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DRAFT

CLOSURE AND CAPPING PLAN

Grant Mine Primary Mine-Tailings Impoundment

ESTER DOME, ALASKA

March 2020

Shannon & Wilson No: 31-20094-007

SHANNON & WILSON

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Submitted To: Mr. Roger Burggraf
3180 Peger Road, Suite 270
Fairbanks, Alaska 99709

Subject: DRAFT CLOSURE AND CAPPING PLAN, 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 March 8, 2018. This report presents closure recommendations for the primary tailings impoundment and was prepared by the undersigned.

Please note that this draft plan does not include the final engineered drawings as we are still in the process of determining the requirements for closure from the DNR Dam Safety Department. We will submit the final drawings once they have been completed. We do not anticipate change to the concept of the cap.

We hope DEC can provide a conditional approval of the plan based on the details we have provided here. The approval will allow the DNR to begin the public notice period for their approval of the institutional controls.

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, INC.

Mark Lockwood, CPG
Senior Associate

MSL:CBD/msl

CONTENTS

Figures

ACRONYMS

18 AAC 75	18 Alaska Administrative Code 75
18 AAC 60	18 Alaska Administrative Code 60
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
BLM	Bureau of Land Management
bgs	below ground surface
°C	degrees Celsius
COC	chain of custody
COPCs	contaminants of potential concern
CSM	conceptual site model
DO	dissolved oxygen
EPA	Environmental Protection Agency
IDW	investigation-derived waste
MCL	maximum contaminant level
RPD	relative percent difference
QA	quality assurance
QAO	quality assurance objective
QC	quality control
SGS	SGS North America, Inc.
Silverado	Silverado Gold Mines, Inc.
SPLP	synthetic precipitation leaching procedure
TCLP	toxicity characteristic leaching procedure
TCM	TriCon Mining, Inc.
ug/L	micrograms per liter
WAD	weak-acid-dissociable

1 INTRODUCTION

This report presents a clean-up/reclamation plan for the primary mine-tailings impoundment at the Grant Mine site 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 mine-tailings impoundment (impoundment) through the Alaska Department of Environmental Conservation (ADEC) contaminated sites program. The contaminated sites database file number for the Grant Mine site is 100.38.182, Hazard ID 731.

Silverado Gold Mines (Silverado)/Tri-con Mining Alaska (TCM), former operators of the mine, prepared a Solid Waste Disposal Permit Application in 1985; there is no record that the permit was obtained. 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. We understand Mr. Burggraf is prepared to undertake this plan for closure of the impoundment without the assistance of the former operators.

1.1 Land Status

The impoundment is located on the following active State of Alaska Mining Claims:

- *Grant 29* (ADL 536567),
- *Grant 28* (ADL 536566), and
- *Grant 16* (ADL 511378).

We understand Mr. Burggraf is in the process of obtaining an easement for the impoundment. He will submit the property description once the easement paperwork is complete.

1.2 Regulatory Framework

We are presenting this background information and the proposed plan to ADEC, the regulatory agency overseeing the tailing impoundment closure, and Alaska Department of Natural Resources (ADNR), the landowner.

1.2.1 ADEC Contaminated Sites

We have prepared this closure plan in general accordance with ADEC's 18 Alaska Administrative Code (AAC) 75 *Oil and Other Hazardous Substances Pollution Control* (18 AAC 75). 18 AAC 75 regulates site characterizations and the cleanup of hazardous substances.

1.2.2 ADEC Solid Waste

Since 18 AAC 75 does not contain guidance for capping, we have prepared this closure plan in general accordance with ADEC's 18 AAC 60 *Solid Waste Management* (18 AAC 60). Although 18 AAC 60.455 defines mining waste, the only section that provides guidance for cover/capping of monofills is 18 AAC 60.485 which presents capping/cover criteria for industrial waste. The cover requirements include:

- The surface may not be sloped more steeply than a 3:1 grade;
- The cover should be at least 18 inches of earthen material with a permeability no greater than 1 x 10^{-5} centimeters per second (cm/sec); and
- the cover should contain at least six inches of earthen material capable of sustaining native plant growth.

