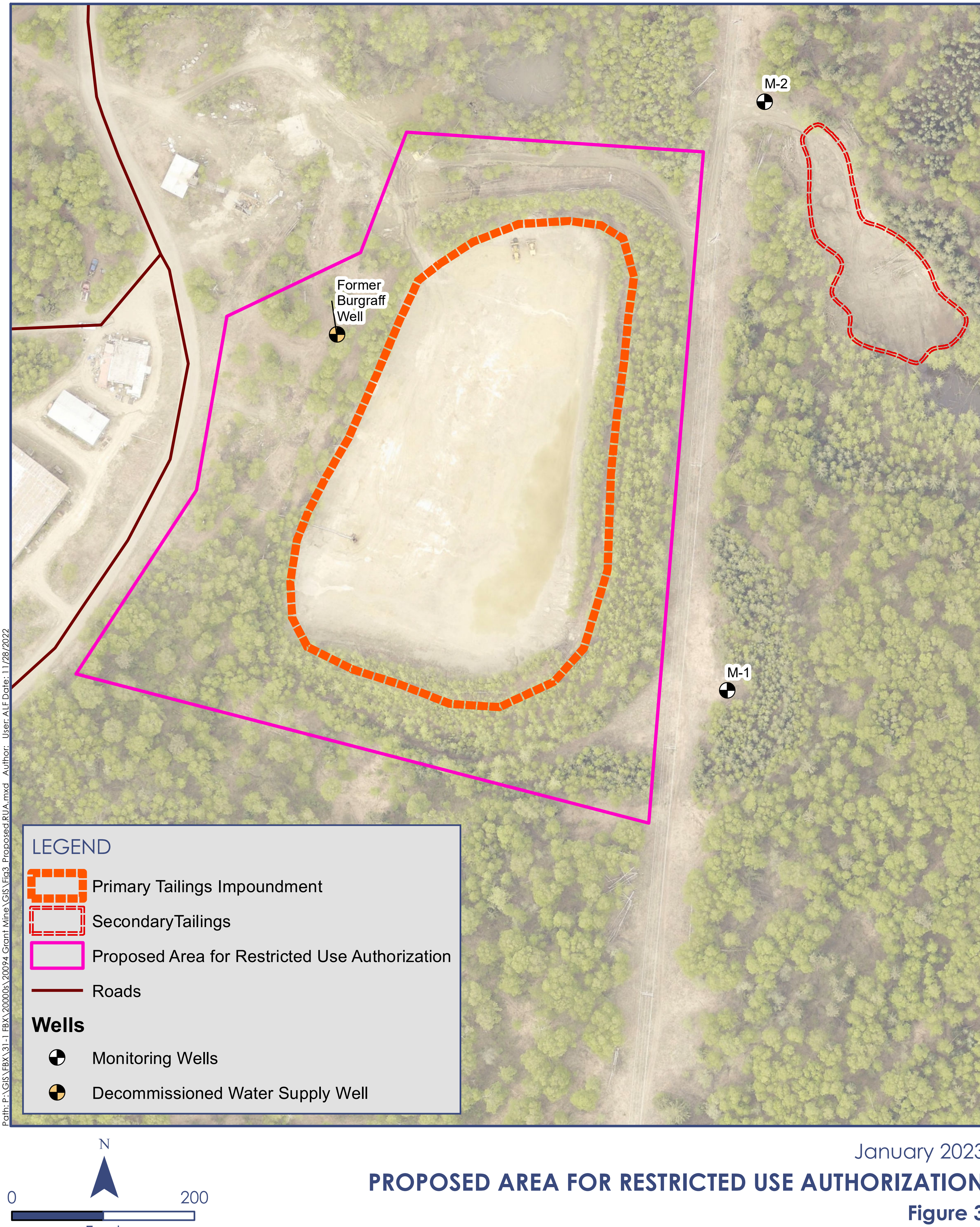
Path: P:\GIS\FBX\31-1 FBX\20000s\20094 Grant Mine\GIS\Fig2_Site Map.mxd Author: User: ALF Date: 11/28/2022

Aerial imagery from Pictometry International 2020, courtesy of Fairbanks North Star Borough GIS Services.

January 2023

SITE MAP

Figure 2



Path: P:\GIS\FBX\31-1 FBX\20000s\20094 Grant Mine\GIS\Fig3_Proposed_RUA.mxd Author: User: ALF Date: 11/28/2022

Aerial imagery from Pictometry International 2020, courtesy of Fairbanks North Star Borough GIS Services.

January 2023

PROPOSED AREA FOR RESTRICTED USE AUTHORIZATION

Figure 3

APPENDIX A: PHOTO LOG

Appendix A

Photo Log


Photo 1: 20210728 Initial Lifts looking south


Photo 2: 20210804 Dismantling southern berm


Photo 3: 20210921 Dismantling northern berm


Photo 4: 20210927 final surface looking east


Photo 5: 20210928 End of 2021 activities looking south


Photo 6: 20220511 Northern portion looking east

Photo 7: 20220511 Southen portion looking east

Photo 8: 20220630 Beginning of Diversion Ditch looking North

Photo 9: 20220723 Placing Riprap looking west

Photo 10: 20220811 Final Surface looking south

Photo 11: 20220811 northern portion looking east

Photo 12: 20220811 southern portion looking east


Photo 13: 20220824 looking NE complete


Photo 14: 20220831 Drone looking SW


Photo 15: 20220916 lower portion of channel


Photo 16: 20220916 Natural Revegetation


Photo 17: 20220916 upper portion of channel

APPENDIX B: STUTZMANN AS-BUILTS

Appendix B

Stutzmann As-Builts

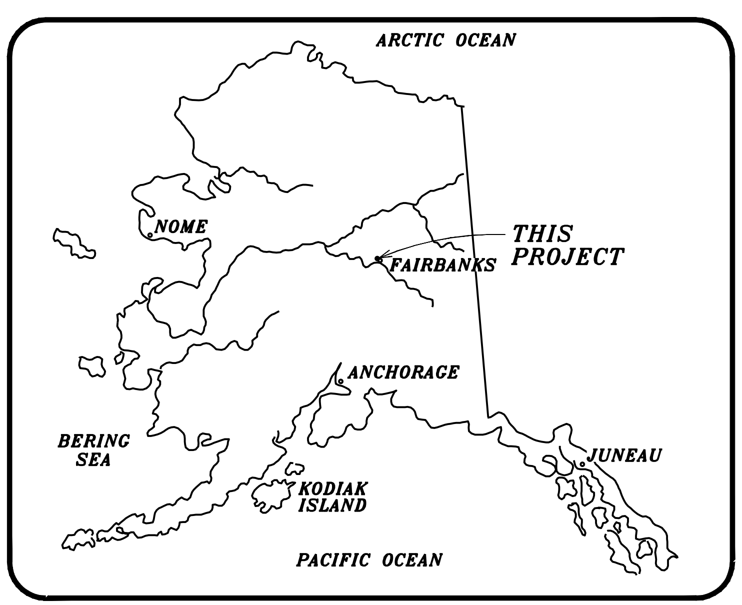
Grant Mine

FAIRBANKS NORTH STAR BOROUGH, ALASKA

TAILINGS IMPOUNDMENT CLOSURE

RECORD DRAWING
AS BUILT
September 16, 2022

TABLE OF CONTENTS



LOCATION MAP

STATE OF ALASKA
49TH
Mark Andrew Smiley
CE 10349
9/16/2022
REGISTERED PROFESSIONAL ENGINEER
C627

