MARATHON PALLADIUM PROJECT – SOILS BASELINE REPORT UPDATE

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EXECUTIVE SUMMARY

Ecometrix Incorporated (Ecometrix) has been retained by Generation PGM Inc. (GenPGM) to provide an updated assessment of soils baseline conditions for the Marathon Palladium project (the Project) near the Town of Marathon, Ontario. The updated soils baseline study provides information required to complete the Environmental Impact Statement (EIS) Addendum for the Project. The objectives of the soils baseline study 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 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.

The original characterization of soils in the Project study area included a desk-top review of published information regarding topography and physiography, sampling of soils and overburden materials for physical and chemical characterization and characterization of overburden material volumes that would likely be excavated to accommodate construction of site infrastructure. Generally, this information continues to be relevant and sufficient to support the updated effects assessment.

A general description of soils has been provided for a new proposed access road alignment and for the new mill site location that is just west of the location identified in the original project description. Additional soil quality information will be collected during geotechnical studies that will be executed in 2021 related to the new road alignment and mill site; these data are not expected to influence outcome of the assessment of potential effects associated with the project. The geochemical properties of overburden materials will be reported under separate cover. An updated estimate on the volume of soil/overburden materials that may be disturbed within the site study area will be presented in the updated effects assessment as it represents a change to the “terrain and soils” VEC.

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1.0 INTRODUCTION

Generation PGM Inc. (GenPGM) proposes to develop the Marathon Palladium Project (the "Project"), which is a platinum group metals (PGM) and copper (Cu) open pit mine and milling operation near the Town of Marathon, Ontario. The Project is being assessed in accordance with the *Canadian Environmental Assessment Act* (CEAA, 2012) and Ontario's *Environmental Assessment Act* (EA Act) through a Joint Review Panel (the Panel) pursuant to the *Canada-Ontario Agreement on Environmental Assessment Cooperation* (2004).

Ecometrix Incorporated (Ecometrix) has been retained by GenPGM to provide an updated assessment of soils baseline conditions for the Project. This report provides an update to the baseline conditions as described in the information currently on the record, including:

- Supporting Information Document 2: Soil Conditions at the Marathon PGM-Cu Project Site prepared by Ecometrix (June 2012) (CIAR #227).
- Responses to IR14.1 (clarification of surficial geology) and IR14.2 (overburden grain size) (CIAR # 227.)

The soils baseline study has been completed to inform the Addendum to the Marathon PGM-Cu Environmental Impact Statement (EIS Addendum) as input to the Panel process. It has been prepared pursuant to the Canadian Environmental Assessment Act, 2012 and in consideration of the Guidelines for the Preparation of an Environmental Impact Statement – Marathon Platinum Group Metals and Copper Mine Project (EIS Guidelines) (Canadian Environmental Assessment Agency (CEAA) and Ontario Ministry of Environment (MOE), 2011).

The information presented in this report is intended to summarize and document changes to the existing environmental conditions relating to soil conditions, relative to those conditions considered in the previous assessment, in order to support the updated assessment of potential environmental effects provided in the EIS Addendum. The information presented herein was obtained from a review of historical information and the updated design plans for the Project provided by GenPGM.

1.1 Project Location and Setting

The Project is located approximately 10 km north of the Town of Marathon, Ontario (**Figure 1-1**). Marathon is a community of approximately 3,300 people (Statistics Canada, 2017) located adjacent to the Trans-Canada Highway (Highway 17) on the northeast shore of Lake Superior approximately 300 km east of Thunder Bay and 400 km northwest of Sault Ste. Marie. The centre of the Project footprint sits at approximately 48° 47' N latitude, 86° 19' W longitude (UTM Easting 550197 and Northing 5403595). The footprint of the proposed mine location is roughly bounded by Highway 17 and the Marathon Airport to the

south, the Pic River and Camp 19 Road to the east, Hare Lake to the west, and Bamoos Lake to the north. Access is currently gained through Camp 19 Road.

The Project is proposed within an area characterized by relatively dense vegetation, comprised largely of a birch and spruce-dominated mixed wood forest. The terrain is moderate to steep, with frequent bedrock outcrops and prominent east-west oriented valleys. Several watercourses and lakes traverse the area, with drainage flowing either eastward to the Pic River or westward to Lake Superior. The climate of this area is typical of northern areas within the Canadian Shield, with long winters and short, warm summers.

The Project is proposed on Crown Land, with GenPGM holding surface and/or mineral rights for the area. Regional land use activities in the area include hunting, fishing, trapping and snowmobiling, as well as mineral exploration (and mining) and forestry. Other localized land uses in the area include several licensed aggregate pits, the Marathon Municipal Airport, the Marathon Landfill, a municipal works yard and several commercial and residential properties.

