2.0 ASSESSMENT OF ALTERNATIVES

2.1 Background

A major component of the environmental assessment (EA) process is the evaluation of alternative methods to carry out the Project. These alternatives include both "alternatives to" the Project and "alternative methods" to carry out the Project. This evaluation helps to guide the Project in a responsible manner with the assurance that any reasonable options have been considered. The assessment of alternatives has been prepared in accordance with the *Canadian Environmental Assessment Act* (CEAA, 2012) environmental impact statement (EIS) guidelines.

Alternatives will be carried forward through the assessment if they are likely to fulfill the following objectives:

- Does the alternative provide a reasonably viable solution to the problem?
- Is the technology both proven and has the necessary ability to operate at the Project scale?
- Is the alternative consistent with other Project objectives and/or company policies and procedures?
- Is the alternative consistent with Provincial government policy initiatives?
- Could they affect any sensitive environmental features or other valued components (VCs) when compared to other viable alternatives?
- Is the alternative reasonable to implement in a practical and economical fashion?
- Is the alternative within the scope of the company to implement?
- Is it possible to implement the alternative within the defined study area?
- Are they able to meet the purpose of the *Ontario Environmental Assessment Act*?

2.2 Assessment Methodology

2.2.1 Project Alternatives

2.2.1.1 Identification of Alternatives

Alternatives for the Project have been carefully considered, bearing in mind that all mining operations pose some unavoidable on-site safety risks, as do other industrial operations. Treasury

Metals is aware of these risks and will put a priority on worker health and safety and training programs.

Alternatives for the Project have been considered with respect to the following Project components:

- Mining;
- Minewater management;
- Mine rock and overburden management;
- Processing methodology and gold recovery;
- Process effluent treatment;
- Tailing storage facility (TSF);
- Water supply sources;
- Water discharge location;
- Project infrastructure locations;
- Aggregate supply;
- Non-hazardous solid waste management;
- Hazardous solid waste management;
- Domestic sewage management;
- Explosives storage facility
- Power Supply; and
- Mine closure.

2.2.1.2 Alternatives Assessment Approach

The approach to the assessment of alternatives for the Project EA is to compare and evaluate the overall advantages and disadvantages of each reasonable alternative using a numerical scoring value where possible. Where not possible, an objective non-numerical scoring was used to evaluate each alternative. Comparable methodologies have been followed in similar EAs for other regional mining projects.

The alternatives assessment was accomplished with consideration of any comments received to date from; Indigenous communities, the general public, local stakeholder groups and government reviewers. The information from local stakeholder groups remains invaluable as it provides an opportunity to assign relative importance of contributing factors from these stakeholder groups.

2.2.1.3 Performance Objectives

The alternatives assessment was completed with the information available at the time and is consistent with the stage of the Project. It compares alternative methods by first identifying and characterizing the advantages and disadvantages of each feasible alternative method, then assessing each against each other for a series of objective measures to arrive at a preferred alternative.

The objective measures used are features that are significant for the realization of the Project as a whole and offer a relative basis to evaluate the distinct alternatives. The following objective measures were used in the comparison of alternatives:

- Overall cost for the life of the Project;
- Technical feasibility and technical reliability;
- Effects to the environment, including human, physical and biological environments; and
- Potential ability for future closure/reclamation processes.

2.2.1.4 Evaluation Criteria

For each aforementioned objective measure, a series of specific criteria and data were used to quantify the alternative characterization:

- Technical reports created by Treasury Metals and its external consultants;
- Baseline studies completed for the Project area;
- Federal, Provincial and Municipal guidelines and reports; and
- Local stakeholders and community members.

Overall Cost for the Life of the Project

The overall cost is the total sum of all costs to implement and operate an alternative including initial and sustaining capital expenditures, operating costs and closure/reclamation costs (Table 2.2.1.4-1).

Table 2.2.1.4-1: Financial criteria for the alternatives assessment

Criteria	Assessment
Goliath Gold Project Financing	Investor desirability and/or risk
Return on Investment (ROI)	Provides a competitive and acceptable ROI
Financial Risk	Provides a manageable or acceptable financial risk

The performance of these criteria is defined as:

- Preferred: Carries an acceptable financial risk while making a competitive ROI.
- Acceptable: Carries an acceptable financial risk while making an acceptable ROI.
- Unacceptable: Carries an unacceptable financial risk or does not provide an acceptable ROI.

Technical Feasibility and Technical Reliability

Technical feasibility and reliability can be used in conjunction to describe the suitability of a specific alternative (Table 2.2.1.4-2).

Table 2.2.1.4-2: Technical feasibility criterion for the alternatives assessment

Criteria	Assessment
Readily Available Technology	Has been successfully implemented in similar mining projects and can be relied upon for sufficient performance over an extended period of time.
	New technologies must be supported by sufficient investigations and technical study to provide confidence in their performance abilities

The performance of these criteria is defined as:

- Preferred: Well understood technical capability of alternative with supporting contingency options.
- Acceptable: Possible technical capability based on theoretical study. Contingency options must be available as a substitute if the alternative fails to perform as expected.
- Unacceptable: No readily available technologies, or technologies that rely solely on unproven studies.

Effects on the Environment, Including Human, Physical and Biological Environments

For this assessment the term human environment refers to the potential for negative human environment effects. These include a wide range of land use, socio-economic, cultural and community factors as outlined in the following table. The term physical and biological environment refers to a wide range of factors within water, air, rock, soil and/or overburden and physical plant or animal species. The evaluation criteria for each factor are described in Table 2.2.1.4-3.

Table 2.2.1.4-3: Environmental Criteria for the Alternatives Assessment

Criteria	Assessment
Local Residents and Recreational Users	• Effect on property values • Effect on employment opportunities • Effect on local access points • Effect on noise levels • Effect on water supply for both well water and drinking water • Effect on visual disturbance • Potential for adverse health effects
Infrastructure	• Effect on local access • Effect on power supply systems
Public Health and Safety	• Attainment of air quality point of impingement standards or scientifically defensible alternatives • Effect on drinking water supply • Effect on local health services
Local Economy	• Effect on local businesses and economic opportunities • Effect on access for tourism operators and/or natural resource harvesters
Tourism	• Effect on local tourism
Regional Economy	• Effect on regional businesses and economic opportunities
Government Services	• Effect on local government services and capacities
Resource Management Objectives	• Effect on established resource management plans
Built and Cultural Heritage	• Effect on any built heritage resource or cultural heritage features • Alteration that is not sympathetic or is incompatible with the historic fabric and appearance of cultural heritage resources • Isolation of a built heritage resource or heritage attribute from its surrounding environment, context or a significant relationship • Direct or indirect obstruction of significant views or vistas within, from or of built heritage resources or cultural heritage landscapes • A change in land use • Avoidance of damage to built heritage resources or cultural heritage landscapes, or document cultural resources if damage or relocation cannot be reasonably avoided
Archaeological Resources	• Effect on land disturbances • Avoidance of archaeological sites or mitigation by excavation if avoidance is not possible, as per the standards and guidelines for Consultant Archaeologists
First Nation Reserves and Communities	• Effect on conditions of community on First Nation reserves
Spiritual and ceremonial sites	• Avoidance of damage or disturbance to known spiritual and/or ceremonial sites
Traditional Land use	• Effect on Traditional Land use as caused by the Project
Aboriginal and Treaty Rights	• Effect on Aboriginal and Treaty rights
Effect on Air Quality and Climate	• Maintain air quality point of impingement standards or defensible alternatives • Emission rates of greenhouse gases (GHGs)

Table 2.2.1.4-3: Environmental Criteria for the Alternatives Assessment (continued)

Criteria	Assessment
Effect on Aquatic Life and Habitat	• Fulfilment of water quality standards and guidelines for protection of aquatic life or ensuring no further degradation of water quality if current conditions do not match Provincial Water Quality Objectives (PWQO) • Management of water level in effected water bodies and streams to maintain aquatic life • Maintenance of fish population • Maintenance of groundwater levels for both flows and quality
Effect on Wetlands	• Fulfilment of water quality standards and guidelines for protection of aquatic life or ensuring no further degradation of water quality if current conditions do not match PWQO • Area, type and quality (functionality) of wetlands that would be displaced or altered • Maintenance of wetland connectivity
Effect on Terrestrial Species and Habitat	• Area, type and quality of terrestrial habitat that would be displaced or altered • Effects of noise disturbance generated by the Project • Maintenance of wildlife movement corridors and plant dispersion • Effect on overall wildlife population
Effect on Species at Risk (SAR)	• Sensitivity level of effected SAR (Endangered, Threatened, Special Concern) • Areal extent, type and quality of SAR that would be displaced or altered • Effects of noise disturbance generated by the Project • Maintenance of wildlife movement corridors and plant dispersion

The performance of these criteria is defined as:

- Preferred: Has no effect or manages to minimize adverse effects with no additional mitigation measures and has a positive overall effect.
- Acceptable: Has no effect or manages to minimize adverse effects with additional mitigation measures and has a positive overall effect.
- Unacceptable: Likely to cause significant adverse effects that cannot be reasonably mitigated.

Potential Ability for Future Closure/Reclamation Processes

The performance of this factor is the ability the alternative to successfully be reclaimed and provide closure (Table 2.2.1.4-4).

Table 2.2.1.4-4: Closure Criteria for the Alternatives Assessment

Criteria	Assessment
Public Safety and Security	• Effect on safety and security risks to the community and general public
Environmental Health and Long Term Sustainability	• Effect on long-term air quality and the ability to meet point of impingement standards • Effect on long-term water quality and the ability to meet water quality guidelines • Effect on long-term wildlife habitats including SARs
Land Use	• Effect on long-term land uses • Effect on long-term visual appearance of Project Site

The performance of these criteria is defined as follows:

- Preferred: Causes limited alteration to the Project site which will in turn create a reduced effort in reclamation activities.
- Acceptable: Causes alteration to the Project site that will require moderate or large reclamation efforts to meet regulatory requirements.
- Unacceptable: Causes alteration to the Project to which reclamation and closure is not technically or reasonably feasible.

2.2.1.5 Identification of Preferred Alternative

Each alternative has been given a classification to be preferred, acceptable or unacceptable to the aforementioned categories. The overall preferred alternative was then chosen using a holistic approach to how the specific alternative interacted with the Project as a greater whole.

2.2.2 Alternatives to the Project

As part of the greater Alternatives Assessment process and in compliance with the CEAA (2012) EIS guidelines, Treasury Metals has assessed three alternatives to the Project. These alternatives to the Project have been identified as:

- Proceed with the Project development, as identified by Treasury Metals;
- Formally delay the Project planning and development until circumstances are more favourable; and
- The “do nothing” alternative (development of the Project is cancelled).

This assessment was carried out to distinguish the relative merits of the different Project alternatives. An analysis of these three alternatives was carried out using the Ontario Ministry of

Natural Resources and Forestry (MNRF) Class EA Environmental Screening Criteria (MNRF, 2003), and the assessment is presented according to:

- Physical and biological environment considerations; and
- Human environment considerations.

For each topic, considerations were expressed relative to potential environmental effects, associated mitigation measures and to the significance of the effect after mitigation. Significance was assessed from low to high levels using a numerical scale of from 1 to 4 for convenience of expression only:

- Low (numerical value of 1): the anticipated future change affects the environmental element in such a way that only a portion of the component is disturbed for a short period of time, or not at all. Level 1 effects are considered to be not significant and serve as the preferred alternative.
- Low-Medium (numerical value of 2): the anticipated future change affects the environmental element so as to bring about a disturbance, but does not threaten the distribution, operation, or abundance of the component. Short-term effects associated with construction and the operation of facilities also constitute a low-medium effect.
- Medium (numerical value of 3): the anticipated future change affects the environmental element so as to bring about a disturbance, and may threaten the distribution, operation, or abundance of the component. Short-term effects associated with construction and the operation of facilities also constitute a medium effect.
- High (numerical value of 4): the anticipated future change affects the environmental element so as to seriously disturb the distribution, operation, or abundance of the component. All components registering as a high-risk alternative are not considered in the Project.

As each one of the components has a different significance and weighting factor, it is not possible to sum the numerical scores to create an overall rating. The overall selection of a preferred alternative is therefore a reasoned process based on best professional judgment (Appendix X).

2.3 Project Alternatives – Construction and Operations

2.3.1 Mining

The choice of a mining method(s) is a function of the geometry and character of the mineralized deposit in relation to the surrounding geology and terrain, mineralization grade, and costs to mine the deposit relative to the mineral resource value (commodity prices), available technologies and environmental sensitivities.

For the Goliath deposit, the near surface resource can be mined by open pit methods and contains potentially mineable mineralized material of just over 5 million tonnes. In addition to the mineralized material, the open pit mining will move approximately 6 million tonnes of overburden and 25 million tonnes of waste rock over a three-year period to expose the mineralized material for processing. A portion of the open pit mineralized material, just over 2 million tonnes, will be lower grade material that is stockpiled during operations for processing in later years. Deeper mineralization will be mined by underground methods, totalling approximately 4 million tonnes. The deep mineralization will be accessed by a ramp from surface.

The available alternatives for mining the Goliath deposit are:

- Open pit mining;
- Underground mining; and
- A combination of open pit and underground mining.

Performance objectives used in the evaluation of mining method alternatives were:

- Cost-effectiveness;
- Technical applicability;
- Minimize effects to the environment; and
- Amenability to reclamation.

Cost-effectiveness

The Goliath deposit is located very close to surface topography and the potentially mineable mineralized material extends to a depth of more than 400 m. The top portion of the Goliath deposit is economically mineable using open pit methods, down to a depth of 160 m below surface, and underground mining is better suited and more economical to access deeper, higher grade portions of the deposit. Based on results of open pit optimization studies, the optimal mining scenario is a combination of open pit and underground mining methods, with approximately 59% of the mineralized tonnage and 38% of the gold ounces to be mined by open pit methods, and the remainder to be mined by underground operations via ramp access.

Either open pit or underground mining on its own does not allow optimal exploitation of the mineralized resource and is therefore not acceptable. The preferred mining strategy is a combination of open pit and underground ramp mining. There are a number of Ontario mines where both open pit and underground mining has occurred, including the Dome Mine (Goldcorp), Musselwhite Mine (Goldcorp), Hemlo Mine (Barrick Gold) and Lac Des Isles (North American Palladium).

Technical Applicability

Open pit and underground mining methods are both well-proven technologies for hard rock gold mining. For the Goliath deposit, underground mining alone is a feasible method, but is not optimal since it is more economical to mine the upper portion of the deposit by open pit. Open pit mining on its own is not feasible to mine to a depth of 400 m below surface. A combination of open pit and underground mining is the optimal method for maximizing recovery of the deposit.

Effects to the Environment

Underground mining methods generate far less surface disturbance compared to open pit mining, and typically yield far smaller quantities of waste overburden and mine rock, and are preferred from an environmental viewpoint where the deposit is amenable to underground mining. Land disturbances associated with open pit mining would include the pit area, together with area required for overburden and mine rock stockpile storage. In addition, the mine rock is predicted to be potentially acid generating (PAG). This material will need to be managed over the short and longer-term after mine closure to prevent potential adverse environmental impacts to the natural environment. Potential adverse impacts to the natural environment include; the risks associated with PAG material infiltrating and seeping into the Blackwater Creek watershed, potentially impacting water quality and aquatic life, as well as the loss of terrestrial habitat due to the development of the open pit infrastructure (stockpiles etc.), and the hydrological changes associated with site development that potentially impact terrestrial and aquatic life in addition to the physiological changes to hydrology.

Effects to the natural environment can be minimized by positioning overburden and mine rock stockpiles as close to the open pit as practical, and by developing higher stockpiles, thereby reducing the overall footprint. However, stockpile height has been limited to 30 m to minimize visual disturbance to the natural environment. Potential acid rock drainage (ARD) concerns can be mitigated through segregation of the majority of the PAG mine rock by encapsulation to limit the potential for ARD development, and where necessary to capture and manage any drainage in an effective manner. Hydrological impacts will be mitigated by capturing all surface water discharge from the site via perimeter containment ditching and delivering the excess captured water to treatment, and discharge via pipeline to Blackwater Creek. This discharge will ensure the continued viability of Blackwater Creek meeting hydrological needs, in addition to continued use by terrestrial and aquatic organisms. Underground mining methods are therefore rated as preferred from a natural environment perspective, and combined open pit / underground mining and open pit mining is rated as acceptable.

Open pit mining typically generates more air and sound emissions compared to underground mining. The intrusive effects of open pit mining on local residents are therefore much more substantive. Measures available to mitigate air and sound emission effects include: stockpile positioning, water sprays and other methods for dust suppression, choice and positioning of heavy equipment, operations scheduling (daytime and night time operations), use of sound barriers and setbacks, and potentially other measures. Open pit mining also has a greater potential to affect fish and wildlife resources compared to underground mining.

2.3.1.1 Selection of Preferred Alternative

Open pit mining in combination with underground mining is the only economically viable strategy for developing the Goliath deposit. Use of these methods will also result in employment and business opportunities that will benefit both the local and regional economies. With proper design and mitigation techniques, the use of open pit and underground mining will result in minimal loss of terrestrial and aquatic ecosystems.

2.3.2 Minewater Management

Minewater that collects in the open pit and underground mine will contain: suspended solids generated from drilling and blasting, and heavy equipment operation; trace metals associated mainly with suspended solids; ammonia residuals from the use of ammonia-based blasting agents; and potentially residual hydrocarbons from occasional hydraulic oil and fuel leaks from heavy equipment. This minewater will need to be collected and treated before it can be released to the environment. Minewater is typically collected in mine sumps (shallow excavations in the pit floor) to allow effective pumping and handling.

The most frequent minewater treatment methods include use of sumps (in pit or underground) to remove bulk suspended solids and residual hydrocarbons, followed by settling in surface ponds to remove suspended solids. Additional technologies such as silt curtains and flocculent can be used in association with sumps or ponds to assist the suspended solids settling process, especially where retention times are more limited (such as less than 10 days). Residual ammonia is most commonly managed by controlling ammonia at source through the selection and management of explosives use and subsequently through natural degradation in extended aging ponds. Through natural degradation, ammonia is lost from the system through uptake as a nutrient by bacteria and algae and through volatilization to the atmosphere. Extended aging for ammonia removal typically takes several weeks during warm water conditions when growing conditions for bacteria and algae and conditions for volatilization are optimal.

The minewater management alternatives considered for the Project after collection are:

- Integrate minewater with TSF operations either directly or through process plant operations; or
- Develop a separate, dedicated minewater treatment and management system.

2.3.2.1 Integrate Minewater Treatment with Site Water Management

The Project will require a number of site runoff and dedicated water management ponds. All of these ponds are required for site effluent and water supply management independent of minewater management needs. As a result, it is possible to integrate minewater management with the proposed water management system without the need to construct additional treatment ponds.

Under an integrated approach, minewater will be pumped from the minewater collection sump(s) in the open pit and underground mine to the minewater pond. Water in the minewater pond will be used for processing. Excess water in the minewater pond not needed for processing will be transferred to either the water treatment facility or the TSF. As such, minewater could be discharged to the TSF either directly or by way of the process plant operations and there will be no direct release of minewater to the environment.

The integrated site water management system will provide sufficient retention time for the settlement of suspended solids and associated heavy metals, as well as for ammonia degradation/volatilization. Excess water from the minewater pond, along with excess water from other site facilities, will be discharged to the environment following treatment to meet applicable regulatory requirements, as required to balance the overall system water inventory.

The integrated site water management system requires a number of large ponds to ensure adequate water availability for processing at all times and does not require any modification to contain and treat minewater. Minewater will be re-used in order to minimize the need for additional freshwater supply. There is also the potential to manage a portion of the minewater separately within the TSF (and hence still as part of the integrated site water management system) as a contingency, if required, to ensure that regulatory requirements can be met for discharge.

2.3.2.2 Separate Minewater Pond System

The other alternative identified is to construct a separate minewater pond system capable of providing extended open air aging for ammonia degradation/volatilization and for suspended solids and residual hydrocarbon removal. The dedicated pond will discharge directly to the environment on meeting all regulatory requirements.

2.3.2.3 Performance Objectives and Evaluation

Performance objectives applicable to minewater management are:

- Cost-effectiveness;
- Technical applicability and/or system integrity and reliability;
- Ability to service the site effectively;

- Effects (adverse) to the natural environment; and

- Amenability to reclamation.

Cost-effectiveness

The only additional costs associated with the integrated minewater management alternative will be for the pumping systems and pipelines required to transfer minewater to the minewater pond; or to the TSF directly. Development of a separate minewater pond system will also require pumping systems and pipelines to collect and transfer water, including the ability to recycle minewater to the process plant. The dedicated ponds and infrastructure will result in substantive extra costs without providing any improvement in minewater treatment or the quality of excess water. Use of the integrated minewater management alternative therefore confers a substantial cost advantage over the development and use of a separate minewater treatment pond system, without conferring any environmental limitation, and is preferred. The substantive costs associated with development and use of a separate minewater pond system cannot be justified, and the alternative is rated as unacceptable for cost-effectiveness.

Technical Applicability and/or System Integrity and Reliability

Both minewater management alternatives will be equally functional and reliable in terms of technical applicability and system reliability; therefore, both are rated as preferred for this attribute.

Ability to Service the Site Effectively

The only criterion applicable to this performance objective is accessibility. Use of the integrated minewater management alternative reduces land requirements, which may require purchase from private land owners. Alternatives that reduce land requirements are therefore preferred. The integrated minewater management alternative requires less land and is therefore preferred. Use of a separate minewater pond system is rated as acceptable.

Minimize Effects to the Natural Environment

There is no difference in the quality of the excess water requiring discharge from the two systems assuming both systems were designed for equivalent retention time and / or treatment methods prior to discharge to the natural environment. Use of the integrated site water management system for minewater management avoids the need to construct a separate minewater treatment pond system, which will unnecessarily expand the overall Project footprint. Expansion of the overall footprint will cause the direct loss of terrestrial habitat and potentially impact additional aquatic habitat based on placement of the facility. Therefore, from a natural environment perspective the integrated system is preferred. Use of a separate minewater pond system is regarded as acceptable.

Amenability to Reclamation

The integrated site water management system will require reclamation at mine closure, irrespective of whether or not it is used for minewater management. Development of a separate minewater treatment pond system will add to mine reclamation requirements without providing any tangible overall benefit to the Project. Use of an integrated site water management system for minewater management is preferred from the perspective of reclamation.

2.3.2.4 Selection of Preferred Alternative

The integrated site water management system will be fully capable of providing capacity for effective minewater treatment, irrespective of whether or not it receives minewater. Development of a separate minewater treatment pond system will add considerable and unnecessary costs to the Project with no tangible technical or performance benefit. In addition, development of a separate minewater treatment pond system will substantively and unnecessarily increase the overall mine footprint, resulting in an unnecessary increased environmental effect for no measurable benefit. The alternative of constructing and operating a separate minewater system will pose an unnecessary cost burden to the Project for no tangible benefit. Use of the integrated site water management system for minewater treatment is therefore the preferred alternative and as such, the minewater pond will be integrated as part of the greater water management system with transfer possible to and from the TSF and processing plant operations and final treatment for effluent discharge.

2.3.3 Mine Rock and Overburden Management

The Project will generate an estimated 6 million tonnes of overburden and 27 million tonnes of waste rock over the life of the mine. Almost all of these waste materials will be generated by open pit mining with underground mining generating just over 2 million tonnes of waste rock. The waste rock is anticipated to be PAG and will have to be managed for ARD during operations and following mine closure. There will also be just over 2 million tonnes of low-grade ore stockpile mineralized material that will be stored on surface during the open pit production life, which will be reclaimed and fed into the process plant along with mineralized material from underground mining. There is no single location on the Project site where all waste rock, overburden and low-grade stockpile material can be reasonably stored and managed. Therefore, it is proposed to place these materials in separate locations, with one location for PAG waste rock, two for overburden, and another for low-grade mineralized material.

The most critical aspects to consider when selecting a suitable location for these materials are:

- Haul distance from the open pit;
- Property ownership boundary;
- Distance to nearest receptors for sound control;

- Potential for water runoff and seepage control;
- Effects on sensitive wildlife;
- Effects on waters frequented by fish; and
- Effects on local access routes.

Haulage distance and the associated cost of waste rock storage is critical due to the large quantity of waste rock involved. Loading and dumping of materials is a base cost common to all alternatives, but there is also an added haulage cost per tonne-kilometre distance. Even small haulage distance differentials can amount to substantive cost differentials between alternatives. Therefore, it is critical that selected stockpile sites be located in close proximity to the open pit.

Property ownership is another critical consideration. Treasury Metals must hold surface rights (or options to obtain surface rights) for any selected sites. If the rights are not held or cannot reasonably be acquired for an alternative, then Treasury Metals will be unable to secure and utilize the location.