PROJECT 19-087

PREPARED FOR:
ROGER BURGGRAF

PREPARED BY:

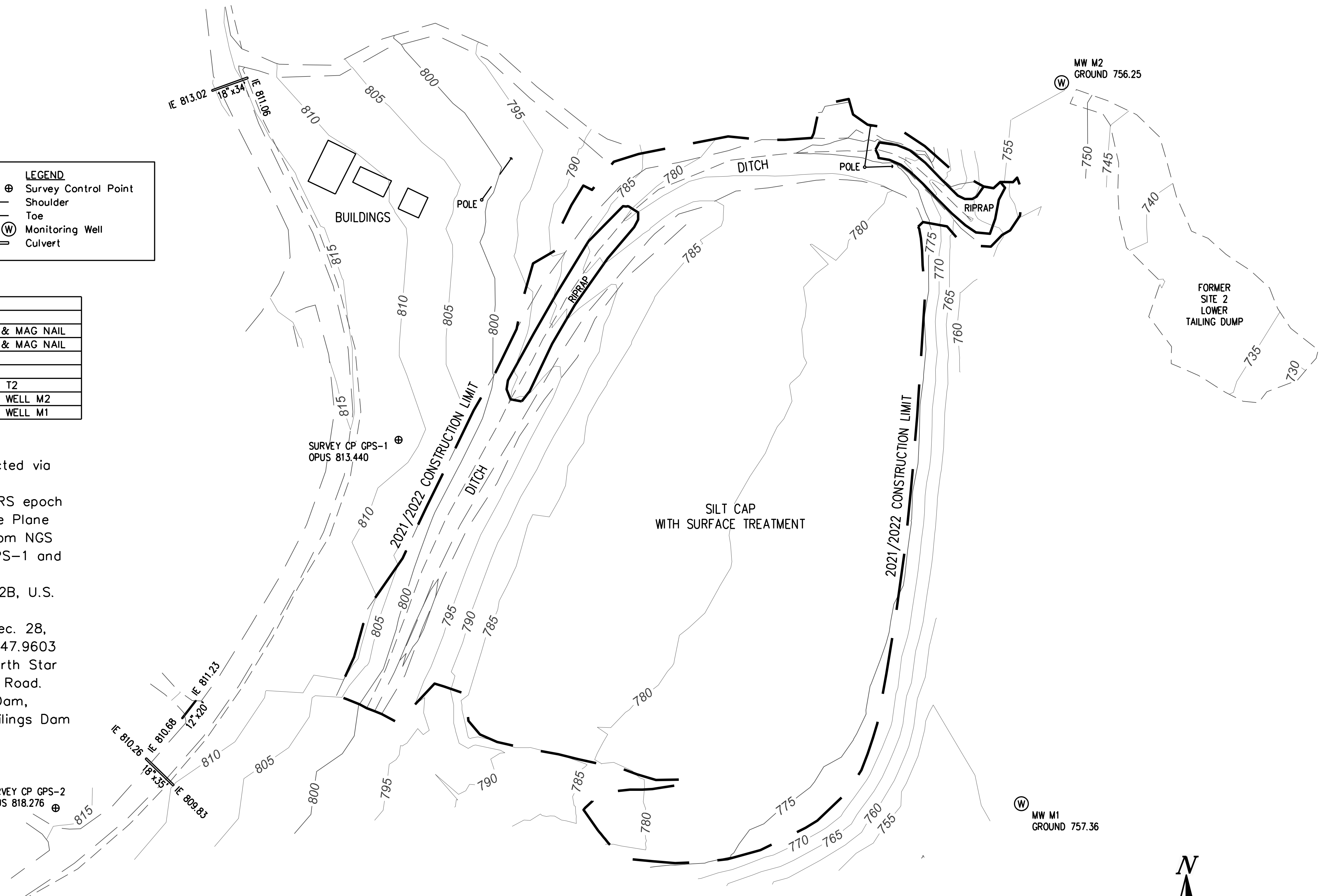
ENGINEERS SURVEYORS PLANNERS
STUTZMANN ENGINEERING ASSOCIATES, INC.
C 627
P.O. BOX 71429
FAIRBANKS, AK 99707
(907) 452-4094

LEGEND

⊕	Survey Control Point
——— ——— ———	Shoulder
— — — — — —	Toe
Ⓦ	Monitoring Well
═══	Culvert

SURVEY CONTROL TABLE				
	NORTHING	EASTING	HEIGHT	TYPE
GPS-1	3980940.476	1335488.622	813.440	HUB & MAG NAIL
GPS-2	3980615.795	1335186.345	818.276	HUB & MAG NAIL
OTHER SIGNIFICANT SHOTS				
112	3981172.86	1336090.08	751.14	LATH T2
113	3981255.33	1336073.11	756.25	MON. WELL M2
114	3980619.61	1336037.76	757.36	MON. WELL M1

NOTES:
1. As-built site topographic data collected via RTK GPS methods, September 2022.
2. Horizontal Datum: NAD83 (2011) CORS epoch 2010.0, projected within Alaska State Plane Zone 3, U.S. Survey Feet, derived from NGS OPUS solutions for control points GPS-1 and GPS-2 on October 3, 2019.
3. Vertical Datum: NAVD 1988, Geoid 12B, U.S. Survey Feet, from OPUS solutions.
4. Site is located within the SE 1/4, Sec. 28, T1N, R2W, F.M., Alaska. Longitude 147.9603 W, Latitude 64.8800 N. Fairbanks North Star Borough TL 2808, 499 Saint Patrick Road.
5. Certificate of Approval to Abandon Dam, dated June 28, 2021, Grant Mine Tailings Dam (NID ID#AK00409)



RECORD DRAWING
AS BUILT

9/16/22

M.A.Smiley, P.E.
Stutzmann Engineering Associates

Notes:
1. Not all utilities shown. Locate before future digging.

STATE OF ALASKA
49TH
Mark Andrew Smiley
CE 10349
9/16/2022
REGISTERED PROFESSIONAL ENGINEER
C627

STUTZMANN ENGINEERING ASSOCIATES, INC.
ENGINEERS SURVEYORS PLANNERS
P.O. BOX 71429, FAIRBANKS, AK 99707
9 ADAK AVENUE, FAIRBANKS, AK 99701
(907) 452-4094 (C 627)

