SECTION 5.0

EXISTING ENVIRONMENT

5.0 EXISTING ENVIRONMENT

This section provides a summary of existing physical, biological and socio-environment baseline conditions as it relates to the proposed SCI Marathon PGM Copper Project.

5.1 Geology

Detailed information regarding regional and deposit geology, host material geochemistry and seismicity are provided by EcoMetrix (2012b, 2012d, 2012e) and MICON (2010). The following sections provide a summary of this information.

5.1.1 Work Scope

The geology within the study area is described in terms of the following components:

- geological components of the region and deposit;
- regional seismicity;
- mine material investigations; and,
- characterization of overburden, mine rock, and Type 1 (low-sulphur) and Type 2 (high-sulphur) process solids in terms of acid rock drainage and metal leaching potential.

Predicted pit water quality post-mine closure and the filling of the pits is also described in this section.

5.1.2 Regional Geology

The Marathon PGM-Cu deposit is hosted within the Eastern Gabbro Series of the Proterozoic Coldwell Complex, which intrudes and bisects the much older Archean Schreiber-Hemlo Greenstone Belt. The sub-circular complex has a diameter of 25 km and a surface area of 580 km^2 and is the largest alkaline intrusive complex in North America (Walker *et al*., 1993a).

The Coldwell Complex was emplaced as three nested intrusive centres (Centres I, II and III) (Mitchell and Platt, 1982) that were active during cauldron subsidence near where the northern end of the Thiel Fault intersected Archean rocks, on the north shore of Lake Superior (Figure 5.1-1). It is considered to be related to other intrusive complexes associated with the Mid-continental rift system, such as the Duluth Complex, Logan Sills, and Crystal Lake Gabbro, which were emplaced at around 1,108 Ma (Heaman and Machado, 1992).

The Eastern Gabbro forms part of a very large magmatic system and contains numerous Cu-PGM occurrences along its entire length. It is up to 2 km thick and strikes for 33 km around the eastern margin of the Coldwell Complex (Figure 5.1-2). It is considered the oldest intrusive phase of the Complex and is interpreted to have formed by at least three discrete intrusions of magma into restricted dilatant zones within a ring dyke possibly associated with ongoing caldera collapse (Walker *et al*., 1993a; Shaw, 1997).

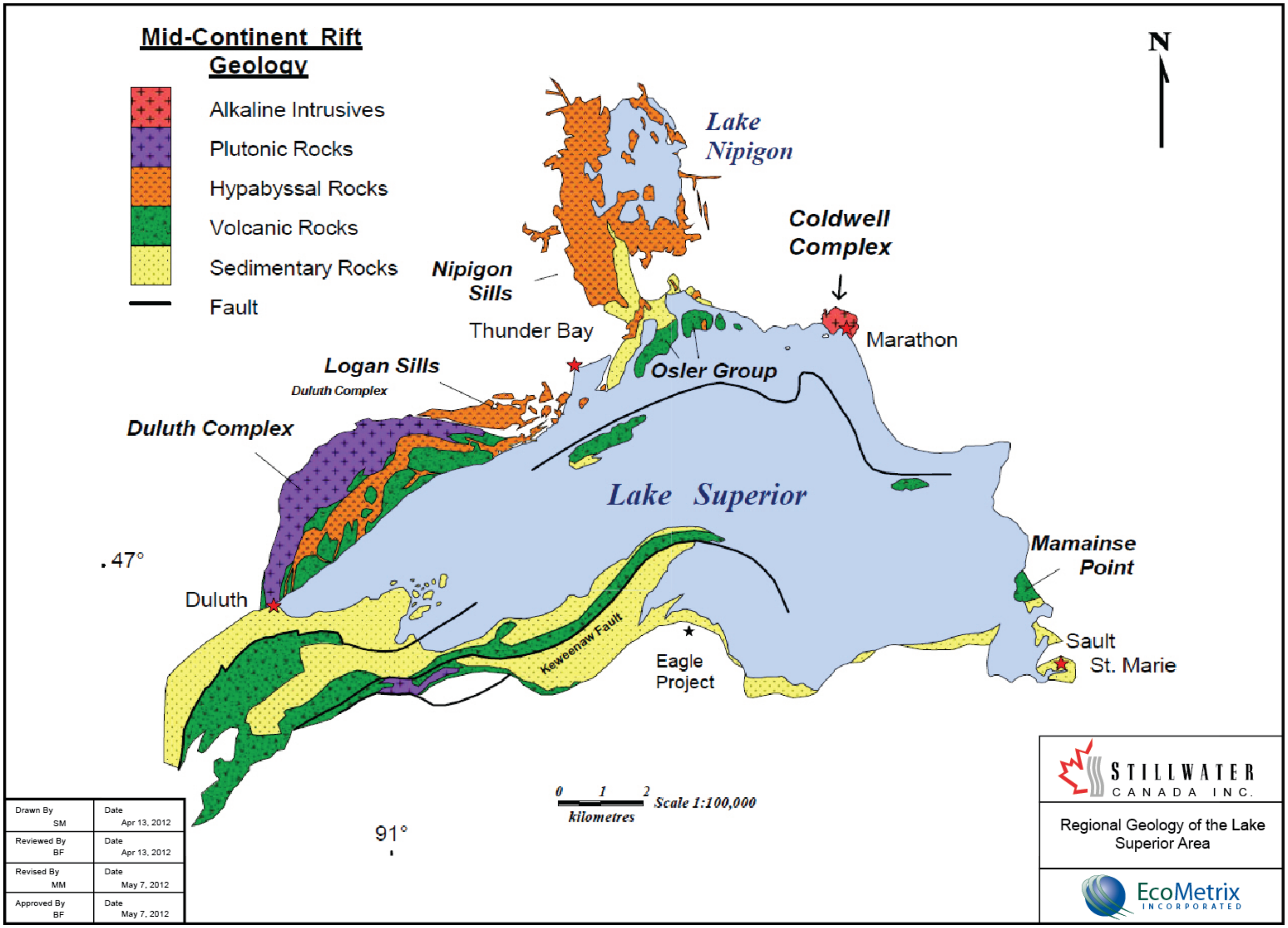


Figure 5.1-1: Regional Geology of the Lake Superior Area

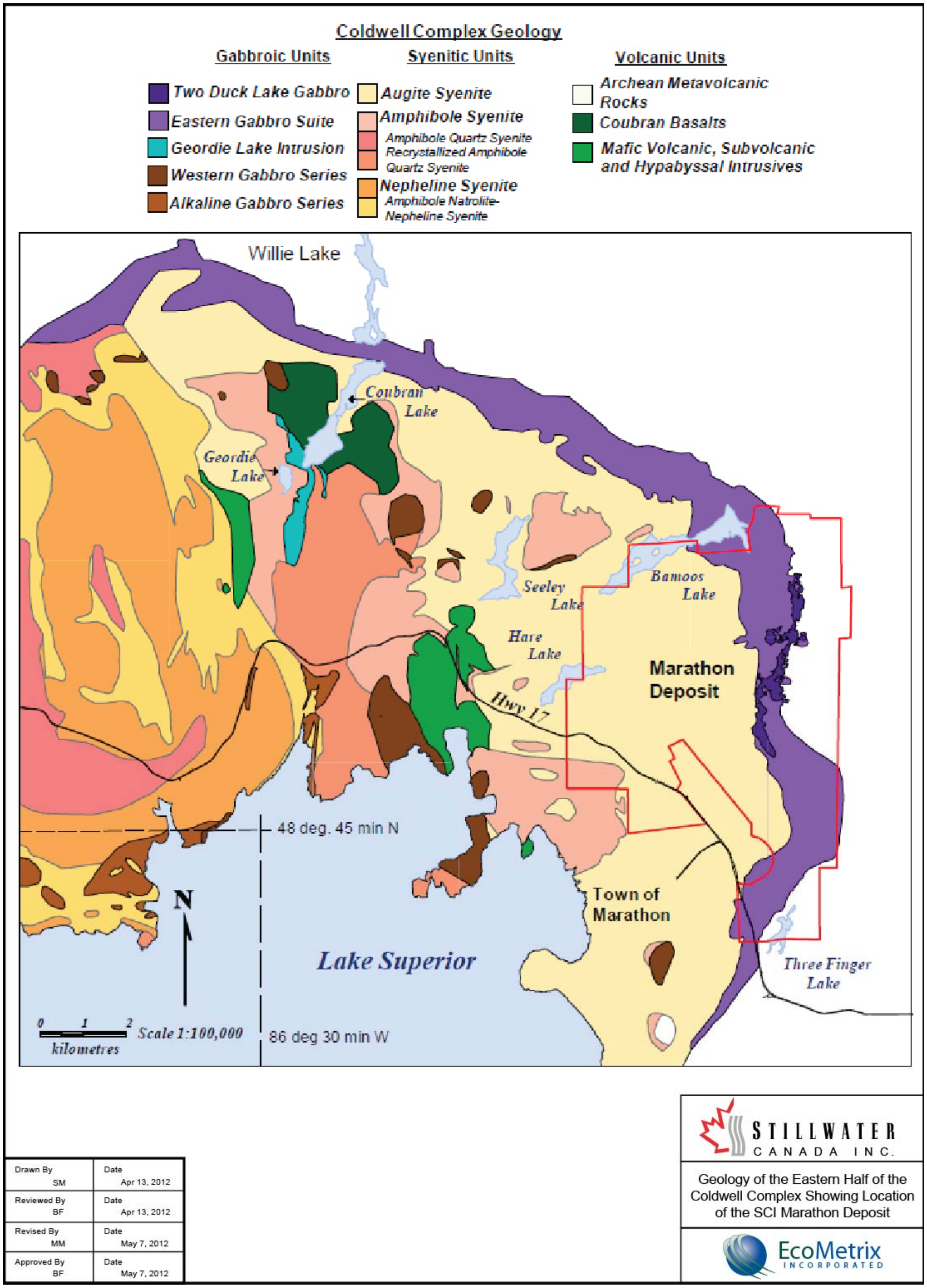


Figure 5.1-2: Geology of the Eastern Half of the Coldwell Complex Showing Location of the SCI Marathon Deposit

5.1.3 Deposit Geology

Mineralization at the Marathon PGM-Cu deposit is part of a very large magmatic system that consists of at least three cross-cutting intrusive olivine gabbro units that comprise the Eastern Gabbro Series of the Coldwell Complex (Figure 5.1-3). Figure 5.1-4 shows the scale and continuity of the Eastern Gabbro and the location of the Marathon PGM-Cu deposit in relation to the town of Marathon, Marathon Airport and Trans-Canada Highway. In order of intrusion, the three gabbroic units consist of: (1) Layered Gabbro Series; (2) Layered Magnetite Olivine Cumulate (LMOC); and, (3) Two Duck Lake (TDL) Gabbro. The relative size and abundance of the gabbroic units decrease in the order Layered Gabbro Series>TDL Gabbro>>LMOC. Late quartz syenite and augite syenite dikes cut all of the gabbros but form a minor component of the intrusive assemblage.

The TDL Gabbro is the dominant host rock for Cu-PGM mineralization and has been the focus of exploration. Additional accumulations of Cu-PGM mineralization are associated with LMOC and occur in the hanging wall of the deposit.

Previous work has suggested the three types of olivine gabbro are part of a single large layered intrusive complex with upper, lower and basal zones and the TDL Gabbro is the basal or contact phase of the Eastern Gabbro Layered Intrusion (Mainwaring *et al*., 1982; Good, 1993, Dahl *et al*., 2001, Crowe *et al.*, 2002; Barrie, 2002). However, the gabbro units clearly do not coexist as an orderly assemblage similar to other layered intrusions. Recent detailed mapping of exploration trenches shows the three gabbroic phases are crosscutting and, in the case of the LMOC and TDL Gabbro, form an anastomosing or bifurcating series of dikes or sills that cut the pre-existing gabbros. Only the TDL Gabbro occurs as a continuous and uninterrupted body and can be traced over a strike length of at least 6 km.

There are many striking similarities between the TDL Gabbro and the Partridge River Intrusion within the Duluth Complex, which is host to major Cu-Ni-PGM deposits (e.g., the Northmet Deposit in northeastern Minnesota). The relevant features described in both locales as discussed by Good and Crocket (1994), include similar ages (about 1,100 Ma) and tectonic origin (mid-continent rifting event), and composition and textures of gabbro and nature of sulphide mineralization.

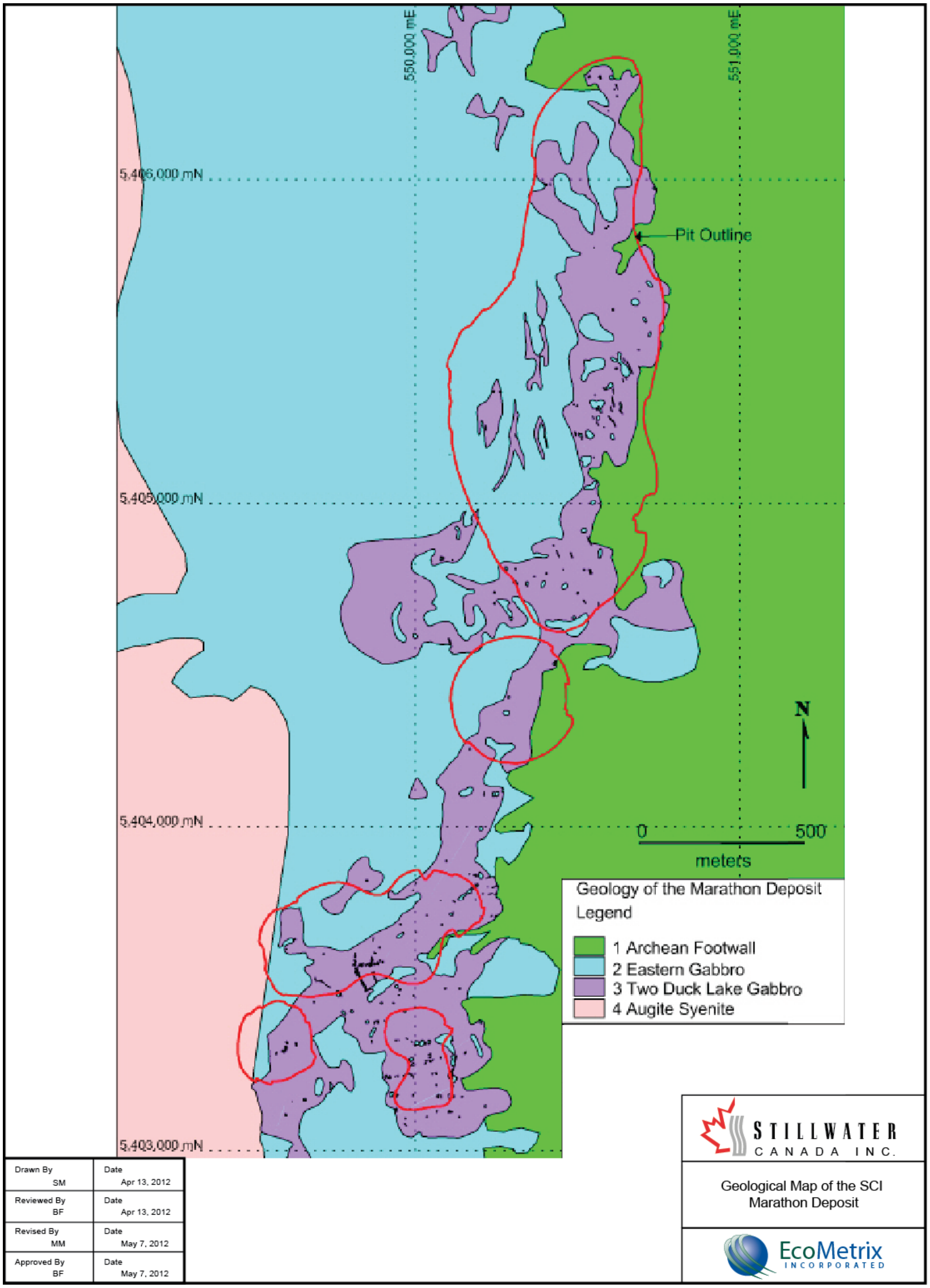


Figure 5.1-3: Geological Map of the SCI Marathon Deposit

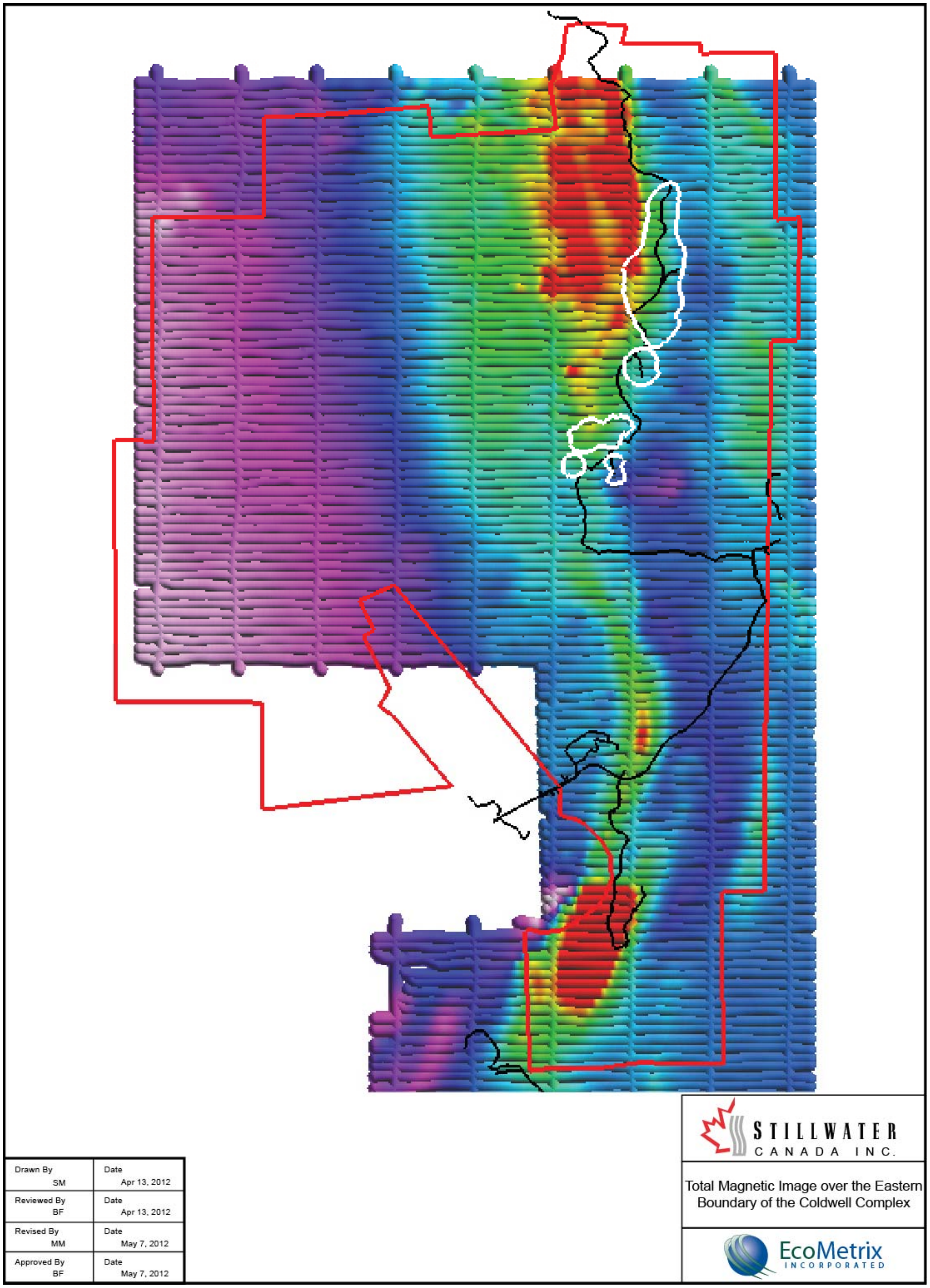


Figure 5.1-4: Total Magnetic Image over the Eastern Boundary of the Coldwell Complex

5.1.3.1 Footwall

The footwall of the Marathon PGM-Cu deposit is comprised of Archean intermediate pyroclastic rocks that have undergone partial melting as a result of the heat of intrusion of the Eastern Gabbro Series. At the contact with gabbro, the footwall is referred to as Rheomorphic Intrusive Breccia (RIB). The RIB/gabbro contact is not a simple contact, as blocks of RIB material occur within the gabbroic series and intrusions of gabbro extend deep below the footwall contact. Also, a few thin near vertical promontories of RIB extend into the gabbroic series. Locally, the footwall forms basins and ridges under the TDL Gabbro.

In a detailed study of the RIB, Abolins (1967) described the breccia as a matrix supported heterogeneous mixture of angular and sub rounded fragments composed of fine to coarse grained gabbroic material, quartzite, pyroxenite and layered quartz pyroxenite. A distinguishing feature of the RIB is the common occurrence of elongate curved pyroxenite fragments. Abolins estimated the composition of the breccia matrix to be close to that of a quartz norite.

5.1.3.2 Layered Gabbro Sheets

The Layered Gabbro Series forms the oldest and most diverse range of rock types in the Eastern Gabbro Series, but is composed predominantly of fine grained gabbro. The Series is up to 2 km thick, strikes near north and dips moderately to the west. At the base, fine grained gabbro is interlayered with footwall RIB and Archean pyroclastic rocks, and near the top it is intruded by syenite of Centre I magmatism of the Coldwell Complex. The diverse range of rock types within this sequence was described by Good (1993) and Shaw (1997).

The most abundant rock type within the layered series is fine grained gabbro. It consists of subhedral clinopyroxene, olivine and magnetite with interstitial plagioclase. Layering can be detected at the metre scale by gradational changes in grain size. Thin layers of massive magnetite up to 20 cm thick occur locally within fine grained gabbro. Contacts with other gabbro units are sharp. A common feature within fine grained gabbro, particularly close to intrusions of TDL Gabbro, is the formation of 1- to 2-cm sized zoned amoeboid shaped blebs with either a clinopyroxene or olivine core or a thin plagioclase rich rim. This texture is interpreted to have formed by heating during intrusion of the TDL Gabbro.

5.1.3.3 Layered Magnetite Olivine Cumulate

Layered Magnetite Olivine Cumulate (LMOC) occurs to the west of and stratigraphically above the TDL Gabbro and makes up less than about 5% of the relatively older and finer grained Layered Gabbro Series. Locally, the LMOC is cut by thin units of TDL Gabbro. Massive magnetite layers within the LMOC are commonly associated with disseminated chalcopyrite and minor pyrrhotite. They have been previously described as reef type accumulations of copper-PGM mineralization (Barrie et al., 2001).

The LMOC consists of alternating and gradational layers of medium to coarse grained magnetite and olivine cumulates with interstitial plagioclase. Magnetite cumulate layers, with up to 95% magnetite, range in thickness from several centimeters to tens of metres. The LMOC occurs as irregular and pod-shaped discontinuous units that strike north-south for a few tens of metres to up to 200 m and are interpreted to have intruded the predominantly fine grained Layered Gabbro Series.

5.1.3.4 Two Duck Lake Gabbro

The Two Duck Lake (TDL) Gabbro is the host rock for the Marathon PGM-Cu deposit. It occurs as a massive and poorly-layered unit approximately 50 to 250 m thick that strikes near north for greater than 6 km (see Figure 5.1-3) and, in general, dips west at angles from 5° to 45°. The TDL Gabbro intrudes Layered Gabbro Series, LMOC and the footwall RIB close to the basal contact of the Layered Gabbro Series. The TDL Gabbro is intruded by thin dikelets of RIB that are partial melt derivatives and, also, by late north-northwest trending quartz syenite dikes.

The TDL Gabbro is distinguished from other gabbro types in the Eastern Gabbro Series by cross cutting relationships and mineral textures resulting from the respective crystallization histories. In TDL Gabbro, plagioclase crystallized first and forms elongate laths that are surrounded by ophitic textured clinopyroxene or olivine, whereas in rocks of the Eastern Gabbro, olivine, clinopyroxene and magnetite crystallized first and the plagioclase is late and fills the voids between the cumulate minerals. Pegmatitic-textured TDL Gabbro occurs locally as pods within coarse grained gabbro or as rims on Eastern Gabbro xenoliths. Mineralized pegmatite makes up less than about 5% of all mineralized zones.

An important aspect of TDL Gabbro relative to other Cu-PGM deposits, such as at Lac des Isles north of Thunder Bay, is the fresh unaltered nature of primary minerals and textures. There is some local development of secondary minerals such as chlorite, serpentine and calcite, but only at the thin-section scale where original minerals are replaced.

There is only a minor fluctuation in mineral compositions across the TDL Gabbro (Good and Crocket, 1994). Plagioclase crystals are normally zoned with compositions between 65% and 52% anorthite and typically exhibit replacement at grain margins by a more calcic plagioclase (69-79% anorthite). The average olivine composition is 56.9% forsterite and contains 540 ppm Ni. Clinopyroxene and orthopyroxene lie respectively within the fields of augite and hypersthene with magnesium values between 0.6 and 0.7% MgO.

5.1.3.5 Breccia Units

The TDL Gabbro intruded by stoping its way along fracture sets or geologic contacts, such as the Eastern Gabbro/footwall RIB contact, and, thereby resulted in the anastomosing shape of the TDL Gabbro and numerous offshoots into the surrounding rock and, also, in the formation of thick brecciated units. The brecciated units consist of heterogeneous subangular blocks of Eastern Gabbro or footwall RIB. Hanging wall breccia units are typically comprised of Eastern Gabbro blocks in a matrix of TDL Gabbro whereas footwall brecciated units consist of footwall and Eastern Gabbro blocks. Brecciated units are usually associated with copper-PGM mineralization.

5.1.3.6 Sulphide Mineralization on the TDL Gabbro

Sulphides in the TDL Gabbro consist predominantly of chalcopyrite, pyrrhotite and minor amounts of pentlandite, cobaltite, bornite and pyrite. They occur in between primary silicates and, to a lesser extent, in association with secondary calcite and hydrous silicates such as chlorite and serpentine (Watkinson and Ohnenstetter, 1992). Chalcopyrite occurs as separate grains or as replacement rims on pyrrhotite grains. Some chalcopyrite is intergrown with highly calcic plagioclase in replacement zones at the margins of plagioclase crystals (Good and Crocket, 1994).

The sulphide assemblage changes gradually up section from the base to the top of mineralized zones. Sulphides at the base of the TDL Gabbro consist predominantly of pyrrhotite and minor chalcopyrite but the relative proportion of chalcopyrite increases up section to nearly 100% chalcopyrite near the top. In the W Horizon, sulphides consist mainly of chalcopyrite and bornite and minor to trace amounts of pentlandite, cobaltite, pyrite and pyrrhotite.

There is a relationship between mineralization and the paleotopography of the footwall contact. For example, mineralization is best developed within basins of the footwall and thins or pinches out above prominent footwall ridges (see Figure 5.1-5).

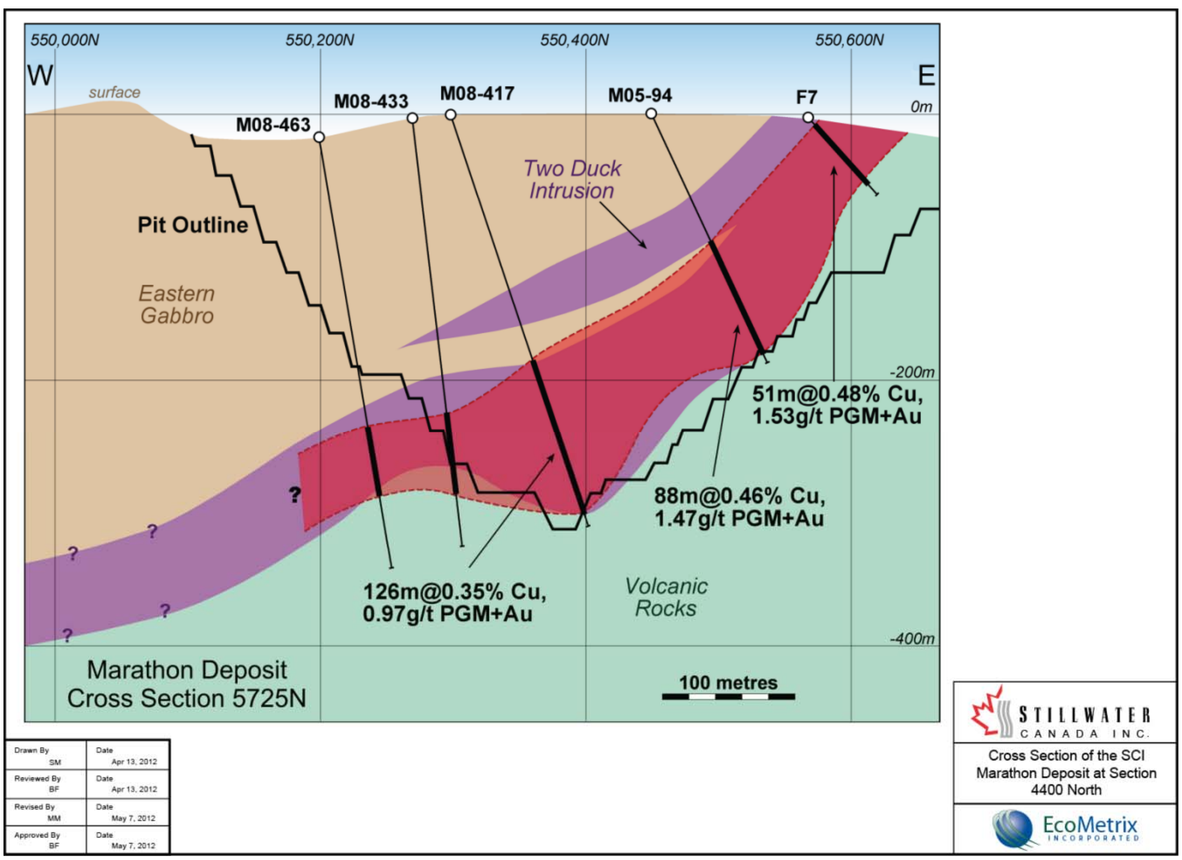


Figure 5.1-5: Cross Section of the SCI Marathon Deposit at Section 4400 North

5.1.4 Seismicity

The Geologic Survey of Canada identifies the Project area as being within a region of relatively low seismicity (Figure 5.1-6) (NRCan, 2011). The peak ground acceleration corresponding to the 1 in 2,475 year earthquake event was used for design. This value corresponds with the guidance in the Canadian Dam Association Guidelines (CDA, 1999) for a dam classified as high consequence.

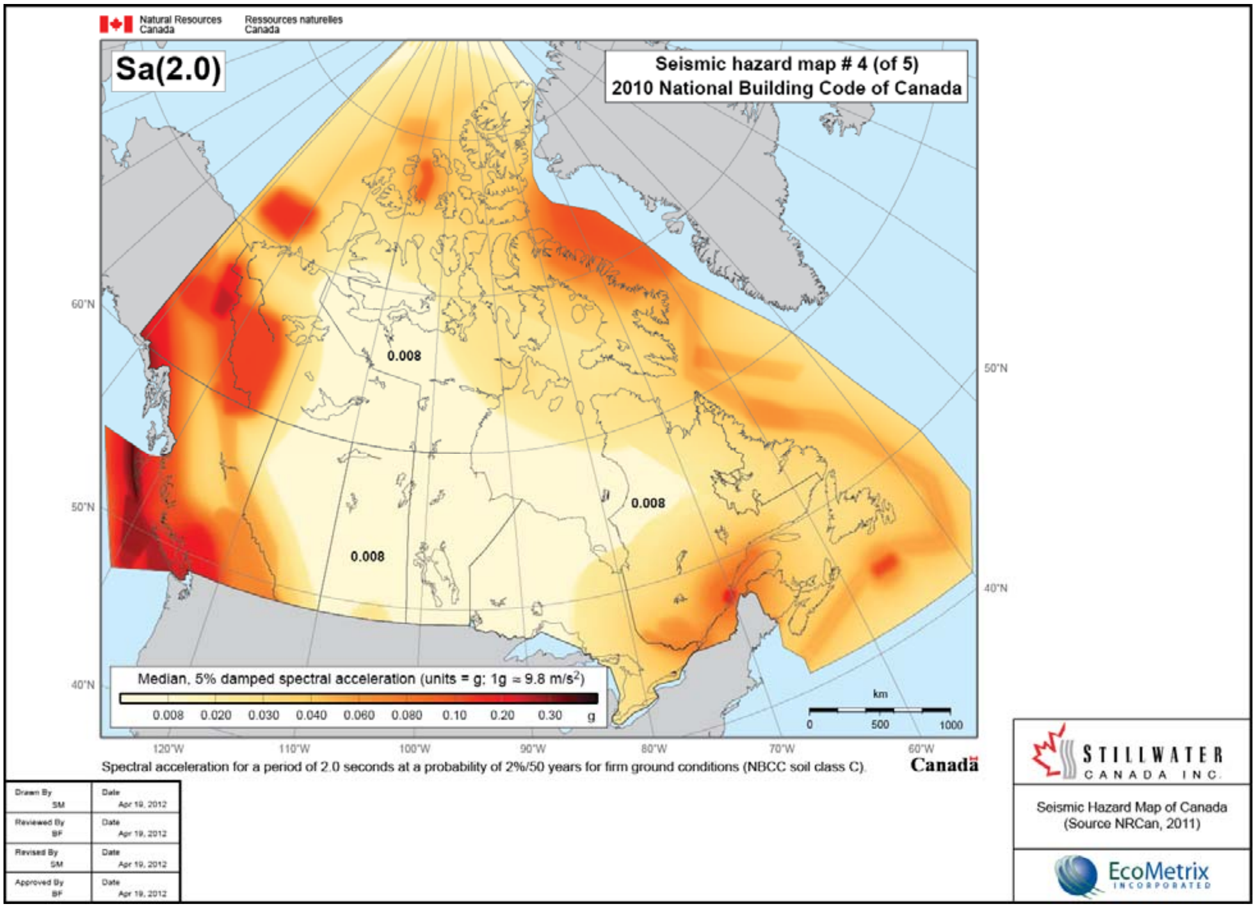


Figure 5.1-6: Seismic Hazard Map of Canada (Source NRCan, 2011)

5.1.5 Geochemical Characterization of the Marathon PGM-Copper Deposit Host Material

5.1.5.1 Chronology and History of ARD/ML Assessment and Investigations

Exploration for copper and nickel deposits on the Project site started in the 1920s and continued until the 1940s with the discovery of titaniferous magnetite and disseminated chalcopyrite occurrences. During the past four decades, the site has undergone several phases of exploration and economic evaluation, including geophysical surveys, prospecting, trenching, diamond drilling programs, geological studies, resource estimates, metallurgical studies, mining studies, and economic analyses. These studies successively enhanced the knowledge base of the deposit.

5.1.5.1.1 Past Mine Material Investigations and Characterizations

Exploration drilling at the project site has been extensive. Drill core samples have been analyzed for elements of economic interest and many samples have been analyzed for sulphur to develop a better understanding of the sulphide content of the ore zone and surrounding material that may be removed as mine rock. Environmental testing of the rock from the Project site was first reported in 2001 (B.C. Research, 2001) for former owners of the property, followed by additional work in 2005 (NAR, 2005) for Marathon PGM Corp. More intensive environmental evaluation that included static and kinetic testing was started in 2007 and reported by Golder (2008). The more recent investigations included a review and assessment of geology, chemical analyses of rock, including Acid Base Accounting (ABA) and the initiation of several kinetic tests that involved humidity cell testing on selected rock samples. A pilot metallurgical test by SGS in 2004 produced process solids that were also tested as part of the recent investigations.

5.1.5.1.2 Recent Mine Material Investigations

As part of the ongoing characterization of the Project site's materials, EcoMetrix carried out a number of different programs and investigations starting in 2008 to characterize the overburden, mine rock, process solids, and materials to be used for construction and other developmental purposes (EcoMetrix, 2012e). The various investigations to characterize the different materials were initiated to provide a baseline characterization of the materials and assess their influence on site management and water quality.

<u>Overburden</u>

Overburden samples were collected across the proposed Project site by EcoMetrix in 2009 and 2011 (EcoMetrix 2012b). Seven locations on the Project site were sampled in 2009 and 21 locations were sampled in 2011 by EcoMetrix. The samples represented areas from the proposed locations of the MRSA, the primary open pit, the satellite pits, and around the mill site. Knight Piésold (KP) also collected nine samples of overburden from geotechnical borehole locations around the perimeter of the proposed Process Solids Management Facility (PSMF). True Grit Consulting Limited (TGCL) collected five samples surrounding the Project perimeter for baseline characterization. These locations corresponded to sites at which baseline air quality sampling was completed.

All overburden and soil samples were characterized for their physical attributes and metal contents and a subset of samples were analyzed for ABA, nutrients, and were subject to shake flask extractions to evaluate leaching properties. A thorough and detailed baseline characterization and assessment of the overburden materials was completed by EcoMetrix (2012b).

Mine Rock and Process Solids

Marathon PGM-Cu initiated several investigations to assess the geochemistry and leaching behaviour of mine rock and process solids (commonly referred to as tailings) and to predict water quality associated with the various mine components. Preliminary investigations into the characteristics of mine materials and their influence on site water quality were initiated in 2007 and reported in Golder (2008). EcoMetrix completed a number of investigations since 2008 to further the geochemical assessment of mine materials (see EcoMetrix, 2012e). Additional investigations included humidity cell tests on low sulphur process solids, and column tests on submerged bulk and Type 2 process solids.

The objective of these investigations was to evaluate the geochemical characteristics of mine materials and to quantify constituent loadings from mine materials and components to assess water quality at the proposed mine. The rock types that will make up the mine rock during mining were identified and sampled in proportion to anticipated inventories. The evaluation included mineralogical and chemical characterization of the various rock types, static ABA, and kinetic studies on a selection of mine rock samples with varying chemical composition as well as process solids. Additional tests involved column tests with submerged materials, humidity cell tests, and short-term leach tests (SPLP). Scenarios were considered for the storage of mine rock stockpiled on-land, low-S (Type 1) process solids stored behind dams on-land, high-S (Type 2) processed solids stored below the water table and under water in a pond or flooded pit, and open pit rock walls. The various investigations were completed to allow an evaluation of water quality of the predicted effluent discharge and site drainage to the surrounding watersheds during operation and the quality of natural drainage from the site after closure and decommissioning.

Updated Programs and Assessments

In addition to the extensive characterization programs that have been implemented, there are a few ongoing studies that are progressing to reflect refinements of the milling process. The main focus of the ongoing work is to characterize the process solids and associated decant water from a 2011 metallurgical pilot plant, which has been optimized to improve concentrate recovery. The 2011 metallurgical process produced Type 1 and Type 2 process solids that are in the process of being assessed through both static and kinetic tests.

5.1.5.2 Geology and Relationship to Acid Rock Drainage (ARD) and Metal Leaching (ML)

5.1.5.2.1 Physical Descriptions

The different mine materials expected to be accumulated, disturbed, processed, and managed as part of the Project operation are described below for their physical characteristics, elemental contents, acid generating potential, and metal leaching.

Overburden Materials

The overburden material on-site is derived from coarse grained glaciolacustrine material and is composed of a variable mixture of sand, silt and clay. Soils in the region are classified as humo-ferric podzols, which typically develop on coarse-textured, stony, glacial tills and outwash and on glaciofluvial sand overlying acidic parent material. Overburden thickness was variable across the site and areas of exposed bedrock were common.

Mine Rock Materials

There are five different rock types that have been identified at the Project site and that will make up varying proportions of overall mine rock inventory during the LOM. A gabbro mine rock represents the largest proportion of mine rock to be generated on site and is represented by two different alteration types, namely the Eastern Gabbro and the Two Duck Lake Gabbro. The Eastern Gabbro is the largest source of mine rock that will have to be stockpiled and managed on site, followed by a small portion of the Two Duck Lake Gabbro. The other three mine rock types include a volcanic or footwall breccia or felsic basement rock, a gabbro breccia, and a syenite.

Ore materials

The ore, with the exception of syenite, will consist of the same rock types as mine rock, but in different proportions. The primary ore grade rock type is the Two Duck Lake Gabbro, which represents roughly 71%, followed by about 14% of the Eastern Gabbro and gabbro breccia. It is also estimated that approximately 1% of the volcanic footwall is of ore-grade quality.

Process Solids: Type 1 and Type 2

The processing of the ore materials in the mill will produce two different streams of process solids. The two different types of process solids are differentiated by both their relative proportion and average sulphur contents. The Type 1 process solids will be a low-sulphur material that makes up the majority (approximately 90 to 95%) of the process solids to be generated. The Type 2 process solids are a high-sulphur material that will be produced in much smaller quantities during the mill process and will represent the other 5 to 10% of the total amount of process solids produced. Based on 2009 metallurgical testing the Type 1 process solids will have an average total sulphur content of 0.15 %S and an average sulphide-sulphur content of 0.08 %S. The Type 2 process solids will have a total sulphur content of 6.7 %S and a sulphide-sulphur content of 6.1 %S.

5.1.5.2.2 Management of Materials

The ore deposit contains some sulphide minerals and therefore the mine materials have been assessed for their potential to generate acid and/or leach metals and other constituents. While the vast majority of mine materials will have low-sulphur content and will not be potentially acid generating, the results from extensive investigations and assessments indicate that a small portion of the mine materials have a potential to generate acid. The sulphide content is the primary indicator for differentiating which materials need to be specially managed. The sulphide content is the basis for designating both the mine rock and process solids as Type 1 or Type 2 materials. The specific management of each type of mine material to prevent acid generation and metal leaching, and hence to protect water quality, is addressed and explained in the following sections.

Construction/Borrow Sources

During site preparation and construction, small quantities of mine materials will be used for construction purposes, such as roads and infrastructure. The material to be used for construction purposes is mine rock that is excavated from the primary pit and satellite pits, and other onsite borrow sources as required. Type 1 material will be used for this purpose.

Overburden

All overburden that is disturbed and generated during the pre-operational and operational phases will be stockpiled and managed on-site. The primary areas where early earth works will generate overburden inventories are the primary pit and satellite pits, and the dam areas of the PSMF. There will also be small quantities of overburden materials that will be collected at the mill site.

The overburden that will be scraped away and excavated in the pit complex area will be stockpiled in this area. The overburden that will be disturbed in the footprint area of the dams of the PSMF will be pushed to the toe side of the dam and stockpiled there during operations. With the exception of the PSMF dam areas there, will not be any excavation of overburden within the overall footprint of the PSMF.

Based on the characterization of the soils and overburden at the Project (EcoMetrix, 2012b) there is little potential for the overburden materials to generate acid if stockpiled on land, and minimal risk of metal leaching. Slightly elevated levels of copper in short-term leach tests on a couple of overburden samples from the primary pit area suggest that some localized copper leaching may occur. Ultimately, during the post-closure phase the overburden material disturbed and stockpiled during operations can be used for reclamation purposes. Overburden characterization is further discussed in Section 5.1.5.4.1 below.

Type 1 Permanent Mine Rock Stockpile

The Type 1 mine rock materials have been defined by low-sulphur content, and as such are deemed suitable for on-land management and long term storage. The Type 1 mine rock material will be stored in the MRSA east of the primary pit (see Section 1.4.3.4.4). As described in Section 1.4.3.4.7, drainage from the MRSA will report to four subwatersheds that comprise the whole MRSA area. Water draining the MRSA will be collected via a series of settling ponds located along the MRSA toe. Any water discharged to the Pic River from the settling basins will be managed through a single discharge location and treated as necessary.

Type 2 Temporary Mine Rock Stockpiles and Long-Term Management

The Type 2 mine rock will be staged in three stockpiles located west of the pit complex, near the edge of either the primary or satellite pits. Since the Type 2 material has a potential to leach metals and to generate acid, the drainage will be directed to the pit complex, where it will be collected managed on site during operations through the PSMF. There will be roughly 20 million tonnes of Type 2 material temporarily stored during the operational phase (Knight Piésold, 2012). Long-term management of Type 2 mine rock will include relocation to the bottom of the primary or satellite pits where it will be covered with water and/or Type 1 process solids to prevent potential acid generation (see Section 1.4.3.4.4).

Type 1 Process Solids

The Type 1 process solids will be managed in the PSMF, as well as in the satellite pits later in mine life (see Section 1.4.3.4.5). The PSMF is designed to have two cells, Cell 1 and Cell 2, where Type 1 process solids will be managed during different stages of the operation. A detailed plan describing how the process solids will be managed and handled throughout the operational phase has been outlined by Knight Piésold (2012).

Type 2 Process Solids

The Type 2 process solids, with higher sulphur content, will be stored and managed in both the PSMF and in mined-out satellite pits later in mine life (see Section 1.4.3.4.5). The Type 2 process solids will be deposited and managed subaqueously to prevent acid generation and metal leaching. The Type 2 material will be covered with Type 1 process solids as a further level of protection. A detailed plan describing how the process solids will be managed and handled throughout the operational phase has been outlined by Knight Piésold (2012).

Temporary Ore Stockpile

A small inventory of ore will be stockpiled near the primary crusher to be fed to the mill process according to the production and processing schedule. The inventory of ore material temporarily stockpiled is assumed to be roughly five days' worth of feed or about 110,000 tonnes. The ore drainage will be managed by diverting the contact water to the pit complex, and from there to the PSMF for management and treatment, if necessary. The ore stockpile has been accounted for as an additional source of loadings during the operational phase and was assessed for its influence on the overall site water quality.

5.1.5.3 Mining Sequence

The proposed mining sequence of the pit complex is independent of the outlined management practices for the different types of mine materials that will be generated. The mining sequence does not affect material management plans and strategies because mine rock materials have been classified as either Type 1 or 2 and will be assayed and classified during mining for designation to the appropriate storage facilities. Since sulphur cut-off criteria have been proposed and thoroughly assessed, the management of rock is independent of the mine sequencing. Similarly, because the process solids will be produced and managed in two different ways, according to Type 1 and Type 2 characteristics, the mine plan will not influence the management of those materials throughout the LOM. Therefore the management plan to segregate materials according to defined sulphur content will allow dynamic management to account for and absorb any changes to the mine sequencing plan.

5.1.5.4 Overburden, Mine Rock, and Process Solids Programs and Objectives

5.1.5.4.1 Overburden

The overburden materials at the Project site and in some of the surroundings areas were characterized during baseline investigations to determine soil types, quality, and potential influences on the environment as a result of mining activity (EcoMetrix, 2012b). The areas of the Project that were investigated included the MRSA, pit complex, mill site, dam areas of the PSMF, and a number of locations at which baseline air quality was assessed.

The objectives of the overburden investigation were:

- to provide a general understanding of terrain, surficial soils and overburden characteristics within the Project footprint;
- to characterize baseline surficial soil chemistry at air quality sampling locations that may be used in the future to monitor the effects of fugitive air emissions from the site;
- to characterize overburden volume in areas where overburden will be removed; and,
- to describe the acid generation and metal leaching potential of overburden materials that will be excavated and subsequently stored to accommodate the construction of Project-related infrastructure on site.

Soil samples were analyzed for bulk chemistry, texture, and general parameters, such as moisture, carbonate ($CaCO_3$), and total nitrogen and phosphorus. Many of the overburden samples were also analyzed for ABA characteristics to assess the potential of acid generation. A select number of samples were subjected to short-term shake flask extraction tests using distilled water following the guidelines outlined in Price (1997, 2009). The leachate was analyzed for metals and other parameters, such as pH and acidity, to evaluate the key indicators of acid rock drainage (ARD).

5.1.5.4.2 Mine Rock

Environmental testing on mine rock in 2007 included a review and assessment of geology and chemical analyses of rock, including ABA (Golder, 2008). In total, 114 mine rock samples from 21 drill holes were collected and were considered to be spatially and lithologically representative of the mine rock that would be excavated during mining. Of 114 samples collected, 15 were considered to be ore grade material based on the net smelter return cut-off value of $10.50 and were not included in the final evaluations and calculations for mine rock destined for stockpiles.

Whole rock and bulk metal analyses were completed on all 114 samples. Eighteen samples of mine rock were subjected to net acid generating tests. Forty-one samples of mine rock material representing a range of rock types were subjected to short-term leach tests (Golder, 2008). The short-term leach test used a "modified" Synthetic Precipitation Leaching Procedure (SPLP) method to simulate what potential constituents were readily soluble in fresh rock samples. Ten samples representing a range of rock characteristics and sulphur contents were subjected to kinetic testing in humidity cells in order to quantify release or loading rates for constituents of potential concern (COPC).

An additional mine rock characterization investigation was subsequently designed and implemented to augment the geochemical database and further improve the understanding of the mine rock material according to lithology, depositional origin, and sulphur content (EcoMetrix, 2012e). The details of the mine rock characterization investigation and methodology implemented for sample selection are outlined in the following sections.

Examining Geological Cross Sections of Pits

A mine rock investigation was carried out to enhance the existing geochemical database and understanding by EcoMetrix in 2010. The 2010 mine rock investigation involved a review of over a 130 geological cross sections created by Marathon PGM Corporation in late 2009. An example of one of the geological cross sections reviewed by EcoMetrix is shown in Figure 5.1-7. The 2010 samples were selected specifically to represent mine rock outside of the ore zone but within the updated planned pit shell design based on net smelter return values, for which $10.50 was considered to be the ore- mine rock cut-off. The geological cross-sections represented east-to-west cross-cut sections of the pit complex at intervals of 25 or 50 m. Each cross-section displays net smelter return values, lithology according to borehole logs, along with copper contents and PGM contents. The program resulted in the selection and analysis of an additional 257 rock core composite samples collected in 2010 by EcoMetrix from existing drill cores. The composite samples were developed from 5 to 15 individual core fragment samples collected over 15 m intervals to represent a typical bench height. More than 2,400 individual samples were collected from rock cores drilled during the 2001, 2006, 2007 and 2009 drilling campaigns. The 200 composite samples were subjected to ABA and bulk metal analysis and 57 were subjected to total sulphur analysis to develop comparative statistics.

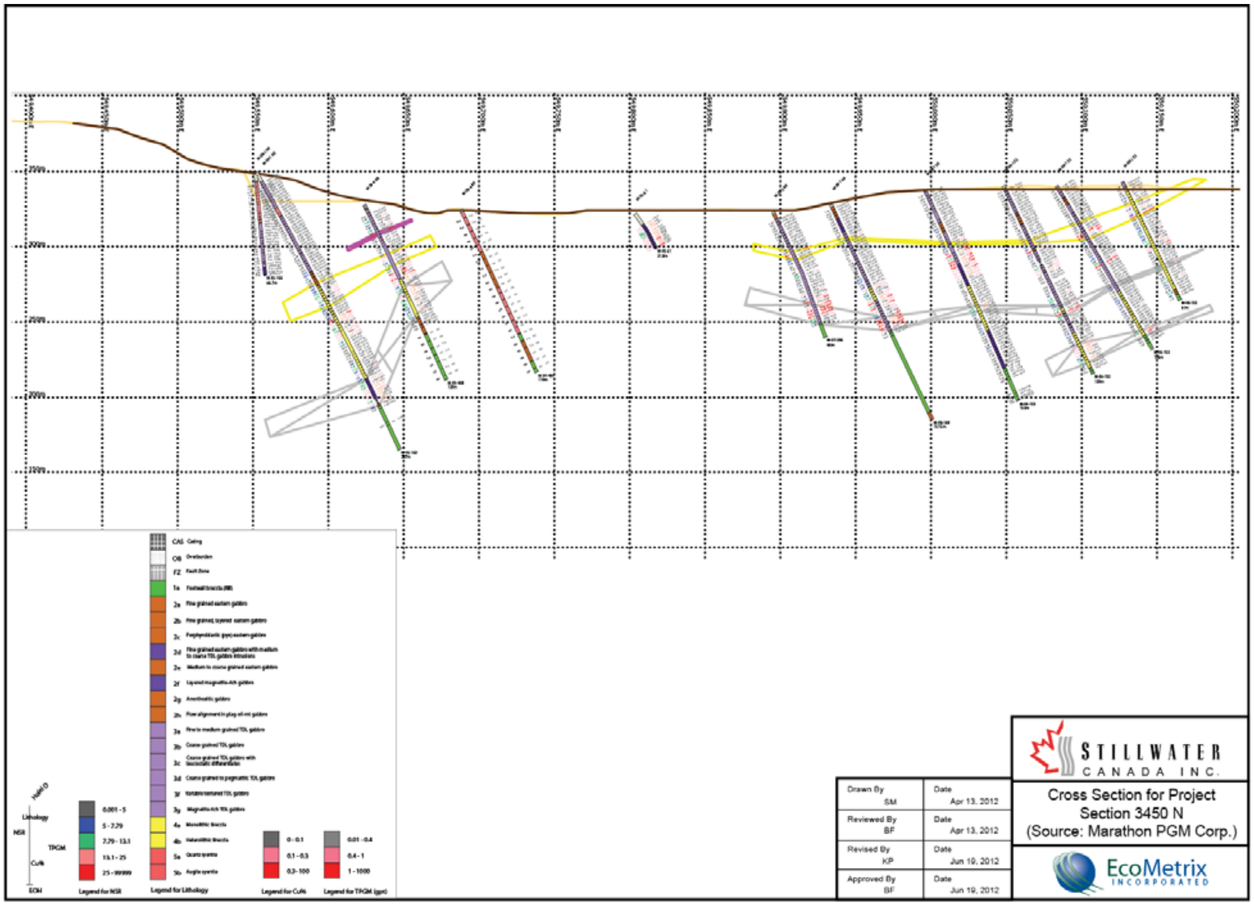


Figure 5.1-7: Cross Section for Project Section 3450 N (Source: Marathon PGM Corp.)

<u>Estimated Proportions of Mine Rock Types</u>

The estimated proportion of rock types in the mine rock stockpile were initially developed by Golder (2008) and were later updated by Marathon PGM Corporation (2009) based on additional drill core samples and updated information on the ore body and mineral deposits (Table 5.1-1). Estimates provided by Marathon PGM Corporation were based on more than 2,400 samples taken from drill cores from 2001, 2006, 2007 and 2009 drilling campaigns.

Table 5.1-1: Summary of Samples Collected for Static Testing and Estimated Percentages of Mine Rock

Rock Type	Number of Samples	Percentage of Total Samples	Estimated % of Mine Rock (Golder, 2008)[1]	Estimated % of Mine Rock (Good, 2009)[2]
Eastern Gabbro	57	50%	44-52%	70.45%
Two Duck Lake Gabbro	32	28%	27-29%	13.13%
Volcanic	10	8%	14-18%	10%
Heterolithic Breccia	6	6%	0.3-12%	1.42%
Syenite	7	6%	0.6-4%	5%
Serpentinite	2	2%	< 1%	<< 1%

[1] Estimated percentage of waste rock for each rock type was visually estimated using the available background information, including geology maps, core logs and cross-sections.

[2] The 2009 estimates were based on more updated and precise information. These percentages were used in the analysis of weighted averages for COPC and sulphur for total Mine Rock produced.

5.1.5.4.3 Process Solids

EcoMetrix assessed three types of process solids representing the different products from the mine milling process: bulk or non-segregated, Type 1 (low-sulphur), and Type 2 (high-sulphur) process solids. The bulk process solids evaluated were from an early mill process flow sheet, which has since been modified to produce only the two types of process solids, Type 1 and Type 2. Therefore, bulk process solids will no longer have to be managed, but rather only the two types of process solids that result from the sulphur separation and segregation process. However, since the bulk process solids were tested kinetically by subaqueous column tests, the results from that investigation were used to assess potential loadings from the submerged Type 1 process solids that will be managed in the PSMF. Since the sulphur content of the bulk process solids is higher than the Type 1 process solids, the estimate of loadings from submerged Type 1 process solids by using the bulk process solids results is considered to be conservative.

The bulk process solids sample was produced in a 2008 metallurgical test by Xstrata Processing Services (XPS). The bulk process solids refer to the material that will be produced after extraction of the economic minerals, but before sulphur separation. The Type 1 process solids were generated by G&T Metallurgical Services Ltd. (G&T) in Kamloops, B.C. using a bench-scale test conducted on a sample of the bulk process solids. The Type 2 process solids sample was a composite of materials produced during the G&T bench tests and a metallurgical test implemented by XPS in April 2010. The Type 2 process solids represent up to 10% of the bulk process solids and will be stored below the water table and covered to prevent acid generation and metal leaching.

The process solids samples were subjected to ABA and bulk metal analysis. Four humidity cell tests containing Type 1 solids were initiated in November 2009 to provide an understanding of long-term loadings from the Type 1 process solids. Column tests with submerged material were completed on the Type 2 process solids, as well as the bulk process solids. The submerged process solids column tests were designed to simulate the management of the Type 2 material that will be stored underwater.

Mill process water will report to the PSMF with each of the two streams of process solids. In the early stages of operation, the mill process water will report to Cell 1 of the PSMF, after which all mill process water will report to Cell 2. Cell 2 will also be the source of reclaim water for the mill process. Additional makeup water for the mill process will be pumped from Cell 1 to Cell 2 when needed. There may also be periods where excess water in the PSMF will require discharge. The excess water will be released from Cell 1 and will be treated, if necessary, before being discharged to Hare Lake. The water in Cell 1 will represent a combination of process water, pit water and local runoff. The quality of process water was assessed by considering water that had been produced during the SGS and XPS metallurgical test work in 2004 and 2008, as well as the decant water produced from the lock cycle test performed in March 2012 with the most recent mill flow sheet design.

5.1.5.5 Mine Materials Characterization

5.1.5.5.1 Overburden

The minimum, maximum, and average bulk-elemental content and ABA values of all the overburden materials sampled from the Project site are provided in Table 5.1-2. The overburden soils were generally slightly acidic, which is typical of podzolic soils. Overburden materials across the Project site were found to have low total sulphur and sulphide contents, and therefore have little to no potential for acid generation. The relationships between total sulphur content and sulphide and sulphate contents are illustrated in Figure 5.1-8. Sulphate content in soils accounted for the majority of the total sulphur content, which is likely explained by the presence of the mineral barite ($BaSO_4$). Carbonate levels in the overburden samples were relatively low suggesting that the overburden material has little neutralization potential. The total organic carbon contents (TOC) of the overburden materials generally accounted for the majority of the total carbon in each sample, as illustrated in Figure 5.1-9.

Table 5.1-2: Summary of Bulk-Elemental Content and ABA of Overburden Samples

Parameter	Units	Average Crustal Abundance[1]	Count	Average	Minimum	Maximum
Antimony (Sb)[4]	mg/kg	0.2	38	< 0.84	0.80	< 1.0
Arsenic (As)	mg/kg	1	38	1.6	< 0.5	6.2
Cadmium (Cd)	mg/kg	0.1	38	0.44	0.04	9.94
Cobalt (Co)	mg/kg	29	38	15.8	1.3	120
Copper (Cu)	mg/kg	75	38	30.0	4.3	406
Lead (Pb)	mg/kg	8	38	7.6	2.0	36.3
Manganese (Mn)	mg/kg	1400	38	716	58.0	5300
Mercury (Hg)	mg/kg	4	38	0.10	< 0.1	0.2
Molybdenum (Mo)	mg/kg	1	38	2.2	0.20	13.6
Selenium (Se)	mg/kg	0.05	38	0.93	< 0.7	1.8
Sulphur (S)	mg/kg	-	38	527	72	5350
Uranium (U)	mg/kg	0.91	38	0.53	0.23	0.83
Zinc (Zn)	mg/kg	80	38	451	8.8	15400
Paste pH	-	-	31	4.7	3.83	8.3
Total C	%	-	31	8.2	0.91	35.8
CO_3	%	-	31	1.3	0.013	16.1
TOC	%	-	31	7.5	0.005	34.1
Total Sulphur	%	-	31	0.09	0.005	0.18
Sulphate Sulphur	%	-	31	0.08	< 0.01	0.17
Sulphide Sulphur	%	-	31	0.01	0.01	0.02

Notes

1 - From Faure, Gunter. 1998. Principles and Applications of Geochemistry. Prentice Hall. New Jersey.