Distance to offsite receptors for sound control is also important. Where it cannot be demonstrated that sound guidelines can be met, the alternative will not be able to be approved. The hauling, dumping and management of stockpiled materials with heavy equipment (principally haul trucks and bulldozers) is a significant source of sound emissions. These operations are carried out on the same frequency as the mining operation (24 hours per day, 7 days per week). Heavy equipment sound can project over distances in excess of 1 km, and are additive to other sound sources such as drills and excavators used in the open pit. There are strict guidelines for permissible sound levels at area receptors (e.g., permanent and temporary residents, and institutional facilities).

A fourth critical aspect is potential for water runoff and seepage control during operations and following closure. This is especially the case for PAG mine rock. Runoff and seepage from waste rock stockpiles must be collected and managed in accordance with MMER requirements, and site-specific Provincial environmental approvals. Sites which cannot reasonably be integrated into a site-wide water management system are less attractive.

Among the more important environmental aspects to consider, aside from the general displacement of habitat, are the potential effects on wildlife and aquatic habitat. Regulations strongly encourage the protection of aquatic habitats that support fish and recommend that proponents make best efforts to develop waste rock stockpiles, which do not overprint waters frequented by fish.

The final critical aspect to consider is effects on local infrastructure, and most notably, access for local residents. Where stockpile locations will block existing access, reasonable alternatives must be available to develop alternative access routes for local residents and services that do not inconvenience people or generate a safety risk.

Alternatives for the storage and management of waste rock and overburden that cannot be reused in construction are:

- Place and manage the waste rock in a stockpile adjacent or proximal to the open pit;
- Develop an alternative waste rock storage and management plan; or
- Establish a temporary stockpile location, with waste rock retained in the open pit during operations and/or returned to the open pit at closure.

It is not feasible to retain overburden within the open pit during operations as such action would interfere with and essentially preclude mining production operations. The overburden needs to be removed to access mineralized material. Temporarily stockpiling overburden and then placing the overburden back in the open pit is possible, but replacing any appreciable volume of materials back in the open pit at closure is cost prohibitive and is not considered. A portion of the stockpiled overburden may be used at closure.

During the latter stages of open pit mining it may be possible to retain a portion of the generated waste rock in mined out areas of the pit. The quantities of such material that can reasonably be retained in the pit are comparatively large; however, any such actions are better regarded as an optimization potential, rather than an alternative disposal method.

It is assumed that three separate permanent stockpile locations will be selected, one location for PAG mine rock and the other two overburden.

Stockpiling of low-grade mineralized material will not be permanent as the material will be reclaimed and fed into the process plant. The low-grade mineralized material will need to be stored close to the primary crusher to allow a short haul for a front-end loader to reclaim the material and tram it to the crusher, since this is the most cost effective and practical method. A site has been selected just south of the crusher so the stockpile is located away from the open pit entrance and does not cause access problems. The underground portal and a ventilation raise are located just north of the crusher, where positioning a stockpile north of the crusher would interfere with underground operations.

2.3.3.1 Waste Rock Storage Area Located to the North of Open Pit

The placement of waste rock to the north side of the open pit allows for economical haulage of this material as there is a sufficient footprint and capacity for this material within a very close distance to the proposed pit haulage routes.

This location provides the ability to place the waste rock wholly on private property owned by the company with the northern boundary lying contiguous to additional exploration claim properties also maintained by the company, which at the time of filing are within the provincial lease process. Noise and dust studies estimate that meeting emissions requirements will be possible for this location. The area to the north of the open pit facilitates the simplest water management strategy as generally all surface runoff from this area can be easily directed to the open pit for subsequent collection. In addition to providing topographical constraints to water management, the area is not sensitive to fish and fish habitat as no known creeks run though the area. Terrestrial habitat removal is minimized in this location as the area has been previously cut by forestry operations and regrowth has been minimal.

2.3.3.2 Waste Rock Storage Area Located to the South of Open Pit

The placement of mine waste rock on the south side of the open pit also allows for a similarly economical haulage profile as there is sufficient footprint directly to the south of the pit area that are nearly completely part of the private land package owned by the company.

The main drawback of this location is that it is generally down gradient from the open pit area as the topography moves from high to low in a southerly direction. This will not facilitate water management in the simple fashion that is allowed by the northern location. In addition the placement of waste rock to the south of the open pit is located within a tributary of Blackwater Creek. The removal of this tributary will alter the hydrology of the watershed and will have a direct impact on fish and fish habitat within Blackwater Creek. For this reason, the southern location is considered not as desirable.

2.3.3.3 Waste Rock Storage Area Located to the North of Open Pit with Co-disposal within Completed Open Pit

The waste rock storage to the north of the open pit as described above is preferred to the southern location. With that being said, one additional alternative was considered once the preferred location was selected. This alternative is to use a co-disposal method of surface rock placement combined with placement of rock within the completed open pit. As the open pit will be mined in sequence with distinct pit bottoms it will be possible to use the previously completed pit bottom for the direct placement of rock from the adjacent pit. Scheduling of the mineralized rock feed to the mill will determine the final volume of rock that is placed into the open pit. At this time it is anticipated that approximately 40% of rock will be placed into the pits.

The benefits of this alternative are similar to those of the northern location highlighted above with the addition that it will reduce the overall Project footprint, height and total volume of the final waste rock storage area. This will further benefit noise reduction as the tipping of haul trucks will occur at a lower ground level as opposed to on top of the waste rock pile. Water management will be further simplified as surface run-off will report directly within the open pit area and will need no further management (pumping, berming or ditching) to have it directed towards the open pit.

Eventual closure of this alternative will subsequently be simplified as much of this rock will be permanently located under a water cover, which will reduce or eliminate ARD potential.

2.3.3.4 Selection of Preferred Alternative

For the reasons stated above, the preferred location for the storage of waste rock material is to the north of the open pit combined with a co-disposal within the completed open pit to the extent possible.

It should be noted that the alternatives available for the storage of overburden material are very similar, if not exact, to the alternatives presented for the storage of waste rock with the exception that there is no possibility for co-disposal for overburden. In this case, Treasury Metals has given priority to the preferred storage location of the waste rock material and by default the preferred alternative for overburden storage is to the south of the open pit area. This does, however, have a number of benefits when compared to using this area for waste rock. The volume of overburden is far less than the volume of waste rock to be stored on site. It is therefore possible to ensure no overburden material is placed within Blackwater Creek Tributary 1 and avoid the placement of material within potential fish habitat. The smaller footprint of this overburden storage also facilitates the collection of run-off water such that it can be treated prior to discharge.

2.3.4 Processing Methodology

Three process plant options were assessed for the Project as part of a distinct study in conjunction with this alternatives assessment (Appendix B). Each option has the same crushing and grinding circuit concept, which will consist of a jaw crusher and a single stage semi-autogenous grinding (SAG) mill. However, the grind size is reduced from P_{80} 106 µm in Option 1 to P_{80} 75 µm in Options 2 and 3. This will result in a longer SAG mill and a larger motor for the increased power required, achieving the finer grind size.

Alternatives considered for the Project's ore processing are:

- Gravity and Carbon-in-Leach;
- Gravity and Floatation; and
- Gravity, Floatation and ILR.

2.3.4.1 Gravity and CIL

Option 1 is a standard carbon-in-leach (CIL) circuit and is considered the base case for the Optimization Study. The ore will be primarily crushed with a jaw crusher and then ground to the target leaching P_{80} using a single stage SAG mill and classifying cyclones. The cyclones will be selected to produce a cyclone overflow density suitable for the leach circuit and eliminate the need for a leach feed thickener. A gravity circuit consisting of a scalping screen and centrifugal concentrator will be fed from the cyclone feed distributor. The gravity concentrate will be batch treated in an intensive leach reactor (ILR) with the pregnant solution treated by electrowinning. Cyclone overflow will pass through a trash screen prior to entering the CIL circuit. In CIL, the ore slurry will be held in agitated leach reactors for 24 hours along with cyanide and carbon. The cyanide will leach gold and silver into solution, while the activated carbon will move counter current to the slurry and adsorb gold and silver. The loaded carbon will be acid washed and then gold and silver will be stripped from the carbon into solution using the Anglo American Research Laboratories (AARL) method. The stripped carbon will be re-activated in a kiln and returned to the CIL circuit, while the eluate containing gold and silver will be passed through electrowinning cells to recover the metals. The electrowon metal sludge will be smelted to produce doré. Leached slurry from the CIL circuit is processed in a cyanide destruction circuit prior to disposal in the tailings storage facility (TSF).

2.3.4.2 Gravity and Floatation with Off-Site Concentrate Processing

Option 2 is proposed as a cyanide-free processing flowsheet. In this option, the CIL circuit is replaced with a flotation circuit. The gravity concentrate will be upgraded using gravity techniques and direct smelting, as opposed to being leached in the intensive cyanide leach reactor. The flotation concentrate will be sold or toll treated (treatment by a third party, typically a smelter, who charges for the treatment of the material and either returns the refined material back to the owner or sells the refined material and reimburses the owner).

The overall flowsheet for this option is much simpler than Option 1, and the flotation circuit is expected to be similar to CIL in terms of operational complexity. The flotation circuit will achieve a lower gold recovery as compared to the CIL circuit, although silver recovery may increase over Option 1. By direct smelting the upgraded gravity concentrate, approximately 50% of the gold and 24% of the silver are recovered economically and sold as doré bar. The remainder of the gold and silver is recovered in the flotation concentrate, which will be dewatered to below the transportable moisture limit (TML) and sold or toll treated off-site. Both ways, there will be a significant reduction in revenue resulting from selling concentrate as compared to doré, and uncertainties will arise when trying to negotiate the value of the concentrate based on assays, transport and toll treatment costs. The primary advantage of Option 2 lies in the absence of cyanide and all cyanide associated issues (cyanide destruction, cyanide code compliance, operator training, and environmental risks). The TSF environmental compliance will be simplified with the absence of cyanide and leached metals in solution. Another notable benefit of Option 2 is that the tailings will be non-acid-generating because the sulphides will be recovered as part of the flotation concentrate and removed from the plant facility.

2.3.4.3 Gravity, Flotation, and ILR

Option 3 provides a flotation circuit similar to Option 2. However, in Option 3, the flotation concentrate and gravity concentrates will be intensively leached using cyanide. Gold will be recovered from solution using a Merrill Crowe circuit and smelted on-site to produce doré. The result is that a significantly smaller amount of material (~5% of the plant feed) will be exposed to cyanide as compared to Option 1.

2.3.4.4 Selection of Preferred Alternative

The three options were comparatively evaluated using evaluation criteria considered critical to the success of the Project (Table 2.3.4.4-1). Option 1 is the preferred option (i.e., has the lowest score).

Table 2.3.4.4-1: Comparison of Process Methodologies using Evaluation Criteria

Evaluation Item	Importance	Relative Ranking*		
		Option 1	Option 2	Option 3
Marketable Final Product	Primary	1	3	1
Gold Recovery (%)		1	3	2
Plant Availability		1	2	2
Initial Capital Cost		2	1	2
Annual Operating Cost		2	1	2
Sub-Total Score - Primary Importance Items		7	10	9
Plant Simplicity – number of unit operations	Secondary	2	1	2
Plant Maintainability - equipment and spares inventory		2	1	2
Gold Security		1	3	1
Tailings / Waste Footprint		2	1	2
Use of Cyanide in Process		3	1	2
Metallurgical Accounting of Product		1	2	2
Sub-Total Score - Secondary Importance Items		11	9	11
Total		18	19	20

Notes:
* Ranking 1 = most favorable
3 = least favorable

Marketable Final Product

Options 1 and 3 produce a gold/silver doré that is directly saleable. Option 2 produces a lesser amount of gold/silver doré as well as a gold-rich concentrate that requires significantly further downstream processing to be equally marketable. Processing of concentrate and refining of doré charges will be deducted from the gold/silver value.

Gold Recovery (%)

Based on metallurgical test work, Option 1 provides the highest gold recovery at 95.5%. The CIL circuit downstream of a gravity circuit provides the lowest risk plant as CIL circuit residence time will compensate for any fluctuations in throughput or reduced recovery in the gravity circuit.

Plant Availability

To achieve high availability, the plant must be designed with standby equipment and provisions for short-term bypass to keep the plant running while equipment breakdowns are attended to. Although all three options have the same high-availability dry end with surge bin and emergency stockpile reclaim, only the CIL plant has bypass provisions for every tank and the capacity to maintain a high recovery operation if the gravity circuit is shut down.

Option 1 has 24 hours of slurry storage capacity built into the CIL circuit while Options 2 and 3 have 30 minutes each built into the flotation circuits. If there is a significant flow surge or interruption in feed, it is unlikely that the Option 1 plant performance will be affected.

Initial Capital Cost

Option 2 provides the lowest capital cost, but it is noted that the final product of this option is substantially different from Options 1 and 3. Options 1 and 3 are of similar capital cost.

Annual Operating Cost

Option 2 provides the lowest operating cost, but this cost does not include the trucking and off-site processing costs associated with the concentrate. Options 1 and 3 are of similar operating costs, but only if the tailings cyanide-wash thickener is included in Option 1. Option 3 provides the lowest operating cost.

Plant Simplicity

Option 2 provides a simple, easy to operate plant with the lowest number of unit operations. Options 1 and 3 are also relatively simple and easy to operate, but not to the extent of Option 2.

Plant Maintainability

Plant maintainability is directly related to the number of equipment items and the spares inventory necessary to keep the plant running. Option 2 has the least number of items of equipment, while Options 1 and 3 are comparable.

Gold Security

Option 2 has poor gold security due to the gold lockup in a relatively voluminous flotation concentrate. This concentrate is trucked and processed off-site. Options 1 and 3 have similar levels of gold security.

Tailings/Waste Footprint

Option 2 has the best opportunity for using a dry-stack tailings deposition method, which will reduce the TSF footprint.

Use of Cyanide in Process

Option 2 avoids the use of cyanide and Option 3 minimizes the amount of material that is exposed to cyanide. The size of cyanide destruction equipment is reduced and the environmental risk is potentially minimized.

Metallurgical Accounting of Product

Metallurgical accounting can be difficult with low volume, high value streams. It is significantly more difficult when the gold / silver-rich stream is locked up in a flotation concentrate and removed from site (Option 2).

On the basis of the analysis above and the other investigations detailed in Appendix B, the preferred alternative has been determined as Option 1 (Gravity Concentration, CIL Circuit). Options 2 and 3, while still technically viable alternatives, have certain inherent disadvantages as compared to Option 1 (Table 2.3.4.4-1).

2.3.5 Process Effluent Treatment

All of the methods considered for managing the cyanide containing streams include cyanide recovery processes to allow the reuse of cyanide and reduction of discharge cyanide concentrations. Alternative methods considered for the treatment of the leach waste stream include:

- Wash the leach tails slurry through CCD (Counter Current Decantation) thickeners to reduce the cyanide concentration below 50 ppm and discharge it to the TSF for natural degradation of remaining cyanide and removal of metals. A cyanide concentration of 50 ppm cyanide is the maximum permissible for tailings storage under the International Cyanide Management Code. Washing the stream through the CCD thickeners also recovers a portion of the cyanide.

- Wash the leach tails slurry through cyanide recovery thickener(s) to recover a portion of the cyanide and destroy the remaining cyanide in the plant prior to discharge of the stream to the tailings facility. In the TSF, additional natural cyanide degradation will occur. Metals are removed in the cyanide destruction circuit.

- A combination of the above whereby cyanide is partially recovered in CCD thickeners, the slurry is discharged to the tailings storage facility with cyanide <50 ppm, and an effluent treatment plant is constructed to destroy cyanide and remove metals contained in the tailings storage facility effluent (final effluent).

Scoring of the methods considered is presented in Table 2.3.5-1, and is detailed below.

Table 2.3.5-1: Alternatives for Water Management, Source, Effluent, Destruction, and Receivers

Scoring (1-4)	Economics	Technical	Suitability	Environmental
Mine Water Management				
Direct Discharge	4	4	1	1
Dedicated Treatment Plant	3	4	4	4
Integrated Treatment Plant	4	4	4	4
Fresh Water Sources				
Nearby Creeks	4	4	4	3
Nearby Lakes	2	4	3	4
Groundwater	3	4	1	3
Cyanide Effluent Management				
Cyanide Recovery by Thickener and Natural Degradation	3	2	2	2
Cyanide Recovery by Thickener and In-Plant Cyanide Destruction	3	4	4	4
Cyanide Recovery by Thickener, Partial Natural Degradation with Effluent Treatment Plant	3	4	3	3
Cyanide Destruction				
Alkaline Chlorination	3	2	2	3
Hydrogen Peroxide	3	3	2	3
Natural Degradation	3	2	2	2
Inco SO_2-Air	3	4	4	4
Sanitary Waste Treatment				
On-site Sewage Treatment Plant	3	4	4	4
Septic System(s)	4	3	3	4
Off-site Treatment	4	4	4	4
Effluent Receiver				
Wabigoon Lake	2	4	3	4
Thunder Lake	2	4	2	4
Hartman Lake	2	4	3	4
Tree Nursery Ponds (Thunder Lake Tributary #3)	4	4	4	3
Black Water Creek	4	4	4	4

2.3.5.1 Natural Cyanide Degradation and Metals Removal in the Tailings Storage Facility

Removal of cyanide and cyanide metal complexes by natural means has been practiced successfully in the mining industry for many years and is a widely accepted practice. A variety of mechanisms are responsible for the natural degradation process over time including volatilization, oxidation, adsorption onto solids, hydrolysis, biodegradation, and precipitation. Although these processes are effective for reducing cyanide, they can require approximately a year to produce acceptable effluent levels and they are difficult to predict.

One issue is that arsenic is not sufficiently removed by natural degradation and thus requires additional chemical treatment. Examples of Canadian plants that have employed natural degradation include the Lupin Mine and the Holt Mine.

Inherent in the natural degradation method is the discharge of cyanide containing slurry from the processing plant into the environment, albeit into a controlled environment. This presents risk to the Project in terms of both approval and perception. The TSF would need to be sized for the residence time required for effective treatment such that high purity water effluent water can be produced, and therefore the footprint and associated environmental impact would be drastically increased as would the cost of constructing and closing the TSF. The complexity of the TSF with respect to seepage, fencing for wildlife, and methods of bird entry prevention would also be increased due to the presence of elevated cyanide concentrations. In addition, due to the unpredictability of the processes involved, effluent treatment may still be required in the future.

For these reasons, this method somewhat meets the objectives of the Project, but is not the preferred method.

2.3.5.2 In-Plant Cyanide Destruction and Metals Removal Followed by Natural Degradation

By maximizing the recycle of cyanide and destroying cyanide prior to discharging the tailings to the storage facility, potential cyanide contamination situations such as dam seepage or tailings facility overflow during extreme storm events late in the Project life are eliminated. By design, the cyanide treatment circuit will destroy cyanide to a level acceptable for MMER compliance and reduce the environmental safety requirements placed on the TSF.

This method ensures that wildlife, including waterfowl and aquatic life are protected, that cyanide consumption is minimized, and that contingency is in place to prevent the inadvertent release of cyanide into the environment. However, to meet PWQO standards at the point of discharge, the TSF would need to be sized for the residence time required for effective passive treatment such that high purity water effluent water could be produced. As result, the TSF footprint and associated environmental impact would be drastically increased as would the cost of constructing and closing the TSF.

For these reasons, this method somewhat meets the objectives of the project but is not a preferred method. The Inco SO_2-Air process has been selected as the preferred method for in-plant cyanide destruction. The Inco-SO_2 process is further defined in Section 3.15, Appendices B and F.

2.3.5.3 Natural Cyanide Degradation and Metals Removal Followed by Effluent Treatment

This method utilizes natural degradation processes to partially remove cyanide and metals from the effluent prior to final treatment using a chemical process suitable for treating effluent such as hydrogen peroxide oxidation or reverse osmosis. By removing only a portion of the cyanide, the tailings storage facility residence time can be reduced thereby reducing the size and cost of the tailings impoundment. The intent is to take advantage of whatever natural degradation occurs in the TSF (that has not been increased in size to allow for degradation), thereby saving effluent treatment reagent costs. This option has similar environmental and project impacts to the natural degradation only method, as well as the added cost of a chemical treatment plant. Albeit, the cost of operating the chemical treatment plant will be lower than the cost of operating the in-plant cyanide destruction circuit.

As a result, this method meets the objectives of the project but is preferable only to the natural degradation only method. The tailings storage facility would contain higher levels of cyanide and as such, pose increased risk to the environment.

2.3.5.4 In-plant Cyanide Destruction and Metals Removal Followed by Natural Degradation Followed by Effluent Treatment

By maximizing the recycle of cyanide and destroying cyanide prior to discharging the tailings to the storage facility, potential cyanide contamination situations such as dam seepage TSF overflow during extreme storm events late in the project life are eliminated. By design, the cyanide treatment circuit will destroy cyanide in the leach tails to a level acceptable for MMER compliance and reduce the environmental safety requirements placed on the TSF.

This method ensures that wildlife, including waterfowl and aquatic life, are protected, that cyanide consumption is minimized, and that contingency is in place to prevent the inadvertent release of cyanide into the environment.

To meet PWQO standards at the point of discharge while maintaining a reasonably sized TSF, an effluent treatment plant would be used to treat the tailings pond water discharge prior to release into the environment. The effluent treatment plant would rely on reverse osmosis technology to obtain high purity water for discharge.

For these reasons, this method is the preferred method. The Inco SO_2-Air process has been selected as the preferred method for in-plant cyanide destruction.

2.3.5.5 Selection of Preferred Alternative

In-plant cyanide destruction followed by natural degradation followed by effluent treatment was the only method that meets provincial and federal effluent requirements, which is imperative for discharge into Blackwater Creek which has a low ability for dilution at the point of discharge.

2.3.6 Tailings Storage Facility

Two Project facilities (a TSF and a minewater pond) will overprint waters frequented by fish and are subject to a regulatory amendment of Schedule 2 of the Metal Mining Effluent Regulations (MMER). Assessment of potential alternatives for facilities that overprint waters frequented by fish is required under Environment and Climate Change Canada’s Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Environment Canada 2013), pursuant to a Schedule 2 regulatory amendment. For the Project, this includes an assessment of tailings deposition technology and tailings storage facility locations.

The alternatives assessment of the TSF and minewater pond was completed as a discrete document with differing methodologies to the alternatives assessment in this section due to previous work completed for the aforementioned requirements. This assessment and methodology is detailed in Appendix D-2 to the revised EIS.

A multiple accounts analysis (MAA) has been prepared, which follows the methodology outlined in the Guidelines for the Assessment of Alternatives for Mine Waste Disposal (the Guidelines), prepared by ECCC. This analysis has been used to examine and compare different effects from mine waste storage alternatives, and to provide a decision-making tool, which is transparent and defensible. A sensitivity analysis is provided to allow for different weightings of key MAA components and to evaluate differing values on potential environmental, technical, economic and social impacts.