LOCATION: Grant Mine

RECORD DRAWING
AS BUILT
CLOSURE

FOR: BURGGRAF

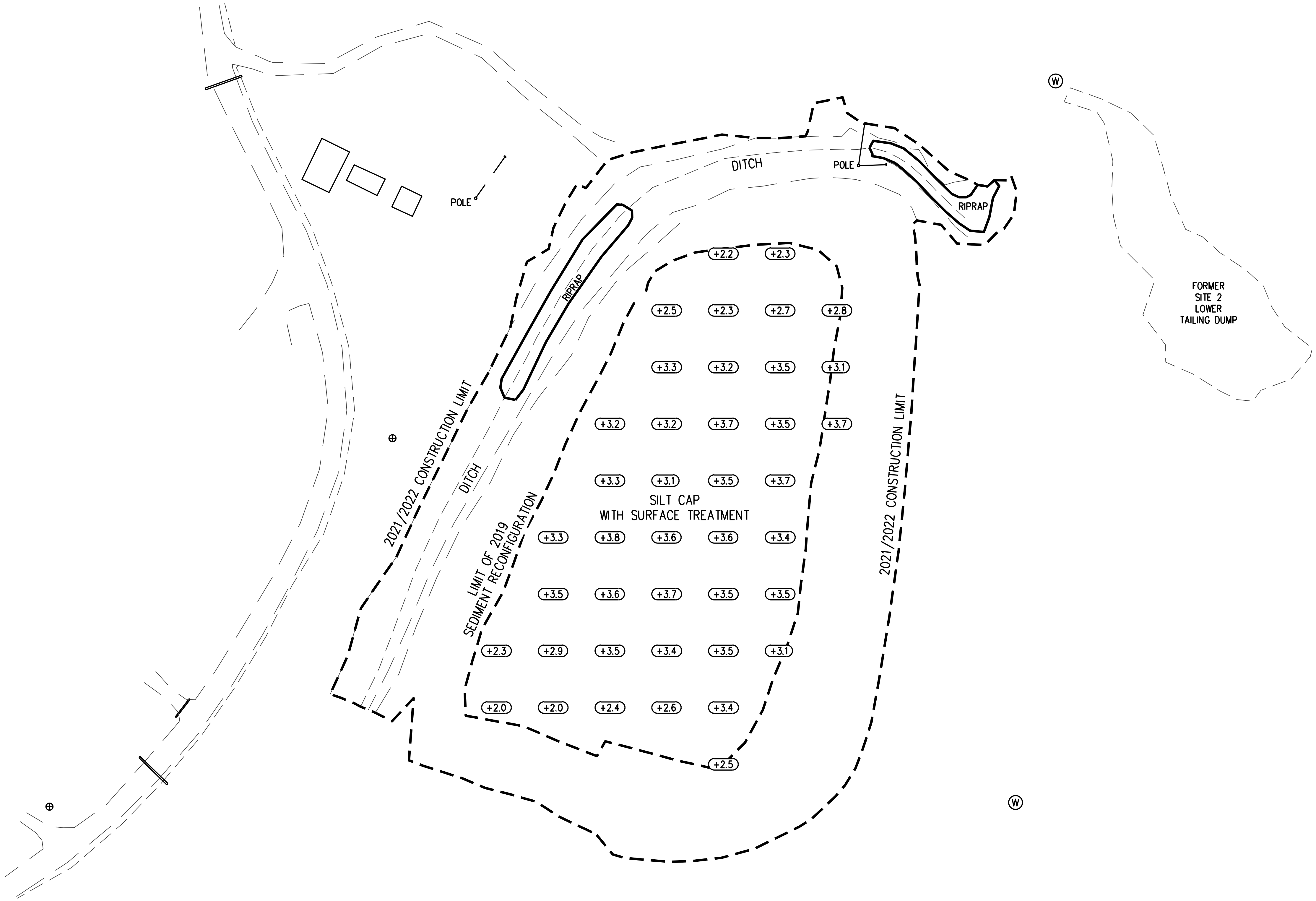
DRAWN: MAS

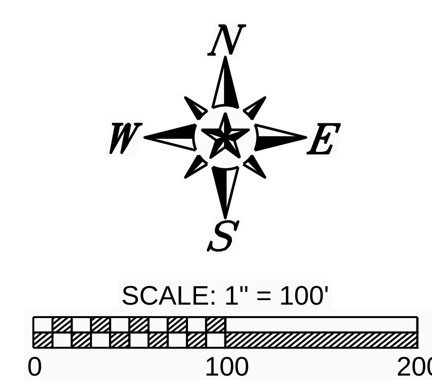
CHECKED: .

DATE: 9/16/22

1

NOTES:
1. This sheet shows cap thickness in feet comparing as–built survey September 16, 2022 to progress as–built survey November 11, 2019 of sediment reconfiguration.





STATE OF ALASKA
49 TH
Mark Andrew Smiley
CE 10349
10/25/2022
REGISTERED PROFESSIONAL ENGINEER
C627

STUTZMANN ENGINEERING ASSOCIATES, INC.
ENGINEERS SURVEYORS PLANNERS
P.O. BOX 71429, FAIRBANKS, AK 99707
9 ADAK AVENUE, FAIRBANKS, AK 99701
(907) 452-4094 (C 627)

LOCATION: *Grant Mine*

AS-BUILT CAP THICKNESS

FOR: BURGGRAF

DRAWN: MAS

CHECKED: .

DATE: 10/25/22

2

APPENDIX C: COMPACTION TESTING RESULTS

Appendix C

Compaction Testing Results

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
2355 HILL ROAD, FAIRBANKS, ALASKA 99709 (907) 479-0600

PROJECT NO.	31-1-20094-009
DATE	7/22/2021
REPORT NO.	1
S&W FIELD REP.	Stephen Chase

COMPACTION TEST WORKSHEET

PROJECT NAME/LOCATION	Grant Mine

WORKSHEET SUBMITTED TO		CONTRACTOR NAME AND CONTACT	
Client	Grant Mine	General	
CC		Subcontractors	

MAKE/MODEL OF NUCLEAR GAUGE	3411b
GAUGE SERIAL NUMBER	11137

	MOISTURE STANDARD	DENSITY STANDARD	DATE OF TEST
CURRENT STANDARD VALUES	584	1742	7/22/2021
MAXIMUM ACCEPTABLE STANDARDS			
MINIMUM ACCEPTABLE STANDARDS			
AVERAGE OF PREVIOUS FOUR			
PREVIOUS FOUR STANDARD VALUES			

COMPACTION TEST RESULTS

INDEX NO.	TIME	LOCATION	LIFT (ELEV.)	TEST NO.	MAT'L CODE	RETEST	TEST DEPTH (in)	PROCTOR DENSITY (pcf)	WET DENSITY (pcf)	DRY DENSITY (pcf)	M.C. (%)	% COMP.
1	2:15	1/3 North, 2/3 Right of Entrance	1	1	ML	---	6	98.1	120.7	104.0	16.0	106.0

LIMITATIONS: The Shannon & Wilson field representative is present on site solely to provide compaction testing services and keep our client informed of the preliminary test results. The presence and activities of the Shannon & Wilson field representative and our acceptance of any non-conforming work or failure to reject any non-conforming work does not relieve the contractor from complying with its contract documents. Shannon & Wilson does not have the authority to direct the contractor's work. Any information provided by the Shannon & Wilson field technician is intended solely to advise the contractor of the preliminary test results. The contractor is solely responsible for its means, methods, sequences, procedures, construction site safety, quality of work, and adherence to the contract documents.