2 - Antimony was quantified with two different detection limits (0.8 and 1.0 mg/L); all samples analyzed were less than their respective detection limit

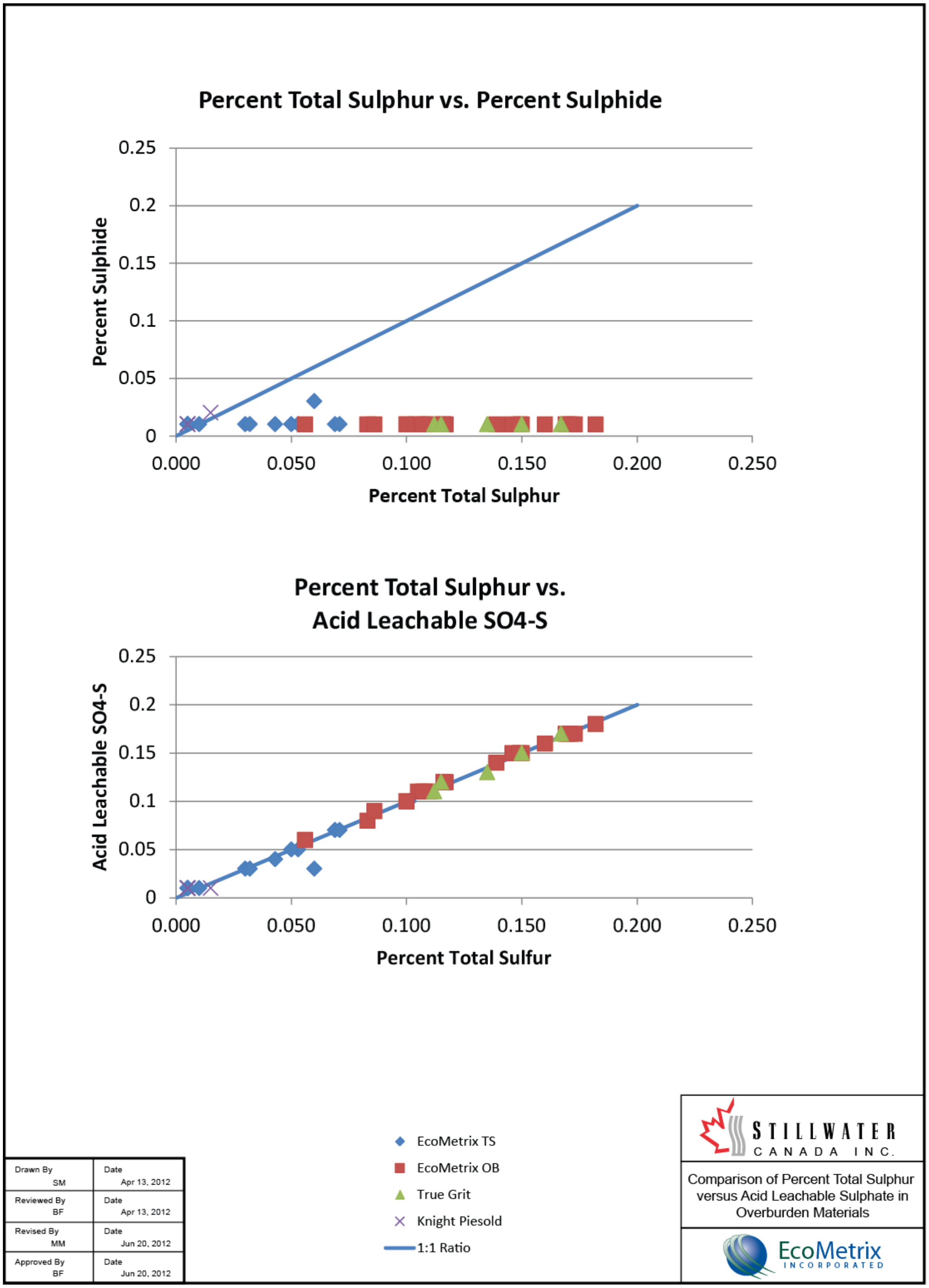


Figure 5.1-8: Comparison of Percent Total Sulphur versus Acid Leachable Sulphate in Overburden Materials

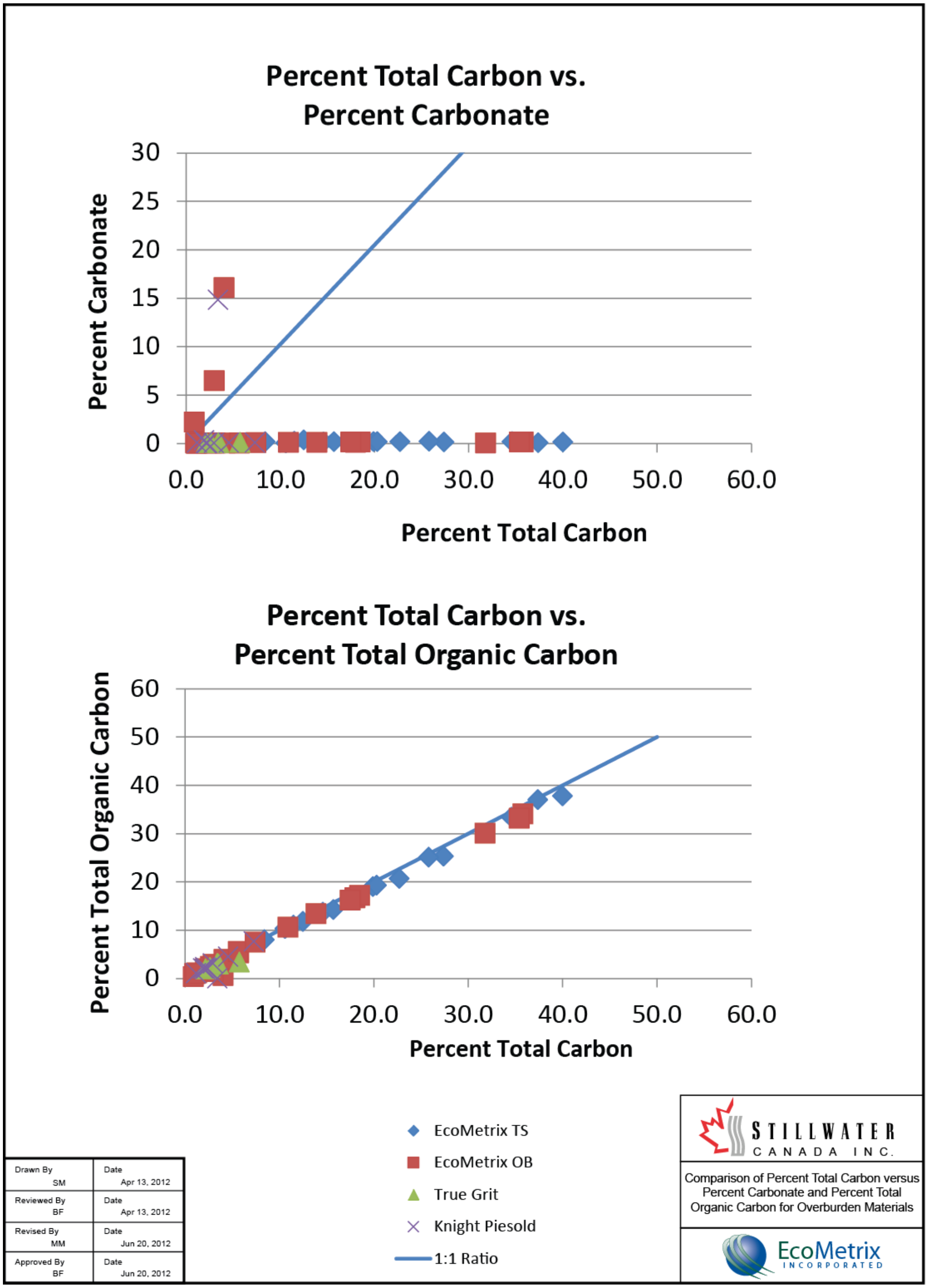


Figure 5.1-9: Comparison of Percent Total Carbon versus Percent Carbonate and Percent Total Organic Carbon for Overburden Materials

5.1.5.5.2 Mine Rock

Summary of Static Results

The sulphur contents of each of the mine rock types were determined by Good (pers. comm., Dave Good, Stillwater Canada Inc., 2010) (Table 5.1-3). The geometric and arithmetic mean weighted sulphur percentages for all mine rock samples analyzed were 0.052 wt. %S and 0.134 wt. %S, respectively. The geometric mean values were considered to be more representative of central tendencies for the sulphur contents as the data exhibited a log-normal distribution, which is common for chemical characteristics in natural samples.

Table 5.1-3: Average Sulphur Contents of Mine Rock Types

Rock Type	Geometric Mean Sulphur (%)	Arithmetic Mean Sulphur (%)
Eastern Gabbro	0.032	0.108
Two Duck Lake Gabbro	0.056	0.113
Volcanic (Footwall)	0.161	0.326
Heterolithic Breccia	0.118	0.208
Syenite	0.087	0.143

The ABA and bulk metal analysis results for the mine rock samples are presented in Table 5.1-4, where summaries are provided for the Type 1 and Type 2 mine rock. This table also shows a screening value for rock that represents values that are 10 times the average crustal abundance in the Earth's crust. The maximum copper content of mine rock is the only COPC that is greater than 10 times the average crustal content. The higher copper content in the mine rock is a reasonable finding given the nature of the ore deposit and region of copper mineralization.

Based on the ABA results of the rock samples, it was concluded that most of the mine rock will not be acid generating. The rock was considered to be not potentially acid generating if the neutralization potential (NP) was two times greater or more that the acid potential (AP) or the NP/AP ratio was greater than 2 (Price, 2009). It was estimated that approximately 7% of the mine rock material could be acid generating (Golder, 2008). Based on net acid generation testing, the majority of samples will not be acid generating, even in cases when the sulphide content exceeds 0.3 wt. %S, due to the presence of neutralizing minerals. The test results suggested that samples with sulphide contents greater than 0.5 wt. %S may have the ability to generate acidic conditions (Golder, 2008).

There were no large differences observed in the chemical characteristics of the various rock types. While rock types are sometimes important in understanding the geochemical behaviour of mine materials, the results of this investigation have demonstrated that sulphur content is the key characteristic that controls the important geochemical reactions related to acid generation and metal leaching in the Marathon PGM mine materials.

Table 5.1-4: Summary of Bulk-Element Content and ABA for Mine Rock Samples

Parameter	Units	10x Average Crustal Abundance[1]	Type 1 Mine Rock[2]				Type 2 Mine Rock[2]			
			No.	Geomean	Min	Max	No.	Geomean	Min	Max
Aluminum (Al)	%	84	279	2.2	0.3	11	20	2.8	0.76	8.2
Arsenic (As)	mg/kg	10	279	2.0	1	13	20	2.2	1	26
Cadmium (Cd)	mg/kg	0.1	279	0.3	0.0015	3.6	20	0.4	0.14	0.89
Cobalt (Co)	mg/kg	290	279	38.2	2	170	20	33.1	5	130
Copper (Cu)	mg/kg	750	279	125	4	2,130	20	430	15	6,300
Iron (Fe)	%	71	279	7.2	2.05	25	20	6.4	2.86	29
Molybdenum (Mo)	mg/kg	10	279	1.1	0.22	31	20	1.2	0.47	3.7
Nickel (Ni)	mg/kg	1,050	279	77.5	1	1,050	20	60.4	4.5	380
Lead (Pb)	mg/kg	80	279	2.9	1	66	20	4.3	2	12
Selenium (Se)	mg/kg	0.5	90	0.7	0.5	3	9	1.3	0.5	6
Uranium (U)	mg/kg	9.1	279	4.1	0.08	15	20	3.3	0.05	15
Vanadium (V)	mg/kg	2,300	279	162	1	1,600	20	125	19	1,600
Zinc (Zn)	mg/kg	800	279	74.2	18	280	20	64.8	24	280
Paste pH	---	---	279	9.43	8.10	10.2	20	9.24	8.20	9.8
Neutralization Potential (NP)	kg-CaCO3/t	---	335	31.0	0.38	120	21	30.4	15.5	66
Acid Generating Potential (AP)	kg-CaCO3/t	---	335	0.95	0.30	9	21	16.5	4.50	198
NP/AP Ratio	---	---	335	32.5	1.22	387	21	1.8	0.10	15
Total Sulphur	%	---	335	0.036	<0.01	0.29	21	0.63	<0.31	6.71
Sulphide Sulphur	%	---	279	0.025	<0.01	0.24	20	0.50	<0.14	6.34
Inorganic Carbon (C)[3]	%	---	279	0.11	<0.01	0.76	20	0.14	<0.05	0.86
NOTES:										
1 - From Faure, Gunter. 1998. Principles and Applications of Geochemistry. Prentice Hall. New Jersey.										
2 - Combined data of EcoMetrix (2011) and Golder (2008)										
3 - Represents carbonate content										

The ABA results of the 2010 samples (EcoMetrix, 2012e) were comparable to the 2007 samples (Golder, 2008) which suggest that the mine rock characteristics are very consistent. The data was therefore pooled for analysis. When material containing greater the 0.3% sulphide as S (Type 2) was excluded from the database, the geomean sulphide content of the remaining samples (Type 1) was 0.03% with a similar geomean for the total sulphur content of 0.04% or about a factor of ten less than the proposed cut-off of 0.3 %S. The NP/AP ratios had a geomean value of 32.5 for samples with a sulphide content less than 0.3 %S. Total sulphur content was found to be a good indicator of the sulphide sulphur content in Marathon PGM deposit, as shown in Figure 5.1-10.

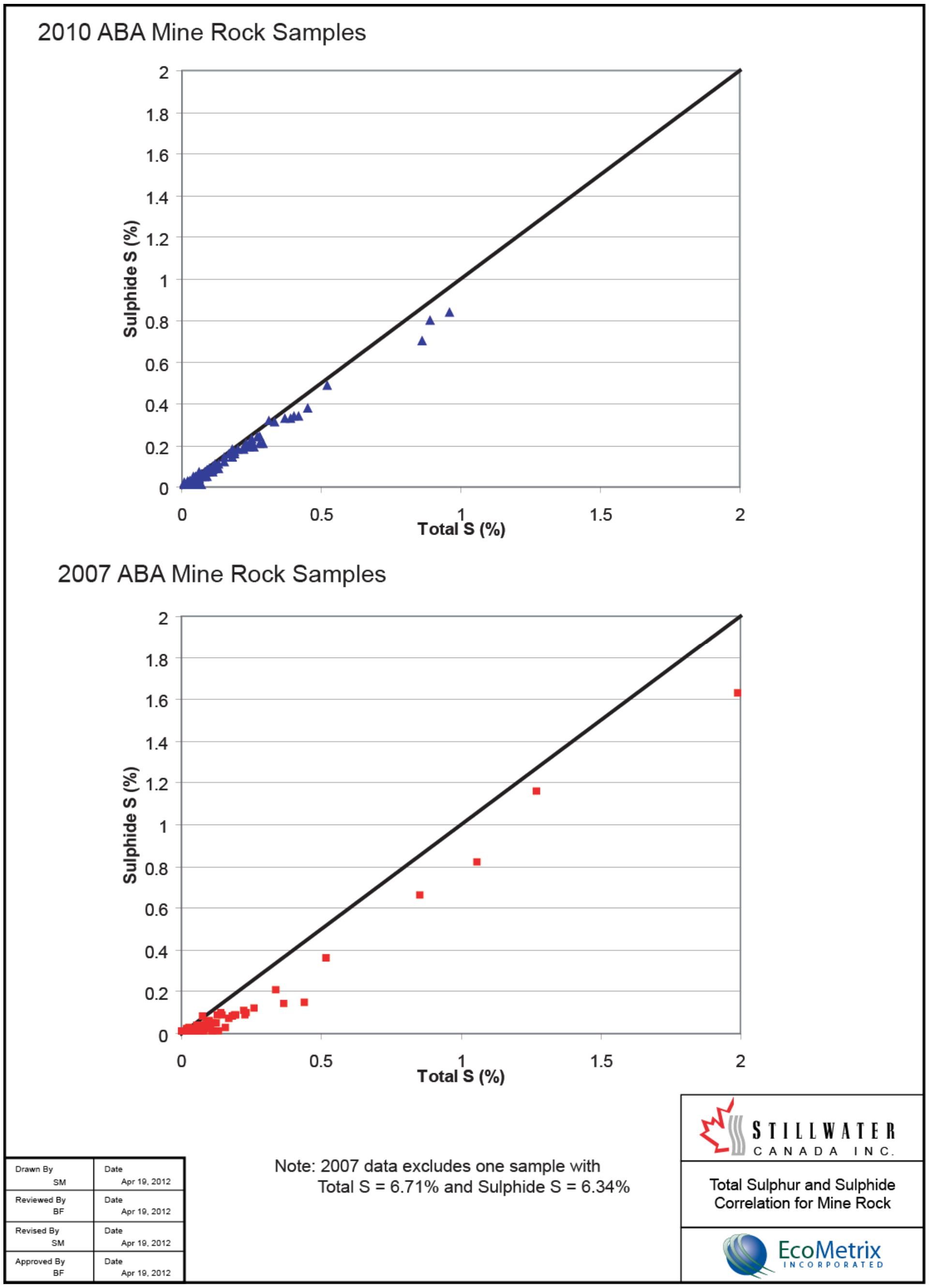


Figure 5.1-10: Total Sulphur and Sulphide Correlation for Mine Rock

Kinetic Tests

Kinetic tests focused on the on-land storage of mine rock with humidity cell tests to evaluate the leaching rates and constituent loadings of the mine rock material. The results from the humidity cell tests were evaluated to estimate loading rates for COPCs, which will later be used in the water quality predictions for the Project. In general, long-term steady-state loading rates were observed around week 20 for the mine rock materials tested, with the exception of the one syenite sample, which exhibited steady-state conditions by week 10.

The kinetic tests results were each assessed according to their classification of being either Type 1, Type 2, or ore material (as defined by the net smelter return cut-off), and were used accordingly to estimate loadings and water quality from those sources are they are managed on site. All humidity cells had circumneutral pH throughout the duration of testing, except for a very high-sulphur sample (6.71 %S), which exhibited pH depression to about a pH of 5 around week 130 of testing. The mine rock material tested showed a good direct correlation between total sulphur content and sulphate concentrations in the leachate. Additional discussion and interpretation of the humidity cell results and derived loading rates is presented below.

5.1.5.5.3 Process Solids

Summary of Static Test Results

Overall, both the ABA and net acid generation test results suggested that most of the bulk process solids material would not be acid generating if sulphur segregation were not to occur in the mill. However, it was conservatively concluded that there was a potential for some of the bulk process solids to be acid generating if sulphide minerals were not removed from the bulk solids (Golder, 2008). Therefore, options for sulphur segregation were investigated and sulphur separation tests were initiated at G&T Metallurgical on the bulk tailings samples that were produced in the 2008 metallurgical test program by XPS. Since then, a refined ore milling process has been developed in which sulphur segregation is part of the metallurgical process to produce the concentrates from the ore. The Type 1 (low-S) process solids are produced in the rougher-stream of the mill and the sulphide concentrate or Type 2 process solids are produced in the cleaner-stream of the mill process.

The water quality analysis of the process solids decant from the 2008 metallurgical tests showed that the dissolved concentrations of aluminum, chromium, iron, molybdenum and zinc were low but marginally greater than the PWQO values. The water quality of the mill process water was estimated by considering water that had been produced during the SGS and XPS metallurgical test work in 2004 and 2008 that produced bulk, non-segregated process solids. The average decant water analysis is shown in Table 5.1-5.

Table 5.1-5: Bulk Process Solids Decant Water Quality

Parameter	Units	PWQO[2]	Process Solids Decant Water[1]
pH	---	6.5-8.5	7.4
Conductivity	µS/cm	No Value	370
Alkalinity	mg/L	No Value	Not Measured
Acidity	mg/L	No Value	5
Dissolved Sulphate (SO_4)	mg/L	No Value	96
Dissolved Chloride (Cl)	mg/L	No Value	Not Measured
Dissolved Aluminum (Al)	mg/L	0.015 - 0.075 [3]	0.3
Dissolved Antimony (Sb)	mg/L	0.02	0.004
Dissolved Arsenic (As)	mg/L	0.005	0.001
Dissolved Barium (Ba)	mg/L	No Value	0.01
Dissolved Beryllium (Be)	mg/L	0.011 - 1.1 [4]	0.00051
Dissolved Bismuth (Bi)	mg/L	No Value	0.000505
Dissolved Boron (B)	mg/L	0.2	0.1
Dissolved Cadmium (Cd)	mg/L	0.0001 - 0.0005 [4]	0.000003
Dissolved Calcium (Ca)	mg/L	No Value	8.7
Dissolved Chromium (Cr)	mg/L	0.001	0.001
Dissolved Cobalt (Co)	mg/L	0.0009	0.00035
Dissolved Copper (Cu)	mg/L	0.001 - 0.005 [4]	0.00075
Dissolved Iron (Fe)	mg/L	0.3	0.3
Dissolved Lead (Pb)	mg/L	0.001 - 0.005 [4]	0.00055
Dissolved Lithium (Li)	mg/L	No Value	0.002
Dissolved Magnesium (Mg)	mg/L	No Value	1.8
Dissolved Manganese (Mn)	mg/L	No Value	0.02
Dissolved Mercury (Hg)	mg/L	0.0002	0.0001
Dissolved Molybdenum (Mo)	mg/L	0.04	0.06
Dissolved Nickel (Ni)	mg/L	0.025	0.003
Dissolved Potassium (K)	mg/L	No Value	10.6
Dissolved Selenium (Se)	mg/L	0.1	0.003
Dissolved Silicon (Si)	mg/L	No Value	3.8
Dissolved Silver (Ag)	mg/L	0.0001	0.00006
Dissolved Sodium (Na)	mg/L	No Value	69
Dissolved Strontium (Sr)	Bq/L	No Value	0.1
Dissolved Thallium (Tl)	mg/L	0.0003	0.0002
Dissolved Tin (Sn)	mg/L	No Value	0.002
Dissolved Titanium (Ti)	mg/L	No Value	0.002
Dissolved Uranium (U)	mg/L	0.005	0.003
Dissolved Vanadium (V)	mg/L	0.006	0.002
Dissolved Zinc (Zn)	mg/L	0.02	0.03
NOTES:			
1 - Average values of 2004 and 2008 Decant water samples			
2 - PWQO = Provincial Water Quality Objectives (MOEE, 1999)			
3 - pH Dependent			
4 - Hardness Dependent			

Short-term leach tests and analysis of the net acid generation test supernatant on the bulk process solids both indicated that there are several metals that would need to be monitored and evaluated for their potential effects on the overall water quality. Short-term leach testing suggested that leached metal concentrations for aluminum, silver, boron, cobalt, chromium, copper, iron, lead, vanadium and zinc were elevated and should be further evaluated. Additionally, the analytical results for the net acid generation test supernatant suggested that metals, such as aluminum, cadmium, cobalt, chromium, copper, nickel, zinc and to a lesser extent boron, iron, lead and thallium were elevated.

The ABA and bulk-elemental analysis results of the process solids are summarized in Table 5.1-6.

Table 5.1-6: Summary of Bulk-Element Content and ABA for Process Solids Materials

Parameter	Units	Bulk Process Solids	Type 1 Process Solids [2]	Type 2 Process Solids [3]
Aluminum (Al)	%	3.03	0.6	2.6
Arsenic (As)	mg/kg	N/A[1]	0.5	4.8
Cobalt (Co)	mg/kg	92	24	100
Copper (Cu)	mg/kg	161	95	1,800
Iron (Fe)	%	6.35	4.6	16
Molybdenum (Mo)	mg/kg	7	5.9	33
Nickel (Ni)	mg/kg	375	183	890
Lead (Pb)	mg/kg	5	1.8	11
Selenium (Se)	mg/kg	Not Analyzed	0.9	9.1
Uranium (U)	mg/kg	<10	0.3	0.79
Vanadium (V)	mg/kg	234	170	160
Zinc (Zn)	mg/kg	46	29	200
Paste pH	---	8.8	8.74	7.64
Neutralization Potential (NP)	kg-CaCO3/t	37	20.8	45.4
Acid Generating Potential (AP)	kg-CaCO3/t	15.9	2.5	191
NP/AP Ratio	---	2.32	8.91	0.24
Total Sulphur	%	0.51	0.14	6.68
Sulphide Sulphur	%	0.5	0.08	6.11
Inorganic Carbon (C)	%	0.13	0.12	0.39
NOTES:				
1 – Data not reported				
2 - Average of four Type 1 process solids samples				
3 - Composited sample of Type 2 process solid materials				

The bulk process solids contain about 0.5% total sulphur and sulphide-sulphur and have NP/AP ratios of 2. Results of the ABA analysis suggest that there is low risk of acid generation in the bulk process solids when no sulphur segregation occurs and material is stored on-land in contact with the atmosphere. However, when the bulk process solids were subjected to sulphur removal and segregation, the Type 2 process solids contained about 7% total sulphur and 6% sulphide-sulphur and the NP/AP ratio was less than 1. In general, the bulk-elemental contents of most COPCs are higher in the Type 2 process solids than those measured in the Type 1 process solids, which suggests that the COPCs are associated with the sulphide minerals. For example the bulk-copper content of the Type 2 process solids is more than 18 times more concentrated than in the Type 1 process solids.

The average total sulphur content of the Type 1 process solids was 0.14 %S and ranged from between 0.12 and 0.21 %S with sulphide-sulphur values in the range of 0.06 to 0.12 %S. All solids exhibited NP/AP ratios of greater than 5, ranging from 5.6 to 11.2. Materials with these characteristics are non-acid generating solids that can be stored in on-land facilities without risk of acidification.

Kinetic Results

The kinetic testing conducted on the different process solids materials, in the form of humidity cell and column tests, were used to assess the effectiveness of long-term management strategies and quantify the predicted influence on site water quality. The bulk process solids were tested both in humidity cells and in submerged column tests. The Type 1 process solids were tested by humidity cells, whereas the Type 2 process solids were tested by submerged column tests.

The pH of the overlying waters in the bulk process solids columns remained relatively neutral during steady-state conditions over 24 weeks of tests with values typically in the range of 6.0 to 7.5. Sulphate concentrations in the overlying column water during the steady-state period were about 25 mg/L and about 45 mg/L in each of the two column tests. The columns were run as duplicates. The concentrations of many COPCs including arsenic, cobalt, copper, lead, nickel, uranium and zinc were near or below reported detection limits in the overlying water for the duration of the test. These results reflect the geochemical stability of the bulk process solids when submerged in water. The results from the column tests were assessed to estimate the loadings of COPCs from the submerged solids into the overlying water.

The pH of the Type 1 leachate generally remained relatively neutral for the duration of the testing on the four samples, where after week 30 pH values were consistently between 6.5 and 7.5. Sulphate concentrations in leachate from all cells were initially high and subsequently decreased after about week 4 to values that approached steady-state with concentrations between 8 and 20 mg/L during the last 20 weeks of testing. The concentrations of other COPCs generally exhibited higher concentrations initially that also decreased to low and steady values after about week 4 of testing.

The pH of the overlying water in the Type 2 column tests was relatively neutral throughout the duration of the testing, where pH values remained between 7 and 8. Sulphate concentrations increased during the initial 10 weeks of testing from about 100 mg/L to a maximum of about 800 mg/L. Steady-state sulphate concentrations of 200 mg/L were observed beginning around week 20 of testing. Concentrations of many COPCs, including arsenic, cadmium, iron, lead, selenium and zinc were near or below detection limits after the start of the test, whereas concentrations of cobalt, copper, molybdenum, nickel and uranium exhibited increasing concentrations during the initial 10 weeks of testing. Relatively stable concentrations of all COPCs were observed from week 30 to the final sample analyzed at week 50. The result of increasing COPC concentrations during the initial testing period are consistent with oxidation of the sulphide minerals during dry storage in air prior to testing and the accumulation of soluble sulphate prior to flooding of the sample. However, long-term stable concentrations suggest that constituent loadings to the overlying water did reach equilibrium, which provided the basis to calculate loading rates for the submerged Type 2 process solids.

5.1.5.6 Acid Rock Drainage and Metal Leaching Potential

5.1.5.6.1 Overburden

As discussed above, ABA results indicate that the overburden material is not potentially acid generating. Results from the short-term leach testing indicate that leachate from the overburden has low dissolved concentrations of most COPCs. However, a couple of samples collected in the primary pit area had slightly elevated copper concentrations in the leachate with a maximum concentration of 0.025 mg/L. This elevated copper concentration is likely site specific, and is only an indicator of possible short-term drainage chemistry from stockpiled overburden material.

5.1.5.6.2 Mine Rock

Type 1 and Type 2 Loading Rates

Initial results from the “modified” SPLP testing suggested that several metals, particularly aluminum, boron, chromium, cobalt, copper, iron, lead, silver, vanadium and zinc, may have specific effects on the overall water quality of the site and should be carefully considered during further mine rock characterization work (Golder, 2008). All of these COPCs were carried through a more detailed assessment of water quality predictions in the EIS. It was also demonstrated by the metal analysis of the net acid generation test supernatant that constituents, such as aluminum, cadmium, cobalt, chromium, copper, nickel, zinc and to lesser extent boron, iron, lead and thallium, should also be evaluated and monitored as COPCs for the overall site water quality, these parameters were therefore included in the detailed water quality assessment.

Humidity cell data from mine rock tests were further reviewed and assessed by EcoMetrix (2012e). Based on the results of these tests, loading rates for each COPC for each type of mine rock material were quantified and used to estimate water quality concentrations. Laboratory loading rates were calculated for the Type 1 and Type 2 mine rock. The laboratory loading rates were generally calculated by using a weighted average of the loading rate for each rock type that is estimated to make up the mine rock inventory. However, for some COPCs an obvious correlation was determined between total sulphur content or bulk-metal content and loading rates, which was applied to determine the most representative loading rate for that constituent. For example, sulphate loadings were found to be directly correlated with total sulphur content. Therefore, the average sulphur content of the Type 1 mine rock was used in the correlation relationship to calculate the loading rate for sulphate.

The laboratory loading rates for both the Type 1 and Type 2 materials were then adjusted to field loading rates by accounting for differences in temperature and grain size. Temperature adjustments were made to account for differences in the kinetics of leaching rates between lab and field conditions. The laboratory loading rates were also adjusted for grain size differences between what was tested in the humidity cell and what will actually be generated during the mining operation. These two adjustment factors were applied to both the Type 1 and Type 2 materials that will be managed on site.

The field loading rates were then used in water quality predictions to calculate total constituent loadings based on estimated mine rock inventories for the permanent Type 1 MRSA and the temporary Type 2 stockpiles. The calculated loadings from each mine rock source were then evaluated with the site's water balance to make water quality predictions during operations and post-closure.

ARD Onset and Depletion Calculations

While the Type 1 mine rock has already been determined to be non-acid generating, there is a potential for the Type 2 mine rock to generate acid drainage. In order to determine if, and when, the Type 2 mine rock might go acidic, depletion calculations were completed based on sulphate leaching rates, total sulphide and ABA parameters, such as AP and NP values. The worst case scenario was investigated by calculating the NP depletion of the highest sulphide sample (6.3 %S) tested kinetically. The high sulphide Type 2 mine rock sample had a NP of about 20 kg $CaCO_3$/t, which translated to neutralization depletion in about 10 years. This calculation suggests that while some of the Type 2 mine rock material with the highest sulphide content may go acidic during operations, much of the Type 2 mine rock will have lower sulphide and higher NP, which will likely prolong the onset of any significant acid generation until operations have ceased. Nevertheless, the drainage from the Type 2 temporary stockpiles will be diverted to the pit complex for collection and management in the PSMF, as a precautionary measure.

5.1.5.6.3 Process Solids

Loading Rates

The kinetic results from humidity cell and column tests on the different types of process solids were used to calculate loading rates and mass-flux rates based on how the materials will be managed. The loading rates were then used to calculate the total mass of constituent that would be released to the site's water balance to predict water quality.

Bulk Process Solids

The flux rate (loadings per surface area) of COPCs from the bulk process solids to the overlying water column were calculated for the steady-state conditions that were observed in the two test columns. The concentrations of many COPCs in the overlying water were reported as below analytical detection limits meaning that the estimated fluxes will represent conservative maximum values. Initially the loading rates (mg/kg/wk) were calculated from mass balance calculations that included mass associated with samples collected for analysis to quantify weekly release rates. The loading rates were then converted to flux values ($mg/m^2/wk$) by dividing by the surface area of the submerged process solids to the overlying water interface. These fluxes were used to simulate the loadings from the Type 1 material that will be stored below water in the PSMF. The calculated mass load inputs to the PSMF were made according to the surface area of the PSMF in each cell that will be submerged. These fluxes and estimated mass loadings were used in making water quality predictions for the operational and post-closure periods of the Project.

Type 1 Process Solids

The laboratory loading rates for COPCs from the Type 1 process solids were estimated from the steady-state conditions exhibited during the humidity cell testing. The results for most of the COPCs are represented by concentrations in the leachate that were below analytical detection limits and therefore the estimated loading rates represent conservative maximum values. The loading rates from the four samples of Type 1 process solids that were subjected to humidity cell tests were then averaged to get a representative loading rate of the Type 1 material. The Type 1 laboratory loading rate was then converted to a field loading rate by accounting for the differences in field and laboratory temperature, which influence leaching kinetics. While the same conversion factor for temperature was used on both the mine rock and process solids, no conversion factor for grain size was applied to the process solids, as they are already representative of the grain size of process solids materials to be produced during operation.

Type 2 Process Solids

The mass flux rate of COPCs from the submerged Type 2 process solids was estimated from the average results of the two Type 2 column tests. Similar to the submerged bulk process solids, a mass loading rate was calculated from concentrations measured in time and then transformed into a flux rate ($mg/m^2/wk$) to assess the loadings that will come from the submerged Type 2 material. The results for some concentrations of COPCs in the column tests were reported as being at or below analytical detection limits therefore the estimated loading rates will conservatively represent maximum values. On the other hand, loading rates for sulphate, arsenic, cadmium, copper, molybdenum, nickel, selenium and vanadium were generally calculated from concentrations that are above detection limits.

The calculated fluxes for the submerged Type 2 process solids were not adjusted for temperature or grain size. The fluxes were used to assess and quantify the mass of constituent loadings that will report to the overlying water in the PSMF where the Type 2 process solids will be managed for most of the operational period. The mass loadings were then calculated according to the surface area interface between the submerged tailings and overlying supernatant pond. When the Type 2 process solids are later covered by the Type 1 process solids they are considered to no longer be a source of loadings to the water quality in the PSMF.

These fluxes are also assessed in the overall water quality predictions for the Project during both the operational and post-closure phases. During late-operation, Type 2 process solids will then report to the satellite pits for storage and management, which is discussed in the Pit Water Quality section, below.

5.1.5.7 Pit water quality

The pit water quality was predicted for both the operational and post-closure phases of the Project. The sources of mass loadings to the pit include the pit walls, rubble left on benches, Type 2 mine rock drainage, and a temporary ore feed stockpile. The water that will come in contact with these mass loading sources will all report to the pit, where it will be pumped out during dewatering and sent to the PSMF for management.

The pit water quality during operations was estimated by accounting for the loadings coming from the pit walls, rubble left on benches, Type 2 stockpiles, and ore feed stockpile. The loadings from the walls were estimated from the Type 1 mine rock loading rates, which are transformed from mass-rates (mg/kg/wk) to surface area-rates (mg/m^2/kg) by converting the mass of material used in the humidity cell tests to the surface area of material. This conversion was done by analyzing the grain size distribution of two samples of mine rock material tested in humidity cells, and then taking an average surface area for 1 kg of material to complete the transformation. The loading rate for the pit wall was also adjusted for temperature. A factor of five was also applied to the estimated total surface area of the pit walls to account for roughness and the presence of any cracks or factures. The inventory of the rubble left on benches was also estimated based on the total aerial surface area of the pit, where a 10 cm thickness was assumed to calculate the volume of rubble left on benches. The mass loadings from the total rubble inventory was estimated using the Type 1 mine rock loading rates, where the volume of rubble was converted to mass using a bulk density of 1.5 t/m^3. The loading from the Type 2 stockpile drainage was also accounted for by using the inventory estimates of the Type 2 material and corresponding field loading rate for each COPC. The last source of loadings to the pit during operations is the temporary ore feed stockpile, which has been assumed to hold approximately 5 days' worth of ore feed. Based on the average production rate of 22,000 t/d, about 110,000 tonnes of ore will be stockpiled near the primary crusher and adjacent to the pit to allow drainage to be diverted to the pit. The loading rate for the ore material, for purposes of evaluating loadings from the feed stockpile that report to the pit, was determined as an average of the three humidity cells that were classified as ore based on their net smelter return.

The pit water quality was then estimated during the post-closure phase, where the Type 2 mine rock has then been placed in the pit to be submerged below water and the ore stockpile is no longer present. The long-term pit water quality was estimated on the basis that the walls and rubble left on benches above the final water level before overflow are the only sources reporting to the pit.

Toward the latter stage of mine life, some Type 2 process solids and mine rock will be stored and managed in the satellite pits. The water quality of the primary pit and satellite pits will be evaluated to predict water quality during operations and post-closure. During operations all the pit water will report to the PSMF where it will be managed and treated, if required, before discharge to the environment. If pit water quality during post-closure is unacceptable for direct release the water will be managed and treated (e.g., bulk lime) before discharge.

5.2 Atmospheric Environment

Detailed information regarding existing atmospheric conditions at and around the Project site is provided by TGCL (2011a). The following sections provide a summary of this information.

5.2.1 Work Scope

The characterization of baseline climate, meteorology and air quality at the proposed Marathon Project site included the following:

- evaluation of Project, local and regional climate and meteorological data including temperature, relative humidity, wind speed, wind direction, precipitation, evaporation, solar radiation, and atmospheric pressure;
- review of incidences of weather phenomena, including tornadoes, lightning, fog and other extreme weather phenomena such as ice storms, extreme rain or snow events or hail;
- measurement of on-site dustfall, inhalable particulate matter (PM_{10}), nutrients in dustfall (sulphate, nitrate), and metals in particulates;
- estimation of Project, local and regional baseline air quality for other criteria air contaminants (CACs) including nitrogen oxides (NO_x), sulphur oxides (as sulphur dioxide, SO_2), carbon monoxide (CO), total suspended particulate (TSP), respirable particulate matter $PM_{2.5}$; and,
- presentation of baseline greenhouse gas emissions in Canada and Ontario.

Canadian Climate Normal data spanning 1971 to 2000 were obtained from Environment Canada for the communities of Geraldton, Sault Ste. Marie, Sudbury and Thunder Bay. Data consisted of 30 year averages for temperature, precipitation and snow depth. Local and regional climate and meteorological data for the period between 1996 and 2011 were obtained from Environment Canada for the Town of Marathon, Marathon Airport, Pukaskwa Park and Hemlo Battle Mountain. Data were comprised of temperature, relative humidity, wind speed, wind direction, snow-on-ground and atmospheric pressure. Historic local conditions were supplemented with data collected on the Project site in 2011 in conjunction with the air quality monitoring.

Evaporation and solar radiation data were obtained from the Hydrological Atlas of Canada and the National Archive System of the Meteorological Service of Canada, respectively.

Regional baseline ambient air quality data were obtained from Ontario MOE (OMOE) air quality reports and raw data from the closest monitoring stations in Thunder Bay to the west and Sault Ste. Marie to the east.

Baseline local concentrations of PM_{10}, dustfall, metals and nutrients were measured at a number of locations on and around the Project site in 2011 (Figure 5.2-1). PM_{10} was measured at three locations on the Project site. Dustfall was measured at five locations (four on and around the Project site and one within the Town of Marathon) for the months of August, September and October 2011. A literature search of provincial and federal GHG emission rates was completed to establish the GHG baseline levels.

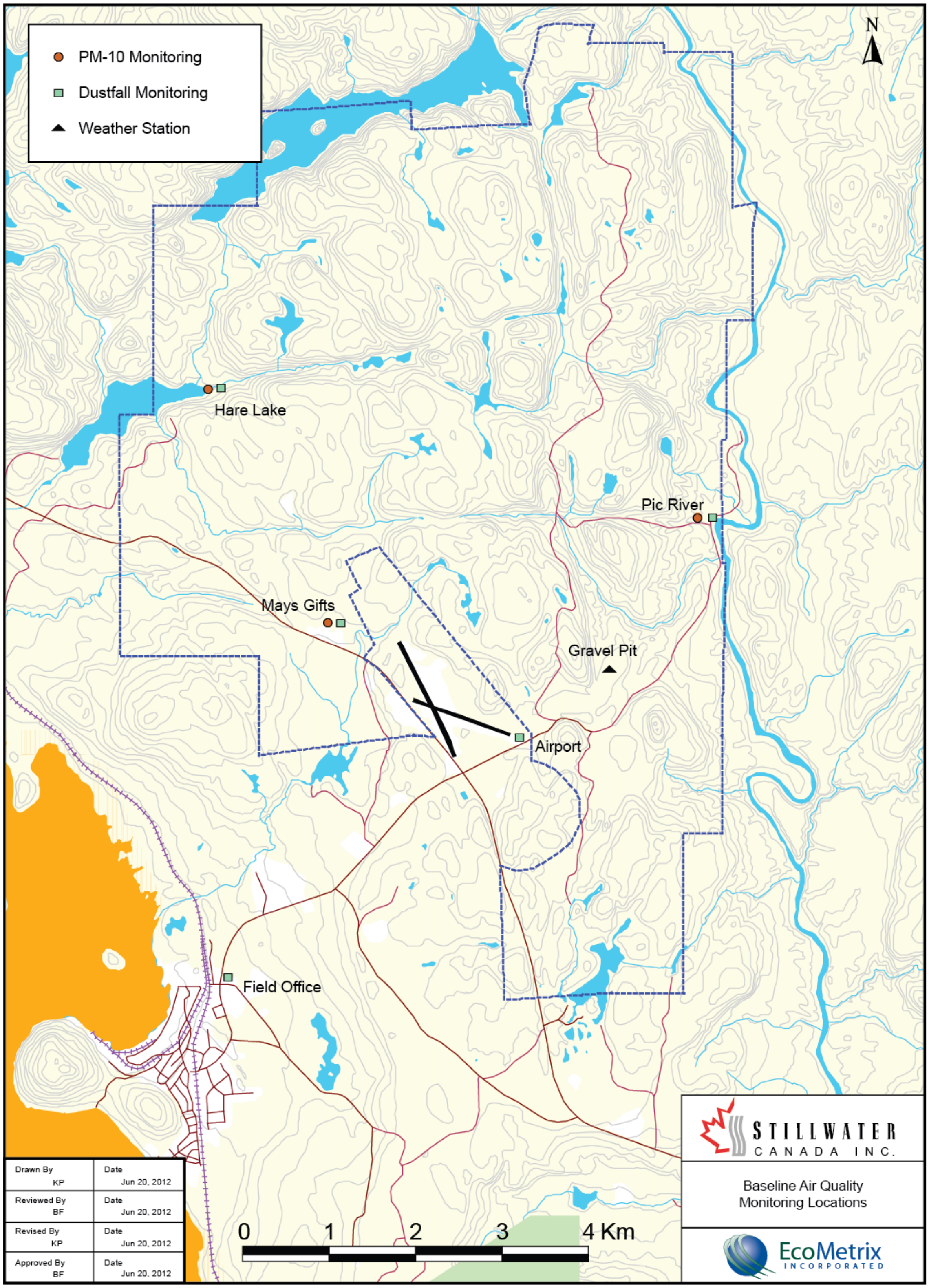


Figure 5.2-1: Baseline Air Quality Monitoring Locations

5.2.2 Existing Conditions

5.2.2.1 Climate and Meteorology

Within the EA context, climate conditions are important for the development of the water balance calculations for the Project and to calculate runoff conditions within and around the site. Temperature and wind conditions affect the assessment of fish and fish habitat as it relates to ice cover in the winter and dust transport around the site, respectively.

Climate and meteorology at the Marathon Project site is typical of northwestern Ontario. Marathon experiences cooler summers and warmer winters likely due to its proximity to Lake Superior compared to other more remote northern communities in northwestern Ontario.

Mean annual temperatures at the Project site are approximately 1.9°C, with extremes of 33.5°C and -43.0°C measured at the Marathon Environment Canada weather stations. Marathon temperatures tend to be cooler in the summer and colder in the winter than other nearby larger communities such as Sault Ste. Marie to the east and Thunder Bay to the west (Table 5.2-1).

Levels of relative humidity (RH) vary from 20 to 100%, with an annual mean of about 75%. Lake evaporation data was not available for the Marathon area but is estimated to be around 510 mm, based on available data from Atikokan, Ontario and other available mapping.

The Marathon area receives approximately 826.5 mm of total precipitation annually comprised of about 587.7 mm of rainfall and 238.1 mm of snowfall (Table 5.2-1). Incidences of particularly heavy snowfall (i.e., more than 10 cm in one day) have been reported on an annual basis along the north shore of Lake Superior since 1971 (approximately six to eight events).

The prevailing winds at the Project Site are typically from the northeast or the southwest, as shown in Figure 5.2-2. Summer winds tend to be dominated by southwesterly winds whereas winter winds are dominated by northeasterly winds. No differentiation was noted in the spring or fall. Mean wind speeds range from about 17 to 28 km/h, higher than what is typically measured across the region (Table 5.2-1), possibly resulting from influences from Lake Superior or the terrain on site.

Table 5.2-1: Summary of local and regional climate data

Parameter	Station		
	Marathon	Sault Ste. Marie	Thunder Bay
Temperature			
Mean Annual Temperature (°C)	1.9	5.2	2.5
Extreme Maximum Temperature (°C)	33.5	36.8	40.3
Extreme Minimum Temperature (°C)	-43.0	-38.9	-41.1
Relative Humidity			
Mean Annual Relative Humidity (%)	75.0	65.5 - 84.8	58.7 – 81.7
Evaporation			
Evaporation (mm)	510		
Precipitation			
Mean Annual Total Precipitation (mm)	826.5	888.7	711.6
Mean Annual Rainfall (mm)	587.7	634.3	559.0
Mean Annual Snowfall (cm)	238.1	302.9	187.6
Wind Speed and Direction			
Prevailing Wind Direction (Blowing From)	NE and SW	W	W
Mean Wind Speed (km/h)	17 to 28	13.3	11.7

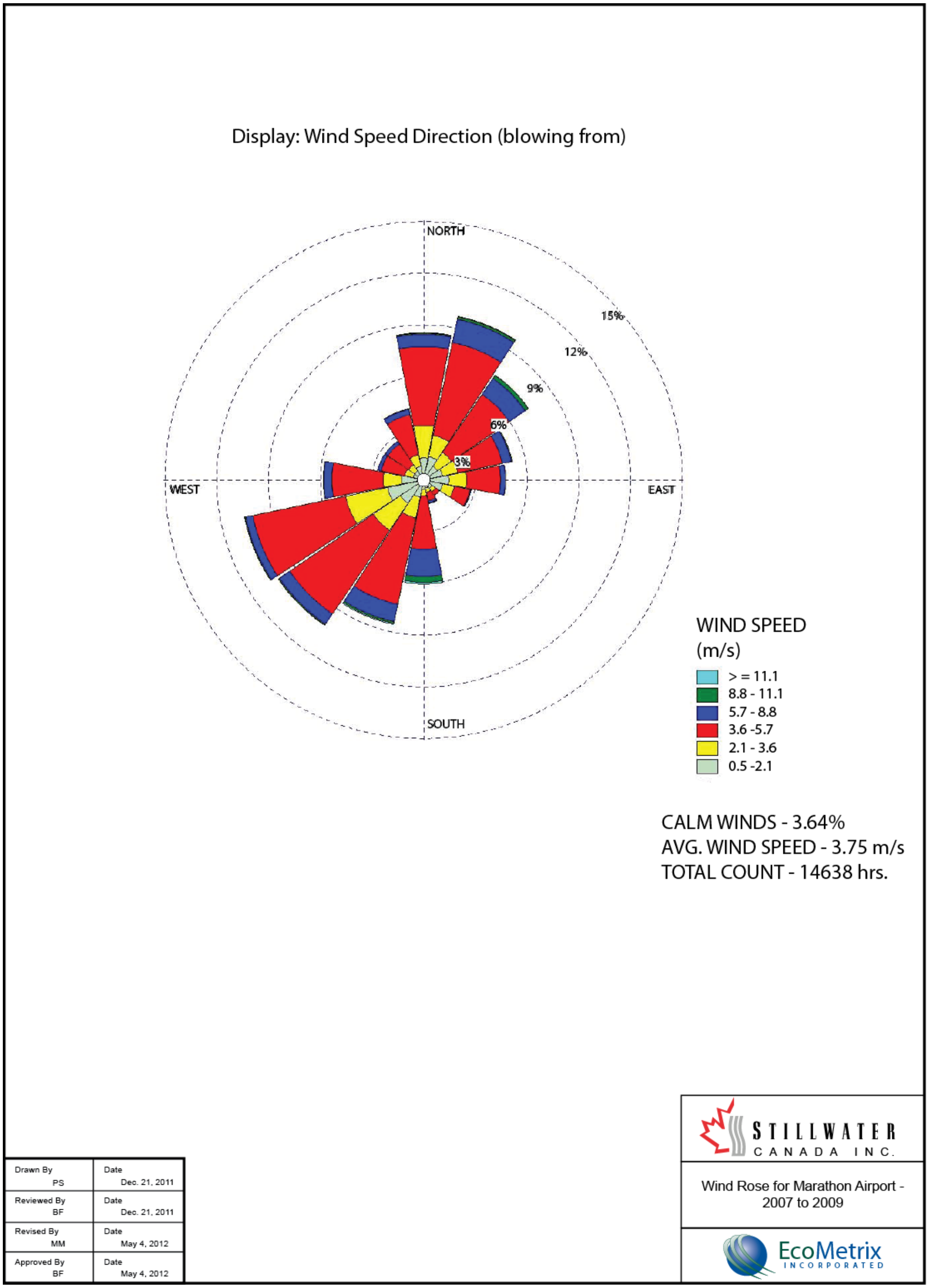


Figure 5.2-2: Wind Rose for Marathon Airport – 2007 to 2009

5.2.2.2 Weather Phenomena and Extreme Weather

Both NRCan[1] and Environment Canada[2] record no occurrences of tornadoes in the Marathon area. Moreover, based on local climate data collect at the Marathon Airport there were no reported damaging wind occurrences (gusts of > 90 km/h) for the Marathon area over the period 1979 and 2009 (TGCL, 2011a).

There are no documented instances of ice storms causing damages in the Marathon area for the period 1979 to 2009 based on climate data collected at the Marathon airport (TGCL, 2011a). The Marathon area is potentially susceptible to heavy snowfall events, with six to eight daily events per year with more than 10 cm of snowfall occurring between 1971 and 2000 (TGCL, 2011a).

Only one report of a potentially damaging hail occurrence was reported for the Marathon area between 1979 and 2009. Compared to southern Ontario where the range of incidences was from 1 to 50, the potential for damaging hail occurrences at the Project site is considered to be low (TGCL, 2011a).

According to Environment Canada records for the period 1999 to 2008, approximately 10 to 15 incidents of cloud to ground lightning are reported per year in the Project area (TGCL, 2011a). The incidence of lightning near the Project site is typical of northern Ontario and lower than the number of incidences observed in southern Ontario.

According to NRCan[3], no “major” floods occurred in the vicinity of Marathon that resulted in significant local or regional damage over the period 1902 through 2005. This fact was confirmed by officials for the Town of Marathon who confirmed that no major weather-related flooding has occurred in Town in the recent past (pers. comm. Brian Tocheri, CAO Town of Marathon).

Based on Environment Canada mapping for the period 1971 to 1999, on approximately 30 days per year visibility is reduced to less than 1 km due to fog. There were no incidents of fog resulting in visibility reduction to less than 1 km between 2007 and 2009, based on Marathon Airport data.

5.2.2.3 Air Quality

The Project site is located within a predominantly undeveloped area north of Highway 17, approximately 10 km north of Marathon, Ontario. With the exception of the Town of Marathon, Pic River First Nation and the Hemlo Gold Camp, located approximately 30 km east of the proposed site, most of the area is forested and undeveloped. As a result, air quality was expected to be good and unaffected by large industrial sources of atmospheric emissions.

[1] http://atlas.nrcan.gc.ca/site/english/maps/environment/naturalhazards/naturalhazards1999/majortornadoes
[2] http://www.ec.gc.ca/scitech/default.asp?lang=En&n=6A2D63E5-1&xsl=privateArticles2,viewfull&po=4008C164
[3] http://atlas.nrcan.gc.ca/auth/english/maps/environment/naturalhazards/floods/majorfloods

Sources of airborne contaminants currently present on site include several permitted gravel pits and the Town of Marathon sewage lagoons, in addition to ongoing exploration drilling being carried out by SCI. Regional influences on air quality include residential/commercial/institutional heating from the Town of Marathon, Pic River First Nation and nearby rural properties, fugitive emissions from traffic along Highway 17, fugitive emissions from airport traffic, and fugitive emissions from other nearby industrial sources, such as the Hemlo Gold Camp.

Between July and October 2011, TGCL measured ambient PM_{10}, dustfall, metals, sulphate and nitrate at various locations around the Project site, as shown in Figure 5.2-1 (TGCL, 2011a). A summary of measured airborne contaminant concentrations on the Project site is provided in Table 5.2-2. Estimated concentrations for $PM_{2.5}$, NO_x, SO_2, and CO were established from measured concentrations at monitoring stations in Thunder Bay and Sault Ste. Marie.

Table 5.2-2: Summary of Measured and Predicted Project Site Air Quality

Contaminant	Averaging Period	Marathon Project Site	MOE AAQC
Measured Air Quality Parameters			
PM_{10} (µg/m^3)	24 h	12.8 – 14.6	50
Dustfall (g/m^2)	30 d	0.33 – 1.44	7
Metals in Dustfall[1] (µg/m^2)			
Ba	day	<8.31 to 27.1	n/a
Cr	day	<1.66 to 6.29	n/a
Co	day	<0.332 to 0.614	n/a
Cu	day	<2.21 to 10.3	n/a
Pb	day	<0.831 to 3.2	n/a
Mn	day	<0.831 to 141	n/a
Ni	day	2.37 to 8.72	n/a
P	day	166 to 209	n/a
Sb	day	0.332 to 1.17	n/a
Zn	day	9.97 to 63.5	n/a
Hg	day	0.0565 to 0.33	n/a
Notes: All other metals were below laboratory method detection limits.			
Nutrients in Dustfall (mg/m^2/30d)			
Sulphate	30 d	79.1 to 161.4	n/a
Nitrate	30 d	8.5 to 27.18	n/a
Estimated Air Quality Parameters			
TSP (µg/m^3)	24 h	35 – 48	120
$PM_{2.5}$ (µg/m^3)	24 h	1 - 5	30
NO_x (ppb)	24 h	33.2	100
SO_2 (ppb)	24 h	3.25	100
CO (ppb)	24 h	0.83	30,000

Where Ontario MOE Ambient Air Quality Criteria (AAQC) criteria exist, measured concentrations were well below criteria. Metals concentrations in dustfall for the Project site were either non-detectable or below estimated regional background concentrations except for copper, nickel and zinc which were higher than regional background concentrations. This may be due to fugitive dust emissions from nearby Highway 17 or on-site activities such as gravel pit extraction and travel on unpaved roads which occurred during the testing period.

Levels of sulphate and nitrate deposition were also measured on site and, when converted to units of eq/ha/year, are less than the 50th percentile critical loads (CLs) for Ontario of 832 eq/ha/year. Critical loads outline the amount of acidifying deposition that the environment (aquatic and terrestrial) can receive without anticipated adverse effects. Calculated on-site values are considered conservative since the neutralizing potential of base cations was not taken into account.

In addition, baseline concentrations of dustfall, metals, sulphate and nitrate may also be elevated relative to annual averages since data is based on testing that occurred between August and October 2011 and does not take into account periods when fugitive dust would be expected to be lower, such as the winter months when areas are covered with snow.

For all remaining contaminants of concern, concentrations were estimated based on published air quality data for the region (i.e., for Thunder Bay and Sault Ste. Marie). Estimated values are considered to be conservative for the Marathon Project site since both Thunder Bay and Sault Ste. Marie are communities much larger than Marathon and ambient contaminant concentrations would be expected to be higher in the larger centres. Concentrations of all predicted concentrations were well below published OMOE AAQC criteria.

5.2.2.4 GHG Emissions

GHG emissions for Ontario and Canada for the years 1990 and 2004 to 2008 are presented in Table 5.2-3. The Canadian total GHG emission estimates up to 2008 were documented by Environment Canada (National Inventory Report, 1990-2008). GHG emissions increased between 1990 and 2004. Between 2004 and 2008, GHG emissions have fluctuated with no real trends.

Table 5.2-3: National and Provincial Greenhouse Gas Emissions

Year	GHG (CO_2e) Emissions (kT/y)			
	Canadian Total	Mining	Ontario Total	
			Electricity Generation	Total from all Sectors
2008	734,000	23,900	34,000	190,000
2007	750,000	23,200	34,000	200,000
2006	718,000	16,800	27,500	192,000
2005	731,000	15,600	32,900	200,000
2004	741,000	14,900	30,100	199,000
1990	592,000	6,190	25,900	176,000

5.3 Acoustic Environment

Detailed information regarding existing acoustic conditions at and around the Project site is provided by TGCL (2011b). The following sections provide a summary of this information.

5.3.1 Work Scope

The baseline noise study considered background/ambient sound sources contributing to the existing acoustic environment. The study focused on three areas: the Project site; the Highway 17 transportation corridor; and, along the Town of Marathon relevant transportation routes to the potential rail load-out facility. The study characterized baseline noise conditions at representative noise sensitive receptors (NSR) (see Figure 5.3-1).