The primary industries in the area have historically been forestry, pulp and paper, mining and tourism. Exploration for copper and nickel deposits in the area extend as far back as the 1920s. A large copper-PGM deposit was discovered on site in 1963. Advanced exploration programs have continued across the site since then. These programs have been supported by various feasibility studies to confirm the economic viability of extracting the deposits.

Several First Nation and Métis groups were originally identified as having a potential interest in the Project based on Treaty Rights, asserted traditional territory and proximity to the Project. Traditional uses which they have identified as occurring in the area include hunting, trapping, fishing and plant harvesting, with activities generally focused on the larger waterways, such as the Pic River, Bamoos Lake and Hare Lake.

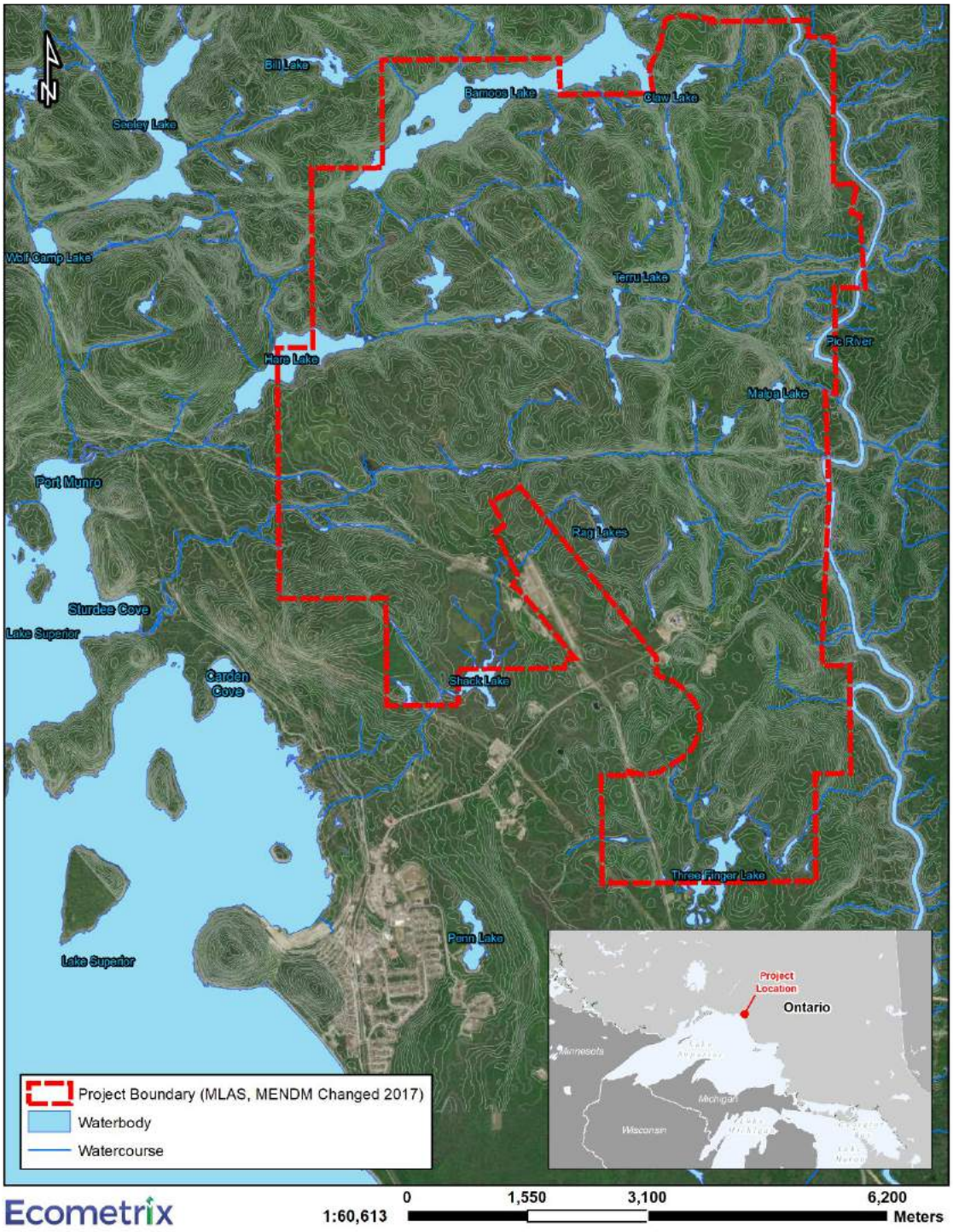

Figure 1-1: Regional Project Location

1.2 Project Overview

The Project is based on the development of an open pit mining and milling operation for copper and platinum group metals. Ore will be mined from the pits and processed (crushed, ground, concentrated) at an on-site processing facility. Final concentrates containing copper and platinum group metals will be transported off-site via existing roadways and/or rail to a smelter and refinery for subsequent metal extraction and separation. Iron sulfide, magnetite and vanadium concentrates may also be produced, depending upon the results of further metallurgical testing and market conditions at that time.