REVIEW BY (initial/date)
wap 7/22/2021

VERSION 1, JANUARY 2010

Appendix D

L.A. Abrasion Test Results

APPENDIX D: L.A. ABRASION TEST RESULTS

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
2355 HILL ROAD, FAIRBANKS, ALASKA 99709 (907) 479-0600

L.A. ABRASION WORKSHEET

PROJECT NO.	31-1-20094
START/END DATE	8-10-2021/8-12-2021
WORK ORDER	4274
TEST METHOD	*ASTM* C131/C535 *AASHTO* T96

PROJECT NAME/LOCATION Grant Mine

CLIENT INFORMATION		S&W LAB TECHNICIANS		EQUIPMENT USED	
Contact		Sample wash	DMS	Balance(s)	269
Client		Gradation	DMS	LA Abrasion	
Address		LA Abrasion	DMS	Oven(s)	187088
Email		Calculations	DMS	Sieve(s)	123,76147e,134, 135, 154
Phone		Data entry	DMS		

SAMPLE IDENTIFICATION

SIZE FRACTION		GRADING							SAMPLE MASS
PASSING	RETAINED	A	B	C	D	1	2	3	
3”	2 ½”					2500 ± 50			
2 ½”	2”					2500 ± 50			
2”	1 ½”					5000 ± 50	5000 ± 50		
1 ½”	1”	1250 ± 25					5000 ± 50	5000 ± 50	1243
1”	¾”	1250 ± 25						5000 ± 50	1196*
¾”	½”	1250 ± 10	2500 ± 10						1251
½”	⅜”	1250 ± 10	2500 ± 10						365*
⅜”	¼”			2500 ± 10					
¼”	NO. 4			2500 ± 10					
NO. 4	NO. 8				5000 ± 10				
TOTAL MASS (g)		5000 ± 10	5000 ± 10	5000 ± 10	5000 ± 10	10,000 ± 100	10,000 ± 100	10,000 ± 100	4055
NUMBER OF SPHERES		12	11	8	6	12	12	12	12
MASS OF SPHERES (g)		5000 ± 25	4584 ± 25	3330 ± 20	2500 ± 15	5000 ± 25	5000 ± 25	5000 ± 25	4993

SPHERE MASS (g)			
394	424	433	417
417	418	418	393
416	418	416	429
TOTAL MASS (g)	4993		

MASS RETAINED ON THE NO. 12 SIEVE (g)	2789
LOSS (g)	1266
PERCENT LOSS	31%

*NOTES: * Sample mass is below standard specification for mass fraction per sieve size.*
3/4” sample mass is below specification by 29g
3/8” sample mass is below specification by 875g

REVIEW BY (initial/date)

Appendix E

Cumulative Risk Assessment Data

APPENDIX E: CUMULATIVE RISK ASSESSMENT DATA

TABLE 2
GRANT MINE TAILINGS IMPOUNDMENT CLOSURE
PRIMARY TAILINGS IMPOUNDMENT HISTORICAL SOIL SAMPLE RESULTS

Analyte	ADEC Cleanup Level	Sample ID: / Sampler: / Units	*88021004* ADEC 2/17/1988 Sediment	*88021005* ADEC 2/17/1988 North Edge Pit	*AG#840* AMAX 5/1/1989 Tailings	*SS001* EPA 7/19/1994 South Pit	*SS002* EPA 7/19/1994 North Pit	*SS002* [a] EPA 7/19/1994 North Pit	*SSCP769040196* Tri-Con 4/1/1996 Surface Composite	*SSCP760040196* Tri-Con 4/1/1996 Mid-depth Composite	*SSCP760040196D* [b] Tri-Con 4/1/1996 Mid-depth Composite	*SSCP751040196* Tri-Con 4/1/1996 Deep Composite	*SSCP751040196D* [c] Tri-Con 4/1/1996 Deep Composite
Antimony	41	mg/kg	0.278	0.250	--	**1950**	**1320**	**870**	24.0	18.0	10.6	<MDL	<MDL
Arsenic	8.8	mg/kg	**3020**	**3980**	**548**	**3600J**	**3230J**	**3210J**	**4410**	**4830**	**4770**	**6310**	**5630**
Barium	20000	mg/kg	16.9	36.1	--	54.5J	12.3J	15.5J	30.7	24.0	26.1	39.9	37.9
Beryllium	200	mg/kg	--	--	--	0.47J	0.310J	0.320J	0.350	0.240	0.270	0.350	0.320
Cadmium	92	mg/kg	<1.00	<1.00	0.420	--	--	--	2.40	1.90	1.80	2.20	2.00
Chromium	1.0×10^5	mg/kg	8.96	14.7	--	31.7	16.6	16.0	22.2	9.90	10.8	15.8	15.6
Cobalt	—	mg/kg	--	--	--	8.0J	6.60J	6.20J	--	--	--	--	--
Copper	4100	mg/kg	21.3[d]	27.7[d]	12.7	45.9	31.5	30.4	29.4	26.4	25.7	30.5	30.2
Cyanide (total)	—	mg/kg	--	--	5.87	8.60	<1.10	<1.10	4.31	0.97	2.46	14.60	16.5
Cyanide (WAD)	—	mg/kg	--	--	<0.0400	--	--	--	2.18	0.56	0.400	3.74	4.35
Cyanide (free)	34	mg/kg	--	--	--	--	--	--	0.0800	<MDL	<MDL	0.7	0.670
Lead	400	mg/kg	16.9	29.0	85.2	188	100	83.0	**399**	106	112	216	217
Manganese	2700	mg/kg	--	--	--	**393**	312	267	--	--	--	--	--
Mercury	3.1	mg/kg	<0.500	0.730	0.0000720	1.00	<0.110	1.30	0.850	**2.11**	0.600	0.110	0.110
Nickel	2000	mg/kg	--	--	--	30.4	29.0	23.7	23.8	11.3	11.4	14.3	13.8
Selenium	510	mg/kg	--	--	--	--	--	--	4.80	2.60	2.80	3.30	3.50
Silver	510	mg/kg	--	--	--	5.70J	9.60J	6.00J	<MDL	<MDL	<MDL	<MDL	<MDL
Thallium	1.0	mg/kg	--	--	--	--	--	--	<MDL	<MDL	<MDL	<MDL	<MDL
Vanadium	510	mg/kg	--	--	--	12.0J	7.70J	7.80J	--	--	--	--	--
Zinc	30000	mg/kg	27.8	36.8	36.5	78.5	78.5	54.3	78.5	36.4	87.5	44.4	39.9
Total Solids	—	%	--	--	--	--	--	--	75.8	88.5	88.4	77.0	76.6
pH	—	--	--	--	--	--	--	--	8.7	9.8	9.8	9.8	9.9

Notes: ADEC Soil Cleanup Levels from 18 AAC 75.341: *Table B1. Method Two - Human Health (Under 40-Inch Zone)*

[a] Sample *SS002* [a] is a field duplicate of sample *SS002.*

[b] Sample *SSCP760040196D* [b] is a field duplicate of sample *SSCP760040196* .

[c] Sample *SSCP751040196D* [c] is a field duplicate of sample *SSCP751040196* .

[d] Analyte concentration may be lower due to unknown analytical interferences.

ADEC Alaska Department of Environmental Conservation

mg/kg milligrams per kilogram

J Estimated concentration

< Analyte not reported above limit of detection.

-- Analysis not requested

— ADEC cleanup level not established for this analyte.

