# SECTION 3.0

# PROJECT ALTERNATIVES

# 3.0 PROJECT ALTERNATIVES

Evaluations of Project alternatives are presented below. The assessment includes an evaluation of *alternatives to* the Project, as well as an assessment of potential *alternative means* by which the Project could be implemented.

## 3.1 Alternatives to the Project

The assessment of "alternatives to" the Project is framed within the context of the Stillwater Mining Company's (SWC or the Company) corporate objectives as determined by its Board of Directors (the Board). As a result of its consideration of SWC's platinum group metal (PGM) business opportunities and corporate risk in the early 2000s, the Board concluded that the company's dependence on one commodity (i.e., PGMs) from a depleting resource mined in one geographical location created an unacceptable level of corporate risk. The Board tasked a management team (the Team) to consider potential diversity strategies based on additional resources, geography and metals commodities for the Company, with a focus on politically stable jurisdictions.

### 3.1.1 Platinum Group Metals Opportunities

The Team considered potential PGM opportunities outside of North America and concluded there were no significant potential PGM projects outside of North America that satisfied SWC's corporate objectives of geographic diversification in a politically stable jurisdiction.

The Team concluded that PGM opportunities in North America would therefore be the most appropriate target. With this in mind, the Team reviewed known PGM opportunities in North America. The following short list of opportunities was identified:

- expansion of SWC's PGM recycling operations;
- development along the J-M Reef at its current operations in Montana; and,
- the advanced stage Marathon PGM-Cu Project.

### 3.1.2 PGM Recycling Operations

SWC regularly sources spent catalytic converter materials containing PGM metals from third-party suppliers and processes them through its metallurgical complex. Such materials may either be purchased outright or may be processed and returned to the supplier for a tolling fee. The spent catalytic material is collected by the third party suppliers, primarily from automobile repair shops and automobile yards that disassemble old cars for the recycling of their parts. The Company also processes spent PGM catalysts from petroleum refineries and other sources, normally on a tolling basis.

Upon receipt of the PGM materials for recycling, they are weighed, crushed and sampled prior to being commingled with mine concentrates for smelting in the electric furnace. Nickel and copper sulfides which occur naturally in the mine concentrates act as a metallurgical collector to facilitate the chemical extraction of the PGMs from the recycled material.

In acquiring recycled automotive catalysts, SWC sometimes advances funds to its suppliers in order to facilitate procurement efforts. The Company typically advances against material that either is awaiting transit or is physically in transit to the Company's processing facilities.

Recycled ounces sold in 2011 increased to 306,200 ounces compared to 156,100 ounces in 2010. In addition to purchased material, the Company processed 171,600 ounces of PGMs on a tolling basis in 2011, down from 235,900 tolled ounces in 2010. In total, recycled volumes fed to the smelter increased to 486,700 ounces of PGMs in 2011, up 21.9% from 399,400 ounces in 2010. The stronger volumes in 2011 resulted from more material coming available in the market in response to higher PGM market prices and to some extent, from new suppliers attracted by SWC's faster processing terms. It has been SWC's experience that in general the volume of spent catalyst available in the market is sensitive to PGM market prices, as suppliers tend to withhold material from the market when prices fall and then release it for sale when prices rise.

Over the past several years SWC has completed the addition of a second electric smelter furnace, an automated analytical laboratory and a recycle crushing and sampling facility in Columbus, Montana. The team had identified an opportunity to move ahead with the conversion of an idled electric furnace into a slag cleaning facility. This entailed installing chutes (launders) that would allow slag periodically to be gravity drained out of the new primary furnace into the slag cleaning furnace, where the additional residence time was expected to improve PGM recoveries. The newly refurbished furnace will now serve as a hot backup for the primary furnace, reducing risk of lost production and increasing total capacity of the system. With completed and planned investments listed above the Team concluded that SWC is well positioned to expand its PGM recycle handling and re-processing volumes.

### 3.1.3 JM Reef Development Opportunities – Montana, USA

An available PGM opportunity identified by the Team was the development of existing PGM resources related to the J-M Reef in Montana. While this approach does not address the Board's mandate to seek geographic diversity, Montana is certainly a politically stable jurisdiction.

Two new developments and potential expansion projects were identified along the J-M Reef. The first of these, known as the Blitz project, will develop new underground drifts on two levels from the current Stillwater Mine toward the eastern extremity of the reef, ultimately involving about 20,000 feet of new development on each level. As now contemplated, this development project will take about five years to complete and is estimated to cost about $180 million. SWC expects to take delivery on a refurbished Tunnel Boring Machine (TBM) for the Blitz project during the second quarter of 2012 and will place this machine into operation later in the year 2012. The other project on the J-M Reef, known as Graham Creek, will develop another 7,000 feet toward the west from the existing East Boulder Mine infrastructure, using a TBM that is already in place underground. This also is designed as about a five-year project but, in view of the single drift and shorter distance, is only expected to cost about $8.0 million. During 2011, the TBM at Graham Creek developed about 1,200 feet of new drift, after which it was idled for a time to allow for definitional drilling behind it. This limited drilling program to date has indicated mineable PGM grades along the new Graham Creek development. Definition drilling as these new drifts progress should provide valuable information about these regions of the J-M Reef. Future ore production from these new areas will be contingent on developing new ventilation raises to the surface to adequately support mining activities there.

### 3.1.4 Marathon PGM-Copper Project

By far the largest and most advanced undeveloped PGM deposit opportunity identified by the Team in North America was the Marathon deposit that has since become the Marathon PGM-Copper Project. It was the only undeveloped PGM deposit identified by the Team that offered a material contribution towards satisfying the Board's mandate for geographic diversification in a politically stable jurisdiction. It was also available for purchase. For all of these reasons, the Team recommended, and the Board concurred, that the Company should attempt to secure the deposit. This was accomplished in the 4th Quarter of 2010 with the acquisition of Marathon PGM Corporation.

### 3.1.5 "Do Nothing" Alternative

In this context, the "do nothing" alternative is not proceeding with the construction and operation of the Project. SWC and its interdisciplinary group of advisors have concluded that the Project can be carried out without causing significant adverse environmental, cultural or socioeconomic effects. To "do nothing" and not proceed with the Project would eliminate potential benefits the Project could provide to a broader spectrum of stakeholders and beneficiaries. In particular, to "do nothing" with respect to the Project would deprive the Town of Marathon, local Aboriginal peoples and the broader economy of Northwestern Ontario of the economic benefits that will accrue from the development and operation of the Project. Given the deterioration of economic conditions in this area from the recent economic downturn and the demise of the forest products industry, SWC does not believe that a decision to not proceed with the Project would be in the best interests of the region's economy, its communities or the company. For these reasons, the "do nothing" alternative was not considered a reasonable or realistic alternative and it was not given further detailed consideration.

### 3.1.6 Beyond PGMs - Diversification

The Team also analyzed project opportunities both in North America and outside of North America for metals other than PGMs for which SWC had established or developing expertise in mining, processing and marketing. This analysis resulted in the recognition of the Altar Project in Argentina as a potentially viable opportunity for SWC. The Altar Project is a relatively early stage project that presented a substantial discovery potential for a porphyry copper-gold deposit within an established mining region and province well known for the occurrence of such deposits. Although other mineral sector organizations actively producing and exploring in that region were expressing increased interest in Altar, the project's technical merits and attractive exploration potential were not widely understood across the broader metals industry or equity marketplace.

Based on SWC's evaluation of the opportunity this project was acquired in the 4th Quarter of 2011 with the purchase of Peregrine Metals Ltd. This acquisition represents another step towards meeting the Board's mandate to long term diversify SWC's metals commodity portfolio.

## 3.2 Alternatives Means of Carrying out the Project

Alternative means of carrying out a project are technically and economically feasible and reasonable ways for a project to be implemented. This could include, for example, alternative locations for infrastructure, routes for Project components, methods of development and implementation and mitigation. Below, alternative means of implementing various aspects of the Project are assessed.

A summary of the results of the assessment of alternative means of carrying out the Project is provided in Table 3.2-1. A description of the framework by which the alternative means assessment was completed is provided in Section 3.2.1. A more detailed account of the results of the alternative means assessment is provided in Section 3.2.2.