The construction workforce will average approximately 450 – 550 people, with a peak workforce of an estimated 900 people, and will be required for between 18 and 24 months. During operations, the workforce will comprise an estimated 350 workers. The mine workforce will reside in local and surrounding communities, as well as in an accommodations complex that will be constructed off-site.

Most of the mine rock[1] produced through mining activities is non-acid generating (non-PAG) and will be permanently stored in a purposefully built Mine Rock Storage Area (MRSA). The non-PAG rock (also referred to as Type 1 mine rock) will also be used in the construction of access roads, dams and other site infrastructure, as needed. Drainage from the MRSA will be collected in a series of collection basins and treated, as necessary, to meet applicable water quality criteria prior to discharge to the Pic River. The remaining small portion of mine rock is considered to be potentially acid generating (PAG) (also referred to as Type 2 mine rock) and will be stored in the open pits or the Process Solids Management Facility (PSMF). This will ensure that drainage from the Type 2 mine rock will be contained during operations. Following closure, the Type 2 mine rock will be permanently stored below water by flooding the open pits and maintaining saturated conditions in the PSMF to prevent acid generation in the future.

Most of the process solids[2] produced at the site will be non-PAG (Type 1 process solids) with the minority being PAG (Type 2 process solids). Both the Type 1 and Type 2 process solids will be stored in the PSMF and potentially within the open pits. In both cases, the Type 2 process solids will be managed to prevent acid generation during both the operation and closure phases of the project. Water collected within the PSMF as well as water collected around the mine site (other than the MRSA), such as water pumped from the pits or run-off collected from the plant site, will be managed within the PSMF. Excess water not

[1] Mine rock: rock that has been excavated from active mining areas but does not have sufficient ore grades to process for mineral extraction.
[2] Process solids: solids generated during the ore milling process following extraction of the ore (minerals) from the host material.

needed for processing ore will be discharged, following treatment as necessary, to Hare Lake.

Access to the Project site is currently provided by the Camp 19 Road, opposite Peninsula Road at Highway 17. The existing road will be upgraded and utilized from its junction with the Highway 17 to a new road running north that will be constructed to access the Project site. The Project will also require the construction of a new 115 kV transmission line that will connect to the Terrace Bay-Manitouwadge transmission line (M2W Line). The width of the transmission corridor will be approximately 30 m.

Disturbed areas of the Project footprint will be reclaimed in a progressive manner during all Project phases. Natural drainage patterns will be restored as much as possible. The ultimate goal of mine decommissioning will be to reclaim land within the Project footprint to permit future use by resident biota and as determined through consultation with the public, Indigenous people and government. A certified Closure Plan for the Project will be prepared as required by Ontario Regulation (O.Reg.) 240/00 as amended by O.Reg.194/06 “Mine Development and Closure under Part VII of the Mining Act” and “Mine Rehabilitation Code of Ontario”.

A further description of the Project and associated project activities and phases will be provided under separate cover in the EIS Addendum.

1.3 Study Objectives

This updated soil baseline study provides information to inform the EIS Addendum for the Project. The objectives of this update were to describe and present available information and characterize changes to the baseline conditions in the study area. The scope of the updated geological baseline study includes the following:

- summary of findings of the existing baseline studies (**Section 2.0**)
- identification of regulatory guidance for the collection of baseline data (**Section 3.0**)
- confirmation of spatial boundaries (**Section 4.0**)
- describe the collection and review of available background information and data, including any additional and/or on-going data collection efforts (**Section 5.0**)
- analysis of information to characterize existing baseline conditions and to determine any changes that have occurred since publication of the original EIS and its supporting documentation (**Section 6.0**)

- provide an updated summary of baseline conditions in the Site Study Area (SSA), Local Study Area (LSA) and Regional Study Area (RSA) specific to conditions relevant to the effects being assessed in the EIS Addendum (**Section 7.0**).

2.0 PREVIOUS CHARACTERIZATION OF EXISTING CONDITIONS

The original characterization of soils in the Project study area included a desktop review of published information regarding topography and physiography, sampling of soils and overburden materials for physical and chemical characterization, and characterization of overburden material volumes that would likely be excavated to accommodate construction of site infrastructure.