According to 18 AAC 60.200, a waste disposal permit is not required since the capping will be considered an "approved contaminated site cleanup plan under 18 AAC 75".

1.2.3 ADNR

1.2.3.1 Division on Mining, Land, and Water

As the owner of the property, ADNR oversees and manages the activities that occur during discovery, mining and reclamation. The following sections describe the ADNR requirements:

The Alaska Statues Section 27.19.020. states "A mining operation shall be conducted in a manner that prevents unnecessary and undue degradation of land and water resources, and the mining operation shall be reclaimed as contemporaneously as practicable with the mining operation to leave the site in a stable condition."

"Stable condition" means the rehabilitation, where feasible, of the physical environment of the site to a condition that allows for the reestablishment of renewable resources on the site within a reasonable period of time by natural processes.

Article 2 of 11 AAC 97.200 - Land reclamation performance standards provides the following:

A miner shall reclaim areas disturbed by a mining operation so that any surface that will not have a stream flowing over it is left in a stable condition.

(1) For the purposes of AS 27.19.100(6) and this section, a stable condition that "allows for the reestablishment of renewable resources on the site within a reasonable period of time by natural processes" means a condition that can reasonably be expected to return waterborne soil erosion to pre-mining levels within one year after the reclamation is completed, and that can reasonably be expected to achieve revegetation, where feasible, within five years after the reclamation is completed, without the need for fertilization or reseeding. If rehabilitation of a mined site to this standard is not feasible because the surface materials on the mined site have low natural fertility or the site lacks a natural seed source, the department recommends that the miner fertilize and reseed or replant the site with native vegetation to protect against soil erosion; however, AS 27.19 does not require the miner to do so. Rehabilitation to allow for the reestablishment of renewable resources is not required if that reestablishment would be inconsistent with an alternate post-mining land use approved under AS 27.19.030(b) on state, federal, or municipal land, or with the post-mining land use intended by the landowner on private land.

(2) If topsoil from an area disturbed by a mining operation is not promptly redistributed to an area being reclaimed, a miner shall segregate it, protect it from erosion and from contamination by acidic or toxic materials, and preserve it in a condition suitable for later use.

(3) If the natural composition, texture, or porosity of the surface materials is not conducive to natural revegetation, a miner shall take measures to promote natural revegetation, including redistribution of topsoil, where available. If no topsoil is available, a miner shall apply fines or other suitable growing medium, if available. However, a miner may not redistribute topsoil and fines over surfaces likely to be exposed to annual flooding, unless the action is authorized in an approved reclamation plan and will not result in an unlawful point or non-point-source discharge of pollutants.

A miner shall reclaim an area disturbed by a mining operation so that the surface contours after reclamation is complete are conducive to natural revegetation or are consistent with an alternate post-mining land use approved under AS 27.19.030(b) on state, federal, or municipal land, or with the post-mining land use intended by the landowner on private land. Measures taken to accomplish this result may include backfilling, contouring, and grading, but a miner need not restore the site's approximate original contours. A miner shall stabilize the reclaimed site to a condition that will retain sufficient moisture for natural revegetation or for an alternate post-mining land use approved under AS 27.19.030(b) on

state, federal, or municipal land, or for the post-mining land use intended by the landowner on private land.

A pit wall, subsidence feature, or quarry wall is exempt from the requirements of (a) and (b) of this section if the steepness of the wall makes them impracticable or impossible to accomplish. However, a miner shall leave the wall in a condition such that it will not collapse nor allow loose rock that presents a safety hazard to fall from it.

If a mining operation diverts a stream channel or modifies a flood plain to the extent that the stream channel is no longer stable, a miner shall reestablish the stream channel in a stable location. A miner may not place a settling basin in the way of the reestablished channel location unless the fines will be properly removed or protected from erosion.

1.2.3.2 Dam Safety Program

The Dam Safety Program (DSP) is in the process of reviewing the configuration of the tailings impoundment. The impoundment was constructed prior to the promulgation of the dam safety regulations. If it is determined the structure is a dam, Mr. Burggraf will need to apply for a certificate of approval to abandon the dam. Since the final closure design will contingent on approval from the DSP, we have not completed the detailed cap design drawings at this time. Once the negotiations with the DSP are complete, we will submit the drawings to ADEC for review. We do not anticipate that DSP requirements for closure will significantly affect the cap design presented in Section 6.