Noise assessment methods and descriptors were selected for each focus area depending on the nature of predominant ambient noise sources with consideration for guidelines to be used to assess Project noise impacts. Baseline noise levels were measured within the Project site in August 2009. Baseline noise levels along Highway 17 and the proposed Town of Marathon transportation routes were determined through traffic noise modeling (TNM) using current relevant traffic data. The Project site and surrounding area can be variously categorized as Class 2 and 3 according to the following definitions:

- Class 2 Area: defines an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 Areas, and in which a low ambient sound level, normally occurring only between 23:00 and 07:00 hours in Class 1 Areas, will typically be realized as early as 19:00. Other characteristics which may indicate the presence of a Class 2 Area include:
    - absence of urban hum between 19:00 and 23:00;
    - evening background sound level defined by natural environment sounds and infrequent human activity; or,
    - no clearly audible sound from stationary sources other than from those under impact assessment.
- Class 3 Area: means a rural area with an acoustical environment that is dominated by natural sounds having little or no road traffic, such as the following;
    - a small community with less than 1,000 populations;
    - agricultural area;
    - a rural recreational area such as a cottage or a resort area; or,
    - a wilderness area.

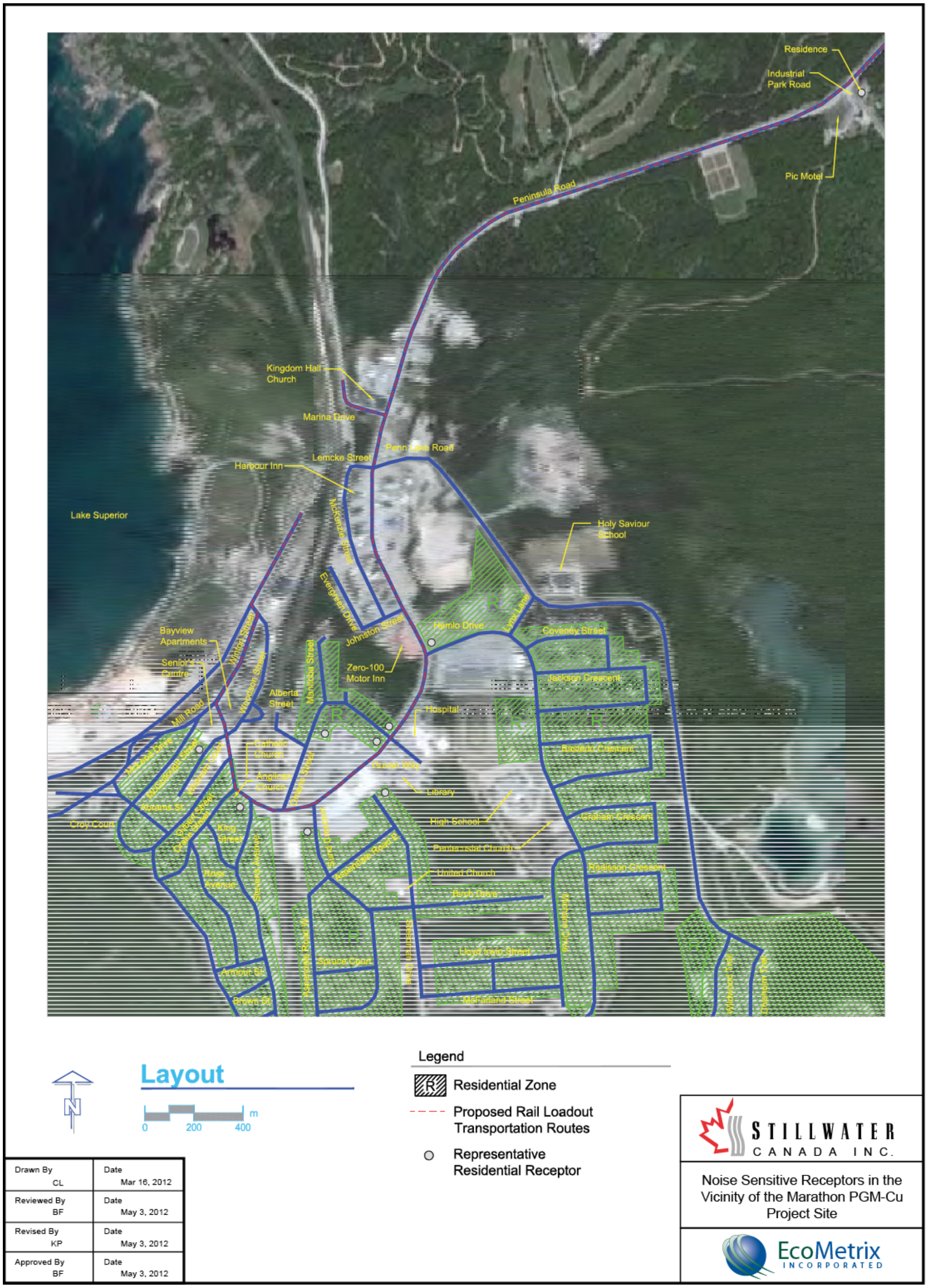


Figure 5.3-1: Noise Sensitive Receptors in the Vicinity of the Marathon PGM-Cu Project Site

5.3.2 Existing Conditions

The Project site measured daytime lowest $L_{eq(1)}$ ranged from 40.0 dBA to 42.0 dBA and the night time lowest $L_{eq(1)}$ ranged from 40.0 to 41.9 dBA. Using TNM, May's Gifts lowest background traffic $L_{eq(1)}$ was 53.4 dBA during the daytime and 44.9 dBA during the night time. Daytime $L_{eq(16)}$ ranged from 4.0 dBA to 57.2 dBA, whereas night time $L_{eq(8)}$ ranged from 0.0 dBA to 51.6 dBA with the minimum occurring at the North Hare Lake Cottage and the maximum being measured at the Travelodge Hotel. Using TNM, the daytime $L_{eq(1)}$ and night time $L_{eq(1)}$ ranged from 39.8 to 61.5 dBA and 34.3 to 55.9 dBA at representative NSR 19 within the Town of Marathon. Results from the individual NSR along the Highway 17 corridor and the NSR 19 within the Town of Marathon are summarized by TGCL (2011b). The NSR included churches, hotels, residences, a hospital, and a library.

Table 5.3-1 summarizes the results of the baseline noise measurements within the project site, along the Highway 17 corridor and within the Town of Marathon.

Table 5.3-1: Key Baseline Noise Descriptors for the Project and Surrounding Area

Location	Baseline Noise Characterization Method	Baseline Noise Descriptor	Baseline Noise Descriptor (dBA)
General Project Site	Measurement (N1, N2, N4, N5)	Daytime Lowest $L_{eq(1)}$	40 to 40.3
		Night time Lowest $L_{eq(1)}$	40.0
Western Project Site North of Hare Lake (represents NSR)	Measurement (N3)	Daytime Lowest $L_{eq(1)}$	42.0
		Night time Lowest $L_{eq(1)}$	41.9
Nearest NSR May's Gifts	Traffic Noise Modeling	Daytime Lowest $L_{eq(1)}$	53.4
		Night time Lowest $L_{eq(1)}$	44.9
Highway 17 Corridor Representative NSR	Traffic Noise Modeling	Daytime Lowest $L_{eq(16)}$	53.2 to 57.2
		Night time Lowest $L_{eq(8)}$	47.6 to 51.6
Town of Marathon Representative NSR	Traffic Noise Modeling	Daytime Lowest $L_{eq(16)}$	39.8 to 61.5
		Night time Lowest $L_{eq(8)}$	34.4 to 55.9

dBA: sound pressure level in A-weighted decibels
NSR: noise sensitive receptor(s)
$L_{eq(1)}$: One hour equivalent continuous A-weighted sound pressure level
$L_{eq(16)}$: Sixteen hour equivalent continuous A-weighted sound pressure level
$L_{eq(8)}$: Eight hour equivalent continuous A-weighted sound pressure level

5.4 Water Quality and Quantity

5.4.1 Hydrology

Detailed information regarding existing hydrological conditions at and around the Project site is provided by Calder (2012a). The following sections provide a summary of this information.

5.4.1.1 Work Scope

Climate and stream flow data were obtained from a variety of sources including Environment Canada, Water Survey of Canada, and the Hydrological Atlas of Canada. Climate data were also obtained from local weather stations within a 35 km radius of the Project (i.e., Marathon, Marathon Airport, Pukaskwa National Park and Hemlo Battle Mountain).

An extensive stream flow monitoring program was implemented at the Project site beginning in 2009. Data were collected monthly (or in some cases quarterly) during the open-water season from a series of stations via both manual measurements and data loggers. Flow monitoring stations are shown in Figure 5.4-1.

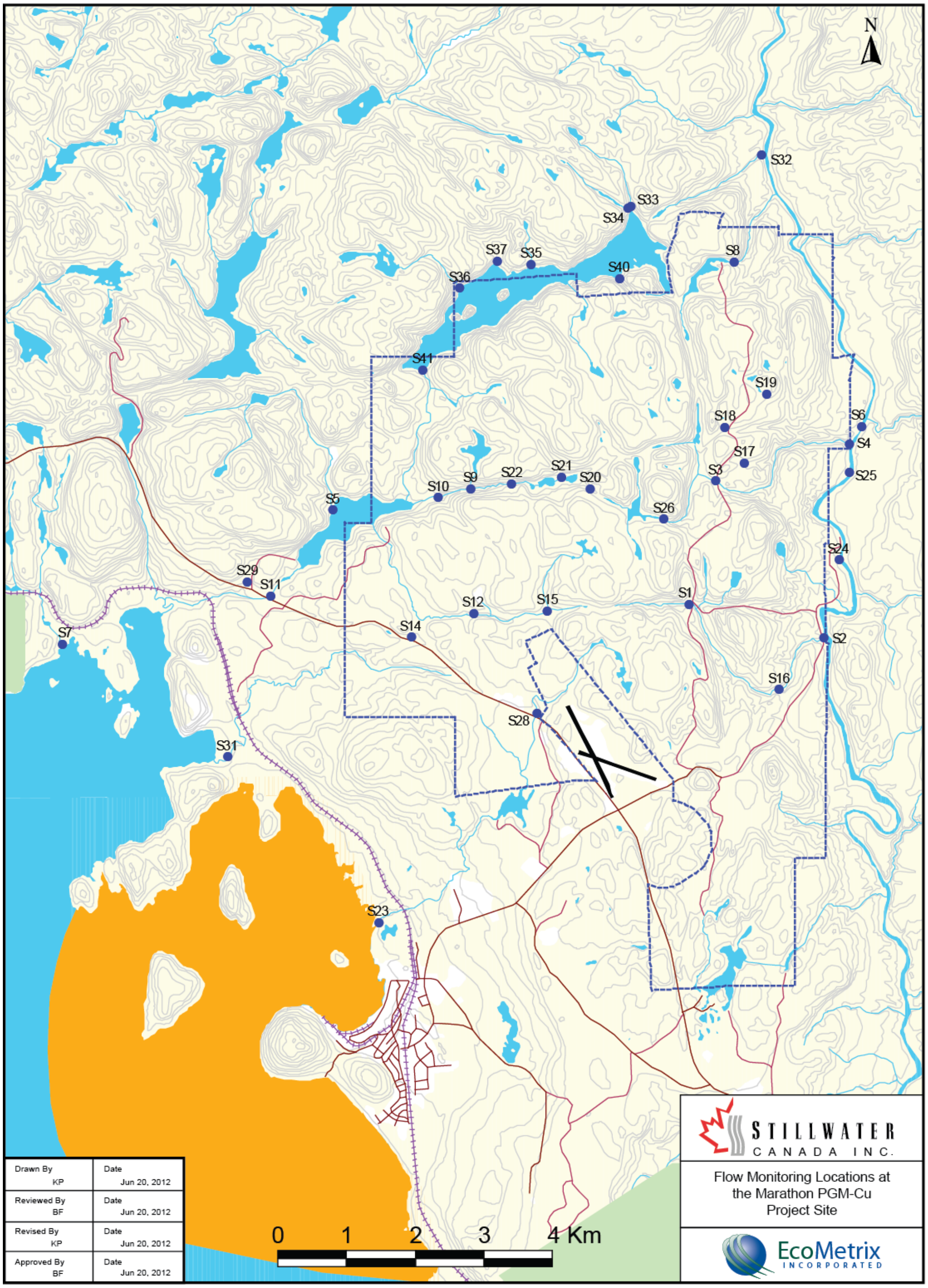


Figure 5.4-1: Flow Monitoring Locations at the Marathon PGM-Cu Project Site

5.4.1.2 Existing Conditions

5.4.1.2.1 General Drainage Patterns

General drainage patterns on the site are described in Section 1.4.2.3.2 and shown on Figure 1.4-10. As indicated, there are a total of six subwatersheds that drain the Project site, four to the Pic River and two to Lake Superior directly.

5.4.1.2.2 Existing Regional Flow Data

Regional flow data are available from four Water Survey of Canada (WSC) flow gauges located close to the Project site. The monthly flow summary for each station is provided in Table 5.4-1. Peak flows typically occur in May and are due to either snowmelt or a combination of snowmelt and rainfall. Annual low flows can either occur in late winter (i.e., February and March) or in September and October.

Table 5.4-1: Monthly flow statistics for WSC stations in the vicinity of the Project site (flows as m^3/s)

	Little Pic River near Coldwell			Pic River near Marathon			Black River near Marathon			Cedar Creek near Hemlo		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
Jan.	4.99	8.19	2.14	14.6	23.7	4.64	7.47	13.4	2.75	0.83	2.27	0.33
Feb.	3.88	6.04	2.01	10.6	16.4	4.49	5.19	9.66	1.85	0.54	1.04	0.23
Mar.	4.23	18.4	2.18	11	51	4.33	6.08	17	1.35	0.55	1.81	0.32
Apr.	31.1	73.2	7.49	95.9	215	19.2	55.1	118	12.8	4.38	11.2	1.11
May	45.7	91.9	12.1	158	277	37.4	83.9	180	21.9	7.07	15.7	1.93
Jun.	21.6	61.4	7.05	73.4	175	15.1	33.9	80.4	11.5	2.49	5.71	0.79
Jul.	14	57.4	3.86	49.1	145	12.0	21.6	55.4	5.01	1.89	7.63	0.33
Aug.	9.19	33.3	2.73	32.5	110	5.07	14.7	40.4	1.14	1.00	2.93	0.08
Sep.	11.3	55.9	2.29	35.3	162	5.19	16.8	63.1	0.29	1.17	4.04	0.04
Oct.	18.8	44.4	1.85	61.6	167	6.62	29.5	78.1	1.23	2.94	6.30	0.15
Nov.	16.9	35.8	2.54	52.5	118	5.78	28.9	61.1	5.12	3.13	14.5	0.58
Dec.	8.17	20.2	2.41	28.3	92.1	5.06	14.5	30	4.09	1.65	4.20	0.40
Year	15.9	22.5	8.84	52.1	78.9	26.2	26.6	41.6	17.9	2.30	3.97	1.10

5.4.1.2.3 Stream Flow on the Project Site

Site-specific stream flow data were used to develop rating curves for the six on-site subwatersheds. The rating curves were subsequently used for the conversion of water level data from the data loggers to monthly flow statistics.

The drainage areas for the Project site range from 2.11 km^2 to 48.33 km^2 within the footprint of the Project. A summary of the sub-basin characteristics are provided in Table 5.4-2.

Table 5.4-2: Summary of Subwatershed Characteristics

Subwatershed	Drainage Area (ha)	Drainage Area (km^2)	Lakes / Waterbodies	Drainage Path/ Outlet
Stream 1	435.41	4.35	Lakes 1, 2	Pic River
Stream 2	346.52	3.47	Lakes 8, 14, 15, 20	Pic River
Stream 3	210.93	2.11	Lakes 9, 10, 11, 12, 13, 16	Pic River
Stream 4	339.21	3.39	Lakes 18, 19, 21, 22	Pic River
Stream 5	4833.34	48.33	Lakes 3, 4, 5, 6, 7, 17, 23, 25, Bamoos Lake, Hare Lake, Seeley Lake, Bill Lake, and Hare Creek	Lake Superior at Port Munro
Stream 6	1098.49	10.98	Lakes 24 and 26	Lake Superior at Sturdee Cove

A summary of mean monthly flow rates for the six major subwatersheds is provided in Table 5.4-3.

Table 5.4-3: Summary of Mean Monthly Stream Flows in the Six Subwatersheds Draining the Project Site (nodes refer to stream flow monitoring locations as provided in Figure 5.4-1)

Subwatershed	Node	Drainage Area (ha)	Mean Monthly Flow (m^3/day)						
			May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
Stream 1	@ S2	435.41	42,984	6,370	5,073	9,577	5,297	4,450	10,449
Stream 2	@ S4	346.52	40,380	6,006	3,699	6,758	4,353	4,466	9,274
Stream 3	@ S6	210.93	36,408	5,461	1,603	2,458	2,911	4,511	7,482
Stream 4	@ outlet	339.21	40,166	5,977	3,586	6,526	4,275	4,468	9,177
Stream 5	@ S30	4833.34	171,805	30,897	73,049	149,053	52,049	17,488	68,588
Stream 5	@ S5	1808.19	83,194	12,656	26,291	53,113	19,891	5,613	28,597
Stream 5	@ S5a	1670.62	79,164	11,970	24,165	48,751	18,428	5,377	26,778
Stream 5	@ S10	562.79	46,715	6,901	7,042	13,617	6,652	4,447	12,133
Stream 5	@ S11	4598.15	164,916	29,263	69,414	141,594	49,549	16,105	65,479
Stream 5	@ S22	352.13	40,544	6,029	3,786	6,936	4,412	4,464	9,348
Stream 5	@ S41	1419.01	71,794	10,748	20,276	40,771	15,754	5,015	23,452
Stream 6	@ S31	1098.49	62,406	9,251	15,322	30,606	12,346	4,682	19,215
Stream 6	@ S12	377.15	41,277	6,131	4,172	7,730	4,678	4,459	9,679
Stream 6	@ S14	488.85	44,549	6,592	5,899	11,272	5,866	4,446	11,156
Stream 6	@ S15	204.81	36,229	5,437	1,508	2,264	2,846	4,514	7,401

Stream 1 Subwatershed

The Stream 1 subwatershed comprises approximately 436 ha, flows in a southeast direction and empties into the Pic River at 551619.748 E, 5401907.181 N. It includes Stream 1 and L1 and L2.

A total of 17 flow measurements were made in 2008 – 2010 at culvert location S2, with a minimum discharge of 0.0004 m^3/s on July 29th, 2008 and maximum of 0.1299 m^3/s on November 3rd, 2009. Mean monthly flows ranged from 2,826 m^3 per day in October to 11,377 m^3 per day in November.

Stream 2 Subwatershed

The Stream 2 subwatershed comprises approximately 347 ha. This subwatershed flows in an eastern direction, emptying into the Pic River approximately 2 km upstream of the mouth of Stream 1 at 551964.616 E, 5404755.763 N. Major lakes and ponds in the sub-basin include, L8, L14, L15, and L20. There are two small ponds located directly west of and connected to L15. There is also a small pond located directly north of and draining into L8. Depending on the condition of beaver dams on L5; L3, L5, L6 and L7 also comprise part of the Stream 2 watershed.

A total of 14 flow measurements were made in 2008 – 2010 at downstream location S4 at the mouth of Stream 2. The minimum discharge was 0.002 m^3/s on August 25th, 2008 and the maximum was 0.1554 m^3/s on May 5th, 2009. Mean monthly flows ranged from 2,574 m^3 per day in October to 8,168 m^3 per day in November.

Stream 3 Subwatershed

The Stream 3 subwatershed comprises approximately 211 ha. Stream 3 flows in an eastern direction and empties into the Pic River approximately 150 m upstream of the mouth of Stream 2 at 552074.788 E, 5404966.443 N. The Stream 3 subwatershed includes Stream 3 and L9, L10, L11, L12, L13, L13a and L16.

Twelve flow measurements were made in 2008 – 2010 at S6 and minimum discharge was determined to be 0.0045 m^3/s on July 14th, 2009 and maximum to be 0.0824 m^3/s on May 5th, 2009. Mean monthly flows in the sub-basin ranged from a minimum of 1,601 m^3 per day in July to a maximum of 4,993 m^3 per day in June.

Stream 4 Subwatershed

The Stream 4 subwatershed comprises approximately 339 ha. Stream 4 flows in the northeast direction and empties into the Pic River approximately 4 km upstream of the mouth of Stream 3 at 550877.486 E, 5408429.376 E. This sub-basin includes Stream 4 and L18, L19, L21 and L22.

Fifteen discharge measurements were completed at the downstream S8 location in 2008 – 2010. Minimum discharge was 0.0014 m^3/s on July 15th, 2009 and maximum discharge was

0.1278 m^3/s on May 4th, 2009. The mean monthly flows ranged from a minimum of 2,553 m^3 per day in October to a maximum of 6,523 m^3 per day in August.

Stream 5 Subwatershed

The Stream 5 subwatershed drains a total area of approximately 4,833 ha, including Stream 5, Bamoos Lake, Seeley Lake, Bill Lake, Hare Lake and Hare Creek, and smaller waterbodies, such as: L3, L4, L5, L6, L7, L17, L23, and L25. As mentioned above, L3, L5, L6 and L7 sometimes flow east into the Stream 2 subwatershed rather than west into Stream 5. The Stream 5 subwatershed is divided into 6 smaller basins, corresponding to locations S5, S5a, S10, S11, S22 and S41. The flow from Seeley Lake meets Hare Lake at stream monitoring location S5. Locations S11, and S41 are located immediately downstream of Hare Lake and Bamoos Lake, respectively. Stream 5 flows southwest towards Hare Lake, and empties into Lake Superior at Port Munro (S30).

Twelve discharge measurements were made in 2008 – 2010 at the downstream location S30 on Stream 5, with a minimum value of 0.0188 m^3/s on September 25th, 2008 and maximum of 0.3893 m^3/s on October 20th, 2008. The mean monthly flows in Stream 5 ranged from a minimum of 15,268 m^3 per day in October to a maximum of 213,984 m^3 per day in May.

Stream 6 Subwatershed

Stream 6 flows south and discharges into Lake Superior at Sturdee Cove. It drains a total area of approximately 1,098 ha, and includes Stream 6 and L24 and L26. The Stream 6 subwatershed can be divided into 3 minor basins with corresponding drainage areas of 377, 205 and 489 ha, respectively.

Seventeen discharge measurements were completed at the downstream location S14 in 2008 – 2010. Minimum discharge was recorded to be 0.0043 m^3/s on November 21st, 2008 and maximum flow to be 0.2762 m^3/s on May 5th, 2009. The mean monthly flows ranged from a minimum of 4,702 m^3 per day in October to a maximum of 40,448 m^3 per day in May.

Pic River

In addition to the six local subwatersheds the Pic River is an important local surface water feature. The mean monthly flow for the Pic River varies from 10.6 m^3/s to 158.0 m^3/s with a mean annual flow of 52.1 m^3/s based on WSC data from 1970-2009. Mean monthly flow ranges from 4.33 m^3/s in March to 277 m^3/s in May (Table 5.4-4). Estimated 7 day duration low flows for 2 year (7Q2), 10 year (7Q10), and 20 year (7Q20) return periods are summarized in Table 5.4-4.

Review of WSC data indicate that annual low flows typically occur in the winter during the months of February and March but can also occur during the months of September and October.

Table 5.4-4: Estimated Low Flows for the Pic River

Return Period	Duration (days)	Pic River near Marathon (m^3/s)
2	7	7.12
2	30	7.73
10	7	4.90
10	30	5.14
20	7	4.52
20	30	4.67

(Notes: low flows for Pic River near Marathon based on data for station 02BB003 from Cumming Cockburn Limited (1995) report, "Regionalization of Low Flow Characteristics for North-eastern and North-western Ontario")

5.4.2 Hydrogeology

Detailed information regarding existing hydrogeological conditions at and around the Project site is provided by TGCL (2012a). The following sections provide a summary of this information.

5.4.2.1 Work Scope

A total of 36 monitoring wells were installed across the site to assess groundwater quality and the hydrogeological conditions at the Project site. Wells were placed up-gradient, down-gradient and cross-gradient on and around the site. The locations of the wells are illustrated in Figure 5.4-2.

Hydraulic conductivity of the water bearing fractures encountered during drilling was assessed via a double packer system. Rising head tests were also performed on most existing monitoring wells. Water level measurements and the collection of samples for the characterization of water quality were collected at regular intervals from 2008 to 2011.

All available hydrogeological data were used to construct and calibrate a three dimensional numerical hydrogeologic model of the site that allows steady state modeling of pre-development conditions and transient modeling of potential mine related impacts. MODFLOW, the current industry standard, was used to create this model. Details of the groundwater model development including grid scale and stratigraphy based on hydraulic conductivity are provided by TGCL (2012a).

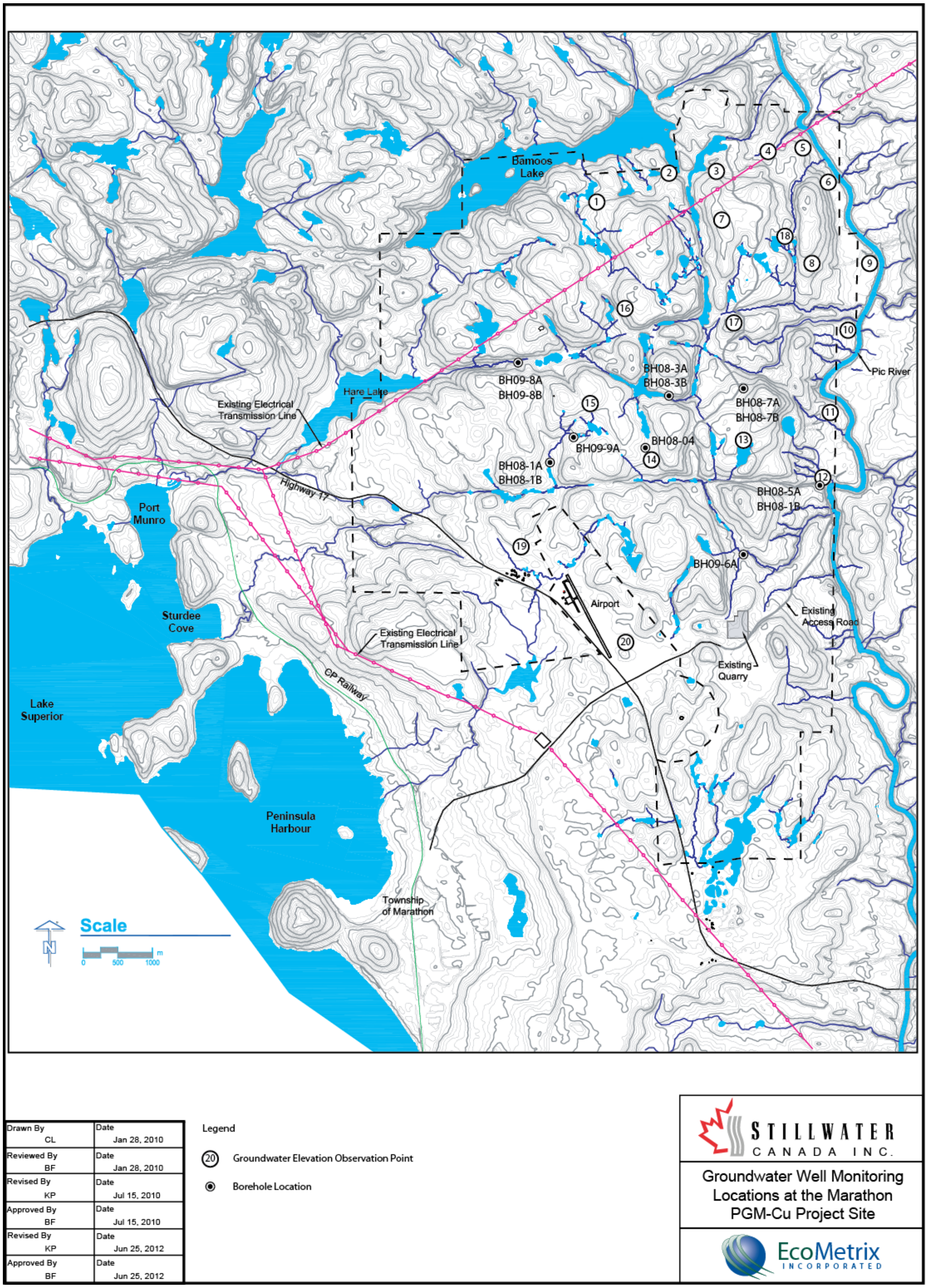


Figure 5.4-2: Groundwater Well Monitoring Locations at the Marathon PGM-Cu Project Site

5.4.2.2 Existing Conditions

5.4.2.2.1 Regional Hydrogeology

The regional bedrock geology has been mapped and characterized in detail and the following description is based on Puskus (1967), Walker *et al.* (1993a; 1993b).

The regional bedrock geology can be subdivided into two main areas. To the west of the Pic River is the alkalic Coldwell Complex consisting of an assemblage of Mesoproterozoic intrusive rock types ranging from syenites to gabbros. The intrusives are described as being massive to layered, and in places can be essentially devoid of structure. East of the Pic River are the Archean mafic to felsic metavolcanics with minor interlayered sedimentary rock. The mafic rocks are essentially massive units and are interbanded with felsic flows and tuffs. Proximate to the Coldwell Complex, these metavolcanics have undergone various metamorphic and assimilative phenomena.

A significant feature of the Coldwell Complex that strongly influences the surficial drainage and likely influences the hydrogeology is the presence of an extensive network of radial and concentric lineaments that are clearly visible on air photos and topographic maps of the area. These lineaments trend roughly east-west and the northerly two are in the area of the proposed open pits. Many of the lineaments that radiate from the Port Coldwell Complex have indications of displacement with a suspected substantial dip component. Where these structures are permeable, they can provide a pathway for the movement of groundwater through the area.

The surficial geology can be generally subdivided into two areas based primarily on elevation (Gartner, 1980; Geddes and Bajc, 1985). Below an elevation of approximately 320 m, thick deposits of massive to varved glaciolacustrine silts and clays are present within the numerous valleys. These deposits were formed by deep water deposition when the ancestral Lake Superior was much higher. As the lake level receded, shallow water deposits of silty, sand and fine sand formed. In general, the low permeability of these fine grained deposits will limit the potential movement of groundwater. The exception is where coarser deposits are present such as the glaciofluvial sand and gravel deposits located northeast and east of Marathon. The permeability of these granular deposits will be much higher and as such significant groundwater resources may be present. For example, the Town of Marathon relies on groundwater for its municipal water supply.

Above an elevation of approximately 320 m, the geology is dominated by rugged bedrock topography. A thin veneer of ground moraine is generally present, as are localized areas of organics where drainage is poor. There are thick accumulations of fine sediments in the deeper ravines and valleys. The ground moraine generally consists of silty sand till with abundant gravel, cobbles and boulders. As the ground moraine is thin, groundwater flow will be controlled by the underlying bedrock topography and the surface water drainage courses. Some groundwater flow into the underlying bedrock may occur where the bedrock is fractured and/or pervious structures are present.

5.4.2.2.2 Site Hydrogeology – Setting

Surficial geologic mapping has not been completed in great detail within the Project area primarily due to the absence of significant overburden through most of the site. The description of the surficial geology is therefore based on the available published mapping, drill holes completed by TGCL and Knight Piésold, as well as the review of other sources of information such as the drill logs and the geotechnical investigations conducted by others.

The proposed open pit area is underlain by various types of gabbroic rocks and is flanked to the west by syenites. The review of the provincial mapping (Walker et al., 1993a; 1993b) indicates that the syenites extend west at least as far as Hare Lake as a near continuous unit with some evidence of dikes in the area of the lineaments. To the east of the gabbros, on the footwall side of the deposit, intermediate to felsic metavolcanics are present. A wide hornfelsic aureole has been developed in the metavolcanics and the contact relationship is complex.

Two main fault structures, trending east-west to southeast—northwest, exist in the area of the primary mine pit and it is likely that other smaller faults also exist in the area. Fault A was intersected in drill hole GD6-03 at a downhole depth of approximately 202 to 207 m. It consists of less than 1.5 m of highly fractured and altered (chloritized) rock with a very low rock mass quality designation. Fault B was intersected in drill hole M-05-107 (134.0 to 138.5 m downhole depth) and consisted of approximately 4.5 m of predominantly graphite. Interpreted faults C and D are outside the proposed open pit areas and do not appear to have been intersected by any explorations drill holes. The review of the drill logs indicates that the major lineament trending south from the east end of Bamoos Lake may consist of a shear or fault zone.

5.4.2.2.3 Site Hydrogeology – Subsurface Conditions

General stratigraphic conditions encountered during drilling are summarized below in relation to the proposed mine layout (see also the drill logs provided in TGCL, 2012a). Based on the drilling, subsurface conditions on the Project site generally consist of overburden of variable composition overlying fresh to moderately weathered bedrock. Bedrock was typically shallow and was encountered at depths less than 25 m. The exceptions were wells along the Pic River where bedrock was not encountered in wells up to 20 m deep.

Groundwater springs were not encountered on the Project site but some intermittent seasonal groundwater seeps were noted in the spring along the steeper slopes west of the Pic River.

5.4.2.2.4 Site Hydrogeology – Hydraulic Conductivity

Hydraulic conductivity testing completed by Golder (2007), TGCL (2012a) and Knight Piésold (2012) on the wells in the non-clay overburden and upper bedrock yielded a geometric mean of 1.6×10^{-6} m/s. There is little difference between the hydraulic conductivity of the non-clay overburden and the upper bedrock. The hydraulic conductivity at the wells installed in clay along the Pic River was much lower, approximately 2.9×10^{-9} m/s. Golder (2007) reported hydraulic conductivities on the order of 10^{-9} m/s for bedrock below 50 metres below ground surface (mbgs).

A summary of hydraulic conductivity tests are presented in Tables 5.4-5 and 5.4-6.

Table 5.4-5: Summary of Hydraulic Conductivity by Depth

Vertical Depth (m below top of bedrock)	Geometric Mean, Hydraulic Conductivity (m/s)
0 to 50	2.2×10^{-7}
50 to 100	6.4×10^{-9}
100 to 150	4.0×10^{-9}
>150	3.2×10^{-9}

Table 5.4-6: Summary of Hydraulic Conductivity Tests in Upper Bedrock & Non-Clay Overburden

Investigator	Year	Method	Max Depth (m)	Geometric Mean (K) m/s
Golder	2007	Packer	50	2.2×10^{-7}
Golder	2008	Packer	21.6	3.1×10^{-7}
TGCL	2009	Packer	8.97	8.6×10^{-6}
Knight Piésold	2011 (winter)	Packer	24.3	1.4×10^{-6}
Knight Piésold	2011 (summer)	Packer	24.6	1.9×10^{-6}
Knight Piésold	2011 (summer)	Rising Head	7.2	1.5×10^{-6}
TGCL	2011	Rising Head	20.42	9.7×10^{-7}
All	2007-2011	Both	50	1.6×10^{-8}

5.4.2.2.5 Site Hydrogeology – Groundwater Conditions

The depth to groundwater is generally less than 2 or 3 mbgs and at times was observed above the ground surface at a few wells. Vertical hydraulic gradients measured at nested well pairs were variable but gradients between groundwater elevations and surface waterbodies were consistently towards the waterbodies. These data support the hydrogeologic conceptual model of localized groundwater flow following topography, recharging at higher elevations and discharging at lower elevations (i.e., wetlands, streams, rivers and lakes).

5.4.2.2.6 Site Hydrogeology – Groundwater Quality

In general, baseline/background groundwater quality in both the overburden and bedrock at the proposed mine site was characterized by hardness, turbidity, iron and manganese concentrations that exceeded the Ontario Drinking Water Standards (ODWS). TDS, pH, dissolved organic carbon, alkalinity, sulphate and aluminum also exceeded the ODWS at various wells. None of the ODWS exceedances were for human health related parameters; the standards are either operational guidelines or aesthetic objectives.

Overburden and bedrock groundwater quality data are summarized in Tables 5.4-7 and 5.4-8, respectively. Parameters with concentrations exceeding ODWS criteria at the identified borehole locations are identified in Table 5.4-8.

Table 5.4-7: Baseline overburden groundwater quality

Field Parameter	Minimum	Maximum
2008		
pH	7.21 (BH08-1B - September)	7.81 (BH08-1B – July)
Temperature (°C)	4.4 (BH08-1B - May)	10.4 (BH08-1B - July)
Conductivity (µS/cm)	172 (BH08-3B - July)	235 (BH08-1B - September)
Dissolved Oxygen (mg/L)	1.13 (BH08-1B – May)	7.06 (BH08-1B – Aug)
2009		
pH	6.78 (BH08-5B – October)	9.12 (BH08-7B – August)
Temperature (°C)	4.4 (BH08-5B - May)	10.9 (BH08-8B – August)
Conductivity (µS/cm)	47 (BH08-8B – July)	750 (BH08-5B – September)
Dissolved Oxygen (mg/L)	0.33 (BH08-7B – June)	7.83 (BH08-5B – August)
2010		
pH	4.73 (BH08-5B – September)	10.93 (BH08-1B – July)
Temperature (°C)	3.3 (BH01-8B – May)	13.7 (BH08-3B – July)
Conductivity (µS/cm)	56 (BH09-8B – July)	797 (BH08-5B – July)
Dissolved Oxygen (mg/L)	1.02 (BH08-7B – May)	10.49 (BH09-8B – August)
2011		
pH	6.86 (MW11-101A – October)	9.21 (BH08-7A – August)
Temperature (°C)	2.4 (MW11-101B - October)	16.4 (BH08-1B – August)
Conductivity (µS/cm)	45 (BH09-8B – October)	1873 (MW11-101A – October)
Dissolved Oxygen (mg/L)	1.87 (MW11-110B – October)	8.48 (MW11-105C – October)

Table 5.4-8: Baseline bedrock groundwater quality

Parameter	ODWS (mg/L)	BH08-1A	BH08-3A	BH08-4	BH09-6A	BH08-7A	BH09-8A	BH09-9A	BH10-01B	BH10-26
2008										
Hardness	80-100	•	•	•						
Turbidity	1	•	•	•						
DOC	5			•						
Aluminum	0.1			•						
Iron	0.3		•	•						
Manganese	0.05		•	•						
2009										
Hardness	80-100	•	•	•	•	•	•	•		
pH	6.5-8.5		•			•		•		
TDS	500				•					
Turbidity	1	•	•	•	•	•	•	•		
DOC	5	•		•	•	•		•		
Aluminum	0.1			•	•	•				
Iron	0.3			•		•	•	•		
Manganese	0.05			•	•		•	•		
2010										
Hardness	80-100		•	•	•	•	•	•		
pH	6.5-8.5		•			•		•		
Turbidity	1	•	•	•	•	•	•	•		
DOC	5			•	•			•		
Aluminum	0.1			•						
Iron	0.3			•				•		
Manganese	0.05			•	•		•			
2011										
Hardness	80-100	•	•	•		•	•	•	•	
pH	6.5-8.5		•			•		•		•
Turbidity	1	•	•	•	•	•	•	•	•	•
DOC	5	•		•	•			•	•	•
Alkalinity	30-500									•
Aluminum	0.1			•					•	•
Iron	0.3			•					•	
Manganese	0.05			•					•	•
2011 Cont'd		**KP11-03A**	**KP11-03B**	**MW11-104A**	**MW11-106A**	**MW11-107A**	**MW11-108A**	**MW11-111A**	**MW11-112A**	
Hardness	80-100	•	•	•	•	•	•	•	•	
Turbidity	1	•	•	•	•	•	•	•	•	
DOC	5		•	•	•	•	•		•	
Aluminum	0.1		•	•	•				•	
Iron	0.3		•		•	•	•		•	
Manganese	0.05	•	•		•	•		•	•	

5.4.2.2.7 Site Hydrogeology – Groundwater Model

Conceptual Model

The groundwater elevations within each area suggest that the water table generally mimics the surface topography of the site. Groundwater enters the system as recharge from precipitation, runoff, and snow melt and leaves the system at discharge zones such as lakes, rivers, creeks and low lying areas, as well as through evapotranspiration. The water table is near or above ground surface in low lying areas and is found at greater depths below the ground surface along bedrock ridges.

The groundwater flow regime at the site as described in the conceptual model and supported by monitoring data collected to date differs from other areas of Canada and the world where extensive aquifers exist and as a result some of the elements mentioned in the EIS Guidelines are not directly applicable to this site and are therefore not presented. Extensive aquifers do not exist at the site and as a result a map of aquifers and their extents has not been provided (a map showing the location of faults is presented in Figure 5.4-3), extensive groundwater flow systems are not present so significant groundwater divides do not exist and groundwater flow directions are not consistent over long stretches but rather mimic the complex topography and can be directly deduced from the contours on Figure 1.4-11.

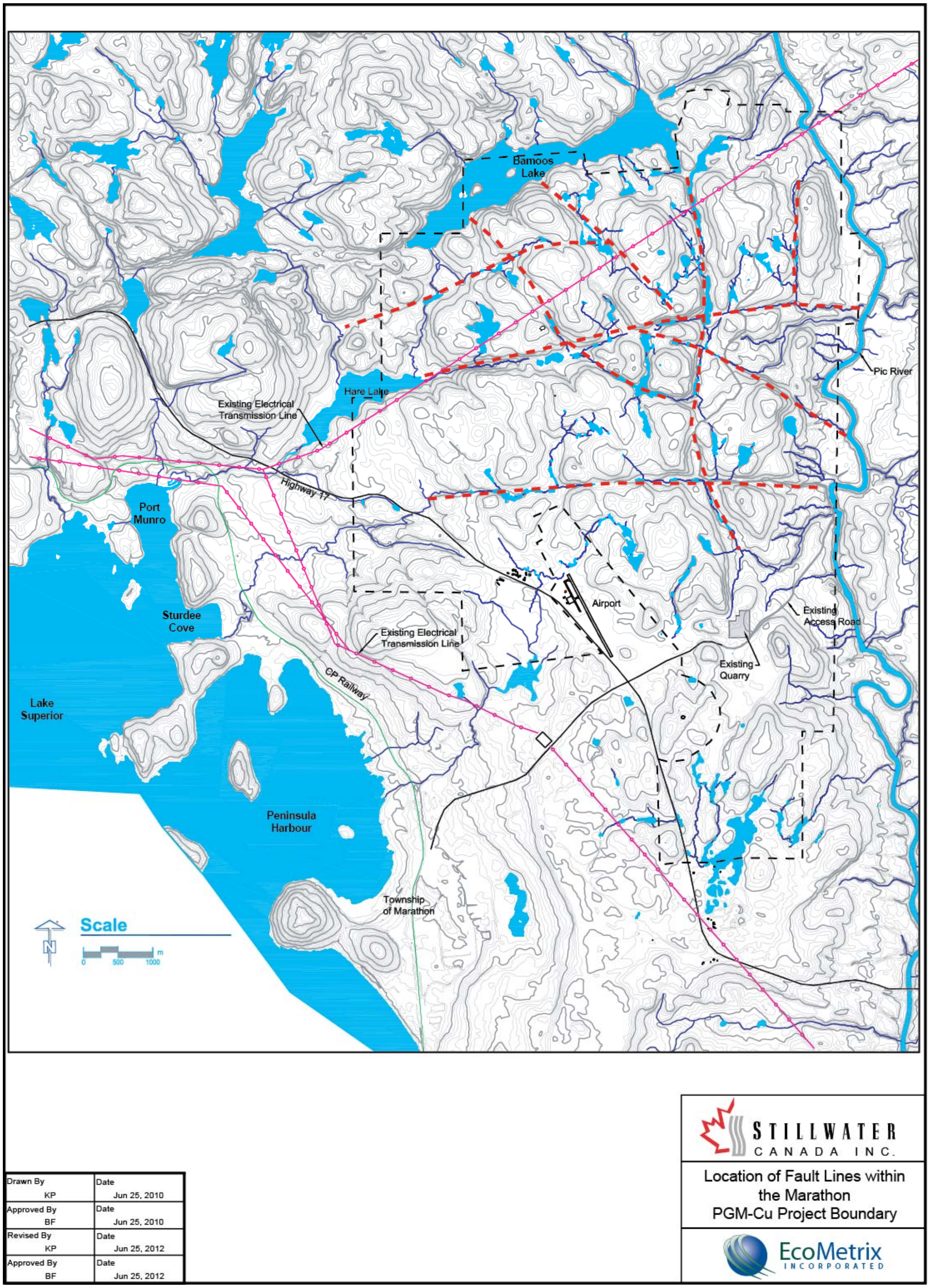


Figure 5.4-3: Location of Fault Lines within the Marathon PGM-Cu Project Site

Calibrated Model

The groundwater flow model for the site was calibrated with measured groundwater elevation data. The water table elevations and inferred shallow groundwater flow directions were consistent with the conceptual model of the site with groundwater being recharged at high elevation and discharging to lower elevations. This confirms that the topography strongly controls the water table elevation.

5.4.3 Surface Water Quality

Detailed information regarding baseline water quality at and around the Project site is provided by EcoMetrix (2012c). The following sections provide a summary of this information.

5.4.3.1 Work Scope

An extensive network of water quality monitoring stations has been established that includes headwater and downstream areas of all of the subwatersheds that traverse the Project site and drain to either the Pic River or Lake Superior. In total the network comprises 58 stations including 13 lentic stations, 4 Pic River stations and 41 stream stations (Figure 5.4-4). Sampling of this network began in the spring of 2008 and is ongoing. Initially sampling was conducted on a monthly basis through the ice-free season (roughly May through November); more recently samples have been collected 4 times during the ice-free season. Samples have also been collected in the winter under ice from the lentic stations within the Project area (2007, 2009). Data also includes spot measurements of water quality that have been collected coincident with other sampling events dating back to the early 2000s.

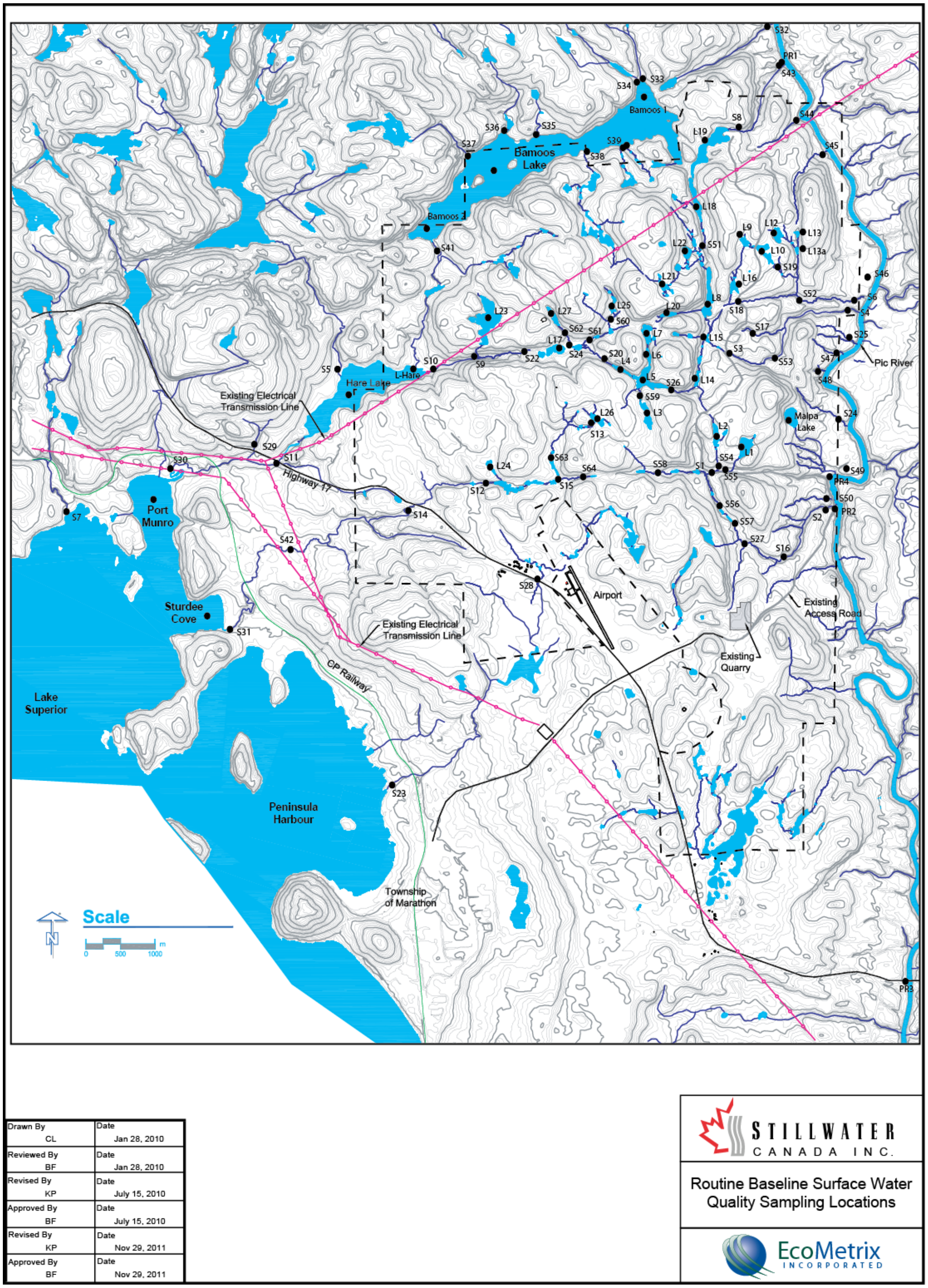


Figure 5.4-4: Routine Baseline Surface Water Quality Sampling Locations

Data have been reported for physical analytes, anions, nutrients, carbon, metals, aggregate organics and radionuclides. The range of parameters for which analyses (or measurements) have been completed is shown in Table 5.4-9.

Table 5.4-9: Parameters for which Analyses Completed as part of Routine Surface Water Quality Sampling on the Project Site

Parameter Category	Analytes
Physical Tests	Colour, Conductivity, Hardness (as $CaCO_3$), pH, TSS, TDS, Turbidity, DO, Temperature
Anions and Nutrients	Alkalinity, Total (as $CaCO_3$), Ammonia-N, Total Bicarbonate, Carbonate, Chloride, Fluoride, Hydroxide, Nitrate-N, Nitrite-N, TKN, Phosphorus (total), Sulphate
Carbon	DOC
Metals	Total Metals (full ICP-MS scan), Dissolved Metals (full ICP-MS scan), Mercury, Hexavalent Chromium
Aggregate Organics	BOD, Tannin and Lignins
Radionuclides	Radium-226

5.4.3.2 Existing Conditions

Existing water quality in all of the subwatersheds that traverse the Project site (Streams 1 to 6, and the Pic River) are presented in Table 5.4-10. Water quality in each stream is discussed separately in the sections below.

Table 5.4-10: Existing Water Quality in and Around the Marathon PGM-Cu Project Site

		Stream 1 (S2)		Stream 2 (S4)		Stream 3 (S6)		Stream 4 (S8)		Stream 5 (S41)		Stream 5 (S10)		Stream 5 (S11)		Stream 5 (S30)		Stream 6 (S14)		Stream 6 (S31)		Pic River (PR1)		Pic River (PR2)	
Analyte	**PWQO (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**	**Max (mg/L)**	**Avg (mg/L)**
Alkalinity (as CaCO3)	-	265	118	150	91	241	88	38.5	15	7.8	6.5	21	7.5	10.5	8.1	36	16	43	18	99	52	139	112	137	107
Dissolved Aluminum	0.075	0.190	0.062	0.151	0.050	0.130	0.046	0.152	0.053	0.037	0.036	0.394	0.174	0.230	0.088	0.120	0.067	0.490	0.181	0.158	0.088	0.071	0.037	0.122	0.035
Ammonia (as N)	See Notes	0.110	0.032	0.040	0.023	0.220	0.037	0.100	0.033	0.021	0.020	0.320	0.052	0.030	0.022	0.040	0.022	0.060	0.031	0.054	0.028	0.053	0.024	0.034	0.022
Arsenic	0.1 or 0.005 (Interim)	0.0100	0.0015	0.0100	0.0016	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0120	0.0020	0.0010	0.0010	0.0010	0.0010	0.0100	0.0016	0.0100	0.0015
Cadmium	0.0001 or 0.0005 (Interim)	0.00090	0.00013	0.00090	0.00014	0.00009	0.00009	0.00019	0.00010	0.00009	0.00009	0.00011	0.00009	0.00009	0.00009	0.00031	0.00010	0.00131	0.00015	0.00009	0.00009	0.00090	0.00014	0.00090	0.00014
Cobalt	0.0009	0.00500	0.00083	0.00500	0.00096	0.00113	0.00056	0.01020	0.00120	0.00050	0.00050	0.00330	0.00070	0.00050	0.00050	0.00050	0.00050	0.00108	0.00054	0.01000	0.00110	0.00500	0.00121	0.00500	0.00105
Copper	0.001 or 0.005 (Interim)	0.0100	0.0031	0.0100	0.0049	0.0138	0.0069	0.0220	0.0064	0.0050	0.0022	0.0018	0.0011	0.0014	0.0010	0.0020	0.0011	0.0026	0.0011	0.0080	0.0015	0.0100	0.0033	0.0100	0.0030
Dissolved Organic Carbon	-	11.5	6.6	10.8	7.1	11.0	6.6	10.3	6.6	5.3	4.6	10.7	8.4	11.9	6.4	8.8	6.2	16.9	11.2	23.0	10.0	15.1	10.1	14.7	8.8
Iron	0.3	4.03	0.80	4.45	1.52	2.49	0.82	5.31	1.08	0.10	0.07	6.37	1.48	0.43	0.21	0.59	0.27	2.72	1.13	1.68	0.67	5.84	1.99	5.47	1.53
Lead	0.001 or 0.003 or 0.005 (Interim)	0.0100	0.0015	0.0100	0.0017	0.0011	0.0010	0.0010	0.0010	0.0010	0.0010	0.0030	0.0011	0.0010	0.0010	0.0010	0.0010	0.0018	0.0010	0.0049	0.0012	0.0100	0.0018	0.0100	0.0017
Mercury	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.001	0.00028	0.0001	0.0001	0.001	0.00025	0.0001	0.0001	0.0001	0.0001
Molybdenum	0.04	0.010	0.0015	0.010	0.0016	0.001	0.0010	0.001	0.0010	0.001	0.0010	0.001	0.0010	0.001	0.0010	0.001	0.0009	0.001	0.0010	0.001	0.0009	0.010	0.0016	0.010	0.0015
Nickel	0.025	0.0200	0.0034	0.0200	0.0038	0.0050	0.0027	0.0036	0.0021	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0200	0.0046	0.0200	0.0040
Nitrate (as N)	-	0.400	0.142	0.471	0.141	0.434	0.171	0.202	0.062	0.219	0.138	0.111	0.056	0.311	0.120	0.130	0.102	0.130	0.054	0.182	0.079	0.131	0.051	0.166	0.058
pH	6.5—8.5	8.3	7.8	8.3	7.9	8.4	8.0	7.8	7.3	7.0	6.8	7.9	6.8	10.2	7.8	7.9	7.4	8.2	7.4	7.7	7.3	8.4	8.0	9.2	8.1
Phosphorus	0.03	0.071	0.022	0.223	0.045	0.109	0.025	0.132	0.023	0.014	0.007	0.042	0.017	0.049	0.008	0.239	0.028	0.023	0.010	0.402	0.052	0.214	0.072	0.170	0.050
Radium-226	1 Bq/L																							0.01	0.01
Selenium	0.1	0.0050	0.0011	0.0050	0.0012	0.0050	0.0010	0.0050	0.0009	0.0004	0.0004	0.0050	0.0009	0.0050	0.0008	0.0050	0.0011	0.0050	0.0009	0.0050	0.0013	0.0050	0.0012	0.0050	0.0011
Sulphate	-	5.40	3.77	6.29	5.00	6.29	4.76	9.17	4.49	4.21	3.92	3.72	2.83	4.71	3.37	4.00	3.51	4.30	2.69	5.11	4.07	3.09	2.16	3.54	2.55
Total Hardness (as $CaCO_3$)	-	263	122	229	109	238	99	47	19	10	9.7	21	9.1	13	11	43	20	47	23	106	57	212	120	217	115
Total Kjeldahl Nitrogen	-	0.397	0.275	0.550	0.312	0.420	0.287	1.890	0.462	0.230	0.205	1.140	0.440	0.310	0.249	0.360	0.217	0.570	0.425	0.590	0.296	0.580	0.436	0.662	0.411
Total Suspended Solids	-	86	18	436	66	162	25	28	4.8	4	2.3	14	4.4	3	2.2	13	2.8	21	4.4	38	6.7	389	118	302	83
Zinc	0.03 or 0.02 (Interim)	0.1300	0.0108	0.3700	0.0289	0.1510	0.0138	0.1040	0.0164	0.0042	0.0032	0.0123	0.0063	0.0067	0.0041	0.0060	0.0038	0.0125	0.0066	0.0090	0.0038	0.0300	0.0082	0.0400	0.0078

Notes:

Station Specific Ammonia as N PWQO were developed using the available data.

When values were less than the method detection limit (MDL) the value was set at the MDL for the average calculations.

5.4.3.2.1 Stream 1 Subwatershed

A summary of the general water quality based on data collected at monitoring station S2, located at the downstream end of the subwatershed, is provided in Table 5.4-10.

Several analytes including arsenic, mercury, molybdenum, and selenium were not detected above their respective method detection limits (MDL). Concentrations of dissolved aluminum were below the Provincial Water Quality Objective (PWQO) value of 0.075 mg/L with the exception of one exceedance occurring in May 2011 with a concentration of 0.19 mg/L. The average concentration was 0.062 mg/L. Concentrations of ammonia did not exceed the site specific objective of 1.5 mg/L NH_3-N for any of the samples, with an average concentration of 0.03 mg/L. Concentrations of cadmium were consistently below the MDL of 0.0009 mg/L with the exception of the sample collected in November 2008 that had a concentration of 0.00012 mg/L. Cobalt concentrations were consistently below the MDL, with the exception of the sample collected in July 2009 that exceeded the PWQO value with a concentration of 0.002 mg/L. This concentration was an order of magnitude higher than all other samples and most likely represents an anomalous value. Concentrations of copper were 0.003 mg/L on average. Samples collected from station 2 exhibited one exceedance the PWQO value in July 2009 with a concentration of 0.007 mg/L. Concentrations of iron were 0.8 mg/L on average and exceeded the PWQO value in 16 of 19 samples collected. Concentrations of lead were consistently below the MDL with the exception of the sample collected in July 2009 with a concentration of 0.002 mg/L. Concentrations of nickel were only above the MDL in 4 of the 19 samples collected and exhibited an average concentration of 0.003 mg/L. Concentrations of total phosphorus were above the MDL on average and exceeded the PWQO value during five sampling events including May and July 2009, July and August 2010 and May 2011. Concentrations of zinc were 0.01 mg/L on average and exceeded the PWQO value for one sampling event in July 2008.

Samples collected from station 2 exhibited consistent pH values ranging from 7.1 to 8.3 with an average value of 7.8. All pH measures were within the PWQO range of 6.5 to 8.5.