2.1 General Description of Soil Conditions

On a regional scale, the overburden is derived from till veneer and, to a lesser extent, fine- and coarse-grained glaciolucustrine material. Podzols are the dominant soil type. On the Project site, the topsoils and overburden are typically relatively thin layers and there are extensive areas of bedrock outcrops. The Pic River flood plain is composed of thick deposits of sand and sandy silts and clays.

2.2 Physical and Chemical Characteristics of Soils and Overburden

In 2009, based on previous work completed work on the site including exploration drilling, EcoMetrix collected soils from seven locations across the Project site (hereinafter referred to as “Soil 1”, “Soil 2”, etc. …). Samples comprised the top 5 cm of the soil horizon and were composites of five augured boreholes at each of the seven sampling sites.

In 2011, EcoMetrix collected topsoil and overburden material at locations across the proposed Project site including the MRSA, the primary open pit, the satellite pits, and the mill site. Samples were collected by digging 0.5 m x 0.5 m test pits with a handheld shovel. Samples were separated according to any visible horizon separation. Samples were labelled according to their associated Project site location. Test pit logs were recorded for each site and the overburden materials were described in accordance with The Canadian System of Soil Classification (Agriculture and Agri-food Canada, 1998).

Soil samples were also collected in 2011 by Knight Piésold and True Grit Consulting Limited (TGCL). Knight Piésold collected samples at a number of geotechnical borehole locations around the perimeter of the proposed PSMF. These samples, which were collected from a hollow stem auger, comprised aliquots of soil from the top of the overburden layer and from the overburden-bedrock interface. TGCL collected surficial samples at sites from which baseline air quality data were also collected. These samples comprised about 1 kg aliquots of material collected from the top 5 cm of the soil horizon with a small shovel. Loose surface material and plants were removed prior to sample collection.

Refer to **Figure 2-1** for all soil sampling locations.