2 SITE DESCRIPTION

The site is located along St. Patrick Road approximately 1.2 miles from the intersection with Ester Dome Road, near Fairbanks, Alaska (Figure 1); 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 site slopes gently to the east and is vegetated with spruce, hardwoods, and shrubs.

The site 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. According to Youcha (2003), the groundwater on Ester Dome is present in unconfined bedrock aquifers, localized by regional faults, fractures, and joints. EPA found elevated concentrations of arsenic, barium, copper, manganese, selenium, and zinc in background groundwater samples; background arsenic concentrations exceeded 1000 µg/L (ADEC cleanup level = 0.52 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). A secondary (initial) tailings impoundment was located about 400 feet to the east and was about one acre. The primary impoundment was last active in 1989 and is fenced to restrict access; the secondary impoundment was used during pilot mill testing of the mill; tailings from the secondary impoundment were moved into the primary tailings impoundment in October 2019.

The land use around the site is a mix of undeveloped land and low-density residential housing (Figure 2). 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 renders the groundwater non-potable.

3 BACKGROUND

Roger Burggraf has held the mining claims since 1972. The land was previously owned by the Bureau of Land Management (BLM) and is now owned by the ADNR. Silverado and TCM leased the claims from 1978 to 2019. Between 1980 and 1983, Silverado operated a pilot mill for metallurgical testing. The pilot mill recovered gold through gravity separation; no cyanide was used during the operation of the pilot mill. Tailings from the pilot mill were placed in the initial tailings area also known the secondary tailings impoundment.

In 1985, Shannon & Wilson prepared a geotechnical investigation in the area of the proposed tailings impoundment for TCM. Shannon & Wilson's report provided geotechnical design recommendations for site preparation, embankment configurations, and fill placement.

The primary tailings impoundment, lined with compacted silt and bordered by a 45-foot high berm, was designed and built by TCM in 1985. The impoundment had a capacity of approximately 130,000 cubic yards. TCM/Silverado operated the mill at the Grant Mine site from 1985 to 1989 using a cyanide process for gold extraction. The cyanide process involved mixing crushed ore with sodium cyanide and lime solution and then extracting the gold, generating 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 tailing throughout the impoundment.

The site came to the attention of ADEC in 1988 when TCM applied for a rezone, and water samples from two wells adjacent to the impoundment contained cyanide concentrations above the federally established maximum contaminant level (MCL) of 0.2 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. Please note that this release did not result in a breach of the western embankment. Monitoring wells, M-1 and M-2, were installed in 1989 and 1990, respectively, to continue monitoring cyanide in groundwater. The wells were routinely sampled for total cyanide and/or weak-acid-dissociable (WAD) cyanide concentrations

Silverado and TCM prepared a *Mine Tailings Impoundment Closure Plan* in 1998. The plan proposed constructing a compacted silt cap to isolate the mine tailings from potential receptors and limit infiltration. As previously mentioned, Mr. Burggraf would like to pursue this plan for final closure of the impoundment.

4 CONTAMINANTS OF POTENTIAL CONCERN

EPA and TCM collected samples of the tailings within the impoundment in 1994 and 1996, respectively. A summary of their results is presented in Table 1. We do not anticipate the concentrations have changed since this sampling occurred. We did not collect soil samples from within the primary tailings impoundment, but assume concentrations remain above regulatory limits.

Contaminants of potential concern (COPCs) at the site are metals and cyanide. Analytical results for the following COPCs in soil exceeded ADEC's most stringent cleanup levels in previous investigations: WAD and/or total cyanide, antimony, arsenic, and mercury. Only antimony and arsenic exceeded the human health risk cleanup levels in the tailings.

5 CONCEPTUAL SITE MODEL

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 is the uncapped mine tailings. The following sections summarize the CSM, and potential receptors and exposure pathways and describes the affect the capping would have on the risk of exposure.