Alkalinity averaged 118 mg/L with a minimum level of 24.2 mg/L occurring in May 2009 and a maximum level of 265 mg/L occurring in August 2008. Dissolved organic carbon (DOC) averaged 7mg/L with a minimum concentration of 4 mg/L in July and August 2008 and a maximum concentration of 11.5 mg/L in August 2009. Nitrate (as N) averaged 0.1 mg/L with a minimum concentration less than 0.03 mg/L on three occasions and a maximum concentration of 0.4 mg/L in November 2008 and May 2010. Sulphate averaged 3.8 mg/L with a minimum concentration of 2.1 mg/L in August 2010 and a maximum concentration of 5.4 mg/L in November 2008. Total hardness averaged 122 mg/L and ranged from 31.8 mg/L in May 2009 to 263 mg/L in August 2010. Total Kjeldahl nitrogen (TKN) showed little variation and was on average 0.28 mg/L. When above the MDL total suspended solids (TSS) ranged from 3.5 mg/L in November 2009 to 86.2 mg/L in July 2008. TSS averaged 18.5 mg/L.

5.4.3.2.2 Stream 2 Subwatershed

A summary of the general water quality based on data collected at monitoring station S4, located at the downstream end of the subwatershed, is provided in Table 5.4-10.

At sampling station S4, several analytes including arsenic, cadmium, mercury, molybdenum, and selenium were not detected at their respective MDL values. Concentrations of dissolved aluminum were consistently above the MDL value and exhibited an average concentration of 0.05 mg/L. An exceedance of the PWQO value occurred in May 2011 with a dissolved aluminum concentration of 0.15 mg/L. Concentrations of ammonia did not exceed the site specific objective of 1 mg/L NH_3-N for any of the samples. Concentrations of cobalt were consistently below the MDL value with the exception of two exceedances occurring in May of 2009 and May of 2011 with concentrations of 0.0015 and 0.002 mg/L, respectively. Concentrations of copper exceeded the PWQO value in 6 of the 16 samples collected with an average concentration of 0.005 mg/L. Concentrations of lead were consistently below the MDL value with the exception of three sampling events in May of 2009, 2010 and 2011 with concentrations of 0.0014 mg/L, 0.0011 mg/L and 0.002 mg/L. Concentrations of lead at location S4 did not exceed the PWQO value for any of the samples collected. Concentrations of nickel were 0.004 mg/L on average and did not exceed the PWQO value. Concentrations of total phosphorus were above the MDL on average and exceeded the PWQO value during 6 of the 15 sampling events. Concentrations of zinc were 0.03 mg/L on average and did not exceed the PWQO value for any of the samples collected.

Samples collected from station S4 exhibited consistent pH values ranging from 7.3 to 8.3 with an average value of 7.9.

Alkalinity averaged 91mg/L with a minimum level of 49 mg/L occurring in May 2009 and a maximum level of 150 mg/L occurring in July 2011. DOC averaged 7.1 mg/L with a minimum concentration of 5 mg/L in both August and October 2008 and a maximum concentration of 10.8 mg/L in August 2009. Sulphate concentrations averaged 5 mg/L with a minimum concentration of 3.9 mg/L in July 2008 and a maximum concentration of 6.3 mg/L in July 2010. Total hardness averaged 109 mg/L and ranged from 50.3 to 229 mg/L in May and 2011, respectively. Nitrate concentrations ranged from 0.034 to 0.471 mg/L with an average of 0.14 mg/L. TKN was consistent throughout the sampling period, averaging 0.3 mg/L and ranging from 0.22 mg/L in July 2011 to 0.55 mg/L in July 2008. TSS varied widely from below the MDL of 2 mg/L in October 2009 to 436 mg/L in May 2011.

5.4.3.2.3 Stream 3 Subwatershed

A summary of the general water quality based on data collected at monitoring station S6, located at the downstream end of the subwatershed, is provided in Table 5.4-10.

At sampling station S6, several analytes including arsenic, cadmium, mercury, molybdenum, and selenium were not detected at or above their respective MDL. Concentrations of dissolved aluminum were 0.046 mg/L on average. An exceedance of the PWQO value occurred in May 2011 with a dissolved aluminum concentration of 0.13 mg/L. Concentrations of ammonia did not exceed the site specific objective of 0.9 mg/L NH_3-N for any of the samples. Concentrations ranged from below detection to 0.22 mg/L with an average concentration of 0.04 mg/L. Concentrations of cobalt were consistently below the MDL with the exception of four samples. An exceedance above the PWQO value occurred in May of 2011 with a concentration of 0.001 mg/L. Concentrations of copper exceeded the PWQO value in 13 of the 15 samples collected with an average concentration of 0.007 mg/L. Concentrations of iron were 0.8 mg/L on average, reaching a maximum concentration of 2.5 mg/L. Concentrations of iron exceeded the PWQO value of 0.3 mg/L in 5 of the 15 samples collected. Concentrations of nickel were 0.003 mg/L on average and did not exceed the PWQO value of 0.025 mg/L for any of the sampling events. Concentrations of total phosphorus were 0.03 mg/L on average and ranged from 0.006 to 0.109 mg/L. Two exceedances of the PWQO value were associated with the May 2010 and May 2011 sampling events with concentrations of 0.037 and 0.109 mg/L, respectively. Concentrations of zinc were 0.01 mg/L on average and with the exception of the August 2008 sampling event, did not exceed the PWQO value for any of the samples collected.

Samples collected from S6 exhibited consistent pH values ranging from 7.3 to 8.3 with an average value of 8.0. All measures were within the PWQO.

Alkalinity averaged 88 mg/L, with a minimum level of 40.5 mg/L in May 2009 and a maximum level of 241 mg/L in August 2008. DOC had an average concentration of 6.6 mg/L, with a minimum concentration of 4 mg/L in July, August and October 2008 and a maximum concentration of 11 mg/L in August 2009. Sulphate concentrations averaged 4.8 mg/L, with a minimum concentration of 4.0 mg/L in July 2008 and a maximum concentration of 6.3 mg/L in October 2008. Total hardness averaged 99 mg/L and ranged from 42.2 mg/L in May 2009 to 238 mg/L in August 2008. The mean nitrate concentration was 0.17 mg/L ranging from 0.06 mg/L in September 2010 to 0.43 mg/L in May 2010. TKN showed little variability, averaging 0.3 mg/L and ranging from 0.2 mg/L in October 2008 to 0.4 mg/L in August 2009. TSS ranged from < 2 mg/L in August 2008 and September 2010 to 162 mg/L in May 2011. Mean TSS was 25 mg/L.

5.4.3.2.4 Stream 4 Subwatershed

A summary of the general water quality based on data collected at monitoring station S8, downstream of Claw Lake (L19) at the downstream end of the subwatershed, is provided in Table 5.4-10.

At sampling station S8, several analytes including arsenic, mercury, molybdenum, and lead were not detected at their respective MDL. Concentrations of dissolved aluminum were 0.053 mg/L on average. Three exceedances of the PWQO value were associated with the sampling events in July 2008, August 2010 and May 2011 with concentrations of 0.14, 0.15 and 0.08 mg/L respectively. Concentrations of ammonia did not exceed the site specific objective of 0.4

mg/L NH_3-N for any of the samples. Concentrations of ammonia were 0.03 mg/L on average. Concentrations of cadmium were above the MDL for two sampling events, August 2010 and July 2011 with concentrations of 0.002 and 0.0001 mg/L respectively. The August 2010 samples also exceeded the PWQO value for cadmium of 0.0001 mg/L. Concentrations of cobalt were consistently below the MDL value with the exception of five samples ranging from 0.0006 to 0.01 mg/L. Concentrations that exceed the PWQO value occurred in September 2008, August 2010 and July 2011 with values of 0.0025, 0.010, and 0.0017 mg/L, respectively. Concentrations of copper exceeded the PWQO value in 12 of the 19 samples collected, ranging from 0.004 to 0.022 mg/L with an average concentration of 0.006 mg/L. Concentrations of iron were 1.1 mg/L on average, reaching a maximum concentration of 5.3 mg/L. Concentrations of iron exceeded the PWQO value of 0.3 mg/L in all of the samples collected from this station. Concentrations of nickel were consistently below the MDL value with the exception of one sample collected in August 2010 with a concentration of 0.0036 mg/L. Concentrations of total phosphorus were 0.023 mg/L on average and ranged from 0.007 to 0.03 mg/L. Three exceedances of the PWQO value were associated with the July 2009, August 2010 and July 2011 sampling events with concentrations of 0.13, 0.08 and 0.43 mg/L, respectively. A selenium concentration of 0.0006 mg/L was reported in August 2010. All other samples exhibited concentrations of selenium that were below the MDL. Concentrations of zinc ranged from 0.003 to 0.1 mg/L and were 0.016 mg/L on average. With the exception of the September and October 2008 and the August 2010 sampling events, did not exceed the PWQO value for any of the samples collected.

Samples collected from station S8 exhibited consistent pH values ranging from 6.6 to 7.8 with an average value of 7.3. All values were within the PWQO range.

Alkalinity was low, averaging 15 mg/L with a minimum level of 8 mg/L occurring in May 2009 and a maximum level of 39 mg/L occurring in August 2010. DOC averaged 6.6 mg/L with a minimum concentration of 5 mg/L and a maximum concentration of 10.3 mg/L. Sulphate concentrations averaged 4.5 mg/L with a minimum concentration of 3.7 mg/L in October 2009 and a maximum concentration of 9.2 mg/L in August 2010. Total hardness averaged only 19 mg/L and ranged from 11 mg/L in May 2009 to 47 mg/L in August 2010. TKN was consistent at Station S8 averaging 0.29 mg/L and ranged from 0.23 mg/L in October 2008 to 0.42 mg/L in August 2009. Nitrate concentrations averaged 0.062 mg/L and range from less than 0.03 mg/L to 0.20 mg/L. TSS displayed little variability, averaging 4.8 mg/L with a minimum concentration below the MDL (2.0 mg/L) occurring on several occasions. The maximum concentration was 28.4 mg/L, sampled in July 2009.

5.4.3.2.5 Stream 5 Subwatershed

Data from four sampling locations are provided to represent the water quality in the Stream 5 subwatershed. Station S41 is located in the Bamoos Lake outlet creek in the upper part of the subwatershed. S10 is located on an inlet to Hare Lake that drains the northwest portion of the Project site (i.e., Stream 5). S11 is located on the Hare Lake outlet and S30 is located near where Hare Creek flows into Lake Superior (Port Munro). General water quality based on data collected at monitoring station S41, S10, S11, and S30 is provided in Table 5.4-10.

S41

At S41, several analytes including arsenic, cadmium, cobalt, mercury, molybdenum, lead, nickel, and selenium, were not detected at their respective MDL. Dissolved aluminum concentrations in July and August 20010 were both around 0.036 mg/L and did not exceed the PWQO. The S41 station specific PWQO for ammonia was determined to be 0.4 mg/L. No samples exceeded this value and only a single sample from November 2009 (0.021 mg/L) was above the MDL. Copper concentrations averaged 0.002 mg/L and ranged from 0.0015 to 0.005 mg/L, all equal to or below the PWQO. Only three of the seven samples resulted in total phosphorus concentrations above the MDL, none of which exceeded the PWQO of 0.02 mg/L.

Samples collected from station S41 exhibited consistent pH values ranging from 6.5 to 7.0 with an average value of 6.8. All values were within the PWQO range.

Alkalinity averaged 6.5 mg/L, with a minimum level of 5.2 mg/L occurring in May 2010 and a maximum level of 7.8 mg/L occurring in August 2009. DOC averaged 4.6 mg/L, with a minimum concentration of 3.8 mg/L in November 2009 and a maximum concentration of 5.3 mg/L in May 2010. Nitrate (as N) averaged 0.1 mg/L, with a minimum concentration of 0.07 mg/L and maximum concentration of 0.2 mg/L. Sulphate and hardness concentrations did not vary greatly, averaging 3.9 mg/L and 9.7 mg/L, respectively. TKN exhibited almost no variability and with concentrations around 0.2 mg/L throughout the sampling period. TSS values were consistently low with a mean of 2.3 mg/L.

S10

At sampling station S10, several analytes including arsenic, mercury, molybdenum, nickel, and selenium were not detected at their respective MDL. Dissolved aluminum had an average concentration 0.174 mg/L. The concentrations ranged from a minimum of 0.08 mg/L to a maximum of 0.394 mg/L. All samples exceeded the PWQO of 0.075 mg/L. The station specific PWQO for ammonia was 13.2 mg/L. Eleven of 19 measures were above the MDL and ranged in concentration from 0.027 to 0.32 with an average of 0.05 mg/L. All samples were at least an order of magnitude below the PWQO. Only one sample exceeded the MDL for cadmium and had a concentration of 0.00011 mg/L (July 2011) which slightly exceeds the PWQO of 0.0001 mg/L. About half of the cobalt samples were below the MDL. The samples above the MDL ranged from 0.0006 mg/L to 0.0033 mg/L. One sample, the maximum from August 2008, exceeded the PWQO. Three samples exceeded the PWQO for copper. These exceedances occurred in May 2010, September 2010, and July 2011 with concentrations of 0.0018, 0.0011, 0.0011 mg/L, respectively. Iron averaged 1.48 mg/L and ranged from 0.316 to 6.37 mg/L and all samples exceeded the PWQO of 0.3 mg/L. Lead was only over the MDL once with a concentration of 0.003 mg/L which exceeds the interim PWQO of 0.001 mg/L. Zinc concentrations averaged 0.006 mg/L with a range of 0.0034 to 0.012 mg/L. None of the measured concentrations exceeded the PWQO of 0.02 mg/L. Phosphorus concentrations averaged 0.0171 mg/L with a concentration range of 0.007 to 0.042 mg/L. The August 2008, October 2009 and September 2010 samples were above PWQO with levels of 0.032, 0.039, and 0.035 mg/L, respectively.

Three of the eight pH measurements were below the lower bound of the PWQO range. The overall mean pH was 6.8.

Alkalinity was low, averaging 7.5 mg/L with a minimum level below the MDL (5.0 mg/L) occurring on several occasions and a maximum level of 21 mg/L occurring in August 2008. DOC averaged 8.4 mg/L, had a minimum concentration of 6 mg/L in November 2008 and a maximum concentration of 10.7 mg/L in May 2009. Nitrate (as N) averaged 0.06 mg/L ranging from below the MDL (0.03 mg/L) on several occasions, to a maximum concentration of 0.11 mg/L in May 2010. Sulphate averaged 2.8 mg/L with a minimum concentration of 1.3 mg/L in August 2008 and a maximum concentration of 3.7 mg/L in May 2010. Total hardness did not vary greatly, averaging 9.1 mg/L. TKN averaged 0.4 mg/L and ranged from less than the MDL, 0.25 mg/L, in October 2011 to 1.1 mg/L in August 2008. TSS averaged 4.4 mg/L, had a minimum concentration below the MDL of 2.0 mg/L occurring on several occasions and a maximum concentration of 14.3 mg/L in July 2011.

S11

At sampling station S11, several analytes including arsenic, cadmium, cobalt, mercury, molybdenum, nickel, and selenium were not detected below their respective MDL. Dissolved aluminum concentration ranged from 0.039 to 0.23 mg/L with a mean of 0.088 mg/L. Seven of the 11 samples measurement for dissolved aluminum exceeded the PWQO or 0.075 mg/L. Ammonia concentrations ranged from below the MDL (i.e., 0.02 mg/L) to 0.03 mg/L. Concentrations were below the station specific PWQO of 1.4 mg/L. All copper concentrations were around 0.001 mg/L which is equal to the MDL. The July, October and November, 2009 samples all slightly exceeded the PWQO (0.001 mg/L). Iron concentrations averaged 0.21 mg/L and ranged from 0.097 to 0.43 mg/L. The November 2008 and 2009 concentrations were 0.38 mg/L and 0.43 mg/L both exceeding the PWQO. Generally, lead concentrations at S11 were below detection, however a single sample (July, 2010) resulted in a concentrations equal to the 0.001 MDL. This value is equal to the PWQO given the hardness in the sample. Approximately two-thirds of the 20 samples had phosphorus concentrations below the MDL (0.005 mg/L). For the remaining third the range was between 0.005 and 0.0491 mg/L. Overall, the mean was 0.008 mg/L. The maximum value from November 2009 exceeded the PWQO of 0.03 mg/L.

The range in pH was 5.7 to 10.6 with these two values being lower than and greater than the PWQO range, respectively. Overall the mean pH was 7.7.

Alkalinity varied little, averaging 8.1 mg/L and ranging from a concentration below the MDL (5 mg/L) in June and October 2009 to a concentration of 10.5 mg/L in July 2009. DOC averaged 6.4 mg/L, had a minimum concentration of 5 mg/L occurring numerous times, and a maximum concentration of11.9 mg/L occurring in May 2011. Nitrate (as N) averaged 0.1 mg/L, had a minimum concentration of 0.03 mg/L in September 2010 and a maximum concentration of 0.3 mg/L in June 2009. Sulphate concentrations averaged 3.4 mg/L, had a minimum concentration of 2.7 mg/L in September 2010 and a maximum concentration of 4.7 mg/L in June 2009. Total hardness averaged 11.2 mg/L and ranged from 9 mg/L in August 2009 to 13.2 mg/L in August 2008. TKN and TSS were consistent, averaging at 0.2 and 2.2 mg/L, respectively.

S30

At sampling station S30, several analytes including cobalt, mercury, molybdenum, lead, nickel, and selenium and were not detected at their respective MDL. The mean dissolved aluminum concentration was 0.0671 mg/L with a range of 0.018 to 0.12 mg/L. All values were below PWQO. No sample concentrations exceeded the ammonia as N PWQO developed for S30. Fifteen of 21 samples were below the MDL (0.02 mg/L) and the highest concentration reported was 0.04 mg/L. Only the 30 July 2008 had a cadmium concentration above the MDL of 0.00009 mg/L with a level of 0.00031 mg/L. This single value exceeds the interim PWQO of 0.0001 mg/L. Half of the samples collected had copper concentrations below the 0.001 mg/L MDL. The remaining samples ranged from 0.0001 mg/L to 0.002 mg/L. After accounting for hardness eight of the 11 samples with copper concentrations at or above the MDL were also equal to or exceeded the PWQO. Iron concentrations averaged 0.26 mg/L and ranging from 0.10 mg/L and 0.59 mg/L. Iron exceeded the PWQO seven times. A single pH measurement in June 2009, 6.4, was below the 6.5 bound outlined in the PWQO. Phosphorus concentrations ranged from below MDL (0.005 mg/L) to 0.24 mg/L. The maximum value was the only instance of a concentration exceeding the PWQO.

The maximum pH was 7.9 and the mean was 7.4. All values were within the PWQO.

Alkalinity averaged 16 mg/L with a minimum level of 9.5 mg/L occurring in May 2011 and a maximum concentration of 36 mg/L occurring in August 2008. DOC averaged 6.2 mg/L with a minimum concentration of 5 mg/L on all sample dates from August to November 2008 and a maximum concentration of 8.8 mg/L in August 2009. Nitrate (as N) averaged 0.1 mg/L, had a minimum concentration of 0.04 mg/L in September 2010 and a maximum concentration of 0.13 mg/L in October 2008. Sulphate concentrations did not vary greatly, averaging 3.5 mg/L with a minimum concentration of 2.7 mg/L in September 2010 and a maximum concentration of 4 mg/L in July 2008. Total hardness averaged 20 mg/L and ranged from a minimum concentration of 13 mg/L in November 2008 to a maximum concentration of 43 mg/L in August 2008. TKN showed little variability, averaging 0.2 mg/L with a minimum concentration below the MDL (0.005 mg/L) in September 2009 and May 2010 and maximum concentration of 0.36 mg/L in July 2008. TSS averaged 2.8 mg/L with a minimum concentration below the MDL (2 mg/L) occurring on several occasions and a maximum concentration of 13 mg/L in July 2009.

5.4.3.2.6 Stream 6 Subwatershed

Data from two sampling locations are provided to represent the water quality in the Stream 6 subwatershed. Station S14 is at the Stream 6 crossing with Highway 17. S31 is near the mouth of Stream 6 at Lake Superior (Sturdee Cove). General water quality based on data collected at monitoring station S14 and S31 is summarized in Table 5.4-10.

S14

In S14, several analytes including arsenic, mercury, molybdenum, nickel, and selenium were not detected at their respective MDLs. Mean dissolved aluminum was 0.182 mg/L exceeding the PWQO. Eight of ten samples exceeded the PWQO and the ranged from 0.04 to 0.49 mg/L. The station specific PWQO for ammonia at S14 of 2.9 mg/L was at least an order of magnitude higher than any of the measured ammonia concentrations. Cadmium was generally below the MDL (0.00009 mg/L). The exception was July 2009 when the cadmium concentration was 0.0013 mg/L, exceeding the PWQO but likely an anomalous data point not representative of the station conditions. Generally, cobalt was below the MDL of 0.0005 mg/L. Twice cobalt concentrations were measured at levels above the MDL and above the PWQO, however similar to cadmium it is not likely these measures indicate the normal cadmium levels in this location. Copper concentrations were below the MDL with the exception of July 2008 and 2009 and May and October 2011. The range of values above the MDL was 0.001 to 0.0026 mg/L with the only instance of copper exceeding the PWQO occurring in May 2011. The mean iron concentration (1.27 mg/L) and all individual samples exceeded the PWQO. Lead was generally below the MDL and was only measured once, in July 2009. In Jul 2009 the measured lead concentration was 0.0018 mg/L a value less than the PWQO. Phosphorus was measured above its respective MDL in 16 of 18 samples analyzed. Levels ranged from less than 0.005 to 0.023 mg/L. The mean was 0.001 mg/L. There were no exceedances of the PWQO of phosphorus at this station.

Samples collected at S14 exhibited relatively consistent pH values with a mean of 7.4. A single measure was 6.3, less than the PWQO range.

Alkalinity averaged 18 mg/L with a minimum level of 6 mg/L occurring in May 2011 and a maximum level of 43 mg/L occurring in August 2008. DOC averaged 11.2 mg/L, had a minimum concentration of 8 mg/L in July, August and October 2008 and a maximum concentration of 16.9 mg/L in July 2010. Nitrate (as N) averaged 0.05 mg/L, had a minimum concentration that was below MDL (0.03 mg/L) occurring on several occasions, and a maximum concentration of 0.13 mg/L in November 2008. Sulphate concentrations averaged 2.7 mg/L with a minimum concentration of 1.4 mg/L in August 2008 and a maximum concentration of 4.3 mg/L in November 2008. Total hardness averaged 22.7 mg/L and ranged from 7.3 mg/L in May 2009 to 47.2 mg/L in August 2008. TKN showed little variability, averaging 0.42 mg/L and ranging from 0.31 mg/L in May 2009 to 0.57 mg/L in July 2008. TSS averaged 4.4 mg/L, had a minimum concentration that was below the MDL (2.0 mg/L) occurring on several occasions and a maximum concentration of 20.8 mg/L in October 2009.

S31

In S31, several analytes including arsenic, cadmium, mercury, molybdenum, nickel and selenium were not detected at their respective MDL. Dissolved aluminum concentrations averaged 0.088 mg/L and range from 0.028 to 0.158 mg/L. In 6 of the 10 samples dissolved aluminum was higher than the PWQO value of 0.075 mg/L. All concentrations for ammonia as N were lower than the station specific developed PWQO (2.9 mg/L) by an order of magnitude. Cobalt was below the MDL in all but on instance. In October 2008 the concentration was 0.0006 mg/L which is below the PWQO. Lead was only above the MDL in on instance (August 2009) with a concentration of 0.0049 mg/L which is above the PWQO. Copper concentrations varied from below the MDL to 0.008 mg/L (August 2008) which was the only exceedance of the PWQO. All iron concentrations exceeded the PQWO. The concentrations ranged from 0.305 to 1.68 mg/L with a mean of 0.67 mg/L. Phosphorus was generally above the MDL and detected values ranged from 0.0064 to 0.402 mg/L. Only the maximum value from May 2010 exceeded the PWQO. Zinc was detected in 8 of the 16 sampling events. The concentrations ranged from 0.003 to 0.009 mg/L. All concentrations were an order of magnitude lower than the PWQO.

Samples collected from the Stream 6 watershed exhibited consistent pH values ranging from 6.6 to 7.7 with an average value of 7.3.

Alkalinity averaged 52 mg/L with a minimum level of 24 mg/L occurring in May 2010 and a maximum level of 99 mg/L occurring in August 2008. DOC averaged 10 mg/L with a minimum concentration of 5 mg/L in August 2008 and a maximum concentration of 23 mg/L in September 2009. Nitrate (as N) averaged 0.08 mg/L, had a minimum concentration below the MDL (0.03 mg/L) in September 2010 and a maximum concentration of 0.18 mg/L in May 2010. Sulphate concentrations averaged 4 mg/L with a minimum concentration of 3 mg/L in August 2009 and a maximum concentration of 5 mg/L in September 2008. Total hardness averaged 57 mg/L and ranged from 29 mg/L in September 2009 to 106 mg/L in August 2008. TKN averaged 0.3 mg/L and ranged from 0.008 mg/L in September 2009 to 0.6 mg/L in October 2008. The majority of TSS measures were relatively low and consistent. In October 2008 and May 2011 TSS was 38.3 and 35.6 mg/L whereas the remainder of the 16 samples were less that 4 mg/L. Overall the average was 6.7 mg/L.

5.4.3.2.7 Pic River

Water quality in the Pic River is represented by data from two monitoring stations, one upstream of the Project site (PR1) and one downstream of the Project site (PR2). General water quality based on data collected at monitoring station PR1 and PR2 is summarized in Table 5.4-10. At PR1 and PR2 several analytes including cadmium, mercury, molybdenum, and selenium were not detected at their respective MDL.

PR1

Average dissolved aluminum concentrations were 0.0368 mg/L and all values were below the PWQO.

Arsenic was only detected once in June of 2009 just above the MDL and was not above the PWQO. Cobalt was detected in half of the sampling events. The detected concentrations ranged from 0.0006 to 0.005 mg/L. The PWQO was exceeded on 5 occasions; May June, August and September of 2009 and May 2011. Copper concentrations ranged from 0.001 to 0.01 mg/L with an average of 0.0033 mg/L. The PWQO was exceeded twice; June 2009 and May 2011. All iron concentrations were above the PWQO with a mean of 1.99 mg/L and a range of 0.311 to 5.84 mg/L. Lead concentrations were generally close to the MDL of 0.001 mg/L and no values exceeded guidelines. All zinc concentrations were below the PWQO and range from 0.003 to 0.018 mg/L. Ammonia concentrations were always below the station specific PWQO (0.8 mg/L). Ammonia ranged from below detection, 0.02 mg/L, to 0.05 mg/L. The mean nickel concentration was 0.0046 mg/L and all measured levels were below the PWQO. Nickel concentrations ranged from 0.002 mg/L to 0.02 mg/L. The mean phosphorus concentration was 0.0716 mg/L and exceeds the PWQO guideline. Overall the range was 0.0078 to 0.214 mg/L of total phosphorus in 15 samples. Individual exceedances occurred in the spring and summer of 2009 (May to September) and 2010 (May, July).

Samples collected from the PR1 station exhibited consistent pH values ranging from 6.7 to 8.4 with an average value of 8.0.

Alkalinity averaged 112 mg/L with a minimum concentration of 81.5 mg/L occurring in May 2009 and a maximum concentration of 139 mg/L occurring in October 2011. DOC averaged 10.1 mg/L with a minimum concentration of 7.0 mg/L occurring in August 2008 and a maximum concentration of 15.1 mg/L occurring in August 2009. Sulphate concentrations did not vary greatly, averaging 2.2 mg/L with a minimum concentration of 1.4 mg/L in September 2010 and a maximum concentration of 3.1 mg/L in June 2009. Total hardness averaged 120 mg/L and ranged from 64.7 mg/L in May 2009 to 212 mg/L in May 2011. TKN showed little variability, averaging 0.44 mg/L and ranging from less than 0.25 mg/L in October 2011 to 0.58 mg/L in July 2008. TSS average 18 mg/L and ranged widely from 12 mg/L to 389 mg/L.

PR2

The mean dissolved aluminum concentration was 0.035 mg/L and ranged from below the MDL to 0.122 mg/L. The maximum level measured in May 2011 was the only exceedance of the PWQO. Ammonia concentrations were generally between 0.02 and 0.03 mg/L and none exceeded the station specific PWQO of 0.65 mg/L. All arsenic concentrations were generally near the MDL (0.001 mg/L). Only two measures exceeded the MDL and neither value exceeded the PWQO. The mean cobalt concentration was 0.001 mg/L. Cobalt levels ranged from below the MDL (0.005 mg/L) to 0.0035 mg/L. Cobalt concentration in May and June 2009 and May 2011 exceeded the PWQO with concentration of 0.0017, 0.0025 and 0.0021 mg/L, respectively. Copper concentrations averaged 0.003 mg/L with a minimum of 0.001 mg/L and a maximum of 0.006 mg/L. In June 2009 and May 2011 the copper concentrations were both 0.006 mg/L exceeding the PWQO. All other copper concentrations were less than PWQO. All iron concentration exceeded the PWQO. The average iron level was 1.53 mg/L with a range of 0.31 to 5.47 mg/L. Nickel concentrations averaged 0.004 mg/L and all values were below the PWQO. Lead was only above the MDL on three occasions, June 2009 and May 2010 and 2011. None of the measured lead concentrations exceeded the PWQO. Zinc levels averaged 0.0078 mg/L ranging from less than 0.003 to 0.04 mg/L. The maximum value measured in July 2008 exceeded the PWQO whereas all other samples were below the 0.02 mg/L guideline. Phosphorus concentration ranged from 0.0059 to 0.17 mg/L with a mean of 0.05 mg/L. Eight of the 17 samples exceeded the PWQO.

The average pH was 8.1. The May 2010 pH value was 9.2 exceeding the upper bound of the guideline range. All other measures were within the 6.5 to 8.5 PWQO range.

Alkalinity averaged 107 mg/L with a maximum level of 137 mg/L occurring in October 2011 and a minimum level of 57 mg/L occurring in September 2009. DOC had an average concentration of 8.8 mg/L with a minimum concentration of 6 mg/L occurring in September 2008 and a maximum concentration of 14.7 mg/L occurring in August 2009. Sulphate concentrations did not vary greatly, averaging 2.6 mg/L with a maximum concentration of 3.5 mg/L in September 2009 and a minimum concentration of 1.8 mg/L in August 2010. Total hardness averaged 115 mg/L and ranged from 61.9 mg/L in September 2009 to 217 mg/L in May 2011. TKN averaged 0.4 mg/L and ranged from less than 0.3 mg/L in October 2011 to 0.66 mg/L in July 2009. Nitrate (as N) concentrations ranged from less than 0.03 mg/L to 0.17 mg/L with an average of 0.058 mg/L. TSS ranged widely from 2.1 mg/L in October 2011 to 302 mg/L inn June 2009 and averaged 83 mg/L.

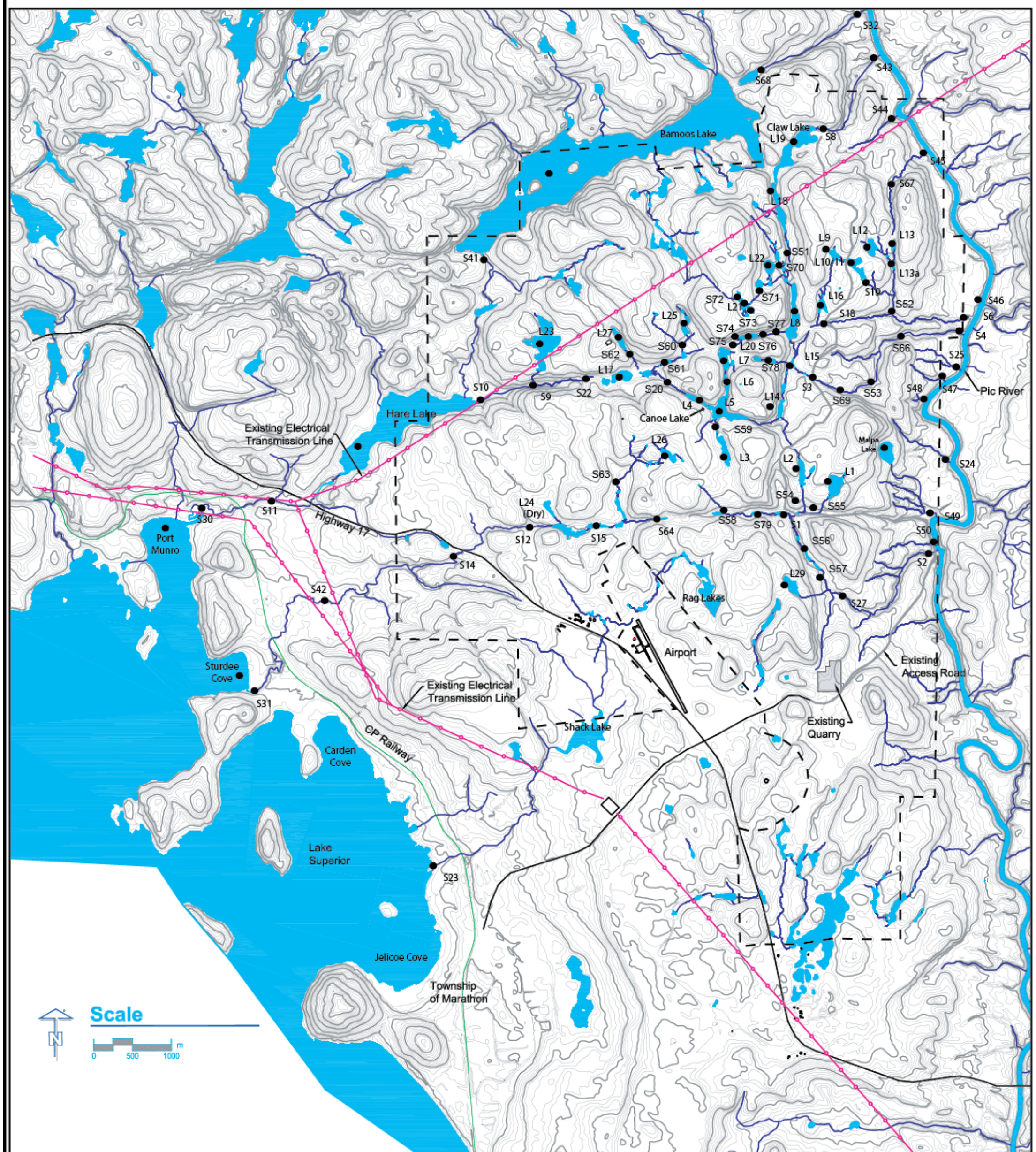
5.4.4 Sediment Quality and Benthos

Detailed information regarding existing sediment quality and benthic invertebrate community conditions at and around the Project site is provided by EcoMetrix (2012a). Additional information is also provided by Golder Associates (2009) and NAR (2007). The following is a summary of that information.

5.4.4.1 Sediment Quality

5.4.4.1.1 Work Scope

The characterization of sediment quality was conducted as part of the aquatic baseline studies (NAR 2007; Golder, 2009; EcoMetrix, 2012a). A detailed account of the methods used and locations from which samples have been collected is provided in the EcoMetrix (2012a). Sediment sampling locations are shown in Figure 5.4-5.



Drawn By CL	Date Jan 28, 2010
Reviewed By BF	Date Jan 28, 2010
Revised By KP	Date July 15, 2010
Approved By BF	Date July 15, 2010
Revised By KP	Date Feb 8, 2012
Approved By BF	Date Feb 8, 2012

Figure 5.4-5: Baseline Sediment Sampling Locations at the Marathon PGM-Cu Project Site

5.4.4.1.2 Existing Conditions

Overall there were frequent exceedances of the Provincial Sediment Quality Guidelines (PSQGs) lowest effect levels (LELs) for a number of base metals in sediments collected in subwatersheds 1 through 5, and in particular at locations that were in relatively close proximity to the ore body and exposed bedrock outcrops. However few exceedances of the PSQGs severe effects levels (SELs) were noted for any of the metals tested. Phosphorus, nitrogen and organic carbon levels were relatively high across most of the study area, likely related to the depositional nature of the waterbodies onsite and the direct result of large amounts of organic matter (woody debris) inputs into these headwater areas.

Metal and nutrient levels in profundal areas of Hare Lake and Bamoos lakes were generally higher than in the littoral zone. Metals and nutrient levels in Lake Superior (Sturdee Cove, Port Munro) were relatively low.

Stream 1 Watershed

Key sediment parameters for the Stream 1 watershed are summarized in Table 5.4-11.

Table 5.4-11: Sediment Quality for the Stream 1 Watershed

				Lentic Stations				Stream Stations	
				L1	L2	L2	L29	S1	S2
	Units	LEL	SEL	NAR	EcoMetrix	NAR	EcoMetrix	Golder	Golder
Physical Tests									
Total Phosphorus	(µg/g)	600	2000	2000	561	1400	715	903	416
Total Kjeldahl Nitrogen	(µg/g)	550	4800	166816	14100	13665	8810	-	-
Organic / Inorganic Carbon									
Total Organic Carbon	%	1	10	20	16	19	15	1.2	1.1
Total Metals									
Aluminum	(µg/g)	-	-	21300	5560	13600	6120	8590	3220
Arsenic	(µg/g)	6	33	12	3.0	4.8	2.9	2.6	2.0
Cadmium	(µg/g)	0.6	10	4.4	0.9	1.6	0.7	0.2	<0.05
Cobalt	(µg/g)	50		7.6	1.9	13	3.8	11	3.4
Copper	(µg/g)	16	110	48	9.3	130	16	38	6.3
Iron	(µg/g)	20000	40000	21000	7110	13600	11300	30300	8520
Lead	(µg/g)	31	250	87	33	43	22	6.1	2.3
Molybdenum	(µg/g)	-	-	2.4	1.4	1.2	1.0	1.1	<0.5
Nickel	(µg/g)	16	75	20	4.3	31	7.2	35	12
Selenium	(µg/g)	-	-	2.7	1.5	0.9	<1.0	<0.50	<0.50
Zinc	(µg/g)	120	820	122	81	70	75	178	16

Stream 2 Watershed

Key sediment parameters for the Stream 2 watershed are summarized in Table 5.4-12.

Table 5.4-12: Sediment Quality for the Stream 2 Watershed

				Lentic Stations								Stream Stations	
				L3	L5	L6	L7	L8	L14	L15	L20	S3	S4
	Units	LEL	SEL	NAR	NAR	NAR	NAR	NAR	NAR	NAR	EcoMetrix	Golder	Golder
Physical Tests													
Total Phosphorus	(µg/g)	600	2000	1300	2200	1900	2100	2400	1000	4500	2910	3440	506
Total Kjeldahl Nitrogen	(µg/g)	550	4800	13591	16945	21151	22000	14709	3744	6854	15600	-	-
Organic / Inorganic Carbon													
Total Organic Carbon	%	1	10	22	19	33	28	19	7.3	8.9	13	1.1	2.3
Total Metals													
Aluminum	(µg/g)	-	-	15200	19250	10000	18800	16100	10300	20700	9920	12500	6950
Arsenic	(µg/g)	6	33	5.8	5.0	1.3	15	3.2	3.0	1.8	3.9	2.4	3.4
Cadmium	(µg/g)	0.6	10	1.8	3.5	1.4	4.2	1.6	0.4	0.5	1.1	0.2	0.1
Cobalt	(µg/g)	50		4.7	4.6	2.1	5.8	14	19	20	4.2	20	6.4
Copper	(µg/g)	16	110	31	25	14	40	100	78	151	30	44	12
Iron	(µg/g)	20000	40000	11500	11650	8990	24000	25300	37400	25400	26500	57700	11800
Lead	(µg/g)	31	250	43	48	15	132	22	13	9.5	13	6.7	4.1
Molybdenum	(µg/g)	-	-	1.4	1.3	0.6	2.0	1.6	0.6	0.5	1.3	1.1	<0.50
Nickel	(µg/g)	16	75	18	15	5.5	14	31	45	41	7.8	40	18
Selenium	(µg/g)	-	-	0.6	1.6	<0.5	2.0	2.8	1.1	1.4	1.3	<0.5	0.6
Zinc	(µg/g)	120	820	66	122	26	186	185	69	83	116	94	28

Stream 3 Watershed

Key sediment parameters for the Stream 3 watershed are summarized in Table 5.4-13.

Table 5.4-13: Sediment Quality for the Stream 3 Watershed

				Lentic Stations									Stream Stations	
				L9	L9	L10	L11	L12	L13	L13a	L16	L16	S19	S6
	Units	LEL	SEL	EcoMetrix	NAR	NAR	NAR	NAR	EcoMetrix	EcoMetrix	EcoMetrix	NAR	Golder	Golder
Physical Tests														
Total Phosphorus	(µg/g)	600	2000	374	710	1400	1600	680	952	871	28100	7950	1190	515
Total Kjeldahl Nitrogen	(µg/g)	550	4800	3520	17419	17239	18437	14000	8200	2300	9100	23313	-	-
Organic / Inorganic Carbon														
Total Organic Carbon	%	1	10	8.6	26	21	17	22	12	4.8	13	30	11	3.1
Total Metals														
Aluminum	(µg/g)	-	-	8140	5900	7310	9730	10600	17700	23500	6260	5410	19000	7300
Arsenic	(µg/g)	6	33	1.5	1.8	1.9	3.9	2.5	3.3	1.9	1.7	2.4	5.8	3.1
Cadmium	(µg/g)	0.6	10	<0.50	1.2	1.1	1.4	0.9	<0.50	<0.50	<0.50	1.1	1.2	0.1
Cobalt	(µg/g)	50		6.3	6.6	10	29	7.6	18	17	25	16	50	6.5
Copper	(µg/g)	16	110	67	167	368	1360	518	140	185	475	529	325	15.7
Iron	(µg/g)	20000	40000	9780	7560	648	8590	4910	18600	18700	33400	33600	-	-
Lead	(µg/g)	31	250	23.5	31	21	43	20	21	6.7	17	21	23	4.1
Molybdenum	(µg/g)	-	-	<1.0	0.9	0.8	1.7	0.6	1.1	<1.0	<1.0	0.7	1.6	<0.50
Nickel	(µg/g)	16	75	14.0	19	45	125	70	40	63	26	30	87	19
Selenium	(µg/g)	-	-	<1.0	2.2	3.0	3.0	2.1	<1.0	<1.0	2.4	3.3	<0.50	0.7
Zinc	(µg/g)	120	820	55.0	67	77	113	79	85	58	82	81	112	27

Stream 4 Watershed

Key sediment parameters for the Stream 4 watershed are summarized in Table 5.4-14.

Table 5.4-14: Sediment Quality for the Stream 4 Watershed

	Units	LEL	SEL	Lentic Stations				Stream Stations		
				L21 Golder	L22 Golder	L18 Golder	L19 Golder	S8 Golder	S43 EcoMetrix	S51 Golder
Physical Tests										
Total Phosphorus	(µg/g)	600	2000	974	2100	3740	1970	556	651	4340
Total Kjeldahl Nitrogen	(µg/g)	550	4800	-	-	-	-	-	470	-
Organic / Inorganic Carbon										
Total Organic Carbon	%	1	10	39	14	7.8	24	2.7	0.66	1.22
Total Metals										
Aluminum	(µg/g)	-	-	5580	13000	12600	13600	19400	14000	10400
Arsenic	(µg/g)	6	33	0.6	0.9	1.9	3.3	6.5	2.1	1.4
Cadmium	(µg/g)	0.6	10	1.1	1.1	0.7	1.3	0.2	<0.50	0.3
Cobalt	(µg/g)	50		1.2	9.6	21	29	20	14	22
Copper	(µg/g)	16	110	13	39	191	234	28	16	20
Iron	(µg/g)	20000	40000	3200	15850	15700	35200	27100	22200	199000
Lead	(µg/g)	31	250	18	15	12	20	11	7.0	5.0
Molybdenum	(µg/g)	-	-	0.7	1.6	0.8	1.4	<0.50	<1.0	8.0
Nickel	(µg/g)	16	75	3.5	17	32	31	47	26	19
Selenium	(µg/g)	-	-	<0.50	<0.50	1	2.4	<0.50	<1.0	1.5
Zinc	(µg/g)	120	820	54	114	40	62	76	48	225

Stream 5 Watershed

Key sediment parameters for the Stream 5 watershed are summarized in Table 5.4-15.

Table 5.4-15: Sediment Quality for the Stream 5 Watershed

	Units	LEL	SEL	Lentic Stations								Stream Stations			
				L4 EcoMetrix	L17 Golder	L25 EcoMetrix	L27 EcoMetrix	Bamoos Littoral EcoMetrix	Bamoos Profundal EcoMetrix	Hare Littoral EcoMetrix	Hare Profundal EcoMetrix	S9 Golder	S10 Golder	S11 Golder	S41 EcoMetrix
Physical Tests															
Total Phosphorus	(µg/g)	600	2000	890	1060	876	793	3074	2260	786	1256	650	1230	319	1020
Total Kjeldahl Nitrogen	(µg/g)	550	4800	12900	-	19500	14500	4482	11492	5622	10686	-	-	-	1400
Organic / Inorganic Carbon															
Total Organic Carbon	%	1	10	13	13	15	25	6.4	12	6.2	12	10	1.1	0.95	1.2
Total Metals															
Aluminum	(µg/g)	-	-	9230	14700	11600	9060	9064	26840	14320	21860	7450	12100	5600	6340
Arsenic	(µg/g)	6	33	3.7	1.7	2.8	2.9	1.8	10	3.9	14	3.4	3.7	1.2	<1.0
Cadmium	(µg/g)	0.6	10	1.1	1.6	1.4	1.1	0.6	2.4	1.4	3.5	0.37	0.4	0.25	<0.50
Cobalt	(µg/g)	50		1.4	6.3	1.5	1.2	8.7	19	9.8	19	2.7	11	4.3	7.5
Copper	(µg/g)	16	110	12	16	11	11	18	100	21	32	4.4	7.7	7.2	17
Iron	(µg/g)	20000	40000	8250	11400	9360	7890	14474	36940	19940	47500	18600	66500	13300	31800
Lead	(µg/g)	31	250	31.3	15	20	20	16	46	18	65	14	8.2	4.5	4.4
Molybdenum	(µg/g)	-	-	1	1.5	1.2	1.4	<1.0	1.5	0.7	1.7	1.0	3.4	0.7	1.3
Nickel	(µg/g)	16	75	6.2	14	5.5	4.3	12	26	15	17	4.4	9.9	9.4	12
Selenium	(µg/g)	-	-	1.3	<0.50	1.4	2.1	0.6	2.7	1.0	2.5	<0.50	<0.50	0.6	<1.0
Zinc	(µg/g)	120	820	56	126	82	59	114	231	208	338	45	98	52	49

Stream 6 Watershed

Key sediment parameters for the Stream 6 watershed are summarized in Table 5.4-16.

Table 5.4-16: Sediment Quality for the Stream 6 Watershed

	Units	LEL	SEL	Lentic Stations		Stream Stations		
				L24	L26	S12	S15	S42
				EcoMetrix	EcoMetrix	EcoMetrix	EcoMetrix	EcoMetrix
Physical Tests								
Total Phosphorus	(µg/g)	600	2000	838	876	646	574	408.6
Total Kjeldahl Nitrogen	(µg/g)	550	4800	7250	19700	840	1710	1246
Organic / Inorganic Carbon								
Total Organic Carbon	%	1	10	11	24	1.7	1.3	0.8
Total Metals								
Aluminum	(µg/g)	-	-	12300	7490	10900	8650	8768
Arsenic	(µg/g)	6	33	2.4	3.3	1.4	<1.0	0.9
Cadmium	(µg/g)	0.6	10	<0.50	1.7	<0.50	<0.50	<0.50
Cobalt	(µg/g)	50		2.5	1.4	8.7	7	6.8
Copper	(µg/g)	16	110	7	10	7.3	10	5.3
Iron	(µg/g)	20000	40000	8720	5610	23300	12700	13440
Lead	(µg/g)	31	250	14	27	6.1	4.4	3.6
Molybdenum	(µg/g)	-	-	<1.0	1.1	<1.0	<1.0	<1.0
Nickel	(µg/g)	16	75	8.8	6.1	13	10	11
Selenium	(µg/g)	-	-	<1.0	1.8	<1.0	<1.0	<1.0
Zinc	(µg/g)	120	820	46	116	88	55	79

Pic River and Small Tributaries

Key sediment parameters for the Pic River and some miscellaneous tributary sampling locations are summarized in Table 5.4-17.

Table 5.4-17: Sediment Quality for the Pic River and some miscellaneous tributary sampling locations

	Units	LEL	SEL	Pic River Stations			Small Tributary Stations					Lentic Stations
				Upstream	Adjacent	Downstream	S24	S32	S44	S45	S46	Malpa
				Golder	Golder	Golder	EcoMetrix	EcoMetrix	EcoMetrix	EcoMetrix	EcoMetrix	NAR
Physical Tests												
Total Phosphorus	(µg/g)	600	2000	397	431	383	376	775	383	415	445	1100
Total Kjeldahl Nitrogen	(µg/g)	550	4800	-	-	-	550	640	1120	390	1930	18816
Organic / Inorganic Carbon												
Total Organic Carbon	%	1	10	2.1	2.0	1.7	0.4	0.98	1.1	0.9	1.1	22
Total Metals												
Aluminum	(µg/g)	-	-	5180	4170	4180	5820	20900	7950	6700	9660	17700
Arsenic	(µg/g)	6	33	2.9	2.4	2.2	1.2	3.4	1.5	1.2	2	5.9
Cadmium	(µg/g)	0.6	10	0.05	0.08	<0.05	<0.50	<0.50	<0.50	<0.50	<0.50	1.5
Cobalt	(µg/g)	50		5.2	3.9	3.9	6	19	7.7	5.8	8.8	14
Copper	(µg/g)	16	110	7.5	5.7	5.2	6.3	35	14	8.3	12	53
Iron	(µg/g)	20000	40000	9750	8090	8050	11300	27600	12000	10100	14800	12400
Lead	(µg/g)	31	250	3	2.6	2.4	6.9	9.3	5	3.8	6.7	39
Molybdenum	(µg/g)	-	-	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	1.7
Nickel	(µg/g)	16	75	13	13	12	11	36	14	11	15	36
Selenium	(µg/g)	-	-	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	3.8
Zinc	(µg/g)	120	820	23	18	19	20	63	26	23	30	168

Lake Superior

Key sediment parameters for Lake Superior are summarized in Table 5.4-18.

Table 5.4-18: Sediment Quality for Lake Superior

				Lake Superior Stations	
				Port Monro	Sturdee Cove
	Units	LEL	SEL	EcoMetrix	EcoMetrix
Physical Tests					
Total Phosphorus	(µg/g)	600	2,000	631	431
Total Kjeldahl Nitrogen	(µg/g)	550	4,800	2534	540
Organic / Inorganic Carbon					
Total Organic Carbon	%	1	10	2.1	0.6
Total Metals					
Aluminum	(µg/g)	-	-	7312	8002
Arsenic	(µg/g)	6	33	3.1	2.4
Cadmium	(µg/g)	0.6	10	0.4	<0.50
Cobalt	(µg/g)	50		7.4	8.5
Copper	(µg/g)	16	110	21	6.4
Iron	(µg/g)	20000	40000	17160	16300
Lead	(µg/g)	31	250	7.5	3.4
Mercury	(µg/g)	0.2	2	0.1	<0.050
Molybdenum	(µg/g)	-	-	<1.0	<1.0
Nickel	(µg/g)	16	75	14	15
Selenium	(µg/g)	-	-	<1.0	<1.0
Zinc	(µg/g)	120	820	76	71

5.4.4.2 Benthos

5.4.4.2.1 Work Scope

Benthic macroinvertebrate collections were conducted as part of the aquatic baseline studies (NAR 2007, Golder 2009 and EcoMetrix, 2012a). A detailed account of the methods used and locations of each sampling point is provided in EcoMetrix (2012a). The benthic sampling methods were dependent on the potential for the waterbody to be a receiver of treated mine discharge during operation. In Bamoos Lake, Hare Lake, Port Munro, Sturdee Cove and Pic River, multiple stations and multiple subsamples were collected in a quantitative manner. In the majority of other stations benthic collection were completed via a semi-quantitative sampling of all available habitats, to develop species presence/absence and relative abundance profiles.

A summary of the results of the benthic collections from all three baseline studies are discussed below, including a summary table for each watershed displaying key benthic invertebrate community endpoints typically used for monitoring for Canadian mines (e.g., Simpson's

Evenness, invertebrate density, taxa richness, etc.). Benthic sampling locations generally correspond to sediment sampling locations and are shown in Figure 5.4-5.

5.4.4.2.2 Existing Conditions

Stream 1 Subwatershed

There were a variety of benthic organisms identified representing a wide range of taxa including worms, leeches, amphipods, mayflies, stoneflies, caddisflies, beetles, midges, clams and snails (Table 5.4-19). The different habitats (lakes and ponds versus streams) resulted in expected differences in the community composition. Stations L1, L2 and S1 were classified as having fair water quality according to the Hilsenhoff Biotic Index; S2 was classified as having good water quality; and L29 was classified as having fairly poor water quality. The quantitative samples conducted at S1 and S2 by Golder resulted in wide ranging densities (i.e., 32 to 3,902 invertebrates/m^2). The Simpson's Diversity and Evenness numbers were moderate to high at both S1 and S2 with the S1 community being more diverse than the downstream community. EPT taxa were collected at the upstream and downstream stations and were generally more prevalent than more tolerant organisms such as chironomids.

Table 5.4-19: Summary of Benthic Macroinvertebrate Data for the Stream 1 Subwatershed

	Lentic Stations			Stream Stations	
	L1[1]	L2[1]	L29	S1[2]	S2[2]
TOTAL NUMBER OF ORGANISMS	-	-	6676	128	9
DENSITY (No./m^2)	-	-	-	1374	93
TOTAL NUMBER OF TAXA	18	22	40	25	10
MEAN NUMBER OF TAXA	-	-	-	11	5
SIMPSON'S DIVERSITY	-	-	0.84	0.76	0.65
SIMPSON'S EVENNESS	-	-	0.15	0.54	0.74
TOTAL EPT	2	3	4	6	5
MEAN EPT	-	-	-	2.0	2.3
HILSENHOFF INDEX	6.0	5.9	6.6	5.6	5.2
EPT/CHIRONOMIDAE	-	-	0.02	1.37	4.00
MAYFLIES	-	-	<1%	2%	2%
STONEFLIES	-	-	0%	3%	23%
CADDISFLIES	-	-	<1%	10%	4%
EPT	-	-	1%	15%	29%
CHIRONOMIDS	-	-	74%	49%	2%
ANNELIDS	-	-	<1%	7%	21%
SPHAERIID CLAMS	-	-	12%	11%	28%

1 - From original NAR (2007) presence/absence benthic data.
2 - Calculated from original Golder (2009) benthic data.
P - present
Note: For sampling methods used see NAR (2007) and Golder (2009).
EcoMetrix samples were collected with a 500 µm D-net Kick and Sweep method standardized to ten minutes of effort within all available habitats.

Stream 2 Subwatershed

Similar to the Stream 1 subwatershed, there were a variety of benthic invertebrates identified in the samples from a wide range of taxa including worms, leeches, amphipods, mayflies, stoneflies, caddisflies, beetles, midges, clams and snails in Stream subwatershed 2 (Table 5.4-20). The different habitats (lakes and ponds versus stream stations) resulted in expected differences in the community composition. Stations L5 (Canoe Lake), L6, L7, L8, L14 and L15 were classified as having fair water quality according to the Hilsenhoff Biotic Index, whereas Station L3 and L20 (Terru Lake) were classified as having fairly poor water quality.

The quantitative benthic macroinvertebrate samples collected at S3 and S4 by Golder had wide ranging densities with the upstream station having higher densities (i.e., 258 to 753 invertebrates/m^2), Simpson's Diversity (i.e., mean 0.85) and taxa richness (i.e., mean 15) compared to the downstream station. Sensitive species such as EPT were prevalent at both the upstream and downstream stations but were generally absent in the mid-reach between S3 and S4.

Table 5.4-20: Summary of Benthic Macroinvertebrate Data for the Stream 2 Subwatershed

	Lentic Stations								Stream Stations			
	L3[1]	L5[1]	L6[1]	L7[1]	L8[1]	L14[1]	L15[1]	L20	S3[2]	S4[2]	S59	S69
TOTAL NUMBER OF ORGANISMS	-	-	-	-	-	-	-	3059	43	4	9933	3512
DENSITY (No./m^2)	-	-	-	-	-	-	-	-	459	47	-	-
TOTAL NUMBER OF TAXA	15	18	32	23	18	12	13	50	29	8	30	41
MEAN NUMBER OF TAXA	-	-	-	-	-	-	-	-	15	3	-	-
SIMPSON'S DIVERSITY	-	-	-	-	-	-	-	0.94	0.85	0.65	0.81	0.93
SIMPSON'S EVENNESS	-	-	-	-	-	-	-	0.33	0.48	0.93	0.17	0.37
TOTAL EPT	1	2	6	4	4	1	2	6	14	5	1	13
MEAN EPT	-	-	-	-	-	-	-	-	7.7	2.3	-	-
HILSENHOFF INDEX	6.57	5.53	5.61	5.86	6.17	5.64	6.50	7.06	4.48	3.38	6.66	4.24
EPT/CHIRONOMIDAE	-	-	-	-	-	-	-	0.14	4.11	4.00	0.01	1.33
MAYFLIES	-	-	-	-	-	-	-	2%	4%	23%	0%	12%
STONEFLIES	-	-	-	-	-	-	-	0%	5%	42%	0%	21%
CADDISFLIES	-	-	-	-	-	-	-	5%	54%	17%	<1%	14%
EPT	-	-	-	-	-	-	-	7%	63%	82%	<1%	47%
CHIRONOMIDS	-	-	-	-	-	-	-	49%	18%	7%	44%	36%
ANNELIDS	-	-	-	-	-	-	-	8%	<1%	0%	3%	<1%
SPHAERIID CLAMS	-	-	-	-	-	-	-	4%	<1%	6%	2%	0%

1 - From original NAR (2007) presence/absence benthic data.
2 - Calculated from original Golder (2009) benthic data.
P - present
Note: For sampling methods used see NAR (2007) and Golder (2009).
EcoMetrix samples were collected with a 500 µm D-net Kick and Sweep method standardized to ten minutes of effort within all available habitats.

Stream 3 Subwatershed

The Stream 3 subwatershed benthic invertebrate community was comprised of a variety of taxa including worms, chironomids, leeches, amphipods, mayflies, stoneflies, caddisflies, beetles, midges, clams and snails (Table 5.4-21). The different habitats (lentic stations versus stream stations) resulted in expected differences in the community composition. The collected samples classified all stations as having fair water quality according to the Hilsenhoff Biotic Index with the exception of S18 which had good water quality. Quantitative samples collected at Stations S19 and S6 by Golder (2009) had wide ranging densities with the upper reach (S19) having higher densities compared to the downstream reach (S6). Mean taxa richness was more than twice as high in the S19 samples compared to the downstream S6 samples. The downstream station had a higher Simpson's Diversity and higher Evenness compared to the upper reach station, however this is likely a result of the low number of individuals collected downstream. Simpson's Diversity and Evenness were high and low respectively in L9, L13, L13a and L16 in 2009 (Table 5.4-21). EPT species were found in the upstream, mid-reach and downstream Stream 3 stations.