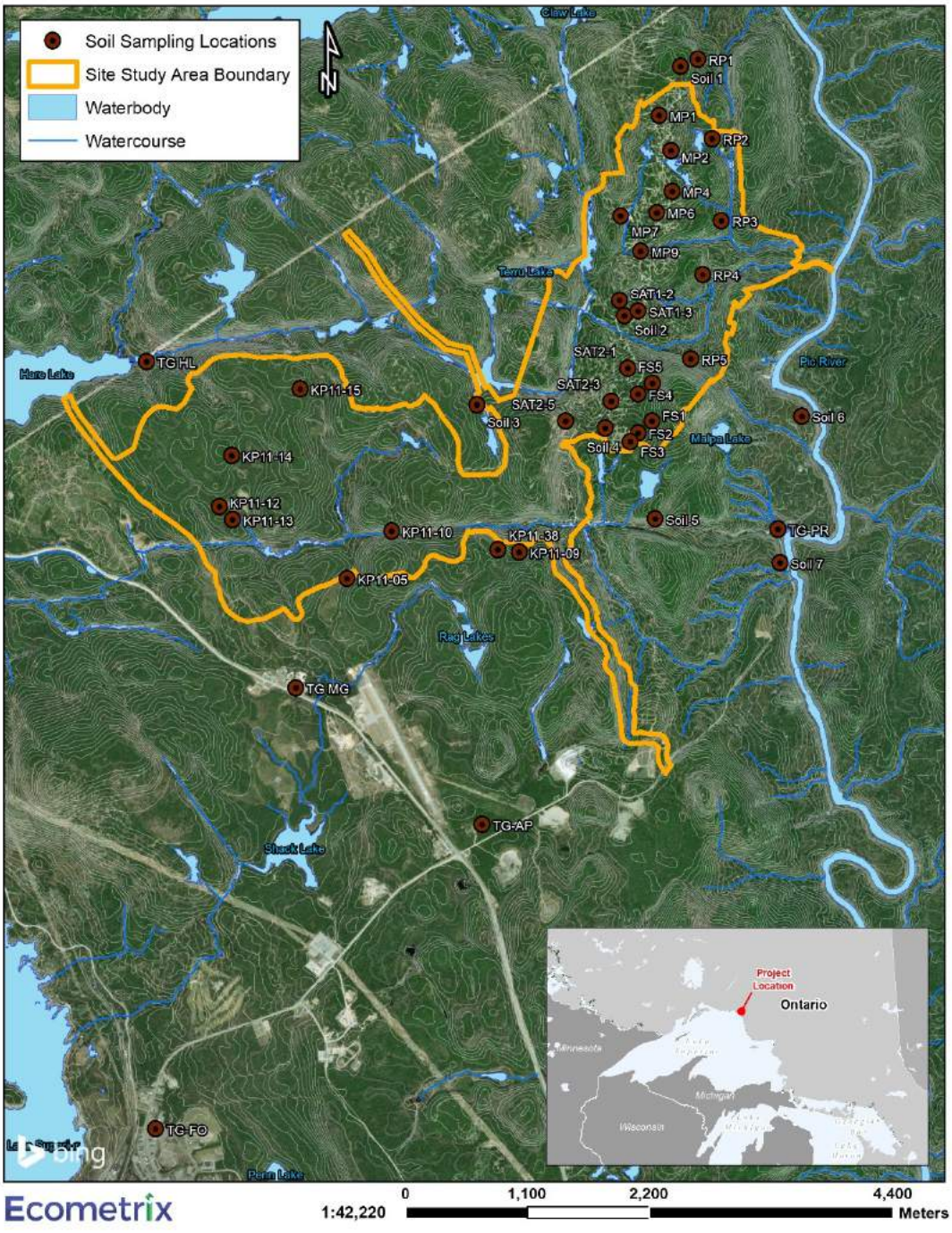

Figure 2-1: Soil sampling on the Marathon Palladium Project site

2.2.1 Physical Characterization

The physical description of soil and overburden materials is summarized in **Table 2-1**. It is noted that the descriptions are provided with reference to the configuration of site aspects as presented in the original EA documentation.

Table 2-1: Summary of the physical description of soil and overburden materials on the Marathon Palladium Project site as presented in the original EIS submission

Project Area	Description
Mine Rock Storage Area	The overburden thickness was variable and ranged from approximately 0.5 to 4.2 m. The overburden topsoils were dark brown to black and rich in organic matter with an average thickness of 7.6 cm. The horizons below the topsoil were typically a mix of fine to coarse sand and silt with gravel and boulder fractions. The subsequent layers were rich in silt and clay with some traces of sand. At some sites clay laminations about 1 cm thick were found in the overburden soils.
Primary Open Pit	The overburden cover was generally thin in the primary open pit area with cover as shallow as 6.0 cm. There were many areas of exposed bedrock outcrop in this area. The average overburden thickness indicated by drill hole investigations was 2.59 m and, in a few cases, overburden cover was over 6.0 m in depth. Overburden topsoils in the main pit were dark brown to black and rich in organic matter including root material with an average thickness of 7.98 cm. The overburden material was typically composed of sand and silt and in some instances gravel. Below the surface horizon, overburden soils were classified as clayey silts and sandy silts and the occurrence of coarse-grained sand, gravel and cobbles increased with depth. Ground water seepage was not evident as test pit sites remained dry after completion.
Satellite Open Pits	Overburden thickness was variable at the satellite pit sites and ranges from approximately 0.25 m to 4.0 m. Outcrops of exposed bedrock are found in these areas. The satellite pit sample site topsoils provided the thinnest cover compared to the other sample sites with an average thickness of 6.86 cm. Topsoils were dark brown to black and rich in organic matter and contained rootlets. Underlying soil horizons were light grey to brown in colour and were composed of a mixture of sand, silt and clay and gravel sized fractions. The majority of the test pits sampled in the satellite pit sites remained dry after completion. Seepage was noted at site TP07-14 and was associated with a peat rich layer.
Mill Site	The overburden thickness at the mill site typically ranged from 0.03 m to 0.61 m. On average, topsoil layers were thickest at the mill site, with an average thickness of 9.91 cm, and were rich in organic material, such as