Bold Detected concentration exceeds the ADEC Human Health (Under 40-Inch Zone) soil cleanup level.

Result Maximum concentration detected for the analyte in the dataset.

Red Bold Maximum concentration detected for the analyte in the dataset exceeds one-tenth of the DEC human health cleanup level.

TABLE 3
GRANT MINE TAILINGS IMPOUNDMENT CLOSURE
SECONDARY TAILINGS IMPOUNDMENT OCTOBER 2019 SOIL SAMPLE RESULTS

		Antimony	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
ADEC Cleanup Level →		41 mg/kg	8.8 mg/kg	20,000 mg/kg	92 mg/kg	100,000 mg/kg	400 mg/kg	3.1 mg/kg	510 mg/kg	510 mg/kg
19GM-DU1		<0.560	**13.8**	184	0.268	26.8	9.85	0.0496 J	0.733 J	0.115 J
19GM-DU2		0.601 J	**55.1**	174	0.251	26.8	14.1	0.0436 J	0.705 J	0.28
19GM-DU3	*Replicate A*	<0.565	**15.2**	178	0.26	26.2	11.6	0.0400 J	0.741 J	0.117 J
	Replicate B	<0.565	**18.9**	205	0.284	26.5	11	0.0401 J	0.694 J	0.130 J
	Replicate C	<0.565	**19.8**	176	0.235	25.9	9.95	0.0454 J	0.631 J	0.137 J
	95% UCL	<0.565	**24.1**	227	0.321	27.0	12.95	0.0496 J	0.828 J	0.154 J
GM19-1		<0.570	**11.5**	194	0.161 J	28.6	9.46	0.0407 J	0.607 J	0.118 J
GM19-10		<0.545	**15.0**	184	0.247	25.7	10.3	0.0409 J	0.464 J	0.136 J
GM19-2		<0.580	**9.09**	183	0.252	31.4	9.75	0.0468 J	0.518 J	0.101 J
GM19-3		0.763 J	**110**	171	0.177 J	28.9	15.1	0.0629 J	0.740 J	0.324
GM19-4		<0.595	**50.0**	152	0.157 J	31.5	8.82	0.0721 J	0.836 J	0.150 J
GM19-5		<0.565	8.22	168	0.188 J	28.3	9.38	0.0423 J	0.544 J	0.127 J
GM19-6		<0.575	**13.9**	209	0.205 J	28.8	9.53	0.0332 J	0.696 J	0.117 J
GM19-7		<0.620	**12.3**	216	0.217 J	30.4	9.41	0.0349 J	0.527 J	0.0899 J
GM19-8		<0.575	**14.6**	211	0.163 J	28.7	9.94	0.0323 J	0.644 J	0.113 J
GM19-9		<0.565	**14.8**	186	0.254	26.8	10.4	0.0450 J	0.517 J	0.144 J

Notes: ADEC Soil Cleanup Levels from 18 AAC 75.341: *Table B1. Method Two - Human Health (Under 40-Inch Zone)*
Sample *GM19-10* is a field duplicate of sample *GM19-1* .
Sample results presented in milligrams per kilogram.

ADEC	Alaska Department of Environmental Conservation
mg/kg	milligrams per kilogram
95% UCL	95% upper confidence limit of mean concentration
J	Estimated concentration, detected greater than the limit of detection (LOD) and less than the limit of quantitation (LOQ). Flag applied by the laboratory.
<	Analyte not detected; result listed as less than the limit of detection (LOD).
Bold	Detected concentration exceeds the ADEC Human Health (Under 40-Inch Zone) soil cleanup level.
Result	Maximum concentration detected for the analyte.
Red Bold	Maximum concentration detected for the analyte in the dataset exceeds one-tenth of the DEC human health cleanup level.

Site-specific Risk Models
Resident Soil (<40 in. Zone) Inputs

Variable	Value
ED_{ress} (exposure duration - resident) yr	26
ED_{ressc} (exposure duration - child) yr	6
ED_{ressa} (exposure duration - adult) yr	20
ET_{ress} (exposure time - resident) hr/day	24
ET_{ressc} (exposure time - child) hr/day	24
ET_{ressa} (exposure time - adult) hr/day	24
BW_{ressa} (body weight - adult) kg	80
BW_{ressc} (body weight - child) kg	15
SA_{ressa} (skin surface area - adult) cm^2/day	6032
SA_{ressc} (skin surface area - child) cm^2/day	2373
LT (lifetime - resident) yr	70
$EF_{ress\ lt\ 40\ in}$ (exposure frequency - resident) day/yr	270
$EF_{ressc\ lt\ 40\ in}$ (exposure frequency - child) day/yr	270
$EF_{ressa\ lt\ 40\ in}$ (exposure frequency - adult) day/yr	270
IRS_{ressa} (soil intake rate - adult) mg/day	100
IRS_{ressc} (soil intake rate - child) mg/day	200
AF_{ressa} (skin adherence factor - adult) mg/cm^2	0.07
AF_{ressc} (skin adherence factor - child) mg/cm^2	0.2
$IFS_{res\ lt\ 40\ in\text{-}adj}$ (age-adjusted soil ingestion factor) mg/kg	28350
$DFS_{res\ lt\ 40\ in\text{-}adj}$ (age-adjusted soil dermal factor) mg/kg	79758
$IFSM_{res\ lt\ 40\ in\text{-}adj}$ (mutagenic age-adjusted soil ingestion factor) mg/kg	128700
$DFSM_{res\ lt\ 40\ in\text{-}adj}$ (mutagenic age-adjusted soil dermal factor) mg/kg	330372
AF_{0-2} (skin adherence factor) mg/cm^2	0.2
AF_{2-6} (skin adherence factor) mg/cm^2	0.2
AF_{6-16} (skin adherence factor) mg/cm^2	0.07
AF_{16-26} (skin adherence factor) mg/cm^2	0.07
BW_{0-2} (body weight) kg	15
BW_{2-6} (body weight) kg	15
BW_{6-16} (body weight) kg	80
BW_{16-26} (body weight) kg	80
ED_{0-2} (exposure duration) yr	2
ED_{2-6} (exposure duration) yr	4
ED_{6-16} (exposure duration) yr	10

Output generated 17JAN2023:18:20:43

Site-specific Risk Models
Resident Soil (<40 in. Zone) Inputs

Variable	Value
ED_{16-26} (exposure duration) yr	10
$EF_{0-2\ lt\ 40\ in}$ (exposure frequency) day/yr	270
$EF_{2-6\ lt\ 40\ in}$ (exposure frequency) day/yr	270
$EF_{6-16\ lt\ 40\ in}$ (exposure frequency) day/yr	270
$EF_{16-26\ lt\ 40\ in}$ (exposure frequency) day/yr	270
ET_{0-2} (exposure time) hr/day	24
ET_{2-6} (exposure time) hr/day	24
ET_{6-16} (exposure time) hr/day	24
ET_{16-26} (exposure time) hr/day	24
IRS_{0-2} (soil intake rate) mg/day	200
IRS_{2-6} (soil intake rate) mg/day	200
IRS_{6-16} (soil intake rate) mg/day	100
IRS_{16-26} (soil intake rate) mg/day	100
SA_{0-2} (skin surface area) cm^2/day	2373
SA_{2-6} (skin surface area) cm^2/day	2373
SA_{6-16} (skin surface area) cm^2/day	6032
SA_{16-26} (skin surface area) cm^2/day	6032
A_s (acres)	0.5
Q/C_{wp} (g/m^2-s per kg/m^3)	93.7736
PEF (particulate emission factor) m^3/kg	1.36E09
A (PEF Dispersion Constant)	16.2302
B (PEF Dispersion Constant)	18.7762
C (PEF Dispersion Constant)	216.108
V(fraction of vegetative cover) unitless	0.5
U_m(mean annual wind speed) m/s	4.69
U_t(equivalent threshold value)	11.32
F(x) (function dependent on U_m/U_t) unitless	0.194
A_s (acres)	0.5
Q/C_{wp} (g/m^2-s per kg/m^3)	93.7736
foc (fraction organic carbon in soil) g/g	0.001
p_b (dry soil bulk density) g/cm^3	1.5
p_s (soil particle density) g/cm^3	2.65
$Theta_w$ (water-filled soil porosity) L_{water}/L_{soil}	0.15