Table 5.4-21: Summary of Benthic Macroinvertebrate Data for the Stream 3 Subwatershed

	Lentic Stations								Stream Stations		
	L9	**L10[1]**	**L11[1]**	**L12[1]**	**L13**	**L13a**	**L16[1]**	**L16**	**S6[2]**	**S18**	**S19[2]**
TOTAL NUMBER OF ORGANISMS	2359	-	-	-	5445	2352	-	2842	8	1563	228
DENSITY (No./m^2)	-	-	-	-	-	-	-	-	83	-	2458
TOTAL NUMBER OF TAXA	46	21	20	17	28	47	23	38	15	42	28
MEAN NUMBER OF TAXA	-	-	-	-	-	-	-	-	7	-	16
SIMPSON'S DIVERSITY	0.91	-	-	-	0.87	0.93	-	0.87	0.82	0.80	0.63
SIMPSON'S EVENNESS	0.24	-	-	-	0.27	0.32	-	0.21	0.93	0.12	0.18
TOTAL EPT	5	3	1	2	2	4	5	4	6	11	6
MEAN EPT	-	-	-	-	-	-	-	-	2.0	-	5.7
HILSENHOFF INDEX	6.50	6.24	6.11	5.64	6.22	6.15	5.78	5.81	5.65	5.18	5.51
EPT/CHIRONOMIDAE	0.13	-	-	-	0.02	0.12	-	0.27	-	1.56	1.92
MAYFLIES	1%	-	-	-	0%	2%	-	6%	0%	15%	7%
STONEFLIES	0%	-	-	-	0%	0%	-	0%	8%	11%	2%
CADDISFLIES	5%	-	-	-	1%	4%	-	1%	25%	4%	13%
EPT	6%	-	-	-	1%	6%	-	7%	32%	29%	23%
CHIRONOMIDS	47%	-	-	-	78%	47%	-	27%	0%	19%	32%
ANNELIDS	8%	-	-	-	2%	1%	-	1%	22%	<1%	2%
SPHAERIID CLAMS	12%	-	-	-	5%	3%	-	14%	0%	0%	38%

1 - From original NAR (2007) presence/absence benthic data.
2 - Calculated from original Golder (2009) benthic data.
P - present
Note: For sampling methods used see NAR (2007) and Golder (2009).
EcoMetrix samples were collected with a 500 µm D-net Kick and Sweep method standardized to ten minutes of effort within all available habitats.

Stream 4 Subwatershed

The Stream 4 subwatershed benthic invertebrate samples indicated that there were a variety of benthic invertebrates identified in the samples from a wide range of taxa including worms, leeches, amphipods, mayflies, stoneflies, caddisflies, beetles, midges, clams and snails. The different habitats (lentic versus stream stations) resulted in expected differences in the community composition. The density of invertebrates varied among replicates and between waterbodies. Stream stations sampled by Golder (2009) exhibited similar taxa richness, with the upstream station having higher Simpson's Diversity and Evenness. Taxa richness in the lower reach was lower than in the middle and upper reaches. EPT taxa comprised a similar proportion of the community at the downstream and upstream stations (i.e., 42% and 31%) which was higher than in the mid-reach station (i.e., 11%) (Table 5.4-22). According to the Hilsenhoff Biotic Index, Stations L18, L19 (Claw Lake) and L21 had fairly poor water quality whereas L22 had fair water quality. The upper reach, mid-reach and lower reach stations (i.e., S51, S8 and S43) were classified as having very good, fair and good water quality, respectively according to the Hilsenhoff Biotic Index.

Table 5.4-22: Summary of Benthic Macroinvertebrate Data for the Stream 4 Subwatershed

	Lentic Stations				Stream Stations			
	L18[1]	L19[1]	L21[1]	L22[1]	S8[1]	S43	S51[1]	S51A
TOTAL NUMBER OF ORGANISMS	2770	514	2468	1780	155	152	66	5300
DENSITY (No./m^2)	39571	7338	35262	25424	1665	-	710	-
TOTAL NUMBER OF TAXA	63	54	37	52	27	11	32	31
MEAN NUMBER OF TAXA	39	30	24	35	15	-	17	-
SIMPSON'S DIVERSITY	0.91	0.87	0.85	0.90	0.39	0.86	0.85	0.77
SIMPSON'S EVENNESS	0.30	0.27	0.29	0.29	0.11	0.67	0.43	0.14
TOTAL EPT	9	8	4	7	8	4	9	7
MEAN EPT	5	4	2	6	6	-	6	-
HILSENHOFF INDEX	7.06	7.05	7.50	6.07	5.58	5.20	4.43	6.14
EPT/CHIRONOMIDAE	0.28	0.94	0.03	0.33	5.01	1.60	0.85	0.10
MAYFLIES	11%	30%	0%	11%	5%	26%	15%	1%
STONEFLIES	0%	0%	0%	0%	0%	0%	0%	1%
CADDISFLIES	2%	3%	2%	4%	6%	16%	16%	5%
EPT	13%	33%	2%	15%	11%	42%	31%	7%
CHIRONOMIDS	63%	36%	74%	45%	5%	26%	40%	72%
ANNELIDS	7%	9%	11%	3%	<1%	11%	3%	<1%
SPHAERIID CLAMS	3%	6%	0%	20%	78%	0%	8%	<1%

1 - Calculated from original Golder (2009) benthic data.
Note: For sampling methods used see Golder (2009).
EcoMetrix samples were collected with a 500 µm D-net Kick and Sweep method standardized to ten minutes of effort within all available habitats.

Stream 5 Subwatershed

In 2009, quantitative benthic samples were collected from five littoral and five profundal zone sites in Bamoos Lake and Hare Lake and a semi-quantitative sample was collected from S41 on Bamoos Creek. Five replicate quantitative samples were collected at S11 in September 2011. Also in 2011, semi-quantitative samples were collected at lentic stations L25, L27 and stream stations S20, S60, S61 and S62. Previously, samples were collected by NAR (2007) at L4 in 2006 and by Golder (2009) in 2007 at Stations S9, S10, S11 and L17. The NAR sample from L4 and the 2009 littoral zone samples from Bamoos Lake and Hare Lake classified the water quality as fair. The Hilsenhoff value classified L17 water quality as poor and L25, L27, and Bamoos and Hare Lake profundal areas as fairly poor. The water quality of the outlets of a number of the headwater ponds were classified as poor to fair, whereas further downstream, the Hilsenhoff values classified the water quality as good to very good.

A wide variety of invertebrates were collected at the stream stations in 2006, 2007, 2009 and 2011. S9, S10, S11 and S41 were dominated by EPT taxa whereas the headwaters stations S60, S61 and S62 were dominated by chironomids. S20 had a fairly even split in dominance between chironomids and EPT taxa. Mollusks (predominantly sphaeriid clams) oligochaetes and leeches also comprised substantial proportions of most stream station benthic communities. In both Bamoos and Hare Lakes, the littoral zone benthic samples were more diverse and generally had higher densities than the profundal stations. In both lakes, dipterans and sphaeriids dominated the benthic communities in both littoral and profundal zones with a number of other groups comprising smaller proportions of the community. Simpson's Diversity was moderate to high at all stations within the watershed and Evenness was generally moderate (Table 5.4-23).

Table 5.4-23: Summary of Benthic Macroinvertebrate Data for the Stream 5 Watershed

	Lentic Stations								Stream Stations								
	L4[1]	L17[2]	L25	L27	Bamoos Lake		Hare Lake		S9[2]	S10[2]	Hare Creek		S20	S41	S60	S61	S62
					Profundal[3]	Littoral[3]	Profundal[3]	Littoral[3]			S11[2]	S11[3]					
TOTAL NUMBER OF ORGANISMS	-	280	7216	3795	38	115	80	386	242	15	89	992	3708	17568	3592	1099	4857
DENSITY (No./m^2)	-	4000	-	-	543	1646	1140	5516	2605	165	954	3553	-	-	-	-	-
TOTAL NUMBER OF TAXA	15	41	23	24	11	17	12	37	28	21	39	60	28	50	31	25	21
MEAN NUMBER OF TAXA	-	20	-	-	6	8	6	14	16	9	22	33	-	-	-	-	-
SIMPSON'S DIVERSITY	-	0.88	0.81	0.81	0.67	0.80	0.68	0.84	0.67	0.80	0.89	0.76	0.82	0.94	0.88	0.87	0.56
SIMPSON'S EVENNESS	-	0.51	0.22	0.22	0.52	0.73	0.57	0.52	0.20	0.66	0.42	0.18	0.20	0.32	0.27	0.30	0.11
TOTAL EPT INDEX	-	3	3	1	0	1	0	3	9	9	16	26	6	25	3	2	3
MEAN EPT INDEX	-	1	-	-	0.0	0.6	0.0	1.0	7	4	12	16	-	-	-	-	-
HILSENHOFF INDEX	6.07	7.68	7.45	7.10	6.79	6.09	7.45	6.17	5.18	4.21	4.30	3.99	5.51	4.45	7.87	6.58	6.46
EPT/CHIRONOMIDAE	-	0.12	0.04	0.01	0.00	0.09	0.00	0.10	3.50	7.00	9.45	3.90	0.45	2.42	0.02	0.04	0.02
MAYFLIES	-	0%	<1%	0%	0%	4%	0%	2%	10%	5%	23%	26%	1%	32%	<1%	0%	0%
STONEFLIES	-	0%	0%	2%	0%	0%	0%	0%	<1%	17%	3%	4%	3%	22%	0%	0%	0%
CADDISFLIES	-	6%	2%	<1%	0%	0%	0%	2%	33%	28%	39%	21%	9%	13%	<1%	2%	<1%
EPT	-	6%	2%	<1%	0%	4%	0%	3%	44%	50%	65%	51%	13%	67%	1%	2%	<1%
CHIRONOMIDS	-	54%	54%	82%	49%	51%	47%	39%	3%	7%	8%	15%	28%	28%	86%	51%	36%
ANNELIDS	-	13%	0%	3%	1%	5%	0%	4%	2%	7%	3%	<1%	<1%	3%	<1%	0%	<1%
SPHAERIID CLAMS		8%	3%	<1%	45%	26%	39%	27%	48%	6%	18%	27%	17%	0%	1%	5%	<1%

1 - From original NAR (2007) presence/absence benthic data.
2 - Calculated from original Golder (2009) benthic data.
3 - Calculated from a mean of five samples.
Note: For sampling methods used see NAR (2007) and Golder (2009).
With exception of Hare Lake, Bamoos Lake and Hare Creek, EcoMetrix samples were collected with a 500 μm D-net Kick and Sweep method standardized to ten minutes of effort within all available habitats.
Hare Lake and Bamoos Lake samples collected using petite Ponar.
S11 samples collected with a 500μm Surber sampler.

Stream 6 Subwatershed

EcoMetrix collected benthic samples at stations S12, S15 and S42 within Stream 6 to compliment the sample collected in the headwaters at S63 in 2007. Station L26, which is situated at the headwaters of Stream 6, was sampled during the 2009 study and L24 was sampled in June 2011. Chironomids were the dominant taxa in both L24 and L26. At S12 and S63, EPT taxa were most common (Table 5.4-24). Annelids and ostracods dominated the S15 benthic community. At S42, near the power transmission lines, chironomids and clams were the principal components of the benthic invertebrate community. Generally, chironomids, annelids and mollusks were more prevalent in slower sections of Stream 6 and in L26 and L24 compared to the areas where there were coarser substrates. Generally the Simpson's Diversity and Evenness values indicated diverse communities that were dominated by a limited number of taxa. The water quality was categorized as excellent at the headwater stream stations to fair downstream according to the Hilsenhoff Biotic Index.

Table 5.4-24: Summary of Benthic Macroinvertebrate Data for the Stream 6 subwatershed

	Lentic Stations		Stream Stations			
	L24	L26	S12	S15	S42[2]	S63[1]
TOTAL NUMBER OF ORGANISMS	1902	5408	1025	981	622	87
DENSITY (No./m^2)	-	-	-	-	8886	940
TOTAL NUMBER OF TAXA	28	18	47	24	50	38
MEAN NUMBER OF TAXA	-	-	-	-	17	21
SIMPSON'S DIVERSITY	0.90	0.78	0.93	0.76	0.72	0.89
SIMPSON'S EVENNESS	0.36	0.26	0.30	0.17	0.26	0.42
TOTAL EPT INDEX	2	1	14	4	8	13
MEAN EPT INDEX	-	-	-	-	1.8	9
HILSENHOFF INDEX	6.04	6.71	5.47	6.35	6.18	3.10
EPT/CHIRONOMIDAE	0.16	0.01	1.44	0.18	0.17	7.56
MAYFLIES	5%	0%	35%	2%	0%	15%
STONEFLIES	0%	0%	6%	0%	2%	1%
CADDISFLIES	<1%	<1%	8%	1%	3%	38%
EPT	6%	<1%	48%	3%	4%	54%
CHIRONOMIDS	36%	86%	34%	15%	32%	8%
ANNELIDS	4%	0%	3%	36%	14%	3%
SPHAERIID CLAMS	0%	2%	4%	11%	42%	18%

1 - Calculated from original Golder (2009) benthic data.
2 - Calculated from a mean of five samples.
standardized to ten minutes of effort and covering all available habitats.
Note: For sampling methods used see Golder (2009).
With exception of S41, EcoMetrix samples were collected with a 500 µm D-net Kick and Sweep method
standardized to ten minutes of effort within all available habitats.
S42 samples collected with a standard Ekman.

Pic River and Small Tributaries

A benthic sample was collected in Malpa Lake in 2006 by NAR (2007) that classified the benthic community as fair despite the lake having the lowest number of taxa of any of the lakes sampled within the Project Area. Benthic samples were collected in 2009 at S24, S32, S44, S45 and S46 (Table 5.4-25). The water quality in these tributaries ranged from fairly poor to good based on the Hilsenhoff Index value. EPT taxa dominated the communities in S32, S44 and S46, whereas chironomids were dominant in S24 and S45. These community differences likely results from the variability of substrates encountered at these stations, some of which were predominantly fine sediments and others that were mainly coarse materials. A number of other invertebrate groups were collected including annelid worms, tipulid midges, dixid flys, mites, ostracods and springtails.

In 2007, Golder (2009) collected benthic samples in three areas of the Pic River. The Simpson's Diversity was moderate for all three areas. Evenness was moderately high in the adjacent and downstream areas but low in the upstream area. Density ranged widely between areas. Invertebrate density in the upstream area was an order of magnitude higher than in the other two areas. Dominant taxa were chironomids upstream, annelids adjacent to and biting-midges downstream of the Project site. EPT taxa were identified in all three areas but the number of taxa was low throughout all areas. The Hilsenhoff Index values classified the water as fairly poor in upstream and adjacent areas and good in the downstream area.

Table 5.4-25: Summary of Benthic Macroinvertebrate Data for the Pic River and other Small Tributaries

	Pic River			Stream Stations						Lentic Stations
	Upstream[2]	Adjacent[2]	Downstream[2]	S24	S32	S43	S44	S45	S46	Malpa Lake[1]
TOTAL NUMBER OF ORGANISMS	131	7	11	344	24	152	104	56	1032	-
DENSITY (No./m^2)	5696	304	464	-	-	-	-	-	-	-
TOTAL NUMBER OF TAXA	24	11	12	12	8	11	11	7	18	10
MEAN NUMBER OF TAXA	16	5	6	-	-	-	-	-	-	-
SIMPSON'S DIVERSITY	0.70	0.66	0.72	0.88	0.85	0.86	0.87	0.77	0.74	-
SIMPSON'S EVENNESS	0.25	0.83	0.72	0.68	0.82	0.67	0.70	0.61	0.21	-
TOTAL EPT INDEX	2	3	3	2	4	4	4	0	5	1
MEAN EPT INDEX	0.7	1.0	1.0	-	-	-	-	-	-	-
HILSENHOFF INDEX	7.45	6.86	5.48	7.00	4.71	5.20	5.09	6.33	4.63	6.00
EPT/CHIRONOMIDAE	0.01	1.00	1.83	0.41	7.00	1.60	3.20	0.00	1.70	-
MAYFLIES	<1%	17%	12%	0%	17%	26%	15%	0%	0%	-
STONEFLIES	<1%	0%	0%	12%	25%	0%	27%	0%	57%	-
CADDISFLIES	0%	0%	3%	5%	17%	16%	19%	0%	2%	-
EPT	<1%	17%	15%	16%	58%	42%	62%	0%	58%	-
CHIRONOMIDS	62%	14%	8%	40%	8%	26%	19%	71%	34%	-
ANNELIDS	13%	41%	8%	26%	0%	11%	4%	7%	<1%	-
SPHAERIID CLAMS	0%	0%	0%	0%	0%	0%	0%	0%	0%	-

1 - From original NAR (2006) presence/absence benthic data.
2 - Mean calculated from original Golder (2009) benthic data.
Note: For sampling methods used see NAR (2007) and Golder (2009).
EcoMetrix samples were collected with a 500 µm D-net Kick and Sweep method standardized to ten minutes of effort within all available habitats.

Lake Superior

In 2009, quantitative benthic invertebrate surveys were conducted in both Port Munro (mouth of Hare Creek) and Sturdee Cove (mouth of Stream 6). The dominant invertebrate groups in both cases were chironomids, ostracods, sphaeriids and tubificid worms comprising 87 and 88% of the mean benthic communities in Port Munro and Sturdee Cove, respectively (Table 5.4-26). Additional taxa included mites, amphipods, trichopterans, emphemeropterans, snails and isopods. Simpson's Diversity values indicated that the benthic communities were diverse at both locations. Evenness was moderate resulting from the small number of taxa dominating the communities.

Table 5.4-26: Summary of Benthic Macroinvertebrate Data for Lake Superior

	Lake Superior	
	Port Monro[1]	Sturdee Cove[1]
TOTAL NUMBER OF ORGANISMS[2]	276	502
DENSITY (No./m^2)	3941	7174
TOTAL NUMBER OF TAXA	46	42
MEAN NUMBER OF TAXA	23	25
SIMPSON'S DIVERSITY	0.89	0.87
SIMPSON'S EVENNESS	0.43	0.31
TOTAL EPT INDEX	2	1
MEAN EPT INDEX	0.6	0.6
HILSENHOFF INDEX	6.72	6.41
EPT/CHIRONOMIDAE	0.01	0.01
MAYFLIES	0%	0%
STONEFLIES	0%	0%
CADDISFLIES	<1%	<1%
EPT	<1%	<1%
CHIRONOMIDS	46%	49%
ANNELIDS	10%	11%
SPHAERIID CLAMS	14%	13%

1 - Calculated from a mean of 5 samples
Note: Lake Superior samples collected using a Petite ponar

5.4.5 Fish and Fish Habitat

5.4.5.1 Work Scope

Fish and fish habitat studies were conducted as part of the aquatic baseline studies (NAR, 2007; Golder, 2009; and EcoMetrix, 2012a). A detailed account of the methods used and locations of each sampling point is provided within the aforementioned reports and is synthesized in EcoMetrix (2012a). Stream stations were sampled via backpack electrofisher, whereas lentic habitats and the Pic River were sampled with a variety of passive sampling gear (i.e., gillnets, trapnets, baited minnow traps, Nordic nets) and beach seine. Sampling was conducted in a variety of seasons. If primary surveys did not indicate the presence of fish, targeted springtime sampling, the time of year when fish are most active and when water levels allow migration between potentially isolated waterbodies, was conducted to increase the potential catchability.

5.4.5.2 Existing Conditions

The distribution of fish across the study area is summarized in Figure 5.4-6. A summary of the results of the fish and fish habitat studies from all three baseline studies are discussed below on a subwatershed by subwatershed basis.

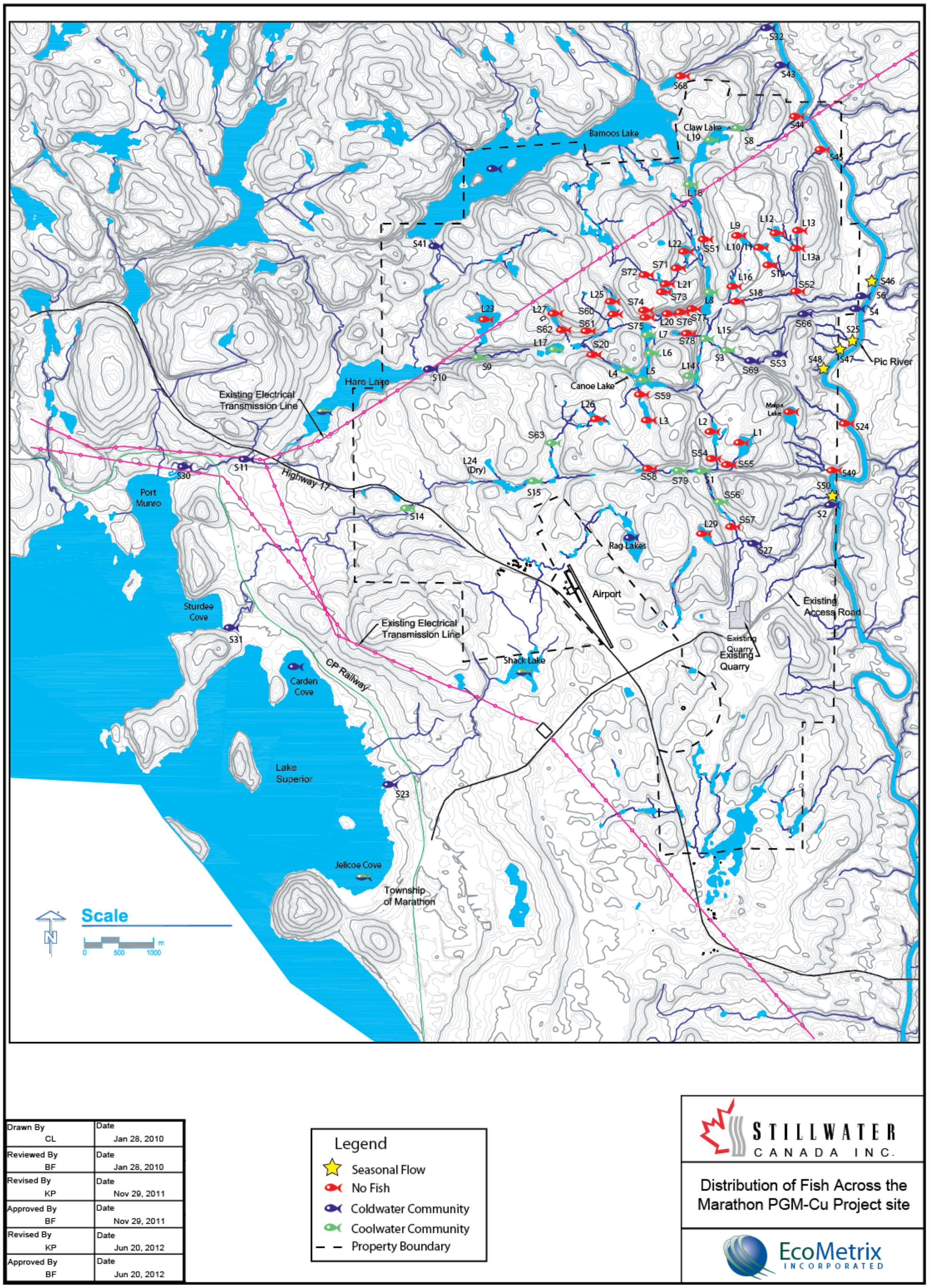


Figure 5.4-6: Distribution of Fish Across the Marathon PGM-Cu Project Site

5.4.5.2.1 Stream 1 Watershed

Multi-season passive and active fishing effort in the headwater lakes (i.e., L1, L2 and L29) within the Stream 1 subwatershed resulted in the capture of no fish. There are several possible reasons for no fish being present within these lakes. There is likely limited overwintering habitat in these lakes, and in L2 and L29 in particular. In addition, oxygen depletion in the hypolimnion of L1 suggests that suitable fish habitat may be limited to the littoral zone of the epilimnion during much of the summer months. All three lakes are situated at the top of fairly steep gradients, which impedes fish colonization from downstream source populations. Overall, it is probable that a lack overwintering habitat, combined with downstream barriers (to upstream fish movement) in the form of natural topography account for the absence of fish in these lakes. .

No fish were collected within the most upstream reaches of Stream 1 (Stations S54, S55, and S58). Fish were captured at S1 and the extent of upstream fish inhabitation was documented in June 2011 (i.e., S79). At Station S79 and within the remaining upper 2nd order reaches small baitfish species were present. Progressing downstream along this watercourse, Brook Trout (*Salvelinus fontinalis*) occurred in the mid-reaches, whereas a more diverse coldwater community including both resident and migratory salmonids was present within the lower reach. It is possible that natural barriers (e.g., low or intermittent flow, dams) to migration occur, which partition the fish communities within this watercourse among the middle and upper, and lower and middle reaches. At the outlet of Stream 1 to the Pic River, there is a perched culvert that impedes the upstream movement of fish during non-freshet flows.

5.4.5.2.2 Stream 2 Watershed

Two of the three headwater areas (i.e., Stations L3 and Terru Lake) within the Stream 2 subwatershed were fishless, whereas L7 contained a large number of Lake Chub (*Couesius plumbeus*). The pH in L3 and Terru Lake were relatively low (in the 4 to 5.5 range) in 2009, and may in part explain the absence of fish. Additional pH measures taken in 2011 confirmed the low pH in L3 but Terru Lake had an acceptable pH at that time. These lakes are relatively deep and may provide overwintering habitat, though reduced oxygen at depth and below winter ice was measured at both, which may indicate at least the possibility of winter-kill due to oxygen deprivation. Beaver activity, topography and low flows in connecting channels also likely impede upstream migration of fish into these waterbodies.

In the middle portion of the subwatershed (i.e., Canoe Lake (L5) and Stations L6, L8, L14 and L15) only one or two species were captured at each waterbody. Canoe Lake and L6 appear to only support Lake Chub, whereas Stations L8 and L15 contained only Brook Stickleback (*Culaea inconstans*). Both species were collected in L14; however only a single Lake Chub was captured suggesting that chub in this waterbody are likely only downstream migrants.

All stream stations from L15 downstream supported fish. Station S3, the most upstream location, only contained Brook Stickleback. At the downstream end of this station (S3) there was a significant natural barrier to upstream migration in the form of a waterfall. This barrier, as well as other topographic barriers which occur downstream, likely contribute to the lack of species diversity encountered in the upstream reaches of the watershed compared to the downstream reaches. The middle reaches of Stream 2 (Station S53 and S69) support a resident coldwater fish community that includes Brook Trout (S53 and S69) and Slimy Sculpin (*Cottus cognatus*) (S53). The presence of Rainbow Trout (*Oncorhynchus mykiss*) at S53 indicates that this area has connectivity with the lower reaches and the Pic River. Within the lowest reaches, upstream of the confluence with the Pic River (S4), Stream 2 supports a diverse fish community. Three surveys (September 2007, May 2009, and August 2009) have occurred at this location and ten species of fish have been collected including Rainbow Trout, Chinook Salmon (*Oncorhynchus tshawytscha)*, Brook Trout, Lake Chub, Finescale Dace (Chrosomus neogaeus), Longnose Dace, (*Rhinichthys cataractae*) White Sucker (*Catostomus commersonii*), Trout-perch (*Percopsis omiscomaycus*), Brook Stickleback and Slimy Sculpin. This tributary affords potential spawning and nursery habitats for resident species (i.e., Brook Trout, Slimy Sculpin), as well as migratory species (i.e., Rainbow Trout, Chinook Salmon).

5.4.5.2.3 Stream 3 Watershed

Despite relatively intensive fish surveys, including increased efforts in 2009, 2010 and 2011, all streams, lakes and ponds surveyed within upper and mid-reaches of the Stream 3 subwatershed yielded no fish. The potential for re-population of this area from downstream reaches is unlikely due to topographic barriers afforded by the steep relief as the watershed drains to the east towards the Pic River

Within the lower reaches, upstream of the confluence with the Pic River, Stream 3 (Station S6) supports a few fish species. Three surveys (September 2007, May 2009, and August 2009) have occurred at this location and five species of fish have been collected including Rainbow Trout, Brook Trout, Longnose Dace, Slimy Sculpin and Johnny Darter (*Etheostoma nigrum*). This lower reach of the tributary affords some nursery and potentially spawning habitat but the lower reach of Stream 3 sees intermittent flow during low flow periods.

5.4.5.2.4 Stream 4 Watershed

No fish were captured upstream of a waterfall located at Station S51a (i.e., Stations S51, L21, L22 and all connecting tributaries). This could possibly be a result of low pH in some of the areas of the upper watershed (i.e., pH of 4.4 in L21). However, water quality was suitable in L22 at the time of the survey suggesting that a lack of overwintering habitat, combined with downstream barriers in the form of beaver dams and/or natural topography such as the waterfall at the downstream end of S51A, likely account for the absence of fish. Stations L18 and L19 and the mid-reach of Stream 4 (S8) supported a variety of fish species including Blacknose Shiner (*Notropis heterolepis*), Finescale Dace, Fathead Minnow (*Pimpephales promelas*), Longnose Sucker (*Catostomus catostomus*), Brook Stickleback, Lake Chub, and Northern

Redbelly Dace (*Chrosomus eos*). The extremely steep cascades within the mid-reaches of Stream 4 may impede upstream migration of fish from the lower reaches.

Within the lower reaches, upstream of the confluence with the Pic River, Stream 4 (S43) supports a number of fish species. Two surveys (May 2009, August 2009) have resulted in the capture of nine species including Rainbow Trout, Brook Trout, Chinook Salmon, Finescale Dace, White Sucker, Trout-Perch, Brook Stickleback, Slimy Sculpin and Johnny Darter. This lower reach of the tributary affords potential spawning and nursery habitat for both migratory and resident salmonids, as well as other small (baitfish) species.

5.4.5.2.5 Stream 5 (Hare Creek) Watershed

The small headwater basins within the Hare Lake watershed support no fish or sustain a very limited community. Station L4 and L17 contained Lake Chub and Brook Stickleback. Stations L23, L25 and L27 were fishless, as were their downstream tributaries (Stations S60, S61 and S62). These headwater areas and tributaries are probably fishless due to a lack of overwintering habitat, combined with barriers in the form of beaver dams and steep gradients, which impede re-colonization from downstream. Within the mid-reach of Stream 5, only Brook Stickleback have been collected (i.e., S22 and S9). Within the lower reach (S10), just upstream of Hare Lake, a resident coldwater fish community existed including Brook Trout and Brook Stickleback. Bamoos Creek between Bamoos Lake and Hare Lake (S41) also supported a resident coldwater fish community including Slimy Sculpin and Brook Trout.

Bamoos Lake supports a diverse coldwater community. Twelve species were captured during the 2009 survey including Lake Trout (*Salvelinus namaycush*), Brook Trout, Cisco (*Coregonus artedi*), Slimy Sculpin, Longnose Sucker, White Sucker, Trout-perch, Brook Stickleback, Ninespine Stickleback (*Pungitius pungitius*), Lake Chub, Finescale Dace and Fathead Minnow. Two additional species, Lake Whitefish (*Coregonus clupeaformis*) and Burbot (*Lota lota*) are also reported for the lake according to OMNR records.

Hare Lake provides coldwater habitat; however the extensive 2009 and 2011 fish surveys indicated that the majority of the community is comprised primarily of coolwater species. The species captured in 2009 included Northern Pike (*Esox lucius*), Yellow Perch (*Perca flavescens*), Spottail Shiner (*Notropis hudsonius*), Logperch (*Percina caprodes*), Cisco and Burbot. In 2011, a single Lake Trout and low numbers of Trout-Perch, Spoonhead Sculpin (*Cottus ricei*) and Longnose Sucker were also captured in Hare Lake. The Lake Trout that was captured was a hatchery fish (fin-clipped) and its origin is unknown – it does not represent a population of Lake Trout in Hare Lake. Historic records also report Fathead Minnow inhabiting the lake. Walleye (*Sander vitreus*) and splake were stocked in the past but have not persisted. Extensive fishing efforts in 2009 and 2011 did not result in the capture of either of these two species.

Hare Creek downstream of Hare Lake was surveyed at two locations, below the Highway 17 crossing (S11) and upstream of the outlet to Lake Superior (S30). Both surveys indicated that the lower portions of Hare Creek support a relatively diverse coldwater fish community including both migratory and resident salmonid species. The fish community in lower Hare Creek includes: Rainbow Trout, Chinook Salmon, Brook Trout, Brook Stickleback, Slimy Sculpin, Rainbow Smelt (*Osmerus mordax*), Longnose Dace, Longnose Sucker, Ninespine Stickleback and Mottled Sculpin (*Cottus bairdii*). The lower reaches of Hare Creek affords spawning and nursery habitat for both migratory and resident coldwater fishes.

5.4.5.2.6 Stream 6 Watershed

Multiple fisheries surveys of L26 during 2009, 2010 and 2011 resulted in no fish being collected. Backpack electrofishing at L24 in 2010 and 2011 indicates that this area does not support fish. Only Brook Stickleback have been collected at Stream 6 stations upstream of Highway 17. Possible explanations for such a limited fish community in the upstream reaches and headwater lakes are a lack of overwintering habitat, low flows and barriers (including beaver dams and cascades). For example, at Station S14 there are a number of cascades that would be impediments to upstream fish passage. There is a waterfall which occurs in the lower reach of Stream 6 upstream of S31 which prevents migrating Lake Superior species from getting upstream.

Within the lowest reaches, upstream of the outlet to Lake Superior, a limited number of salmonids were captured in 2009. In total four fish species were collected including Rainbow Trout, Chinook Salmon, Longnose Dace and Mottled Sculpin. This reach of Stream 6 provides a limited amount of nursery habitat for migratory coldwater species from Lake Superior, as well as some other small-bodied species. The quality of this lower reach for nursery is reduced compared to other tributaries in the area due to the primarily sandy substrates compared to more productive habitats which are typically comprised of courser substrates (i.e., gravel, cobble). A small area just below the barrier falls near S31 has coarser substrates and does provide limited potential spawning habitat for Rainbow Trout and Chinook Salmon.

5.4.5.2.7 Pic River and Small Tributaries

Of all of the Pic River tributaries which appeared to have some fisheries potential, fish were only collected in one. The presence of Rainbow Trout fry at Station S32 (a small tributary north of the Project site) indicates that this tributary affords potential (albeit limited) nursery habitat – no potential spawning habitat was noted. Overall the value of these small streams from a fish habitat perspective is considered minimal as flows are dependent on the amount of precipitation and salmonid spawning habitat is relatively scarce due to the paucity of coarse substrates in most of the tributaries.

The fish community of the Pic River is diverse, with a variety of coolwater and coldwater fish species reported including Lake Sturgeon (*Acipenser fulvescens*), Walleye, Longnose Sucker, Silver Redhorse (*Moxostoma anisurum*), Muskellunge (*Esox masquinongy*), Trout-perch, Spottail Shiner, Northern Redbelly Dace, Rainbow Trout, Coho Salmon (*Oncorhynchus kisutch*), Chinook Salmon, Brook Trout, Rainbow Smelt, Northern Pike, White Sucker and Shorthead Redhorse (*Moxostoma macrolepidotum*).

5.4.5.2.8 Lake Superior

The nearshore embayments of Lake Superior provide habitat for a variety of fishes, including both coldwater and coolwater species. These embayments offer nursery habitats for many species including whitefish, salmon, trout and suckers. Spawning habitat for species such as whitefish is also likely present. In addition, many Lake Superior species migrate through the embayments to spawning tributaries which outlet to the lake.

5.4.5.2.9 Fish and Fish Habitat Summary

The Project site is drained by a total of six primary subwatersheds, four of which drain to the Pic River. Waterbodies and watercourses in the interior of the Project site include small streams, ponds and lakes, many of which are maintained by active or inactive beaver dams, or debris jams. The interior of the Project site is isolated from both the Pic River and Lake Superior by steep relief (i.e., topography) and therefore much of this area is fishless. In the instances where fish do occur the community is limited to small-bodied (forage) fish.

The Pic River watershed tributaries afford limited coldwater spawning and/or nursery habitats within their lowest reaches for migratory species (e.g., Rainbow Trout, Chinook Salmon), as well as resident species (e.g. Brook Trout, Slimy Sculpin). The fish community of the Pic River is diverse, with a variety of coolwater and coldwater fish species reported including Lake Sturgeon and Walleye. Lake Sturgeon move extensively up and down the Pic River during spawning migration and utilize the lower river for foraging.

Bamoos Lake supports a diverse coldwater community, including Lake Trout, Brook Trout and Cisco. The Hare Lake fish community is comprised primarily of coolwater species, including Northern Pike and Yellow Perch. Hare Creek (Stream 5), below the Highway 17 crossing, supports a coldwater fish community and affords spawning and nursery habitats for both migratory and resident salmonids. Within its lowest reaches, below a cascade barrier, Stream 6 provides a limited amount of nursery and spawning habitat for coldwater migratory species from Lake Superior.

5.5 Terrain and Soils

Detailed information relating to terrain and soils across the project site is provided by EcoMetrix (2012b, 2012d). The following sections provide a summary of this information.

5.5.1 Work Scope

Terrain within the Project area was assessed with the aid of available topographic maps (1:20,000 to 1:50,000), LIDAR data collected at the Project site and aerial photographs of the area. Soils were assessed to gain a general understanding of the surficial soil and overburden characteristics within the project footprint, to characterize baseline surficial soil chemistry and to describe the acid generation and metal leaching potential of overburden materials that will be excavated and subsequently stored on site or used for reclamation purposes.

5.5.2 Existing Conditions

5.5.2.1 General Site Geography

The Project site is characterized by moderate to steep hilly terrain and a number of streams, ponds and small lakes. Vegetation in the area is dense and consists of birch-dominated mixed birch-spruce forest.

The general elevation around the proposed mine site is slightly higher than the overall regional topography. Ground surface elevations in the area range from approximately 200 m to over 400 m above sea level (ASL). A central ridge comprising an area of higher elevation is found in the central north portion of the Project site. Differences in relief between this area and the Pic River flood plain to the east are the most severe seen on the site, with differences in elevation of 150 m or more seen over a distance of 1.5 to 2 km. Overall there is a gradual decrease in elevation on the Project site from north to south, and to a lesser extent from east to west.

On a regional scale the overburden is derived from till veneer and to a lesser extent fine- and coarse-grained glaciolacustrine material (Fulton, 1995). In the vicinity of the Town of Marathon, and on the Project site in particular, coarse-grained glaciolacustrine material is the most prominent host material.

In terms of soils, on a regional level podzols are the dominant soil type (Baldwin *et al.*, 2000). Podzols extend in a wide band from north and east of Lake Superior to the Ontario-Quebec border and from the claybelt to the southern limit of the Canadian Shield. This soil type typically develops under forest stands on coarse-textured, stony, glacial tills and outwash and on glaciofluvial sand overlying acidic parent material. In Ontario, podzols are of the humo-ferric variety, which are commonly associated with exposed bedrock.

The soils on the Project site do not have agricultural value and there are no large scale agricultural operations in the vicinity of the site.

5.5.2.2 Overburden and Soils at the Project Site

Overburden depth is highly variable across the study area. Frequent bedrock outcrops are common in the area where active mining is proposed. The overburden is thickest in deep valleys and in particular in the Pic River flood plain, where it is as much as several tens of metres thick. Overburden composition is also variable and ranges from gravel and boulder in the central area of the Project site to sandy-silt and clay within the vicinity of the Pic River.

The topsoil layer is generally thin (< 5 cm) but is thicker (> 10 cm) in the steepest stream valleys. Generally top soil is rich in organics and ranges in colour from dark brown to black.

5.5.2.3 Overburden Excavation Volume Estimate

Based on data derived from drilling and test pitting it is possible to develop a first-order estimate of the volume of overburden material that will be excavated within each of the main areas of the proposed mine infrastructure (see Table 5.5-1). It is estimated that approximately 3,680,000 m^3 of overburden will be excavated during site development, which will be available for use as borrow material and or reclamation purposes.

Table 5.5-1: First-order estimate of overburden volumes to be excavated at the Project site

Zone	Volume (m^3)
Main Pit	1,300,000
Satellite Pit	700,000
Facilities Site	280,000
Process Solids Management Facility	1,400,000
Total	**3,680,000**

5.5.2.4 Solids Characterization

Typical of podzols in this region, the soils and overburden across the study area have pH values generally in the range of 5 to 6. TOC is high (> 5%) in the majority of top soil samples and this material would be valuable for reclamation purposes. Despite the relatively low carbonate levels in the bulk of the areas sampled, the concentrations of sulphide and total sulphur are also low and the soils pose little risk of generating acid drainage if stockpiled.

5.5.2.5 Overburden and Soils Metal Content

In general, the metal content of the Project site's overburden material either does not exceed or only marginally exceeds the OMOE province-wide background site condition standards. Elevated levels of metals were found in a few samples from across the Project site and appear to be from isolated locations, typically in relative close proximity to the ore body. On this basis therefore, overburden material at the Project site would be suitable for use as reclamation material.

Topsoil samples were collected at air quality monitoring locations to establish baseline soil conditions in off-site locations for possible future use to assess fugitive air emissions from the site. As with the overburden, the metal levels in these topsoils generally did not exceed OMOE background criteria.

5.5.2.6 Leach Testing Results

Leach test results indicate that soils and overburden across the Project site do not generally exhibit a tendency to leach metals (see Section 5.1.5.6.1).

5.6 Vegetation

Detailed information relating to vegetation across the Project site is provided by Northern BioScience (2012a) and Golder Associates (Golder, 2009). The following sections provide a summary of this information.

5.6.1 Work Scope

Initial ecosystem mapping focused on acquiring and compiling existing map data and aerial and LIDAR imagery for the study area. These data were supplemented by information collected via a number of systematically conducted aerial (helicopter) surveys of the Project site and surrounding area. The primary purposes of the aerial reconnaissance were to confirm existing information and to select specific areas/habitats for field sampling.

Vegetation features were assessed on the ground in 2007, 2008 and 2009. First, plot surveys were conducted in preselected areas identified during the initial mapping phase as described above. Unique or sensitive ecosystems, locally, provincially or federally important, and potentially at-risk plants identified in the field were described and photographed and voucher specimens were collected. In this case the sampling programs followed standard methods for Canada to provide information for building and testing ecosystem maps. Field information was collected by surveying 10 m x 10 m or 20 m x 20 m plots, depending on site variability. Collected vegetation information included an overall assessment of the cover (as a percent) of shrubs, herbs, and grasses, as well as a list of predominant species (with a corresponding percent cover). Secondly, incidental observations of vegetation in the area (i.e., visual encounter survey) were made (and noted) coincident with other baseline sampling activities.

Based on the information collected, vegetation communities have been classified according to the Northwestern Ontario ecosite classifications (Racey et al., 1996) and were assigned to Forest Resource Inventory (FRI) polygons.

5.6.2 Existing Conditions

5.6.2.1 Ecosystem Mapping and Vegetation

5.6.2.1.1 Regional Perspective

The Project site is located within the Big Pic Forest Management Area and the Abitibi Plains Ecoregion, which borders the southern boundary of the James Bay Lowland ecoregion and extends from the western edge of the northern clay belt in Ontario to east of the Nottaway River and Lac au Goéland in western Quebec (Environment Canada, 2005). Throughout this region the typical forest habitat is described as a mixed forest characterized by stands of white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), white birch (*Betula papyrifera*) and trembling aspen (*Populus tremuloides*) (Environment Canada, 2005). Drier sites may have pure stands of jack pine (*Pinus banksiana*) or mixtures of jack pine, white birch, and trembling aspen (Environment Canada, 2005). Wet sites are characterized by black spruce (*Picea mariana*) and balsam fir with an understory of moss and lichen (Environment Canada, 2005).

5.6.2.1.2 Project Site Overview and Land Classification

Over 90% of the area defined by the Project site boundary (including relevant claim block and lease areas for a total area of 5,331 ha) is forested. Non-forest communities (including wetlands) cover less than 5% of the site. The Ecological Land Classification analysis for the site is summarized in Table 5.6-1 and Figure 5.6-1. Species composition of the forest community is displayed in Figure 5.6-2.

Birch-dominated mixedwood forest (ES27 and ES28; Racey *et al.*, 1996) makes up about 79% of the study area. Balsam fir, black spruce and white spruce are the most common secondary tree species, usually with a rich understory of mountain maple (*Acer spicatum*), beaked hazel (*Corylus cornuta*), and other tall shrubs. White birch-black spruce stands on shallow (less than 30 cm) silty soils are common on slopes and tops of low hills. Some of the white spruce are large, supercanopy trees, extending above the main birch canopy.

Upland black spruce dominated stands on silty soils (ES25) occur mainly on deeper glaciolacustrine deposits and make up about 12% of the study area. These stands almost always include balsam fir, white birch and a tall shrub understory. Black spruce forest on peat (ES35, ES36, ES37) is uncommon (total area less than 2 ha) and is confined to a few small bedrock depressions filled with organic soils. Stands dominated by jack pine and trembling aspen are absent in the study area although these species are generally common in northwestern Ontario.

As indicated, non-forest communities, which are largely represented by rock barren (ES7) and wetland ecosites (swamp [ES35, ES36, ES37, ES44], fen [ES40, ES41, ES45] and marsh [ES46, ES47, ES49]), comprise a relatively small proportion of the Project site. No provincially significant wetland areas have been identified at the Project site. Small wetland areas are found in isolated pockets to the west of the proposed primary pit, in the Stream 6 subwatershed and in the headwaters of the Stream 1 subwatershed. Rock barren cover which includes lichen (*Cladina*), blueberries (*Vaccinium sp.*) and other low shrubs are largely found in the vicinity of the proposed mill site and Malpa Lake, as well as south of Bamoos Lake.

Table 5.6-1: Ecological Land Classifications for the Project Study Area (Racey *et al.*, 1996).

NW Ecosite	Description	Notes
ES1	Beach / Bar	Very small sand beach present at the west end of Bamoos Lake
ES4 ES5	Cliff Talus or Steep Slope	Several small cliffs up to about 12 m high. Larger cliffs have a band of talus at the base.
ES7	Rock Barren	Several extensive areas of rock barren present totaling almost 58 ha. Vegetation is predominantly *Cladina* lichens, blueberries, and other low shrubs.
ES25	Pine - Spruce / Feathermoss: Fresh, Silty Soil	Upland black spruce stands on silty soils. Almost always with balsam fir and white birch and a tall shrub understory.
ES27	Fir - Spruce Mixedwood: Fresh, Silty - Fine Loamy Soil	Birch dominated mixedwoods make up about 79% of the study area. Balsam fir, black spruce and white spruce are the common secondary tree species. Usually with a rich understory of mountain maple, beaked hazel and other tall shrubs. Pure white birch stands, mainly in the southern part of the study area along the Pic River, are mostly young stands (approximately 20 years) apparently originated from logging.
ES28	Hardwood-Fir-Spruce Mixedwood: Fresh, Silty Soil	
ES35	Poor Swamp: Black Spruce: Organic Soil	Lowland black spruce stands on organic soils make up less than 2 ha but are not mapped in FRI. In valley bottoms and bedrock depressions.
ES36	Intermediate Swamp: Black Spruce (Tamarack): Organic Soil	
ES37	Rich Swamp: Cedar (Other Conifer): Organic Soil	
ES40 ES41	Treed Fen: Tamarack- Black Spruce / Sphagnum: Organic Soil Open Poor Fen: Ericaceous Shrub / Sedge / Sphagnum: Organic Soil	Peatland communities confined to small areas in bedrock basins, isolated from lakes and streams. Total area is 22 ha.
ES44	Thicket Swamp: Organic–Mineral Soil	Alder thickets on stream floodplains. Total area is 59 ha.
NW ES45 NW ES46	Shore Fen: Organic Soil Meadow Marsh: Organic-Mineral Soil	Located on shores of lakes and streams. Vegetation consists of sedges, grasses and low shrubs. Total area is 56 ha.
NW ES47 NW ES49	Sheltered Marsh: Emergent: Sedimentary Peat Substrate Open Water Marsh: Submergent / Floating-leaved: Sedimentary Peat Substrate	Small areas in sheltered bays on lakes. Not mapped in FRI. Total area probably less than 1 ha.

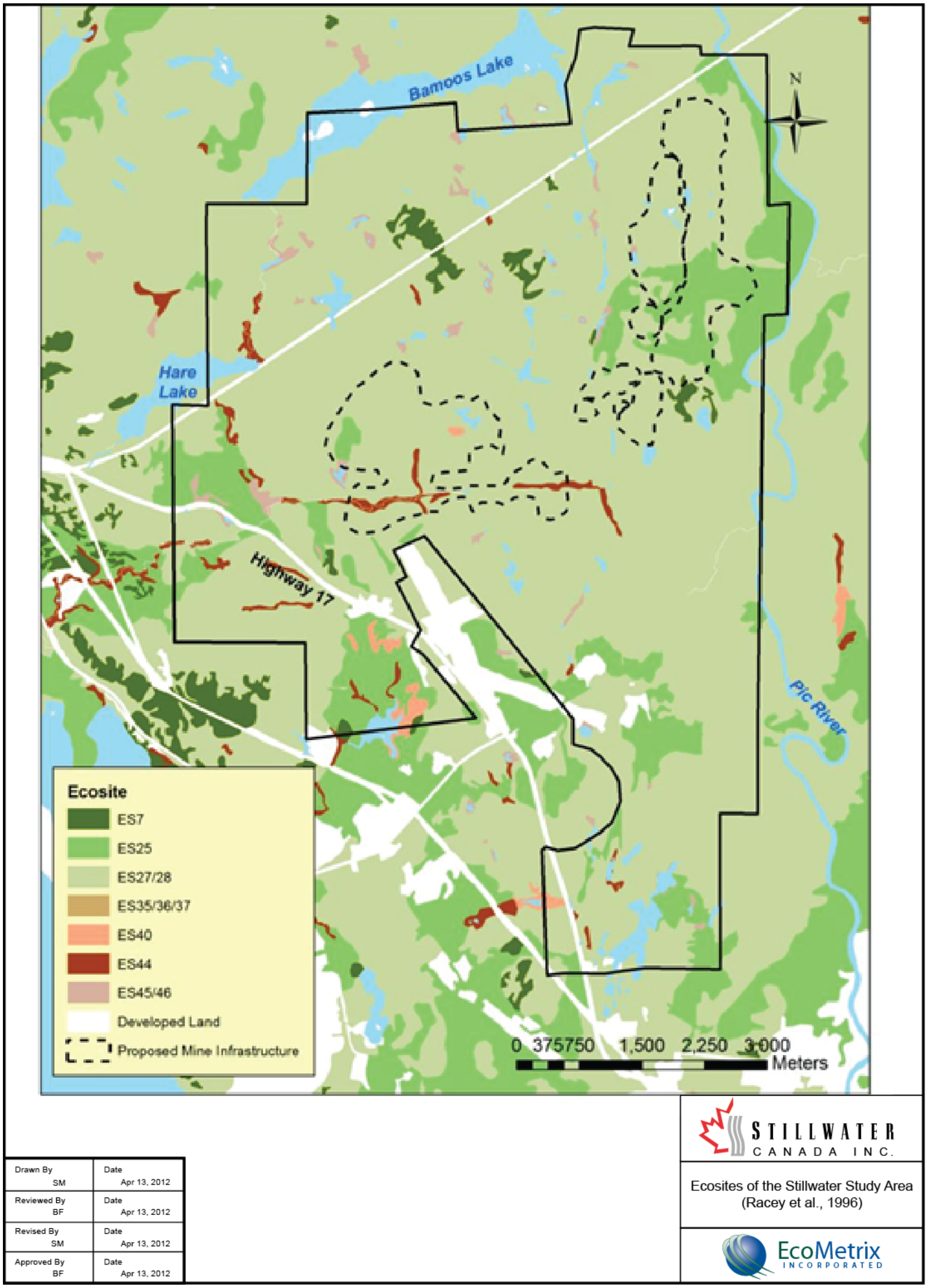


Figure 5.6-1: Ecosites of the Stillwater Study Area (Racey et al., 1996)

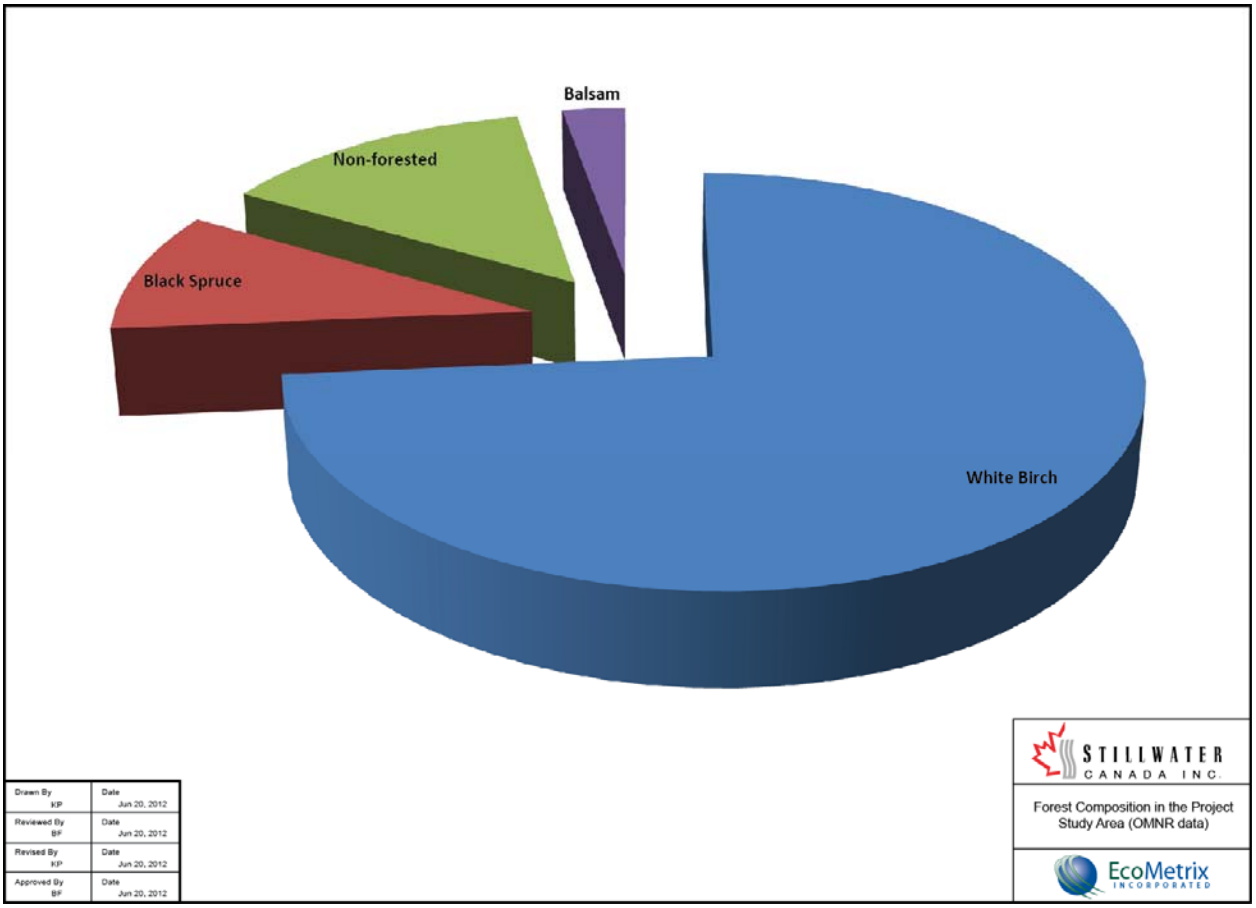


Figure 5.6-2: Forest Composition in the Project Study Area (OMNR data)

5.6.2.1.3 Plant Species

A total of 340 vascular plant species were observed in the study area. Most species are typical boreal forest plants that are common throughout northwestern Ontario.

Several species of arctic-alpine disjunct plant species, including fragrant cliff fern (*Dryopteris fragrans*), glaucous bluegrass (Poa glauca), alpine bistort (*Polygonum viviparum*), rock cranberry, northern woodsia (*Woodsia alpina*), and smooth woodsia (*Woodsia glabella*) were discovered on cool, north-facing cliffs. These species are noteworthy because they are geographically separated from their main ranges in arctic and alpine regions in northern and western Canada.

Thirty non-native plant species were discovered, mainly along roads and trails. Typical non-native species along the old logging road include clovers (*Trifolium* spp.), common dandelion (*Taraxacum officinale*), oxeye daisy (*Chrysanthemum leucanthemum*) and common plantain (*Plantago major*).

5.6.2.1.4 Species of Special Interest

Natural resource values information provided by the OMNR indicate that there are no known occurrences of habitat or plant species listed as Endangered, Threatened, or Special Concern by the provincial or federal governments within the Big Pic Forest. There were a number of "rare" species identified during baseline fieldwork or that potentially occur on the Project Site. A more detailed account of these "rare" plants is provided in Section 5.8 (Species at Risk).

5.6.2.1.5 Forest Management Practices

As previously mentioned the Project site is located within the Big Pic Forest Management Unit. The following is a summary of the forestry practices in the Big Pic Forest Management Unit.

The Big Pic Forest includes 643,990 ha of Crown land east and north of Lake Superior. The Project's development footprint encompasses an area of approximately 641 ha or about 0.1% of the total area of the unit. According to the harvesting plan approximately 63,000 ha of forest is planned for harvest within the unit over the period 2007 to 2017. Currently, no harvesting is planned for the Project site.

5.7 Wildlife

Detailed information relating to wildlife across the Project site is provided by Northern BioScience (2012a) and Golder Associates (Golder, 2009). The following sections provide a summary of this information.

5.7.1 Work Scope

The wildlife program consists of two main parts: (1) compilation of existing information on wildlife species and wildlife habitat information from outside sources (including published literature and reports [Northern Ontario Engineering Geology Terrain Study Maps – NOEGTS], Ontario Breeding Bird Atlas, "grey" literature]), air photograph interpretation, interviews with local agency staff (e.g., OMNR, Parks Canada) and (2) fieldwork.

Extensive targeted baseline field work was completed between 2007 and 2011, and covered all seasons. Observations were also made incidentally during other baseline field surveys. Terrestrial habitat mapping was based on FRI data. A summary of field activities for characterization of wildlife in the study area is provided in Table 5.7-1.