Project Area	Description
	roots and leaf litter. Underlying soil horizons were composed of variable mixtures of silt, sand and clay (clayey-silt and silty-sand horizons were typical). Seepage was evident in the organic rich topsoil layers at sites BH08-3, BH08-9, BH08-11 and TP08-13.
Process Solids Management Facility	The overburden thickness at the PSMF site was generally shallow, with a typical overburden cover of 0.3 m. The overburden cover was thicker at the southernmost end of the PSMF site, where overburden thickness was greater than 11 m. The shallow overburden soils sampled at the PSMF location were reddish-brown to light brown to grey in colour and were predominately sandy with some traces of silt, clay and gravels. Groundwater seepage was encountered at KP11-09 and KP11-38 at a depth of 1.5 and 1.6 m.
Pic River Flood Plain	The Pic River area was composed of thick (as much as > 20 m in some places) deposits of sand, silt, and clay with a moist, black topsoil cover ranging from 20 to 30 cm thick. Test pits in the Pic River area both indicated overburden thickness greater than 4.55 m (depth terminated at 4.55 m), consistent with visual inspection of the area's overburden cover. Historically this material is derived from river bedload that has been deposited in the floodplain during times of high water. The overburden stratigraphy generally consisted of clayey silt with trace sand to sand with trace silt for about 1.25 to 2 m below the topsoil cover. Below this depth, the material gradually transitioned into a more clay-rich silt with trace interlayered sands. Test pits in the Pic River flood plain had variable instances of ground water seepage. Grain size distribution was dominantly medium to fine sands with smaller proportions of silt, clay, coarse sands, and gravel.
Proposed Access Road	The overburden thickness at test pit sites along the corridor for the proposed access road were as shallow as 0.1 m and reached a depth greater than 4 m. Bedrock was not encountered at most test pits sites sampled. Overburden cover was over 13 m at one borehole site. Topsoil was 0.21 m thick on average and contained moist, black organic silt or peat material containing rootlets. The overburden soils were generally made up of horizons that had a variable composition and distribution of sand, silt, and clay. The soil horizons beneath the topsoil layer tended to follow a trend of increased silt to sand ratios from south to north along the proposed access road, with increasing clay content with depth along the same trajectory. The occurrence of gravels tended to be in the more sandy horizons, and the gravels became less abundant travelling north along the proposed access road. The soils along the proposed access road, just south of the intersection with the existing access road, tended to have higher silt and clay contents than the soil horizons to the south. With the exception of a single test pit (TP08-2), groundwater seepage was indicated at depths ranging from 1.5 m

Project Area	Description
	to 2.6 m; however, groundwater was only indicated in a small percentage of the sites, whereas the rest remained dry after the completed excavation.
Air Quality Monitoring Stations	Soil sampled at Hare Lake (HL) was dark brown to black and was rich in organic matter. The soils at other sites were predominately sandy soils. The Airport site had sandy soils with traces of gravel.

2.2.2 Chemical Characterization

The chemical description of soil and overburden materials is summarized in **Table 2-2**.

Table 2-2: Summary of the chemical description of soil and overburden materials on the Marathon Palladium Project site as presented in the original EIS submission

Project Area	Description
Mine Rock Storage Area	The pH of MRSA topsoils and overburden materials were variable and ranged from 4.22 to 5.22 in the topsoils and from 3.83 to 4.67 in the overburden material, typical of podzolic soils in northern Ontario. The total organic carbon content in the topsoil was relatively high as concentrations ranged from 10.3% to 37.0%. Topsoils sampled at the MRSA were visibly rich in organic matter, as the soils were a rich dark brown to black and contained root material. Carbonate levels were comparatively low, and total organic carbon was found to account for the majority of the total carbon content in the soils. Overburden material was comparatively rich in organic carbon and low in carbonate. Total organic carbon contents in the overburden ranged from 13.4% to 34.1%, with the highest levels occurring at sites “RP-2” and “RP-3” (30.1% and 34.1%). Total sulphur content in the topsoils ranged from 0.01% to 0.069% and from 0.056% to 0.169% in the overburden material. Sulphide contents were either at detection limits or marginally above detection limits in materials. Sulphate accounts for the majority of the sulphur content in the soils, attributed to the presence of sulphate rich minerals, most likely barite. Overburden samples collected from the MRSA were elevated with respect to average crustal abundance concentrations for antimony, arsenic, cadmium, lead, molybdenum and selenium. With the exception of antimony, most samples did not exceed or only slightly exceeded the Ontario Ministry of the Environment[3] (MOE) background standards.
Primary Open Pit	Topsoil pH values were variable and ranged from 3.95 to 5.08; overburden pH values ranged from 5.60 to 6.09.

[3] The standards were published by the MOE at that time, now the Ministry of Environment, Conservation and Parks (MECP).