5.1 Description of Potential Receptors

We consider mine workers, site visitors, trespassers, construction workers, and nearby residents to be current or future potential receptors. We do not consider farmers or subsistence harvesters and consumers to be potential receptors at present. Animals are also

potential receptors as moose tracks have been seen inside the fence in the primary tailings impoundment, and birds may be attracted to standing water in the impoundment; to date; no bird fatalities have been observed within the impoundment. Plants may uptake contaminants in tailings if they colonize the bare tailings surface but will unlikely be affected by groundwater because of the depth to the water table.

5.2 Potential Exposure Pathways

Potential human and wildlife exposure pathways include direct contact with tailings or groundwater leading to potential incidental ingestion and dermal absorption of contaminants.

5.2.1 Direct Contact with Soil

Dermal absorption and direct ingestion of surface soil will no longer be exposure pathways once the cap is in place. Direct contact with subsurface soil at the site is unlikely since future land use restrictions will prohibit excavation.

5.2.2 Direct Contact with Groundwater

Nearby residential wells may be a potential direct-contact exposure pathway via groundwater which was measured at approximately 155 feet bgs during field activities. Industrial workers/contractors sampling monitoring wells on-site and residents with wells downgradient from the site may be exposed to contaminated groundwater through ingestion or dermal exposure. Previous investigation of on-site monitoring wells detected elevated levels of cyanide and some metals; however, contamination was not identified in the measured off-site residential wells.

Current groundwater conditions do not indicate COPCs are present above ADEC cleanup levels, except for arsenic at concentrations below previously established background concentrations. The likelihood of ingestion from residential wells is unknown but presumed to be low due to high natural levels of arsenic and minerals that deter residents from drinking groundwater.

Placement of the cap will not affect this exposure pathway.

5.2.3 Direct Contact with Surface Water

Snowmelt and rainwater will no longer accumulate in the primary impoundment once the cap is in place.

6 CAPPING PLAN

This capping plan has been developed to reduce the potential for redistribution, exposure, and surface-water infiltration with a minimum amount of future maintenance. The capping plan presented here is based on the following:

- The horizontal and vertical extent of the tailings has been adequately characterized.
- Free product and surface soil staining are not present in the area of the primary tailings impoundment.
- Site COPCs are below ADEC human health-based soil cleanup levels except for arsenic and antimony. A cap would eliminate the potential for contact with the tailings.
- The tailings in the primary impoundment are not contributing to the metals in groundwater at the site as evidenced by higher concentrations of metals in upgradient, background wells.
- Sensitive subpopulations and permanently occupied buildings are not present at the site.
- There are no unacceptable human health or ecological risks once the cap is in place.
- No streams flow through or near the impoundment; ditches and culverts are effective at channeling surface water away from the impoundment. St. Patrick's Road is maintained by the Alaska Department of Transportation and Public Facilities (DOT&PF). In the event the road is threatened by clogged ditches, DOT&PF would clean the sediment from the ditch.
- The proposed cap thickness of 36 inches exceeds the 24-inch cover thickness recommended in the DEC Solid Waste Regulations.
- The capping material will support the establishment of native plant species. Any organic material removed from the ground surface will be stockpiled and spread over the surface of the cap to encourage the growth of native vegetation.
- Consolidation occurs naturally over time. The angular nature of individual grains allow for tighter packing limiting the material's compressibility. Since the tailings have been in place for over thirty years, we anticipate the subsidence of the tailings will be minimal.
- The capping does not preclude future mining.

6.1 Cap Design and Construction

Stutzman Engineering (Stutzman) is preparing a grading plan for the impoundment; the final plans will be stamped by a professional engineer licensed to practice in Alaska. Figure 2 provides a schematic of the capping which will be finalize once coordination with the ADNR Dam Safety Program is complete. Stutzman's plans will show the extent of the cap and the location of the area to be excavated to provide the capping material. They will

specify a lift thickness of 8 inches. Compacting the individual lifts will require a minimum of two passes with loaded rubber-tired equipment to achieve a permeability of no less than 1×10^{-5} cm/sec.