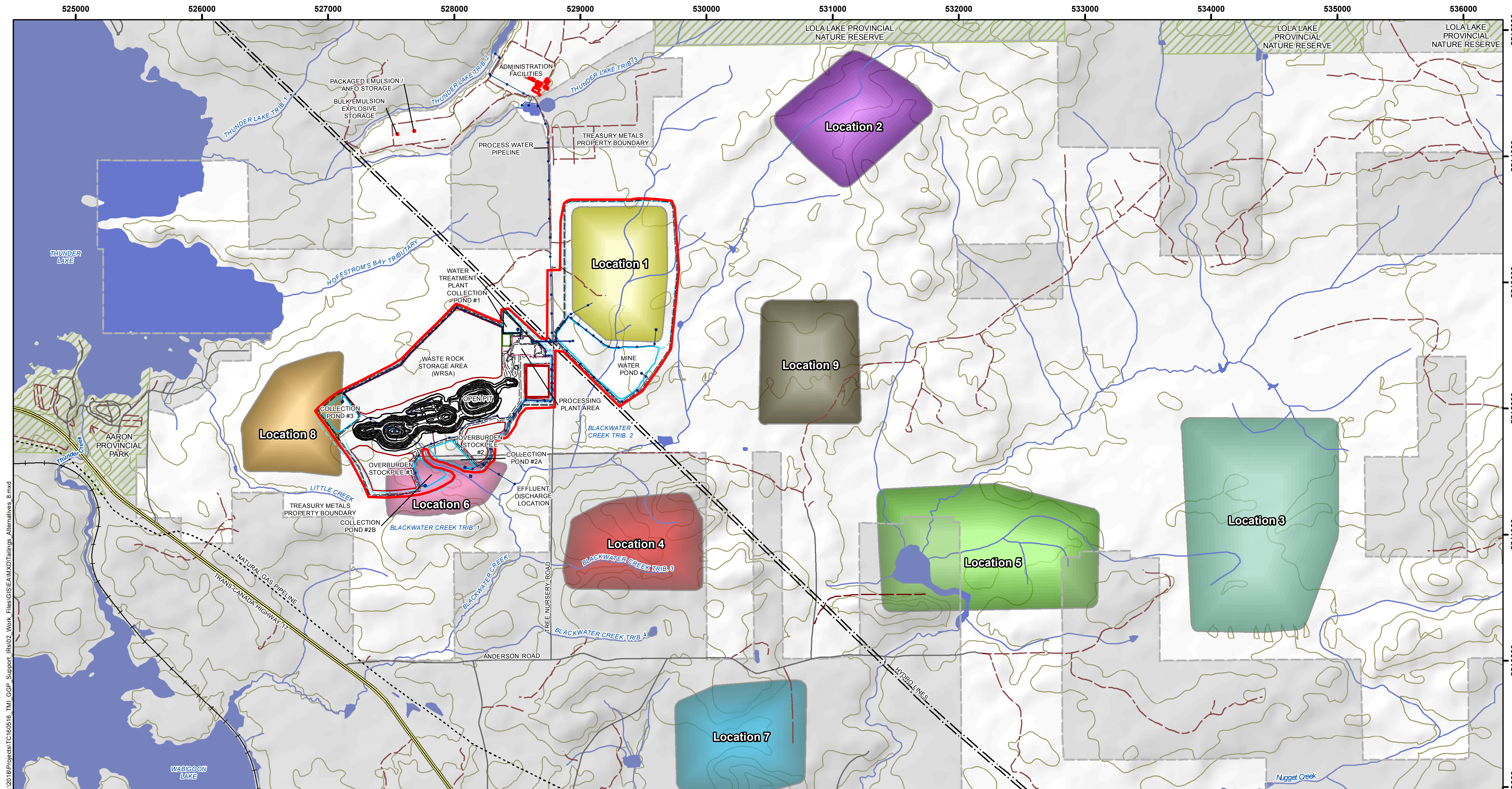
2.3.6.1 Pre-Screening Analysis and Identification of Alternatives

The assessment considered five candidate tailings storage methods, nine candidate tailings storage locations and nine candidate minewater pond locations. To focus the MAA on alternatives that are practicable, a pre-screening analysis was conducted to eliminate candidates with fatal flaws. Figure 2.3.6.1-1 shows the locations of each TSF candidate location. Figure 2.3.6.1-2 shows the location of each minewater pond candidate location. Tables 2.3.6.1-1 and 2.3.6.1-2 summarize TSF each location and methodology and give results of the pre-screening analysis. Nine potential minewater pond locations are described in Table 2.3.6.1-3 with a summary of the results of the pre-screening analysis.

A detailed description of the pre-screening results is provided in Appendix D-2.

Following a pre-screening (fatal flaw) analysis, two of the tailings storage methods, three tailings storage locations and four minewater pond locations were retained for further consideration through the MAA. In the interest of having a focused and manageable MAA rather than assessing every possible combination, alternatives which make the most sense from a mine development perspective have been developed for consideration in the MAA. All candidates not eliminated in the pre-screening step are considered through the alternatives carried forward to the MAA.

Four alternatives were developed using each of the candidate tailing storage methods and various locations, as summarized below.



LEGEND

- Railway
- Hydro Line
- Natural Gas Pipeline
- Highway
- Local Street
- Resource / Recreation Trail
- Provincial Park / Nature Reserve
- Watercourse
- Waterbody
- Contours (10 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Tailings Alternatives

- Location 1
- Location 2
- Location 3
- Location 4
- Location 5
- Location 6
- Location 7
- Location 8
- Location 9

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Security Fence
- Proposed Minewater and Collection Ponds
- Stockpile

0 0.5 1 2 3 4 5 Kilometres

NOTES:
- Topographic data extracted from Land Information Ontario, MNRF.

Datum: NAD83
Projection: UTM Zone 15N

N S E W

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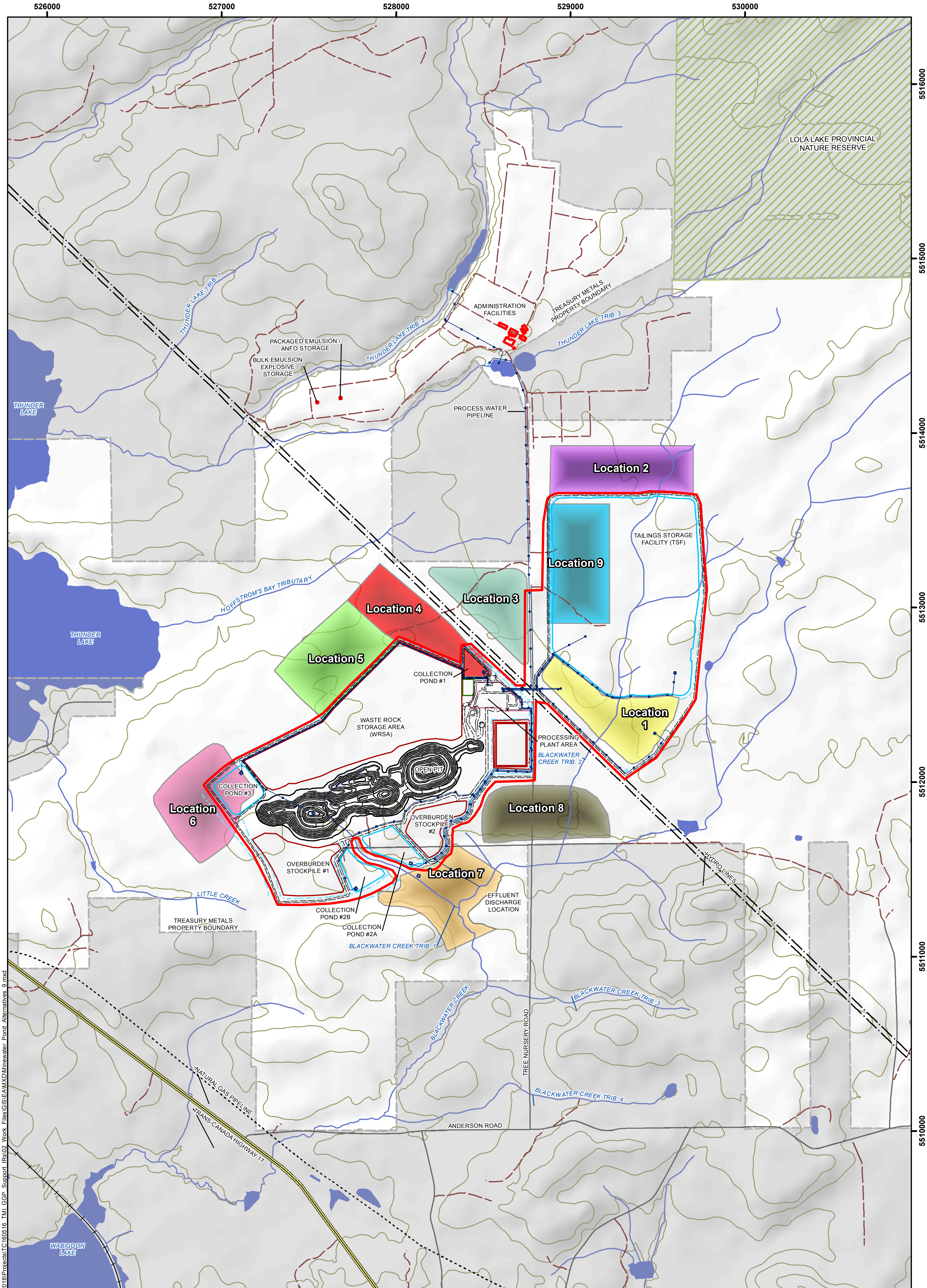
GOLIATH GOLD PROJECT

Location of Tailings Storage Facility Alternatives

PROJECT Nº: TC160516	**FIGURE: 2.3.6.1-1**
SCALE: 1:28,500	DATE: August 2017



LEGEND

- Railway
- Hydro Line
- Natural Gas Pipeline
- Highway
- Local Street
- Resource / Recreation Trail
- Provincial Park / Nature Reserve
- Watercourse
- Waterbody
- Contours (10 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Minewater Pond Alternatives

- Location 1
- Location 2
- Location 3
- Location 4
- Location 5
- Location 6
- Location 7
- Location 8
- Location 9

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Security Fence
- Proposed Tailings Storage Facility and Collection Ponds
- Stockpile

NOTES:
- Topographic data extracted from Land Information Ontario, MNRF.

Datum: NAD83
Projection: UTM Zone 15N

0 0.25 0.5 1 1.5 Kilometres

GOLIATH GOLD PROJECT

Location of Minewater Pond Alternatives

PROJECT Nº: TC160516	FIGURE: 2.3.6.1-2
SCALE: 1:20,000	DATE: August 2017

Table 2.3.6.1-1: Identification of TSF Candidates and General Location

Project Aspect	Candidate Locations	General Location	Result of Pre-Screening
Tailings Management Facility Location	Location 1	Northeast of the proposed plant site	Carried Forward
	Location 2	Northeast of Location 1	Eliminated
	Location 3	Far east of the Project site	Eliminated
	Location 4	South of Location 1, east side of Tree Nursery Road and south of Normans Road	Eliminated
	Location 5	ESE of plant site between Location 4 and Location 3	Eliminated
	Location 6	South of proposed mine site and south of existing Normans Road	Carried Forward
	Location 7	SSE of plant site, south of the Project boundary, south of Anderson Road	Eliminated
	Location 8	West of open pit area	Eliminated
	Location 9	Directly east of processing plant	Carried Forward

Table 2.3.6.1-2: Identification of TSF Methodology of Tailings Disposal

Tailings Storage Method	Pre-Screening Result	Description
Underground Storage	Eliminated	Insufficient volumes for life of mine storage.
Open Pit Storage	Eliminated	Insufficient volume for life of mine storage, planned storage of waste rock within mined out open pit
Filtered Tailings	Carried Forward	Eliminates dam breach potential, no fatal flaws
Thickened Tailings	Eliminated	No significant advantages over conventional tailings due to site topography
Conventional Slurry Tailings	Carried Forward	Proven methodology, no fatal flaws

Table 2.3.6.1-3: Identification of Minewater Pond Candidates and General Location

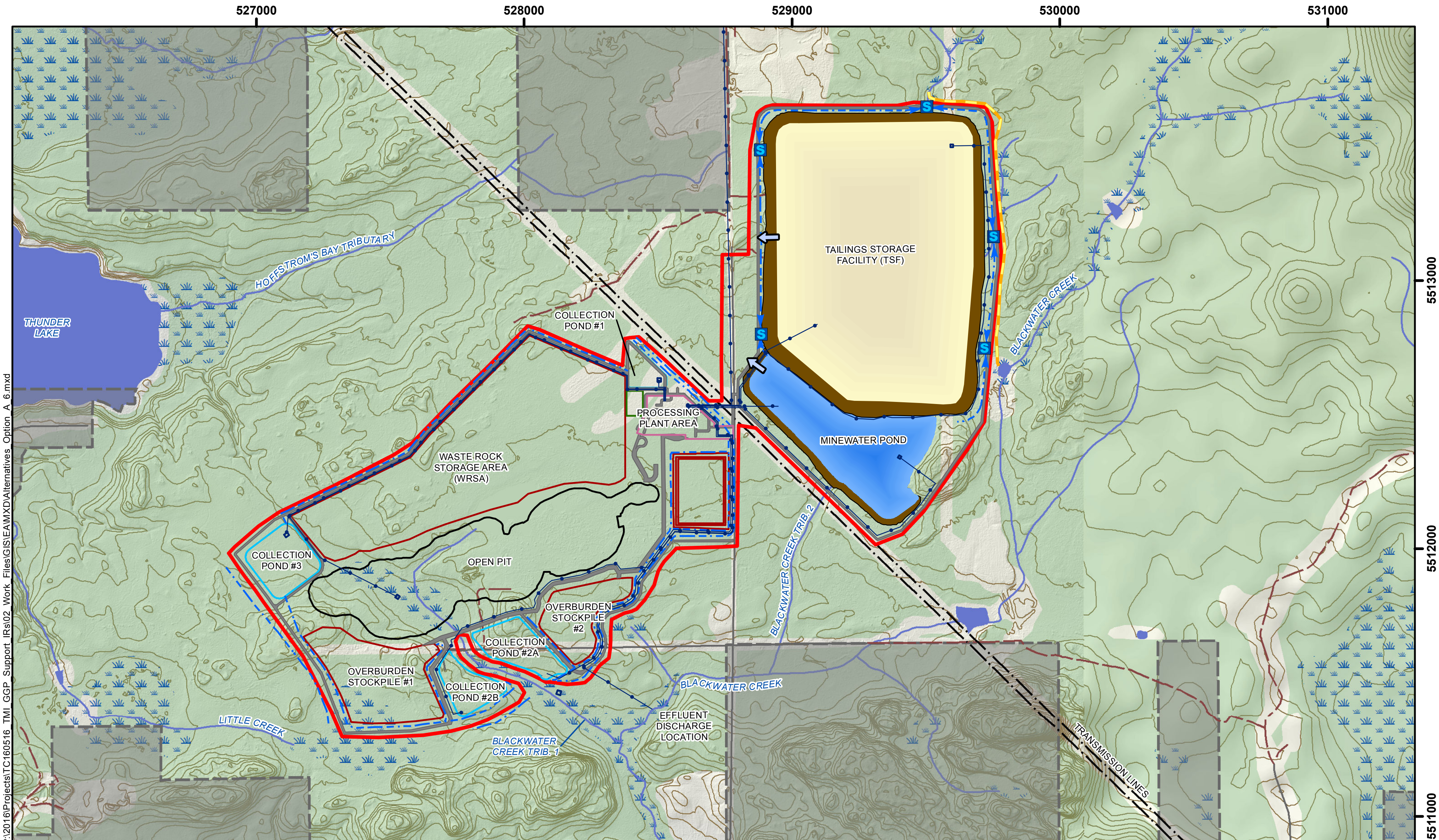
Project Aspect	Candidate Locations	General Location	Result of Pre-Screening
Minewater Pond	Location 1	Directly south of TSF Location 1	Carried Forward
	Location 2	Directly north of TS Location 1	Eliminated
	Location 3	North of processing plant, west of Tree Nursery Road	Carried Forward
	Location 4	Northeast of waste rock storage area	Eliminated
	Location 5	North of waste rock storage area	Eliminated
	Location 6	West of waste rock storage area	Carried Forward
	Location 7	South of open pit within Blackwater Creek Tributary #1	Eliminated
	Location 8	Southeast of processing plant	Eliminated
	Location 9	Northeast of plant site, east of Tree Nursery Road within footprint of TSF Location 1	Carried Forward

Alternative A (Figure 2.3.6.1-3) is the tailings and minewater pond approach presented through the Revised EIS. It utilizes conventional slurry tailings, deposited at TSF Location 1. Minewater would be managed in a pond adjacent to the TSF at minewater pond Location 1. Both the TSF and minewater pond would require a MMER Schedule 2 regulatory amendment.

A variant of Alternative A, Alternative B (Figure 2.3.6.1-4) uses the same conventional slurry tailings approach, deposited at TSF Location 1. Minewater pond Location 3 was selected, as it is situated near TSF Location 1, and avoids the need for a MMER Schedule 2 regulatory amendment for the minewater pond. The TSF would require a MMER Schedule 2 regulatory amendment.

Filtered stack tailings was one of the deposition methods carried forward from the pre-screening assessment. The previous assessment of alternatives report (WSP 2014) found that the highest rated filtered stack location was at TSF Location 6. Accordingly, Alternative C (Figure 2.3.6.1-5) utilizes filtered stack tailings deposition at TSF Location 6. Minewater pond Location 6 has been identified as the best minewater pond location for a filtered stack at TSF Location 6, as it maintains a compact site footprint by not placing mine wastes to the east of Tree Nursery Road. Alternative C will require a MMER Schedule 2 regulatory amendment for the TSF, but not for the minewater pond.

Alternative D (Figure 2.3.6.1-6) was selected as the best alternative that avoids placing mine waste over waters frequented by fish, and accordingly has no MMER Schedule 2 requirements. It utilizes conventional slurry tailings, deposited subaerially at TSF Location 9. A minewater pond at Location 9 was selected as it does not overprint water frequented by fish, has favorable terrain for a pond, and is located near TSF Location 9.



LEGEND

- Transmission Line
- Local Street
- Resource / Recreation Trail
- Wetland
- Watercourse
- Waterbody
- Contours (2 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Components of Alternative A

- Emergency Spillway
- Sumps (Not to scale)
- Dam
- Minewater Pond
- Tailings
- Watercourse Realignment

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Collection Ponds
- Stockpile

NOTES:
- Contours created from a combination Land Information Ontario (LIO) data and LiDAR data.
- Watercourses represent pre-development conditions based on LIO database, as modified by KBM.

0 0.25 0.5 1 1.5 Kilometres

Datum: NAD83
Projection: UTM Zone 15N

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GOLIATH GOLD PROJECT

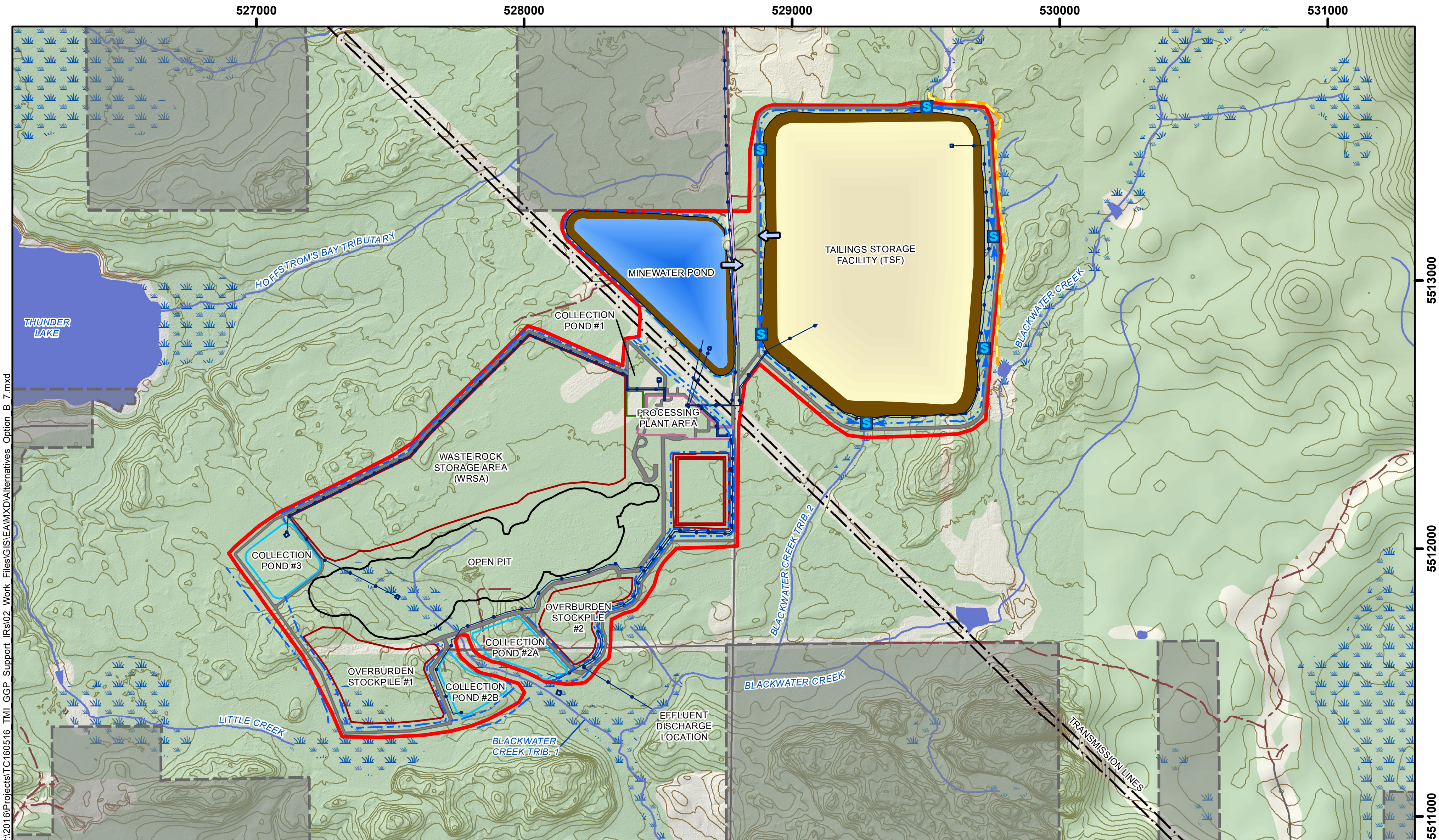
Alternative A Configuration

PROJECT Nº: TC160516

FIGURE: 2.3.6.1-3

SCALE: 1:20,000

DATE: August 2017



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LEGEND

- Transmission Line
- Local Street
- Resource / Recreation Trail
- Wetland
- Watercourse
- Waterbody
- Contours (2 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Components of Alternative B

- Emergency Spillway
- Sumps (Not to scale)
- Dam
- Minewater Pond
- Tailings
- Watercourse Realignment
- Road Realignment

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Collection Ponds
- Stockpile

0 0.25 0.5 1 1.5 Kilometres

NOTES:
- Contours created from a combination Land Information Ontario (LIO) data and LiDAR data.
- Watercourses represent pre-development conditions based on LIO database, as modified by KBM.

Datum: NAD83
Projection: UTM Zone 15N

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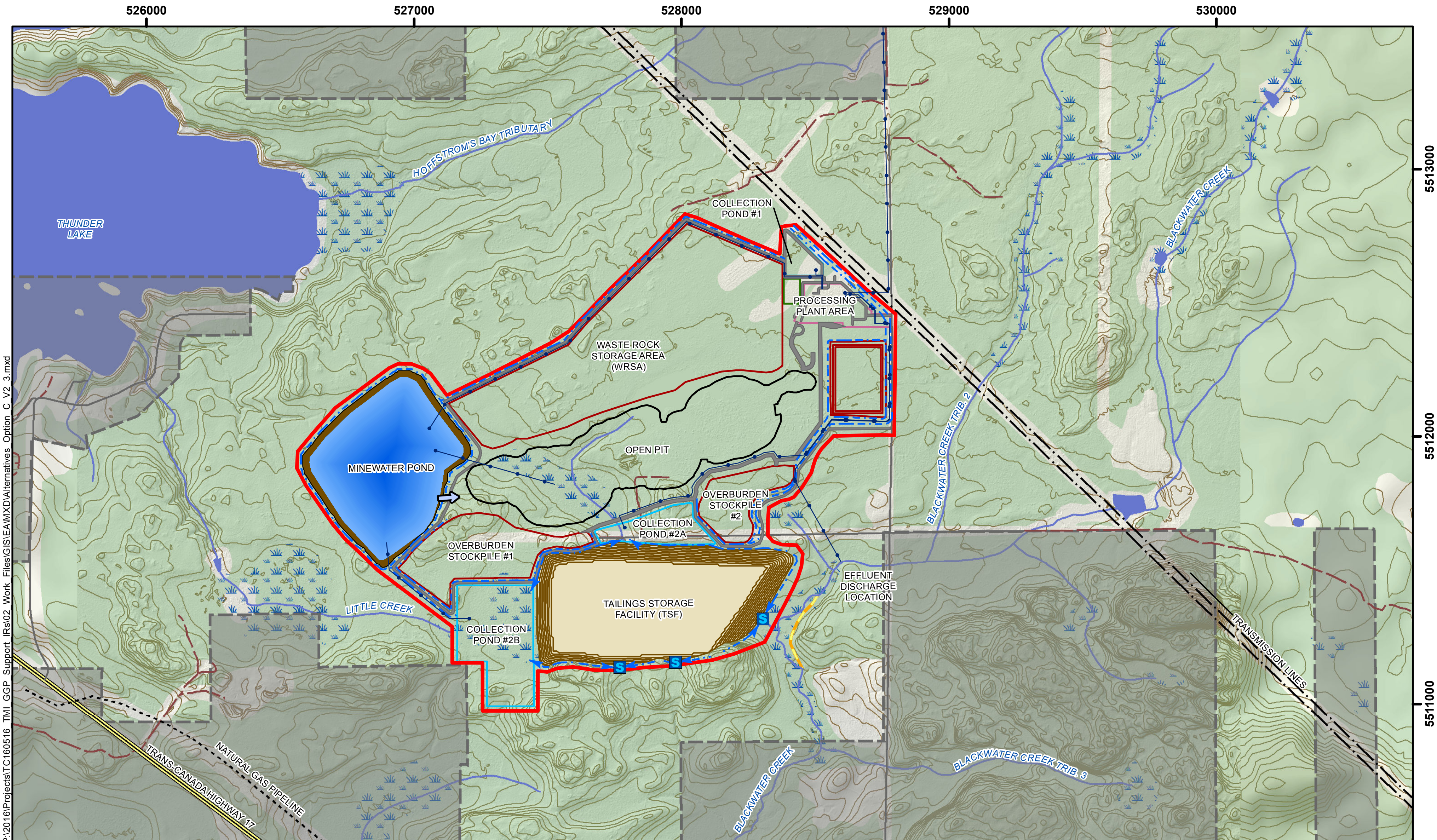
GOLIATH GOLD PROJECT

Alternative B Configuration

PROJECT N°: TC160516	FIGURE: 2.3.6.1-4
SCALE: 1:20,000	DATE: August 2017



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LEGEND

- Transmission Line
- Natural Gas Pipeline
- Highway
- Local Street
- Resource / Recreation Trail
- Wetland
- Watercourse
- Waterbody
- Contours (2 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Components of Alternative C

- Emergency Spillway
- Sumps (Not to scale)
- TSF Contours (2 m interval)
- Dam
- Minewater Pond
- Tailings
- Potential Watercourse Realignment

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Collection Ponds
- Stockpile

NOTES:
- Contours created from a combination Land Information Ontario (LIO) data and LiDAR data.
- Watercourses represent pre-development conditions based on LIO database, as modified by KBM.