Project Area	Description
	Total organic carbon was greater in the topsoil compared to the overburden material. Topsoil total organic carbon contents ranged from 14.2% to 33.4% and the total organic carbon content in the overburden material ranged from 0.995% to 7.50%. Carbonate content was considered to be low (< 0.02%) in the topsoils and overburden materials. The total sulphur content in the topsoils ranged from the detection limit (0.01%) to 0.101% and from 0.116% to 0.173% in the overburden material. Sulphate was found to account for the majority of the total sulphur content in the soils and overburden material, due to the presence of the sulphate rich mineral barite. Most samples exceeded average crustal abundance concentrations for the selected constituents, but only cobalt, mercury, molybdenum and selenium were found to exceed the MOE background standards.
Satellite Open Pits	Topsoil pH values ranged from 5.31 to 6.08, and overburden material pH values ranged from 3.83 to 5.98. Total organic carbon was variable in the topsoil samples and ranged from 8.0% to 19.3%. The total organic carbon content of the overburden material was higher than levels found in the topsoil with concentrations ranging from 2.83% to 33.2%. Carbonate content in the topsoil and overburden was low, as total organic carbon content accounted for the majority of the total carbon content. Average total sulphur contents in the topsoil and overburden material samples were 0.042% and 0.151%, respectively. Sulphate levels were found to account for the majority of the total sulphur. Topsoil and overburden material generally exceeded average crustal abundance concentrations for the selected constituents, but only a few samples exceeded the background standards for cadmium, cobalt, copper, molybdenum and zinc. In most cases the constituents were only marginally elevated with respect to the MOE background levels.
Mill Site	Mill site topsoils were slightly acidic as pH values ranged from 3.80 to 5.56. Overburden material pH values were variable and ranged from 5.39 to 8.06. The more alkaline pH values observed in the overburden at some of the sites can be attributed to the carbonate content in the overburden materials. Carbonate contents at sites “FS-2”, “FS-3” and “FS-4” were 16.1%, 6.48% and 2.19%, respectively. Total organic carbon in the mill site topsoils was high and ranged from 13.7% to 25.3%. The carbonate content of the topsoils was low (<0.2%). Total organic carbon contents were comparatively low in the overburden material as concentrations ranged from 0.581% to 1.99%. As indicated above, carbonate concentrations were relatively high in overburden at three of the five mill area sites. These high carbonate contents may be explained by

Project Area	Description
	erratic mineral deposits from glacial outwash, as the soils were developed on glacial tills. Total sulphur contents in the topsoils were low and generally below detection limits (<0.01%). Average sulphur content in the overburden material was 0.11%, with sulphate accounting for much of the total sulphur content. Soils and overburden at the mill site have little potential for acid generation due to these low total sulphur and sulphide contents. Overburden soils were found to be elevated in antimony, arsenic, cadmium, lead, molybdenum, and selenium with respect to average crustal abundance concentrations. Molybdenum and selenium concentrations were found to slightly exceed the MOE background standards. Overburden soils were found to be elevated in antimony, arsenic, cadmium, lead, molybdenum, and selenium with respect to average crustal abundance concentrations. Molybdenum and selenium concentrations were found to slightly exceed the MOE background standards.
Process Solids Management Facility	The pH of the overburden material sampled at the PSMF site was variable with values ranging from 4.61 to 6.42. Material sampled at a depth of 8.8 - 9.4 m (“KP11-05”) were more alkaline with a pH of 8.28, which corresponded to higher carbonate levels in the sample. Total organic carbon contents in the overburden soils sampled were variable and ranged from 0.01% to 7.64%. Carbonate concentrations were generally low. Total sulphur and sulphide contents were found to be below detection limits (<0.01%). All constituent concentrations were either below or only marginally above crustal abundance concentrations. Only molybdenum and selenium concentrations were found to exceed MOE background site standards and were only marginally elevated at a few sites. Overburden material from the PSMF site would be suitable for use as reclamation material.
Pic River Flood Plain	Arsenic, cadmium, lead, selenium, silver and thallium exceeded average crustal abundance levels at both sampling locations in the Pic River flood plain. No constituent exceeded the full depth background site condition standards provided by the MOE.
Air Quality Monitoring Stations	The soils sampled at the air quality monitoring stations were slightly acidic in nature with an average pH of 5.63. Total organic carbon ranged from 1.98% to 3.38% and carbonate content ranged from 0.05% to 0.09%. Sulphur content was low in the air quality station soils. Average total sulphur, sulphate and sulphide contents were 0.14%, 0.13% and <0.01%, respectively. Soil samples collected from the off-site air quality monitoring stations were elevated in arsenic, cadmium, lead, molybdenum and zinc content with respect to average crustal abundance concentrations. Only

Project Area	Description
	molybdenum was found to exceed the MOE standards at the “AP” and “HL” sites. Characterizing the metal content in soils at the air quality monitoring sites was appropriate for establishing baseline soil conditions of off-site locations for use in possible future fugitive air emission studies. This data can be used during later phases of mine life to monitor fugitive dust emissions.
Additional Areas	Sampling sites “Soil 3” and “Soil 5” are not associated with any specific mine-related facility and represent general overburden conditions within the Project area (see Figure 2.1-1). “Soil 3” is located near the north eastern end of the PSMF and “Soil 5” is located east of the southeast corner of the PSMF and east of the proposed access road. At both sites, constituent concentrations were generally below average crustal abundance concentrations and no constituents were found to exceed MOE standards.

2.2.3 Short-term Leach Testing

Short-term leach tests (shake flasks) were performed in order to assess the metal leaching potential of overburden materials. For reference purposes only, the soluble concentrations of select constituents were compared the Provincial Water Quality Objective (PWQO) guidelines (MOE, 1994).