**Table 3.2-1: Summary of the Assessment of Alternative Means by which the Project could be implemented**

| Alternative Means | Assessment Criteria | | | | | Overall Rating |
|---|---|---|---|---|---|---|
| | Biophysical Environment Factors | Socio-economic Factors | Aboriginal Considerations | Technical Factors | Cost Factors | |
| **Site Access Road** | | | | | | |
| Existing Road | Acceptable | Acceptable | Acceptable | Acceptable | Acceptable | Acceptable |
| New Road | Preferred | Acceptable | Preferred | Preferred | Acceptable | Preferred |
| **Electrical Power Supply** | | | | | | |
| 115 kV Transmission Line | Preferred | Acceptable | Acceptable | Preferred | Preferred | Preferred |
| Diesel Generators | Acceptable | Acceptable | Acceptable | Acceptable | Unacceptable | Unacceptable |
| **Aggregate and Rock Fill Supply** | | | | | | |
| On-site sources | Preferred | Preferred | Unacceptable | Acceptable | Preferred | Preferred |
| Off-site sources | Acceptable | Acceptable | Unacceptable | Acceptable | Acceptable | Acceptable |
| **Mining Method** | | | | | | |
| Open Pit | Acceptable | Preferred | Preferred | Preferred | Preferred | Preferred |
| Block Caving | Unacceptable | Unacceptable | Acceptable | Unacceptable | Unacceptable | Unacceptable |
| Long-hole Stoping | Preferred | Unacceptable | Acceptable | Unacceptable | Unacceptable | Unacceptable |
| **Concentrate Transport from the Mine Site to a Remote Processing Facility** | | | | | | |
| Direct via road | Acceptable | Acceptable | Acceptable | Acceptable | Acceptable | Acceptable |
| Via road and rail combined | Acceptable | Acceptable | Acceptable | Acceptable | Acceptable | Acceptable |
| **Process Solids Deposition** | | | | | | |
| Conventional Slurry | Preferred | Acceptable | Acceptable | Preferred | Preferred | Preferred |
| Dry Process Solids | Acceptable | Acceptable | Acceptable | Acceptable | Acceptable | Acceptable |
| **Solid Non-hazardous Waste Disposal** | | | | | | |
| Off-site landfill | Acceptable | Acceptable | Acceptable | Unacceptable | Acceptable | Unacceptable |
| Dedicated on-site landfill | Acceptable | Preferred | Acceptable | Acceptable | Acceptable | Acceptable |
| Co-disposal in the PSMF | Acceptable | Preferred | Preferred | Acceptable | Preferred | Preferred |
| **MRSA Reclamation** | | | | | | |
| Passive reclamation | Acceptable | Acceptable | Acceptable | Acceptable | Preferred | Acceptable |
| Proactive reclamation | Preferred | Preferred | Preferred | Preferred | Acceptable | Preferred |
| **PSMF Reclamation** | | | | | | |
| Hare Lake discharge | Acceptable | Acceptable | Acceptable | Acceptable | Acceptable | Acceptable |
| Stream 6 discharge | Preferred | Preferred | Preferred | Acceptable | Acceptable | Preferred |
| **Siting and Location of Mine Infrastructure** - Options for locating the majority of the infrastructure is dictated by the location of the open pit, the PSMF and MRSA, as well as geographic and environmental sensitivity constraints. No significantly different alternatives were considered. The overall goal of the mine design was to reduce the footprint and maintain activities within catchment areas that are provided control. | | | | | | |

### 3.2.1 Alternatives Means Assessment Framework

To assess alternatives means by which the Project could be implemented a set evaluation criteria were developed as follows:

- biophysical environment factors;
- socio-economic environment factors;
- Aboriginal considerations;
- technical factors; and,
- cost factors.

For each of the evaluation criteria, SCI further developed a set of indicators. The indicators were developed in consideration of input received from the public, government agencies and Aboriginal groups during Project-related consultation activities, as well as using the experience of the Project team. The evaluation criteria and associated indicators used as applicable to assess Project-related alternatives are set out in Table 3.2-2.

A rating scheme was used as a method by which to compare the proposed alternative means. The rating scheme identifies the proposed alternative means as “preferred”, “acceptable”, or “unacceptable”, in relation to the evaluation criteria. The rating scheme is explained in Table 3.2-3.

The alternative means assessment was based on the following premises:

- all evaluation criteria were considered important to Project success;
- an alternative means should generally be rated as acceptable in all cases to be advanced to conceptual design; and,
- an “unacceptable” rating for any evaluation criteria would generally render the alternative unacceptable.

The assessment of alternative means presented herein was carried out at a screening level.

## Table 3.2-2: Alternatives Means Assessment Evaluation Criteria and Evaluation Criteria Indicators

| Evaluation Criteria | | Evaluation Criteria Indicator | |
|---|---|---|---|
| **Criteria** | **Criteria Rationale** | **Indicator** | **Indicator Rationale** |
| Biophysical Environment Factors | The Project will interact with the biophysical environment and potential effects of the Project on the biophysical environment are assessed as part of the environmental assessment process. The biophysical environment comprises surface water and groundwater, the terrestrial environment and the atmospheric environment. | Surface water | A greater hydrological footprint implies a greater potential for water resources and aquatic habitats to be potentially affected. |
| | | Groundwater | A greater hydrogeological footprint implies a greater potential for water resources and aquatic habitats to be affected. |
| | | Fisheries Resources | Adverse impact to fisheries resources where appropriate compensation cannot be provided should be minimized. |
| | | Air quality | Adverse effects on air quality should be minimized. |
| | | Vegetation | Removal or reduction in vegetation should be minimized where possible/practical. |
| | | Wildlife | Removal or reduction in wildlife habitat or direct impacts on wildlife should be minimized where possible/practical. |
| | | Species at risk | Removal or reduction in species at risk habitat or direct impacts on species at risk should be minimized where possible/practical. |
| Socio-economic Environment Factors | The Project will interact with the socio-economic environment and potential effects of the Project on the socio-economic environment are assessed as part of the environmental assessment process. The socio-economic environment includes economic factors (e.g., employment, contribution to the local, | Economic factors | Alternatives that provide the most positive economic benefits on local, regional and national scales are preferred. |
| | | Human health | Alternatives with less potential risk to human health are preferred. |

| Evaluation Criteria | | Evaluation Criteria Indicator | |
|---|---|---|---|
| **Criteria** | **Criteria Rationale** | **Indicator** | **Indicator Rationale** |
| | regional and national GDP and tax bases), human health, land and resource uses and archaeology and cultural and heritage features. | Land and resource uses | Alternatives that do not negatively affect land and resources uses are preferred. |
| | | Archaeology and cultural and heritage features | Alternatives that do not negatively affect archaeological and cultural heritage features are preferred. |
| Aboriginal Considerations | The Project site falls within an area covered by the Robinson-Superior Treaty and in which Aboriginal groups are present.. The PRFN have filed a Statement of Claim in Ontario related to exclusive aboriginal title over lands which includes the Project Site. The Project has the potential to affect Aboriginal land uses for traditional purposes such as gathering country foods and Aboriginal archaeological and cultural and heritage features. The EA process must consider Aboriginal interests. | Aboriginal traditional land uses | Alternatives that do not affect Aboriginal traditional land uses are preferred. |
| | | Aboriginal archaeological and cultural and heritage features | Alternatives that do not adversely affect Aboriginal archaeological and cultural and heritage features are preferred. |
| Technical Factors | The implementation of a mining Project is a complex undertaking. It is most desirable to limit complexity in design, construction, operation and decommissioning to the extent practical. | Complexity of design | Simple or straightforward designs relying on tested and proven technologies are preferred. |
| | | Complexity of construction | Simple or straightforward construction activities using standard and proven techniques are preferred. |
| | | Complexity of operation | Simple or straightforward operational procedures using available standard operating procedures are preferred. |
| | | Amenability to decommissioning/reclamation | Alternatives that are more amenable to decommissioning and/or reclamation are preferred. |
| Cost Factors | Each aspect of the Project has cost implications. The Project can only proceed if it is economically feasible | Capital costs | Lower capital costs are preferred to reduce the pre-production cash flow requirements and |

| Evaluation Criteria | | Evaluation Criteria Indicator | |
|---|---|---|---|
| **Criteria** | **Criteria Rationale** | **Indicator** | **Indicator Rationale** |
| | to do so. Life-of-mine costs relate to capital costs, operational costs and closure costs. | | ensure the project is economic. |
| | | Operating costs | Lower operational costs are preferred to maintain project economics. |
| | | Closure costs | Lower closure and post closure costs are preferred to reduce long term liabilities. |

**Table 3.2-3: Alternative Means Assessment Evaluation Criteria Rating Scheme**

| Evaluation Criteria | Evaluation Criteria Ratings |
|---|---|
| Biophysical Environment Factors | • Preferred - minimal adverse effects to the biophysical environment without mitigation<br>• Acceptable - minimal adverse effects to the biophysical environment with mitigation<br>• Unacceptable - likely to cause significant adverse effects to the biophysical environment that cannot reasonably be mitigated |
| Socio-economic Environment Factors | • Preferred - minimal adverse effects to the socio-economic environment without mitigation<br>• Acceptable - minimal adverse effects to the socio-economic environment with mitigation<br>• Unacceptable - likely to cause significant adverse socio-economic effects that cannot reasonably be mitigated |
| Aboriginal Considerations | • Preferred - minimal adverse effects to Aboriginal groups without mitigation<br>• Acceptable - minimal adverse effects to Aboriginal groups with mitigation<br>• Unacceptable - likely to cause significant adverse effects to Aboriginal groups that cannot reasonably be mitigated |
| Technical Factors | • Preferred - predictably effective with contingencies if the alternative does not perform as expected<br>• Acceptable - appears effective based on modeling/predicted results; contingencies are available if the alternative fails to perform as expected<br>• Unacceptable - effectiveness appears questionable or relies on unproven technologies |
| Cost Factors | • Preferred - facilitates the most favourable return on investment<br>• Acceptable - facilitates an acceptable return on investment<br>• Unacceptable - cannot be financially supported by the Project. |

### 3.2.2 Alternative Means Assessment

The aspects of the Project that were considered within the alternative means assessment are as follows:

- site access road;
- electrical power supply;
- aggregate and rock fill supply;
- mining method;
- concentrate transport from the mine site to a remote processing facility;
- process solids consistency;
- solid non-hazardous waste disposal;
- reclamation of the MRSA;
- reclamation of the PSMF; and,
- siting of mine infrastructure.

#### 3.2.2.1 Site Access Road

3.2.2.1.1 Alternatives Considered

At present access to the Project site is via the Camp 19 Road, a gravel road which runs off Hwy 17 to the northeast, opposite Peninsula Road. Continued use of this road as well as a new access road configuration were considered herein. The two potential site access road routes are shown in Figure 3.2-1.

As indicated, the first alternative involves the continued use of the existing road to access the site, maintaining its current route. Upgrades to the road would be needed to accommodate the mine development. At a minimum these upgrades would include reinforcing and re-grading the road bed and widening the road allowance by about 15 m. Additional road bed upgrades and river bank stability/reinforcement works would be required specifically in areas where the existing road is subject to erosion by the Pic River (see Figure 3.2-1).

The second alternative contemplates the creation of a new road segment to access the Project site. The proposed road segment would extend north from the Camp 19 Road about 2.4 km from the Hwy 17 junction. This proposed new section of road follows an existing forestry cut line for approximately 3 km to the proposed mill site. Upgrades to the segment of the Camp 19 Road that would continue to be used would be needed as described above.