Output generated 17JAN2023:18:20:43

Site-specific Risk Models
Resident Soil (<40 in. Zone) Inputs

Variable	Value
Theta$_a$ (air-filled soil porosity) L_{air}/L_{soil}	0.28396
n (total soil porosity) L_{pore}/L_{soil}	0.43396
T (exposure interval) s	819936000
A (VF Dispersion Constant)	16.2302
B (VF Dispersion Constant)	18.7762
C (VF Dispersion Constant)	216.108

Output generated 17JAN2023:18:20:43

Site-specific Risk Models
Resident Cumulative Risk
Soil (<40 in. Precipitation Zone)

ca=Cancer, nc=Noncancer, ca* (Where nc SL < 100 x ca SL), ca** (Where nc SL < 10 x ca SL),
max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat, sol=SL exceeds Solubility
I=IRIS; D=Drinking Water/Health Advisory Goals; P=PPRTV; A=ATSDR; C=Cal EPA; X=APPENDIX PPRTV SCREEN; H=HEAST; S=SURROGATE; W=RPF

Chemical	Mutagen?	Volatile?	Chronic RfD (mg/kg-day)	Chronic RfD Ref	Chronic RfC (mg/m³)	Chronic RfC Ref	Ingestion SF (mg/kg-day)$^{-1}$	SFO Ref	Inhalation Unit Risk (μg/m³)$^{-1}$	IUR Ref	GIABS	ABS	MW	ρ (g/cm³)
Antimony (metallic)	No	No	4.00E-04	I	-		-		-		0.15	-	121.76	6.68E+00
Arsenic, Inorganic	No	No	3.00E-04	I	1.50E-05	C	1.50E+00	I	4.30E-03	I	1	0.03	74.922	4.90E+00
Lead and Compounds	No	No	-		-		-		-		1	-	207.2	1.13E+01
Manganese (Non-diet)	No	No	2.40E-02	S	5.00E-05	I	-		-		0.04	-	54.938	7.30E+00
Mercury (elemental)	No	Yes	1.60E-04	C	3.00E-04	I	-		-		1	-	200.59	1.35E+01
**Total Risk/HI*			-		-		-		-		-	-	-	-

Output generated 17JAN2023:18:20:43

Site-specific Risk Models
Resident Cumulative Risk
Soil (<40 in. Precipitation Zone)

ca=Cancer, nc=Noncancer, ca* (Where nc SL < 100 x ca SL), ca** (Where nc SL < 10 x ca SL),
max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat, sol=SL exceeds Solubility
I=IRIS; D=Drinking Water/Health Advisory Goals; P=PPRTV; A=ATSDR; C=Cal EPA; X=APPENDIX PPRTV SCREEN; H=HEAST; S=SURROGATE; W=RPF

D_{ia} (cm^2/s)	D_{iw} (cm^2/s)	H`	Volatilization Factor (m^3/kg)	K_{oc} (cm^3/g)	K_d (cm^3/g)	Particulate Emission Factor (m^3/kg)	RBA	Concentration (mg/kg)	Ingestion Noncarcinogenic CDI Child	Inhalation Noncarcinogenic (Volatiles) CDI Child
-	-	-	-	-	4.50E+01	1.36E+09	1.00E+00	1.95E+03	1.92E-02	-
-	-	-	-	-	2.90E+01	1.36E+09	6.00E-01	6.31E+03	3.73E-02	-
-	-	-	-	-	9.00E+02	1.36E+09	1.00E+00	3.99E+02	-	-
-	-	-	-	-	6.50E+01	1.36E+09	1.00E+00	3.93E+02	3.88E-03	-
3.07E-02	6.30E-06	3.52E-01	4.77E+04	-	5.20E+01	1.36E+09	1.00E+00	2.11E+00	2.08E-05	3.27E-05
-	-	-	-	-	-	-	-	-	-	-

Site-specific Risk Models
Resident Cumulative Risk
Soil (<40 in. Precipitation Zone)

ca=Cancer, nc=Noncancer, ca* (Where nc SL < 100 x ca SL), ca** (Where nc SL < 10 x ca SL),
max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat, sol=SL exceeds Solubility
I=IRIS; D=Drinking Water/Health Advisory Goals; P=PPRTV; A=ATSDR; C=Cal EPA; X=APPENDIX PPRTV SCREEN; H=HEAST; S=SURROGATE; W=RPF

Inhalation Noncarcinogenic (Particulates) CDI Child	Dermal Noncarcinogenic CDI Child	Ingestion Carcinogenic CDI	Inhalation (Volatiles) Carcinogenic CDI	Inhalation (Particulates) Carcinogenic CDI	Dermal Carcinogenic CDI	Ingestion HI Child	Inhalation (Volatiles) HI Child	Inhalation (Particulates) HI Child	Dermal HI Child
-	-	-	-	-	-	4.81E+01	-	-	-
3.43E-06	4.43E-03	4.20E-03	-	1.27E-03	5.91E-04	1.24E+02	-	2.29E-01	1.48E+01
-	-	-	-	-	-	-	-	-	-
2.14E-07	-	-	-	-	-	1.62E-01	-	4.28E-03	-
1.15E-09	-	-	-	-	-	1.30E-01	1.09E-01	3.83E-06	-
-	-	-	-	-	-	***1.73E+02***	***1.09E-01***	***2.33E-01***	***1.48E+01***

Site-specific Risk Models
Resident Cumulative Risk
Soil (<40 in. Precipitation Zone)

ca=Cancer, nc=Noncancer, ca* (Where nc SL < 100 x ca SL), ca** (Where nc SL < 10 x ca SL),
max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat, sol=SL exceeds Solubility
I=IRIS; D=Drinking Water/Health Advisory Goals; P=PPRTV; A=ATSDR; C=Cal EPA; X=APPENDIX PPRTV SCREEN; H=HEAST; S=SURROGATE; W=RPF

Noncarcinogenic HI Child	Ingestion Risk	Inhalation (Volatiles) Risk	Inhalation (Particulates) Risk	Dermal Risk	Carcinogenic Risk
4.81E+01	-	-	-	-	**-**
1.39E+02	6.30E-03	-	5.48E-06	8.86E-04	**7.19E-03**
-	-	-	-	-	**-**
1.66E-01	-	-	-	-	**-**
2.39E-01	-	-	-	-	**-**
1.88E+02	***6.30E-03***	***-***	***5.48E-06***	***8.86E-04***	***7.19E-03***