Table 5.7-1: Summary of Terrestrial Baseline Field Sampling Efforts on and around the SCI Marathon Project Site in 2007 to 2011

Date	Nature of Surveys	Comments
August 2007	Vegetation, Wildlife	Visual encounter surveys across Project site.
September 2007	Vegetation, Wildlife	Visual encounter surveys across Project site.
April 2008	Aerial (wildlife [ungulates], Vegetation [assemblage level]), Raptor stick nest	Aerial survey across Project site and adjacent areas.
May 2008	Raptor call-back	42 plots were sampled across Project site at locations representing different vegetation types (ecosite phase and wetlands type).
June 2008	Breeding birds, Vegetation	A total of thirty-six breeding bird survey plots were established on and around the proposed Project footprint. The plots were located in habitat types that were representative of the Project area and included coniferous forests of various stages, marshes, disturbed areas, and forest edges according to the Canadian Wildlife Service methodology (2008). Vegetation was surveyed by visual encounter.
March 2009	Aerial (wildlife [ungulates], Vegetation [assemblage level])	Aerial survey across Project site and adjacent areas.
May 2009	Vegetation, Wildlife	Visual encounter surveys across Project site.
June 2009	Aerial (wildlife [ungulates], Vegetation [assemblage level]), Birds, Species at Risk habitat	Aerial survey across Project site and adjacent areas. Bird monitoring was conducted at 33 stations following the Forest Bird Monitoring Program (FBMP) protocol. Special attention was paid to areas that could represent habitat for species at risk.
July 2009	Species at Risk, Vegetation	Visual encounter surveys in the northeast portion of the study area
August 2009	Species at Risk, Vegetation, Wildlife	Visual encounter surveys across Project site.
May 2010	Species at Risk, Vegetation	Visual encounter surveys along the previously proposed transmission line
June 2010	Vegetation, Wildlife	Visual encounter surveys across Project site.
July 2010	Species at Risk, Bird Monitoring	Bird monitoring was conducted at 22 stations, along the previously proposed transmission line, following the Forest Bird Monitoring Program (FBMP) protocol. Special attention was paid to areas that could represent habitat for species at risk.
May 2011	Aerial Survey	Aerial survey for waterfowl breeding pairs across the northern 2/3 of the Project area.
June 2011[1]	Vegetation, Wildlife	Visual encounter surveys across Project site.
June 2011	Eastern Whip-poor-will/ Common Nighthawk survey	Nocturnal listening survey at 10 and 5 stations following the Ontario Whip-Poor-Will project protocol.

Fieldwork completed on the Project site in collaboration with supplemental information were used to create a wildlife species list for both the Project site and the local and regional area around Marathon.

5.7.2 Existing Conditions

5.7.2.1 Species in the Project Area

Observations of wildlife (or wildlife signs [e.g., tracks, scat]) around the Project site have included a generally typical range of mammal, bird, amphibian and invertebrate species.

5.7.2.1.1 Amphibians and Reptiles

In total, eight species of amphibians were identified at the site during non-targeted, non-breeding season field work. No reptiles were observed on the site. Thirteen species that may occur in the nearby Coldwell wind energy site were identified by Hatch Energy (2008). All amphibian and reptile species that occur or potentially occur on the Project site are provided in Table 5.7-2. Of the observed species spring pepper (*Pseudacris crucifer crucifer*), wood frog (*Rana sylvatica*) and American toad (*Bufo americanus americanus*) were common, whereas a single green frog (*Rana clamitans melanota*) was heard in 2009. Mink frogs (*Rana septentrionalis*) were heard calling on several occasions. The two observed salamander species, red-backed and blue-spotted, were each seen once. Red-spotted newts (*Notophthalmus viridescens viridescens*) were very common in fishless lakes within the Project site.

The reptiles and amphibians at the study site are generally those considered typical of the boreal forest. There is no indication that the species or habitats at the study site are unique relative to the surrounding area. The salamanders are likely relatively rare as they are considered uncommon north of Lake Superior (Foster et al., 2004). The site does provide breeding, nursery, foraging and overwintering habitat for a number of species. All of the amphibian species are considered secure or apparently secure provincially with S ranks of S-4 and S-5.

Table 5.7-2: The Amphibian and Reptile Species Occurring or Potentially Occurring within the Study Site

Type	Common Name	Scientific Name
Salamander	Red-spotted newt [1 2 4 7]	*Notophthalmus viridescens viridescens*
	Central newt [1 2 4]	*Notophthalmus viridescens lousianensis*
	Blue-spotted salamander [1 3 4 5]	*Ambystoma laterale*
	Jefferson-Blue-spotted salamander complex [4]	*Ambystoma laterale* and A. *jeffersonianum* species complex
	Spotted salamander [1 4]	*Ambystoma maculatum*
	Eastern red-backed salamander [1 3 4]	*Plethodon cinereus*
Frogs and Toads	Eastern American toad [1 3 4]	*Bufo americanus americanus*
	Spring peeper [1 3 4 6]	*Pseudacris crucifer crucifer*
	Boreal chorus frog [1 4 6 8]	*Pseudacris maculata*
	Wood frog [1 3 4 8]	*Rana sylvatica*
	Northern leopard frog [1 4 6 7 8]	*Rana pipiens*
	Green frog [1 3 4 6]	*Rana clamitans melanota*
	Mink frog [1 3 4]	*Rana septentrionalis*
	Tree Frog [8]	*Hyla versicolor*
Turtles	Western painted turtle [1 4]	*Chrysemys picta belli*
Snakes	Eastern garter snake [1 4]	*Thamnopis sirtalis sirtalis*

[1] noted in Hatch Energy (2008) as species which may occur in the area, not generally identified to subspecies level

[2] noted in (Hatch Energy 2008) as simply eastern newt (*Notophthalmus viridescens*)

[3] confirmed on the study area during 2009 field work (Harris & Foster 2009)

[4] Interpreted as being potentially present in study area based upon records in Oldham & Weller (2000)

[5] For convenience, all populations including pure *laterale* (LL) and *laterale*-dominated genomes might be included in the species *A. laterale* (NHIC 2012)

[6] noted in Hatch Energy (2008) as having been observed on the study site

[7] collected in the study site during fisheries sampling (pers. comm., Joseph Tetreault, EcoMetrix Incorporated)

[8] observed during the Golder Baseline Studies (Golder, 2009).

5.7.2.1.2 Mammals

A total of 18 mammal species were observed either during targeted surveys or incidentally as part of other baseline studies completed between 2007 and 2011. An additional 29 species of mammals potentially occur in the study area. The following table summarizes the mammals occurring and potentially occurring in the study area (Table 5.7-3). Of the observed and potentially occurring mammal species, four are classified as species at risk, woodland caribou (*Rangifer tarandus caribou*), eastern wolf (*Canis lupus lycaon*), little brown myotis (*Myotis lucifugus*) and northern myotis (*Myotis septentrionalis*). However, none of these species were observed on the site during baseline studies. A detailed account of species at risk is provided in Section 5.8.

Table 5.7-3: Mammal Species Occurring or Potentially Occurring in the Study Area

Family	Common Name	Scientific Name
Shrews	Masked shrew [4]	*Sorex cinereus* [4]
	Water shrew	*Sorex palustris*
	Smoky shrew	*Sorex fumeus*
	Arctic shrew	*Sorex arcticus*
	Pygmy shrew [4]	*Sorex hoyi* [4]
	Northern short-tailed shrew [4]	*Blarina brevicauda*
Moles	Star-nosed mole [4]	*Condylura cristata*
Smooth-faced Bats	Little brown myotis [3]	*Myotis lucifugus*
	Northern myotis [3]	*Myotis septentrionalis*
	Silver-haired bat	*Lasionycteris noctivagans*
	Big brown bat	*Eptesicus fuscus*
	Red bat	*Lasiurus borealis*
	Hoary bat [3]	*Lasiurus cinereus*
Rabbits and Hares	Snowshoe hare [1 3]	*Lepus americanus*
Squirrels	Least chipmunk [1]	*Tamias minimus*
	Eastern chipmunk [1]	*Tamias striatus*
	Woodchuck [4]	*Marmota monax*
	Red squirrel [1 2 3]	*Tamiasciurus hudsonicus*
	Northern flying squirrel [4]	*Glaucomys sabrinus*
Beavers	Beaver [1 2 3]	*Castor canadensis*
Rats, Mice and Voles	Deer mouse [4]	*Peromyscus maniculatus*
	Southern red-backed vole [4]	*Clethrionomys gapperi*
	Southern bog lemming [4]	*Synaptomys cooperi*
	Heath vole [4]	*Phenacomys intermedius*
	Muskrat [1]	*Ondatra zibethicus*
	Meadow vole [4]	*Microtus pennsylvanicus*
	Rock vole [4]	*Microtus chrotorrhinus*
Jumping Mice and Jerboas	Meadow jumping mouse [4]	*Zapus hudsonius*
	Woodland jumping mouse [4]	*Napaeozapus insignis*
New World Porcupines	Porcupine [1 3]	*Erethizon dorsatum*
Dogs	Coyote [1 2]	*Canis latrans*
	Grey wolf [1 2 3]	*Canis lupus*
	Eastern wolf [4]	*Canis lupus lycaon*
	Red fox [1 3]	*Vulpes vulpes*
Bears	Black bear [1 3]	*Ursus americanus*
Raccoons and their Allies	Raccoon [4]	*Procyon lotor*
Weasels and their Allies	Marten [1 2]	*Martes americana*
	Fisher [1 2]	*Martes pennanti*
	Ermine [4]	*Mustela erminea*
	Long-tailed weasel [4]	*Mustela frenata*
	"Weasel" [2]	*Mustela* sp.
	American mink [1]	*Mustela vison*
	Striped skunk [4]	*Mephitis mephitis*

Family	Common Name	Scientific Name
Weasels and their Allies Cont'd	River otter [1 2 3]	*Lutra canadensis*
Cats	Canada lynx [1 2 3]	*Lynx canadensis*
Deer	Woodland caribou [4 5]	*Rangifer tarandus caribou*
	White-tailed deer [1]	*Odocoileus virginianus*
	Moose [1 3]	*Alces alces*

[1] confirmed on the study area during 2007 -2011 field work
[2] recorded on trapping harvest records
[3] evidence of presence observed at nearby Coldwell wind energy study area (Hatch Energy 2008)
[4] potentially present in study area based upon broad distribution and suitable habitat
[5] study area is within the area of discontinuous caribou distribution

5.7.2.1.3 Moose (Alces alces)

Moose are the primary cervid species (i.e., deer family) in the study area and in the surrounding region. The study area falls within the cervid ecological zone (CEZ) B, where management practices in the Cervid Ecological Framework (CEF) indicates a guidance of 0.0 to 0.4 moose/km^2. The more broad guidance for cervid habitat management in CEZ B according to the CEF is to emphasize caribou habitat as the primary management consideration, emphasize moose habitat where appropriate and not to emphasize deer habitat. The study site straddles two Wildlife Management Units (WMU) 21A and 21B with target moose numbers of 0.25 and 0.22 moose/km^2, respectively (Ray Tyhuis, OMNR, pers. comm.; Figure 5.7-1). Current moose populations in both of these WMUs exceed the targeted densities, with the population steadily increasing since the 1990s and stabilizing since 2000 (OMNR, 2007a).

The study area does not appear to provide high quality habitat for moose, with generally poor winter habitat and no moose observed during the winter aerial survey. Moose sign was relatively scarce but was observed at five locations. Six additional occurrences of ungulate tracks were also observed during the aerial survey. These were also likely from moose owing to the rarity of deer in the area and the absence of definitive caribou sign such as cratering, slush pits or groups of tracks from multiple animals. Moose were observed directly during 2009 summer fieldwork and tracks and droppings were common especially along linear features such as trails, roads and cut lines. Summer season moose browse, particularly mountain maple, is relatively abundant in over-mature mixedwoods. According to OMNR data there is also a Class 4 (very high potential; Ranta, 1993) moose aquatic feeding area present on a small stream about 600 m south of the west end of Bamoos Lake.

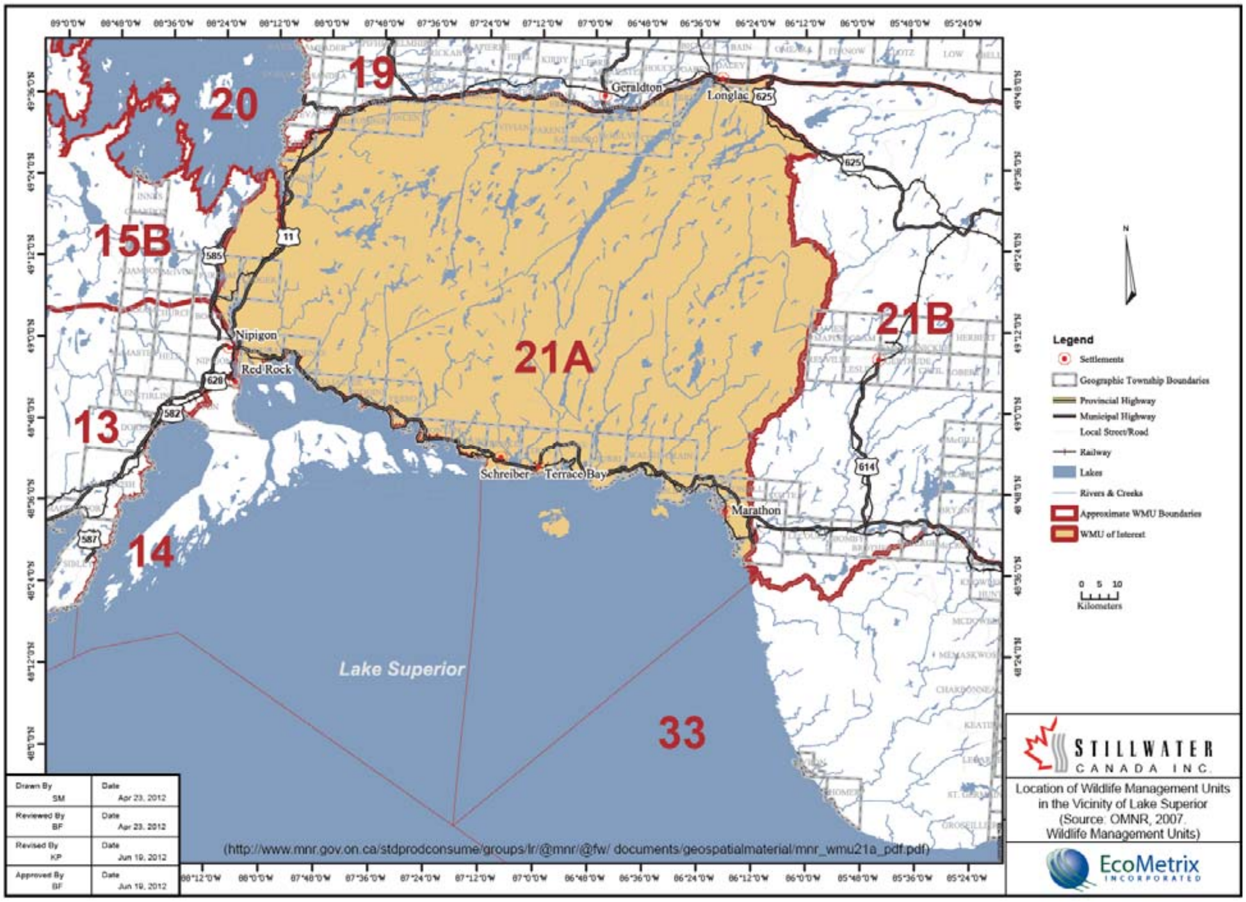


Figure 5.7-1: Location of Wildlife Management Units in the Vicinity of Lake Superior (Source: OMNR 2007, Wildlife Management Units)

5.7.2.1.4 White-tailed Deer (Odocoileus virginianus)

White-tailed deer populations have increased in number and expanded their range across much of northwestern Ontario in recent decades; however they remain uncommon northeast of Lake Superior. Although sightings of deer have increased in the region, especially in WMU 21A, the number of deer seen per hunter day is very low. A deer was observed by Golder (2009) during aquatic baseline studies but very few deer appear to live in or in close proximity to the study site. Overall the site does not provide high quality habitat for white-tailed deer.

5.7.2.1.5 Black Bear (Ursus americanus)

Sightings of black bears were common in the study site during baseline studies, and sign was evident during targeted wildlife surveys. Black bear are widely distributed across northern Ontario. Bear densities north of Lake Superior are estimated at 0.20 – 0.40 bears/km^2 with local densities varying considerably. Black bears tend to be habitat generalists, often occurring in forest areas with substantial amounts of disturbed or second growth forests. Habitat selection is primarily affected by food availability particularly summer and fall feeding areas (Taylor, 2006). Forested areas with a mixture of clearings, lakes and deciduous forest can provide the supply and variety of foods required by bears throughout the active time of year (Taylor, 2006).

The study site does not appear to provide higher than average habitat quality. The majority of the study area contains hardwood dominated mixedwood forest with a rich understory. However, most of the forest is mature with little recent natural disturbance and limited forest openings except in rocky areas, wetlands and watercourses. Bear density in the study site is likely comparable to those in the surrounding landscape and lower than those in more disturbed areas.

5.7.2.1.6 Grey Wolf (*Canis lupus*)

Grey wolf are present at the study site; tracks were observed during the March 2009 aerial moose survey. Wolf densities and trends in the immediate vicinity of the study site are not known but hunter surveys indicate a steady increase in their numbers regionally, throughout the 2000s (Patterson and de Almeida, 2011). Generally the increase in wolf numbers is thought to be in response to increase moose and deer numbers. The Project site does not however appear to have above average moose or deer populations and therefore the wolf population is likely comparable to the remainder of the northwestern Ontario.

5.7.2.1.7 Furbearers and Small Mammals

A number of furbearers and small mammals are known to inhabit both the general region and the study area, although some species are not likely to be present due to uneven distribution and lack of habitat. No small mammal trapping was conducted, so the list of species should not be considered complete and is based upon limited sightings and field surveys in Coldwell (Hatch Energy, 2008).

Two trap lines overlap the study area (TR022 and TR023). The primary furbearers harvested over two winters on TR023 (2007-08 and 2008-09) were American marten (*Martes americana*), beaver (*Castor canadensis*), red fox (*Vulpes vulpes*), red squirrel (*Tamiasciurus hudsonicus*), fisher (*Martes pennant*), Canada lynx (*Lynx canadensis*) and weasel. In the 1990s a small number of coyote (*Canis latrans)* and grey wolf were also harvested from TR023. Beaver are common in the study area with a number of active beaver lodges throughout. A beaver lodge survey was conducted in 2009 identifying 12 active lodges. American marten are the most heavily harvested and most sought after furbearer in the study area. Although harvest numbers cannot be assumed to directly reflect the population, it appears that marten are much more common than some other medium sized furbearers including fisher and Canada lynx.

5.7.2.1.8 Bats

A number of bat species are potentially present in the study area, although no specific monitoring studies were conducted at the study site as part of the baseline studies. Fall acoustic monitoring of bats at a nearby site confirmed the presence of three bat species, including little brown myotis, northern myotis, and hoary bat (*Lasiurus cinereus*) (Hatch Energy, 2008). Of these the hoary bat was the most commonly encountered and the most widely distributed bat species. Another three bat species could potentially occur in the area; however there have not been any confirmed observations.

There are no known bat hibernacula, daytime roosts or maternal colonies within the study area. There were no caves observed and no records of abandoned mines in the Project area (Ontario Ministry of Northern Development and Mines *Abandoned Mines Information System*) that may have potential as roosting sites or hibernacula. It is possible that some of the cliff/talus habitat or very mature trees may provide some opportunities for diurnal roosts. The study area is anticipated to provide foraging habitat for bats, particularly over lakes, near shorelines and open areas, dependent on the species.

5.7.2.1.9 Birds

The Project study area is located in the Boreal Softwood Shield, Ontario Bird Conservation Region 8. A total of 88 bird species were observed in the study area during the 2008 – 2010 breeding seasons.

The species composition and density is typical of a mature mixedwood forest bird community, with a diversity of warblers, thrushes, sparrows, and vireos. White-throated sparrow (*Zonotrichia albicollis*), black-throated green warbler (*Dendroica virens*), and winter wren (*Troglodytes troglodytes*) are among the most common (see Table 5.7-4).

Table 5.7-4: The Most Common Birds Encountered on the Marathon Project Site during the Baseline Forest Bird Monitoring

Common Name	Scientific Name
White-throated Sparrow	*Zonotrichia albicollis*
Black-throated Green Warbler	*Dendroica virens*
Winter Wren	*Troglodytes troglodytes*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American robin	*Turdus migratorius*
American redstart	*Setophaga ruticilla*
Least flycatcher	*Empidonax minimus*
Red-eyed vireo	*Vireo olivaceus*
Nashville warbler	*Vermivora ruficapilla*
Magnolia warbler	*Dendroica magnolia*
Mourning warbler	*Oporornis philadelphia*
Ovenbird	*Seiurus aurocapillus*
Golden-crowned Kinglet	*Regulus satrapa*
Red-breaseted Nuthatch	*Sitta canadensis*
Yellow-rumped warbler	*Dendroica coronata*
Common Raven	*Corvus corax*

A waterfowl survey of the Project site in May 2011 resulted in the observation of 54 individuals from 9 species. The most common species encountered were: ring-necked duck (*Aythya collaris*), hooded merganser (*Lophodytes cucullatus*) and common goldeneye (*Bucephala clangula*). The density of waterfowl throughout the Project area is lower than other aerial surveys of northern Ontario, but likely typical of areas of similar habitat and lake densities. Piscivorous waterfowl such as common loon (*Gavia immer*) and common merganser (*Mergus merganser*) are uncommon, likely because the majority of the waterbodies within the Project site contain no fish.

There were a total of four raptor species observed during the field surveys. An additional six species could potentially occur within the study area. During the aerial moose survey four potential peregrine falcon (*Falco peregrinus*) nesting cliffs were identified. Two nests were observed during the stick nest survey in April 2008 both from common raven (*Corvus corax*). (Golder, 2009). Table 5.7-5 summarizes the observed and potential raptor species at Project site.

Table 5.7-5: Raptor Observed or Potentially Occurring on the Project Site.

Common Name	Scientific Name
American Kestel[1]	*Falco sparverius*
Bald Eagle[3]	*Haliaeetus leucocephalus*
Broad-Winged Hawk[1]	*Buteo platypterus*
Great Grey Owl[2]	*Strix nebulosa*
Merlin[1]	*Falco columbarius*
Northern Goshawk[2]	*Accipiter gentilis*
Northern Hawk Owl[2]	*Surnia ulula*
Peregrine Falcon[2]	*Falco peregrinus*
Red-tailed Hawk[1]	*Buteo jamaicensis*
Rough-legged Hawk[2]	*Buteo lagopus*
Sharp-Shinned Hawk[2]	*Accipiter striatus*

1—during field surveys between 2008 and 2011.
2—recorded in the Breeding Bird Survey or established as being a potential inhabitant of the Project site.
3—observed at the Marathon Airport in 2007.

The habitat characteristics of the study area do not suggest that there is significant overwintering use by birds. Most of the area is boreal forest with no open water most years from November to April. Open fields where wintering raptors congregate are absent. During years of high owl populations some areas of the Project may provide winter habitat for great gray owl (*Strix nebulosa*) and northern hawk owl (*Surnia ulula*). A total of 99 bird species were identified in 31 years of the Marathon Christmas Bird counts (National Audubon Society, 2011). Of these 99, 38 inhabit forested habitat and are expected to occur in the study area in winter. Four of these species are found in the area only in the winter and the remaining 34 are year-round residents. The most common winter inhabitants of the Project site include woodpeckers, chickadees (*Parus* spp.), red-breasted nuthatch (*Sitta canadensis*), jays and the common raven.

The Project site is not likely a significant migratory corridor for birds or a stopover location. In 2006 and 2007 a study completed approximately 7 km west of the study area found relatively small numbers of migrations compared to monitoring stations on major migration routes around the Great Lakes (Hatch Energy, 2007). Possible exceptions are Canada geese (Branta canadensis) following the Pic River (Canada geese tend to follow north-south river corridors), common loons flying north in the spring from Lake Superior and rough-legged hawks (*Buteo lagopus*) flying along the Lake Superior coast in fall.

Of all of the bird species occurring or potentially occurring in and around the Project, ten are designated as species at risk (see Section 5.8 Species at Risk).

5.7.2.1.10 Invertebrates

Twelve species of butterflies and 19 species of dragonflies and damselflies (odonates) have been observed in the study area (Northern Bioscience, 2012a). Most of the odonate species were associated with lakes, ponds, or small streams. Relatively few clubtail (Gomphidae) species, usually associated with larger, fast-flowing streams, were observed.

No rare species of butterflies or odonates were observed despite targeted surveys, or in the aquatic resource baseline studies completed on site (EcoMetrix, 2012a). The cold, wet conditions that predominated during the 2009 fieldwork meant that few butterflies or odonates were flying and reduced the likelihood of finding rarer species. Two rare butterflies identified as potentially occurring in the study area – large marble (*Euchloe ausonides*) and taiga alpine (*Erebia mancinus*) – have not been found on the Project site.

5.7.2.2 Wildlife Habitat

Over 90% of the study area (total area 5,331 ha) is forested, with lakes (3%), rock barren (1%), non-forested wetlands (2%), and developed land (2%) making up the remainder. Birch-dominated mixedwood forest (Ecosite [ES] 27 and 28; Racey *et al.*, 1996) makes up about 79% of the study area. Balsam fir, black spruce and white spruce are the most common secondary tree species, usually with a rich understory of mountain maple, beaked hazel, and other tall shrubs. White birch-black spruce stands on shallow (less than 30 cm) silty soils are common on slopes and tops of low hills. Some of the white spruce are large, supercanopy trees, extending above the main birch canopy.

Upland black spruce dominated stands on silty soils (ES25) occur mainly on deeper glaciolacustrine deposits and make up about 12% of the study area. These stands almost always include balsam fir and white birch and a tall shrub understory. Black spruce forest on peat (ES35, 36 and 37) is uncommon (total area less than 2 ha) and is confined to a few small bedrock depressions filled with organic soils.

Stands dominated by jack pine and trembling aspen are absent in the study area despite these species are generally common in northwestern Ontario.

The ecological classifications of the Project study area are provided in Table 5.6-1.

5.7.2.3 Wildlife Corridors and Barriers to Movement

The Project is in a forested landscape with few manmade barriers to wildlife movement and no specifically identified wildlife corridors in or adjacent to the study area. With much of the forest in a mature condition, there would appear to be no barriers to the movements of animals requiring mature forest, other than the relatively rugged site terrain. A digital terrain model indicated that there is a narrow linear area of lower elevation to the north of the study area, in a southwest-to-northeast direction from the northeastern corner of Lake Superior to areas to the north (OMNR, 2006). At the broad landscape level, such an area could facilitate landscape-level movements of wildlife species, although there is no specific confirmation.

5.7.2.4 Protected Areas

Protected areas in the region in which the project site occurs include four provincial parks, two provincial nature reserves, four conservation reserves, one national park, two enhanced management areas and the Lake Superior Marine Conservation Area. These sites are described in Section 1.4.2.

5.7.2.5 Species of Special Interest

Species were characterized as to the likelihood that they would be found on or near the Project site given the nature of the available habitat on site. Targeted field surveys of species at risk candidate habitat locations were undertaken, as described above (see Table 5.7-1). More detailed accounts of the species of special interest are provided below in Section 5.8.

5.8 Species at Risk

Detailed information relating to species at risk is provided by Northern BioScience (2012a), EcoMetrix (2012a) and Golder Associates (Golder, 2009). The following sections provide a summary of this information.

5.8.1 Work Scope

Species of interest in Ontario include those afforded legislative protection (i.e., threatened, endangered) according to the Species at Risk Act (SARA, Federal) and the Endangered Species Act (provincial) and those that are managed to prevent the progression of their status to threatened or endangered (i.e., species of special concern, regionally rare). Also included are species designated by COSEWIC as Endangered, Threatened, or Special Concern, but which are not on Schedule 1 of Canada's *Species at Risk Act*. Species at risk include species that are and are not afforded protection.

Species at risk were identified based on available records of the area. Wildlife observed during the baseline surveys as well as those with a high likelihood of being affected by the Project development are included. The potential of a species not observed to occur on the Project was characterized based on available habitat in the Project site.

5.8.2 Existing Conditions

5.8.2.1 Birds

Table 5.8-1 provides the species that are listed as species at risk (i.e., special concern, threatened, endangered) by either the federal or provincial governments and characterizes the potential for these species to occur within the Project area. More detail on each of the species is provided below. Based on the review of species range information, there is potential for seven bird species that are afforded protection (i.e., threatened, endangered) under federal legislation and four species that are afforded protection (i.e., threatened, endangered) under provincial legislation to occur in the region in which the Project site is located. Two other species, eastern meadowlark (*Sturnella magna*) and chimney swift (*Chaetura pelagica*), also occur in northwestern Ontario but are not known to nest within several hundred kilometers of the Project area.

Table 5.8-1: Bird Species at Risk that Occur or Potentially Occur Within the Project Area

Species Specifics		Listed By		Potential
Scientific Name	Common Name	Federal	Provincial	
Falco peregrinus	Peregrine falcon	Special Concern	Threatened	Low – Cliffs with "marginal" peregrine falcon habitat have been identified on site but no evidence of nesting.
Haliaeetus leucocephalus	Bald eagle	Not at risk	Special Concern	Low – Bald eagles are known to occur within the Nipigon MNR District but no nests are documented at the Project site.
Chordeiles minor	Common Nighthawk	Threatened	Special Concern	Moderate – Although not observed during baseline surveys they are known to occur within the area.
Caprimulgus vociferus	Whip-poor-will	Threatened	Threatened	Low – Closest record 40 km from site; at edge of species range.
Hirundo rustica	Barn Swallow	Threatened	Not at risk	Moderate - Although not observed during baseline surveys they are known to occur within the area.
Chaetura pelagica	Chimney Swift	Threatened	Threatened	Low – No known breeding records within several hundred km.
Sturnella magna	Eastern Meadowlark	Threatened	Threatened	Low – Potential habitat at Marathon Airport, but no known breeding records within several hundred km.
Dolichonyx oryzivorus	Bobolink	Threatened	Threatened	Low – only suitable nesting habitat occurs at the Marathon Airport.
Melanerpes erthrocephalus	Red-headed Woodpecker	Threatened	Threatened	Low – No suitable habitat. Closest breeding population 400 km southeast of the site.
Wilsonia canadensis	Canada Warbler	Threatened	Special Concern	Confirmed Observed in 2009
Contopus cooperi	Olive-sided Flycatcher	Threatened	Special Concern	Confirmed Observed in 2009
Euphagus carolinus	Rusty Blackbird	Special Concern	Not at risk	Confirmed Observed in 2009

5.8.2.1.1 Canada Warbler (*Wilsonia canadensis*; COSEWIC: Threatened; Ontario: Special Concern)

Canada warbler is a common nesting species in birch-dominated mixedwood forest in the study area. Thirteen were observed during species at risk encounter surveys and the species was detected at 5 out of 91 forest bird monitoring program (FBMP) stations (total of 6 birds). Canada warblers were also recorded every year of 23 years of Breeding Bird Surveys south of the study area (1976 to 2004) with a maximum count of 15 in 1985. At a density of 0.03 birds/ha, there are an estimated 23 birds in the Project footprint. Typical habitat includes mixed coniferous – deciduous forest with a well-developed understory of shrubs, especially in low-lying area (McLaren, 2007). In northwestern Ontario, Canada warbler are often found in pure white birch or trembling aspen forests on mesic sites (pers. ob., Allan Harris, Northern BioScience).

5.8.2.1.2 Rusty Blackbird (*Euphagus carolinus*; COSEWIC: Special Concern; Ontario: Not at Risk)

A family group of rusty blackbirds were identified on a beaver meadow in the Project footprint. Searches of similar habitat elsewhere in the study area failed to discover any more individuals. Rusty blackbird was not recorded in the Breeding Bird Survey along Highway 17 south of the study area (U.S. Department of the Interior, 2009) nor in the Breeding Bird Atlas square encompassing the study area (Ontario Breeding Bird Atlas, 2011). Typical habitat includes forested wetlands and swamps (Francis, 2007) but in northwestern Ontario often includes cutovers, shorelines, and open wetlands (pers. obs., Allan Harris, Northern Bioscience).

5.8.2.1.3 Olive-sided Flycatcher (*Contopus borealis*; COSEWIC: Threatened; Ontario: Special Concern)

A single olive-sided flycatcher was seen on the shore of a small lake southeast of Bamoos Lake. The presence of this species in July suggests that it nests in the study area, but no singing males or other nesting evidence was observed. This species was reported in 2 years (1979 and 1980) of 23 years of Breeding Bird Surveys south of the study area (U.S. Department of the Interior, 2009). Typical habitat is shorelines, burns, cutovers and peatlands with scattered trees (Cheskey, 2007).

The following seven bird species were not recorded in the study area, but are known to nest in the region.

5.8.2.1.4 Common Nighthawk (*Chordeiles minor*; COSEWIC: Threatened; Ontario: Special Concern)

Although no common nighthawks were observed in 2008 – 2010, or during the 2011 nocturnal survey, this species was tallied once (1998) in the Breeding Bird Survey south of the study area. It may be an uncommon nesting species in the study area, preferring open bedrock ridges, burns and cutovers (Sandilands, 2007).

5.8.2.1.5 Whip-poor-will (*Caprimulgus vociferous*; COSEWIC: Threatened; Ontario: Threatened)

No whip-poor-will were detected during the 2011 nocturnal survey. During the 2000 – 2005 Breeding Bird Atlas, the nearest records were from approximately 90 km east of the study area and approximately 175 km west of the study area (Mills, 2007). Both were recorded as "possible" breeding records (singing male and species present in suitable habitat respectively). There is also an unconfirmed report of whip-poor-will calling near Manitouwadge (about 40 km to the northeast) (pers. comm., Virginia Thomson, OMNR). This ground-nesting species prefers rock or sand barrens with scattered trees, savannahs, old burns, and open conifer plantations (Mills, 2007). There is potentially suitable habitat on some of the rocky ridges throughout the study area, but whip-poor-will is unlikely to occur in the study area given the lack of records within at least 40 km and its position at the edge of the species' range (Mills, 2007).

5.8.2.1.6 Peregrine Falcon (COSEWIC: Special Concern; Ontario: Threatened)

No peregrine falcons were observed in the study area from 2008 to 2010. OMNR data shows the nearest nest location approximately 8 km west of the study area. An aerial survey in March 2009 found four potential nesting cliffs just outside the study area (west end of Hare Lake, Seeley Lake, unnamed lake north of Seeley Lake and southwest of Pukatawagan Lake; (Northern BioScience, 2012a). However, a follow-up aerial survey in June 2009 found no evidence of nesting on these cliffs. Cliff habitat within the study area was classified as "marginal" habitat value (cliff faces less than 15 m high and less than 100 m long; pers. comm., Brian Ratcliff, Northern Bioscience).

5.8.2.1.7 Bald Eagle (*Haliaeetus leucocephalus*; COSEWIC: Not at Risk Nationally; Ontario: Special Concern)

Bald eagles are not known to nest in the study area. This species is apparently an uncommon nesting bird in the Marathon area. No nests or birds were observed in 2009 fieldwork, although a single adult was observed near the Marathon Airport in 2008 (Golder, 2009). None were reported in 23 years of Breeding Bird Surveys along Highway 17 at the south edge of the study area. OMNR data show the nearest bald eagle nest at about 11 km north of the study area.

5.8.2.1.8 Barn Swallow (*Hirundo rustica*; COSEWIC: Threatened; Ontario: Not at Risk)

Barn swallows were recorded almost annually in the Breeding Bird Survey along Highway 17 south of the study area (U.S. Department of the Interior 2009) and in the Breeding Bird Atlas square encompassing the study area (Ontario Breeding Bird Atlas, 2011). Typical nesting habitat includes buildings and bridges, and rarely includes natural habitats such as cliffs and caves (Lepage, 2007). Within the study area, barn swallows may nest on buildings along Highway 17 (pers. comm., Nick Escott, Thunder Bay Field Naturalists). Some potential cliff nesting habitat does occur on Bamoos Lake in the study area, but the species was not observed during 2008 – 2010 fieldwork.

5.8.2.1.9 Bobolink (*Dolichonyx oryzivorus*; COSEWIC: Threatened; Ontario: Threatened)

Bobolink was recorded on 11 occasions between 1976 and 2000 on the Breeding Bird Survey south of the study area (U.S. Department of the Interior, 2009) but was not observed in the Breeding Bird Atlas square encompassing the study area (Ontario Breeding Bird Atlas, 2011). Nesting habitat includes open hayfields and other grasslands (Gahbauer, 2007). The open areas at the Marathon Airport constitute the only suitable habitat in or near the study area.

5.8.2.1.10 Red-headed Woodpecker (*Melanerpes erthrocephalus*; COSEWIC: Threatened; Ontario: Special Concern)

A single red-headed woodpecker was observed in 1991 on the Breeding Bird Survey south of the study area (U.S. Department of the Interior, 2009) but was not recorded in the Breeding Bird Atlas square encompassing the study area (Ontario Breeding Bird Atlas, 2011). Nesting habitat includes open woodlands and riparian forest (Woodliffe, 2007). The bird at Marathon was almost certainly a vagrant individual rather than part of a local nesting population given the lack of suitable habitat. The nearest known nesting areas are on Manitoulin Island (400 km to the southeast) and the Rainy River area (600 km to the west) (Woodliffe, 2007).

5.8.2.2 Mammals

Four species of mammal (little brown myotis, northern myotis, eastern wolf and woodland caribou) have the potential to inhabit the Project site based on available habitat. These four species including their habitat requirements and potential of occurrence are discussed below.

5.8.2.2.1 Little Brown Myotis and Northern Myotis (COSEWIC: Endangered; Ontario: Not Ranked)

These bat species were designated as Endangered by COSEWIC in February 2012. White-nose Syndrome, a fungal disease, has caused massive mortality of hibernating bats in eastern Canada and is expected to spread across Canada within 11 to 22 years (Forbes, 2012a, b). Both of these species are known to occur near the Project area (Hatch Energy, 2008), but hibernacula (caves and abandoned mines) apparently do not exist in the immediate vicinity.

5.8.2.2.2 Eastern Wolf (COSEWIC: Special Concern; Ontario: Special Concern)

The eastern wolf is a smaller form of the grey wolf and recent genetic analyses indicate it is the result of interbreeding with red wolf (*Canis lupus rufus*) and coyote. They are typically found mainly in the Great Lakes and St. Lawrence regions of Quebec and Ontario in deciduous and mixed forests in the southern range and coniferous forests in the north. According to the current understanding, the eastern wolf is found from Sault Ste. Marie in the west to southern Quebec. This represents a decrease of over 50% from its historical range. Similar to the grey wolf, the eastern wolf's prey consists mainly of deer and moose, with caribou also part of their diet in the northern parts of their range. The Project site contains habitat that is suitable for eastern wolves; however, understanding of their current range indicates there is a low potential that this species would be found in the study area.

5.8.2.2.3 Woodland Caribou (COSEWIC: Threatened; Ontario: Threatened)

Forest-dwelling woodland caribou (*Rangifer tarandus caribou*) are listed as Threatened under both federal and provincial species at risk legislation. They are the focus of a provincial conservation plan. Woodland caribou range and abundance in Ontario have declined, mainly due to anthropogenic disturbance and associated changes in alternate prey and predator abundance. Across the north shore of Lake Superior, they are now almost entirely restricted to isolated populations in protected areas. The largest populations, approximately 100 and 400 individuals respectively, are found within Slate Islands and Michipicoten Island provincial parks, both of which lack large predators. Pukaskwa National Parks' population has declined from approximately 30 caribou in the 1970s to an estimated four currently, largely due to predation by wolves and possibly black bears. An estimated 8 to 15 caribou still use Pic Island in Neys Provincial Park and adjacent mainland at least part of the year, down from approximately 80 in the 1970s.

The OMNR has designated a 10-km wide strip along the north shore of Lake Superior as the "Lake Superior Coastal Range". The Project site is in this range. North of this 10-km wide coastal strip is an area designated by the OMNR as the "Upper Lake Superior Uplands Linkage", where the main conservation intent is to maintain and enhance connectivity between the coastal range and caribou ranges to the north.

The Marathon PGM-Cu Project site has no documented historic or current use by woodland caribou as indicated by OMNR records, surveys conducted during the present study, and traditional ecological knowledge provided to SCI for this EIS. There is no known calving or nursery habitat near the Project; the two islands on Bamoos Lake to the north of the Project are unsuitable primarily due to their small size and proximity to the mainland. There is no preferred winter habitat on the Project site due to the low abundance of mature, conifer-dominated forests as well as other landscape attributes. Although atypical, it is possible that caribou could use small, lichen-rich openings on some of the bedrock hills near the Project, but there is no evidence of past or current use. Approximately 360 ha of potential caribou refuge habitat is within 500 m of the Project, of which 88 ha overlaps the proposed pits, rock stockpile, or PSMF. However, all but 12 ha of potential refuge habitat is in what is considered by OMNR and Environment Canada models as disturbed habitat (i.e., within the existing 500 m of existing disturbance). The potential refuge habitat found in scattered patches on the site, mainly near the highway and Pic River, and the abundance of predators and alternate prey on the site further reduces its suitability for use by woodland caribou. Refuge habitat is abundant elsewhere in the adjacent "coastal" and "discontinuous" ranges. The vast majority of the Project site is already considered disturbed by OMNR's range assessment protocol; the proposed project would add approximately 258 ha of new disturbance. This represents 0.07% of additional disturbance on a range-wide basis.

5.8.2.3 Fish

Three fish species of special interest have ranges that overlap with the Project area, in that they are or potentially are found in the Pic River. The Northern Brook Lamprey (*Icthyomyzon fossor*) is known to occur in the lower reaches of the Pic River downstream of the Project site. This species has not been collected during baseline fisheries studies (see Section 5.4.5). Lake Sturgeon is also known to occur in the Pic River and have been captured during baseline fisheries studies in the river adjacent to the Project site. The range of the Silver Lamprey (*Ichthyomyzon unicuspis*) overlaps with the Pic River and has historically been identified in rivers to the north, west and east of the project study area.

5.8.2.3.1 Northern Brook Lamprey (COSEWIC: Special Concern; Ontario: Special Concern)

The Northern Brook Lamprey is a non-parasitic species that feeds on zooplankton. The species lives in small rivers with adults spawning in gravelly riffles and subsequently dying. Hatches larvae make burrows is soft sediments including mud and silt where they remain for six years. After this six years of feeding the species metamorphoses and lives for up to a year before spawning and dying. Northern Brook Lamprey are known to inhabit the lower regions of the Pic River tens of kilometres downstream of the Project site.

5.8.2.3.2 Lake Sturgeon (COSEWIC: Threatened; Ontario: Threatened)

The Pic River is one of 12 Lake Superior tributaries that support Lake Sturgeon spawning. A radio telemetry and spawning assessment study was undertaken from 2007 to 2010 to monitor movement patterns and to identify critical habitat in the Pic River (Ecclestone, 2012). Three migration patterns were observed, two of which related to foraging and one related to spawning. Spawning fish entered the river and rapidly ascended the river to one of two uppermost barriers (Manitou and Kagiano Falls), whereas foraging individuals either remained at the mouth of the river or migrated 20 km to 30 km upriver to deep pools throughout the lower rapids. A key foraging area was identified approximately 2 km downstream of the Stream 1 confluence. Pools exist at many of the sharp bends in the Pic River and these are likely important refuge areas for Lake Sturgeon.

5.8.2.3.3 Silver Lamprey (COSEWIC: Special Concern; Ontario: Not at Risk)

Adult Silver Lamprey prefer the clear waters of large streams rivers and lakes. Similar to Northern Brook Lamprey, they build nests and spawn in gravel-bottom rivers. Larvae begin life in slow moving areas dominated by organics and then migrate to more sandy environments as they grow. After metamorphosis adult Silver Lamprey begin their parasitic life stage feeding on a number of different fish species. The medium sized Pic River does not likely provide a large amount of adult habitat owing to the high suspended sediment load. This may also limit the amount potential of reproduction occurring in the Pic River. Silver Lamprey have historically been identified in a number of Lake Superior tributaries, but not in the Pic River.

5.8.2.4 Plants

Natural Resource Value data provided by the OMNR indicate that there are no known sites of occurrence of, and/or high value habitat for species of flora listed as threatened or endangered, and no known sites of occurrence of flora identified as species of special concern within the Big Pic Forest Management Area.

5.8.2.4.1 Observed Provincially Rare

The following plants, which have been found on or near the Project site, are designated as provincially rare (S1 to S3; NHIC, 2009) but are not listed under endangered species legislation:

- Appalachian Firmoss (*Huperzia appalachiana*) (S3) – A few individuals of this species were discovered growing in a bedrock crevice on the south shore of Bamoos Lake;
- Alpine Woodsia (*Woodsia alpina*) (S2) – A small population of this fern was discovered on a north-facing cliff. Alpine woodsia is an arctic-alpine disjunct species, found in colder than average microclimates outside its typical range;
- Braun's Holly Fern (*Polystichum braunii*) (S3) – A single patch of Braun's holly fern grows in a wooded valley between two cliffs near the centre of the study area;
- Alga Pondweed (*Potamogeton confervoides*) (S2) – This aquatic species was discovered in two waterbodies in the study area. It was quite abundant where it did occur, forming dense mats on the lake beds. Alga pondweed is easily overlooked and may be more common in the study area; and,
- Shore Plantain (*Littorella Americana*) (S3) – Shore plantain grows on a sand beach at the west end of Hare Lake.

5.8.2.4.2 Observed Regionally Rare Plants

Eleven plant species that are rare in Thunder Bay District (TBFN, 2003) are found in the study area (Table 5.8-2). Although rare in Thunder Bay District (found at less than 6 locations), these plants are common elsewhere in Ontario. Notable among these is Oake's pondweed (*Potamogeton oakesianus*), which was not previously known to occur in Thunder Bay District (TBFN, 2003). This aquatic plant was discovered at six locations in small waterbodies on the Project site.

Table 5.8-2: Plant Species that are Considered Rare in Thunder Bay District

Common Name	Scientific Name
Common Ragweed	*Ambrosia artemisiifolia*
Whitlowgrass	*Draba cana*
Northern St. Johnswort	*Hypericum mutilum*
Broad-lipped Twayblade	*Listera convallarioides*
Wood Millet Grass	*Milium effusum*
Small-flowered Evening Primrose	*Oenothera parviflora*
Canadian Mountain Rice	*Oryzopsis canadensis*
Oakes' Pondweed	*Potamogeton oakesianus*
Slender Pondweed	*Potamogeton pusillus*
Narrow-leaved Cattail	*Typha angustifolia*
Marsh Speedwell	*Veronica scutellata*

5.8.2.4.3 Rare Plant Communities

The Natural Heritage Information Centre (2102) database includes two occurrences of *American Dune Grass – Beach Pea – Sand Cherry Dune Grassland Type* and one of *Great Lakes Arctic – Alpine Basic Open Bedrock Shoreline Type* on Lake Superior, but no rare plant communities in or adjacent to the Project area.

Several provincially rare cliff and talus communities were observed during 2009 and 2010. Although bedrock types were not tested in the field, indicator plant species suggest that these were *Basic Open Cliff Type* (G?, S3S4), usually associated with relatively small areas of Basic *Open Talus Type* (G?, S3S4) (Bakowsky, 2002). Most cliffs were only between 3 and 5 m at the base of steep, wooded bedrock slopes.

5.8.2.4.4 Potentially Occurring Species

According to the Natural Heritage Information Centre Biodiversity Explorer records of provincially rare species (i.e., ranked as S1 to S3) include nine vascular plants, two lichens and two mosses from the areas surrounding the Project site (Table 5.8-3).

Table 5.8-3: Provincially rare (S1 to S3) Plant Species Occurring Surrounding the Project Area (NHIC, 2012).

Scientific Name	Common Name	G-rank	S-rank	Last Observed Date
Botrychium ascendens	Upswept Moonwort	G2G3	S1	21/06/2008
Botrychium campestre	Prairie Moonwort	G3G4	S1	17/06/1986
Botrychium hesperium	Western Moonwort	G4	S1	20/06/1988
Botrychium pseudopinnatum	False Northwestern Moonwort	G1	S1	19/06/1998
Botrychium spathulatum	Spatulate Moonwort	G3	S1	22/06/2000
Bromus pumpellianus	Pumpelly's Brome	G5T5	SH	07/07/1939
Diphasiastrum sabinifolium	Ground-fir	G4	S3	10/08/1995
Trichophorum clintonii	Clinton's Clubrush	G4	S2S3	21/06/1970
Zizia aptera	Heart-leaved Alexanders	G5	S1	19/06/1998
Bryum blindii	A Moss	G3G5	S2	19/07/1971
Bryum pallens	A Moss	G4G5	S1	12/08/1971
Anaptychia setifera	A Lichen	G3G4	S3	18/07/1962
Peltigera collina	A Lichen	G3G4	S1	01/09/1965

5.8.2.4.5 Moonworts (*Botrychium* spp.)

Five species of rare moonworts have been reported near the Project area. All the records are from at or near the Angler rail siding, about 3 km southwest of the west side of Project area. Habitat for these species includes grassy rail rights-of-way and other sandy open habitats (Oldham and Brinker, 2009). None of these species was observed in the study area despite searches of potential habitat especially in disturbed areas at old gravel pits.

5.8.2.4.6 Heart-leaved Alexanders (*Zizia aptera*) and Pumpelly's Brome (*Bromus pumpellianus*)

Heart-leaved Alexanders and Pumpbelly's brome have been recorded along rail lines south of the Project area. There are two records of heart-leaved Alexanders, one at the Angler siding and the other near the town of Marathon about 7 km south of the study area. In Thunder Bay District, most or all records of both these species are along rail lines, where they are probably non-native (Oldham and Brinker, 2009; pers. comm., Mike Oldham, OMNR, 2006). There is little or no suitable habitat in the study area.

5.8.2.4.7 Clinton's Clubrush (*Trichophorum clintonii*)

This species was reported 12 km southeast of the Project area in 1970. Typical habitat includes open woods and rocky crevices along rivers (Oldham and Brinker, 2009).

5.8.2.4.8 Ground-fir (Diphasiastrum sabinifolium)

This species was reported 4 km southwest of the Project area in 1995. Typical habitat includes cutovers and disturbed sandy soil (pers. obs., Allan Harris, Northern Bioscience).

5.8.2.4.9 Mosses and Lichens

Two mosses and two lichens have been reported near the Project area (see Table 5.8-3). These species were collected at various locations along Lake Superior south and west of the Project area. In general, the distribution and status of mosses and lichens are poorly known in Ontario.

5.9 Socio-economics, Culture and Human Health

This section provides an overview description of the existing socio-economic environment. The detailed baseline characterization for the socio-economic environment is provided by gck Consulting (2012a). The baseline socio-economic environment was characterized in terms of economic factors, social factors, resource use, human health and navigable waters, and is discussed in the following sections.

5.9.1 Work Scope

The socio-economic assessment focuses on the people and communities who live in and make use of the area potentially affected by biophysical changes resulting from the Project. As such, the study areas are defined more broadly for the socio-economic assessment than the atmospheric, aquatic and terrestrial assessments. The regional study area (RSA) for the socio-economic assessment includes communities within a 100 km travel distance of the Project, though regional economic benefits might be realized along the corridor between Wawa and Thunder Bay. The local study area (LSA) for the socio-economic assessment includes the area immediately surrounding the Project, including the Town of Marathon and the Pic River First Nation community.

The Town of Marathon is centrally located on TransCanada Highway (Hwy 17) between Thunder Bay and Sault Ste. Marie on the North Shore of Lake Superior in Northwestern Ontario. Marathon is surrounded by the Towns of Terrace Bay and Schreiber to the west, the Town of Manitouwadge to the north northwest, Town of White River to the east, and the First Nations communities of Pic River, Pic Mobert, and Pays Plat as shown in Figure 5.9-1.

Figure 5.9-1: Communities within 100 km of the Project Site

5.9.2 Social Factors

5.9.2.1 Local Community Profiles[4]

5.9.2.1.1 Marathon

Marathon was born as a railroad community named Peninsula due to its location on a peninsula on Lake Superior. The railroad was constructed between 1881 and 1883. After the railroad was constructed, Peninsula's population dwindled considerably and didn't rise again until approximately 1946 when a pulp mill was constructed. The name of the town was changed, first to Everest after D.C. Everest, President of the Marathon Corporation of Wisconsin, which was the owner of the pulp mill. Then, later that same year, the name was changed to Marathon in honor of the pulp company itself.

[4] Profiles for First Nation communities of interest to the Project are provided in Section 5.11.

In the early 1980s, gold was discovered at the Hemlo Camp; an uninhabited area adjacent to the Highway 17, 40 km east of Marathon. By the late 1980s, three mines were operating at the Hemlo Camp with two of the three mines locating their employees in Marathon, which effectively doubled its population and rendered it the largest town along the North Shore between Sault Ste. Marie and Thunder Bay.

The current population of Marathon is 3,353, down about 25% in the last decade.

5.9.2.1.2 Terrace Bay

Terrace Bay is located on the TransCanada (Highway 17) and is approximately 210 km from the major metropolitan area of Thunder Bay. The municipality is located within the District of Thunder Bay and is situated on the northern shore of Lake Superior.

Terrace Bay refers to itself as the Gem of the North Shore and is named after the sand and gravel terraces in the region that were left behind when glaciers receded about 20,000 years ago. The town is a planned community, with the decision to develop first conceived in the early 1940s by the Longlac Pulp and Paper Company. In 1972, the Kimberly Clark Pulp and Paper Company Ltd. and Kimberly Clark of Canada Ltd. merged, causing a rapid rise in population. The pulp mill has been an economic cornerstone in the region. In 2005, Kimberly Clark sold the mill to Neenah Paper Company of Canada which in turn sold the facility to the Buchanan Group of Companies in 2006 when the mill was renamed to its current name, Terrace Bay Pulp Inc. The mill is currently idled.

The current population of Terrace Bay is about 1,471, down about 25% in the last decade.

5.9.2.1.3 Schreiber

Schreiber is located approximately 200 km from Thunder Bay. Schreiber is located within the District of Thunder Bay and is situated on the northern shore of Lake Superior, adjacent to Terrace Bay. Founded in the 1883 as a railway construction camp, steamships loaded with supplies for building the railway docked at this location, known then as Isbester's Landing. The town was renamed Schreiber in 1887 after Sir Collingwood Schreiber, a railway engineer, founding member of the Canadian Society of Civil Engineers and Deputy Minister of Railways and Canals from 1892 to 1905. The CPR moved the divisional office from White River to Schreiber in 1912. The CPR remains as one of the town's biggest employers. The town's economy has also been sustained over the last several decades by the pulp mill in Terrace Bay, which is located 15 minutes away.

The town was the site of one of the four work camps established for Japanese-Canadian internees in World War II. The town is near the main exposure of the Gunflint Chert, which contains rare single-celled Proterozoic fossils.

The current population of Schreiber is about 1,126, down about 20% in the last decade, although the population has increased by 25% since the 2006 census.

5.9.2.1.4 Manitouwadge

Manitouwadge is located in the centre of Ontario and lies halfway between Thunder Bay and Sault Ste. Marie. Nestled on the shores of Manitouwadge Lake, north of Lake Superior, it is situated at the end of Highway 614, approximately 50 km north of the Highway 17. Manitouwadge, named from the Ojibway *manitouwadj*, meaning *cave of the great spirit*, has a past rich with the history of mining.

Over 50 years ago, Manitouwadge was built by Noranda (now a part of Xstrata) to support the Geco copper mine. In the early 1980s, gold was discovered at Hemlo 50 km south of the community. Noranda later acquired the mining rights to a significant portion of the land in that area and built the Golden Giant Mine that offered housing to many of its employees in Manitouwadge. When the Geco mine closed in 1995, the population of Manitouwadge decreased significantly, followed by another population decrease in 2006 when the Golden Giant Mine closed.

The current population of Manitouwadge is about 2,105, down about 30% in the last decade.

5.9.2.1.5 White River

White River is located at the intersection of Highway 17 and Hwy 631, approximately midway between Thunder Bay and Sault Ste. Marie. The small community of White River was established because of its scenic landscape and abundant resources; however, location was a more important factor for being a rail town. William Van Horne picked what is now White River to be a stopover point for the Northwest division; a tiny spot he referred to as Snowbank. Although it was a CPR work camp in 1885, by 1886 it was a modern rail town with a deluxe station house, fine hotels and an ice house.

With the completion of the TransCanada Highway in 1961, White River ceased to be exclusively a railway community. With the highway came new industries and businesses particularly relating to the tourism sector. In the 1970s, Abitibi Price established a lumber mill in White River, which was eventually sold to Domtar Forest Products. In July 2007, Domtar Forest Products indefinitely shut down the White River operations and has yet to reopen.

The current population of White River is about 607, down about 33% in the last decade.

5.9.2.2 Demographics

The demographic characteristics of a community are important indicators of the well-being within a community and can also identify the physical and social assets necessary to support a community. According to Statistics Canada 2011 census data, the population in all of the municipalities in the Project area has decreased, with the exception of Schreiber whose population has increased by 25% since 2006. According to Statistics Canada 2011 census data, 3,353 people live in Marathon, a 13% decrease from the 2006 census data. This trend is apparent in Terrace Bay, Manitouwadge, and White River, as shown in Figure 5.9-2. The 2011 populations and population density in Marathon and the RSA are presented in Table 5.9-1.

According to the Statistics Canada 2011 census data, the population of Pic River First Nation increased 3.1% and the population of Pays Plat First Nation decreased by 5.1% since the 2006 census. The census data for Pic Mobert First Nation is split between two traditional settlements, North and South. Pic Mobert North experienced an increase in population of 40.9% and Pic Mobert South experienced a decrease in population of 7.7% since the 2006 census.