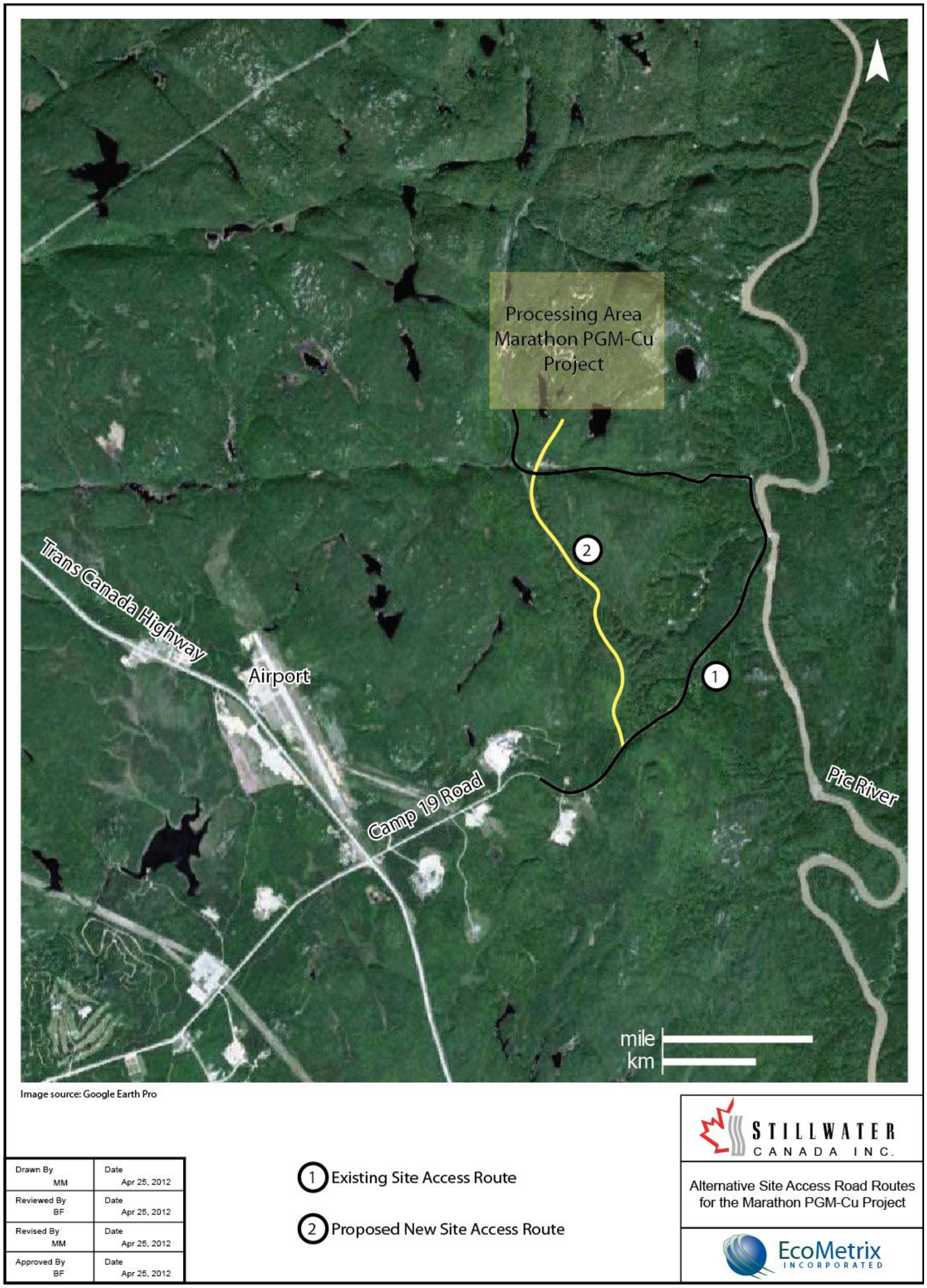


**Figure 3.2-1: Alternative Site Access Road Routes for the Marathon PGM-Cu Project**

#### 3.2.2.1.2 Evaluation of Alternatives

Biophysical Environment Factors

No difference with respect to potential effects on surface water features or fisheries resources would be expected for either access road option. Water crossings along the proposed route can be constructed following appropriate DFO and MNR operational statements, guidance and protocols so as to maintain water conveyance and permit fish passage. Water crossings on the existing road are in need of upgrades and these upgrades would likely improve current water conveyance, as well as fish passage.

The widening of the existing road corridor would increase the Project footprint marginally but not into environmentally sensitive habitat. The construction of the new road segment would increase the Project footprint along a largely previously undisturbed area, though no sensitive environmental habitat or features have been identified along the proposed route.

Neither road option would affect groundwater quality in the area.

Potential air quality effects associated with the use of either road option are the same (fugitive dust emissions) and can be mitigated.

The primary concern related to the continued use of the existing access road route is related to the risk of a vehicle leaving the road and going into the Pic River. There is a length of the road that runs directly adjacent to the Pic River, which has a relatively steep grade and includes a 90° bend. An accident resulting in a vehicle (e.g., a concentrate haul truck) leaving the road and entering the river could have significant adverse effects on the river. Juvenile Lake Sturgeon feeding habitat has been identified in the vicinity of the length of the existing access road that is in closest proximity to the Pic River. Use of the new road segment mitigates the possibility of this accident scenario.

Development of a new site access road segment is judged to be the preferred alternative for this criterion, as it mitigates the possibility of an accident resulting in a vehicle being lost to the Pic River.

Socio-economic Environment Factors

No specific potential economic and human health related differences between the two proposed site access road alternatives have been identified by SCI. Public and Aboriginal sentiment in favor of the new road segment as a potential alternative to take traffic away from the immediate vicinity of the Pic River has been expressed during consultation.

Access to Project site, or some areas in the vicinity of the Project site that are currently accessed by the Camp 19 Road, will be limited for public protection, and therefore potential land and resource uses will be limited into the closure phase until such time as access is deemed safe. This is the case for either of the site access road configurations considered and therefore neither option can be considered preferred for this indicator.

Based on archaeological surveys on the Project site (see (Woodland Heritage Services Ltd., 2008; Ross Archaeological Research Associates, 2009; Section 5.11.6) no archaeological and cultural and heritage features would be affected by the development of the new road segment or by the continued use following upgrades of the existing road.

Aboriginal Considerations

The development of the mine will restrict potential Aboriginal uses (e.g., animal harvesting and country food gathering) on the Project site (Site Study Area) for a period of time, regardless of which site access road route is utilized.

Aboriginal peoples also expressed the desire for continued use of the existing road to access the Pic River. The development of the new road segment would allow continued use of the portion of the existing road that accesses the Pic River without the need to share it with mine-related traffic.

Based on archaeological surveys on the Project site (see (Woodland Heritage Services Ltd., 2008; Ross Archaeological Research Associates, 2009; Section 5.11.6) no Aboriginal archaeological features would be affected by the development of the new road segment or by the continued use following upgrades of the existing road.

The Pic River itself is considered an important natural feature, by local Aboriginal groups, in particular the PRFN. Development of the new road segment would keep heavy equipment traffic away from the river; thereby mitigating the possibility of an accidental heavy equipment vehicle loss into the river, which Aboriginal input indicates would be the preferred option.

Technical Factors

Both alternatives are technically feasible from the perspective of design, construction and operations and would service the site; however, the new road segment would be significantly more efficient and reliable based on length and fewer bends in the road. There would be ongoing concerns over potential road bed erosion near the Pic River for the existing access road alternative, but these concerns are manageable through erosion control works.

It has been estimated that the reclamation effort associated with the two alternatives would be similar. The nature of these efforts (e.g., road decommissioning) would be determined during detailed mine closure planning and would respect and attempt to balance public, Aboriginal group and government desires as it pertains to future land and resource uses.

Cost Factors

The capital costs associated with upgrading the existing road and constructing the new road segment are expected to be similar. From an operational perspective, the costs associated with the longer transport route of the existing road are higher than the transportation costs associated with the new road segment.

As indicated above, it has been estimated that the reclamation effort, and the costs associated with the two alternatives would be similar and that specific decommissioning/reclamation options would be determined during detailed mine closure planning.

Overall Conclusion

The preferred alternative is the construction of the new site access road segment, primarily to mitigate the accident and consequential environmental and public safety risks associated with the existing route.

#### 3.2.2.2 Aggregate and Rock Fill Supply

##### 3.2.2.2.1 Alternatives Considered

Two alternatives have been considered for aggregate and rock fill supply for the Project. Aggregate and rock fill will be required on site for dam and embankment construction, road construction, as well as the development of other site-related infrastructure.

The first alternative comprises obtaining all necessary aggregate and rock fill required for the Project from on-site sources including overburden removed in areas of the mine site that will be developed (e.g., PSMF dam locations, mill site, open pits), mine rock excavated from the open pits and SCI's 10 Ha licensed aggregate pit located at the south end of the property off the Camp 19 Road. SCI would operate its own screening and crushing facility to generate the necessary material, as required. Owing to the nature of the regional and local geology, the majority of the mine rock generated through the development of the ore body will be "aggregate quality" material. That is, testing has demonstrated that the majority of the mine rock is NAG (EcoMetrix, 2012e).

The second alternative comprises obtaining the necessary aggregate and rock fill from existing off-site sources. These off-site sources would include currently licensed operations, or operations that would be in production by the time construction begins, in the region surrounding the Project site. There are a number of current and future licensed operations that produce or could produce materials that are suitable for specific applications at the Project.