The cap will be a minimum of three feet thick, constructed from silt obtained from the berms and the area west of the impoundment. The silt will meet the definition of DOT&PF's Type C - Select Material which contains no muck, peat, frozen material, roots, sod, or other deleterious material. The surface of the cap will be graded to a 2-percent grade sloped to the west and planar to minimize accumulation of standing water; the surface will be tracked with a dozer to encourage the accumulation of seeds. A new diversion ditch will be established on the uphill side of the capped area to carry runoff to the north then east away from the impoundment.

The areas of the berm and to the west of the impoundment will be cleared and grubbed before silt for the cap is obtained. Stutzmann estimated about 20-percent of the material will be waste. This surficial organic-rich material will be stockpiled and later spread over the completed cap to encourage revegetation with native plants.

6.2 Future Land Use

6.2.1 Institutional Controls

Since the tailings within the impoundment exceed ADEC's human health risk cleanup levels and will not be removed from the site, ADEC will require institutional controls (ICs) in the form of a deed notification/environmental covenants to ensure future land use will not adversely affect the cap. ADNR, as the landowner, will need to agree with and comply with the ICs and modify the deed as required by 18 AAC 60 and 18 AAC 75.

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 closure.

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

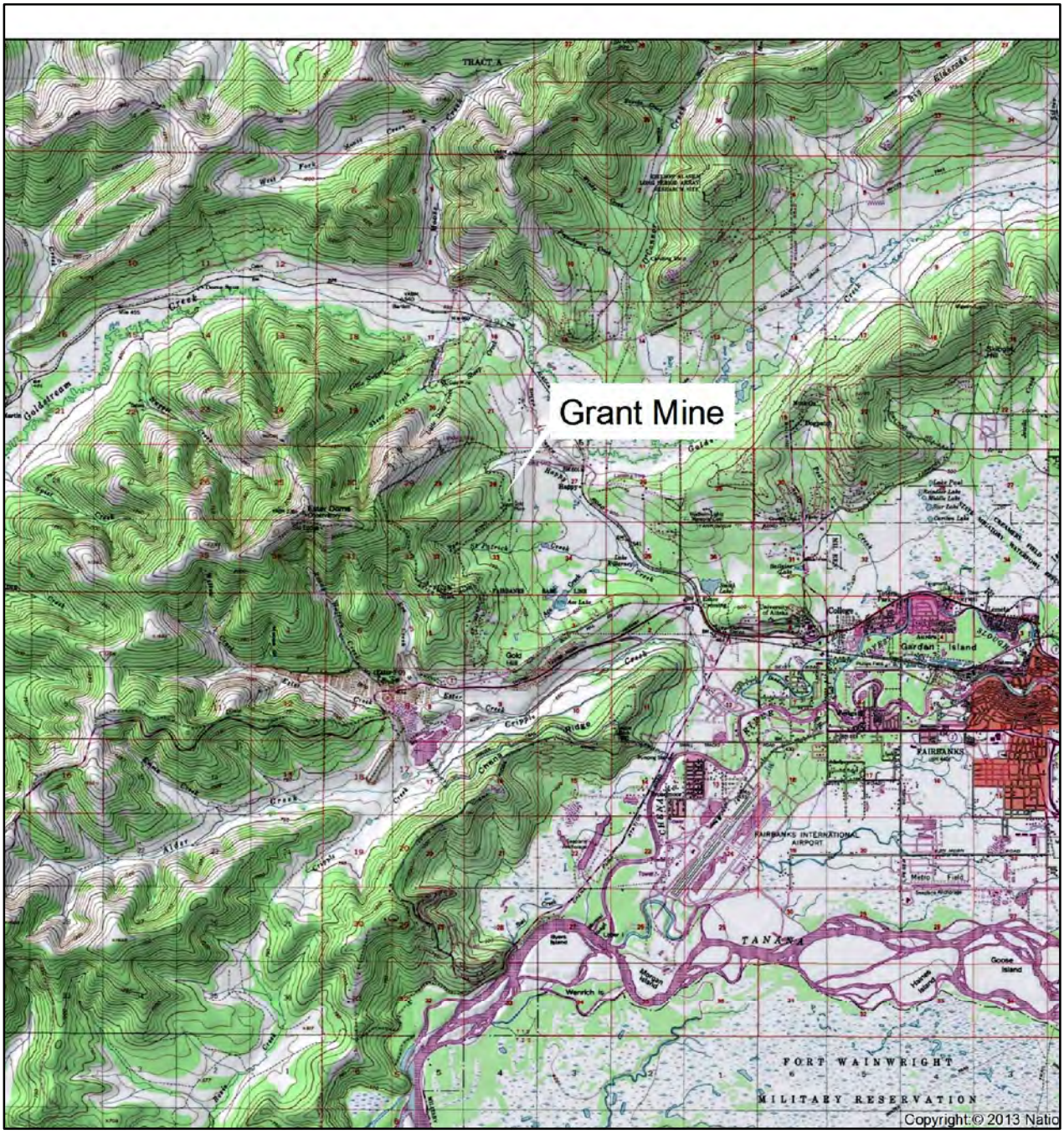
(2) an engineered feature or structure that requires monitoring, maintenance, or operation, or that will not function as intended if disturbed.