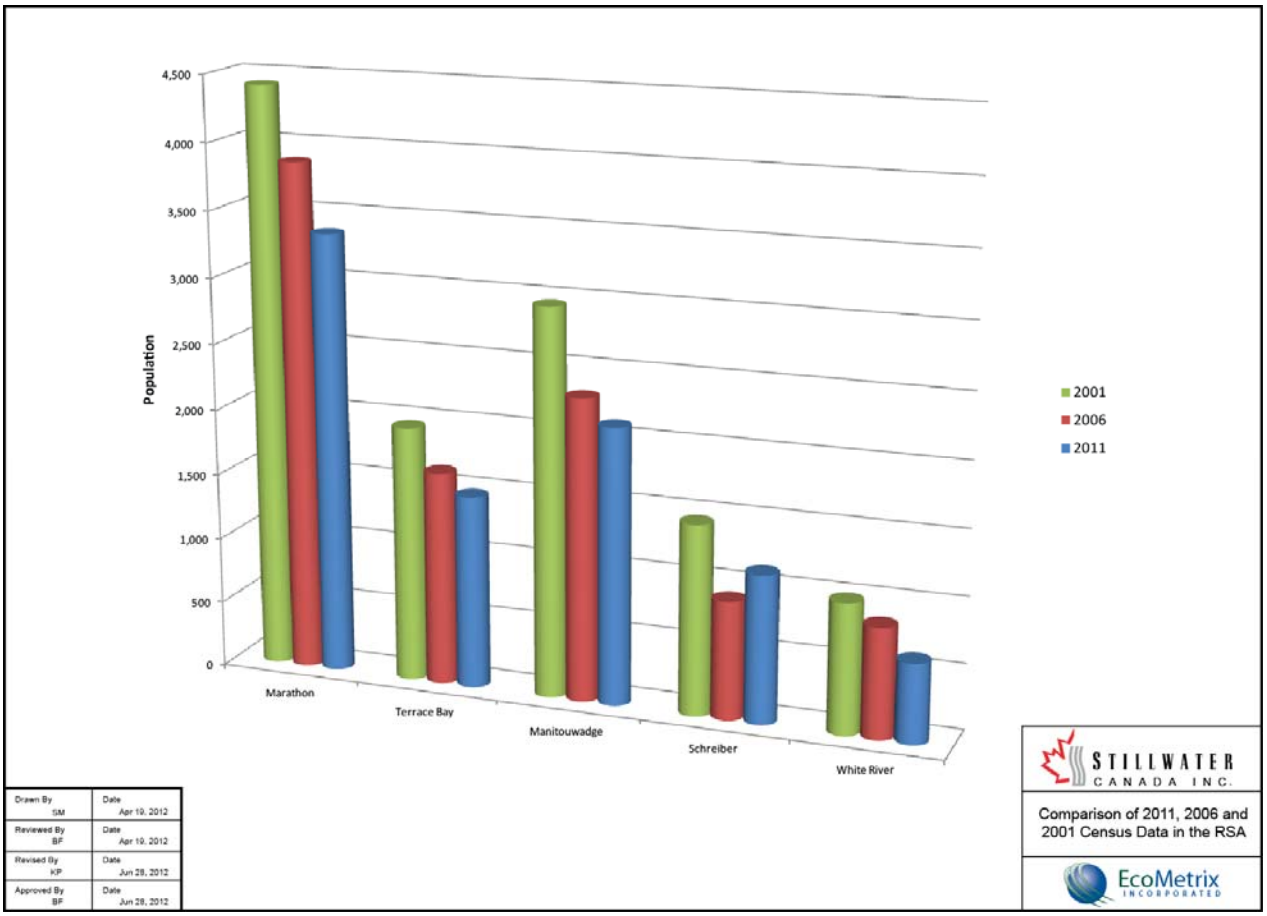


Figure 5.9-2: Comparison of 2011, 2006, and 2001 Census Data in the RSA

Table 5.9-1: 2011 Population and Population Density for Locations of Interest (FN data for on-reserve populations)

Location	2011 Census Population	Population Density per km^2
Marathon	3,353	19.7
Terrace Bay	1,471	9.7
Manitouwadge	2,105	6.0
Schreiber	1,126	30.6
White River	607	6.3
Pic River First Nation	395	108.3
Pic Mobert First Nation	North: 193 South: 96	North: 111.3 South: 282.4
Pays Plat First Nation	75	34.3

At the time of writing this EIS, further breakdown of 2011 census data was not available; therefore, 2006 census data is used for the information below. In Marathon, the breakdown of population by gender is balanced. Each municipality has experienced a decline in the 25 to 44 years age bracket and an increase in the 55 to 64 years age bracket, when compared to 2001 census data. Overall, within the communities the population in the 25 to 44 years age bracket decreased by 33 to 47% and the population in the 55 to 64 years of age bracket increased by 20 to 38%. The 2006 age class distributions of the populations of Marathon, Terrace Bay, Manitouwadge, Schreiber and White River are displayed in Figure 5.9-3.

Throughout its economic history in the forestry and mining sectors, Marathon has attracted and maintained a significant number of younger individuals; however, as these people age, and youth continue to out-migrate, a deficit in the younger population is occurring. As employment opportunities such as the proposed Project emerge, municipalities in close proximity have the opportunity to attract the younger population back to the area.

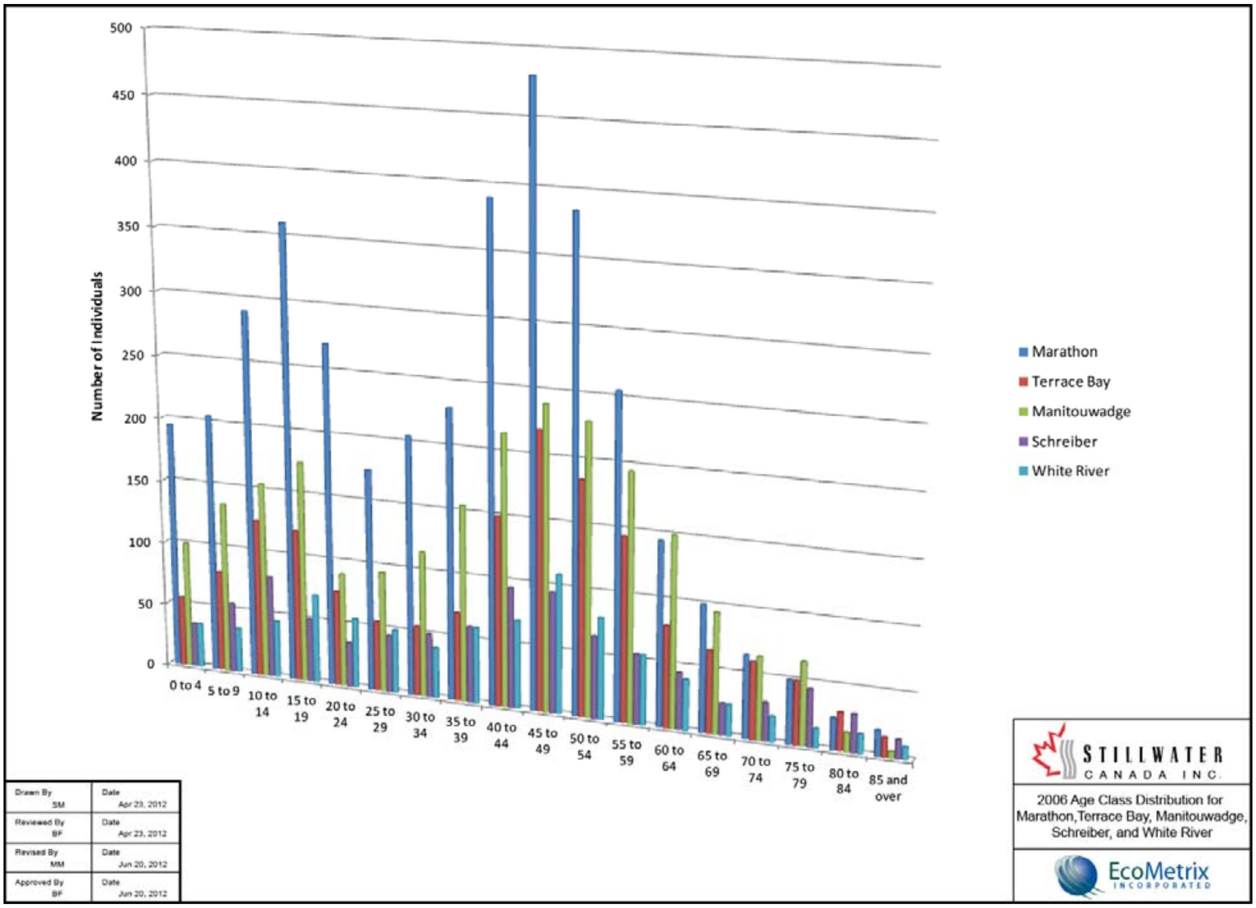


Figure 5.9-3: 2006 Age Class Distribution for Marathon, Terrace Bay, Manitouwadge, Schreiber, and White River

Figure 5.9-4 shows that the populations of the First Nations in the local and regional study area are relatively young – 42% of the population of Pic River First Nation and Pays Plat First Nation and 40% of the population of Pic Mobert First Nation are under the age of 25.

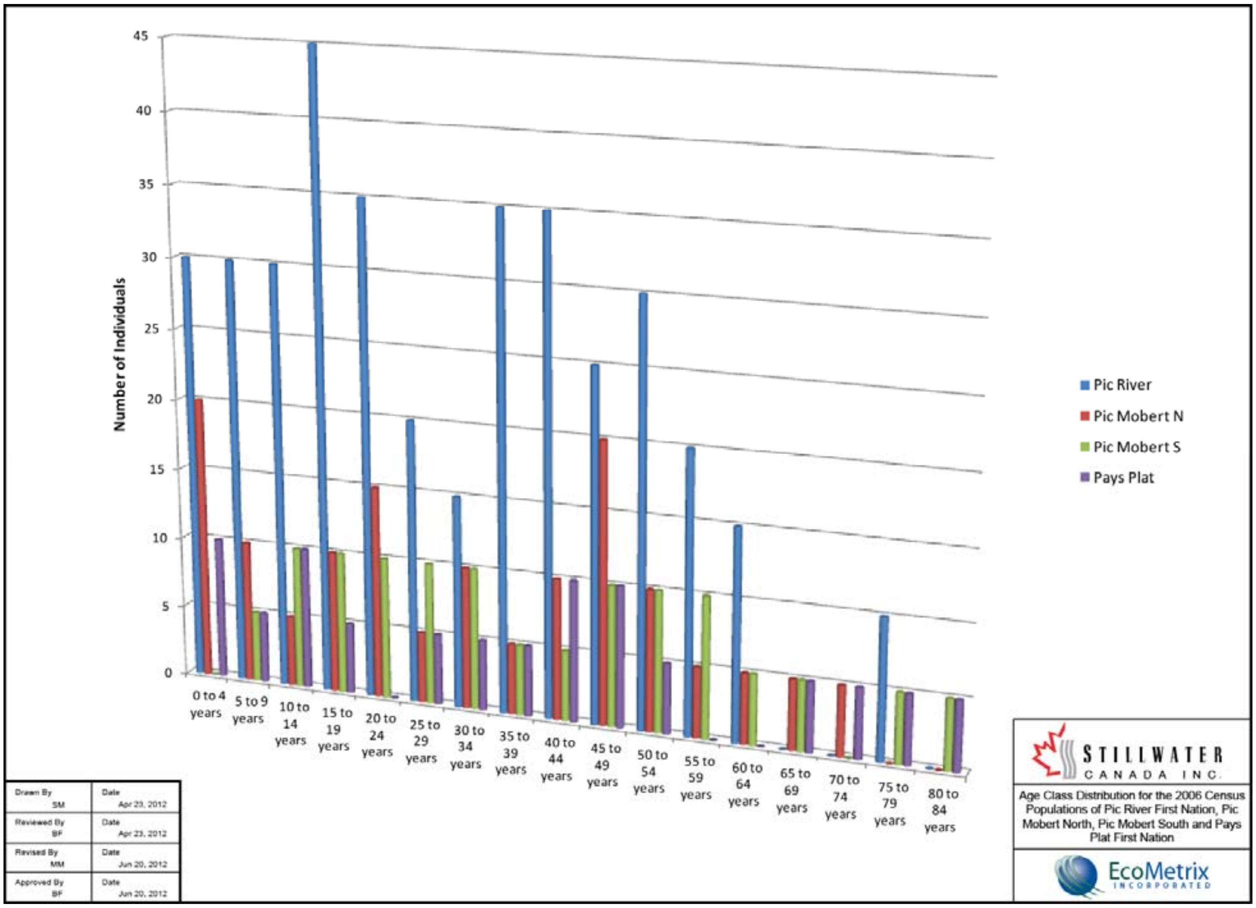


Figure 5.9-4: Age Class Distribution for the 2006 Census Populations of Pic River First Nation, Pic Mobert North, Pic Mobert South and Pays Plat First Nation

5.9.2.3 Housing and Housing Market

As of the 2006 census, there were 1,678 total private dwellings in Marathon, which represents a 5% decrease from 1,766 dwellings in 2001. Figure 5.9-5 shows the distribution of the types of private occupied dwellings in Marathon. The majority of dwellings are single-detached houses and duplex apartments.

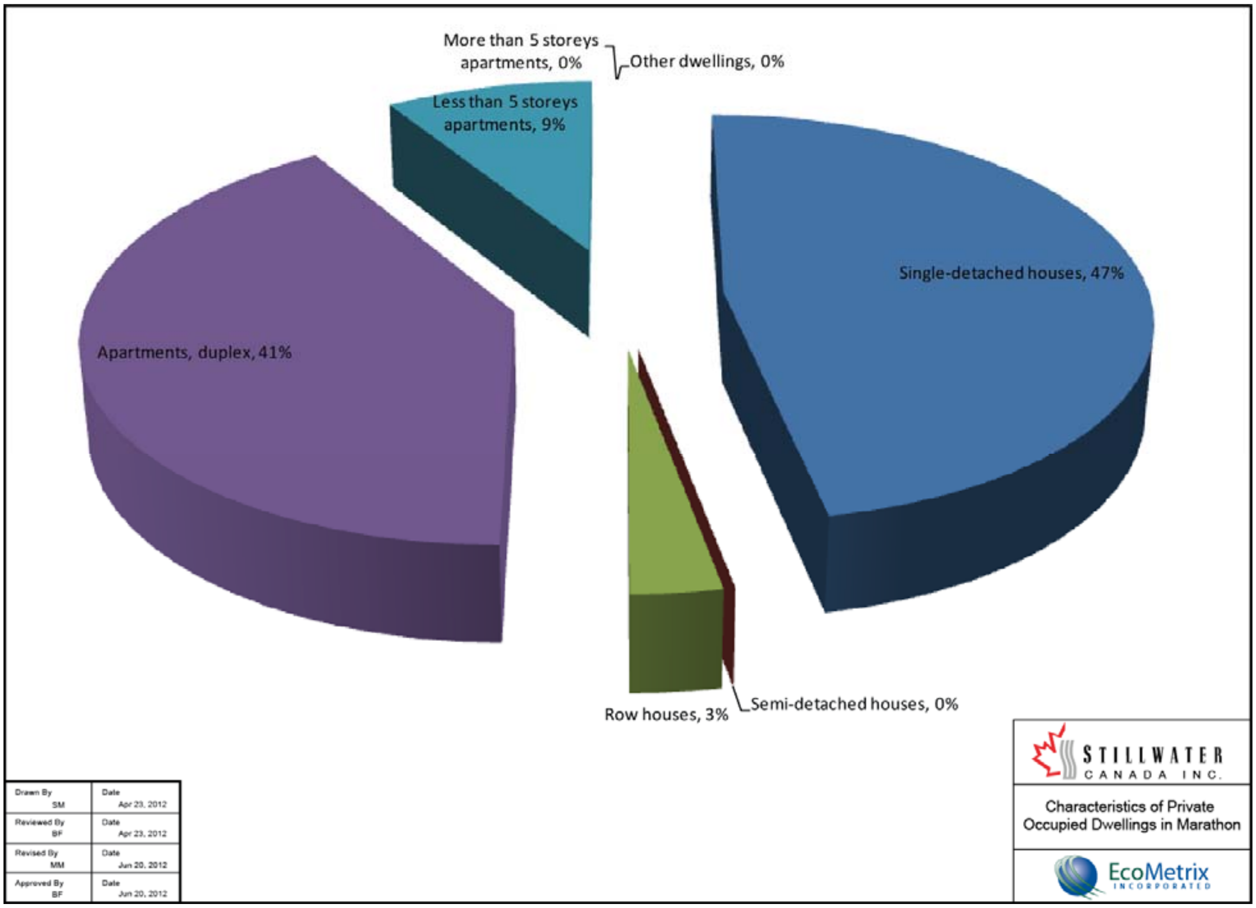


Figure 5.9-5: Characteristics of Private Occupied Dwellings in Marathon

In Marathon, approximately 75% of the residents own their dwellings and 25% rent. In Ontario overall, a lower percentage of residents own their dwellings – approximately 71% of dwellings are owned. Historically, this difference may be partially attributed to higher median incomes in Marathon than the provincial median, allowing more people the ability to buy rather than rent. According to 2006 census data, the approximate value of homes in Marathon is $72,905.

Generally, housing vacancy rates of 5% for rental units and 2% for ownership stock are thought to be sufficient to accommodate reasonable housing choices (Karakas, 2009). Based on dwellings listed on Multiple Listing Service (MLS) website operated by the Canadian Real Estate Association as of February 3, 2011, the vacancy rate in Marathon is 1.7%, slightly below the desired level of 2%. However, Marathon has 20 reasonably priced, fully serviced lots available for immediate purchase. In addition, the municipality has an approved subdivision development contained within its official plan, which includes 80 building lots.

Utilizing data supplied by the municipal office in Marathon, there are approximately 80 vacant rental units – a rental vacancy rate of 19%. The vacancy rate for rented dwellings in Marathon is well above the desired level of 5%. There are also a number of hotel and motel rooms available in Marathon and in the RSA to accommodate at least a component of the influx of temporary workers during the construction phase of the Project. Table 5.9-2 summarizes the available permanent and temporary housing in Marathon and the RSA.

Table 5.9-2: Summary of Available Housing in Marathon and Surrounding Municipalities

Municipality	Available Homes for Sale[1]	Available Rental Units	Serviced Lots	Planned Lots	Hotel Rooms
Marathon	19	80	20	80	157
Terrace Bay	22	16	15	62	97
Manitouwadge	37	15	0	50	0
Schreiber	5	36	28	0	118
White River	21	10	N/A	N/A	101

1. Based on MLS listings from February 3, 2011

The term acceptable housing refers to housing that is adequate in condition (does not require major repairs), suitable in size (enough bedrooms for size and make-up of residents) and affordable (costs less than 30% of before tax household income). Table 5.9-3 summarizes the percent change in median income, rental payments and mortgage payments for municipalities within the area. Overall, in most of the municipalities, household income has increased and rental and mortgage payments have decreased, contributing to affordable housing.

Table 5.9-3: Percent Change in Median Income, Rental Payments, Mortgage Payments (2001 to 2006) for Municipalities of Interest

	Marathon			Terrace Bay			Manitouwadge			Schreiber			White River		
	2001	2006	Percent Change	2001	2006	Percent Change	2001	2006	Percent Change	2001	2006	Percent Change	2001	2006	Percent Change
Median household income ($) – All households	$70,870	$82,991	17%	$77,754	$80,240	3%	$70,921	$78,894	11%	$57,497	$42,513	-26%	$59,803	$57,297	-4%
Median monthly payments for rented dwellings	$544	$501	-8%	$447	$526	18%	$493	$530	8%	$455	$416	-9%	$582	$550	-5%
Median monthly payments for owner-occupied dwellings	$682	$664	-3%	$766	$600	-22%	$945	$516	-45%	$684	$634	-7%	$533	$633	19%
Source: Statistics Canada, 2001 and 2006 Census Community Profiles for Schreiber															

5.9.2.4 Education and Employment

There are twelve primary schools and four secondary schools in the RSA – four of which are located in Marathon. Confederation College operates a satellite campus in Marathon, which acts as the coordinating focal point for college level education programming in the area.

In the five municipalities, between 68 and 94%t of the population aged 25 to 34 years has attained education or training at or beyond the high school level. This includes between 20 and 40% with high school certificates or equivalent between 0 and 14% who have received an apprenticeship or trade certificate or diploma, between 16 and 33% who have received a college equivalent certificate or diploma and between 12 and 25% who have received a university diploma or degree.

Pic River First Nation offers elementary and secondary educational services on reserve to its members. There are four education programs that are offered to individuals residing in the community, including elementary, secondary, special education and post-secondary student support programs.

Pic Mobert First Nation ensures that education is provided to its Band Members. Netamisakomik Center for Education is located on the Reserve to provide education to students from Junior Kindergarten through Grade 8. Pic Mobert First Nation also ensures that post-secondary education support is available through application assistance.

Pays Plat First Nation does not offer elementary or secondary educational services on reserve. Support is provided to elementary and secondary school students, as well as those pursuing post-secondary education through a number of programs. There is an educational counsellor on reserve.

5.9.2.5 Community Services

The following section summarizes some of the key existing community services available to Marathon residents and the surrounding communities such as emergency services, social services, recreation, justice, commercial, retail and industrial services.

Emergency services in the area are provided by the Ontario Provincial Police (OPP) for policing, local fire departments for fire protection and Superior North Emergency Medical Services for local dispatch offices for ambulance services, which are all accessible on the 911 network. Police services in Pic River First Nation and Pic Mobert First Nation are provided by the Anishinabek Police Service (APS). Pays Plat First Nation is serviced by the OPP Nipigon Detachment – Schreiber Satellite Detachment.

From 2007 to 2010, reported violent crimes in Marathon and Manitouwadge have increased slightly. The clearance rate for these violent crimes is 98%, which is slightly higher than the national average. There has been a 20% increase in property-related crimes over that same period. The OPP accounts for the rise in incidents through the better collection of information. Results Driven Policing (RDP) and media campaigns for victims and witnesses to report incidents to police have been successful. From 2007 to 2009, the number of violent crimes in the Nipigon/Schreiber area has decreased by 22%, while the number of property crimes has remained constant.

During the 2010 – 2011 year, guns and gang unit investigations showed increases in several areas. The highest areas of incident were: firearms seized; prohibited devices seized; other weapons seized; compliance check of known gang members; involved arrests; and, charges resulting from joint investigations.

Drug-related occurrences and report of local drug use have decreased by 20% in the last number of years but are still a major concern within Marathon and Manitouwadge. The Marathon Detachment of the OPP plans to further improve reductions by proactively addressing local drug issues through targeted investigation strategies and public education.

Traffic volumes on Highway 17 amount to an average of 2,100 vehicles daily. Volumes on secondary provincial highways are considerably less. With Highway 17 being a portion of the TransCanada Highway system, most of the traffic is commercial or transient in nature.

The area offers an array of community and social services programs. The programs range from support services for children, families, adults, women and seniors and are funded through various levels of government (municipal, provincial and federal). Information concerning these programs and supports are available on each municipality’s website. The municipalities also offer their residents many social, specialty, hobby, sports and professional service clubs.

Marathon has 56 hectares of municipal parkland including Penn Lake Park, Peninsula Golf Course and various school properties. Marathon’s parkland provides designated areas and facilities for a wide variety of four-season recreational activities including hiking, snowshoeing, cross-country skiing and mountain biking. Marathon also has over 200 km of groomed snowmobile trails which require trail permits to use. Marathon has indoor recreation facilities such as an indoor pool, arena, bowling, and curling.

5.9.2.6 Existing Infrastructure

Marathon and its surrounding municipalities have good access to healthcare and social services. Each municipality is serviced by its own health care facility offering services ranging from family medicine, maternity and pediatrics, emergency, tele-medicine, and consultation. There are several medical clinics and hospitals in the LSA and RSA. The two facilities located in Marathon are Wilson Memorial General Hospital and Marathon Family Health Team. Health services in the First Nations are provided through federally-funded, community-based programs that are operated through local health centres. The programs focus mainly on health promotion and prevention strategies.

With the exception of Manitouwadge, all of the municipalities are located on TransCanada Highway 17 and are serviced by the Canadian Pacific Railway (CPR). There is passenger rail service available from White River to Sudbury. Each municipality maintains paved and gravel roads within their municipal boundaries. No public transit is available but private companies provide local taxi service.

Marathon, Manitouwadge and White River operate local airports. There is currently no regular air service but landing and fuel services are available. The airports can also provide for remote access flights. International travel can be accommodated at the Thunder Bay International Airport and various Canadian flights can be scheduled at the Wawa and Sault Ste. Marie airports. Ocean-going vessels can dock at the Peninsula Harbour (in Marathon), delivering or picking up cargo, though it is not an active port at this time.

The northern shore of Lake Superior does not have access to the natural gas line and, as a result, the major energy source is electricity. Residents utilize electricity or heating oil for residential heating purposes. Electricity is provided to the area by Hydro One. Pic River First Nation currently obtains its energy from three hydroelectric dam facilities.

Marathon has an excellent supply of raw ground water, designed to accommodate a population of approximately 5,500 people, well above the current population. The city's wastewater collection system includes 26 km of sanitary sewer pipe and 4.4 km of storm sewer piping. Wastewater is treated at the Marathon Wastewater Treatment Plant via an activated sludge process. The design capacity of the effluent treatment system is 4,400 m^3/d. At present, monthly average final effluent discharge rates are in the range of 1,000 to 1,200 m^3/d. Treated municipal effluent is discharged into Lake Superior south of the town.

Bulk propane is provided by two suppliers. A private company maintains bulk storage of fuel oil for heating and diesel power within Marathon.

Marathon operates a landfill site within the municipal boundaries. In order to meet the immediate and long term needs of the community, the municipality has recently received approval to expand the current boundaries of the landfill site, while also concurrently seeking approvals for a new site.

5.9.2.7 Traffic

Existing traffic around the Project site is discussed in terms of road traffic only. Other modes of transportation such as rail, water, and air are discussed under infrastructure (Section 5.9.1.6).

Existing access to the Project site is through a gravel access road (Camp 19 Road) from Highway 17, directly across from Peninsula Road. Peninsula Road is the main road into Marathon. The existing intersection of Highway 17, Peninsula Road, and Camp 19 Road does not have any traffic signals; however both Peninsula Road and Camp 19 Road have stop signs at the intersection of Highway 17. Table 5.9-4 provides a description of the existing roads and associated traffic volumes at the intersection of Highway 17, Peninsula Road, and Camp 19 Road, as measured by Engineering Northwest Ltd. (ENL, 2012).

Level of Service (LOS) is a qualitative measure of traffic operating conditions using delay at intersections to determine the acceptability of the un-signalized intersection. Overall the intersection of Highway 17, Peninsula Road, and Camp 19 Road are operating at LOS A – that is, little or no conflicting traffic for minor street approach, with an average total delay of less than 10 seconds per vehicle. This is considered the best level of service.

Table 5.9-4: Description of Road Network and Existing Traffic Volumes

Road	Description	Direction of Traffic Flow	Weekday Traffic Volume (# of vehicles)	
			AM[a]	PM[b]
Highway 17	• Comprised of 2 lanes, Rural Arterial Undivided King's Highway • Part of Trans-Canada Highway • Posted speed limit is 90 km/h, but designed for 110 km/h • Left turn lane to turn onto Peninsula Road	Eastbound	25	38
		Westbound	13	57
		Turning onto Peninsula Rd	29	185
		Turning onto Camp 19 Rd	0	2
Peninsula Road	• Comprised of 2 lanes providing access to Town of Marathon • Posted speed limit is 80 km/h • Right turn ramp to turn onto Highway 17 east	Northbound to Camp 19 Rd	2	2
		Turning westbound onto Hwy 17	28	46
		Turning eastbound onto Hwy 17	33	51
Camp 19 Road	• Road is paved for a distance of 100 m • Intersects Highway 17, directly across from Peninsula Road	Southbound to Peninsula Rd	1	4
		Turning westbound onto Hwy 17	1	0
		Turning eastbound onto Hwy 17	0	0

a. Peak morning time from 7:00am to 8:00am
b. Peak afternoon time from 4:15pm to 5:15pm

The road conditions of Peninsula Road and Highway 17 are good. Peninsula Road from Highway 17 to the Town of Marathon was reconstructed in 2008. In 2008/9, the Ministry of Transportation reconstructed Highway 17 from 0.6 km west of Peninsula Road, 17.8 km east. The project included repaving the existing highway and constructing a new eastbound passing lane starting at the Peninsula Road intersection.

5.9.3 Economic Factors

5.9.3.1 Overview

Historically, the primary industries that have supported the local economy include mining (both mineral exploration and development) and forestry. Currently, only the Hemlo Gold Camp (including the David Bell and Williams Operating mines both of which are owned by Barrick

Gold), 35 km east of Marathon, continues to operate. The Hemlo Gold Camp employs a workforce of about 650. Recent Closure Plan amendments suggest that mining operations will continue to about 2025. Closed mines in the area include Geco Mine, Willory Mine, Winston Lake Mine, and Zenmac/Zenith Mine.

As indicated forestry, in particular pulp production, has historically also been an integral part of the local economy. There has however been a general and significant downturn in the forestry sector in the region in the last 10 to 15 years. Marathon Pulp Inc. operated more or less continuously from 1946 to 2009 but is now closed. The Terrace Bay pulp mill has operated on an off-and-on basis for the last number of years and at the time that this report was prepared the mill had been idled. White River was home to the Domtar Inc. sawmill until its closure in 2007. Forestry in the area has declined largely because there is little demand for the fibre supply that it generates.

5.9.3.2 Employment

Figure 5.9-6 displays employment and unemployment data for the Project area. Terrace Bay and Schreiber have the highest unemployment rates with Marathon, Manitouwadge and White River having significantly lower rates. The unemployment rates in Marathon, Manitouwadge and White River continue to hover between 7 and 8%, which is consistent with the Ontario unemployment rate of 8.7% and national unemployment rate of 7.6%.

Census-reported unemployment rates in the First Nation communities range from 13% in Pic River First Nation and 53% in Pays Plat First Nation although these figures may not be accurate.

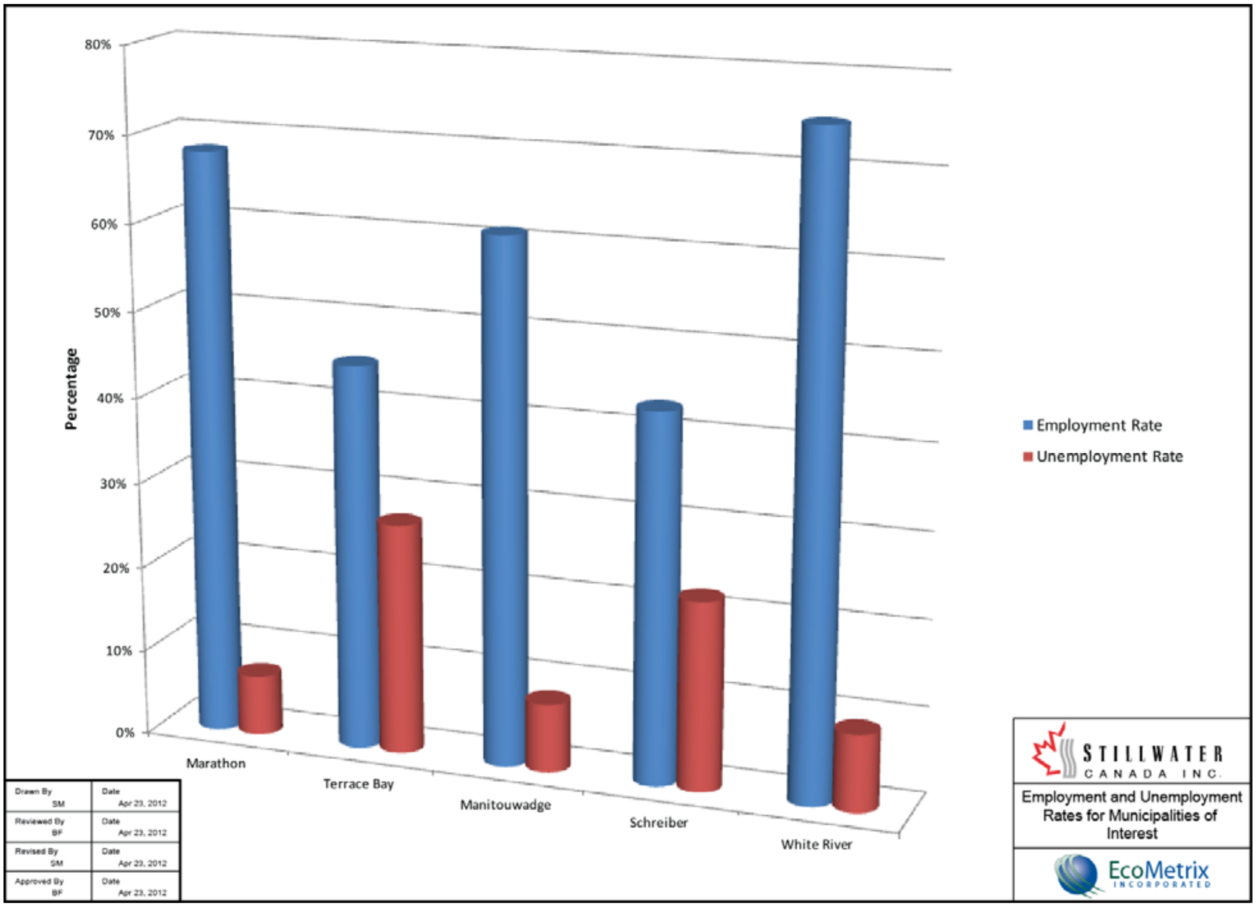


Figure 5.9-6: Employment and Unemployment Rates for Municipalities of Interest

5.9.3.3 Labour Force

The total labour force in Marathon is estimated to be 2,360 individuals with a labour force participation rate of 74% (78.2% for males and 69.1% for females). The LSA and RSA is dominated by labour force participation in mining, oil and gas extraction, manufacturing, retail trade, transportation and warehousing, agriculture, forestry, fishing and hunting, and educational services industries. The labour force for the First Nations is concentrated in other services, including agriculture and resource-based services, health care and social services and educational services.

The occupations of the labour force in the area serve to support these industries. Occupations continue to be concentrated in business, finance and administration; occupations unique to primary industry; trades, transport and equipment operators; sales and service; and, social science, education, government service and religion. Figure 5.9-7 shows the distribution of occupations held in Marathon.

The main employer in the Project area is Barrick Gold Inc. (Hemlo mine). The workforce at Barrick Gold Inc. has remained fairly constant. Terrace Bay Pulp Inc. is currently in idle state, so the number of employees is in flux. In January 2012, the company announced that the operation would be put up for sale and it was placed under protection from its creditors on January 25th, 2012. The mill has been idled while potential buyers conduct the due diligence activities for potentially acquiring the mill.

Based on 2006 census data, Marathon had the highest average annual household income of $117,459 per year and Schreiber and White River have the lowest, of $77,668 and $73,690, respectively. PRFN had a median household income of $42,368 and median family income of $49,408. Household income data were not available for PMFN or PPFN.

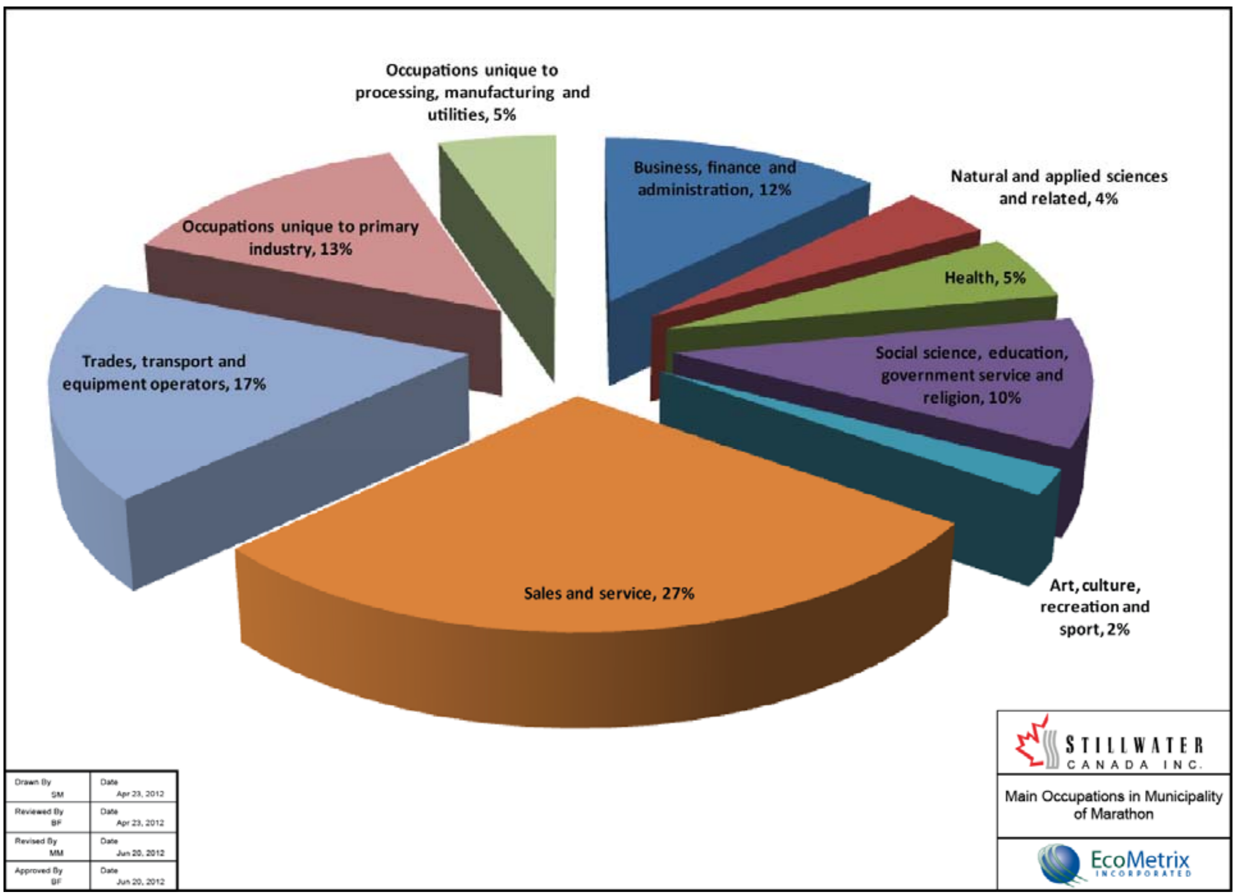


Figure 5.9-7: Main Occupations in Municipality of Marathon

5.9.3.4 Government Funding

Municipalities collect the majority of operating finances through annual taxes levied on property owners. These funds are applied towards the administration of all municipal departments for the provision of many essential services: police and fire protection; road maintenance; sewage and drainage; parks and recreation; economic development; and, tourism. The total tax rate comprises municipal and education tax levy components, although the education tax levy is not set by the municipality but by the province.

The First Nations finance the administration and operation of their governments through transfer payments from the federal government.

5.9.3.5 Economic Development

Within the municipal government of Marathon, the Community Services and Economic Development Department is responsible for the development and administration of a community economic development strategy, including economic and community development initiatives and projects, business retention and expansion and the promotion of industrial and commercial development. The department is also responsible for community tourism projects, as well as operating the Marathon Visitor Information Centre.

The Marathon Community Development Assistance Fund (CDAF) is a community development assistance program funded and administered by the municipality. It provides assistance to community development projects and events that meet specific criteria.

The Marathon Economic Development Corporation (MEDC) promotes economic development and diversification and provides support for enterprises, institutions and entrepreneurs engaged in the economic, cultural and social development within Marathon. The MEDC has developed a Strategic Action Plan (SAP) that identifies eight economic themes that will be the cornerstones upon which Marathon's economic sustainability and future prosperity will be built and anchored:

- Mining;
- Forestry;
- Health;
- Transportation;
- Energy;
- Education;
- Retail; and
- Government.

Pic River First Nation owns and operates Pic River Development Corporation, an economic development corporation with forestry and fire fighting activities. They also own and operate cable television and high-speed internet companies. PRFN has participation and ownership interests in three hydroelectric generating stations (Umbata, Wawatay and Twin Falls). PRFN is also proposing to construct hydroelectric facilities at Manitou Falls and High Falls, located on the Pic River approximately 70 and 85 km upstream from Lake Superior. The facility at Manitou Falls would have a generating capacity of 2.8 MW and the facility at High Falls would have a generating capacity of 3.2 MW. PRFN has also taken steps to pursue two wind energy initiatives. The first is Superior Shores Wind Farm and it is to be 100% owned by the First Nation. They are also developing the Coldwell Wind Farm northwest of Marathon through a partnership with Brookfield Renewable Power.

Pic Mobert First Nation is involved in hydroelectric generation and is working on the Gitchi Animki Hydroelectric Project that will generate approximately 95 GWh of electricity annually to support approximately 12,000 homes. The operation is expected to be functional by 2013.

5.9.4 Resource Uses

Local and regional resource uses are discussed elsewhere in this report (Section 1.4.3.2). Supplemental information specifically as it pertains to fishing and hunting activities, trapping and tourism is provided below.

5.9.4.1 Hunting and Fishing

The Ministry of Natural Resources (OMNR) manages hunting and fishing activities under the authority of the Fish and Wildlife Coordination Act. The Project site is within Wildlife Management Unit (WMU) 21A . The RSA overlaps both WMU 21A and 21B, as shown in Figure 5.9-8. To manage wildlife resources in a WMU, the OMNR issues Outdoors Cards, hunting licenses, validation tags and game seals. The number of validation tags issued for the WMU in a year is determined by the OMNR and considers the number of a particular species that can be harvested in a sustainable manner within the WMU.

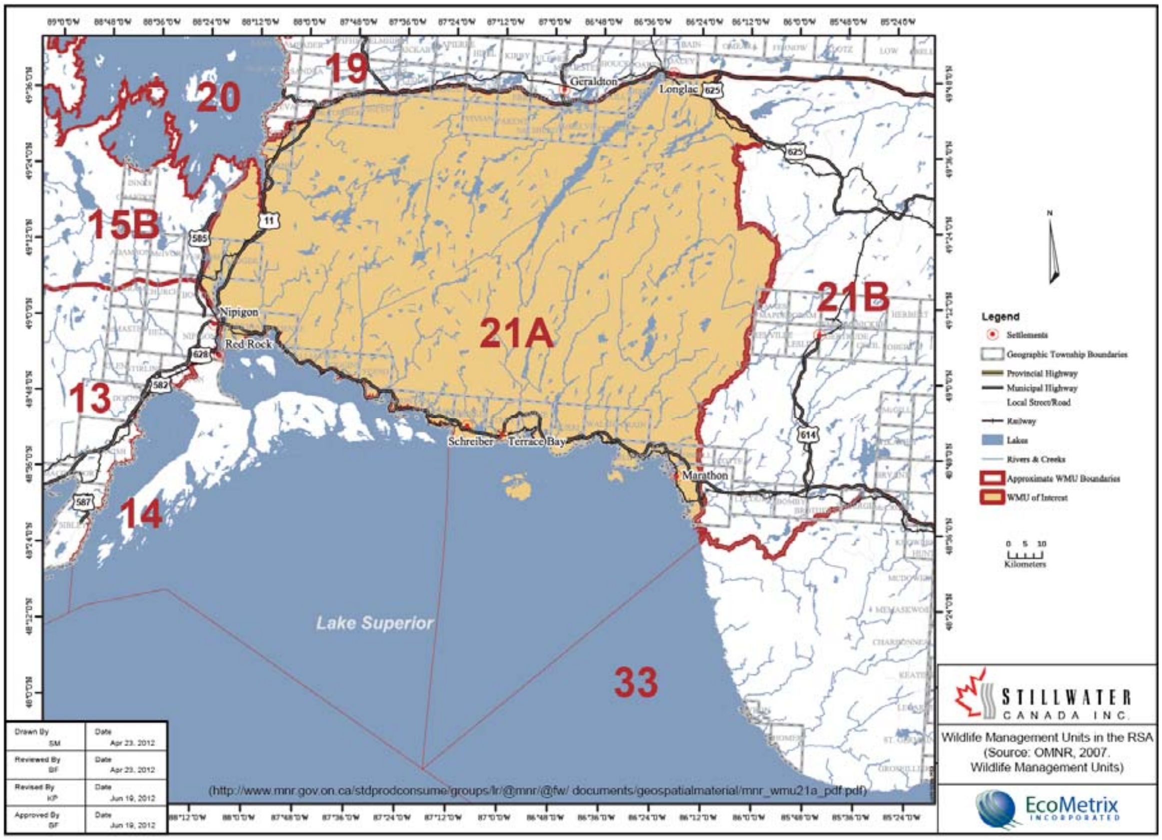


Figure 5.9-8: Wildlife Management Units in the RSA (Source: OMNR, 2007. Wildlife Management Units. http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@fw/ documents/geospatialmaterial/mnr_wmu21a_pdf.pdf)

The RSA falls within Fish Management Zone 7, as shown in Figure 5.9-9. Fish managed in this zone include: Walleye, Sauger (*Sander canadensis*), Largemouth Bass (*Micropterus salmoides*), Smallmouth bass (*Micropterus dolomieu*), Northern Pike, Yellow Perch, Sunfish, Brook Trout, Brown Trout (*Salmo trutta*), Lake Trout, splake, Chinook Salmon, Atlantic Salmon (*Salmo salar*), and Lake Whitefish. OMNR issues sport fishing licenses and conservation fishing licenses. All license types regulated by the OMNR are identified on the back of an Outdoors Card.

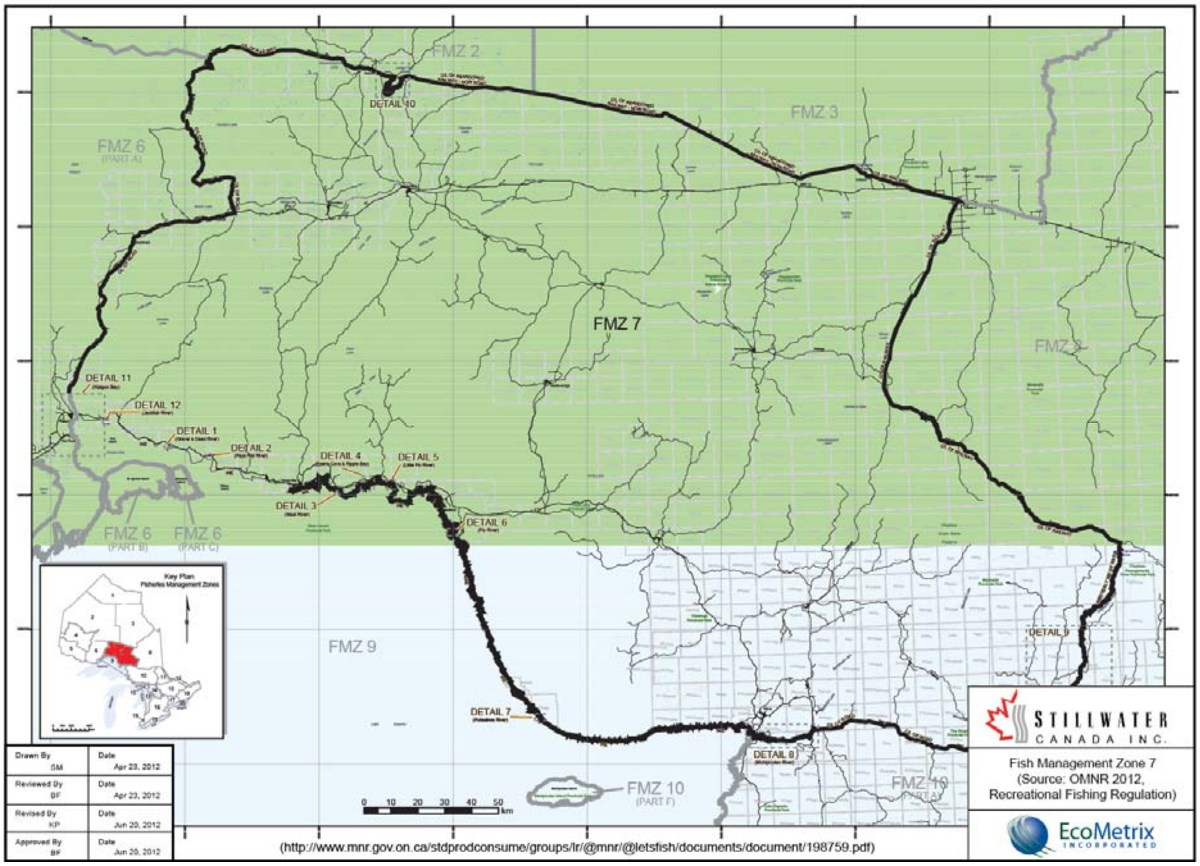


Figure 5.9-9: Fish Management Zone 7 (Source; OMNR, 2012, Recreational Fishing Regulations. http://www.mnr.gov.on.ca/stdprodconsume/groups/ lr/@mnr/@letsfish/documents/document/mnr_e001327.pdf)

The Marathon Visitors Centre has published a list of ten easily reached fishing spots in and around Marathon. This list is presented in Table 5.9-5.

Table 5.9-5: Easily Reached Fishing Spots in and Around Marathon (Source: Marathon Information Centre, 10 Easily Reached Fishing Spots in and Around Marathon, http://www.marathon.ca/upload/documents/10-easily-reached-fishing-spots-in-and-around-marathon.pdf)

Location	Species
Shack Lake/Creek	Speckled Trout
Angler Creek	Speckled Trout
Pic River/Lake Superior	Pickerel, Pike, Muskie, Trout, Salmon, Sturgeon
Coldwell Bay	Lake Trout
Penn Lake	Pike, Pickerel
Mink Creek	Speckled Trout, Rainbow Trout
Little Pic River (Neys Park)	Salmon, Lake Trout
Wolf Camp Lake	Speckled Trout, Perch
Red Sucker Lake	Speckled Trout, Perch

As it pertains specifically to the Project site, activity of any kind is limited due to the difficulty in accessing the interior of the site and the overall ruggedness of the terrain. The existing access road, which forms the southern limit of the site before turning north along the Pic River, is likely used by anglers to access the Pic River and by snowmobile users in the winter. There is no recreational fishery associated with the Project site. Recreational fishing activity is likely focused on the Pic River, which contains a variety of coldwater and coolwater fish species, Hare and Bamoos lakes and the near shore area of Lake Superior. Hare Lake is road accessible from its southwest corner and has two cottages. Bamoos Lake, which is upstream from Hare Lake within the same catchment, is accessible by air and portage from Hare Lake/Creek and is accessible during the winter using snow machines. Northern Pike and Yellow Perch are the primary recreational fish species that can be found in Hare Lake. Lake Trout and Brook Trout are the primary recreational fish species that can be found in Bamoos Lake.

5.9.4.2 Trapping

There are two trap line permit areas within the boundaries of the Project site (TR022, TR023 [see Figure 5.9-10]), though activity within these areas is minimal. There is a trapper cabin located in TR023, to the northeast of the Project site, on Pukatawagan Lake (OMNR, 2007). Data collected from 2007 to 2010 indicate that no animals were harvested from TR022. From TR023, 104 and 43 animals (mostly beaver and marten) were harvested in 2007 and 2008 (Allison, B. “FW: Fur Harvest Data.” Message to Robert Foster. 17 Jan. 2011. E-mail).

Figure 5.9-10: Trap Line License Areas in the Vicinity of the Project site (the black outline shows the mining lease area associated with the Project)

People of the Pic River First Nation also run trap lines in the area. The majority of this trapping currently occurs in close proximity to the Camp 19 and site access roads (see Section 5.11).

5.9.4.3 Tourism

Marathon is part of the North of Superior region, which is one of the largest tourism regions in Ontario. The North of Superior region is located in the northwest part of the province, encompassing 155,000 km^2. The region is the area bordered on the North by the Albany River, on the South by the Canada-United States border, on the West by Highway 599 and Quetico Park and on the East by the District of Algoma.

In 2004, total visitor spending in the North of Superior region was approximately $700 million, contributing approximately $500 million to the GDP (Forest, 2008). However tourism in Marathon specifically is not extensive. From 1995 to 2004 the annual number of visitors to Marathon has been relatively consistent at 8,000 to 10,000 visitors. Most visitors are coming to

Marathon for recreation purpose. One of the key attractions is camping. Marathon has developed a strategic plan to expand its tourism industry. The key priorities being undertaken are beautification and development of infrastructure and signage at the entrance to the town. This includes: improvements to Pebble Beach to make it a destination, improvements to trails, improvements to the highway and town signage, and the development of better material for the Visitors Centre (Marathon Tourism Action Committee, 2006). Plans are also underway to revitalize Penn Lake Park, involving complete restoration of the RV and tenting campground with water, sewer and internet connections. Construction of a new comfort station, children's playground and a beach volleyball court are also planned (Forest, 2008).

5.9.5 Human Health

Human health is defined in terms of physical well-being, social well-being, and mental well-being. Physical well-being focuses on how environmental components such as air quality, noise, surface water and groundwater quality impact health. Socio-economic conditions related to physical well-being, such as health and safety services, are also considered. Indicators for social well-being include population and demographics, employment and income, health and safety services and community and recreational facilities and programs. Indicators for mental well-being of the public include feelings of personal health and safety, satisfaction with community, attitude towards the Project site, and traffic.

5.9.5.1 Physical Well-being

The various components of the biophysical environment that potentially effect human health and therefore help to define physical well-being have been described in previous sections of this EIS including: air quality (Section 5.2.2), noise (Section 5.2.3), surface water quality (Section 5.4.3) and groundwater (Section 5.4.2). Additional information related to these components of the biophysical environment not previously presented, as well as other relevant information is provided below.

5.9.5.1.1 Air Quality

The Air Quality Index (AQI) is an indicator of air quality, based on air pollutants that have adverse effects on human health and the environment. The pollutants are ozone, fine particulate matter, nitrogen dioxide, carbon monoxide, sulphur dioxide and total reduced sulphur compounds. According to the OMOE:

- if the AQI reading is below 16, the air quality is in the very good category;
- if the AQI reading is in the range of 16 to 31, the air quality is in the good category;
- if the AQI reading is in the range of 32 to 49, the air quality is in the moderate category, and there may be some adverse effects for very sensitive people;

- if the AQI reading is in the range of 50 to 99, the air quality is in the poor category, and may have adverse effects for sensitive members of human and animal populations, and may cause significant damage to vegetation and property; and,
- if the AQI reading is above 99, the air quality is in the very poor category, and may have adverse effects for a large proportion of those exposed.

The nearest AQI monitoring stations to the Project area are located in Sault Ste. Marie to the south and Thunder Bay to the northwest. These locations could be considered to provide an indication of air quality within the region and therefore also the area around the Project site. Based on measurements taken in the last couple of years the average, maximum and minimum daily AQI values in Sault Ste. Marie and Thunder Bay are provided in Table 5.9-6.

Table 5.9-6: Air Quality Index Scores for Sault Ste. Marie and Thunder Bay, 2010 through May 2012.

	Average	Max	Min
Sault Saint Marie	21.7	51	5
Thunder Bay	21.5	62	7

Air quality based on these indicators is on average in the high end of the “good” category.

5.9.5.1.2 Groundwater Quality

Marathon’s potable water source is raw groundwater obtained from five active groundwater wells (Wells no. 2,3,4,5 and 6) located throughout the community, as shown in Figure 5.9-11. The water from the wells is typically low in turbidity, and slightly basic. Bacteriological analysis of the raw water indicates a source of relatively good quality. The biggest threat to Marathon’s drinking water source is potential leakage from the underground fuel oil storage tanks located in the Town of Marathon. The aquifer underneath the ski hill in Marathon was identified as a potential alternate source of drinking water (Harden Environmental, 2009). There is no connectivity between the groundwater flow paths on the Project and the Town of Marathon’s groundwater supply (TGCL, 2012a).

The Marathon distribution system has approximately 1,379 residential and 142 commercial/industrial connections servicing a population of approximately 3,000 people, but designed to accommodate a population of approximately 5,500 people. From the well houses, water is pumped to the distribution system and reservoir. The water is delivered via a system of various diameter water mains totaling approximately 32 km in length. There are a total of 308 fire hydrants located throughout the distribution system. Treated water quality monitoring includes weekly bacteriological sampling, regular physical/chemical sampling, on-line turbidity and chlorine residual testing, and annual lead testing. Water available for public consumption is required to conform to the Ontario Drinking Water Quality Standards set out by the OMOE.

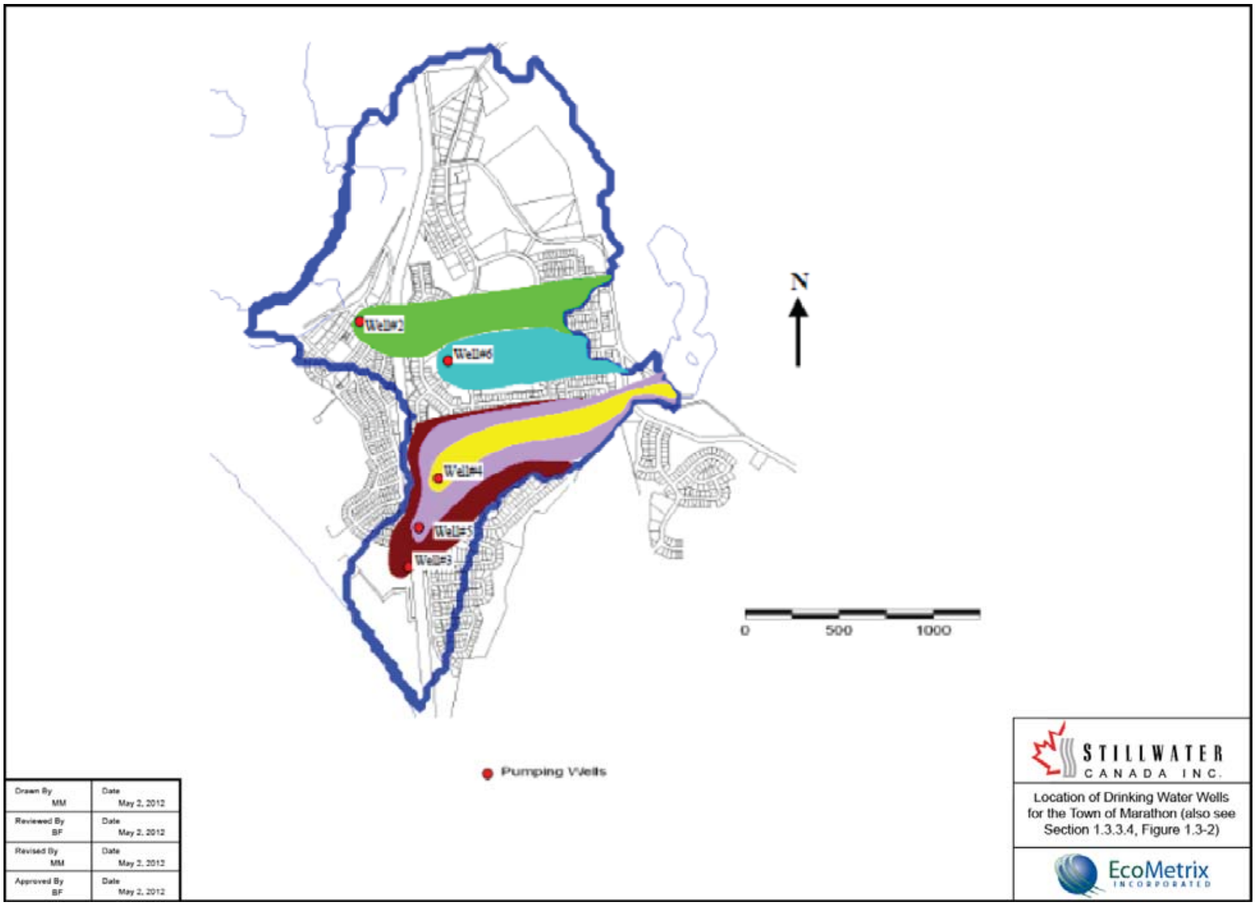


Figure 5.9-11: Location of Drinking Water Wells for the Town of Marathon

5.9.5.2 Background Levels of Electric and Magnetic Fields

Low frequencies of electric and magnetic fields (EMFs) are produced every time electricity and electrical appliances are used. EMFs produced from electrical transmission lines also emit extremely low frequencies of EMFs (below 300 Hertz). EMFs from electrical devices and power lines can cause weak electric currents to flow through the human body. However, these currents are much smaller than those produced naturally by your brain, nerves and heart, and are not associated with any known health risks. Exposure to EMFs is greatest directly underneath the transmission line, but diminishes significantly as distance from the source increases. Health Canada (2010, http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/magnet-eng.php) and the Federal-Provincial-Territorial Radiation Protection Committee (2008, http://www.hc-sc.gc.ca/ewh-semt/radiation/fpt-radprotect/emf-cem-eng.php) believe that there is insufficient scientific evidence to conclude that exposures to EMFs from power lines cause health problems; therefore no Canadian government guidelines for exposure to EMFs have been set.

As discussed in Section 1.4, power to the Project site will be provided via a new 115 kV transmission line that will be constructed from a purposefully built junction point on the Marathon-Manitouwadge transmission line located about 4 km northeast of Highway 17, heading south and subsequently east over a distance of about 3.8 km to an electrical substation near the mill site. The width of the transmission corridor will be approximately 30 m.