#### 3.2.2.2.2 Evaluation of Alternatives

Biophysical Environment Factors

The principal environmental concern is to minimize the overall Project footprint and the loss of wildlife habitat, whether it is related to an on-site or off-site aggregate and rock fill source. To the extent therefore that this material can be utilized from areas to be disturbed on site or previously disturbed areas off site these are the preferred alternatives. For the on-site source alternative this means using source material from areas where overburden will be removed or disturbed and crushing excavated mine rock. This latter on-site source has the added benefit of potentially lessening the volume of rock that will require storage in the MRSA. For the off-site alternative this means that preference would be given to sourcing material from existing aggregate pits.

Regardless of the source of the material used adverse effects on surface water, groundwater or fisheries resources would not be expected. Any materials used as aggregate or rock fill will be NAG. Geochemical testing of on-site material confirms that an abundant supply of NAG material would be available (EcoMetrix, 2012d, 2012e).

The crushing and screening processes needed to produce the materials for site development are essentially the same whether carried out on or offsite and air quality issues that could be associated with these processes (i.e., fugitive dust releases) would be mitigated using standard operating practices.

The only material basis that was identified to distinguish between on- and off-site sources for this criterion is transportation effects. On-site sources were determined to be preferred to off-site sources as the energy (fuel) needs to transport the material to the site and the associated vehicle emissions could be avoided.

Socio-economic Environment Factors

Neither alternative would affect economic factors, human health, land and resource uses or archaeological and cultural and heritage features.

Aggregate and rock fill resources can at times be in short supply, such that the wise use of aggregate resources is beneficial to society as a whole. Consuming aggregate and rock fill resources will necessarily deplete future resources for other potential users. In Ontario, the Provincial Policy Statement places importance on aggregate protection. In this context therefore, on-site sources are preferred as they are unlikely to be developed or utilized for any other purpose – that is, their use will not impact the otherwise current or potential aggregate and rock fill supply for other purposes. Use of on-site sources will also avoid any potential effects associated with off-site supply (e.g., transportation related effects).

Aboriginal Considerations

Neither alternative would affect aboriginal land and resource uses or archaeological and cultural heritage features, as neither is associated with a material incremental increase in the footprint otherwise needed to facilitate the development of the mine.

Technical Factors

The critical aspect of aggregate materials is their quality, particularly for mine-related applications in that they need to meet very specific specifications (e.g., for concrete manufacturing vs. road bed material vs. dam construction material). Both alternatives considered would have to meet these requirements, and both were considered acceptable in this regard. The on-site supply would be provided by standard crushing and screening equipment and techniques. Similarly, the off-site supply would be sourced from existing licensed operators that produce the type of material needed for the Project on a day-to-day basis.

Cost Factors

Although there are some initial capital costs associated with procuring the appropriate crushing and screening equipment, life-of-mine costs associated with obtaining all of the aggregate and rock fill material from on-site sources are considerably less than those for the off-site option. Given the volumes of material, and in particular rock fill required for dam construction, the costs associated with procuring and transporting aggregate from off-site sources would be prohibitive. On-site rock fill and aggregate sources are therefore the preferred option for this criterion.

Overall Conclusion

The preferred alternative is to use to the on-site aggregate and rock fill to meet Project requirements, for environmental and cost reasons.

#### 3.2.2.3 Mining Method

##### 3.2.2.3.1 Alternatives Considered

Two basic mining methods to extract the deposit have been considered herein: accessing the ore body via an open pit or via underground mining. Two underground mining methods were considered - block caving or long-hole mining. Other underground approaches, such as cut and fill methods, or any method requiring extensive backfilling were not considered, as the geometry of the ore body is not amenable to large scale backfilling campaigns.

Block caving is sometimes used for large sized ore bodies which are typically composed of low-grade, friable ore. The method works best with vertical to sub-vertical dipping ore bodies with widths exceeding 100 meters, and lengths that are several hundred meters. Pre-production mining development work consists of driving accesses underneath the ore body. This includes the development of drawpoints by undercutting and blasting. Initially, blasted ore is removed via the extraction level underneath the drawpoints until a sufficient area of unsupported ore is formed that the ore body begins to fracture and cave on its own. The eventual aim of the block caving method is that the friable ore needs no blasting and continues to fracture and break up on its own, flowing down into the drawpoints to the extraction level, allowing for mucking and hoisting or conveying of the ore to surface.

Long-hole mining is the removal of the wanted ore from an underground mine leaving behind an open space known as a stope. Long-hole stoping requires the development of drill levels through the ore body, whereupon long drill holes are made into the ore body along the contacts with the background rock, and within the ore to promote good fragmentation during blasting. The broken ore then falls by gravity to a lower level, which is mucked out mechanically, the ore being hauled to surface by hoist, ramp or conveyor. Long-hole mining methods are best suited to;

- ore bodies that are moderately to steeply dipping (55 degrees to vertical), and are of narrow extent to limit the potential of failure due to rock span. In systems of wider extent, the standard practice is to backfill the cavity with cemented rock fill; and,
- ore bodies where the geological contacts between ore and rock are very well defined (i.e., differential rock types or high-grade deposits with differential mechanical characteristics).

Open pit mining requires the removal of surface materials to expose the ore body, followed by the stepwise development of concentric levels (rings) into the deposit, with an inclined roadway, or ramp, connecting the various mining levels or benches. Open pit mining methods are well suited to:

- shallow deposits that are exposed at surface, or are near surface covered directly by comparatively shallow overburden;
- large deposits that have a more uniformly distributed resource or scattered, often randomly distributed pockets, that are not readily traceable by underground mining methods; and,
- higher tonnage, lower grade deposits, which may be uneconomic using underground mining techniques.

For reference purposes, some basic information regarding the Marathon PGM-Cu deposit that is used in the evaluation below is as follows. The dip[1] of the deposit is between 25 and 30 degrees, with localized areas that range between zero and 45 degrees. The thickness of the deposit varies, but is generally in excess of 20 meters. Rock quality is generally very good. Based on current (2012) pricing, and utilizing the grades presented in the most recent feasibility

[1] The “dip” is the angle at which mineral deposits are inclined relative to the horizontal plane.

study (MICON, 2010), the ore would have an average value of approximately $40/tonne, which takes into account mining dilution and recovery rates of metals in processing.

3.2.2.3.2 Evaluation of Alternatives

Biophysical Environment Factors

Underground mining methods generally cause less direct surface disturbance to terrestrial and aquatic habitats than open pit mining. However with block caving there is the risk of uncontrolled caving to surface, resulting in long term instability, which cannot be reasonably mitigated at this deposit.. Effects to terrestrial and aquatic habitats and species associated with open pit mining and long-hole stoping can be mitigated to the extent that no significant adverse effects would be anticipated. However due to the smaller footprint long-hole stoping was judged to be preferred in this regard.

SCI did not identify a basis to prefer one alternative over another as it concerns the groundwater environment due to the low permeability and water flow in the host material.

No air quality issues would be associated with either of the underground mining methods proposed. Effects on air quality associated with fugitive dust emissions from the open pits and infrastructure related to the pit (e.g., a more extensive road network) can be mitigated using standard techniques.

Overall, underground mining, in particular long-hole stoping was judged preferred for this criterion.

Socio-economic Environment Factors

Open pit mining is the only means by which the Marathon PMG-Cu Project deposit can be economically developed (see below). Therefore any positive socio-economic effects associated with the creation of local and regional economic opportunities arising from the Project can only occur if the Project proceeds as an open pit mining operation.

The different mining methods would not be expected to have any materially different effects with the implementation of mitigation strategies, as appropriate, on human health, physical or cultural resources, or archaeological features. Access to the Project site would be limited regardless of the mining method until such time is the site is deemed safe for public access and no basis was identified to prefer one alternative over another from this perspective.

SCI assesses open pit mining as preferred for this criterion.

Aboriginal Considerations

As indicated, open pit mining is the only means by which the Marathon PMG-Cu Project deposit could be economically developed. Any positive socio-economic effects associated with the creation of local and regional economic opportunities for Aboriginal people arising from the Project can only occur if the Project proceeds in this manner.

The different mining methods would not be expected to have any materially different effects on Aboriginal cultural and heritage features resources or archaeological resources. Access to the Project site (Site Study Area) for Aboriginal uses would be limited regardless of the mining method until such time is the site is deemed safe for public access and no basis was identified to prefer one alternative over another from this perspective. SCI is committed to working with PRFN in particular to ensure that there is as little disruption as possible to areas or access to areas that PRFN may wish to utilize for traditional pursuits such as animal harvesting, fishing and country food collection.

SCI assesses open pit mining as preferred for this criterion and underground mining as unacceptable.

Technical Factors

Accessing the ore body by open pit mining is the optimum method for developing the deposit based on the tonnage, grade and orientation.

Accessing the ore body via block caving is not technically acceptable because:

- dilution of the ore with waste material would be excessive given the vertical height or thickness of the deposit; and,
- there is the risk of uncontrolled caving to surface, resulting in long-term instability, for which there is no mitigation.

Accessing the ore body via long-hole mining methods provides a significant enough technical challenge so as to be questionable from a feasibility point of view. The ore body dip is too shallow to allow muck flow by gravity, thereby requiring substantial secondary development.

Open pit mining of the deposit is judged as preferred for this criterion.

Cost Factors

First-order life-of-mine cost estimates on a per tonne basis have been developed in consideration of current (2012) pricing and utilizing the grades presented in the most recent feasibility study (MICON, 2010) for the mining methods that have been deemed technically feasible as follows:

- open pit mining - $20-$29/tonne; and,
- underground long-hole stoping - $115-$130/tonne.

The only mining method for which life-of-mine costs do not exceed estimated value of the resource is open pit mining. For the only feasible underground method, the life-of-mine costs exceed the estimated value of the deposit and therefore this potential alternative is considered unacceptable for this criterion.