TABLE 1
GRANT MINE TAILINGS IMPOUNDMENT CLOSURE
2018-2021 GROUNDWATER SAMPLE RESULTS

Analytical Method	Analyte	ADEC Cleanup Level	Units	*M-1* 9/14/2018	*M-101* 9/14/2018	*M-2* 9/14/2018	*M-1* 6/20/2019	*M-2* 6/20/2019	*M-102* 6/20/2019	*M1* 10/17/2019	*M2* 10/17/2019	*M202* 10/17/2019	*M1* 6/16/2021	*M2* 6/16/2021	*M101* 6/16/2021	*M1* 9/27/2021	*M2* 9/27/2021	*M101* 9/27/2021
SW9016	Cyanide (free CN-)	1.5	µg/L	<0.544	<0.544	<0.544	1.04 J	1.42 J	**1.55 J †**	<0.544	<0.544	<0.544	<0.544	<0.544	<0.544	<0.544	<0.544	<0.544
SW6020A (Metals)	Antimony	7.8	µg/L	<1.50	<1.50	<1.50	—	—	—	—	—	—	—	—	—	—	—	—
	Arsenic	0.52	µg/L	**61.5**	**65.1**	**196**	—	—	—	—	—	—	—	—	—	—	—	—
	Barium	3,800	µg/L	42.8	44.8	12.2	—	—	—	—	—	—	—	—	—	—	—	—
	Cadmium	9.2	µg/L	<1.00	<1.00	<1.00	—	—	—	—	—	—	—	—	—	—	—	—
	Chromium	22,000	µg/L	<2.00	<2.00	<2.00	—	—	—	—	—	—	—	—	—	—	—	—
	Lead	15	µg/L	0.456 J	0.495 J	1.41	—	—	—	—	—	—	—	—	—	—	—	—
	Mercury	0.52	µg/L	**0.249**	0.237	<0.100	—	—	—	—	—	—	—	—	—	—	—	—
	Selenium	100	µg/L	<10.0	<10.0	<10.0	—	—	—	—	—	—	—	—	—	—	—	—
	Silver	94	µg/L	<1.00	<1.00	<1.00	—	—	—	—	—	—	—	—	—	—	—	—

Notes: Regulatory groundwater cleanup levels were obtained from the November 2021 18 AAC 75.345 *Table C. Groundwater Cleanup Levels.*
Sample *M-101* is a field-duplicate of sample *M-1* .
Sample *M-102* is a field-duplicate of sample *M-2* .
Sample *M202* is a field-duplicate of sample *M2* .
The most recent analytical results for each location were assessed for inclusion in the cumulative risk evaluation.

ADEC Alaska Department of Environmental Conservation
µg/L micrograms per liter
— Analyte not requested.
< Analyte not detected; result listed as less than the limit of detection (LOD).
J Estimated concentration, detected greater than the LOD and less than the limit of quantitation (LOQ). Flag applied by the laboratory.
Bold Detected concentration exceeds the ADEC Human Health groundwater cleanup level.
Result Maximum concentration detected for the analyte in the dataset.
Red Bold Maximum concentration detected for the analyte in the dataset exceeds one-tenth of the DEC human health cleanup level.
† Cyanide was not included in the cumulative risk evaluation; though cyanide was detected in 2019, it was not detected in subsequent samples.

Site-specific Risk Models
Groundwater Inputs

Variable	Value
LT (lifetime - resident) year	70
K (volatilization factor of Andelman) L/m^3	0.5
l_{sc} (apparent thickness of stratum corneum) cm	0.001
ED_{resw} (exposure duration - resident) year	26
ED_{reswc} (exposure duration - child) year	6
ED_{reswa} (exposure duration - adult) year	20
ED_{0-2} (mutagenic exposure duration first phase) year	2
ED_{2-6} (mutagenic exposure duration second phase) year	4
ED_{6-16} (mutagenic exposure duration third phase) year	10
ED_{16-26} (mutagenic exposure duration fourth phase) year	10
EF_{resw} (exposure frequency) day/year	350
EF_{reswc} (exposure frequency - child) day/year	350
EF_{reswa} (exposure frequency - adult) day/year	350
EF_{0-2} (mutagenic exposure frequency first phase) day/year	350
EF_{2-6} (mutagenic exposure frequency second phase) day/year	350
EF_{6-16} (mutagenic exposure frequency third phase) day/year	350
EF_{16-26} (mutagenic exposure frequency fourth phase) day/year	350
$ET_{resw-adj}$ (age-adjusted exposure time) hour/event	0.67077
$ET_{resw-madj}$ (mutagenic age-adjusted exposure time) hour/event	0.67077
ET_{resw} (exposure time) hour/day	24
ET_{reswc} (dermal exposure time - child) hour/event	0.54
ET_{reswa} (dermal exposure time - adult) hour/event	0.71
ET_{reswc} (inhalation exposure time - child) hour/day	24
ET_{reswa} (inhalation exposure time - adult) hour/day	24
ET_{0-2} (mutagenic inhalation exposure time first phase) hour/day	24
ET_{2-6} (mutagenic inhalation exposure time second phase) hour/day	24
ET_{6-16} (mutagenic inhalation exposure time third phase) hour/day	24
ET_{16-26} (mutagenic inhalation exposure time fourth phase) hour/day	24
ET_{0-2} (mutagenic dermal exposure time first phase) hour/event	0.54
ET_{2-6} (mutagenic dermal exposure time second phase) hour/event	0.54
ET_{6-16} (mutagenic dermal exposure time third phase) hour/event	0.71
ET_{16-26} (mutagenic dermal exposure time fourth phase) hour/event	0.71
BW_{reswa} (body weight - adult) kg	80

Output generated 22NOV2022:13:44:57

Site-specific Risk Models
Groundwater Inputs

Variable	Value
BW_{reswc} (body weight - child) kg	15
BW_{0-2} (mutagenic body weight) kg	15
BW_{2-6} (mutagenic body weight) kg	15
BW_{6-16} (mutagenic body weight) kg	80
BW_{16-26} (mutagenic body weight) kg	80
$IFW_{res-adj}$ (adjusted intake factor) L/kg	327.95
$IFWM_{res-adj}$ (mutagenic adjusted intake factor) L/kg	1019.9
IRW_{reswc} (water intake rate - child) L/day	0.78
IRW_{reswa} (water intake rate - adult) L/day	2.5
IRW_{0-2} (mutagenic water intake rate) L/day	0.78
IRW_{2-6} (mutagenic water intake rate) L/day	0.78
IRW_{6-16} (mutagenic water intake rate) L/day	2.5
IRW_{16-26} (mutagenic water intake rate) L/day	2.5
EV_{reswa} (events - adult) per day	1
EV_{reswc} (events - child) per day	1
EV_{0-2} (mutagenic events) per day	1
EV_{2-6} (mutagenic events) per day	1
EV_{6-16} (mutagenic events) per day	1
EV_{16-26} (mutagenic events) per day	1
$DFW_{res-adj}$ (age-adjusted dermal factor) cm^2-event/kg	2610650
$DFWM_{res-adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8191633
SA_{reswc} (skin surface area - child) cm^2	6365
SA_{reswa} (skin surface area - adult) cm^2	19652
SA_{0-2} (mutagenic skin surface area) cm^2	6365
SA_{2-6} (mutagenic skin surface area) cm^2	6365
SA_{6-16} (mutagenic skin surface area) cm^2	19652
SA_{16-26} (mutagenic skin surface area) cm^2	19652