The new transmission line will not be constructed near residential populations; therefore, residents of the Town of Marathon or the surrounding municipalities are not expected to be exposed to EMFs from the transmission line. Workers may be exposed to EMFs; however, exposure diminishes significantly as distance from the source increases. The magnetic field directly underneath a typical 120 kV transmission line ranges from 2.5 to 3.0 microtesla (25 to 30 milligaus). At 30 m distance from a 120 kV transmission line the magnetic field decreases to 0.16 to 0.26 microtesla (Hydro Quebec. Electric and Magnetic Fields Sources and Intensity. http://www.hydroquebec.com/sustainable-development/champs/force.html).

The current Canadian position on EMFs as articulated by Health Canada (Health Canada. 2010. Electric and Magnetic Fields at Extremely Low Frequencies. Retrieved from, http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/magnet-eng.php) and the Federal-Provincial-Territorial Radiation Protection Committee (Federal-Provincial-Territorial Radiation Protection Committee. 2008. R esponse Statement to Public Concerns Regarding Electric and Magnetic Fields (EMFs) from Electrical Power Transmission and Distribution Lines. Retrieved from, http://www.hc-sc.gc.ca/ewh-semt/radiation/fpt-radprotect/emf-cem-eng.php) is that there is insufficient scientific evidence to conclude that exposures to EMFs from power lines cause health problems such as cancer. EMF exposure as a human health issue is not considered further within this report.

5.9.5.3 Social Well-being

Information related to social well-being is discussed in EIS report sections 5.9.2 and 5.9.3. Additional information related to community and public health and safety services is provided below. Health and safety services refer to those community facilities and services that directly affect a community's well-being. The key health and safety aspects of a community include its health services, fire services, policing, and emergency preparedness. These services play a crucial role in maintaining people's feelings of health and a sense of safety on a daily basis and during crisis situations, thus affecting people's satisfaction with community.

5.9.5.3.1 Health Services

Healthcare facilities and progressive health-related services and programs provide excellent care and benefit the residents of Marathon and its surrounding communities.

Each municipality in the area is serviced by its own health care facility offering services ranging from family medicine, maternity and pediatrics, emergency, tele-medicine and consultation. The following hospitals and clinics service the area:

- Wilson Memorial General Hospital in Marathon;
- Marathon Family Health Team in Marathon;
- McCausland Hospital in Terrace Bay and servicing Schreiber;
- Aguasabon Medical Clinic in Terrace Bay;
- J. E. Stokes Medical Clinic in Schreiber;
- Manitouwadge General Hospital in Manitouwadge; and,

Wilson Memorial General Hospital is an acute and chronic care hospital with approximately 25 beds that service Marathon and the surrounding area and employs approximately 150 people. Marathon Family Health Team is a full-service family medical clinic with 9 physicians, 2 Registered Nurses, 2 Registered Practical Nurses, a social worker and an epidemiologist on staff.

Together, Schreiber and Terrace Bay pool their health care resources and offer residents exemplary services. McCausland Hospital, located in Schreiber, is a modern, fully accredited 23-bed facility servicing the immediate region with tertiary care available in Thunder Bay.

The Aguasabon and J. E. Stokes Medical Clinics are part of the North Shore Family Health Team, which was established in 2006. The Aguasabon Clinic is located within McCausland Hospital in Terrace Bay, while the J. E. Stokes Clinic is situated in Schreiber. There are currently 3 physicians and staff shared between the two sites.

A leader in the region when it comes to health care, Manitouwadge has a community hospital with 3 full time physicians who are supported by a competent team of medical personnel. The hospital has a laboratory and imaging department and also offers 24-hour Emergency Medical Services coverage, including air ambulance transfer, helicopter first response capability and off-road rescue.

North of Superior Program is a mental health program that has an office in Schreiber and offers assessments, referrals and counselling services. The Mental Illness Support Network is also available and provides adult mental health/addictions support, advocacy, information and education.

A branch office of the Thunder Bay District Health Unit is also located in Marathon. In response to the health needs of the community, the Health Unit provides health information and prevention-related clinical services to people of all ages, advocates for healthy public policy, protects citizens by investigating reportable diseases and upholds regulations that apply to public health.

Health services in the First Nations are provided through federally-funded, community-based programs that are operated through local health centres. The programs focus mainly on health promotion and prevention strategies.

The Pic River First Nation community signed a Health Transfer Agreement with the Medical Services Branch of Health and Welfare Canada in May of 1997, which was renewed for another five years in 2007. This agreement allows for increased autonomy in determining what types of health care services are provided in the community to meet the needs of members.

5.9.5.3.2 Safety Services

Emergency services in Marathon are provided by the Ontario Provincial Police (OPP) for policing services, Marathon Fire Department for fire protection services and Superior North Emergency Medical Services for ambulance services, through the Marathon District Ambulance Service for ambulance services, which are all accessible on the 911 network. Superior North Emergency Medical Services also operates individual bases in Terrace Bay, Schreiber, and Manitouwadge.

The OPP Marathon Detachment also services Manitouwadge. The OPP Nipigon Detachment – Schreiber Satellite Detachment services Schreiber and Terrace Bay. Police services in White River are provided by the OPP Superior East (Wawa) Detachment.

Marathon, Terrace Bay, Schreiber, Manitouwadge, and White River each have their own fire department comprised of a combination of some employed personnel and a team of volunteers. In 2008, the Marathon station received 495 calls and had a 90th percentile response time of 25.04 minutes – 90% of all emergency calls (code 4) responded to resulted in an ambulance at the scene in 25.04 minutes or less. The Marathon Fire Department offers the following services to the residents of Marathon: structural firefighting; wild land firefighting; vehicle extrication on a 100-kilometre stretch of the TransCanada Highway; water and ice rescue; low angle rope rescue; ground-based search and rescue for lost persons; snowmobile-based rescue for lost or injured persons;, fire prevention; inspections; and public education.

Emergency services in Pic River First Nation and Pic Mobert First Nation are provided by the Anishinabek Police Service (APS) for policing services and Superior North Emergency Medical Services through the Marathon District Ambulance Service for ambulance services, which are all accessible on the 911 network. Ambulance services in Pic Mobert First Nation are also provided by the Algoma Emergency Medical Services through the White River dispatch office. Police services in Pays Plat First Nation are provided by the OPP Nipigon Detachment – Schreiber Satellite Detachment and ambulance services are provided by Superior North Emergency Medical Services through the Schreiber Emergency Medical Services Station. Each community has its own Fire Hall for fire protection services.

5.9.5.4 Mental Well-being

The Community Well-Being (CWB) Index was developed by Indian and Northern Affairs Canada (INAC) to help measure the quality of life of First Nations and Inuit communities in Canada relative to other communities and over time. This tool uses Statistics Canada's Census of Population data to produce 'well-being' scores for individual Canadian communities based on indicators of education, income, labour force activity and housing to measure the well-being of First Nation, Inuit and other Canadian communities.

Index scores are available for the towns of Marathon, White River and Terrace Bay and the FN communities of the PRFN, PMFN and PPFN (see Table 5.9-7). The most recent score available are based on the 2006 census data. The average CWB score for non-Aboriginal communities across Canada in 2006 was 77. Scores for each of the three local communities were modestly higher than this. The average CBW score on a national basis for Aboriginal communities in 2006 was 57. The CWB for PRFN (71) was the highest amongst the three First Nations communities and exceeded the average CWB by about 25%. The CWB for PPFN (62) was modestly higher than the average, whereas the CWB for PMFN (53) was lower than average. INAC (2010) reports that there was little progress with the overall CWB score of First Nation communities between 2001 and 2006. The education component of the CWB has increased in First Nation communities over this period, whereas the housing component has declined because of the increasing need of major housing repairs.

Table 5.9-7: Community Well-Being (CWB) Index Scores for Local Communities in the Vicinity of the Marathon PGM-Cu Project

Community	CBW Index Score
Marathon	84
White River	80
Terrace Bay	82
Pic River First Nation	71
Pic Mobert First Nation	53
Pays Plat First Nation	62

5.9.6 Navigable Waters

The Navigable Waters Protection Act broadly defines navigable water such that it "*includes a canal and any other body of water created or altered as a result of the construction of any work*". Though there are no waterways on the site that would be considered transportation corridors *per se*, some of the waterbodies and watercourse on the site will be altered as the result of the proposed development.

In cases where waters that are considered navigable are influenced by works to the extent that navigation is negatively impacted an approval for the proposed works by Transport Canada.

Conversely, no authorization is required for waters that are "private" or can be characterized as "minor". Private lakes are lakes that measure 5 hectares or less in size and:

- All land abutting the navigable water is owned by one person or company other than the federal or provincial government;
- No navigable water enter or exit the lake;
- There is no current or past public access to the lake; and
- There are no easements or servitudes that allow access to the lake.

Watercourses are classified as minor if:

- average depth of the navigable water measured at the high-water level is < 0.30 m; or
- average width of the navigable water measured at the high-water level is < 1.20 m.

The screening process for characterizing a waterbody or watercourse as minor further considers the following criteria:

- If the average width over the 200 m long section of the navigable water is 1.20 m or more but not more than 3.00 m and one of the following four conditions are also true, the navigable water may be considered a minor navigable water and an application for approval under the NWPA is not required. The four conditions include:
    1. average depth of the navigable water measured at the high-water level is 0.60 m or less;
    2. the slope is greater than 4 percent;
    3. the sinuosity ratio is greater than 2; or
    4. there are 3 or more natural obstacles.

A detailed assessment of the effect of the proposed Project on navigable waters is provided by EcoMetrix (EcoMetrix, 2012l). Overall an authorization related to works that will affect navigation in 9 waterbodies, ranging in size from 0.06 to 1.91 ha and comprising a total surface area of 7.02 ha, will be required. All of the watercourse (connecting channels) that drain the site can be considered "minor" and no authorization related to these will be necessary.

5.10 Physical and Cultural Heritage Resources

Detailed information regarding existing physical and cultural heritage resources at and around the Project site in provided by Woodland Heritage Services Ltd. (2008) and Ross Archaeological Research Associates (2009). The following sections provide a summary of this information.

5.10.1 Work Scope

The purpose of the baseline program was to identify physical and cultural heritage resources that might be affected by the proposed development. Stage I archaeological assessments were carried out in 2007 and 2009 (Woodland Heritage Services Ltd., 2008; Ross Archaeological

Research Associates, 2009), with efforts focusing on the identification of known or registered archaeological sites in the Project area and surrounding region from existing information sources (e.g., Ontario Ministry of Culture, Canadian Heritage Information Network), as well as identifying potential locations on which to concentrate in-field studies (i.e., Stage II assessments).

Two separate Stage II archaeological assessments of the Project area were completed according to established guidelines and sampling guidance. The first was conducted in 2007 and efforts were focused on the Pic River corridor and the interior of the Project site (Woodland Heritage Services Ltd., 2008). The second study was completed in 2009 and efforts were focused on the Bamoos Lake-Hare Lake-Lake Superior and Angler Creek-Lake Superior corridors (Ross Archaeological Research Associates, 2009).

5.10.2 Archaeology

The Stage I assessment identified four registered sites from Ontario Ministry of Culture records within the general vicinity of the Project area, though each was outside the Project footprint. One of the sites was associated with non-Aboriginal heritage, whereas the remaining three were Aboriginal in nature (see Section 5.11). This site is a World War II prisoner of war camp, which was located in the vicinity of Sturdee Cover near the mouth of Angler Creek at Lake Superior.

In-field investigations did not identify any previously unknown archaeological sites on the Project site.

5.10.3 Built Heritage and Cultural Heritage Landscapes

No significant cultural sites or resources were identified on the Project site during Stage I and Stage II archaeological assessments.

5.11 Aboriginal Considerations

SCI has undertaken consultation and engagement activities with PRFN, PMFN, PPFN, RSMIN, the Jackfish Métis and SNSMC (MNO) as described in Section 4.0 of this EIS on a variety of matters pertaining to the Project. Significant funding has been advanced to the groups by SCI for this purpose. The land and resource use information is summarized below and is largely derived from information obtained from the PRFN. The PRFN have compiled detailed land and resource use information for their traditional territory. The information provided to SCI by the other Aboriginal groups was more generic in nature. Some of the groups have thus far declined to provide detailed land and resource use information to SCI.

5.11.1 Cultural Prehistory of the Region

People have inhabited the Marathon area of northern Ontario since the end of the last glaciation when the land was capable of supporting plants and animals. The precontact era (i.e., prior to

European arrival) is divided into four time periods (Paleo-Indian, Archaic, Initial Woodland, Terminal Woodland) that span the years 9500 to 400 BP. Each of the periods is described in brief in Table 5.11-1.

Table 5.11-1: Periods in the Cultural Prehistory of the Marathon Area (9500 to 400 BP)

Period	Time	Description
Paleo-Indian Period	ca. 9500 to 7000 BP	These precontact peoples were the first inhabitants of the area. Most likely, they arrived by following herds of caribou across the tundra/parkland environment of newly opened lands left by the retreating glaciers. Within a few hundred years, the Boreal forest moved in, causing an adaptation to a forest environment and settlement concentrations along lakes and river systems. Several types of early spear points indicate that different groups of these early hunters moved in at various times.
Archaic Period	ca 7000 to 2500 BP	An environmental transition brought about warmer, drier conditions resulting in a change in the plant and animal communities, which consequently impacted the subsistence patterns of humans living in the region now represented by north-central Ontario. These alterations of subsistence patterns are reflected in the artefact assemblages. For instance, in response to the hunting of smaller game, large spear points were replaced by smaller, notched projectile points and stone knives generally became smaller. A new technology involving the production of stone tools by grinding rather than chipping was also utilized. About 3,000 B.P, people started to make use of copper, which was cold-hammered to form spear points, knives, gaff hooks and elaborate jewellery.
Initial Woodland Period	ca 2500 to 1100 BP	The Early Woodland Period marks the first appearance of ceramics in the archaeological record. Archaeologists refer to the first pottery-using period in northern Ontario as the Laurel Tradition. Laurel peoples sites are marked by the introduction of fired clay pottery vessels. These vessels were made by the coil method, had conical bases and were smooth, with the exception of the neck and rim which were decorated with distinctive toothed or sinuous-edged

		tools. The Laurel peoples also practised a way of life similar to the Archaic peoples who lived in the region before them: fishing, hunting and collecting wild plants on the major waterways. There are two major theories concerning the origin of the Laurel culture. One is that it arose out of an Archaic base, differing only by the adoption of pottery. The other is that the people moved into the region following the expansion of wild rice habitats about 500 B.P
Terminal Woodland Period	ca 1100 to 400 BP	Two distinctive cultures, both of which appear to have developed from a Laurel cultural base, are present in the Terminal Woodland Period. One of these cultures is the referred to as the Blackduck tradition; the other distinct culture is the Selkirk tradition. The Blackduck culture is characterized by unique globular pottery vessels. The body of these vessels is textured by cord-wrapped paddles and the rim is decorated with cord-wrapped object impression. Some archaeologists believe the Blackduck tradition was ancestral to the modern Ojibway (Anishnabek) Aboriginal Peoples and First Nations. The other Late Woodland culture, the Selkirk tradition, is distinguished by their fabric-impressed globular vessels. They are found farther north. According to many archaeologists, the Selkirk peoples are ancestral to the Cree Aboriginal Peoples and First Nations.

5.11.2 General Ethnohistorical Background of the Project Area

The present day First Nations with settlements in the vicinity of the Project are Ojibway. The Métis of this area also trace their Aboriginal ancestry largely to Ojibway roots. The Ojibway are the second largest population of First Peoples north of Mexico, with the Cree being the most populous. Based on their surrounding geography and who encountered them, the Ojibway have hundreds of associated names, including Ojibwa or Ojibwe, Chippewa or Chippeway, Salteaux, and Mississaugas. On the north shores of Lake Superior they call themselves Ojibway. Ojibway are Anishinaabek-speaking peoples, a branch of the Algonquian language family, which includes the Algonquin, Nipissing, Oji-Cree, Odawa and Potawatomi. The plural form, Anishinaabeg or Anishinabek has a meaning of 'First' or 'Original Peoples'. It is also said to refer to 'the good humans' (Warren, 1885; Schmalz, 1991).

Thousands of years ago, it is the believed that the ancestors of the Ojibway people came from the St. Lawrence River area of the eastern seaboard. This was recorded in the *Wallum Olum*, an ancient written record on bark tablets and song sticks, which is said to date back to 1600 B.C., and is the oldest written record of North America. The arrival of Ojibway peoples on Lake Superior has been dated to approximately 1400 AD according to oral tradition (Benton-Banai, 1988), and 1500 AD for populating the northern shores (Cornell, 1986).

Traditional Ojibway culture was dynamic and changed in response to environmental conditions. Pre-contact, the Ojibway lived in small family bands for most of the year, enabling them to survive the region's harsh weather. In the spring time, each family would go to its "sugar bush" and make maple sugar, an important staple used to flavour various foods. In the summer, bands congregated for fishing, trading, social exchange, and ceremonies (Bieder, 1985).

First contact with Europeans occurred in the seventeenth century with French fur traders. By hunting and trading fur with Europeans, Ojibway became part of an international market economy. When the British defeated the French in 1763, Ojibway started trading with the British. By about 1840, the local fur trade economy was in a near state of collapse, because of the depletion of most fur-bearing animals in the area. Ojibway generated income from working in mining, agriculture, forestry, as well as fishing and berry picking; however, as these were seasonal activities, they often endured economic hardship. Into the 19th century, some traditional ways were given up, because they lacked usefulness in the new era, and others blended with cultural elements of other tribal and European-American origins (Bieder, 1985).

William Benjamin Robinson negotiated the Robinson Treaties for the north shores of Lakes Huron and Superior in 1850. The Robinson Treaties opened the area to natural resource exploration and exploitation. The Robinson-Huron and Robinson-Superior treaties included provision for the creation of twenty-one Aboriginal reserves. The Crown was to hold each reserve for the "use and benefit" of the respective native groups whose leaders' names were listed on the agreements. Through the Robinson treaties, the Crown made a commitment that Aboriginal people could hunt and fish throughout the ceded territory "as they have heretofore been in the habit of doing" (Aboriginal Affairs and Northern Development Canada (AANDC) 2010b, Canadian Encyclopedia 2012).

PRFN initiated an application before the Ontario Superior Court in 2004 in which it asserts that it has never relinquished titles to territory described in the Statement of Claim (including the Project site). That application is before the courts and currently in the discovery stage.

5.11.3 Aboriginal Groups of Interest

Fourteen Aboriginal communities, First Nations and Métis, were originally identified as having a potential interest in the Project based on aboriginal and treaty rights (see Table 5.11-2). The Project is situated within the geographic territory of the Robinson-Superior Treaty. Four of the fourteen expressed an interest in the Project based on traditional and/or current land uses: the

Pic River First Nation (PRFN), the Pic Mobert First Nation (PMFN), the Pays Plat First Nation (PPFN) and the Red Sky Métis Independent Nation (RSMIN). Two additional Métis groups have expressed a direct interest in the Project: Jackfish Métis; and, Superior North Shore Métis Council (SNSMC). .

The remaining ten communities did not express a direct interest in the Project, leaving direct consultation to those communities that are in relative close proximity to the site. SCI is not aware of any formal relationships among or between the different Aboriginal communities as it pertains to overlapping traditional territories and land and resource uses within those territories.

Table 5.11-2: First Nation Communities of Potential Interest to the Marathon PGM-Cu Project

First Nation	Proximity to Project Site[1]
Pic River First Nation	~ 20 km (south)
Pic Mobert First Nation	~ 50 km (east)
Pays Plat First Nation	~ 90 km (west)
Ginoogaming First Nation	~100 km (north)
Long Lake No. 58 First Nation	~110 km (north)
Michipicoten First Nation	~ 145 km (southeast)
Animbiigoo Zaagi'igan Anishinaabek	~ 150 km (northwest)
Biinjitiwaabik Zaaging Anishinaabek	~ 150 km (northwest)
Red Rock Indian Band	~ 150 km (west)
Bingwi Neyaashi Anishinaabek	~ 150 km (west)
Fort William First Nation	~ 225 km (west)
Gull Bay First Nation	~ 230 km (northwest)
Whitesand First Nation	~ 260 km (northwest)
Red Sky Independent Métis Nation	NA (RSIMN has no land base)

[1] Distances provided are "as-the-crow-flies".

5.11.3.1 Pic River First Nation

The Ojibway of the Pic River First Nation (PRFN) community was at one time called Begetikong. The Pic River Reserve is located on the north shore of Lake Superior at the mouth of the Pic River south of Marathon. The reserve is 316.6 ha in size and serves as the land-base for the PRFN. The PRFN is the only FN that has expressed a direct interest in the Project that has explicitly defined what they believe to be their traditional territory (see Figure 5.11-1). They have defined their traditional territory in terms of an "exclusive claim area", which comprises approximately 1 million ha, as well as a "shared claim area", which comprises an additional approximately 2.7 million ha.

The mouth of the Pic River has been a central place for trade and settlement for First Nation people of this area as it provided access to the northern lands and a canoe route to James Bay. As a halfway point for canoers moving west and east, it was a strategic location in the region's water transportation. "The Pic" first appeared on European maps in the mid seventeenth century, after First Nations' trade began with French traders coming to the area in the late 1770s and setting up a permanent post by 1792. In 1821, the Hudson's Bay Company set up a permanent post at Pic River that was relocated in 1888 due to encroaching settlement (Aboriginal Multi-Media Society, 2007; Pic River First Nation, www.picriver.com).

According to Aboriginal Affairs and Northern Development Canada 2010 data, the Ojibway of PRFN had a total registered population of 1,007, with 511 living on-reserve and 496 off-reserve, (AANDC, 2011). The 2011 Census noted a population of 383 for the Pic River 50 Indian reserve and 166 private dwellings with 149 occupied by usual residents (Statistics Canada, 2012). The 2006 Census listed a population of 385 of those 360 as registered Indian and 20 as non-registered Indian; 300 as 15 years and older; 190 in the labour force with 165 employed and 25 un-employed (Statistics Canada, 2011a). We do not have an explanation for the large difference in population reported by AANDC and Statistics Canada.

The current electoral leadership is made up of Chief Roy Michano and nine councillors: Debbie Bouchie, Barry Desmoulin, Simone Desmoulin, Art Fisher, Bonnie Goodchild, Arnold Michano, Daniel Michano, Duncan Michano Jr., and Robert Starr. Their two-year term began on October 1, 2011. Chief Roy Michano was first elected Chief in 1973, and is the most re-elected Chief in PRFN history.

The PRFN is actively engaged in restoring Ojibway language and culture with a Native language program, as well as a Native immersion program. Tracy Starr, a Pic River First Nation reserve resident, was selected as a first place winner in the National Film Board's *One Drum, Many Hearts* contest, for sharing a story about her community in which she praises the improvements of language programs. Other cultural traditions are observed with the community hosting an annual powwow, having three sweat lodges in their community, and ready access to a nearby Anishinaabe Camp to see and learn about traditional housing (Aboriginal Multi-Media Society, 2007).

The PRFN offer a variety of services and infrastructure to members some of which include:

- comprehensive education programs to community members, including elementary, secondary, special education, and post-secondary student support programs;
- family Support Services, including implementing prevention programs for drug and alcohol abuse, sexual abuse, and family violence;
- a Family Support Worker acts to help resolve individual and family crises, and work with other services to design and carry out plans for clients; and,
- in 2010 an innovative energy efficient six-plex multi-unit housing development project was completed as part of Canada's Economic Action Plant. Chief Roy Michano

commented: "*Housing developments like this one give greater hope and opportunity for the individuals and families in our community*" (Ross Archaeological Research Associates, 2009).

The PRFN are successfully pursuing economic development. They are attempting to create a self-sustainable reserve with employment, education and the use of resources from within the reserve itself, as well as from their asserted traditional territory. The PRFN own and operate Pic River Development Corporation. Thus far, the PRFN have forestry, firefighting, cable and high-speed internet companies. The PRFN has participation and ownership interest in three hydroelectric generating stations: Umbata Falls (25.0 MW) on the White River; Wawatay (13.5 MW) on the Black River; and, most recently, Twin Falls (5.0 MW) on the Kagiano River. They are also partners in several other proposed hydroelectric and wind power generating facilities. The PRFN also have a commercial fishing license on Lake Superior (OMNR, 2002). The community continues to pursue increased timber and commercial fish allocations, as well as future hydro development opportunities.

The PRFN took a proactive step to oversee activities related to their asserted traditional territory and created a position for a Lands and Resources Coordinator in 2008. Projects with ongoing consultation in 2011 included: the Marathon PGM-Cu Project; the Marathon Regional Landfill; the Pukaskwa National Park Management Plan; and, the Barrick Gold Corp. Hemlo Camp Mines.

More information regarding the PRFN can be found at the following URL: www.picriver.com.

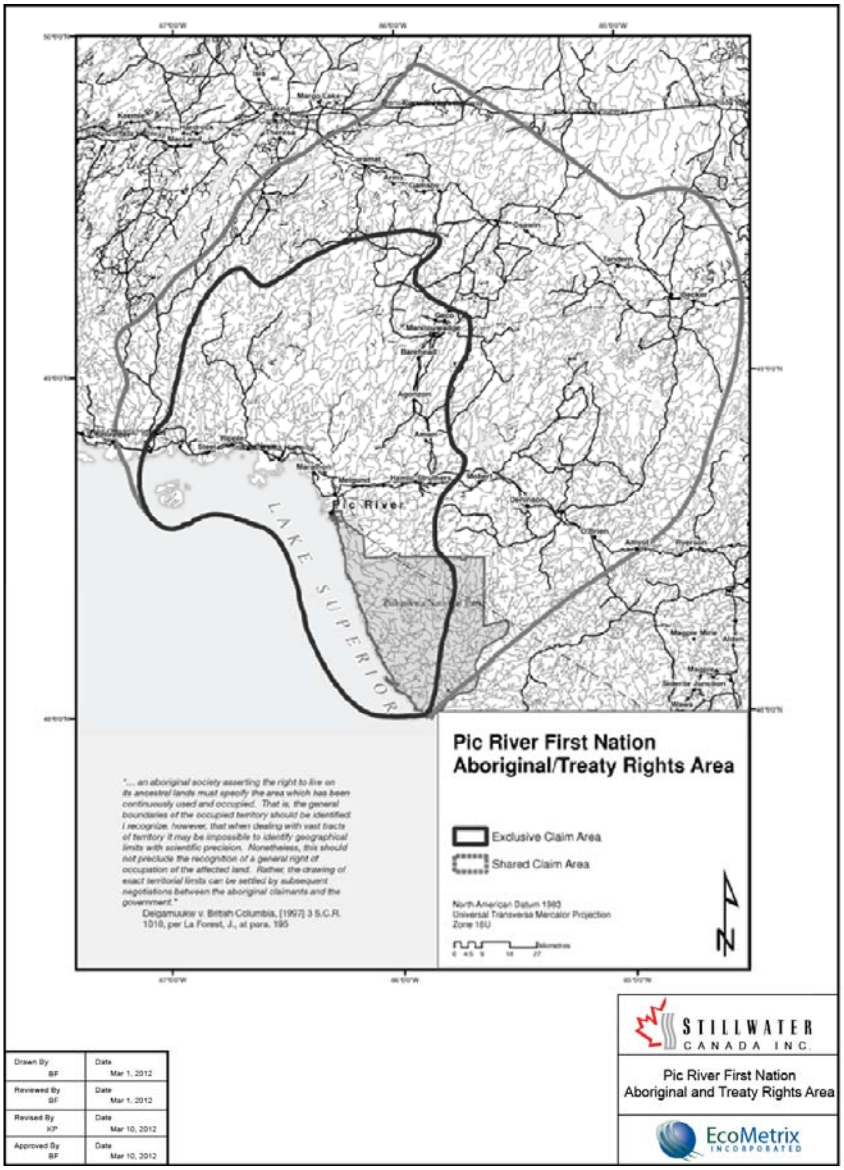


Figure 5.11-1: Pic River First Nation Aboriginal and Treaty Rights Area

5.11.3.2 Pic Mobert First Nation

The Mobert Reserves are within the boundaries of the territory described by the Robinson-Superior Treaty of 1850. In 1885, 323.7 ha of reserve land were set aside for Band members under the Robinson-Superior Treaty. Pic Mobert achieved legal Band status in 1957 when it formally separated from the Pic Heron Bay Band. Mobert Indian Reserve No. 82 (Mobert South) was officially proclaimed a reserve under the Indian Act in 1971. Two reserve lands, Pic Mobert South and Pic Mobert North, were established comprising 30.20 ha. These reserves are located at the southwest end of White Lake, about 82 and 72 km east of Marathon. PMFN signed an agreement in principle in 2002 to add 1,600 ha of Crown Land as reserve land through The Land and Larger Land Base process.

The PMFN is governed by a duly elected Chief and Council for a two year term following election rules established by AANDC. Current administration includes: Chief Johanna Desmoulin, and eight Councillors: Jeff Desmoulin, John Kwissiwa Sr., James Kwissiwa, Wayne Sabourin, Stan Sabourin, Christopher Bananish Sr., Shawn Desmoulin, and Pamela Bananish (PMFN, 2010).

In 2010 the PMFN had 840 registered members (as defined by the *Indian Act*), with 330 living on-reserve and 510 off-reserve (AANDC, 2011). The 2011 Census of Population listed a registered on-reserve population of 96 with 64 private dwellings at Pic Mobert South Indian reserve and a population of 193 at Pic Mobert North with 65 private dwellings (Statistics Canada, 2012). The 2006 Census listed a population at Pic Mobert South of 140, with 55 in the labour force and 40 employed and 15 unemployed. Pic Mobert North's population was registered at 100, with 50 in the labour force and 35 employed and 20 unemployed (Statistics Canada 2006a, 2006b).

Today, PMFN and PRFN maintain friendship and family bonds through their annual powwows (Turtle Island Productions, 2012).

The PMFN has a variety of services including:

- the Netamisakomik Centre for Education, which is used to provide schooling from kindergarten to Grade 8;
- employment services exist which lists employment opportunities in the area;
- the Pic Mobert First Nation Health and Social Team provides client services (individual, group, advocacy and case management), as well as prevention programming at the community level related to addictions, with a primary focus on drug abuse; and,
- the Pic Mobert Health Centre.

The PMFN created a Land and Resource Department under the leadership of current Chief Desmoulin. A recent initiative was the traditional ecological knowledge (TEK) Research Mapping Project completed in 2011, recording traditional knowledge and creating a dynamic map of PMFN territory and traditional values. The traditional values included: trapping, hunting, fishing and gathering areas, historical sites, spiritual practices and recreation.

In 2006, the Pic Mobert First Nation entered as partners in a joint venture with White River Hydro Limited Partnership, a wholly owned subsidiary of Regional Power Inc. The plan is to commence construction of the Gitchi Animki Hydroelectric Project on the White River within the Pic Mobert First Nation's traditional territory in 2012 (PMFN, 2010). The project is at an advanced state in the approvals process.

Further Information regarding the PMFN can be found at the following URL: www.picmobert.ca.

5.11.3.3 Pays Plat First Nation

Pays Plat First Nation (PPFN) is an Ojibway community named “flat land” by French traders due to the reserve area’s flat land situated between two mountains. Pays Plat is about 200 km east of Thunder Bay or about 90 km west of the Project site. The PPFN reserve is situated near the centre of the Robinson-Superior Treaty Areas, on Highway 17. The PPFN has a land base of 259 ha.

According to Aboriginal Affairs and Northern Development Canada 2010 data, the PPFN have a total registered population of 211, with 75 living on-reserve and 136 off-reserve (AANDC, 2011). The 2011 Census of Population cites the Pays Plat 51 Indian Reserve to have a registered on-reserve population of 75, and 36 private dwellings with 29 occupied by usual residents (Statistics Canada, 2012). The Chief of PPFN is Xavier Thompson with Council members: Frank Achneepineskum, Raymond Goodchild, and Darlene Morriseau.

Infrastructure on the PPFN reserve includes:

- a band office;
- a band hall;
- a fire hall;
- a water plant;
- recreational areas including an ice rink and playground;
- a Church; and
- a business centre which contains a daycare centre, restaurant area, gas bar, and health centre.

In August, 2009, PPFN signed an Agreement in Principle (AIP) with Ontario and Canada regarding the expansion of the reserve lands through the 1991 Land and Larger Land Base Framework Agreement (Legislative Assembly of Ontario, 2005). The AIP concerns a 1,650 ha area adjacent to the existing reserve and possibly a further 1 km^2 if certain conditions are met.

Information regarding the PPFN can be found at the following URL: www.paysplat.com.

5.11.3.4 Red Sky Métis Independent Nation

The Red Sky Métis Independent Nation (RSMIN) represents descendants of the original 84 “half-breeds” recognized by the Crown as annuitants and beneficiaries under the Robinson-Superior Treaty of 1850.

The Red Sky Métis trace their ancestry in Canada to as early as 1506. This was the time when early French explorers married Aboriginal women and gave birth to a new generation of Canadians embodying two distinct lineages and worldviews. The name Red Sky Métis has special significance to their heritage as the skies were used for navigation and the ‘red sky’ to predict upcoming weather conditions. The Métis celebrate their unique culture, and see their customs, practices, traditions and traditional lands as distinct from First Nations peoples. The RSMIN are currently working toward asserting treaty rights protected by Section 35 of the Constitution of Canada, and are negotiating lands claims (RSMIN 2012a, RSMIN 2012b).

The Chief of the RSMIN is Troy DeLaRonde, who inherited his position from his late father Roy DeLaRonde. The administrative headquarters of the RSMIN are based in Thunder Bay, Ontario. The RSMIN represent about 8,000 members who live within and beyond the Robinson-Superior Treaty area. The RSMIN serves to protect, sustain and enhance treaty and Aboriginal rights of status Métis included in the Robinson-Superior Treaty of 1850. The RSMIN also celebrates and promotes its distinct culture, laws and territory.

The RSMIN provides services through:

- the Employment Resource Centre (training and employment opportunities);
- Ontario Hunters Safety Education (firearm licensing assistance and registration assistance, as well as Firearm Safety and Hunter Safety Courses);
- family service (advocacy for individuals and families experiencing difficulties with the education system); and,
- family and counseling services (assistance to access community programs, referrals and information) (211 Ontario North – Lakehead Social Planning Council 2011, RSMIN 2012b).

The RSMIN have engaged, or are engaging, in a variety of Projects with governments, the private sector, and specifically for power generation (RSMIN 2012c).

Information regarding the RSMIN can be found at the following URL: www.rsmin.ca.

5.11.3.5 Jackfish Métis

The Jackfish Métis is a community-based affiliate organization of the Ontario Coalition of Aboriginal People (OCAP) based in Schreiber, Ontario. OCAP is an incorporated, not-for-profit, membership based coalition formed to advocate for the rights and interests of Métis, Non-Status, Inuit and Off-Reserve status people living in urban, rural and remote areas throughout Ontario (Ontario Coalition of Aboriginal People, 2012).

Information regarding OCAP can be found at the following URL: www2.o-cap.ca.

5.11.3.6 Superior North Shore Métis Council

The Superior North Shore Métis Council (SNSMC) is a chartered community council of the Métis Nation of Ontario (MNO). The SNSMC is head quartered in Terrace Bay. Among other things the MNO seeks to pursue a rights-based agenda asserting the Métis existence as a distinct Aboriginal people within Ontario; protect and preserve the distinct culture and heritage of the Métis Nation in the province; and, improve the social and economic well-being of Métis children, families and communities throughout the province.

Information regarding the MNO can be found at the following URL: www.metisnation.org.

5.11.4 Aboriginal and Treaty Rights

The Project site lies within the geographical extent of the area associated with the Robinson Treaty for the Lake Superior Region (Figure 5.11-2). Commonly called the Robinson-Superior Treaty, it was entered into on September 7, 1850, at Sault Ste. Marie, Ontario, between Ojibwa Chiefs inhabiting the Northern Shore of Lake Superior from Pigeon River to Batchawana Bay and The Crown. As noted above, the PRFN assert in an application currently before the Ontario Superior Court that title to an area including the Project site was never relinquished by the PRFN or its predecessors. It is our understanding that the effect of this assertion, if found by a court to be correct, would be that PRFN is not bound by the Robinson-Superior Treaty.

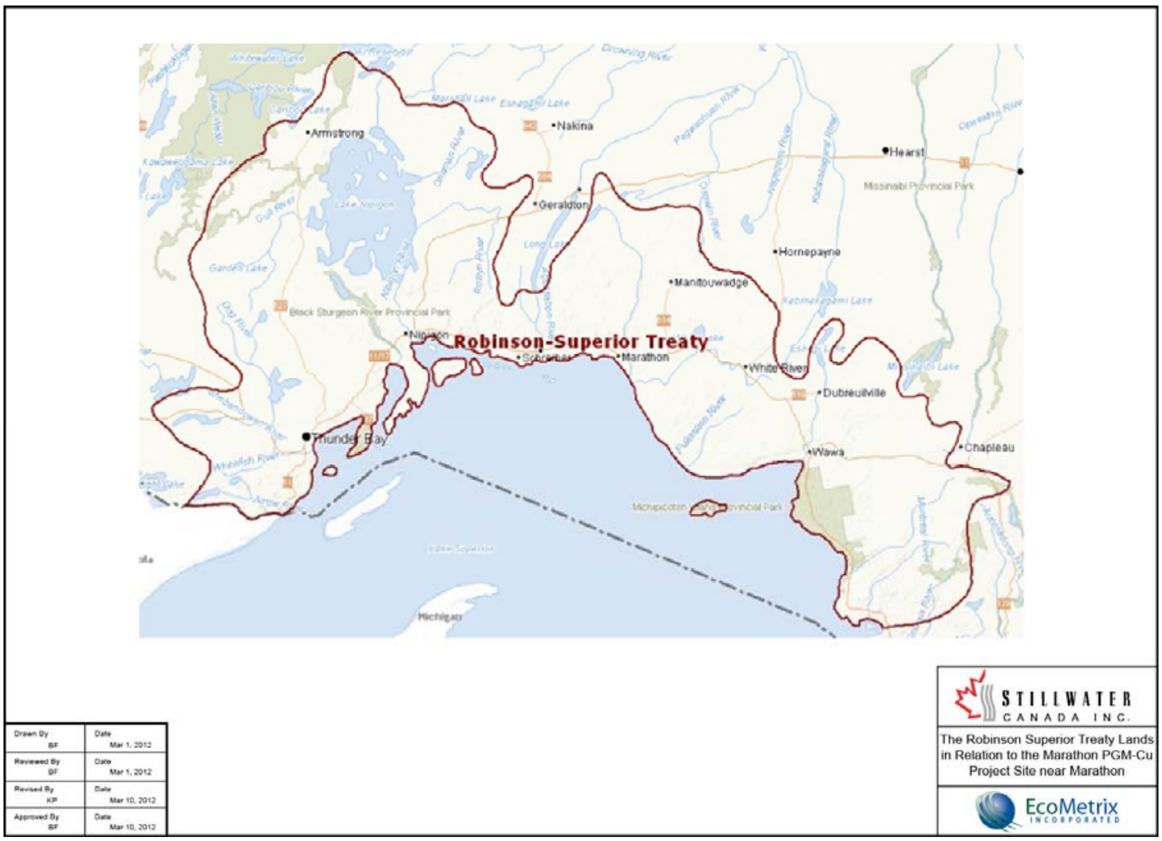


Figure 5.11-2: The Robinson-Superior Treaty Lands in Relation to the Marathon PGM-Cu Project Site near Marathon

The Crown was represented by a delegation headed by William Benjamin Robinson. The Treaty is registered as the Crown Treaty Number 60. The terms and conditions of the Robinson-Superior Treaty were based on previous land cession agreements, but also contained several innovations, including having individual band chiefs select their own reserve sites, consideration of mineral rights, the rights of half-breeds and hunting and fishing rights (Surtees, 1986). The Treaty agreed to *"… allow the said chiefs and their tribes the full and free privilege to hunt over the territory now ceded by them, and to fish in the waters thereof as they have heretofore been in the habit of doing, saving and excepting only such portions of the said territory as may from time to time be sold or leased to individuals, or companies of individuals, and occupied by them with the consent of the Provincial Government."*. The treaty also provided for annuities from the Crown.

Three Aboriginal groups - the PMFN, PPFN and the RSIMN, assert these treaty rights over a traditional area that includes the Project site.

The Robinson-Superior Treaty is reproduced in its entirety below[5].

THIS AGREEMENT, made and entered into on the seventh day of September, in the year of Our Lord one thousand eight hundred and fifty, at Sault Ste. Marie, in the Province of Canada, between the Honorable WILLIAM BENJAMIN ROBINSON, *of the one part, on behalf of* HER MAJESTY THE QUEEN, *and* JOSEPH PEANDECHAT, JOHN IUINWAY, MISHE-MUCKQUA, TOTOMENCIE, *Chiefs, and* JACOB WARPELA, AHMUTCHIWAGABOU, MICHEL SHELAGESHICK, MANITSHAINSE, *and* CHIGINANS, *principal men of the* OJIBEWA *Indians inhabiting the Northern Shore of Lake Superior, in the said Province of Canada, from Batchawana Bay to Pigeon River, at the western extremity of said Lake, and inland throughout that extent to the height of land which separates the territory covered by the charter of the Honorable the Hudson's Bay Company from the said tract, and also the Islands in the said Lake within the boundaries of the British possessions therein, of the other part, witnesseth*:

THAT for and in consideration of the sum of two thousand pounds of good and lawful money of Upper Canada, to them in hand paid, and for the further perpetual annuity of five hundred pounds, the same to be paid and delivered to the said Chiefs and their Tribes at a convenient season of each summer, not later than the first day of August at the Honorable the Hudson's Bay Company's Posts of Michipicoten and Fort William, they the said chiefs and principal men do freely, fully and voluntarily surrender, cede, grant and convey unto Her Majesty, Her heirs and successors forever, all their right, title and interest in the whole of the territory above described, save and except the reservations set forth in the schedule hereunto annexed, which reservations shall be held and occupied by the said Chiefs and their Tribes in common, for the purpose of residence and cultivation, and should the said Chiefs and their respective Tribes at any time desire to dispose of any mineral or other valuable productions upon the said reservations, the same will be at their request sold by order of the Superintendent General of the Indian Department for the time being, for their sole use and benefit, and to the best advantage.

[5] Source - Aboriginal Affairs and Northern Development Canada (www.aandc-aadnc.gc.ca)

And the said William Benjamin Robinson of the first part, on behalf of Her Majesty and the Government of this Province, hereby promises and agrees to make the payments as before mentioned; and further to allow the said chiefs and their tribes the full and free privilege to hunt over the territory now ceded by them, and to fish in the waters thereof as they have heretofore been in the habit of doing, saving and excepting only such portions of the said territory as may from time to time be sold or leased to individuals, or companies of individuals, and occupied by them with the consent of the Provincial Government. The parties of the second part further promise and agree that they will not sell, lease, or otherwise dispose of any portion of their reservations without the consent of the Superintendent General of Indian Affairs being first had and obtained; nor will they at any time hinder or prevent persons from exploring or searching for mineral or other valuable productions in any part of the territory hereby ceded to Her Majesty as before mentioned. The parties of the second part also agree that in case the Government of this Province should before the date of this agreement have sold, or bargained to sell, any mining locations or other property on the portions of the territory hereby reserved for their use and benefit, then and in that case such sale, or promise of sale, shall be forfeited, if the parties interested desire it, by the Government, and the amount accruing therefrom shall be paid to the tribe to whom the reservation belongs. The said William Benjamin Robinson on behalf of Her Majesty, who desires to deal liberally and justly with all Her subjects, further promises and agrees that in case the territory hereby ceded by the parties of the second part shall at any future period produce an amount which will enable the Government of this Province without incurring loss to increase the annuity hereby secured to them, then, and in that case, the same shall be augmented from time to time, provided that the amount paid to each individual shall not exceed the sum of one pound provincial currency in any one year, or such further sum as Her Majesty may be graciously pleased to order; and provided further that the number of Indians entitled to the benefit of this Treaty shall amount to two thirds of their present numbers (which is twelve hundred and forty) to entitle them to claim the full benefit thereof, and should their numbers at any future period not amount to two thirds of twelve hundred and forty, the annuity shall be diminished in proportion to their actual numbers.

Schedule of Reservations made by the above named subscribing Chiefs and principal men.

FIRST - Joseph Pean-de-chat and his Tribe, the reserve to commence about two miles from Fort William (inland), on the right bank of the River Kiminitiquia thence westerly six miles, parallel to the shores of the lake; thence northerly five miles; thence easterly to the right bank of the said river, so as not to interfere with any acquired rights of the Honorable Hudson's Bay Company.

SECOND - Four miles square at Gros Cap, being a valley near the Honorable Hudson's Bay Company's post of Michipicoten, for Totominai and Tribe.

THIRD - Four miles square on Gull River, near Lake Nipigon, on both sides of said river, for the Chief Mishimuckqua and Tribe.

Signed, sealed and delivered at Sault Ste. Marie, the day and year first above written in presence of,

GEORGE IRONSIDE,
S. I. Affairs.

ARTHUR P. COOPER,
Capt. Com. Rifle Brig.

H. M. BALFOUR,
2nd Lieut. Rifle Brig.

JOHN SWANSTON,
C. F. Hon. Hud. Bay Co.

GEORGE JOHNSTON,
Interpreter.

F. W. KEATING,

W. B. ROBINSON,		
JOSEPH PEAN-DE-CHAT,	his + mark.	[L. S.]
JOHN MINWAY,	his + mark.	[L. S.]
MISHE-MUCKQUA,	his + mark.	[L. S.]
TOTOMINAI,	his + mark.	[L. S.]
JACOB WAPELA,	his + mark.	[L. S.]
AH-MUTCHINAGALON,	his + mark.	[L. S.]
MICHEL SHELAGESHICK,	his + mark.	[L. S.]
MANITOU SHAINSE,	his + mark.	[L. S.]
CHIGINANS,	his + mark.	[L. S.]

As noted above, the PRFN has initiated an action against, Canada, Ontario and the Town of Marathon asserting exclusive aboriginal title over an area that includes the Project site and joint aboriginal title over a broader area.

5.11.5 Aboriginal Archaeological Resources

Stage I archaelogical assessments were carried out in 2007 and 2009 (Woodland Heritage Services Ltd., 2008; Ross Archaeological Research Associates, 2009), with efforts focussing on:

- the identification of known or registered archaeological sites in the Project area and surrounding region from existing information sources (e.g., Ontario Ministry of Culture, Canadian Heritage Information Network); and,
- the indentification of areas of potential archaeological interest on and around the Project site that would be investigated through in-field reconaissance (i.e, Stage II assessment).

Two separate Stage II archaeological assessments of the Project area were completed according to established guidelines and sampling guidance. The first was conducted in 2007 and efforts were focussed on the Pic River corridor and the interior of the Project site (Woodland Heritage Services Ltd., 2008). The second study was completed in 2009 and efforts were focussed on the Bamoos Lake-Hare Lake-Lake Superior and Angler Creek-Lake Superior corridors (Ross Archaeological Research Associates, 2009).

No siginificant archaeoloogical sites or resources were identified on the Project site during Stage I and Stage II archaeological assessments. Ontario Ministry of Tourism, Culture and Sport records indentify four registered sites within the general vicinity of the Project site. Three of which are related to Aboriginal heritage. These site are so-called “Pukaskwa Pits”, which are rock-lined pits dug in cobblestone beaches and are about one to two meters long and one and a half meter deep. The fourth registered archaeological site is a World War II prisoner of war camp, which was located in the vicinity of Sturdee Cover near the mouth of Angler Creek at Lake Superior.

5.11.6 Local and Regional Spiritual Sites

The Ojibway peoples place great value in “the land” from economic[6], social, spiritual and cultural perspectives. According to a recent report provided to SCI by PRFN “the land” from this perspective not only contributes to the cultural identity of the Ojibway peoples, it is central to the formation of their cultural identities, and how the Ojibway distinguish themselves from others, both collectively and individually

Based on the information provided by PRFN to SCI, there are no specific locations having particular spiritual significance such as ceremonial sites, sacred sites, burial sites or death sites within the Site Study Area (SSA); that is the area within the development footprint of the mine. A “ceremonial area” is identified outside the SSA but in relative close proximity to it, as is a site designated as a “toponym”, which in this context relates to a geographic feature that has a legend or story attached to them. Access to the “ceremonial area” and to the “toponym” would not be restricted by the development of the mine. In addition, PRFN identified numerous spiritual sites in the regional study area. The spiritual sites vary in nature but include “ceremony sites”, “death sites”, sites from which earth resources are procured, “burial sites”, “sacred areas” and “toponyms”.

The PRFN report that they have not done a comprehensive toponym study at this time.

5.11.7 Current Uses of Lands and Resources for Traditional Purposes

As indicated, SCI provided significant financial support to obtain information from six aboriginal groups in relation to uses of lands and resources for traditional purposes at and around the Project site.

While all of the six Aboriginal groups indicated current or historical general land and resources uses on or within the relative close proximity to the Project site, the PRFN alone report extensive use of the area for traditional land and resource related pursuits. The PRFN have indicated that the Project site is one of a small number of areas within their asserted traditional lands utilized for such purposes. This is understood to be because the site is relatively close to the Pic River Reserve and in particular can be accessed by an existing road and is at least in part accessible via the Pic River, which historically would have been a significant north-south trade and travel route.

Some spatial interpretation of the information is provided relative to the different study areas defined in Section 2.0 of this report: the Site Study Area (SSA) – the footprint of mine-related

[6] “Economic” in this context is meant to be broadly interpreted, referring not only to a financial value but also to value associated with living off the land (i.e., a subsistence-based way of life).

infrastructure where direct land disturbance will occur; the Local Study Area (LSA) – although defined differently for different components of the environment the LSA generally corresponds to the area extending out from the SSA where local subwatersheds drain, where air quality and/or noise effects could reasonably be expected to occur and where local wildlife movements on and off the site could reasonably be expected to occur; and, the Regional Study Area (RSA) – which for some components of the environment entered beyond the area asserted by PRFN to be their exclusive territory. The spatial interpretation of the land and resources uses is informed by both the information obtained directly from Aboriginal peoples, as well as data collected by SCI during its environmental baseline survey programs.

5.11.7.1 Animal Harvesting

The PRFN report that the SSA and LSA is an important animal harvesting location. Animal harvesting via trapping and hunting includes the collection of furbearers, large mammals and ungulates and birds. The entire SSA and a large portion of the LSA is within the PRFN community trap line area (see Figure 5.9-10), which the PRFN report is used extensively with its proceeds shared within the community. The PRFN report utilization of animals or parts thereof (e.g., eggs, feathers) for food, cultural and medicinal purposes. The range of animals collected by the PRFN and their uses is summarized in Table 5.11-3.

Table 5.11-3: Animals or parts thereof identified by PRFN on or around the Project site that are Utilized for Food, Cultural and/or Medicinal purposes.

Animal	Reported Use		
	Food	Cultural	Medicinal
Beaver	✓	✓	
Black Bear	✓	✓	✓
Lynx		✓	
Deer	✓		
Fisher	✓	✓	
Marten	✓	✓	
Mink	✓	✓	
Muskrat	✓		
Moose	✓	✓	
Otter	✓		
Porcupine	✓	✓	
Red Fox		✓	
Rabbit	✓		
Squirrel	✓		
Weasel	✓		
Wolf			✓
Blackbird	✓		
Crow	✓		
Duck	✓		
Eagle		✓	
Killdeer		✓	
Geese	✓		
Gulls	✓		
Sandpiper		✓	
Owl		✓	
Papasay (woodpecker)		✓	
Spruce Grouse	✓		

5.11.7.2 Plant Harvesting

Information provided by the PRFN indicates that the SSA and LSA is an important plant harvesting location. The PRFN have identified a wide variety of plants that are periodically collected for food, ceremonial and and/or medicinal purposes. The plant species identified for these purposes by the PRFN are summarized in Table 5.11-4.

Table 5.11-4: Plants identified by PRFN on or around the Project site that are Harvested for Food, Cultural and/or Medicinal purposes.

Plant	Reported Use		
	Food	Cultural	Medicinal
Balsam Fir (seeds)			✓
Bear Root			✓
Birch		✓	✓
Black Ash		✓	
Blueberry	✓		✓
Bunch Berry	✓		
Cedar			✓
Choke Cherry	✓		✓
Dandelion			✓
Gooseberries	✓		
Hazelnut	✓		
Highbush Cranberry	✓		✓
Labrador Tea			✓
Moss		✓	
Mountain Ash	✓		✓
Pine			✓
Poplar			✓
Raspberry	✓		
Red Osier Dogwood			✓
Red Willow			✓
Rosehip	✓		
Sage			✓
Saskatoon Berry			✓
Speckled Alder			✓
Spruce (White)			✓
Spruce (Black)			✓
Sweetgrass			✓
Tamarac			✓
White Ash			✓
Wild Strawberry	✓		
Willow			✓

5.11.7.3 Fish Harvesting

A number of different fish species are reportedly harvested by PRFN by a variety of means (net, hook, trap) in the general vicinity of the Project site, however the SSA does not provide fish harvesting opportunities. The waterbodies and connecting channels within the SSA are largely fishless, with resident fish communities where they occur being limited to forage fish such as stickleback. The LSA includes Bamoos Lake, Hare Lake, Hare Creek, Angler Creek (Stream 6), the near shore area of Lake Superior in the vicinity of watercourses that drain the Project site (Hare Creek, Angler Creek [Stream 6]) and the Pic River, and fishing is generally reported by PRFN in these locations. The PRFN have a commercial fish license for Lake Superior.

Fish species of interest as reported by the PRFN include[7]: carp (Lake Superior), Lake Trout (Bamoos Lake, Lake Superior), Muskellunge (Pic River), perch (Hare Lake, Lake Superior), Walleye (Pic River, Lake Superior), smelt (Pic River), Brook Trout (Bamoos Lake), Lake Sturgeon (Pic River, Lake Superior), suckers (ubiquitous), whitefish (Bamoos Lake, Lake Superior) and migratory salmonids such as Rainbow Trout, Coho Salmon and Chinook Salmon (Lake Superior, Pic River, Hare Creek, Angler Creek [Stream 6]).

5.11.7.4 Timber Harvesting

Timber can be harvested for its value as a wood or fibre source, as firewood or for other purposes. Timber available on and around the Project site could be used for any of these purposes. Based on the information SCI obtained regarding timber harvesting no specific harvest locations were identified within the SSA. Timber is reportedly harvested by PRFN as firewood and for other purposes in the LSA.

5.11.7.5 Habitation Sites

The PRFN report that there are habitation sites such as cabins, tent sites, lean-tos or other overnighting locations in the LSA and RSA. None of the sites specifically identified by the PRFN is within the SSA.

5.11.7.6 Trade and Travel Routes

The Pic River is and historically was an important north-south corridor linking Lake Superior with more inland areas. The Lake Superior shoreline provides an east-west corridor but would have historically played a more significant role than it does today. The Bamoos Lake-Hare Lake corridor provides a portage route between the Pic River and Lake Superior.

Existing roadways are identified as travel-ways including Highway 17, Peninsula Road and Camp 19 Road. The PRFN identify the Camp 19 Road, which provides access to the Project

[7] Locations of fish in parentheses from EcoMetrix (2012a) based on baseline program and OMNR data. Some species may be found in more locations than indicated.

site as a key modern route as there are relatively few north-south corridors that provide direct access to the interior of their asserted traditional lands. The Camp 19 Road also provides direct access to the Pic River.

5.11.8 Country Foods

Historically, the Aboriginal peoples in the region in which the Project site falls lived a subsistence lifestyle. PRFN advise that for the Ojibway people in particular, a subsistence lifestyle held deeper meaning than just the ability to obtain the necessities of life from the land; rather, this lifestyle was central to their social, cultural and spiritual identity.

There have been changes in the focus and reliance on the subsistence lifestyle since first European contact, through the rise and fall of the fur trade era and subsequently the advent of permanent settlements; however, information recently provided to SCI by PRFN suggest that the continued importance of this lifestyle to PRFN cannot be ignored. The collection and distribution of country foods within the PRFN provide a level of what the community terms “food security”. The foods reportedly collected on and around the Project site are said to contribute to the community’s sense of food security. Below the contemporary contribution of country foods to PRFN is provided.

5.11.8.1 Economic Considerations related to Country Foods

Although the cash equivalent value of living off the land is less than the income PRFN foragers acquire by participating in the larger Canadian economy, information recently provided to SCI by PRFN indicates that the gathering of country foods makes an important contribution to the overall economy of the community. It is estimated that on an annual basis the cash equivalent produced by PRFN foragers who forage in the vicinity of the Project site would be approximately $7,600 per forager. It is also reported that since foragers regularly distribute the food they produce within the community at large the household economies with whom the food is shared consequently also benefit from foraging.

5.11.8.2 Social Considerations related to Country Foods

Information provided to SCI by PRFN comments on the social importance for the PRFN of sharing what is taken from the land and indicates that Pic River foragers regularly share what they take with relatives and friends who are otherwise occupied, with elders, and with one another. This is reported to strengthen community solidarity and kinship and friendship. PRFN suggest that when gifts from the land are given and received, mutually obligatory social relationships are established that bind the Pic River Ojibway into a larger, cohesive, social whole.

As it relates to kinship and friendship it is reported that PRFN members regularly hunt, trap, fish and gather in the company of relatives and friends and that this further fosters community solidarity. The PRFN express the sentiment that foraging is as much a process as an activity as it provides an opportunity for people to share experiences.

The PRFN report that the distribution of what is taken from the land is the primary means by which foragers in the community acquire prestige or social status. That is, the more they give the better their reputation, though the manner in which gifts are given is also important.

5.11.8.3 Cultural Considerations related to Country Foods

Dating back to the signing of the Robinson-Superior Treaty those Ojibway chiefs and headmen who endorsed the agreement did so maintaining that the capability to live off the land was essential, not only because it provided them the materials they used for subsistence, gifts, and trade, but also because of the role that living off the land played in their cultural lives (Hallowell, 1955).

This same sentiment with respect to living off the land is expressed by the PRFN today. They report that the capacity to live off the land continues to be admired within the community as a whole. The PRFN further indicate that although hunting, trapping, fishing, and gathering are not the only vehicles through which Pic River men and women establish their cultural identities, the importance of subsistence activities in the formation of their cultural identities cannot be underestimated. A report recently provided to SCI by PRFN suggests that the pursuit of natural resource harvests continues to provide those who engage in these activities, and those who benefit, with the ability to establish and maintain a cultural identity that is uniquely Ojibway.

5.11.8.4 Spiritual Considerations related to Country Foods

Along with the fact that subsistence endeavours play important roles in the economic, social, and cultural lives of the Pic River Ojibway, these activities are also reported to have a spiritual dimension, as reflected in Ojibway myths, legends, and folktales.

5.11.9 Preponderance of Traditional Dietary Habits

The PRFN report that the preponderance of traditional dietary habits within the community is high. Given that the PRFN also report that the SSA and LSA is used frequently for traditional land and resource related pursuits including hunting, trapping and plant collection and moreover that the foragers from the PRFN readily share collected foods within the community it follows that the Project site and surrounding area may provide an important contribution to the traditional dietary habits of the PRFN community as a whole.