Overall Conclusion

Open pit mining is the only method for which the estimated value of the ore body exceeds the life-of-mine costs of mining. Block caving is not technically suitable for this deposit and long-hole stoping is not economically feasible. Both underground mining methods therefore were rejected from further consideration.

#### 3.2.2.4 Concentrate Transport from the Mine Site to a Remote Processing Facility

3.2.2.4.1 Alternatives Considered

Concentrate produced at the on-site mill will be transported off-site to an existing facility for further processing. SCI contemplates two alternatives for the delivery of concentrate to a remote third-party or SWC facility: direct transport via truck or transport via a combination of truck and rail.

The direct truck transport alternative contemplates the delivery of concentrate from the mine site along existing highways. A specific processing facility has not been contracted as of yet but the concentrate would be moved east of the Project site with the route potentially covering several hundred kilometers. SCI would procure a licensed third-party trucking contractor for this purpose.

The truck-rail option includes the movement of the concentrate via truck from the mine site to a proposed rail load-out facility in the Town of Marathon (see Section 1.4.3.7.3) and subsequently rail transport to the processing facility by rail from there. A specific processing facility has not been selected as of yet but the concentrate would be moved either east or west of the Project site with the rail route potentially covering several hundred to over a thousand kilometers. Two possible locations for the rail load-out facility in Marathon are under consideration. In both cases the facilities are situated on existing rail sidings in close proximity to the CP rail line (see Figure 1.4-2). For this alternative, it is possible that SCI would operate its own haul trucks between the mine and the rail load-out facility, though it is also possible that a third-party trucking contractor could be used for this purpose.

#### 3.2.2.4.2 Evaluation of Alternatives

Biophysical Environment Factors

No adverse environmental effects would be associated with either transportation alternative, as they apply to the biophysical environment indicators considered in this assessment. The primary biophysical environment concerns related to either option are accident and malfunction scenarios whereby concentrate would be lost to the environment. These scenarios, and their potential environmental effects, are presented in Section 6.2.12 of this report. An accident and malfunction scenario of this sort would generally be considered to be a low probability event, and one whose potential affects would be limited in scope and magnitude. There is no basis to consider either alternative preferred over the other in this regard.

Socio-economic Environment Factors

Either alternative is perceived to be acceptable as it pertains to socio-economic effects. Development of a rail load-out facility at an existing brownfield site within the Town of Marathon does not pose a human health concern, nor is it a concern from a land use or from an archaeological perspective. Both options use established highway and rail networks.

Aboriginal Considerations

The alternatives are not distinguishable from one another based on Aboriginal land and resource uses or Aboriginal archaeological and cultural and heritage features.

Technical Factors

The alternatives considered are technically feasible from the design, construction, operations and closure points of view and would service the Project in an effective and reliable manner.

From a decommissioning and reclamation perspective, more effort would be required for the alternative that includes the rail load-out facility but no technical challenges would be expected in this regard. If this option went forward, rail load-out facility design factors would be incorporated that would consider the ultimate closure of the facility.

Cost Factors

A detailed assessment to determine the preferred concentrate processing and delivery option has yet to be undertaken. Beyond consideration of capital, basic operations and decommissioning/reclamation costs, this analysis will ultimately be driven by negotiations with potential third-party processors, which are premature at this point in time, as well as by available processing capacity at potential processing facilities.

There are obvious life-of-mine costs associated with the design, construction, operation and closure of a rail load-out facility in the Town of Marathon that would not be incurred if concentrate was transported directly via truck to a remote processing facility. However, the feasibility level analysis completed by MICON (2010) indicated that each of the alternatives under consideration would be viable from a cost perspective. Under these circumstances therefore each option is considered acceptable.

Overall Conclusion

Both alternatives can be considered acceptable at this point in time, as no basis to conclude either as unacceptable was identified.

#### 3.2.2.5 Process Solids Deposition

##### 3.2.2.5.1 Alternatives Considered

Two alternatives have been considered as it pertains to deposition of the process solids stream: a conventional slurry and a paste or thickened non-segregating slurry.

A conventional process solids stream is a solid-liquid slurry that is deposited in the PSMF via a pumping system. Following deposition the solids drop out of the slurry, settle and consolidate. The liquid fraction of the slurry would be collected and recycled back to the ore processing mill as reclaim water. The moisture content of the conventional slurry as envisioned for the Project would be approximately 45 to 70%.

The paste or thickened non-segregating slurry is a solids-liquid slurry that is thickened and pumped to the PSMF and contains a moisture content of approximately 22 to 25%. The slope angle of the deposited thickened process solids varies from 5% for thickened non segregating slurry to approximately 10% for paste. This type of process solids storage is referred to as stack process solids.

##### 3.2.2.5.2 Evaluation of Alternatives

Biophysical Environment Factors

The primary concerns associated with the process solids consistency alternatives relate to their storage in consideration of terrestrial and aquatic habitat disturbance, protection of water quality and dust generation.

The dam raises associated with a PSMF used to stored stacked process solids would likely be of lower elevation than for a PSMF designed to contain a conventional slurry; however, the overall footprint of the PSMF would be similar. In practice, this means that the potential habitat and wildlife disturbance associated with the storage of either the dry solids or a conventional slurry would not be distinguishable from one another and therefore neither alternative was judged as preferred in relation to the other for this indicator.

The Type 2 process solids generated by the ore milling process will be potentially acid generating (PAG) because of their relatively high sulphur content and relatively low neutralization capacity (EcoMetrix, 2012e). The preferred storage method for this type of material is below water, or the water table to mitigate the potential for acid generation. Both methods can accommodate this storage strategy.

As it concerns air quality, fugitive dust emissions are of greater concern with dry process solids than with a conventional slurry. By definition, the stacking creates large open expanses of process solids that are susceptible to erosion by wind. Although this can be mitigated with compacting and the use of dust suppressants, stacking presents a greater technical challenge from a dust generation perspective than does a conventional slurry. The chief concern with the conventional slurry with regard to fugitive dust emissions is ensuring that process solids beaches, which are susceptible to wind erosion, are not formed. Avoiding beach formation can be achieved through effectively managing the manner in which process solids are deposited in a given area of the PSMF.

Based on potential issues related to fugitive dust generation a conventional slurry is judged as preferred for this criterion.

Socio-economic Environment Factors

No basis was identified to prefer one alternative over the other from a socio-economic perspective. The PSMF under both process solids scenarios would occupy a similar footprint and therefore potential effects related to land use or from an archaeological perspective would be the same. The PSMF configuration currently proposed would not affect land and resource uses or archaeological and cultural and heritage features.

Aboriginal Considerations

No basis was identified to prefer one alternative over the other from an Aboriginal perspective. The PSMF under both process solids scenarios would occupy a similar footprint and therefore potential effects related to traditional land and resource uses such as animal harvesting and country food collection perspective would be the same. The PSMF configuration currently proposed would not affect Aboriginal archaeological features.

Technical Factors

Both options are technically feasible for the Project from design, construction, operations and closure perspectives.

Though there is less industry-wide experience and history with stacked process solids it has been applied to the extent that it can be considered an accepted standard. The most typical application of the stack alternative is in arid climates where water is scarce and it is necessary to recover as much of the liquid component of the process solids stream to supply the mill with the water volumes necessary to operate.

As discussed above, there could be operational challenges associated with a stacked process solid from a dusting perspective given the proximity of public infrastructure, in particular the Marathon airport, to the Project site. The same level of technical challenge as it pertains to controlling fugitive dust emissions is not apparent with the conventional slurry.

From a closure perspective each of the process solids consistencies is acceptable. Reclamation and re-vegetation of the PSMF is technically achievable for both.

Based on potential technical challenges related to controlling fugitive dust generation a conventional slurry is judge as preferred for this criterion.

Cost Factors

First-order cost estimates associated with the process solids consistency indicate that that conventional process solids slurry is the more cost effective life-of-mine alternative, and therefore the preferred option for this criterion. Higher initial capital costs are associated with the Plant equipment required to generate the thickened or paste process solids. Operational costs associated with stacked process solids are higher than conventional slurry processes due to the operation and maintenance of additional pumps and associated equipment. The costs associated with closure of the PSMF would not be significantly different for either alternative.

Overall Conclusion

Based primarily on concerns over the ability to effectively mitigate dusting from the thickened or paste stack option the conventional process solids slurry is the preferred option.

#### 3.2.2.6 Solid Non-hazardous Waste Disposal

##### 3.2.2.6.1 Alternatives Considered

Non-recyclable, solid non-hazardous wastes will require management during the all mine development phases, with the exception of demolition wastes associated with mine closure. Solid non-hazardous wastes are expected to consist primarily of:

- domestic waste (e.g., inorganic materials, clothing); and,
- miscellaneous inert wastes (e.g., non-recyclable construction debris).

Three options have been considered as it pertains to the disposal of Project-related solid non-hazardous waste:

- collection and disposal of non-hazardous solid waste off site by a third-party contractor and local disposal;
- collection and disposal of non-hazardous solid waste in an on-site landfill constructed and permitted under Part V of the Ontario Environmental Protection Act; and,
- collection and disposal of non-hazardous solid waste in a designated area within the PSMF.

The first alternative would rely upon a third-party contractor to manage solid non-hazardous waste disposal. Solid non-hazardous wastes generated on site would be collected on a regular schedule and transported to a local or regional off-site landfill. The nearest approved off-site landfill is the Town of Marathon Landfill, which services the Town of Marathon and the immediate surrounding area. It is currently at capacity, but has recently received approval for an expansion that would service area needs at current accumulation rates for about ten to 15 additional years. An approvals process is underway for a new regional landfill site some distance from the Town, though it is unclear if (and/or when) final approval will be issued. The site when (or if) operational would provide an estimated 40-years of disposal.