0 0.25 0.5 1 1.5 Kilometres

Datum: NAD83
Projection: UTM Zone 15N

N W E S

amec foster wheeler

GOLIATH GOLD PROJECT

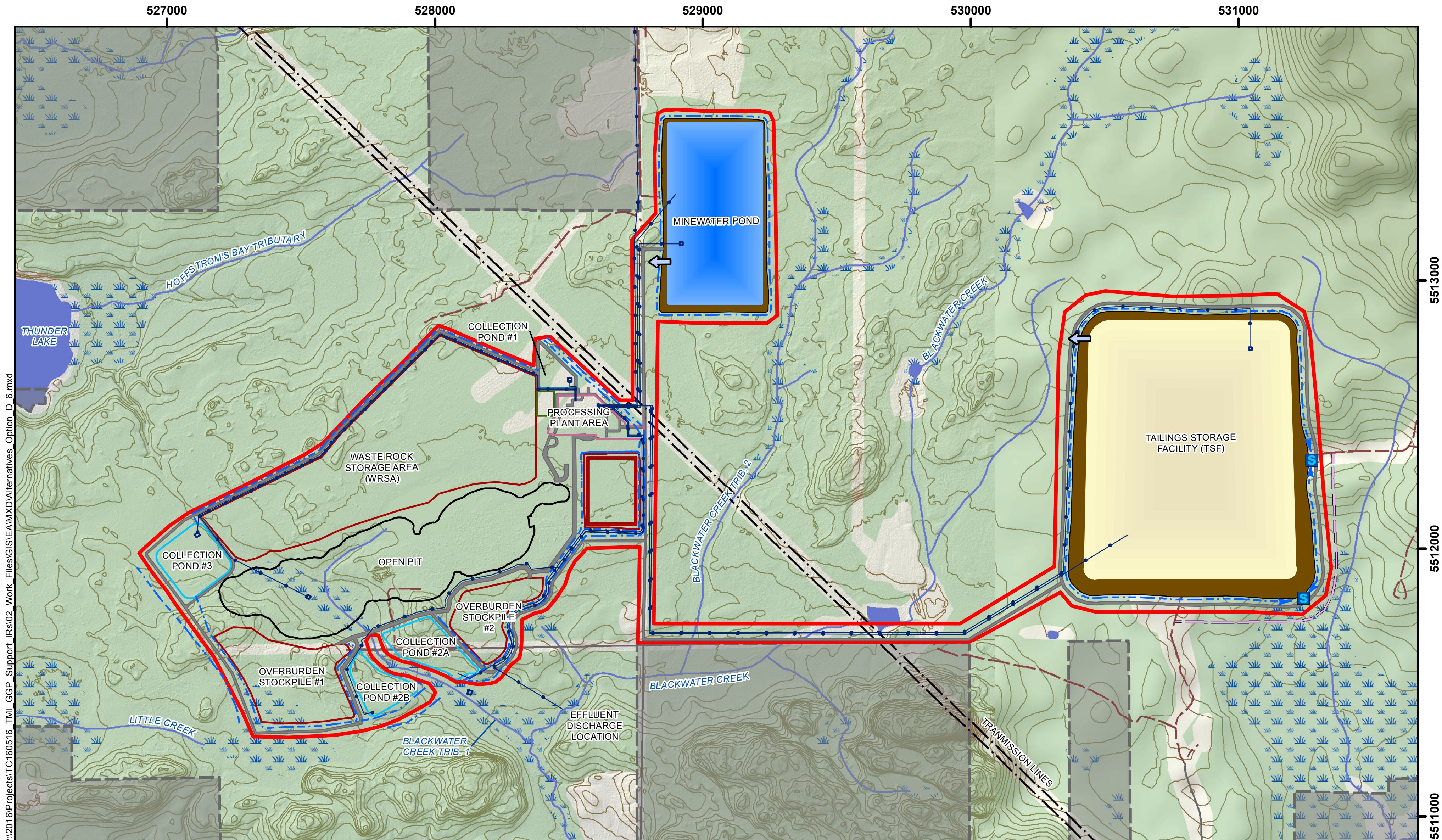
Alternative C Configuration

PROJECT N°: TC160516

FIGURE: 2.3.6.1-5

SCALE: 1:20,000

DATE: August 2017



LEGEND

- Transmission Line
- Local Street
- Resource / Recreation Trail
- Wetland
- Watercourse
- Waterbody
- Contours (2 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Components of Alternative D

- Emergency Spillway
- Sumps (Not to scale)
- Dam
- Minewater Pond
- Tailings
- Trail Realignment

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Collection Ponds
- Stockpile

0 0.25 0.5 1 1.5 Kilometres

NOTES:
- Contours created from a combination Land Information Ontario (LIO) data and LiDAR data.
- Watercourses represent pre-development conditions based on LIO database, as modified by KBM.

Datum: NAD83
Projection: UTM Zone 15N

N W E S

amec foster wheeler

GOLIATH GOLD PROJECT

Alternative D Configuration

PROJECT N°: TC160516	FIGURE: 2.3.6.1-6
SCALE: 1:20,000	DATE: August 2017

2.3.6.2 Alternative Characterization

2.3.6.2.1 Alternative A

Alternative A utilizes conventional slurry tailings technology with a TSF located to the northeast of the open pit, within the Blackwater Creek Tributary 2 basin. The minewater pond is located adjacent to the TSF, sharing the south dam of the TSF. The focus in designing this alternative was to contain effects from the Project to within the Blackwater Creek watershed and avoid effects to Thunder Lake. As both the TSF and minewater pond overprint Blackwater Creek Tributary 2, both structures would require an MMER Schedule 2 regulatory amendment.

Environmental Characterization - The focus of designing the TSF and minewater pond for Alternative A from an environmental perspective was to contain effects from the Project to within the Blackwater Creek watershed. This design approach is largely successful, as Alternative A has the least amount of area that is outside the Blackwater Creek watershed (5.0 ha) compared to the other alternatives assessed. Alternative A will overprint more fish habitat in minor tributaries than the other alternatives (2,300 m of Blackwater Creek Tributary 2). This alternative does not overprint any main stem / river watercourse fish habitat and does not require new roadway watercourse crossings. A fish habitat compensation plan will likely need to be developed for the tributary fish habitat loss associated with Alternative A.

Alternative A will overprint 85.3 ha and 12.6 ha of forest and wetlands, respectively. The amount of overprinted forest is comparable to Alternative B (92.9 ha), higher than Alternative C (37.6 ha) and lower than Alternative D (117.3 ha). Alternative A will overprint the largest area of wetland (12.6 ha overprinted), compared to Alternatives B, C and D (10.9, 9.4 and 1.8, respectively).

During baseline studies of the LSA, a small number of SAR were identified as potentially inhabiting the Project area: Common Nighthawk, Barn Swallow, Little Brown Myotis and Northern Myotis. Of these species, the Little Brown Myotis and Northern Myotis are the only species that are classified as Endangered both Provincially (ESA) and Federally (SARA), and may require habitat compensation. Alternative A was assessed with bat surveys, which identified that there is 5.1 ha of habitat that could potentially support bat maternity roosts.

There are three areas that have been assigned Provincial protection in relatively close proximity to the Project. Alternative A (and B) is situated the same distance to Lola Lake Provincial Nature Reserve and Aaron Provincial Park (1.2 km and 3.3 km, respectively). Additionally, Alternative A is located outside the Nugget / Hughes Creek watershed and will not affect the Provincial Fish Sanctuary in Barrett Bay.

Technical Characterization - Alternatives A and B share a TSF design with differing minewater pond designs. The location suitability of the TSF for Alternative A is very good with a storage volume to dam ratio of 3.6, higher than the other conventional slurry alternative with a ratio of 2.8 (Alternative D). The maximum TSF dam height of 23 m would occur on the south dam of the TSF, and is shorter than the maximum dam height of the other conventional slurry alternative at 31 m

(Alternative D). The ground foundation at Alternatives A and B is the most suitable out of the four alternatives, as the conditions provide free draining materials with good foundation shear strength.

The hazard potential of the TSF is greatest for Alternative A (and B) out of the four alternatives, as there is infrastructure in the form of Tree Nursery Road and Normans Road downgradient of the TSF, which are occasionally used by local residents. The hazard potential of the minewater pond is fair for Alternative A, and has the potential to affect the same infrastructure as the TSF in the event of a dam failure.

Alternative A was designed with the minewater pond adjacent to the TSF to allow for the best flexibility of water management between the two structures out of the four alternatives. The alternative has the shortest length of perimeter ditching required (4.1 km). In additional to seepage capture infrastructure required by the MMER, Alternative A is almost entirely located within the 2 m groundwater drawdown zone created by mine dewatering, which will result in seepage draining to the mine during operations and closure, until the water table has risen to pre-development levels.

Alternative A has moderate expansion capabilities as TSF dams are partially constrained by the minewater pond to the south, Tree Nursery Road to the west and Blackwater Creek to the east. However, Alternative A has good economics for potential future dam expansions should they be required if additional resources are mineable, compared to the other alternatives due to favorable topography that lowers dam raise costs.

Project Economics Characterization - Alternative A is projected to have the lowest overall costs out of the four alternatives.

For the conventional slurry alternatives, the cost of building the TSF dams is greatest contributor to capital costs. Alternatives A and B will have the lowest TSF dam construction costs due to favorable topography, which reduces the dam requirements.

The operational costs of conventional slurry tailings deposition are significantly less than that of filtered stack construction. The TSF and minewater pond of Alternative A, based on the short distance from the process plant to the TSF and the open pit to the minewater pond, have very low costs of tailings pumping and deposition compared to the other alternatives. Alternative A also has reduced water management costs as it has low dam heights that decreases the cost of pumping seepage back to the TSF and is situated close to the process plant for water recycle.

Closure costs and post-closure costs are not major contributors to overall costs for Alternative A (dominated by capital costs). Alternative A will impose additional costs for fish habitat compensation. Alternative A along with Alternative B, are believed to have the least financial risk to Treasury Metals, due to overall lower costs of tailings management and have a lower risk of Project delays, compared to Alternatives C and D.

Socio-economic Characterization - Although no specific heritage sites were identified in the Project operations area to date by Aboriginal peoples, the intrinsic value of traditional uses of the land is understood by Treasury Metals. The configuration of Alternative A is anticipated to result in a lower reduction to traditional land access (743 ha of land). This area is comparable to Alternatives B (702 ha) and C (782 ha), and less than Alternative D (1,254 ha). Potential effects to wildlife abundance will be reduced as the TSF and minewater pond of Alternative A are contiguous with the mine site, maintaining a fairly compact Project site. Thunder Lake was identified by First Nations as culturally important and this alternative limits potential effects to Thunder Lake watershed as Alternative A has the smallest TSF / minewater pond footprint in the watershed (5.0 ha).

The Project is located in a populated area with nearby residents. The Alternative A TSF and minewater pond is situated approximately 4.0 km away from the Village of Wabigoon, 2.5 km away from the residents and cottagers on Thunder Lake, 0.8 km away from nearby rural residents and 3.2 km away from Aaron Provincial Park. These distances are comparable to Alternative B and D with slight distance variations between the individual operations area and the four receptors. Alternative C was significantly closer to each of the four receptors compared to Alternative A as described in Section 7.3, and has a much greater probability of leading to operational effects.

2.3.6.2.2 Alternative B

Alternative B utilizes conventional slurry tailings technology and has a TSF to the northeast of the open pit, within the Blackwater Creek Tributary 2 basin. The minewater pond is located to the west of the TSF, between the existing transmission line and Tree Nursery Road. The focus in designing this alternative was to contain effects from the TSF to within the Blackwater Creek watershed as much as practicable, while ensuring the minewater pond does not overprint watercourses frequented by fish. For this alternative, only the TSF overprints Blackwater Creek Tributary 2 and would require an MMER Schedule 2 regulatory amendment.

Environmental Characterization - The Alternative B design results in 16.8 ha of the TSF and minewater pond outside of the Blackwater Creek watershed. The greatest anticipated flow reductions are to Hoffstrom's Bay Tributary. Alternative B will overprint a shorter length of Blackwater Creek Tributary 2 (2 km) compared to Alternative A (2.3 km), as the minewater pond does not overprint the watercourse. This alternative does not overprint any main stem / river fish habitat and does not require road watercourse crossings. A fish habitat compensation plan is expected to be required to offset and compensate for fish habitat losses.

Alternative B will overprint 92.9 ha and 10.9 ha of forest and wetlands respectively. The amount of overprinted forest is comparable to Alternative A (85.3 ha), higher than Alternative C (37.6 ha) and lower than Alternative D (117.3 ha). Alternative B will overprint the second largest area of wetland at 10.9 ha compared to Alternatives A, C and D (12.6, 9.4 and 1.8 respectively).

During baseline studies of the LSA, a small number of SAR species were identified as potentially inhabiting the Project area: Common Nighthawk, Barn Swallow, Little Brown Myotis, Northern Myotis). Of these species, the Little Brown Myotis and Northern Myotis are the only species that are classified as Endangered both Provincially (ESA) and Federally (SARA). It was identified during bat surveys that Alternative B would overprint 5.1 ha of habitat that could potentially support bat maternity roosts.

Alternative B (and A) is situated the same distance to Lola Lake Provincial Nature Reserve and Aaron Provincial Park at 1.3 km and 3.3 km, respectively. Additionally, Alternative B is located outside the Nugget / Hughes Creek watershed and accordingly, will not affect the Provincial Fish Sanctuary in Barrett Bay.

Technical Characterization - Alternatives A and B share a TSF design with differing minewater pond designs. The location suitability of the TSF for Alternative B is very good with a storage volume to dam ratio of 3.6, higher than the other conventional slurry alternative with a ratio of 2.8 (Alternative D). The maximum TSF dam height of 23 m (south dam) is shorter than the maximum dam height of Alternative D (31 m). The dam foundations of Alternative B (and A) is the most suitable out of the four alternatives as the conditions provide free draining materials with good foundation shear strength. The minewater pond dam height would be significantly shorter than the TSF, but the minewater pond dam for Alternative B is the second tallest (12.0 m) of all the alternatives.

The hazard potential of the TSF is greatest for Alternative B (and A) of the four alternatives assessed, as there is infrastructure in the form of Tree Nursery Road and Normans Road downgradient of the TSF, which are occasionally used by local residents. Additionally, the hazard potential of the minewater pond is fair for Alternative B, and has the potential to affect the same infrastructure as the TSF in the of a dam failure, and could also fail towards a property not owned by Treasury Metals located adjacent to the minewater pond.

Alternative B was designed with the minewater pond in close proximity to the TSF while not overprinting water frequented by fish. The close proximity of these two structures allows for good flexibility of water management, but it is not as flexible as Alternative A. Additionally, as Alternative B does not have a shared TSF and minewater pond dam, a longer (5.8 km) perimeter ditch would be required to capture runoff (as opposed to 4.1 km for Alternative A). In additional to seepage capture infrastructure required by the MMER, Alternative B is almost entirely located within the 2 m groundwater drawdown zone created by mine dewatering, which will result in seepage draining to the mine during operations and closure, until the water table has risen to pre-development levels.

The Alternative B TSF has a large capacity for expansion should it be needed, and good economics for expansion due to topographic conditions at the TSF.

Project Economics Characterization - Alternative B is projected to have the second lowest overall costs out of the four alternatives after Alternative A.

For conventional slurry alternatives, the capital cost of building the TSF dams is the greatest cost of the alternative. Alternative B (and A) will have the lowest TSF dam construction costs due to favorable topography, although Alternative C will not require TSF dams. Alternative B will have higher minewater pond dam construction costs compared to Alternative A due to less favorable topography and the presence of high ground in the proposed minewater pond area.

The operational costs of conventional slurry tailings deposition are significantly less than that of filtered stack construction. The TSF and minewater pond of Alternative B, based on the short distance from the process plant to the TSF and the open pit to the minewater pond, have very low costs of tailings pumping and deposition compared to the other alternatives. Additionally, Alternative B has reduced water management costs, as it has low dam heights that reduce the cost of pumping seepage back to the TSF and is situated close to the process plant for water recycle.

Closure costs and post-closure costs are not major contributors to overall costs for Alternative A (dominated by capital costs). Alternative B assumes additional costs for fish habitat compensation and a realignment of Tree Nursery Road. Alternative B along with Alternative A, are believed to have the least financial risk to Treasury Metals, due to overall lower costs of tailings management and have a lower risk of Project delays, compared to Alternatives C and D.

Socio-economic Characterization - Although no specific heritage sites were identified in the Project operations area to date by Aboriginal peoples, the intrinsic value of traditional uses of the land is understood by Treasury Metals. The configuration of Alternative B is anticipated to result in limited traditional access to approximately 702 ha of land, which is slightly less than Alternatives B (702 ha) and C (782 ha), and considerably less than Alternative D (1,254 ha). Potential effects to wildlife abundance will be reduced as the TSF and minewater pond of Alternative B are generally contiguous with the mine site, maintaining a fairly compact Project site. Alternative B has a notable TSF and minewater pond footprint within the Thunder Lake watershed (16.8 ha). Thunder Lake was identified by First Nations as culturally important and effects from the Project should be limited at this lake.

The Project is located in a populated area where nearby residents could experience potential effects (air, noise and aesthetics) from some of the alternative configurations. The Alternative B TSF and minewater pond is situated approximately 4.4 km away from the Village of Wabigoon, 1.9 km away from the residents and cottagers on Thunder Lake, 1.1 km away from nearby rural residents and 2.7 km away from Aaron Provincial Park. These distances are comparable to Alternative A and D with slight distance variations between the individual operations area and the four receptors. Alternative C was significantly closer to each of the four receptors compared to Alternative A, and has a much greater probability of leading to operational effects due.

2.3.6.2.3 Alternative C

Alternative C utilizes filtered stack tailings with the TSF located south of the open pit, within the basin of both Blackwater Creek and Blackwater Creek Tributary 1. The minewater pond is located to the west of the open pit and provides a contiguous site footprint that minimizes the Project footprint. The focus in designing this alternative was to place the TSF in close proximity to the process plant and maintain a compact site footprint, while utilizing a TSF without a tailings pond located over impounded tailings. As the TSF overprints two watercourses frequented by fish, Alternative C would require an MMER Schedule 2 regulatory amendment.

Environmental Characterization - The focus of designing the TSF and minewater pond for Alternative C from an environmental perspective was to maintain a compact site footprint. Although the TSF is located win the Blackwater Creek watershed, modifications to the site layout result in other aspects of the Project (overburden stockpile and runoff collection pond) being located in the Thunder Lake watershed. Alternative C results in larger flow reductions to nearby watercourses compared to the other alternatives and Little Creek will experience approximately 23% flow reductions. Although Alternative C will overprint significantly less tributary fish habitat than Alternatives A and B at 750 m of Blackwater Creek Tributary 1, it may require realignment of 415 m of the Blackwater Creek main stem, depending on size requirements of the TSF runoff collection ponds. A fish habitat compensation plan would need to be developed for the tributary and main stem fish habitat loss for Alternative C.

The alternatives vary significantly between the amount of terrestrial resources that each overprint. Alternative C will overprint 37.6 ha and 9.4 ha of forest and wetlands respectively. The amount of overprinted forest is considerably less than all the other alternatives with the second least overprinting 85.3 ha (Alternative A). Alternative C will overprint the third largest area of wetland at 10.9 ha compared to Alternatives A, B and D with 12.6 ha, 10.9 ha and 1.8 ha respectively.

During baseline studies of the LSA, a small number of SAR were identified as potentially inhabiting the Project area including: Common Nighthawk, Barn Swallow, Little Brown Myotis and Northern Myotis. Of these species, the Little Brown Myotis and Northern Myotis are the only species that are classified as Endangered both Provincially (ESA) and Federally (SARA) and may require habitat compensation. Alternative C was the only alternative that was found to not overprint habitat supporting potential bat maternity roosts.

Alternative C is situated the greatest distance away from Lola Lake Provincial Park (3.5 km) but the closest alternative to Aaron Provincial Park (1.9 km). Alternative C is located outside the Nugget / Hughes Creek watershed and will not have any effect on the Provincial Fish Sanctuary in Barrett Bay.

Technical Characterization - Alternative C utilizes a filtered stack approach to tailings management, such that there is no tailings pond. The location suitability of the TSF for Alternative C is good, although a moderate length haul route from the dewatering plant to the filtered stack will be required. The foundation of Alternative C is the least suitable of the four alternatives, as the conditions provide low permeable material with only fair foundation shear strength. The minewater pond storage volume to dam volume ratio for Alternative C is the same as Alternative A of 3.9, greater than Alternative B (2.5) and less than Alternative D (5.1).

As Alternative C uses filtered stack technology, large containment dams would not be required around the TSF. As such, the potential of the dry stack failure is generally limited to slope failure, or collection pond failure. Potential risks to public safety are reduced compared to the other alternatives. The hazard potential of the minewater pond is higher, as it is situated on high ground near residents along Thunder Lake, which could be affected by a failure.

Alternative C has the least flexibility to manage water of the alternatives, as the filtered stack option has less available water storage capacity to manage upset conditions, such as higher than anticipated sediments, or during periodic maintenance on the water treatment plant. Also, the minewater pond overprints a waste rock storage area collection pond and the design requires mixing of waste rock runoff with mine water. As filtered stack construction requires extensive dewatering of the tailings slurry from the process plant, the maximized water recycle will increase the amount of water on site requiring treatment before discharge. This may require Treasury Metals to increase the size of the treatment plant to accommodate the excess water. In additional to seepage capture infrastructure required by the MMER, Alternative C is located entirely within the 2 m groundwater drawdown zone created by mine dewatering, which will result in seepage draining to the mine during operations and closure, until the water table has risen to pre-development levels.

The location of the TSF will require realignment of Blackwater Creek Tributary 1 as part of closure, and the realignment of the Blackwater Creek main stem; during site preparation and construction. A relatively short perimeter ditch (4.4 m) would need to be built around the TSF, which is slight longer than Alternative A (4.1 m), which has the shortest perimeter ditch requirements.

Alternative C has large expansion capabilities with good economics and is comparable with Alternative B as the best alternatives for expansion. Using filtered stack tailings deposition does not require the raising of dams, and allows for the tailings pile to be built higher without having to increase the land area overprinted.

Alternative C will utilize filtered stack technology, which has a much greater potential to generate fugitive dust emissions compared to conventional slurry technology. Additionally, the TSF will be located near the property boundary, which does not provide a buffer to reduce effects from dust emissions outside the property. That stated, it is unlikely that Alternative C will be able to meet the regulatory requirements for air quality at the property boundary, and may not be possible to obtain the necessary environmental approvals.

Project Economics Characterization - Alternative C is projected to have the highest overall costs out of the four alternatives.

Capital costs for Alternative C are lower than the conventional slurry alternatives, as costly embankment dams for the TSF are not required. A filtration plant capable of dewatering the tailings to an unsaturated state will be required at a lower cost than the dams.

Operational costs for Alternative C are much higher than the other alternatives as a result of several factors including: tailings dewatering at the filtration plant, transportation of filtered tailings by truck, spreading tailings and constructing the stockpile, and treating excess water.

Although relatively minor compared to capital and operational costs, Alternative C has the highest closure costs of the four alternatives. Alternative C is the only alternative that requires a dry TSF cover, which will require more material movement compared to the other alternatives. Alternative C will have additional costs associated with fish habitat compensation.