(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.

Mr. Burggraf will work with ADEC and ADNR to develop the appropriate deed notice/environmental covenant for the portion of the property surrounding the impoundment.

6.2.2 Post-Closure Monitoring

18 AAC 60.490 (c) outlines the post-closure monitoring requirements for monofills. The owner/operator shall conduct visual monitoring, for settlement and erosion, for at least 60 consecutive months following the closure. Additional monitoring may be required as described in 18 AAC 60.815, if a change is observed. At the end of the post-closure period, the owner or operator shall submit a report to the department that describes site conditions and summarizes the information collected during post-closure period.



N

1 Mile

Grant Mine Tailing Impoundment Closure
Ester Dome, Alaska

SITE VICINITY

March 2020 31-1-20094-007

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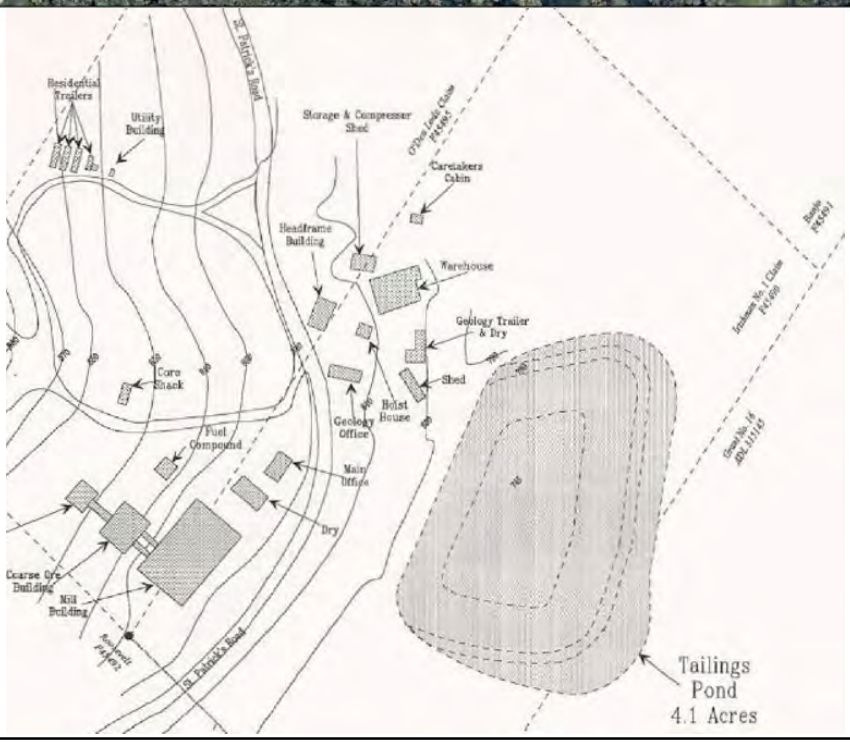
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Figure 1



N

200 Feet

Grant Mine Tailing Impoundment Closure
Ester Dome, Alaska

SITE MAP

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Figure 2

FIGURE 3. SCHEMATIC OF GRANT MINE TAILINGS IMPOUNDMENT CAP