Alternative 2 includes the development of a dedicated landfill site within the Project site. No specific siting investigations have as yet been undertaken but sufficient space would be available either to the north the PSMF, or off the Camp 19 Road to the west of proposed new site access road section. A provincial approvals process under the Environmental Protection Act would need to be undertaken in the event that the development of a dedicated landfill site within the Project footprint moved forward.

Alternative 3 involves disposing of solid non-hazardous waste in the PSMF. In this case a small area of the PSMF would be used for co-disposal. In relative terms, the volume of non-hazardous solid wastes that need to be disposed of through mine life is insignificant when compared to the storage capacity of the PSMF and no special allowance for this volume needs to be accounted for in the PSMF design. The provincial approval requirements would be handled through the sewage works approval required for the PSMF under the *Ontario Water Resources Act*.

#### 3.2.2.6.2 Evaluation of Alternatives

<u>Biophysical Environment Factors</u>

The assessment of potential effects on the biophysical environment focusses herein on the on-site disposal alternatives only. Potential issues related to the natural environment for the off-site disposal alternatives are not considered as they would be mitigated through the environmental management plan and approval requirements for the off-site facility.

For comparison sake it is assumed that the design of an on-site landfill would be based on what is proposed for the PSMF. That is, it is assumed that a dedicated on-site facility would have a geomembrane liner and appropriate seepage controls.

No effects to surface water quality or quantity would be expected for the co-disposal option, as water quality is already being managed in the PSMF and subsequently in a water treatment plant if necessary and there is no incremental increase in the hydrological footprint associated with this option. Drainage from a dedicated facility would have to be collected and may need some form of quality control. This could be achieved by pumping the water back to the PSMF. A dedicated facility would increase the hydrologic footprint of the mine site. If the drainage that was collected from the facility was directed to a different subwatershed as part of its management, there would be a small net loss of water and potentially aquatic habitat in that subwatershed.

Based on facility design considerations neither option can be distinguished from the other in terms of potential effects on groundwater. As indicated above, it is assumed that both on-site alternatives would have a geomembrane liner and appropriate seepage controls.

Potential effects on fisheries resources are likely similar between the two alternatives and no material basis was identified to prefer one on-site option over the other for this indicator. There is a possibility of a loss of aquatic habitat in the instance where drainage from the dedicated facility was directed to a different subwatershed, as described above, but the likely significance of this effect is low and if a short-term effect was seen it would be reversible after closure.

No basis was identified to prefer one on-site alternative over the other from an air quality perspective.

The incremental increase in footprint needed to accommodate a dedicated on-site disposal facility is not likely to cause adverse effects on vegetation, wildlife and species at risk when the additional site clearing needs required to develop such a facility are considered within the context of the development of the site as a whole. A less than one percent increase in the development footprint would be needed for that purpose. On this basis neither on-site alternative was judged to be preferred over the other for these indicators.

Socio-economic Environment Factors

No basis was identified to prefer one on-site alternative over another from archaeological and cultural and heritage features perspectives. Based existing information (see Woodland Heritage Services Ltd., 2008; Ross Archaeological Research Associates, 2009; Section 5.11.6), a dedicated disposal option could be located at the Project site and not affect archaeological and cultural and heritage features.

In relative terms, the footprint of the dedicated on-site disposal site only results in a small incremental increase in the mine site footprint and would therefore not affect land and resource uses on the Project site materially.

Utilization of local landfill capacity by SCI diminishes the landfill capacity for the local community. Local waste management capacity (or the potential lack thereof) is a significant community concern. For this reason the on-site disposal options were considered preferred for this criterion.

Aboriginal Considerations

On-site co-disposal of non-hazardous solid waste with process solids in the PSMF or collection and disposal of non-hazardous solid waste off-site are preferred to disposal in a separate dedicated on-site disposal area in order to lesser the footprint of the mine site and in turn the potential effects on Aboriginal land uses.

It is understood there may be Aboriginal concerns (in particular with PRFN) with the Town of Marathon's new landfill proposal; therefore the on-site co-disposal option was judged to be preferred over the other alternatives in this regard.

Technical Factors

The two on-site solid non-hazardous waste disposal alternatives are technically feasible in terms of design, construction, operations and closure. Each of these options would be capable of servicing the site effectively over the life of the mine using standard and proven technologies, and neither presents a significant technical challenge from a closure perspective.

It is less clear the extent to which the off-site alternative is feasible and/or reliable from an operations perspective. The Town of Marathon Landfill has limited extended capacity and it is apparent that no resolution to the issues that are continuing to delay the Crown Land Disposition process for the new regional landfill is imminent. It is therefore likely undesirable from the Town of Marathon's perspective to permit SCI to plan to landfill its solid non-hazardous waste until such time as its waste management strategy is resolved. Due to this uncertainty the off-site alternative was judged as unacceptable for this criterion.

Cost Factors

There would be no incremental capital costs associated with the use of an off-site disposal location or the disposal of solid non-hazardous wastes in the PSMF. In the former instance the capital costs have been borne previously by the landfill operator and in the latter case the capital costs have already been allocated to the development of proposed mine-related infrastructure (the PSMF). There would be capital costs associated with the development of a dedicated non-hazardous waste disposal facility on the mine site outside of the PSMF. These costs could be significant assuming the facility would have to be constructed with a geomembrane liner and other seepage mitigation strategies that are proposed for the PSMF.

From an operations perspective, off-site disposal of solid wastes in the Town of Marathon Landfill (or subsequently to the regional site that is currently in the approvals process) would be the most expensive of the available alternatives, as it would necessarily involve procuring a third-party contractor to transport the material, as well as tipping fees at the disposal facility. Co-disposal of solid non-hazardous waste in the PSMF is also the more cost-effective option from an operations point of view, as it does not include the incremental costs associated with the ongoing maintenance and/or monitoring of a dedicated on-site facility.

No special closure costs are associated with the use of an off-site disposal location or the disposal of solid non-hazardous wastes in the PSMF. In the former instance the closure costs would be borne by the facility operator and in the latter case the capital costs would have already been allocated within the site Closure Plan. There would be an incremental increase in the overall mine site closure costs associated with the closure of a dedicated on-site area, associated with physically closing the facility and providing for long-term maintenance and monitoring.

In consideration of the above, SCI considers the co-disposal of solid non-hazardous waste in the PSMF as the preferred option for this evaluation criterion.

<u>Overall Conclusion</u>

The preferred alternative is co-disposal of solid non-hazardous waste in the PSMF. Use of the Town of Marathon Landfill (or subsequently the regional landfill site) was determined to be unacceptable because there is uncertainty as to the current viability of such an alternative and its use maybe controversial with other uses given the challenges Marathon has experienced with its existing landfill. It is understood that PRFN has concerns with the Town's proposal for a regional landfill. There was no obvious advantage identified for a standalone on-site waste disposal site in comparison to co-disposal in the PSMF, which is an accepted and standard mining industry practice. Conversely a standalone disposal site would involve additional costs and site disturbance.

#### 3.2.2.7 Closure – Reclamation Mine Rock Storage Area

##### 3.2.2.7.1 Alternatives Considered

Closure of the MRSA will be based on the requirements as set out by the "Ontario Mining Act, Regulation 240/00. The primary objectives for the MRSA closure plan include:

- ensuring slope stability;
- ensuring run-off drainage control on and around the MRSA is maintained; and,

- pursuing reclamation strategies that are consistent with or promote post closure land use.

Alternatives specifically pertaining to the reclamation of the MRSA as it concerns covers and re-vegetation have been considered. The two alternatives considered are:

- passively allowing the MRSA to develop a soil layer and re-vegetate through natural process;
- proactively developing cover material and promoting re-vegetation via seeding.

The first alternative allows for the natural reclamation of the MRSA. Over time organic matter and other material will collect on the surface of the MRSA and in the interstices and will function as substrate for plant growth. Vegetation would take hold in these areas. The “greening” of the MRSA would likely take place naturally over several decades.

In the second alternative, reclamation of the MRSA would be proactive. Proactive reclamation of the MRSA would include placement of surface soils on the horizontal surfaces and subsequently seeding these surfaces.

#### 3.2.2.7.2 Evaluation of Alternatives

Biophysical Environment Factors

The primary differentiation between the two alternatives as it concerns the biophysical environment is the rate at which wildlife habitat and associated biological populations and communities would be re-established. A more rapid revegetation and re-colonization process is desirable and for this reason the proactive reclamation of the MRSA is the preferred alternative for this criterion.

Socio-economic Environment Factors

Proactive reclamation of the mine site in general, including the MRSA, restores the site for post mine closure land uses in a shorter time frame. For this reason pro-active reclamation as described herein is preferred over passive reclamation.

Aboriginal Considerations

As indicated above, proactive reclamation of the MRSA restores the site for post mine closure Aboriginal land uses in a shorter time frame. For this reason pro-active reclamation as described herein is preferred over passive reclamation.

Technical Factors

Either reclamation strategy is technically feasible. A passive reclamation strategy is an acceptable alternative from the standpoint that natural re-vegetation of the MRSA would be successful over the long-term. Given an appropriate length of time (several decades perhaps) leaf litter and other organic and inorganic material will accumulate to the extent that vegetation would become established.

There are no technical issues associated with the success of proactively reclaiming the MRSA in the manner described in the second alternative. The timeframe over which successful re-vegetation would occur would be significantly reduced, as compared to the strategy of natural re-vegetation, by implementing the proactive reclamation plan.

Because of the reduced time-frame over which successful revegetation would occur for the proactive reclamation strategy it is the preferred alternative for this criterion.

Cost Factors

Passive reclamation is the more cost effective of the two MRSA reclamation alternatives considered and can therefore be characterized as preferred for this criterion. Proactive reclamation as described above would not be cost prohibitive to implement and is therefore deemed acceptable.

Overall Conclusion

The proactive MRSA reclamation strategy as described above was determined to be the preferred alternative.

#### 3.2.2.8 Closure – Reclamation PSMF

3.2.2.8.1 Alternatives Considered

Reclamation and closure of the PSMF will be based on the requirements as set out by the Ontario Mining Act, Regulation 240/00. The primary objectives for the conceptual PMSF closure plan are:

- ensuring safe and secure storage of process solids in perpetuity;
- minimizing dust generation from the process solids surface;
- safely routing runoff and stream flows through, around and off the PSMF;
- ensuring that the surface water flows from the facility are of suitable quality; and,
- minimizing the visual impact of the facility on the surrounding environment.

Specific activities that will be implemented as part of the closure of the PSMF and associated structures comprise:

- contouring the downstream slopes of the PSMF embankments, cut slopes, access routes, other disturbed areas, etc., as necessary to remove any areas of concentrated runoff leading to erosion and sediment production;
- minimizing standing water on top of the PSMF;
- establishing vegetative cover over the surface of the process solids;
- decommissioning process solids delivery and distribution systems;
- decommissioning the water reclaim and excess water release systems;
- dismantling and removing other infrastructure not required beyond mine closure; and,
- providing ongoing monitoring of the PMSF for a period of time sufficient to confirm suitable water quality and ongoing stability of the facility.

Two alternative PSMF closure scenarios were considered pertaining to where run-off from the PSMF will drain over the long term. The PSMF falls within the Stream 6 subwatershed. During operations, excess water from the PSMF will be discharged to Hare Lake, which is within subwatershed 5 to the north of Stream 6. It would be possible at closure through the grading of the PSMF surface to make water drain to either subwatershed. Two alternatives were therefore considered:

- grading the PSMF surface and creating an overflow structure in the northwest corner of PSMF at closure to direct drainage to Hare Lake, maintaining the flow direction that was established during operations; and,
- grading the PSMF surface and creating an overflow structure in the southwest corner of PSMF at closure to direct run-off to Stream 6, restoring its natural drainage.

#### 3.2.2.8.2 Evaluation of Alternatives

Biophysical Environment Factors

The primary basis on which the two alternatives can be distinguished from one another concerns the net benefits that would accrue to the aquatic habitat in the Stream 6 subwatershed if the restoration of natural drainage patterns was completed in combination with further aquatic habitat restoration activities elsewhere in the subwatershed. The possibility of these restoration activities has been presented as a potential option in the fish habitat compensation strategy developed in support of this EIS (EcoMetrix, 2012g). Restoration of natural drainage patterns in the Stream 6 subwatershed was judged as the preferred alternative for this criterion.

Socio-economic Environment Factors

As above, the primary basis on which the two alternatives considered can be distinguished from one another concerns the net benefits that would accrue to the aquatic habitat in the Stream 6 subwatershed. From a socio-economic perspective the re-establishment of the natural drainage patterns would enable all current potential land uses in the subwatershed to be restored following mine closure. With this in mind, restoration of natural drainage patterns in the Stream 6 subwatershed was judged as the preferred alternative for this criterion.

Aboriginal Considerations

The re-establishment of the natural drainage patterns would enable all current potential Aboriginal land uses in the Stream 6 subwatershed to be restored following mine closure. Restoration of natural drainage patterns was therefore determined the preferred alternative for this criterion.

Technical Factors

Both alternatives are technically feasible and can be implemented through the use of standard engineering practices. Neither one of the alternatives presents a unique challenge that would be considered less likely to result in a positive outcome and therefore neither was preferred over the other for this criterion.

Cost Factors

There are no significant differences in the costs associated with the implementation of either of the two alternatives. Moreover, the alternatives are not cost prohibitive and can be characterized as acceptable, and no basis for a preference was identified.

Overall Conclusion

Restoration of natural drainage patterns whereby drainage from the PSMF is directed to the Stream 6 subwatershed is judged to be the preferred option.

#### 3.2.2.9 Siting and Location of Mine Infrastructure

##### 3.2.2.9.1 Alternatives Considered

Site infrastructure as considered herein comprises: the concentrator; primary crusher; secondary crusher; ancillary structures (dry warehouse, administrative office, garage, wash bay, hazmat building, offices, shops, etc.); fuel storage; explosives manufacturing facility and magazine; electrical substation, diesel generators and the on-site electrical distribution system; and, on-site roads and pipelines.

Options for locating the majority of these facilities are dictated by the location of the open pit, the PSMF and MRSA (whose locations were determined based on the Knight Piesold assessment described in Section 3.3), as well as geographic and environmental sensitivity constraints. Given the foregoing, there are relatively few, if any, siting alternatives for most of the above-referenced infrastructure that are significantly different from one another. In general there has been a concerted effort with each of the iterations of the conceptual site plan for the Project to reduce the overall footprint of the development.

The first priority for site infrastructure is appropriately locating the concentrator and crusher facilities. The concentrator and crusher facilities are typically placed as close to the open pits as practicable to minimize ore haul distance, and secondarily they are typically positioned between the open pit and the PSMF to minimize pipeline lengths. The concentrator and crusher facilities also require heavy foundation support, with bedrock at or near surface. Given these constraints, the most practical location for the concentrator and secondary crusher facility, assuming one is included in the final design, is the high point of land along the ridge to the south of Satellite Pit 1 and to the east of Satellite pits 2, 3 and 4 (see Figure 1.4-12). The primary crusher has been located just to the south-east of the primary pit to minimize haul distances. Crushed ore would be moved from the primary crusher to the secondary crusher or directly to the mill if SAG equipment is used in the grinding circuit, via an above-grade conveyor system.

With the concentrator and crusher facility locations fixed, the locations for ancillary structures are also essentially fixed, as these structures are typically logically placed in close proximity to the processing plant (concentrator building). The optimal position for the ancillary structures is the general area of the concentrator and crusher facilities so as to effectively support these operations. Similarly, the fuel storage facility has also been placed as centrally as possible to the primary mining operations fleet area, just off the main access road to the south-east of Satellite Pit 4. The electrical substation is also ideally placed in a central area, in the general area of the concentrator and crusher buildings.

Mine site service roads, pipelines and the electrical distribution system are dictated by the locations of the infrastructure that they are required to service. These have been sited to obtain the shortest routes practicable, while avoiding direct interference with other Project components, taking into consideration constraints such as topography and the locations of sensitive environmental features such as watercourse and waterbodies.

Siting of the explosives manufacturing plant and the associated explosives magazines requires appropriate setbacks from other site infrastructure to meet regulated safety requirements. The most suitable location identified for the manufacturing plant is on the east side of the new section of the site access road about 1.5 km north of the Camp 19 Road. The explosives and detonator magazines will be located to the north of the PSMF.

#### 3.2.2.9.2 Evaluation of Alternatives

As indicated, options for locating the majority of mine infrastructure facilities are dictated to a great extent by the elements of the proposed development whose positions are more or less fixed (e.g., the open pits) or whose siting is of greater priority (e.g., the PSMF and MRSA). All efforts have been made to reduce the overall footprint of the Project as the design process has progressed; however, the process has been one of fine tuning as opposed to considering alternative locations that would fundamentally change the nature of the development or unnecessarily expand the site footprint. With this in mind, no formal evaluation of site infrastructure location alternatives is considered herein.

## 3.3 Assessment of Alternatives for Long Term Mine Waste Storage

### 3.3.1 Assessment Framework

SCI retained Knight Piesold Ltd. to develop alternative assessments for long term storage of the by-products of the mining and milling processes, mine rock and process solids, respectively (see Knight Piesold, 2012). The assessment of alternatives for mine rock and process solids storage considered a number of options, including options that did not involve the use of a natural water body(ies) frequented by fish as storage areas. The alternatives assessment was conducted consistent with Environment Canada's *Draft Guidelines for the Assessment of Alternatives for Mine Waste Disposal (May 2011)* and considered the following evaluation criteria:

- environmental factors (including water quality and impacts to fisheries, flora and fauna);
- socio-economic factors (including effects to the population with respect to human health, resource and recreational uses and Aboriginal land uses);
- technical factors (including complexity of design, construction and operating considerations); and,
- cost factors (including life of mine costs).

The results of the assessments of alternative storage areas for both mine rock and process solids are summarized below and provided in detail by Knight Piesold (2012).

### 3.3.2 Mine Rock Storage

Eight candidate sites were considered within the MRSA evaluation. An initial screening assessment of the candidate sites eliminated four locations primarily because of issues related to insufficient storage capacity and difficulties related to runoff water management, as well as relatively long haul distances between the open pits and the potential storage area. The remaining four candidate sites - Options 2, 4, 6 and 8 (see Figure 3.3-1) - were advanced for a more detailed assessment utilizing the evaluation criteria listed above.

The results of this assessment indicated that Option 4 – the MRSA located along the east side of the primary open pit - was the preferred MRSA option for the Project. Option 4 received the highest scores for each of the evaluation criteria. As it pertained to environmental factors, Option 4 was preferred due to its more straightforward water management requirements and its relatively low impact to fish communities. As it pertained to socio-economic factors, Option 4 was rated highest primarily due to better indicator scores for human health. As it pertained to technical factors, the main reason Option 4 ranked highest was related to the fact that a lower number of runoff collection and monitoring locations is required for water management (i.e., it provides for simpler design, construction and operation related to water management). Finally, on cost factors, Option 4 scored better than the other alternatives due to lower initial capital costs, associated with simpler water management infrastructure requirements, and due to lower closure costs, associated with the need for a lesser amount of reclamation.

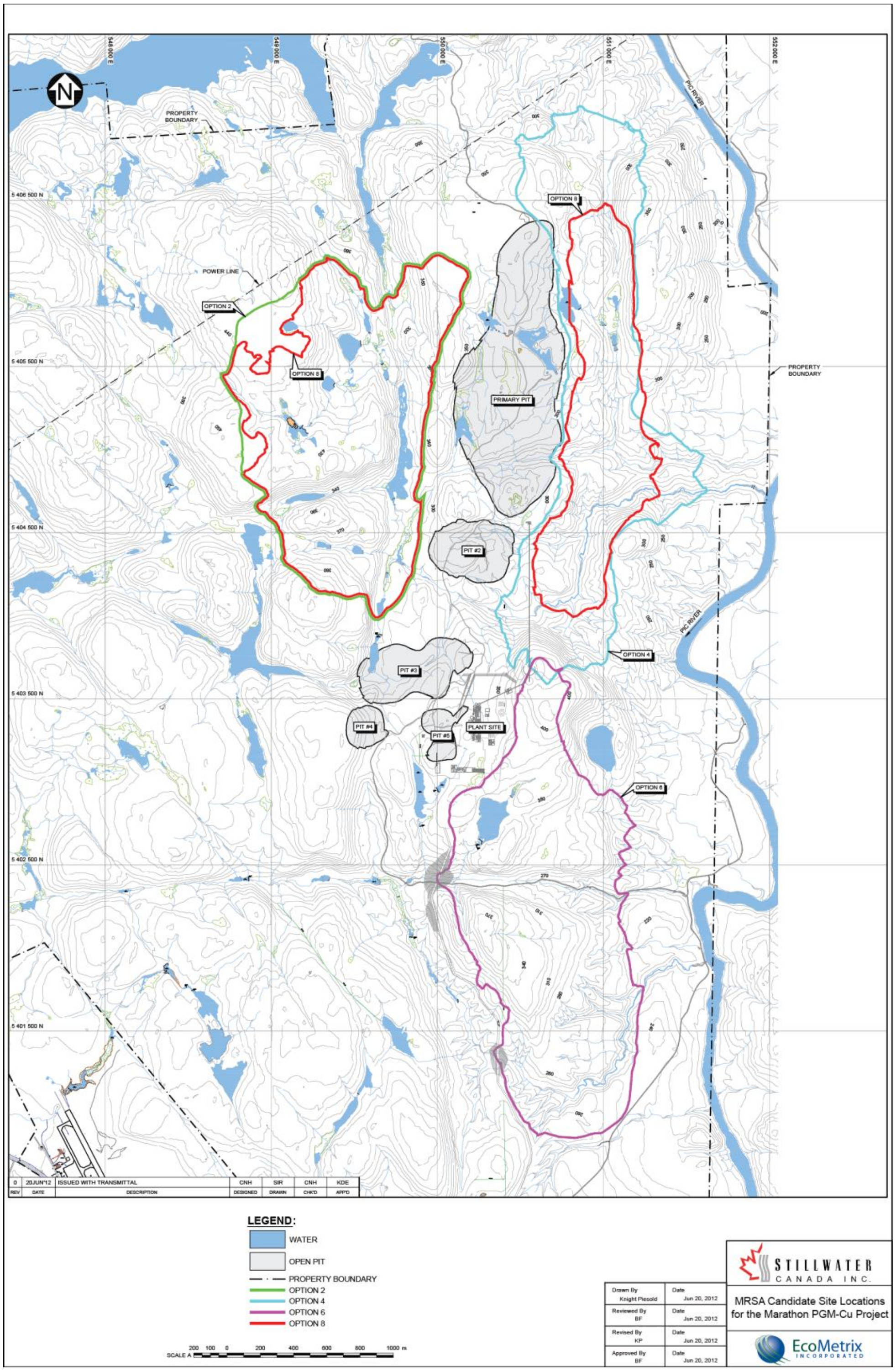


**Figure 3.3-1: MRSA Candidate Site Locations for the Marathon PGM-Cu Project**

### 3.3.3 Process Solids Storage

The evaluation of process solids storage alternatives has been completed on an ongoing basis concurrent with the development of the Project over the last number of years. Golder (2008) and AMEC (2009) identified as many as eight distinct candidate sites for process solids storage, including areas to the north, south and west of the ore body.

Both Golder (2008) and AMEC (2009) concluded that the area located directly west of the ore body, roughly defined by the limits of the upper reaches of the Stream 6 subwatershed and a small portion of the Hare Creek subwatershed to the south of Hare Lake, was the most appropriate location for process solids storage. This conclusion was based on consideration that the area afforded some natural storage potential, that the total volume of process solids that was anticipated to be generated through mine life could be accommodated there in a relatively small footprint thereby reducing disturbance to the surrounding environment, that water management requirements were more technically achievable and that it provides economic advantages due to its relative close location to the proposed mill site.

Knight Piesold (2012) advanced three potential storage options from the earlier work (Golder, 2008; AMEC, 2009), all of which were located to the west of the ore body as described above, for detailed assessment utilizing the same evaluation criteria listed above. The options were designated as: South Option PSMF; Improved Option 3 PSMF; and, Combined Storage Area PSMF (see Figure 3.3-2).

The results of the assessment indicated that the Combined Storage Area PSMF - a multi-cell PSMF approximately 350 ha in size, largely limited to the Stream 6 subwatershed – was the preferred PSMF option for the Project. This option had the highest rating scores for both environmental and socio-economic evaluation criteria, which offset the moderate ratings it received in relation to technical and cost factors.

As it pertained to environmental factors, Combined Storage Area PSMF ranked higher than the South Option and Improved Option 3 because it comprises a smaller footprint and has less effect on fish communities. As it pertained to socio-economic factors, Combined Storage Area PSMF scored higher than the other alternatives as it has lower potential for dust generation and is located entirely on SCI property. As it pertained to technical factors, Improved Option 3 was rated highest due to the lower material volumes required to raise its embankments (dams), though any of the three alternatives were deemed technically feasible. As it pertained to cost factors, Improved Option 3 was rated ahead of the other alternatives due the lower initial and ongoing capital costs associated with the embankment construction. Neither the Combined Storage Area PSMF, nor the South Option was deemed to be cost prohibitive.

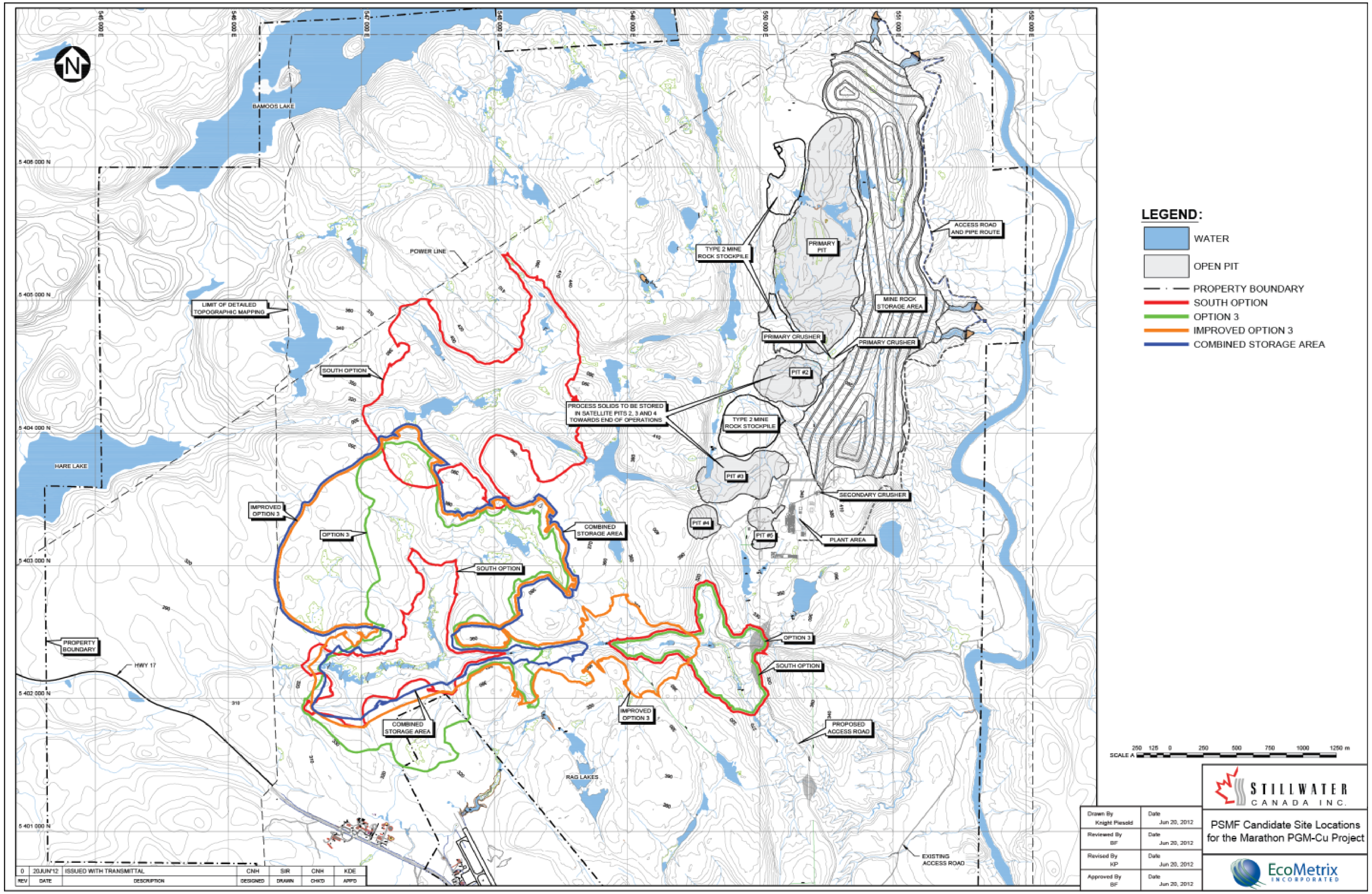


**Figure 3.3-2: PSMF Candidate Site Locations for the Marathon PGM-Cu Project**