Due to the high overall costs associated with Alternative C, there is an increased risk that fluctuations in the price of gold would could result in Project delays, entering a care and maintenance phase, or forced early shutdown. Alternative C also has the greatest risk of EA or environmental approval delays or rejection due to potential compliance issues with fugitive dust emissions from the TSF. Additionally, Alternative C has the greatest risk of displacing nearby rural residents due to exceedances in health guidelines for fugitive dust at sensitive receptors. Treasury Metals may have to buy the land, or go through lengthy court battles that could take years to acquire the land, resulting in Project delays.

Socio-economic Characterization - Although no specific heritage sites were identified in the Project operations area to date by Aboriginal peoples, the intrinsic value of traditional uses of the land is understood by Treasury Metals. The configuration of Alternative C is anticipated to result in limited traditional access to approximately 782 ha of land. Effects to wildlife abundance will be reduced as the TSF and minewater pond of Alternative C allow for the most compact Project site of the alternatives. Alternative C has the largest TSF / minewater pond footprint in the Thunder Lake watershed, and also moves other mine infrastructure (overburden stockpile and a runoff collection pond) into the Thunder Lake watershed (37.8 ha). Thunder Lake was identified by First Nations as culturally important and effects from the Project should be limited at this lake.

The Project is located in a populated area where nearby residents could experience potential effects (air, noise and aesthetics) if approvals for the alternative could be obtained. As Alternative C utilizes a filtered stack for TSF storage, the drier tailings will result in greater fugitive dust emissions, resulting in increased air quality and aesthetic effects. The drier tailings are also expected to result in increased particulate matter concentrations in the air, in excess of guidelines for the protection of human health, likely requiring the relocation of two nearby residents if approvals could be obtained. TSF construction will also be continuous, resulting in continuous noise emissions associated with TSF construction, unlike the conventional slurry alternatives, which will require occasional dam raises, predominately during daytime hours.

The Alternative C TSF and minewater pond are closer to nearby dwellings compared to the other alternatives; situated approximately 3.1 km away from the Village of Wabigoon, 0.5 km away from the residents and cottagers on Thunder Lake, 0.5 km away from nearby rural residents and 3.2 km away from Aaron Provincial Park.

2.3.6.2.4 Alternative D

Alternative D utilizes conventional slurry tailings technology with the TSF to the east of the open pit and the minewater pond to the northeast of the open pit. It has the largest site footprint with both the TSF and minewater pond located the furthest away from the centroid of the open pit of all the alternatives. The focus in designing Alternative D was to have an alternative that does not overprint any waters frequented by fish.

Environmental Characterization - The main focus of designing the TSF and minewater pond for Alternative D was to not overprint waters frequented by fish. To avoid these waters however, there is 91.1 ha of the Alternative D TSF and minewater pond outside the Blackwater Creek watershed and the alternative affects multiple watersheds in the area including Hoffstrom's Bay Tributary, Blackwater Creek and the Hughes Creek / Nugget Creek system. Two haul road watercourse crossings will also be required over Blackwater Creek and Blackwater Creek Tributary 2, which could result in an increased effect to the aquatic environment at the crossings.

Alternative D will overprint 117.3 ha of forest and 1.3 ha of wetlands. The amount of overprinted forest is the largest of the alternatives, but Alternative D will overprint the smallest area of wetland (1.8 ha compared to Alternatives A, B and C with 12.6, 10.9 and 9.4 respectively).

During baseline studies of the LSA, a small number of SAR species were identified as potentially inhabiting the Project area including: Common Nighthawk, Barn Swallow, Little Brown Myotis and Northern Myotis. Of these species, the Little Brown Myotis and Northern Myotis are the only species that are classified as Endangered both Provincially (ESA) and Federally (SARA) and may require habitat compensation. The Alternative D minewater pond will overprint 2.9 ha of habitat that could potentially support bat maternity roosts. The TSF is located in a forested area that was not assessed during bat surveys.

Alternative D will have the greatest greenhouse gas emissions of the alternatives based on diesel fuel use associated with haul truck traffic for TSF construction. Over the projected life of the mine, Alternative D will have an estimated 1,330,000 km of total haul distance, compared to 181,000 km for Alternatives A and B and 877,000 km for Alternative C.

There are three areas that have been assigned Provincial protection in relatively close proximity to the Project. Alternative D is situated 1.9 km away from Lola Lake Provincial Park and is the furthest alternative to Aaron Provincial Park (4.7 km). However, a portion of Alternative D is located within the Nugget / Hughes Creek watershed and it could potentially affect the Provincial Fish Sanctuary in Barret Bay.

Technical Characterization - As a requirement of the Schedule 2 process, Alternative D was designed to not overprint any water frequented by fish. This design approach significantly impacts the technical aspects of the alternative. This alternative has the worst location suitability of the TSF alternative considered, with a storage volume to dam ratio of 2.8, which is lower than the other conventional slurry alternatives with a ratio of 3.6 (Alternatives A and B). The maximum TSF dam height of 31 m would be built on the south dam of the TSF and is the largest dam that would be built out of the four alternatives. The foundation of Alternative D is rated fair as conditions provide moderately free draining material with moderate foundation shear strength. The minewater pond dam height would however, be the shortest of the alternatives with a maximum height at 8.0 m.

The hazard potential of the TSF for Alternative D is better than the other conventional slurry alternatives (Alternatives A and B), as a dam failure would only affect a forestry road seldom used by local residents. Additionally, the hazard potential of the minewater pond is poor for Alternative D, as a dam break has the potential to affect local infrastructure occasionally used by local residents (Tree Nursery Road and Normans Road).

As Alternative D was designed to not overprint water, a location could not be found which allowed the TSF and minewater pond to be situated in close proximity to each other. Alternative D has the least flexibility of water management of the conventional slurry alternatives (Alternative A and B), as there is a considerably greater distance for water to be pumped between the TSF and processing plant / minewater pond area. Although seepage capture infrastructure required by the MMER, unlike the other alternatives, Alternative C is located entirely outside of the 2 m groundwater drawdown zone created by mine dewatering, and seepage that bypasses the seepage collection system would report to the Nugget Creek / Hughes Creek system.

The overall size of the TSF for Alternative D requires the longest perimeter ditch system (6.0 km) to capture runoff. However, the benefit of Alternative D is that it does not overprint water, and it is also the only alternative that does not require a watercourse realignment.

Alternative D has large expansion capabilities with poor economics and is a slightly worse alternative compared to Alternatives B and C for expansion. The TSF dams can be raised on all sides without affecting existing mine infrastructure and is much less likely to require a second TSF in the event more ore was viable for processing. However, to cost to raise the dams would be significant primarily because of the large southern dam.

Alternative D will utilize conventional slurry technology, which has a lower potential to generate fugitive dust emissions compared to filtered stack technology. Additionally, the TSF will be located away from the property boundary, which provides a large buffer from dust emissions affecting outside the property. As such, Alternative D has the greatest likelihood of meeting all regulatory requirements for air quality at the property boundary and complying with environmental approvals.

Project Economics Characterization - Alternative D is projected to have the second highest overall costs out of the four alternatives.

For conventional slurry alternatives, the capital cost of building the TSF dams is the greatest cost of the alternative. Due to the selection of less favorable topography, which is required to avoid overprinting watercourses, Alternative D will have larger and more costly dams than the other conventional slurry alternatives. Alternative D is also further from the ore processing plant, requiring longer haul roads and pipeline infrastructure compared to the other alternatives, further increasing capital costs.

The operational costs of conventional slurry tailings deposition are significantly less than that of filtered stack construction. The TSF and minewater pond of Alternative D, based on the long distance from the process plant to the TSF and the open pit to the minewater pond, have higher costs of tailings deposition and pumping compared to the other conventional slurry alternatives.

Closure costs and post-closure costs are not major contributors to overall costs for Alternative D (dominated by capital costs). However, Alternative D will have relatively high closure costs in comparison to the other conventional slurry alternatives, primarily due to the larger TSF and minewater pond footprints, and additional haul road and pipeline infrastructure to be reclaimed.

Due to the high overall costs associated with Alternative D, there is an increased risk that fluctuations in the price of gold would could result in Project delays, entering a care and maintenance phase, or forced early shutdown.

Socio-economic Characterization - Although no specific heritage sites were identified in the Project operations area to date by Aboriginal peoples, the intrinsic value of traditional uses of the land is understood by Treasury Metals. Due to the spread out nature of Alternative D, it is anticipated to result in greater areas where traditional access could be limited or restricted (1,254 ha) compared to the other alternatives, which range from 702 to 782 ha. Effects to wildlife abundance will be greater than the other alternatives, as the Project site will be larger and less compact, resulting in greater habitat loss and extending Project related effects into a relatively undisturbed area.

Alternative D is more remote from nearby residents than several of the other alternatives, as it is situated in a relatively undeveloped area, approximately 4.1 km away from the Village of Wabigoon, 2.5 km away from the residents and cottagers on Thunder Lake, 1.5 km away from nearby rural residents and 3.3 km away from Aaron Provincial Park.

Alternative D will require a minor realignment of a forest access road, and will require Normans Road to be closed to public traffic, in addition to Tree Nursery Road.

2.3.6.3 MAA Ledger

The alternative characterization above provides a detailed description of the alternatives to ensure that every aspect of an alternative is properly considered and to allow for direct comparison within the remaining alternative set.

Site-specific characterization criteria were developed for the Project by a multidisciplinary team and are categorized into four categories or “accounts” as defined by Environment and Climate Change Canada (Guidelines for the Assessment of Alternatives for Mine Waste, September, 2013), that reflect the entire project life cycle. A multiple accounts ledger includes a three-level hierarchy comprised of accounts, sub-accounts and indicators. Accounts identify the general area of consideration and include:

- Environmental;
- Technical;
- Project economics; and
- Socio-economic.

The four "accounts" are summarized below.

Environmental Account

Characterize the local and regional environment surrounding the proposed TIA. These include elements such as climate, geology, hydrology, hydrogeology, water quality and potential impacts on aquatic, terrestrial and bird life.

Technical Account

Characterization of the engineered elements of each alternatives such as storage capacity, dam size and volume, diversion channel size and capacity, dumping techniques (if applicable), haul distances (if applicable), sedimentation and pollution control, dam requirements, tailings discharge methods, pipeline grades and routes, closure design, discharge and/or water treatment infrastructure and supporting infrastructure such as access roads.

Economic Account

Characterizes the project life economics, all aspects of the Tailings Management Plan (TMP) needs to be considered including investigation, design, construction (inclusive of borrow development and royalties where applicable), operation, closure, post-closure care and maintenance, water management, associated infrastructure (including transport and deposition systems), compensation payments and land use or lease fees.

Socio-economic Account

Identifies how a proposed TIA may influence local and regional land users. Elements that are considered here include characterization and valuation of land use, cultural significance, presence of archaeological sites and employment and/or training opportunities.

Each account is split into evaluation criteria (sub-accounts) that are used to determine the level of impact to the account. For example, an environmental account could contain sub-accounts that include terrestrial ecosystem impacts, aquatic ecosystem impacts, impacts to groundwater and impacts to air quality. Sub-accounts should conform to the following criteria detailed by Environment Canada (2013):

- Sub-accounts need to be impact driven;
- The sub-account must differentiate one alternative from another;
- The sub-account must be relevant to the account;
- The sub-account must be understandable, and unambiguously defined for clarity;
- Sub-accounts must not be redundant; and
- Sub-accounts should be judgmentally independent (one sub-account cannot depend on the value of another sub-account).

While sub-accounts measure impacts between the alternatives, they are often not easy to quantify and rank in a transparent manner. Measurement criteria (indicators) allow qualitative or quantitative measurement of the impact associated with each sub-account.

For the purposes of this MAA, each indicator has a six-point scale established that details how an alternative is valued, as suggested in the guidance (Environment Canada, 2013). Based on consultant experience with other recent assessments of alternatives, for indicators measured by quantitative data, the six-point scale is set up to reflect and maximize the relative differences between each alternative. Typically, this results in one alternative with the best indicator value of six, one alternative with the lowest indicator value of one, while the remaining alternatives are somewhere in the middle of the scale depending on their relative characteristics.

Qualitative scales are set up to cover a wider range of scenarios for added clarity and to ensure that an independent reviewer would also assign the same values. Typically, this results in the alternatives tending to have values towards the middle of the scale.

Deliverables for the multiple accounts ledger include a comprehensive list of accounts, sub-accounts and indicators, including rational for selection, and six-point value scales for each of the indicators.

2.3.6.4 Values Based Decision Process and Sensitivity Analysis

A value-based decision process is applied for each of the site alternatives upon conclusion of providing the scoring matrix for each of the indicators and accounts. This process entails taking the list of accounts, sub-accounts and indicators and assessing the combined impacts for each of the alternatives under review. This entails valuing of all indicators and also weighting of all indicators, sub-account and accounts and quantitatively determining merit ratings for each alternative. There are three steps to this process (Valuing, Weighting and Quantitative Analysis; Appendix D-2).

An experienced multidisciplinary team with representatives from Treasury Metals and Amec Foster Wheeler held a workshop to determine appropriate weightings for the sub-accounts and indicators. Where possible, views of external stakeholders as identified during engagement were incorporated when determining weights.

Weights were applied to each sub-account and indicator on a scale of one to six based on the relative importance of each sub-account and indicator. A weight of two is considered twice as important as a weight of one, likewise, a weight of four is twice as important as a weight of two. By design of the scale, no sub-account or indicator can be weighted more than six times above another sub-account or indicator.

The base case account weights as suggested by Environment and Climate Change Canada (Environment Canada 2011, Section 2.6.2 therein) are as follows:

- Environment – 6;
- Technical – 3;
- Socio-economic – 3; and
- Project economics – 1.5.

As provided in the Guidelines, the base case includes weighting the environment account twice as important as the technical and socio-economic accounts, which in turn are weighted twice as important as the Project economics account.

A sensitivity analysis is recommended for completion as part of the Assessment of Alternatives. The sensitivity analysis is completed by adjusting the weights of accounts, sub-accounts and indicators to determine the range of variances within the alternatives and the sensitivity to various scenarios. This part of the analysis is completed to eliminate bias and subjectivity, and to consider other scenarios beyond Environment and Climate Change Canada's base case (e.g., increasing the weight of the socio-economic account).

2.3.6.5 Selection of Preferred Alternative

Overall results of the MAA base case scenario, and calculation of alternative merit ratings, are provided in Table 2.3.6.4-1. Supporting steps in the MAA quantitative analysis are provided as follows; MAA Values in Table 2.3.6.4-2; the analysis of indicators in Tables 2.3.6.4-3, 2.3.6.4-4, 2.3.6.4-5, 2.3.6.4-6, and the analysis of sub-accounts in Tables 2.3.6.4-7, 2.3.6.4-8, 2.3.6.4-9, and 2.3.6.4-10.

Table 2.3.6.4-1: Multiple Accounts Analysis Base Case Results

Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score
Environment	6	4.2	25.0	4.2	25.1	3.8	22.6	3.5	21.1
Technical	3	4.3	12.9	4.1	12.4	3.2	9.6	4.0	11.9
Project Economics	1.5	5.2	7.8	5.0	7.5	3.0	4.5	3.1	4.7
Socio Economic	3	4.0	12.0	3.9	11.7	3.8	11.5	3.4	10.2
Alternative Merit Score		57.8		56.7		48.3		47.9	
Alternative Merit Rating		4.3		4.2		3.6		3.5	

Table 2.3.6.4-2: Multiple Accounts Values

Account	Sub-Account	Indicator	Indicator Value			
			Alternative A	Alternative B	Alternative C	Alternative D
Environmental	Surface and Groundwater Quantity and Quality	Flow Loss	3	3	1	5
		Flow Reductions Outside Blackwater Creek	6	5	4	1
		Seepage Capture During Operations	6	6	6	1
	Aquatic Resources	Tributary Fish Habitat Losses	1	2	4	6
		Mainstem Watercourse Fish Habitat Losses	6	6	1	6
		Watercourse Crossings	6	6	6	4
	Terrestrial Resources	Forest Loss	3	3	6	1
		Wetland Loss	1	2	3	6
		Use of Recently Disturbed Land	5	4	6	1
	SAR	Common Nighthawk	2	3	1	6
		Barn Swallow	6	6	2	1
		Bats	4	4	6	2
	Atmospheric Emissions	Fugitive Dust	6	6	2	5
		Noise Emissions	6	4	6	2
		Greenhouse Gas (GHG) Emissions	6	6	2	1
		Light Trespass	5	5	3	4

Table 2.3.6.4-2: Multiple Accounts Values (continued)

Account	Sub-Account	Indicator	Indicator Value			
			Alternative A	Alternative B	Alternative C	Alternative D
	Protected Areas	Distance to Nature Reserve	1	1	6	3
		Distance to Provincial Park	3	3	1	6
		Provincial Fish Sanctuary	6	6	6	4
	Closure / Post-Closure	Potential for Seepage to Report to Thunder Lake	3	3	1	6
		Surface Water Discharges	5	5	3	2
Technical	Design Factors	TSF Location Suitability	5	5	4	3
		Minewater Pond Location Suitability	3	1	3	6
		Foundation Suitability	4	4	2	3
	Safety Factors	TSF Hazard Potential	3	3	5	4
		Minewater Pond Hazard Potential	3	2	1	3
		Maximum TSF Dam Height	5	5	6	1
		Maximum Minewater Pond Dam Height	1	2	5	6
		Worker Health	5	5	1	6
Technical (cont'd)	Water Management	Seepage During Operations	5	5	6	1
		Runoff Management	6	2	5	1
		Watercourse Realignment	3	3	2	6
		Excess Water Management	5	5	1	5
		Flexibility for Water Management	5	4	1	2
	Expansion Capacity	Expansion Capacity	4	6	6	5
	Compliance with Environmental Approvals	Dust Management	5	5	1	6
Project Economics	Capital Cost	Clearing / Site Preparation	2	2	6	1
		TSF Dam Construction	5	5	6	1
		Tailings Dewatering Infrastructure	6	6	2	6
		Minewater Pond Construction	4	1	3	6
		Roads	6	6	3	1
		Pumping Infrastructure	4	5	6	1

Table 2.3.6.4-2: Multiple Accounts Values (continued)

Account	Sub-Account	Indicator	Indicator Value			
			Alternative A	Alternative B	Alternative C	Alternative D
		Seepage Collection Infrastructure	6	2	5	1
	Operational Costs	Tailings Deposition	6	6	2	4
		TSF Water Management	6	6	1	3
		Minewater Pond Pumping	2	5	6	1
	Closure Costs	TSF Cover	6	6	1	5
		Minewater Pond Reclamation	6	4	2	1
		Road Reclamation	6	6	3	1
	Post Closure Costs	Inspection / Maintenance / Monitoring	5	5	6	1
		Risk of Additional Treatment Facilities	6	6	4	1
	Ancillary Costs	Fish Habitat Compensation	1	2	3	6
		SAR Compensation	1	1	6	3
		Road Realignment	6	3	6	1
		Haul Distances for Overburden Stockpiles	6	6	1	6
	Risk	Risk of EA or Environmental Approval Delays or Rejection	5	5	1	5
		Risk Arising from TSF Costs	4	4	1	3
		Delays from Displacing Local Residents	6	6	4	6
Socio-economic	Aboriginal Land Use and Heritage Value	Access Effected Areas	5	6	5	1
		Wildlife Abundance	4	4	5	2
	Aboriginal Land Use and Heritage Value (cont'd)	Loss of Undisturbed Habitat	3	2	6	1
		Avoidance of Thunder Lake Watershed	6	4	1	5
	Land Use	Loss of Tree Stands	2	2	6	1
		Access Along Transmission Line	5	5	6	4
		Area with Air Quality Above Health Based Guidelines	6	6	1	6
	Operational	Village of Wabigoon	5	6	1	5
		Residents and Cottagers Around Thunder Lake	6	4	1	6
		Nearby Rural Residents	2	4	1	6

Table 2.3.6.4-2: Multiple Accounts Values (continued)

Account	Sub-Account	Indicator	Indicator Value			
			Alternative A	Alternative B	Alternative C	Alternative D
		Aaron Provincial Park	6	5	1	6
		Fugitive Dust	6	6	2	5
		TSF Elevation	1	1	6	1
		Frequency and Duration of Construction	4	4	1	3
	Local Infrastructure	Access Along Tree Nursery Road	3	3	6	2
	Drinking Water Quality	Potential for Seepage to Affect Drinking Water Wells	2	2	6	1
	Public Safety	Hazard Potential of TSF	3	3	5	4
		Hazard Potential of Minewater Pond	3	2	1	3
	Local Employment / Business	Risk to Local Economy	4	4	1	3
	Displacement of Residents	Potential for Displacing Local Residents	6	6	4	6

Table 2.3.6.4-3: Environmental Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Surface and Groundwater Quantity and Quality	Flow Loss	2	3	6	3	6	1	2	5	10
	Flow Reductions Outside Blackwater Creek	3	6	18	5	15	4	12	1	3
	Seepage Capture During Operations	5	6	30	6	30	6	30	1	5
	Sub Account Merit Score		54		51		44		18	
	Sub Account Merit Rating		5.4		5.1		4.4		1.8	
Aquatic Resources	Tributary Fish Habitat Losses	3	1	3	2	6	4	12	6	18
	Mainstem Watercourse Fish Habitat Losses	4	6	24	6	24	1	4	6	24
	Watercourse Crossings	2	6	12	6	12	6	12	4	8
	Sub Account Merit Score		39		42		28		50	
	Sub Account Merit Rating		4.3		4.7		3.1		5.6	
Terrestrial Resources	Forest Loss	3	3	9	3	9	6	18	1	3
	Wetland Loss	4	1	4	2	8	3	12	6	24
	Use of Recently Disturbed Land	2	5	10	4	8	6	12	1	2
	Sub Account Merit Score		23		25		42		29	

Table 2.3.6.4-3: Environmental Indicator Analysis (continued)

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
	Sub Account Merit Rating		2.6		2.8		4.7		3.2	
SAR	Common Nighthawk	2	2	4	3	6	1	2	6	12
	Barn Swallow	3	6	18	6	18	2	6	1	3
	Bats	6	4	24	4	24	6	36	2	12
	Sub Account Merit Score		46		48		44		27	
	Sub Account Merit Rating		4.2		4.4		4.0		2.5	
Atmospheric Emissions	Fugitive Dust	3	6	18	6	18	2	6	5	15
	Noise Emissions	4	6	24	4	16	6	24	2	8
	Greenhouse Gas Emissions	5	6	30	6	30	2	10	1	5
	Light Trespass	1	5	5	5	5	3	3	4	4
	Sub Account Merit Score		77		69		43		32	
	Sub Account Merit Rating		5.9		5.3		3.3		2.5	
Protected Areas	Distance to Nature Reserve	5	1	5	1	5	6	30	3	15
	Distance to Provincial Park	2	3	6	3	6	1	2	6	12
	Provincial Fish Sanctuary	4	6	24	6	24	6	24	4	16
	Sub Account Merit Score		35		35		56		43	
	Sub Account Merit Rating		3.2		3.2		5.1		3.9	
Closure / Post-Closure	Potential for Seepage to Report to Thunder Lake	5	3	15	3	15	1	5	6	30
	Surface Water Discharge	4	5	20	5	20	3	12	2	8
	Sub Account Merit Score		35		35		17		38	
	Sub Account Merit Rating		3.9		3.9		1.9		4.2	

Table 2.3.6.4-4: Technical Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Design Factors	TSF Location Suitability	6	5	30	5	30	4	24	3	18
	Minewater Pond Location Suitability	3	3	9	1	3	3	9	6	18
	Foundation Suitability	4	4	16	4	16	2	8	3	12
	Sub Account Merit Score		55		49		41		48	
	Sub Account Merit Rating		4.2		3.8		3.2		3.7	
Safety Factors	TSF Hazard Potential	6	3	18	3	18	5	30	4	24

Table 2.3.6.4-4: Technical Indicator Analysis (continued)

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
	Minewater Pond Hazard Potential	4	3	12	2	8	1	4	3	12
	Maximum TSF Dam Height	2	5	10	5	10	6	12	1	2
	Maximum Minewater Pond Dam Height	1	1	1	2	2	5	5	6	6
	Worker Health	3	5	15	5	15	1	3	6	18
	Sub Account Merit Score		56		53		54		62	
	Sub Account Merit Rating		3.5		3.3		3.4		3.9	
Water Management	Seepage During Operations	5	5	25	5	25	6	30	1	5
	Runoff Management	3	6	18	2	6	5	15	1	3
	Watercourse Realignment	2	3	6	3	6	2	4	6	12
	Excess Water Management	4	5	20	5	20	1	4	5	20
	Flexibility of Water Management	3	5	15	4	12	1	3	2	6
	Sub Account Merit Score		84		69		56		46	
	Sub Account Merit Rating		4.9		4.1		3.3		2.7	
Expansion Capacity	Expansion Capacity	1	4	4	6	6	6	6	5	5
	Sub Account Merit Score		4		6		6		5	
	Sub Account Merit Rating		4.0		6.0		6.0		5.0	
Compliance with Environmental Approvals	Dust Management	1	5	5	5	5	1	1	6	6
	Sub Account Merit Score		5		5		1		6	
	Sub Account Merit Rating		5.0		5.0		1.0		6.0	