Site-specific Risk Models
Groundwater Cumulative Risk
Groundwater

ca=Cancer, nc=Noncancer, ca* (Where nc SL < 100 x ca SL), ca** (Where nc SL < 10 x ca SL),
max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat, sol=SL exceeds Solubility
I=IRIS; D=Drinking Water/Health Advisory Goals; P=PPRTV; A=ATSDR; C=Cal EPA; X=APPENDIX PPRTV SCREEN; H=HEAST; S=SURROGATE; W=RPF

*The sum of PFOS and PFOA concentrations should not exceed 0.07 ug/L.

Chemical	Mutagen?	Volatile?	Chronic RfD (mg/kg-day)	Chronic RfD Ref	Chronic RfC (mg/m³)	Chronic RfC Ref	Ingestion SF (mg/kg-day)$^{-1}$	SFO Ref	Inhalation Unit Risk (μg/m³)$^{-1}$	IUR Ref	GIABS	MW	log K_{ow} (unitless)	In EPD?
Mercury (elemental)	No	Yes	1.60E-04	C	3.00E-04	I	-		-		1	200.59	6.20E-01	Yes
**Total Risk/HI*			-		-		-		-		-	-	-	

Concentration (μg/L)	Ingestion Noncarcinogenic CDI Child	Inhalation Noncarcinogenic (Volatiles) CDI Child	Dermal Noncarcinogenic CDI Child	Ingestion Carcinogenic CDI	Inhalation (Volatiles) Carcinogenic CDI	Dermal Carcinogenic CDI	Ingestion HI Child	Inhalation (Volatiles) HI Child
2.49E-01	1.24E-05	1.19E-04	5.47E-08	-	-	-	7.76E-02	3.98E-01
-	-	-	-	-	-	-	***7.76E-02***	*3.98E-01*

Dermal HI Child	Noncarcinogenic HI Child	Ingestion Risk	Inhalation (Volatiles) Risk	Dermal Risk	Carcinogenic Risk
3.42E-04	**4.76E-01**	-	-	-	**-**
3.42E-04	***4.76E-01***	***-***	-	***-***	***-***

Appendix E

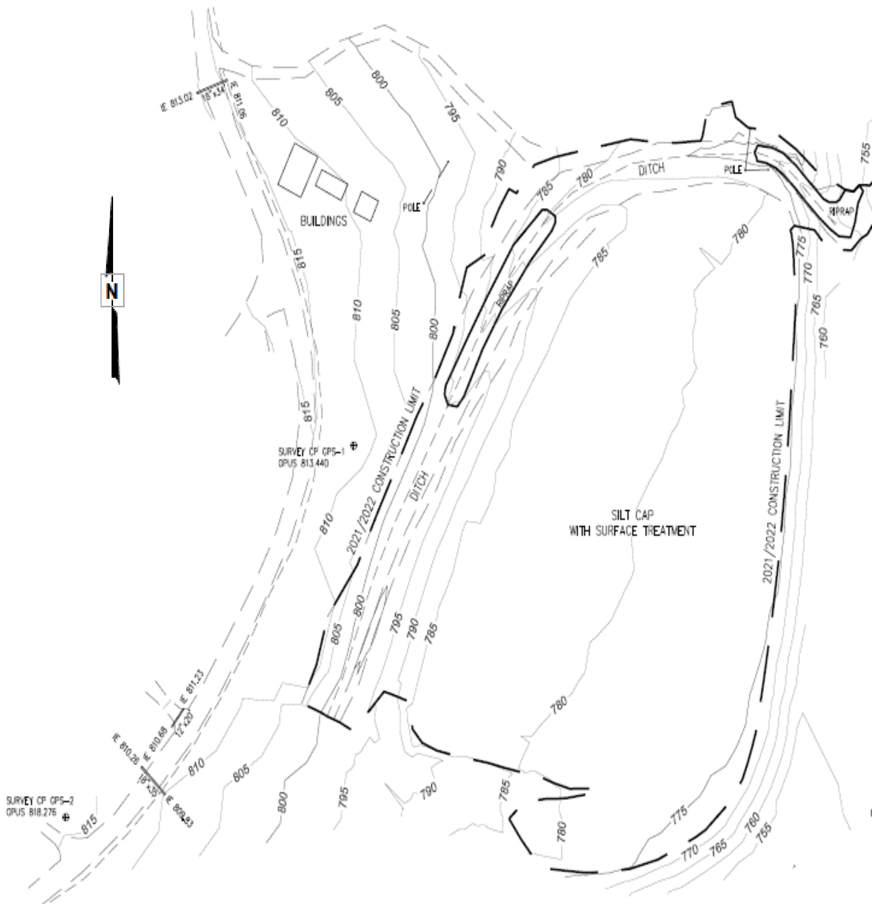
Post-Closure Monitoring Form

APPENDIX F: POST-CLOSURE MONITORING FORM

POST-CLOSURE MONITORING FORM

GRANT MINE TAILINGS IMPOUNDMENT
ESTER, ALASKA

This form is to be used to document post-closure monitoring required for the Grant Mine Tailings Impoundment. Post-closure inspections will be performed by an independent third-party inspector who is familiar with the site and closure requirements. Inspections will be performed monthly for 60 consecutive months following closure. DNR-DMLW will then monitor the site yearly for 5 years, and every five years after. Reports will be provided to ADEC and DNR-DMLW SAIL Section.



1. Note the following, if present, on the figure . Document with photos as appropriate. ▪ Any signs of erosion, settlement, or slumping of the impoundment cap or perimeter embankment. ▪ Areas of grass and other vegetative ground-cover greater than approximately 50% on impoundment cap and unlined ditches. ▪ Signs of surface water runoff (overland flow) on the impoundment cap surface and apparent direction of flow. ▪ Pooling water.	
2. Note the observer's route or observation points during the site inspection.	
3. Is vegetative growth well established on the perimeter embankment (trees/shrubs)?	*Yes / No*
4. Are brush barriers on the impoundment cap surface in place and in a suitable state to limit traversable routes.	*Yes / No*
5. Are there signs of degradation of the terraces/scarification on the impoundment cap surface.	*Yes / No*
6. Are surface drainage system components in good condition (culverts clear and functioning, drainage ditch erosion/sedimentation, roadbed integrity). Alert DOT&PF if road maintenance is needed to protect drainage plan.	*Yes / No*

Actions Taken Since Previous Inspection: ____

____

____

*Actions Indicated by Current Inspection:*____

____

____

Personnel____ Weather____

Company____ Date______________________________

IMPORTANT INFORMATION

Important Information

About Your Geotechnical/Environmental Report

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

IMPORTANT INFORMATION

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged

IMPORTANT INFORMATION

to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland