Water Use Management Plan

Saunders Demonstration Mine

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Twin Pines Minerals, LLC

GEORGIA
REGISTERED
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Introduction

The Saunders Demonstration Mine is a 773-acre site located approximately three miles west of St. George, Charlton County, Georgia. The heavy mineral sands at the site contain commercially marketable amounts of titanium and zircon. The proposed mining operations have been designed to minimize impacts to the environment and to recycle water as much as possible. In general, the sands will be collected, processed, and then returned to their point of origin. The sands will be collected using an open-pit dragline method with a maximum sand removal depth of 50 feet below ground surface (bgs).

Mining Operations and Ore Processing

Mineral-bearing sands will be collected from an approximately 100-foot-wide excavation advancing at an average rate of 100-200 feet per day. The excavation pit will be backfilled with post-processed sand as mining advances. After the heavy minerals have been removed from the sand, a conveyor will move the tailings back to the excavation site, where they will be used to refill the excavated area that will then be restored.

Ore beneficiation (i.e., processes that improve the economic value of ore) will occur through centrifugal processing to separate heavy minerals from sand, followed by electrostatic and magnetic separation of the minerals, and return of post-processed sand back to the point of origin for reclamation. Only water and physical/mechanical processes are used; no chemical separation processes are included. The only chemicals used will be for pH control of the process water and to flocculate/reduce suspended solids.

See Surface Mining Land Use Plan (SMLUP) for details of the mining operations and ore processing

Previous Studies

Previous studies have been performed for the Mine and are attached as Appendices. The following reports, in chronological order, were prepared by Professor Robert Holt at the University of Mississippi and TTL, Inc. (TTL).

Appendix A - "Geologic Characterization at Twin Pines Mine," dated October 31, 2019. This study was prepared to characterize the pre-mining conditions along Trail ridge, provide models to predict the impact of mining operations on groundwater discharge to streams and wetlands adjacent to the proposed mine, and to aid in the evaluation of post-mining hydrogeologic conditions to assist reclamation/restoration efforts. (Since the publication of this study, it has been agreed that the mine will be a zero-discharge site with no discharge to adjacent streams and wetland.) For the study, a total of 492 borings were advanced and analyzed. Additionally, 86 piezometers were installed to monitor groundwater within the surficial aquifer and two (2) deep pumping wells, and 22 observation wells were installed.

Appendix B - "Water Quality at Twin Pines Mine," dated October 31, 2019. This study obtained water samples from six (6) piezometers and two (2) surface water locations, analyzed the samples for various physical and chemical properties, and reported the results.

Appendix C - "Hydrogeologic Field Characterization at Twin Pines Mine," dated October 31, 2019. Study characterizing the results of two independent well pump tests in wells installed approximately 115 feet below ground surface (bgs).

Appendix D - "Climate Data at Twin Pines Mine," dated November 15, 2019. This study compiled annual temperature, precipitation, and evapotranspiration data and concluded that the site historically has been subjected to an average annual precipitation of 51.25 inches of precipitation and an average annual evapotranspiration of 39.50 inches for a net average annual gain of 11.75 inches of precipitation from 1986 – 2017. The numbers for the period 1947-1971 were 55.75 inches of annual precipitation, 38.50 inches of evapotranspiration, with a net average annual gain 17.25 inches of precipitation.

Appendix E - "Local Groundwater/Surface Water Hydrology at Twin Pines Mine," dated November 22, 2019. The purpose of the study was to obtain water-elevation data that could be used to evaluate (1) the response of groundwater and surface water to precipitation events, (2) groundwater and surface water interaction, (3) fluctuations of water elevations over time, and (4) groundwater flow direction and velocity.

Appendix F - "Laboratory Testing Data at Twin Pines Mine," dated November 26, 2019. This study advanced fourteen (14) borings and obtained three (3) relatively undisturbed samples from each of the borings for a total of 42 samples. The samples were tested for vertical hydraulic conductivity, porosity, grain-size distribution, Atterberg Limits, and soil-moisture retention characteristics.

Appendix G - "Subsurface Lithology of the Surficial Aquifer at Twin Pines Mine," dated December 1, 2019. The purpose of this study was to document the subsurface soil/sediments that comprise the surficial aquifer at the Twin Pines Mine.

Appendix H - "Impact of the Proposed Twin Pines Mine on the Trail Ridge Hydrologic System," dated January 14, 2020. The purpose of this study is to document and develop numerical and analytical groundwater models to evaluate the impact of the proposed Twin Pines Mine on the hydrologic system underlying Trail Ridge.

Appendix I - "Assessing the Impact of Soil Amendments During the Reclamation of the Proposed Twin Pines Minerals, LLC Saunders Demonstration Mine Using Groundwater Flow Models," that reports the results of bench-scale studies that can be used to design a soil amendment strategy, if one is required by EPD.

Appendix J - "Modeling the Groundwater Flow System at the Proposed Twin Pines Mine on Trail Ridge, dated July 20, 2021, prepared by GSI Environmental, Inc. (GSI) to document the revised groundwater modeling efforts conducted to evaluate the impact of the proposed TPM mine on the Trail Ridge hydrologic system and to address issues raised by EPD including (1) the addition of a continuous consolidated black sand unit within the model, and (2) the placement of a bentonite soil amendment layer in order to reconstitute the consolidated black sand unit post-mining.

Water Supply

Water supply to the facility will be provided by two (2) new wells screened in the Floridan aquifer far below the zone in which mining will take place. The proposed locations of the wells are shown on Sheet C-200 of the Drawings. Well FWP-01 is located east of the Fuel Storage Area on the south portion of the sheet; Well FPW-02 is located east of the Alternate Storage Pond on the north portion of the sheet.

A proposal for the construction of two new wells was received from the Donald Smith Company, Inc. (DSC) of Headland, Alabama. The proposal from DSC included the installation of two 650-feet deep open bottom limestone wells installed by rotary drilling with 12-inch steel casing and 75 hp line-shaft vertical turbine pumps (VTP) set at a depth of 180 feet bgs. A line-shaft VTP has an above-ground motor and the one proposed by DSC can produce 600 gpm of water at 300 feet or less of total hydraulic head; the discharge pipe is 8-inch in diameter. DSC reports that they have installed other wells in the limestones of the Hawthorne formation and that well screens are generally not required. However, if sand is encountered during drilling or well development, screens will be added. For additional details, see the DSC proposal in Appendix K.

The supply will primarily be applied directly to the process water ponds (Sheet C-200) to maintain the needed volume for recirculation. It is assumed that there will be an average loss of 300 gpm to retention on the tailings and evaporation throughout the process facilities.

Process Flow Diagram

A Process Flow Diagram (PFD) for internal process water use is shown on Sheets C-571/572. Wells FWP-01/02 will feed Pond P3 which will distribute the process water to Ponds P1, P2, and P4 (see sheet C-205). The ponds are interconnected with valves and pumps and water can be distributed as required to equalize the basins and feed water to the various ore processing components as shown on the PFD.

Process Water Requirements

Major processing components are labelled on Drawing C-205. A process holding basin, consisting of a series of three (3) lined process water ponds (P1-P3) and one (1) lined process water overflow pond (P4), will be constructed for storing process water as part of the closed-loop water recycling system. The individual pond volumes are shown on Sheet C-200; the total capacity of these four ponds is approximately 3.9 MG and the working capacity with appropriate freeboard is 3.4 MG.

The initial process water will be drawn from wells from the Floridan Aquifer pursuant to a groundwater use permit. To reduce the amount of groundwater withdrawn, all process water will be returned to the basin so that it can be continually recycled after use.

Water usage consists of 3,000 gpm to feed the ore processing facility needs; this water will be returned to the basin at a rate of approximately 2,700 gpm with 300 gpm being consumed. The return flow will pass through a thickener (item 12 on C-205) and underflow ponds (item 11 on C-205) to remove sediments. Sediments in the thickener (and all other ponds) will be cleaned out by vacuum sediment dredging as required.

The daily process water demand is 4.32 MG (3,000 gpm x 60 min/hr x 24 hr/day x 1MG/1,000,000 gal = 4.32 MG). Dividing the working capacity by the demand gives an average detention time in the process ponds of about 19 hours.

The makeup water requirement is 300 gpm which is equivalent to 0.43 MG (300 gpm x 60 min/hr x 24 hr/day x 1 MG/$1x10^6$ gal = 0.43 MG). The annual makeup water requirement, assuming continuous operation, is 157 MG (0.43 MGD x 365 days/year = 157 MG).

Water Management Ponds Additional Storage

Along with the Process Water Ponds (Ponds P1-P4 on C-205), are supplemental water management ponds M1-M4. These additional ponds are shown on Drawing C-200 along with their total and working volumes. The ponds are interconnected with sluice gates so that the impounded water can be effectively managed.

These ponds have a total area of 50.8 acres and a maximum working volume of 111.8 MG of water. Normal operations will target on operating depth of about five (5) feet in each of the Water Management Ponds except for M4, the alternate storage pond. This pond will be mostly empty during normal operations to provide 12.6 MG of emergency storage. Ponds M1 – M3 have a normal operating volume of 59.4 MG at five (5) feet of water depth.

Each pond has a 200 feet long broad-crested weir overflow section that is two (2) feet below the top of the berm. The overflow section is designed to pass water to the lower, adjacent pond once the water elevation exceeds the overflow elevation if necessary. The overflow section can pass about 820 cubic feet per second (0.368 MG/min) based on a weir coefficient of 1.45 ($Q = 1.45 \times 200$ feet * 2 feet $^{3/2}$ = 820 cfs).

The annual makeup water requirement exceeds the total working capacity of the ponds by 45.2 MG (157 MG – 111.8 MG = 45.2 MG). A portion of the makeup water requirement can be balanced by rainfall storage. Climate data analysis (Appendix D) indicates that the average net amount of rainfall more than evapotranspiration at the site is 11.75 inches per year. Multiplying the surficial area by the rainfall, results in about 16.2 MG/year of average accumulation of rainwater in the Water Management Ponds. This represents about 10% of the annual makeup water requirement.

Mine Pit Dewatering

In addition to storing rainwater, the Mine Pit Water Management Pond M1 will be used to store water pumped out of the mining pit should dewatering be necessary due to mining equipment breakdown or maintenance. Twin Pines estimates that mine pit dewatering will be relatively rare and may be required no more than two times per year. Mine pit dewatering is a manual process consisting of personnel placing submersible pumps inside the mine pit and connecting them to above ground hoses that transmits the water to the Mine Pit Water Management Pond M1. Planned shutdown/start-up of the mining operation requiring dewatering will only occur when adequate storage is available and when significant rainfall events are not forecast. A conceptual model of the mine pit is shown in Figure 2 and Figure 1.

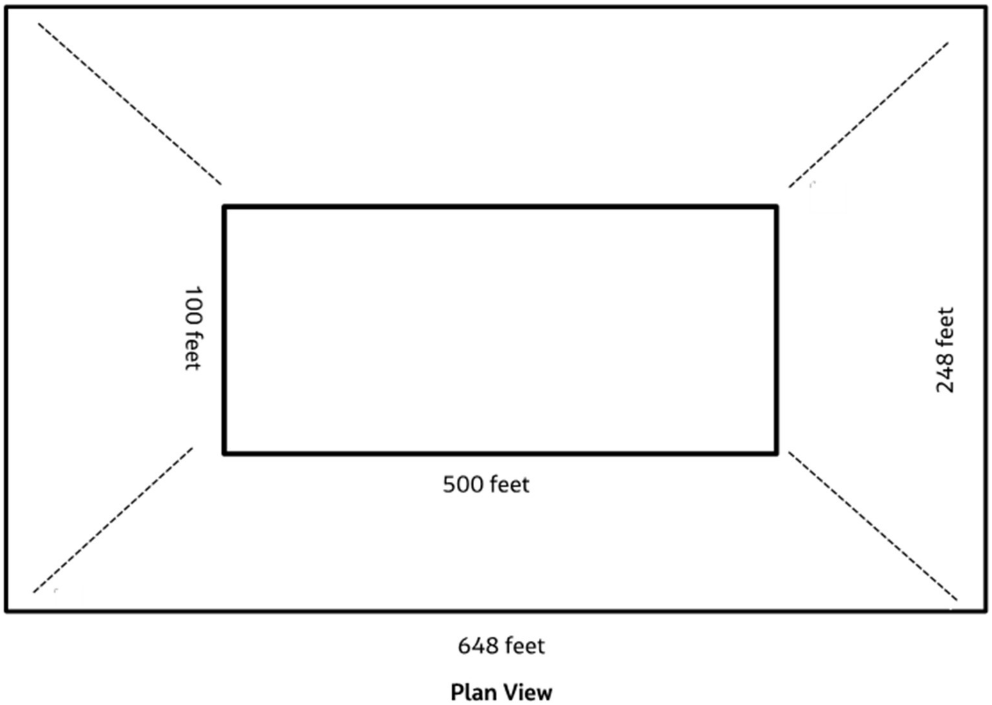

Figure 1. Mine Pit Conceptual Model (Plan View)

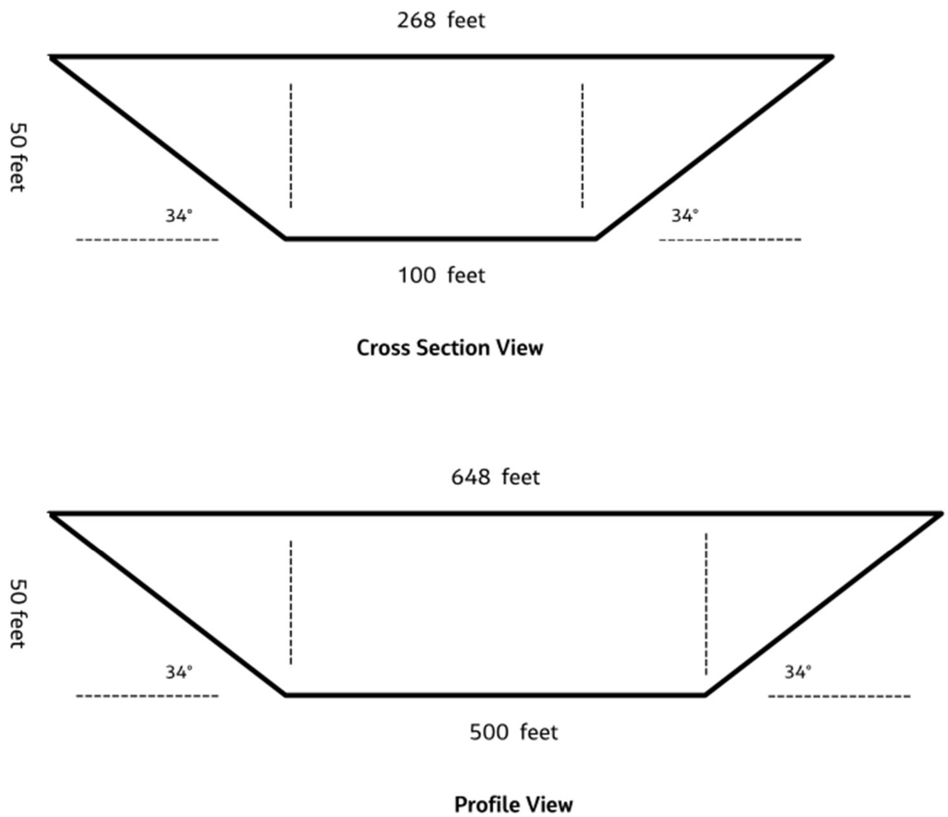

Figure 2. Mine Pit Conceptual Model (X-section and Profile)

The mine pit water management pond M1 contains internal baffles (Sheet C-302) to increase the circulation path of the water entering the pond to allow for sedimentation. The ponds will be vacuumed periodically to remove sediments.

The volume of the mine pit is the average area at the top and bottom, times the depth giving a total volume of 39.4 MG.

<u>Maximum volume of water to dewater pit</u>

$$A_1 := 248\ ft \cdot 648\ ft = 160704\ ft^2$$

$$A_2 := 100\ ft \cdot 500\ ft = 50000\ ft^2$$

$$A_{avg} := \frac{A_1 + A_2}{2} = 105352\ ft^2$$

$$Vol := A_{avg} \cdot 50\ ft = \left(5.27 \cdot 10^6\right)\ ft^3$$

$$Vol = 39.4\ MG$$

$$\frac{Vol}{300\ gpm} = 91.21\ day$$

Since it is unlikely that the full 50 feet depth would require dewatering, the 38.3 MG available in the Mine Pit Water Management Pond would be sufficient. If additional capacity is necessary, there is potentially 73.5 MG of additional storage in the three adjacent ponds depending on the amount of lead time.

Another consideration is that dewatering would commence immediately upon a work stoppage. Seepage into the mine pit is not instantaneous and sufficient pumps will be used to keep up with the seepage water entering the pit. Operationally, Pond M1 would be dewatered prior to use for mine pit water, and after the pit dewatering event, the use of mine pit water in Pond M1 would be prioritized so that the mine pit water would be consumed as makeup water as quickly as practicable. With the makeup water requirement of 300 gpm, Pond M1 would be effectively emptied in about 90 days which should be considered the minimum time between dewatering events.

Automatic Level Sensor Control

In addition to the overflow weirs, pumps P-101 (primary pump) and P-102 (secondary pump) located at the Sand Processing Area Water Management Storage Pond-M3 can transfer water from M3 to P2. These pumps are equipped with an acoustic wave sensor to monitor water elevation. The acoustic wave sensor utilizes a high-powered acoustic wave transmit pulse which reflects the surface of the material being measured to control the pumps based on certain water levels of the Sand Processing Area Water Management Storage Pond-M3. The acoustic wave sensor will control the pumps at five different levels, a low-low level (LLL), a low level (LL), normal operating levels, (NOL) a high level (HL), and a high-high level (HHL). A control action will accompany each water level shown in the table below:

Table 1 - Water Level Alarms

Level	Action
Low-low level	A low-low alarm will signal to the operator that a low-low level has been reached.
Low Level	The primary pump will shut off.
Normal Operating level	The primary pump will run during normal operating levels.
High Level	The secondary pump will turn on along with the primary pump until the water returns to normal operating levels.
High-High Level	Both pumps will continue to run, and a high alarm will signal to the operator that a high-high level has been reached.

** See Twin Pines Minerals, Saunders Demonstration Mine (ID NO. 2073) exact water levels

The alarm levels for M3 are:

- Low-Low level is the elevation indicating that the pump intake is sucking air.
- Low Level is the elevation preventing cavitation of the intake (EL. 161) at M3.
- Normal Operating Level is between EL 161 – EL 163
- High Level is 0.5 feet below overflow crest elevation (EL 165.0 – 0.5 = EL 164.5)

- High Level is the overflow crest elevation EL 165.0

The Acoustic Wave Sensor will allow the monitoring of the pond's water levels automatically. Additionally, all ponds will also be equipped with a visual monitoring stick for manual readings of the pond levels.

Another acoustic wave sensor will control the water levels at the Primary Holding Pond-P4. It will control P-103 (primary pump) and P-104 (secondary pump) using the same level sequence located in the table above. The Primary Holding Pond-P4 will also be equipped with a visual monitoring stick for manual readings of the pond levels.

Berm Design and Construction

The Process Water and Water Management Ponds will be designed in accordance with Georgia Safe Dams Engineering Guidelines regarding subsurface exploration, testing, and engineering analyses by a Georgia Safe Dams Certified Engineer.

Water Management During Closure

Water management during closure of the mine is relatively straightforward. Mining operations will necessarily cease prior to the completion of ore processing. The most economical procedure to take the ponds out of service is to schedule mine closure to occur in the drier winter months. The Water Management Ponds would be drained sequentially starting with the contents of the Mine Pit Water Management Pond M1 being drained into the Sand Processing Area Water Management Pond M2. Once drained, the liner would be removed, but the berms left in place. Next, Sand Processing Area Water Management Pond M2 would be drained into Sand Processing Area Water Management Storage Pond M3. Once drained, the line would be removed, but the berms left in place. Finally, Sand Processing Area Water Management Pond M3 would be drained into the Alternate Storage Pond M4. Water retained in the Alternate Storage Pond M4 can be minimized by limiting process water makeup withdrawal from the wells as much as possible. There will inevitably be some water remaining in the Alternate Storage Pond M4 after ore processing ceases. This final water will be disposed of by installation of a site evaporation system or else the water will be collected and trucked offsite. A brochure for a typical industrial evaporator system is shown in Appendix L.

Once the last water has been removed and the final liner hauled off site, the soil used to construct the berms can be spread over the existing site to the final grades. Additional details can be found on TTL Sheet 9: Post-Mining Reclamation Plan (1) and Sheet 10: Post-Mining Reclamation Plan (2).

APPENDICES

Appendix A

Geologic Characterization at Twin Pines Mine

Appendix B

Water Quality at Twin Pines Mine

Appendix C

Hydrogeologic Field Characterization at Twin Pines Mine

Appendix D

Climate Data at Twin Pines Mine

Appendix E

Local Groundwater/Surface Water Hydrology at Twin Pines Mine

Appendix F

Laboratory Testing Data at Twin Pines Mine

Appendix G

Subsurface Lithology of the Surficial Aquifer at Twin Pines Mine

Appendix H

Impact of the Proposed Twin Pines Mine on the Trail Ridge Hydrologic System

Appendix I

Assessing the Impact of Soil Amendments During the Reclamation of the Proposed Twin Pines Minerals, LLC Saunders Demonstration Mine Using Groundwater Flow Models

Appendix J

Modelling the Groundwater Flow System at the Proposed Twin Pines Mine on Trail Ridge

Appendix K

Donald Smith Company, Inc. (DSC) Well Proposal

Appendix L

Example Industrial Evaporator Product Brochure