Table 2.3.6.4-5: Project Economics Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Capital Cost	Clearing / Site Preparation	1	2	2	2	2	6	6	1	1
	TSF Dam Construction	6	5	30	5	30	6	36	1	6
	Tailings Dewatering Infrastructure	3	6	18	6	18	2	6	6	18
	Minewater Pond Construction	2	4	8	1	2	3	6	6	12
	Roads	2	6	12	6	12	3	6	1	2
	Pumping Infrastructure	1	4	4	5	5	6	6	1	1
	Seepage Collection Infrastructure	1	6	6	2	2	5	5	1	1
	Sub Account Merit Score		80		71		71		41	

Table 2.3.6.4-5: Project Economics Indicator Analysis (continued)

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
	Sub Account Merit Rating		5.0		4.4		4.4		2.6	
Operational Costs	Tailings Deposition	6	6	36	6	36	2	12	4	24
	TSF Water Management	4	6	24	6	24	1	4	3	12
	Minewater Pond Pumping	1	2	2	5	5	6	6	1	1
	Sub Account Merit Score		62		65		22		37	
	Sub Account Merit Rating		5.6		5.9		2.0		3.4	
Closure Costs	TSF Cover	6	6	36	6	36	1	6	5	30
	Minewater Pond Reclamation	2	6	12	4	8	2	4	1	2
	Road Reclamation	2	6	12	6	12	3	6	1	2
	Sub Account Merit Score		60		56		16		34	
	Sub Account Merit Rating		6.0		5.6		1.6		3.4	
Post-Closure Costs	Inspection / Maintenance / Monitoring	2	5	10	5	10	6	12	1	2
	Risk of Additional Treatment Facilities	4	6	24	6	24	4	16	1	4
	Sub Account Merit Score		34		34		28		6	
	Sub Account Merit Rating		5.7		5.7		4.7		1.0	
Ancillary Costs	Fish Habitat Compensation	3	1	3	2	6	3	9	6	18
	SAR Compensation	1	1	1	1	1	6	6	3	3
	Road Realignment	3	6	18	3	9	6	18	1	3
	Haul Distance for Overburden Stockpiles	1	6	6	6	6	1	1	6	6
	Sub Account Merit Score		28		22		34		30	
	Sub Account Merit Rating		3.5		2.8		4.3		3.8	
Risk	Risk of EA or Environmental Approval Delays or Rejection	5	5	25	5	25	1	5	3	15
	Risk Arising from TSF Costs	3	4	12	4	12	1	3	3	9
	Delays from Displacing Local Residents	4	6	24	6	24	4	16	6	24
	Sub Account Merit Score		61		61		24		48	
	Sub Account Merit Rating		5.1		5.1		2.0		4.0	

Table 2.3.6.4-6: Socio-economic Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
	Access Effected Areas	6	5	30	6	36	5	30	1	6

Table 2.3.6.4-6: Socio-economic Indicator Analysis (continued)

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Aboriginal Land Use and Heritage Value	Wildlife Abundance	3	4	12	4	12	5	15	2	6
	Loss of Undisturbed Habitat	3	3	9	2	6	6	18	1	3
	Avoidance of Thunder Lake Watershed	4	6	24	4	16	1	4	5	20
	Sub Account Merit Score		75		70		67		35	
	Sub Account Merit Rating		4.7		4.4		4.2		2.2	
Land Use	Loss of Tree Stands	2	2	4	2	4	6	12	1	2
	Access Along Transmission Line	2	5	10	5	10	6	12	4	8
	Area With Air Quality Above Health Based Guidelines	4	6	24	6	24	1	4	6	24
	Sub Account Merit Score		38		38		28		34	
	Sub Account Merit Rating		4.8		4.8		3.5		4.3	
Operational Impacts (Air, Noise and Aesthetics)	Village of Wabigoon	5	5	25	6	30	1	5	5	25
	Residents and Cottagers Around Thunder Lake	5	6	30	4	20	1	5	6	30
	Nearby Rural Residents	5	2	10	4	20	1	5	6	30
	Aaron Provincial Park	3	6	18	5	15	1	3	6	18
	Fugitive Dust	3	6	18	6	18	2	6	5	15
	TSF Elevation	1	1	1	1	1	6	6	1	1
	Frequency and Duration of Construction	4	4	16	4	16	1	4	3	12
	Sub Account Merit Score		118		120		34		131	
	Sub Account Merit Rating		4.5		4.6		1.3		5.0	
Location Infrastructure	Access Along Tree Nursery Road	1	3	3	3	3	6	6	2	2
	Sub Account Merit Score		3		3		6		2	
	Sub Account Merit Rating		3.0		3.0		6.0		2.0	
Drinking Water Quality	Potential for Seepage to Affect Drinking Water Wells	1	2	2	2	2	6	6	1	1
	Sub Account Merit Score		2		2		6		1	
	Sub Account Merit Rating		2.0		2.0		6.0		1.0	
Public Safety	Hazard Potential of TSF	6	3	18	3	18	5	30	4	24
	Hazard Potential of Minewater Pond	3	3	9	2	6	1	3	3	9
	Sub Account Merit Score		27		24		33		33	
	Sub Account Merit Rating		3.0		2.7		3.7		3.7	
Local Employment / Business	Risk to Local Economy	1	4	4	4	4	1	1	3	3

Table 2.3.6.4-6: Socio-economic Indicator Analysis (continued)

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
	Sub Account Merit Score		4		4		1		3	
	Sub Account Merit Rating		4.0		4.0		1.0		3.0	
Displacement of Residents	Potential for Displacing Local Residents	1	6	6	6	6	4	4	6	6
	Sub Account Merit Score		6		6		4		6	
	Sub Account Merit Rating		6.0		6.0		4.0		6.0	

Table 2.3.6.4-7: Environmental Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Environment	Surface and Groundwater Quantity and Quality	4	5.4	21.6	5.1	20.4	4.4	17.6	1.8	7.2
	Aquatic Resources	6	4.3	26.0	4.7	28.0	3.1	18.7	5.6	33.3
	Terrestrial Resources	4	2.6	10.2	2.8	11.1	4.7	18.7	3.2	12.9
	SAR	5	4.2	20.9	4.4	21.8	4.0	20.0	2.5	12.3
	Atmospheric Emissions	3	5.9	17.8	5.3	15.9	3.3	9.9	2.5	7.4
	Protected Areas	4	3.2	12.7	3.2	12.7	5.1	20.4	3.9	15.6
	Closure / Post-Closure	4	3.9	15.6	3.9	15.6	1.9	7.6	4.2	16.9
	Account Merit Score		124.8		125.5		112.8		105.6	
	Account Merit Rating		4.2		4.2		3.8		3.5	

Table 2.3.6.4-8: Technical Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Technical	Design Factors	6	4.2	25.4	3.8	22.6	3.2	18.9	3.7	22.2
	Safety Factors	5	3.5	17.5	3.3	16.6	3.4	16.9	3.9	19.4
	Water Management	5	4.9	24.7	4.1	20.3	3.3	16.5	2.7	13.5
	Expansion Capacity	2	4.0	8.0	6.0	12.0	6.0	12.0	5.0	10.0
	Compliance with Environmental Approvals	3	5.0	15.0	5.0	15.0	1.0	3.0	6.0	18.0
	Account Merit Score		90.6		86.5		67.3		83.1	
	Account Merit Rating		4.3		4.1		3.2		4.0	

Table 2.3.6.4-9: Project Economics Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Economic	Capital Cost	6	5.0	30.0	4.4	26.6	4.4	26.6	2.6	15.4
	Operational Costs	5	5.6	28.2	5.9	29.5	2.0	10.0	3.4	16.8
	Closure Costs	3	6.0	18.0	5.6	16.8	1.6	4.8	3.4	10.2
	Post-Closure Costs	1	5.7	5.7	5.7	5.7	4.7	4.7	1.0	1.0
	Ancillary Costs	2	3.5	7.0	2.8	5.5	4.3	8.5	3.8	7.5
	Risk	3	5.1	15.3	5.1	15.3	2.0	6.0	4.0	12.0
	Account Merit Score		104.1		99.4		60.6		62.9	
	Account Merit Rating		5.2		5.0		3.0		3.1	

Table 2.3.6.4-10: Socio-economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Socio-economic	Aboriginal Land Use and Heritage Value	6	4.7	28.1	4.4	26.3	4.2	25.1	2.2	13.1
	Land Use	3	4.8	14.3	4.8	14.3	3.5	10.5	4.3	12.8
	Operational Impacts (Air, Noise and Aesthetics)	4	4.5	18.2	4.6	18.5	1.3	5.2	5.0	20.2
	Location Infrastructure	1	3.0	3.0	3.0	3.0	6.0	6.0	2.0	2.0
	Drinking Water Quality	6	2.0	12.0	2.0	12.0	6.0	36.0	1.0	6.0
	Public Safety	5	3.0	15.0	2.7	13.3	3.7	18.3	3.7	18.3
	Local Employment / Business	2	4.0	8.0	4.0	8.0	1.0	2.0	3.0	6.0
	Displacement of Residents	5	6.0	30.0	6.0	30.0	4.0	20.0	6.0	30.0
	Account Merit Score		128.5		125.3		123.2		108.4	
	Account Merit Rating		4.0		3.9		3.8		3.4	

The MAA found that Alternative A is the preferred alternative with an alternative merit rating of 4.3 out of a maximum of 6.0. The runner-up alternative (Alternative B) received an alternative merit rating of 4.2. Alternatives A and B are very similar, differentiated only by minewater pond location, and the closeness of account merit ratings is reflective of their many similarities.

In all sensitivity analysis scenarios Alternative A was found to be the preferred alternative. This leads to a high confidence that the MAA has come to the appropriate conclusion.

The characterization of each Alternative is presented in the following pages. A full description of the multiple accounts ledger, quantitative analysis and sensitivity analysis can be found in Sections 8, 9 and 10 of Appendix D-2, respectively.

2.3.7 Water Supply

The processing plant will consume an estimated average 3,044 m^3/d of freshwater during operation, which it is estimated on a normal year and equates to approximately 58 m^3/d taken from local surface water sources (Appendix F). This freshwater will be used for makeup of select reagents, various spray nozzles, carbon elution, plant wash down and cleanup, and potable water. Potable water will be produced to provincial standards by clarifying, removing harmful constituents, and disinfecting the raw freshwater as required by the source.

During construction activities, the freshwater supply requirement is expected to be similar to or less during operations depending on the stage of construction. During closure, freshwater consumption will taper to nil. During the start-up of the plant, an initial first fill quantity of water will be required, however, this water does not need to be freshwater and as such will be supplied by the mine dewatering activities and taken from the contact water sediment ponds as required. The only freshwater required at plant start-up is the first fill of the raw water tank (includes firewater), potable water tank, and select reagent tanks. This demand is insufficient to warrant additional consideration.

The following alternative water taking sources were considered: nearby creeks, groundwater, nearby lakes and ponds. The ability of the source to supply uninterrupted water sufficient to meet the project requirements is critical. Scoring of the sources of freshwater is presented in Table 2.3.5-1.

2.3.7.1 Nearby Creeks

Based on spot flow gauging of creeks within the Project area (Appendix M) including Blackwater Creek, Hughes Creek, Little Creek, Thunder Lake Tributaries 3 and 2, and Hoffstrom's Bay Tributary, insufficient water flow is available throughout the year in most of these creeks to support the plant's freshwater requirements. However, the refined water balance for the Project (Appendix F) have reduced the fresh water requirements to a point where the fresh water needs can be supplied from the three ponds located on the former MNRF tree nursery, which are referred to collectively as the tree nursery ponds. These dug ponds were used for irrigation during the historical operation of a tree nursery and are situated on the creeks referred to as Thunder Lake Tributary 2 and Thunder Lake Tributary 3. To meet the processing plant requirements, taking into account the storage of mine runoff water and recycling a high proportion of the plant water, less than 5% of the flow of Thunder Lake Tributary 2 and Thunder Lake Tributary 3 would be required.

2.3.7.2 Groundwater

Per the Project hydrogeology report (Appendix M), groundwater levels measured were consistently within 7 m of ground surface and on average within 3 m of ground surface. Groundwater level fluctuations were typically on the order of 1 m to 2 m.

Each of the nine groundwater stations was sampled six times for water quality with assaying including major ions and anions as well as dissolved metals. All of the groundwater monitoring stations produced water suitable for freshwater consumption. With respect to drinking water, some manganese and iron assays were above provincial standards; however, these elements would be removed during the potable water treatment process.

The ability of wells to supply freshwater has yet to be assessed. However, as the total seepage into the proposed open pit and underground mine workings is predicted to be only 1,320 m^3/d, the production of water by a reasonable number of ground wells is assumed to be inadequate. Work completed to date suggests that the overburden characteristics north of the former tree nursery may yield wells with sufficient capacity, however, this is yet to be determined. Due to the technical uncertainty of capacity, groundwater supply is not considered viable at this time.

2.3.7.3 Nearby Lakes

The three significantly sized bodies of water closest to the Project site in order of distance are: Thunder Lake (approximately 4.9 km), Wabigoon Lake (approximately 6.5 km), and Hartman Lake (approximately 14.4 km). These distances are estimated pipeline lengths, as opposed to straight-line distances. Each of these lakes is of sufficient capacity to supply the freshwater demands of the Project, and the most desirable source is the one with the shortest pipeline, and hence lowest cost – Thunder Lake. However, the cost of building a pipeline to Thunder Lake discounts this option. Pipeline construction has the potential to negatively impact fish and fish habitat in addition to the terrestrial habitat loss. In addition to biological loss, socio-economically the pipeline intake may be seen as a negative and potentially impact recreational and economic activities on the particular water body.

2.3.7.4 Selection of Preferred Alternative

The results of the Alternatives Assessment have indicated the tree nursery ponds are the preferred alternative for sourcing freshwater supply for the Project. The tree nursery ponds will have sufficient quantity to serve the needs of the Project. The ponds also provide the low capital needs associated with infrastructure development, and closure costs, in addition to providing low risk to the permitting timeline opposed to the alternatives.

2.3.8 Water Discharge Location

There are several lakes and creeks capable of receiving the effluent from the Project. The three significantly sized bodies of water closest to the Project site in order of distance are: Thunder Lake (approximately 4.9 km), Wabigoon Lake (approximately 6.5 km), and Hartman Lake (approximately 14.4 km). These distances are estimated pipeline lengths, as opposed to straight-line distances. Each of these lakes is of sufficient capacity to assimilate the effluent from the Project. Secondary to this is the creek systems that are capable of receiving effluent from the Project. These include the Thunder Lake Tributary 3 / Tree Nursery Ponds (approximately 2.2 km), and Blackwater Creek (approximately 1.5 km). The most desirable destination is the alternative with the shortest pipeline to minimize local impact and overall footprint of the Project, and in addition to the lowest cost. Blackwater Creek is the preferred effluent receiver.

2.1.1.1 Wabigoon Lake

Wabigoon Lake is the second farthest receiver with an estimated 6.5 km long pipeline. To reach Wabigoon Lake, the effluent pipeline must cross multiple creeks and roads including the TransCanada highway and the CP Railway line. Wabigoon Lake is the source of drinking water for the City of Dryden and discharge of mining effluent into the lake via an underwater diffuser could present social acceptance issues. The pipeline will require the removal of terrestrial and aquatic habitat and will negatively impact species within the area.

2.3.8.1 Thunder Lake

Thunder Lake is a highly valued fishing lake within the local community. The lake is perceived as naturally beautiful and there are a number of cottages located on the lake. Because of the close proximity of Thunder Lake and its assimilative capacity, it is the preferred effluent receiving lake out of Wabigoon, Thunder and Hartman lakes. In the interest of preserving the perceived value of Thunder Lake, other effluent receivers will be sought. In addition to the human acceptance concern, delivery of discharge via pipeline to Thunder Lake has the potential to negatively impact fish and fish habitat in addition to the terrestrial habitat loss.

2.3.8.2 Hartman Lake

Hartman Lake is the farthest lake identified as a possible effluent receiver with an estimated pipeline distance of 14.4 km. To reach Hartman Lake, multiple creek and road crossings are required in addition to the relatively lengthy access road required for maintenance of the pipeline. Due to the length of the pipeline, the area of land impacted is significantly larger than the alternatives and the cost to the Project is significantly increased. Although Hartman Lake is likely to be the most socially acceptable lake for effluent discharge, it is the highest capital cost alternative and is not a preferred alternative. With increasing distance comes a larger number of piping low points that will require drainage during winter stoppages to prevent freezing increasing the complexity of operation.

2.3.8.3 Thunder Lake Tributary 3 / Tree Nursery Ponds

Discharge into the tree nursery ponds will require ongoing environmental impact monitoring because of the lack of assimilative capacity of the ponds and the creek flowing through the ponds. This creek is a tributary to Thunder Lake and may present the same social issues as discharging to Thunder Lake directly. In addition, this creek and the established former tree nursery ponds have been selected as the preferred freshwater source for the Project, although this does not negate the possibility of discharging effluent downstream of the freshwater intake. Due to the aforementioned complications, effluent discharge to the tree nursery ponds is not the preferred option.

2.3.8.4 Blackwater Creek

Discharge into Blackwater Creek will require ongoing environmental impact monitoring due to the lack of assimilative capacity. Using this waterway will present an ongoing environmental operating cost for treatment to the Project. Consideration will need to be given to the physical flow rate receiving capacity of Blackwater Creek throughout the seasons with the possible regulation of flows and temporary storage of effluent within the water management system (TSF and minewater pond). Blackwater Creek intersects Anderson Road, the TransCanada highway, and the CP railway line. Due to these intersections, the flow capacity of these crossings will need to be determined and taken into consideration when determining the maximum effluent discharge flow rate. Further to this overall capacity of the creek will need to be taken into consideration to ensure the continued stable aquatic environment (creek erosion etc.). Due to its proximity to the processing plant, tailings storage facility, and eventual destination in Wabigoon Lake versus Thunder Lake, Blackwater Creek is the preferred final effluent receiver.

2.3.8.5 Selection of Preferred Alternative

Blackwater Creek is capable of meeting the Project's water discharge needs. Water discharge would be treated, restricted, and controlled and is not expected to have any adverse effects. Aquatic life is will not be adversely affected due to effluent, changes in flow, or changes in quality. All aspects of the creek including aquatic life will be monitored in all phases of development. Lastly, Blackwater Creek provides the lowest cost option and one of the options identified as preferable to members of the public.

2.3.9 Watercourse Realignments

Watercourse realignments may be necessary to accommodate Project components, specifically the processing plant (Section 2.3.10). Their development and locations are dependent on the location of Project components, which in turn are subject to land acquired for the Project and the topography. As a result of Treasury Metals' goal of keeping the Project to a minimal footprint there are only a few alternatives for the required watercourse realignments. Therefore, alternative watercourse alignments were not assessed for the EIS.

The proposed development will require a tributary of Blackwater Creek to be realigned if the processing plant is to be located south and east of the open pit. The realignment of this area is to allow safe development and operation to Treasury employees. The realignment of Blackwater Creek is driven by TSF development and the proposed processing plant.

The guidelines for the selection of the watercourse realignment of Blackwater Creek were:

- Select alignments with the aim of minimizing the over Project footprint;
- Select alignments that maximize economic efficiencies;
- Minimize disturbance of existing hydrological network
- Minimize disturbance to existing aquatic habitat and species;
- Minimize disturbance of existing terrestrial habitat and species;
- Minimize water transfer amongst Wabigoon Lake and Thunder Lake watersheds; and
- Ensure safety for workers in the components in close proximity to proposed realignments.

Realignments are not final and are subject to discussion with regulators and advancement of further engineering.

2.3.9.1 Realignment of Blackwater Creek Tributary #2 Northeast of Processing Plant Discharge Point within Blackwater Creek Tributary #2

Realignment of Blackwater Creek Tributary #2 will be required to ensure the safety and development of the Project. This option will require the realignment of approximately 360 m of Blackwater Creek Tributary #2. The diversion will run adjacent to proposed road surrounding the processing plant, crossing south of the parking lot area and returning to Blackwater Tributary #2 south of the processing plant. The realigned channel will run approximately 429 m. The proposed realignment allows for minimal disturbance to the existing Blackwater Creek Tributary #2 channel, therefore limiting effects to aquatic habitat destruction, and hydrological impacts. Proposed tributary would require a single new water crossing south of the proposed parking lot infrastructure. This culvert would be designed to handle all water, and traffic needs. The realignment would also require an upgrade to the existing culvert on Normans Road, to ensure proper water management and road maintenance.

2.3.9.2 Realignment of Blackwater Creek Tributary #2 to Northeast of Processing Plant Discharge Point in Blackwater Creek

Realignment of Blackwater Creek Tributary #2 will be required to ensure the safety and development of the proposed TSF facility, and processing plant. This option will require approximately the diversion of approximately 700 m of Blackwater Creek Tributary #2. The realignment will run parallel to the road surrounding the processing plant, traveling south and crossing Normans Road and linking with the primary channel of Blackwater Creek. The realigned channel will run approximately 600 m. The Blackwater Creek Tributary #2 channel will be directly impacted due to the proposed realignment, impacting aquatic habitat and hydrological function of the creek. In addition to loss of the tributary, the proposed option will potentially be impacted by COC associated with road networks (oils, grease, salt, snow removal), due to running parallel to the development. This development would require the construction of one culvert system, crossing Normans Road.

2.3.9.3 Selection of Preferred Alternative

There are only marginal differences between each of the proposed realignment locations and each site is well suited for infrastructure development and worker safety. The preferred alternative in this case is the realignment of Blackwater Creek Tributary 2 northeast of processing plant, discharge point within Blackwater Creek Tributary 2. The selection of this option is based on the ecological benefits of maintaining part of the creek, and the concern with COC delivery to Blackwater Creek with parallel development.

2.3.10 Infrastructure and Buildings

The Project proposes to maximize the use of infrastructure that is already in place and does not assess alternatives for the following features:

- Site access will be via existing roads such as Tree Nursery Road and Anderson Road. The company sees no benefit to creating an additional access road.

- Administrative offices and warehousing facilities are readily available at the current Project offices (former tree nursery offices) and the company sees no additional benefit to creating supplementary facilities expanded from the original footprint. Offices and administrative space will be incorporated within the processing plant facility to support the operational needs of the Project. Office and warehousing facilities therefore have not been assessed.

Excluding the aforementioned existing facilities, the processing plant and remaining infrastructure was assessed as part of a greater facility that will be constructed within a specified footprint. Treasury sees no benefit to having separate facilities in differing locations. The overall site topography, location and layout of the proposed Project lend to the ability for all built facilities to be placed in one singular location.

Each facility location is required to be located in close proximity to the existing power line to limit construction costs for transmission line (Figure 2.3.10-1). The plant must also be at a sufficient distance to not interfere with mining operations while at the same time being placed close enough to not create a burden for transport of mineralized material.

2.3.10.1 North of Open Pit area

The area to the north of the open pit is beneficial as it is further from the strike of the ore-body and hence has a lower probability of being located on the top of mineralized rock material that could be possibly mined in the future. The location to the north of the open pit would allow for a greater distance from the southern limit of the company's property and would provide a greater buffer from neighbouring residents on Tree Nursery Road. The topography and overburden conditions at this location would be well suited for the construction of the plant and infrastructure needs of the Project. RWDI also reports in Appendix J that mitigation of noise and air quality will be possible at this location to meet provincial permitting requirements.

Disadvantages of this location are that it will be marginally closer and marginally more visible to Thunder Lake Road residents.. This location is situated on land that is under mining lease for use by Treasury Metals.

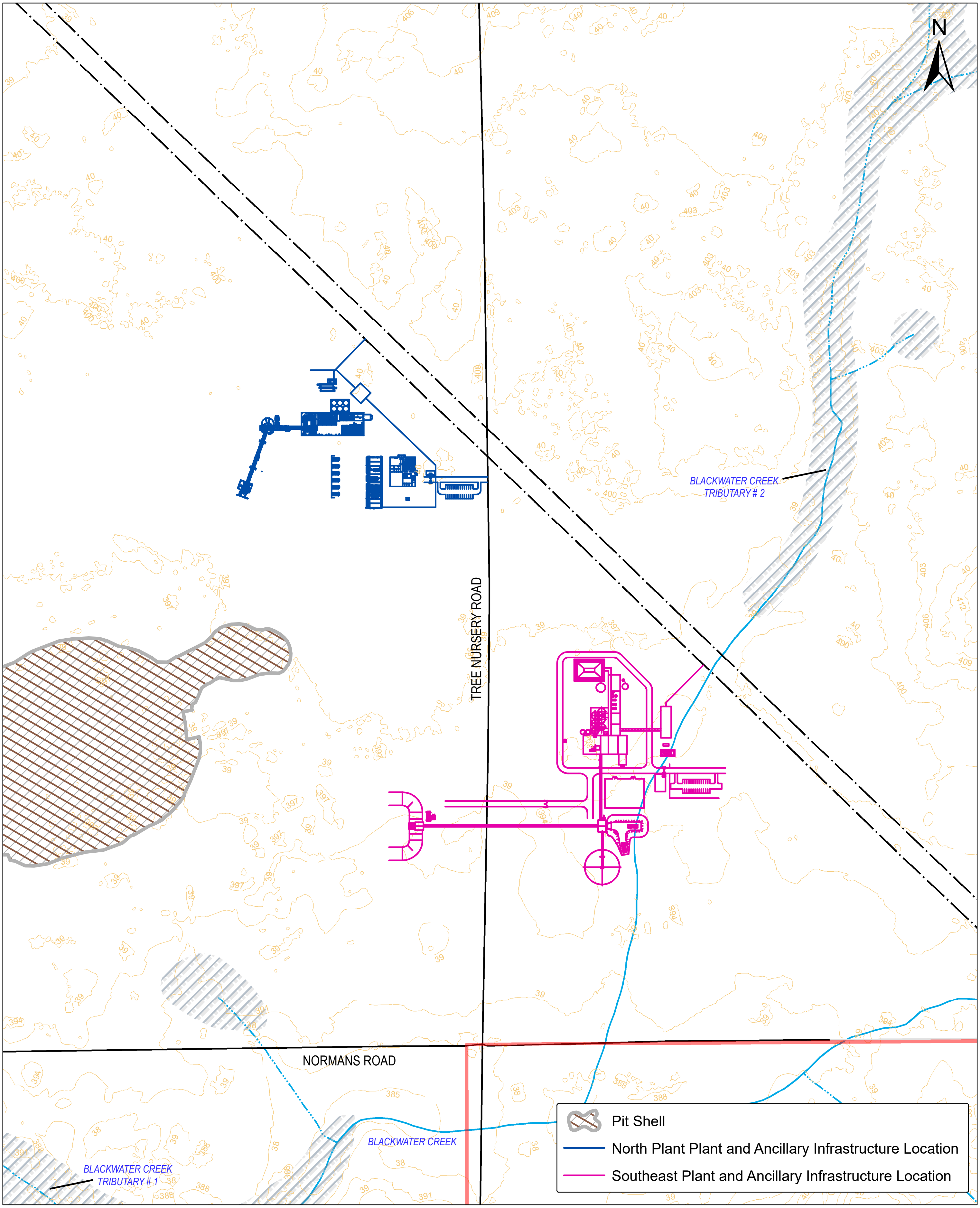
2.3.10.2 South and East of Open Pit area

The area to the south and east of the open pit area shares similar attribute to the area to the north in that topography would also be ideal to the construction of the plant and infrastructure. Although this location is closer to the company's southern property boundary, it is also further away from Thunder Lake residents and therefore less likely to be visible. RWDI also reports in Appendix J that mitigation of noise and air quality will be possible at this location to meet provincial permitting requirements.

This location is also located well within the boundaries of the Blackwater Creek watershed which will make the overall water management marginally simpler over the life of the Project. This location falls wholly within private land owned by Treasury Metals. It is likely that this location will require a diversion of Blackwater Creek Tributary 2 prior to construction, further impacting the aquatic environment.

2.3.10.3 Selection of Preferred Alternative

The primary difference between the plant and infrastructure locations is the need for diversion and to realignment of Blackwater Creek Tributary 2 prior to construction for the south and east location. However, the south and east location falls wholly within private land owned by Treasury Metals. On balance, the location north of the open pit has been selected as the preferred option on the basis of avoiding the need for a realignment of Blackwater Creek Tributary 2.



GOLIATH GOLD PROJECT
DRYDEN, ONTARIO, CANADA

TREASURY METALS INCORPORATED

Plant and Ancillary Infrastructure Alternatives

DESIGN:	MP	31/07/2017
GIS:	MP	31/07/2017
CHECK:	MW	31/07/2017
REVIEW:	MW	31/07/2017

Figure 2.3.10-1 REV.01

Hydro Line
Natural Gas Pipeline
Provincial Parks
Railway
Expressway / Highway
Local
Resource / Recreation
Contours (3 meters)
Intermittent Watercourses
Permanent Watercourses
Waterbody
Wetland

SCALE 1:7,000

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

0 100 200 300
Meters

Base Data:
Treasury Metals Inc., LIO Database, KBM Resources Group

Notes:
All details preliminary and subject to change as engineering designs are updated.

2.3.11 Aggregate Supply

Geochemical characterization of the deposit and mine site has indicated that the mine rock within the Project is PAG. Due to the ARD concerns it may be necessary to investigate additional aggregate sources. Identification of alternative aggregate supply sources was assessed as part of the Alternatives Assessment and the analysis is presented in Appendix X. The three options selected for the Project include:

- Mine rock;
- Dedicated on-site aggregate pit(s); and
- Commercial off-site aggregate pits.

2.3.11.1 Overburden and Mine Rock

The use of mine rock and overburden as aggregate material reduces waste and disturbance of habitat, while also being cost-effective and close to the components where the material would be used. Potential air emissions would be greatly reduced as blasting forms part of the Project development and transport would be limited to the Project site. Due to the geochemical characterization of PAG rock at the Project site, the use of mine rock for aggregate supply was considered unacceptable due to ARD concerns.

2.3.11.2 On-site Aggregate Pit

On-site aggregate pits provide a cost-effective alternative that can provide material for construction and Project development. However, no existing on-site aggregate pit(s) are present, making the creation and operating cost high. Additional equipment, crushing, and blasting will be required which would increase the disturbance to local residents and wildlife. Increased air emissions would also be present to produce a sufficient supply for the Project's needs. In addition, no site has been identified to date that contains non- acid generating (NAG) rock suitable for aggregate construction.

2.3.11.3 Commercial Off-site Aggregate Pit

Using an off-site location would potentially limit the Project's footprint from crushing and blasting required on-site, and air emissions. However, greenhouse gas (GHG) emissions could potentially be increased. Hauling would increase local traffic and could potentially increase the risk of traffic accidents. The use of commercial aggregate would provide a source of material that is NAG in nature and providing less risk to Project development.

2.3.11.4 Selection of Preferred Alternative

The results of the Alternatives Assessment have indicated that sourcing commercial off-site aggregate is the preferred alternative for the Project. Due to the geochemical condition of the Project site mine rock, on-site aggregate supplies are not considered a viable option. Off-site aggregate supply provides low risk to the permitting timeline opposed to the alternatives and can be sourced from local providers contributing economic benefits to the area.

2.3.12 Non-hazardous Solid Waste Management

Alternatives considered for the management of non-hazardous waste are negligible due to the close proximity of the Project to the licenced facilities around the community of Dryden. Alternatives to non-hazardous waste management will require long-term monitoring and carry potential closure liabilities, making it less attractive from a cost-effectiveness perspective. Therefore, the primary option will require trucking of non-hazardous waste to an existing licenced landfill facility. Treasury Metals may give consideration to controlled burning in accordance with environmental regulations and timing. Burning would include clean wood, and cardboard waste to reduce waste volumes.

The waste produced at the Project site would be temporarily stored on-site and regularly transported by trucks to an off-site licenced facility which has currently not been identified. It has been confirmed in discussions with the appropriate authorities (City of Dryden, Public Works Operations Manager) that the City of Dryden Highway 502 Landfill site will have the capacity for the Project's waste disposal needs. This option allows for liabilities to be transferred to the landfill facility operator, which would benefit cost-effectiveness. Transport would increase traffic along local roads, thereby increasing the risk of potential collisions and spills, and relies on the services and management of the selected contractor.

2.3.13 Hazardous Solid Waste Management

Hazardous solid and liquid waste will be hauled off site by licenced contractors to licenced management facilities. Contaminated soils could potentially be remediated on site using methodologies which have demonstrated effectiveness in northern Ontario environments.

No site alternatives were considered acceptable or meet Treasury criteria for alternatives. Specifically, the potential negative effects on the physical, biological, and human environment are unacceptable when compared to transporting the material to an existing licenced facility. Therefore, the development of an on-site facility was not considered.

2.3.14 Domestic Sewage Management

During operations, the Project processing plant is expected to support the sanitary requirements of approximately 50 persons during the day shift. During construction, the requirement expands to around 400 persons. Due to the immediate proximity of the city of Dryden, neither a long-term construction camp nor permanent residences will be constructed by the project. Given the large discrepancy in waste treatment demand for the construction versus operating phases, it is proposed that all sanitary waste generated during the construction phase be handled by an approved third party contractor and processed offsite. During the operating phase of the Project, the following methods of treatment were reviewed and will be considered further in later stages of the Project:

- Sewage treatment plant;
- Septic system(s); and
- Offsite treatment.

2.3.14.1 Sewage Treatment Plant

The sewage treatment plant presents an alternative that is of low risk to Project development and offers cost-certainty. The sewage treatment plant will require capital expenditures for development and closure, in addition to increasing the land base for the Project, and therefore further disturbing terrestrial habitat. A sewage treatment plant is considered to be an option for future discussion once domestic sewage rates have been calculated for the operating facility.

2.3.14.2 Septic System

The septic system presents an alternative that is of low risk to Project development and offers reliability. The septic system will require additional capital expenditures for development and closure, in addition to increasing the land base for the Project, causing additional loss to terrestrial habitat. Septic systems also have the potential to leach into the environment, potentially impacting groundwater resources used for human consumption. Use of a septic system is an option for future discussion once domestic sewage rates have been calculated for the operating facility.

2.3.14.3 Offsite Treatment

Off-site treatment presents an option that requires limited closure costs, and initial capital expenditures. The trucking of domestic waste to an off-site alternative has a higher operational cost, and dependence on an external service provider. This option provides no capacity constraints and, due to external disposal, no additional environmental impacts are expected. It has been confirmed in discussions with the appropriate authorities (Dean Walker, City of Dryden, Waterworks Manager) that the City of Dryden Sewage Treatment Plant will have the capacity for the Project's disposal needs.

2.3.14.4 Selection of Preferred Alternative

All alternatives provide an effective and reliable alternative to meet Project domestic sewage management needs. The selected preferred alternative is that of off-site treatment, which provides no capacity constraints and, due to the variable domestic sewage needs presented though construction and initial operations, allows for certainty that all domestic sewage will be handled in the proper manner. Additionally, off-site storage presents no anticipated environmental impacts on sites besides vehicular accident. Once domestic sewage rates have been observed use of a septic system, or sewage treatment plant will be considered with consultation with the appropriate regulatory bodies.

2.3.15 Explosives Storage Facility

Treasury is in communication with several explosives suppliers for the supply and storage of explosive on-site for open pit operations. Preliminary indications point to a regular delivery of explosives from a regional site storage which would indicate that a relatively low volume of explosives will be stored on-site.

2.3.15.1 Selection of Preferred Alternative

The location of the on-site temporary storage will be dictated by the total volume in storage and the distance from any existing infrastructure. Two preliminary locations have been identified currently. These locations include the extreme north-west end of the former tree nursery infrastructure or north of the deposit lying east of the Tree Nursery Road. Both options present relatively similar alternatives in that both are easily accessible by current roads and infrastructure and both lie on relatively flat ground that has been previously disturbed. Each facility would maintain an equal footprint. The main benefit of the location on the extreme north end of the Tree Nursery property is the possible ability to hold a greater volume of explosives due to its distance from employees or infrastructure. Further to this the location allows for Treasury to mitigate the security risks associated with an explosive facility as the area is currently excluded from public use due to current fencing, in addition to the security needs to be constructed with the facility. The location at the northwest end of the Tree Nursery facilities has been selected as the preliminary location due to its proximity to the Project and the minimal environmental impact in access development that would be required for the location, opposed to the location north of the nursery facility which would require road upgrades potentially impact terrestrial habitat.

2.3.16 Electrical Power Supply

It has been conservatively estimated that the Goliath project will require a maximum of 9.9 MW of electrical power to sustain operations at peak production. During the initial years of proposed mining, until the underground operations are in full production, the mine will use an estimated maximum of 6.8 MW. The primary power demand for the project will come from the grinding and milling circuit, underground production and underground ventilation requirements. One local Hydro One 22 kV line is currently supplying the Project offices but it has been indicated that there is not sufficient capacity on this line to support mine operations.

The closest major power line is the Hydro One M2D 115/230 kV line which lies approximately 600 m northeast of the open pit. The Project is in the beneficial position to make use of this line for power supply as it has been indicated by the appropriate authorities that there is a provisional capacity available.

For the purposes of this report the Project has considered the aforementioned M2D power supply and has also considered the following power supply alternatives:

- Develop an on-site Natural Gas power generation facility; and
- Develop alternative means of power generation such as wind or solar.

2.3.16.1 Use of Existing Hydro One Power infrastructure

Power is planned to be supplied to the Goliath Project from the 115 kV overhead M2D powerline which is owned, operated and maintained by Hydro One and is routed in an existing easement and cuts through the property. The company has contacted both Hydro One and the Independent Electrical System Operator to confirm that there is provisionally sufficient supply on the M2D line to power the Project over the course of its life.

The scope of the main power supply for the plant and related infrastructure for the initial open pit mining operation includes:

- Installation of an overhead line take off structure at a proposed tee-off point and construction of approximately 50-100m of an 115 kV overhead line from the tee-off point to the plant HV switchyard. This scope and cost will likely be borne by Hydro One, with costs reimbursed through a signed take-off agreement.
- Procurement and construction of a 115 / 4.16 kV, 1 x 5 / 7.5 MVA transformer / outdoor switchyard at the process plant site (costs borne by the project).

For the future U/G mine operation, a duplicate circuit breaker and 1 x 5 / 7.5 MVA transformer will be procured and installed to provide the additional U/G mine 5 kV substation/switchgear. The costs required for this additional transformer and switchgear will be deferred until year 3.

This alternative represents the lowest capital cost alternative and is generally similar in operating costs to the other options. As much of the power generated in Ontario is now from clean sources this also represents the alternative with the least environmental impact overall.

This alternative further benefits from the nearly ideal location of the M2D power line and the ability to locate the processing facility as close to this line as possible. As such, the power supply as proposed represents the smallest footprint of the considered alternatives.

2.3.16.2 On-site Natural Gas Power Generation Facility

Due to the proximity of an existing Trans-Canada natural gas main to the site, natural gas generators have been identified as an alternative to generate the power required for the process plant and associated mine infrastructure.

Continuous 2000kW output natural gas generators are proposed and have been used to develop the capital costs for this option as industry feedback suggests generators larger than this size are uneconomical. For the initial open cut mining operation (years 1-4), four generators will supply the initial power requirements and provide N+1 redundancy to allow for generator planned and unplanned maintenance. For the future U/G mine operation, an additional two generators will be installed to meet the additional U/G power demand as well as continue to provide the system N+1 equipment redundancy.

The individual cost of each 2MW, 4160 V generator is approximately $2.4M CAD, which includes the supply and installation of:

- The generator and natural gas driven engine;
- Housing;
- Synchronous panels; and
- Disconnect and Load share equipment

The estimate fuel consumption for one generator at 100% of the rated load (2000kW output power) is 17.08 MMBTU/hr, which corresponds to a respective generator mechanical and electrical efficiency (ISO30146/1) of 42.2% and 40.0%.

Compared to a HV transformer, the generators are also maintenance intensive on an operating hour basis. The units need to be taken offline frequently for planned maintenance, i.e. oil changes, etc., which reinforces the requirement for the N+1 equipment redundancy. The operating life of the equipment is approximately 60,000 hours per generator. When the equipment exceeds 60,000 hours, a complete replacement is recommended.

This option represents a higher capital investment cost in relation to the existing Hydro One infrastructure. Though it does offer a benefit of slightly lower operation costs over the life of the Project. While the operation of this type of facility is certainly feasible over the course of the Project the company feels that the additional footprint, costs and environmental greenhouse gas emissions do not justify this alternative.

2.3.16.3 Develop Alternative Power Generation (Wind or Solar)

These power sources have developed in a meaningful way in the recent past and technology is helping to bring down the cost and up the availability of such power sources.

As part of this assessment it was concluded that the Project could not justify the additional risk of implementation of such technologies that have yet to be proven on a large scale industrial basis and certainly has not been proven for an existing operational mine.

Additional drawbacks of these systems are the extremely large footprints required, the very high capital costs needed for construction and the possible visual disturbance created by infrastructure such as windmills.

For these reasons, the use of alternative power generation has been ruled out of the screening process for this assessment.

2.3.16.4 Selection of Preferred Alternative

As previously stated in Section 2.3.9.1, the use of existing Hydro One power supply infrastructure represents the lowest capital cost alternative and is generally similar in operating costs to the other options. As much of the power generated in Ontario is now from clean sources this also represents the alternative with the least environmental impact overall. This alternative also represents the lowest overall footprint of all the options with the ability to locate the power supply infrastructure as needed to suit the mining and milling operations. The use of the existing Hydro One M2D power line is selected as the preferred alternative.

2.4 Project Alternatives - Closure

Treasury is dedicated to the rehabilitation of the Project over the life of the Project. Over the course of the closure phase, mining is completed and final reclamation measures for the site and related infrastructure are assessed and conducted.

Closure methodologies have been consistent with Provincial regulatory needs and have been considered in order to prevent potential environmental effects. The following components were assessed:

- Open pit mine;
- Water management system
- Stockpiles;
- TSF;

- Buildings and equipment;
- Infrastructure; and
- Drainage and stream realignments.

A detailed certified Closure Plan (including financial reassurance) is required under Ontario Regulation 240/00 of the *Mining Act*. This detailed plan will be submitted by Treasury for review by applicable government agencies, First Nations, and general public. A conceptual closure plan based on preferred alternatives identified below is detailed in Section 11.

2.4.1 Open Pit Closure

The main objective for closure of the open pit is to bring the open pit area to a state that is both chemically stable and physically safe in regards to the human environment. The closure of the open pit will follow the Mine Reclamation Code of Ontario (the Code) pursuant to the Ontario *Mining Act*. Section 21 of the Code provides for the following approaches for reclamation and closure of open pits in the order of their preference:

- Backfilling (with mineral waste; preferred if feasible);
- Flooding;
- Sloping (if flooding or backfilling are not appropriate);
- Boulder fencing or berming (if all of the above are impractical); and
- Chain link fencing (if none of the above is practicable).

The code also acknowledges that the process of closure may include various methodologies before the final closure and reclamation of the open is completed.

The following alternatives have been assessed for open pit closure:

- Natural flooding; and
- Enhanced flooding.

Backfilling with mineral waste was omitted from the assessment as it has already been selected as an alternative that a substantial amount of mine waste will be backfilled during operations. The cost to place the additional mine waste stored on surface would be cost prohibitive and would not allow the project to move forward.

In both of the assessed alternatives it is anticipated that once open pit mining and waste rock backfill operations have been completed the pits will be prepared for closure and flooding. The overburden slopes around the perimeter of the pits will be graded to a 3 horizontal to 1 vertical slope. The overburden will be armored to an elevation of 1 m above the discharge spillway crest. The armoring will prevent erosion of the overburden by wave action, runoff, and ice action during pit flooding and water level fluctuations. Slope armoring will be sourced from a clean local quarry. The overburden slopes above the armoring will be vegetated to prevent erosion and sediment transport. Any excess overburden generated during the slope grading will be stockpiled for use in the closure of the TSF, if necessary, or placed in the pits. As the waste rock is PAG, the option of stockpiling boulders for a perimeter barrier is not available therefore a berm will placed around the perimeter of the open pits as per Section 25 of the Mine Reclamation Code. Clean, locally sourced material will be used to construct a perimeter berm.

The final goal of the open pit closure is to have an overflow water quality that is acceptable for passive discharge with no further treatment.

2.4.1.1 Natural Flooding

Treasury has defined the term natural flooding to include the flow of water by gravity or infiltration from groundwater to the open pit with no adjustments to the overall site water management. All pit inflow will be directly from precipitation falling into the pit, water flow from directly surrounding the pit and ground water infiltration. The time for flood of this method is estimated to be approximately 20 to 30 years. As the existing water table in the open pit area is near to the surface, it is anticipated that the fully flooded pit will subsequently rise to the surface level and overflow at the current Blackwater Creek Tributary directly to the south of the proposed open pit. An outlet would be constructed at final closure to facilitate this overflow. This method of filling will provide exposure of both the open pit walls and mine waste that has been previously placed into the completed open pits and create the potential for acid rock drainage and metal leaching to occur. The time needed to create a stable state for open pit water quality characteristics will also be increased with this methodology.

2.4.1.2 Enhanced Flooding

The use of enhanced flooding would reduce the time that is needed for the open pit to reach a fully flooded state and therefore would likely reduce the overall time needed for the closure phase of the Project.

Enhanced flooding can be defined as using additional water sources to achieve a higher rate of total water inflow into the completed open pit. This would be done by actively managing the proposed water management systems through the closure phase to ensure that any surface water runoff from the operations area be directed towards and eventually into the open pit. Most of these systems, such as drainage berms and ditches would already be in place and would solely necessitate the delay of the closure of these systems. Tailings water present I the TSF would be withdrawn, treated and used to help fill the open pit. The open pit would also continue to receive groundwater inflow. Much of the enhanced flooding would be passive in nature in that the overall site layout has been designed for much of the natural water flow to be directed towards the open pit.

This method of filling will provide for less exposure of both the open pit walls and mine waste that has been previously placed into the completed open pits and in turn will reduce the time available for potential acid rock drainage and metal leaching to occur. The time needed to create a stable state for open pit water quality characteristics will also be reduced.

2.4.1.3 Selection of Preferred Alternative

The preferred alternative is to use enhanced flooding. Little to no additional work will be needed to employ this alternative in that the majority of the water management systems will be in place at the time of closure. Once the open pit has been fully flooded, these water management systems will be closed as per the suggested method in Section 2.4.4.

Enhanced flooding will reduce the time for flooding which will subsequently reduce the time needed for the closed open pit to reach a stable chemical state. This reduction in time further decreases risks or uncertainties while the open pit is in the closure phase.

2.4.2 Underground Closure

Underground workings will be closed out in accordance in Ontario Regulation 240/00, amended O.Reg. 307/12, and the Code of the Ontario *Mining Act*. Section 24(2) of Regulation that states the following to closure of underground mining activities:

> *All…mine openings to surface that create a mine hazard shall be stabilized and secured; and*
>
> *All surface and subsurface mine workings shall be assessed by a qualified professional engineer to determine their stability, and any surface areas disturbed or likely to be disturbed by such workings shall be stabilized.*

Due to the nature of these regulations, no alternatives were considered as part of the EIS. All infrastructure and equipment of value in the Project's underground mine workings will be removed and any waste cleaned up. The underground workings will then be allowed to flood naturally through groundwater inflow and potentially through the flooding of the open pit. It is not expected that any of the surface openings to underground will discharge to the environment during or after flooding, and cause no effect to the overall water management on site.

The entrance or portal to the underground workings will be sealed using NAG rock. The entire ramp opening will be backfilled and overfilled with mine rock to ensure no potential entry point is visible or accessible. After sealing the area will be regraded, covered with overburden and planted with local flora.

2.4.2.1 Selection of Preferred Alternative

Natural flooding of the underground working is the preferred alternative for the Project. No other alternatives were considered. Portal entrance will be closed in accordance with Ontario closure standards, sealed, and revegetated as the Closure Plan specifications.

2.4.3 Waste Rock Storage Area Closure

Once mining has been completed the mine waste storage areas must be closed out in accordance with Ontario Regulation 240/00, amended O.Reg. 307/12, and the Code of the Ontario *Mining Act*. Section 24(2) of Regulation states the following:

> *All tailings, rock piles, overburden piles and stockpiles shall be rehabilitated or treated to ensure permanent physical stability and effluent quality.*

Section 59(2) of the Code states the following:

> *In order to ensure the chemical and physical stability of the ML or ARD generating materials and that the quality of the environment is protected, the management plan [for waste rock stockpiles] shall consider, where appropriate:*
>
> - *The design and construction of covers and diversion works; and*
> - *The use of passive and active treatment systems.*

Section 71 of the Code states the following:

> *When revegetating waste rock storage areas … or other steeply sloped features, the following specific measures shall be considered, where appropriate:*
>
> - *Contouring to mimic local topography and blend into surrounding landscape;*
> - *The application of soil to a depth sufficient to maintain root growth and nutrient requirements;*
> - *The incorporation of organic materials, mulches and fertilizers based upon soil assessment;*
> - *The scarification or ripping of flat surfaces which may have been compacted by heavy equipment; and*
> - *Improving site drainage, to prevent water erosion on rehabilitated areas.*

Due to the anticipated PAG characteristics of the mine waste rock, it was evaluated that the ‘do nothing’ approach for closure of the waste rock storage area (WRSA) would not be sufficient to meet the aforementioned needs. Instead, waste rock from the development of the three pits will be placed in a waste rock storage area as well as backfilled in the central and east pits.

Approximately 15 megatonnes (Mt) off waste rock will be placed in the WRSA and 13 Mt will be returned to the west and central pits as backfill. The WRSA will be operated during the development of the west and central open pits. Once backfilling of the west pit commences, the WRSA will be closed and reclaimed.

2.4.3.1 Selection of Preferred Alternative

Closure and reclamation of the WRSA will consist of placing a water-shedding cap over the WRSA that is tied into the up-gradient clay soil and vegetation of the cap and disturbed areas. The WRSA will grade as required and a pioneer or base/stabilization layer will be placed over the waste rock to fill voids. A low permeable layer of clay will then be placed over the pioneer layer. The clay layer will be tied into clay zone to provide complete encapsulation of the waste rock surface. A granular shedding layer will be placed over the clay layer to allow runoff to shed from the surface. A layer of topsoil, stockpiled from the site preparation activities, will then be placed over the granular layer and the final surface will be vegetated. Capping activities will allow for limited exposure for waste rock, limiting potential for ARD development. Vegetated surface will allow for recolonization by local biological community.

Runoff collection ditches will be realigned to direct runoff into the open pits. All disturbed areas surrounding the WRSA that are not required for mine operation will also be decommissioned and vegetated.

The west and central pits will be backfilled such that the waste rock will remain below the final water surface elevation of the flood pits. This will ensure the backfill remains under water in post-closure. Enhanced flooding will be used to ensure all waste rock covered to provide for less exposure of both the open pit walls and mine waste that has been previously placed into the completed open pits and reduce the time available for potential acid rock drainage and metal leaching to occur. The time needed to create a stable state for open pit water quality characteristics will also be reduced.

Stockpiles that will require closure include the mine rock area (MRA), containing the overburden and mine rock stockpile, and potentially the low-grade ore stockpile. Low-grade ore stockpile will be fully consumed by ore processing facility; overburden will be used throughout site as material for closure activities.

2.4.4 Minewater Management System Closure

The Project’s water management system includes a number of components that are tied directly to infrastructure (including pump stations, culverts, and collection ponds). The preferred alternative of the closure of the water management system is to dismantle the system and remove all structures once they are not needed to support the full closure of the facility, or any future land use on the Project site.

Three alternatives have been determined in the closure of the water management facility:

- Stabilize and leave in place;
- Partial removal (and restoration); and
- Removal (and restoration).

Culverts and ditching at the Project site used to support road development and as required for drainage management around the project site. Ditching on the Project site will include:

- Road-site ditching;
- Water management ditching around Project components; and
- Ditching in support of regulatory management plans such as Metal Mining Effluent Regulations (MMER).

All ditching designed for regulatory requirements will be left in place until compliance is achieved and no longer needed. Once compliance is demonstrated, all ditching would be stabilized and left in place. Road-sized ditching will be stabilized and replanted if needed. Backfilling all ditches would serve no purpose and has not been considered as an alternative. If roads are to be used in future land use practices, all culverts and ditching will remain in place.

As part of the site water management various ponds have been proposed as part of the design. These ponds include:

- Seepage collection ponds associated with the mine rock area, TSF, and low-grade ore stockpile;
- TSF polishing pond; and
- TSF reclaim pond.

As dictated by Closure Plan requirements Subsections 71(1), (5) and (7) of the Code state the following relative to site preparation and drainage control for final closure, respectively:

- Contouring to mimic local topography and blend into the surrounding landscape;
- Improving site drainage to prevent water erosion on rehabilitated areas; and
- Contouring and sloping of impoundment areas must be integrated with engineering design.

TSF seepage, reclaim and polishing ponds will be closed as part of the TSF closure plan as detailed in Section 2.4.5.

Seepage collection ponds are used to dictate run off and to monitor seepage and collection. Collection ponds have been incorporated into the design in support of all major Project components. These Project components include the processing plan and the mine rock areas (overburden storage area, waste rock storage area, and low-grade stockpile). These ponds will be drained and closed in accordance with the requirements as designated by the Closure Plan. Should water quality be deemed not suitable to discharge water will be pumped though water treatment facility for discharge to the environment.

All pipelines associated with the water management system will be closed as per the details outlined in Section 2.4.7. Pipelines associated with the water management system include:

- Tailings discharge and reclaim lines;
- Freshwater lines; and
- Other internal site water transfer lines.

2.4.4.1 Selection of Preferred Alternative

Fully removing all components of the water management system is currently the preferred alternative. However, due to closure schedule and future land use options, selected components of the water management system may be kept in place.

2.4.5 Tailings Storage Facility Closure

At the completion of mining, the TSF must be closed out in accordance with Ontario Regulation 240/00, amended O.Reg. 307/12, and the Code of the Ontario *Mining Act*. Section 24(2) of Regulation which states the following:

> *All tailings rock piles, overburden piles and stockpiles shall be rehabilitated or treated to ensure permanent physical stability and effluent quality.*

Sections 35 and 36 of the Code state:

> *The objective of this Part of the Code is to ensure the long term stability of tailings dams and other containment structures.*
>
> *The procedures and requirements set out in the Dam Safety Guidelines published by the Canadian Dam Safety Association shall be given due regard by all persons engaged in the design, construction, maintenance and decommissioning of tailings dams and other containment structures.*

Section 72 of the Code states:

When revegetating tailings surfaces, the following reclamation measures shall be considered, where appropriate:

- *Contouring to provide accessibility and good surface drainage while controlling surface erosion;*
- *Removing any crests prone to wind erosion or creating/planting live wind breaks;*
- *The scarification or ripping of crusted surfaces;*
- *The incorporation of organic materials and mulches;*
- *Correcting the pH and adding fertilizer based upon soil assessment and vegetation requirements; and*
- *Applying soils or a gravel barrier.*

The closure phase of the project for the TSF will be initiated once the mining activities and ore processing have been completed. The EIS has identified two potential alternatives for TSF closure:

- Permanent flooding; and
- Capping and reclamation.

2.4.5.1 Permanent Flooding

Permanent flooding of the TSF is seen as a well-accepted closure strategy. This strategy is successful in providing an oxygen barrier to prevent development of ARD for PAG tailings, as projected for the Project. At closure the tailings water present in the TSF would be withdrawn, treated and used to help fill the open pit. The final tailings beach surface regraded, as required to ensure it is totally free draining. Grading of the final tailings beach surface will be completed in conjunction with placement of a pioneer or base/stabilization layer over the tailings surface for access. The tailings would then be covered with non-process water to chemical isolate the tailings and prevent the onset of ARD.

The water reclaim pump, reclaim pipeline and tailings delivery and distribution pipelines will be decommissioned and removed from the site. The emergency overflow spillway will be remain in place, with excess water from the TSF being directed to the open pit. The monitoring wells present in the crest of the dam can remain in-place as well as the monitoring wells located on the downstream area of the dam for use during the closure monitoring phase. Access roads that are no longer required will be scarified and revegetated.

Permanent flooding requires additional costs in the form of reinforcement or raises to dam structures due to additional water volume in addition to on-going monitoring and maintenance of water levels, and dam stability. Monitoring of the closed facility will be completed and will consist of annual Dam Safety Inspections of the closed facility as well as Dam Safety Reviews at the required timeline interval, as discussed above for the Operations Phase.

2.4.5.2 Capping and Reclamation

Closure and reclamation of the TSF will consist of capping the final tailings beach surface and reclamation of the facility. Standing water that is present at the end of the operations will be withdrawn, treated and used to help fill the open pit. The final tailings beach surface regraded, as required to ensure it is totally free draining. Grading of the final tailings beach surface will be completed in conjunction with placement of a pioneer or base/stabilization layer over the tailings surface for access. A low permeable layer will then be placed over the pioneer layer to limit the availability of oxygen tot eh tailings and manage the formation of ARD. A granular water shedding layer will be placed over the low permeability cover to allow runoff to be shed from the surface, further limiting potential ARD development. A layer of topsoil, stockpiled from the site preparation activities, will then be placed over the granular and the final surface will be vegetated. The downstream slopes of the embankments will also be regraded and covered with topsoil and revegetated. Vegetation will be consistent with local flora allowing for recolonization of the TSF area by the local biological community.

The water reclaim pump, reclaim pipeline and tailings delivery and distribution pipelines will be decommissioned and removed from the site. The emergency overflow spillway will be decommissioned. The monitoring wells present in the crest of the dam can remain in-place as well as the monitoring wells located on the downstream area of the dam for use during the closure monitoring phase. Access roads that are no longer required will be scarified and revegetated.

Monitoring of the closed facility will be completed and will consist of annual Dam Safety Inspections of the closed facility as well as Dam Safety Reviews at the required timeline interval, as discussed above for the Operations Phase.

2.4.5.3 Selection of Preferred Alternative

Capping and reclamation of the TSF is the preferred option for closure of the TSF. Permanent flooding is not attractive from a cost-effectiveness. As part of the revision of the EIS, it has been identified that there is an increased potential for ARD with a capping and reclamation option. Based on the available geochemical information, it is possible that the off-site environmental effects would be higher following closure with the capping and reclamation option. If the conservative geochemistry results are likely to occur, then the permanent flooding option would be preferred to reduce off-site environmental effects. To address this uncertainty, additional geochemical evaluations will be undertaken during operations to determine which closure option is preferred from an environmental perspective.

2.4.6 Buildings and Equipment Closure

Primary buildings and related structures on the Project site will include the following:

- Ore processing plant (including primary crusher, and control room);
- Administrative building;
- Project office (OMNRF Tree Nursery facility);
- Maintenance shop, warehousing;
- Security hub;
- Explosives storage;
- Truck wash; and
- Fuel bay.

Two alternatives for the disposal of buildings and equipment have been determined:

- Disassembly and removal; and
- Re-use of acceptable buildings and equipment.

In accordance with, Ontario Regulation 240/0, amended O.Reg. 307/12, and the Code of the Ontario *Mining Act*, buildings must be dismantled and removed. Subsection 24(2) of O.Reg. 307/12 of the Ontario *Mining Act* states the following:

> *All buildings, power transmission lines, pipelines, waterlines, railways, airstrips and other structures shall be dismantled and removed from the site to an extent that is consistent with the specified future land use.*

It is generally assumed that buildings and equipment that are not suitable for re-sale or re-use off-site can be disposed of in a licenced landfill site. Hazardous materials such as gear boxes containing petroleum products must be shipped to a licenced landfill capable of receiving such materials. The two alternatives listed above are not exclusive in that off-site shipment of buildings and equipment can only occur if a market exists to obtain them. There is no guarantee that such a market will exist at the time of closure.

Therefore, there is no selection of a preferred alternative as part of the alternatives assessed in the EIS. The closure of the buildings and equipment associated with the Project will be a blend of both alternatives and will be implemented in accordance with available market conditions at the time of mine closure and applicable regulatory requirements.

2.4.7 Infrastructure Closure

The primary Project site infrastructure includes roads, pipelines (including pump house and related infrastructure), power transmission lines and equipment.

The Project related access roads are expected to include:

- Site haul and access roads;
- Tree Nursery Road crusher diversion; and
- Service access roads.

The Project-related pipelines are expected to include:

- Tailings discharge and reclaim lines;
- Freshwater lines; and
- Other internal site water transfer lines.

The Project-related transmission lines are expected to include:

- 115 kV connecting line to the Provincial grid; and
- Smaller capacity distribution lines for routing power around the Project site.

Primary equipment for the Project (Appendix B) includes:

- Crushers and processing equipment housed within the primary crusher and in the ore processing plant;
- Conveyor systems, including conveyors linking the primary crusher, coarse ore stockpile transfer house and ore processing plant;
- Pumps and pump housing;
- Storage tanks; and

- Mobile heavy equipment including but not limited to: diesel and electric shovels, excavators, bulldozers, haul trucks, loaders, jumbos, bolters, load haul dump vehicles, scissor lifts, crane trucks, forklifts, graders, diamond drills, and explosive loaders.

In accordance with, Ontario Regulation 240/0, amended O.Reg. 307/12, and the Code of the Ontario *Mining Act*, buildings must be dismantled and removed. Subsection 24(2) of O.Reg. 307/12 of the Ontario *Mining Act* states the following:

> *All buildings, power transmission lines, pipelines, waterlines, railways, airstrips and other structures shall be dismantled and removed from the site to an extent that is consistent with the specified future land use.*
>
> *All transportation corridors shall be closed off and revegetated to an extent that is consistent with the specified future use of the land.*
>
> *All machinery, equipment and storage tanks shall be removed from the site to an extent that is consistent with the specified future use of the land.*

Alternatives relating to the decommissioning of these items include:

- Decontamination and removal;
- Leave in place for future use; and
- Reclaim in place.

All haul roads and service roads associated with the Project have flexibility for potential future use. These roads may be left in place to support future land use, or reclaimed in place. It is anticipated that the MNRF Tree Nursery facility designated to serve as the Project office will remain in place. If any other buildings are retained for future use, all applicable access roads would remain in place. In turn, all freshwater pipelines and any associated infrastructure would have to remain in place. Closure responsibilities of these buildings and associated infrastructure would shift to whoever takes over the facilities.

Haul road and service road reclamation in place will occur progressively at closure when they are longer required for building access/maintenance/monitoring requirements. This is the cost-effective alternative that would allow the area to be reclaimed as terrestrial habitat or for future land use requirements.

Since all pipelines at the Project site will have specific function to the Project, all pipelines are best decontaminated and fully removed. All pipeline material would be moved to a licenced facility. As stated, in the event that buildings are retained for future use, the freshwater pipelines and any associated infrastructure would remain in place. This is anticipated to affect the Project office.

Some pipelines due to site conditions or those installed underground may be reclaimed by decontamination and then filled and capped. This is a commonly used practice.

The 115 kV transmission line connecting the Project to the Provincial grid and the smaller transmission lines connecting various buildings and infrastructure around the Project site are specific in design to Project needs and therefore only have value to the Project. As per the regulatory requirements, these transmission lines will be removed. All materials of value or re-use would be sold or transferred to applicable utility suppliers or negotiated with other buyers. All materials not applicable for re-use or of value will be transferred to a licenced facility. In the event that buildings are retained for future use, the transmission lines will be left in place to provide power to these building. This is anticipated to include the Project office. Although not expected, if utility providers in the area are willing to take over the 115 kV line, substation and associated lines closure responsibilities would be passed in turn to the associated utility agency.

All machinery, equipment and other materials are anticipated to be dismantled and taken off-site for sale or re-use if applicable and economically feasible. Steel and other materials inert in nature from dismantled equipment will be disposed of in a licenced facility.

2.4.7.1 Selection of Preferred Alternative

Based on the alternatives assessment, the preferred alternative is to decontaminate and remove all Project-related pipelines, access roads, transmission lines and equipment, once they are decommissioned or no longer needed for Closure Plan implantation, maintenance, or monitoring requirements.

However, given potential future land use of the Project and use of infrastructure by others, a combination of the proposed alternatives may be implemented. Roads will be reclaimed in place, while some infrastructure may remain for future use. The Project office and its associated infrastructure will remain in place and for future use by Treasury. It is currently anticipated that all infrastructure not tied to the Project office will be removed following completion of all closure and post-closure activities unless future land use permits are required.

2.4.8 Drainage Closure

The Project site drainage modifications, as part of the water management system (Section 2.3.2), include a number of modifications directly affecting the Blackwater Creek watershed and drainage pattern. Alternatives relating to surface draining restoration at closure include:

- Stabilize and leave in place; and
- Removal (and restoration).

The realignment of Blackwater Creek is necessary to support development of the infrastructure associated with the Project, including the TSF and processing plant. The proposed realignments of Blackwater Creek are aimed at maintaining the existing watershed flow paths to reduce potential effects on the environment.

2.4.8.1 Stabilize and Leave in Place

Stabilizing and leaving drainage systems in place would be a cost-effective alternative that would not preclude the establishment of passive drainage systems, and sections could provide for alternate fish passage. Watershed drainage would not be expected to differ from the existing condition. This would eliminate the need for additional disturbance to the environment as part of closure activities, but ongoing maintenance and monitoring may be required with this alternative, in accordance with Ontario Regulation 240/00, amended O.Reg. 307/12, and the Code of the Ontario *Mining Act* (Section 66), and in accordance with MMER requirements. Localized weather conditions may compromise stabilization efforts, creating potential for delivery of contaminants of concern (such as sediment release) into the Blackwater Creek watershed.

2.4.8.2 Removal

Removal of drainage systems would be a more costly alternative that would also impose some-disturbance due to closure activities, but it would allow for natural watershed drainage to be established akin to pre-mining conditions. In this alternative, all drainage ponds would be breached and re-contouring of the land may be required in some sections. Materials would be disposed of in an approved on-site demolition landfill.

2.4.8.3 Selection of Preferred Alternative

Based on the above, the preferred alternative is to stabilize site drainage systems (collection ponds and watercourse realignments) and leave them in place. It is a cost effective alternative that would not impose any notable effects to the environment, unless failure of stabilization efforts occurs due to flooding event.

However, removal of some drainage features and decommissioning of minor watercourse realignments may be required to allow the natural watershed drainage to be re-established akin to pre-mining conditions, and may be necessary to re-incorporate the open pit lake formed at closure (Section 2.4.1) into the existing water systems. It is currently anticipated that the Blackwater Creek realignment will be left in place to become part of the water systems in the area, as well as some of the drainage ditch associated with the TSF tied to Blackwater Creek.

2.5 Summary of Alternatives

A summary of alternatives proposed for the Project is provided within Table 2.5-1.

Table 2.5-1: Summary of Alternatives

Project Element	Alternative	Assessed in the EA	Rationale
Mining	Open pit mining	Yes	Ore body is near surface which is suited to open pit mining.
	Underground mining	Yes	Orebody is near surface, and at depth indicating that underground mining is feasible.
	Open pit and underground mining	Yes	Orebody is near surface, and at depth indicating that using both open pit and underground mining is feasible. Combination mining is also the most economically viable mining method.
Minewater management	Separate minewater system	Yes	Integrated site water management system will be fully capable of providing capacity for effective minewater treatment, irrespective of whether or not it receives minewater.
	Integrated minewater system	Yes	Development of a separate minewater treatment pond system will add considerable and unnecessary costs to the Goliath project with no tangible technical or performance benefit.
Processing methodology	Gravity and CIL	Yes	The EA considered proven methodology for the recovery of gold. Cyanide and non-cyanide methods were considered.
	Gravity and floatation with off-site concentrate	Yes	
	Gravity, flotation, and ILR	Yes	
Mine rock and overburden management	Place and manage the mine rock and overburden in stockpile adjacent to open pit	Yes	Minimizing mine rock movement is critical to cost performance for the Project, placing mine rock as close to pit as practicable is commonly used standard within the industry. Alternatives to storage include backfill to the pit though sequence development of open pit.
	Establish temporary location for mine rock and overburden and return to pit upon closure	Yes	Moving large amounts of overburden and mine rock would lead to excessive costs, and render the Project uneconomical.
Effluent treatment	Natural cyanide degradation and metals removal	Yes	The use of natural degradation to destroy cyanide presents greater environmental risk.
	In-plant cyanide destruction and metals removal followed by natural degradation	Yes	Natural degradation with cyanide destruction ensures that wildlife, including waterfowl and aquatic life, are protected, that cyanide consumption is minimized, and that contingency is in place to prevent the inadvertent release of cyanide into the environment.
	In-plant cyanide destruction, natural degradation followed by effluent treatment	Yes	Natural degradation with cyanide destruction will ensure minimal environmental impact, and that contingency is in place to prevent the inadvertent release of cyanide.
Tailings storage facility	Conventional slurry tailings	Yes	Clay-lined earthfill dam with a natural clay basin integrated with an internal drain system with a

Table 2.5-1: Summary of Alternatives (continued)

Project Element	Alternative	Assessed in the EA	Rationale
			secondary downstream seepage and pump-back system. Minimal cost required as existing roads will assist with construction of pipeline alignments and access to site. No additional open bodies of water will be directly impacted.
	Thickened tailings	Yes	Due to the greater density of the tailings, this alternative is very costly. A lower dam embankment is required than that of slurry tailings, however some diversions of excess water from seasonal runoff will be required. Existing roads will assist in construction, and no additional open bodies of water will be directly impacted.
	Dry stack tailings	Yes	Tailing waste will be stockpiled on surface. Runoff will be collected and routed to a facility for containment and reclaim. Dust and emissions are very likely. Low cost for remediation. No additional open bodies of water will be directly impacted.
	Co-disposal	Yes	Natural clay basin and clay lined dam. Local topography anticipated to reduce embankment heights. Underground co-disposal will occur during the underground phase which will decrease the amount of tailings. Low complexity of water containment and reclaim, however closure requires complex reclamation. No additional open bodies of water will be directly impacted.
Water supply	Nearby creeks	Yes	The method and location of meeting fresh waters needs for the Project was considered with the EA.
	Groundwater	Yes	
	Nearby lakes	Yes	
Water discharge	Wabigoon Lake	Yes	Discharge locations were evaluated based on the current water balance anticipated, and the effect on the receiver based upon hydrological characteristics, and quality modelling. Also in conjunction to this economic and social parameters were analyzed.
	Thunder Lake	Yes	
	Hartman Lake	Yes	
	Tree nursery ponds	Yes	
	Blackwater Creek	Yes	
Watercourse realignment	Use of Exisiting Hydro One power supply infrastructure	Yes	Power generation was evaluated based on several factors including capital cost, operating cost, environmental emissions and required footprint.
	Develop alternative means of power generation such as Natural gas, wind or solar	Yes	
Infrastructure and buildings	Power plant facility	Yes	As the Project design phase continues, the optimal locations for these are further reviewed and defined.
	Fuel and energy locations	Yes	
	Temporary storage facilities	Yes	
	Explosive storage facility	Yes	
Aggregate supply	Overburden and mine rock	Yes	Project aggregate needs and sources were identified and assessed within the EA.
	On-site aggregate pit	Yes	
	Commercial off-site aggregate pit	Yes	
Non-hazardous solid waste management	Moving waste to licenced facility off-site	Yes	EA considered alternatives for disposal of non-hazardous solid waste.

Table 2.5-1: Summary of Alternatives (continued)

Project Element	Alternative	Assessed in the EA	Rationale
Hazardous solid waste management	Moving waste to licenced facility off-site	Yes	EA considered alternatives for disposal of hazardous solid waste.
Domestic sewage management	Sewage treatment plant	Yes	EA considered proven methods of treating domestic sewage waste.
	Septic system	Yes	
	Off-site treatment	Yes	
Open pit closure	Natural flooding	Yes	EA considered proven methods of open pit closure.
	Enhanced flooding	Yes	
	Backfill with mineral waste	Yes	
Mine rock and overburden stockpile closure	Re-use	Yes	EA considered proven methods of mine rock and overburden stockpile closure.
	Stabilize, cover and vegetate	Yes	
	Backfill	Yes	
	Engineered cover	Yes	
Minewater management closure	Leave in place	Yes	EA considered proven methods of minewater infrastructure closure.
	Partial removal	Yes	
	Full removal	Yes	
TSF closure	Permanent flooding	Yes	EA considered proven methods of closure of TSF.
	Capping and reclamation	Yes	
Explosives storage facility	North of tree nursery	Yes	As the Project design phase continues the optimal locations this facility will be reviewed and defined.
	Adjacent to tree nursery road	Yes	
Buildings and equipment closure	Disassembly and removal	Yes	EA considered proven alternatives for the closure of buildings and equipment developed and used by the Project.
	Re-use	Yes	
Infrastructure closure	Decontamination and removal	Yes	EA considered proven alternatives for the closure of infrastructure developed by the Project.
	Leave in place for future use	Yes	
	Reclaim in place	Yes	
Drainage closure	Stabilize and leave in place	Yes	EA considered proven alternatives for the closure of drainage structures developed by the Project.
	Removal	Yes	
Alternatives to the Project	Proceed with the Project	Yes	EA considered alternatives to development of the Project.
	Delay the Project	Yes	
	"Do Nothing"	Yes	