The leach test results are summarized in **Table 2-3**.

Table 2-3: Summary of the short-term leach tests for overburden materials on the Marathon Palladium Project site

Project Area	Description
Mine Rock Storage Area	The overburden samples were marginally elevated above MOE guidelines for cadmium and cobalt.
Primary Open Pit	Soluble copper concentrations exceeded the screening criteria at a couple of locations. Dissolved zinc and cobalt concentrations only marginally exceeded the guidelines.
Satellite Open Pits	Soluble cobalt concentrations were marginally elevated above MOE guidelines at one location.
Mill Site	Soluble cobalt concentrations were marginally elevated above MOE guidelines at one location.
Process Solids Management Facility	Overburden samples were marginally elevated above MOE guidelines for dissolved copper, cobalt and zinc concentrations.

2.2.4 Overburden Excavation

A preliminary estimate of the quantity of overburden material that could be excavated was made at each of the following four development zones: the primary open pit, satellite pits, the mill site, and the PSMF. For the purposes of overburden estimate, the surface areas of the primary open pit, satellite pits, and the mill site were estimated from the site layout map. Overburden thickness in each of the areas was extrapolated from the results of a compilation of site-wide overburden thickness information, and it was assumed that the overburden would be fully excavated across its entire depth. Acknowledging the aforementioned assumptions, it is estimated that approximately 3,710,000 m^3 of overburden could be excavated. Of this volume, 39% would be obtainable from the PSMF, 35% from the primary open pit, 19% from the satellite pits, and the remaining 8% from the mill site.

3.0 REGULATORY SETTING

There are no regulatory requirements, policies, nor guidance, *per se*, that are specifically associated with characterization of baseline soil conditions at the project site. For reference purposes, soil chemistry data were screened against average crustal abundance concentrations according to Faure (1998) and the MOE (2011) full depth background site condition standards, which are based on typical background concentrations found in non-contaminated Ontario soils. These standards have not changed since that time.

Section 2.6.1.1. of the EIS Guidelines (CEA Agency and MOE, 2011) describes the reporting requirements associated with the discussion of existing conditions on the site as it pertains to soils, surficial and bedrock geology of the deposit, host rocks, and overburden units. Section 2.6.1 1 also refers to the characterization of potential acid rock drainage and metal leaching. Some information concerning the solids context and leaching properties of overburden materials were presented in the soils baseline report; however, the detailed geochemical characterization of project-related materials was presented under separate cover as part of the original EIS submission (see SID #5, CIAR #231), and similarly updated geochemistry information is provided elsewhere.

The information that was presented in the original soils conditions baseline report was used to support the assessment of effects on the “terrain and soils” valued ecosystem components (VEC) and also on other select VECs, in particular where these VECs may be affected by changes in soil quality. This continues to be the case for the updated EIS submission.

4.0 STUDY AREA

For the purpose of this assessment, the spatial boundaries considered in this assessment include the direct and indirect effects related to site preparation, construction, operation, and decommissioning / project closure of the Project. These areas are generally consistent with the spatial boundaries used in the EIS (2012) and associated supporting information documents, with appropriate revisions / refinements and rationale provided below.

4.1 Site Study Area (SSA)

The Site Study Area (SSA) is the direct footprint at the immediate mine site of the Project. Based on refinements to the Project footprint, and in recognition of project components originally located outside of the SSA, a revised SSA has been developed that encompasses the immediate area in which Project activities and components may occur and, as such, represents the area within which direct physical disturbance may occur as a result of the Project, whether temporary or permanent. The SSA is consistent for all VECs as depicted on **Figure 4-1**.

4.2 Local Study Area (LSA)

The Local Study Area (LSA) is the maximum area within which environmental effects from Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. It consists of the Project Development Area (PDA) and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information and professional judgment. The LSA for soils is depicted on **Figure 4-2**. The area corresponds to that of the atmospheric environment LSA, as the primary pathway of potential effects on soils outside the SSA would be from project-related emissions to air.

The LSA used in this baseline reports in similar to the LSA used in the original EIS submission.

4.3 Regional Study Area (RSA)

The Regional Study Area (RSA) is the area within which residual environmental effects from Project activities and components may interact cumulatively with the residual environmental effects of other past, present and future (i.e., certain or reasonably foreseeable) physical activities. The RSA is based on the potential for interactions between the Project and other existing or future potential projects.

It is not anticipated that effects that may be associated with the Project would act cumulatively with others outside the LSA. For this reason, the RSA for the soil and terrain VEC is the same as the LSA.

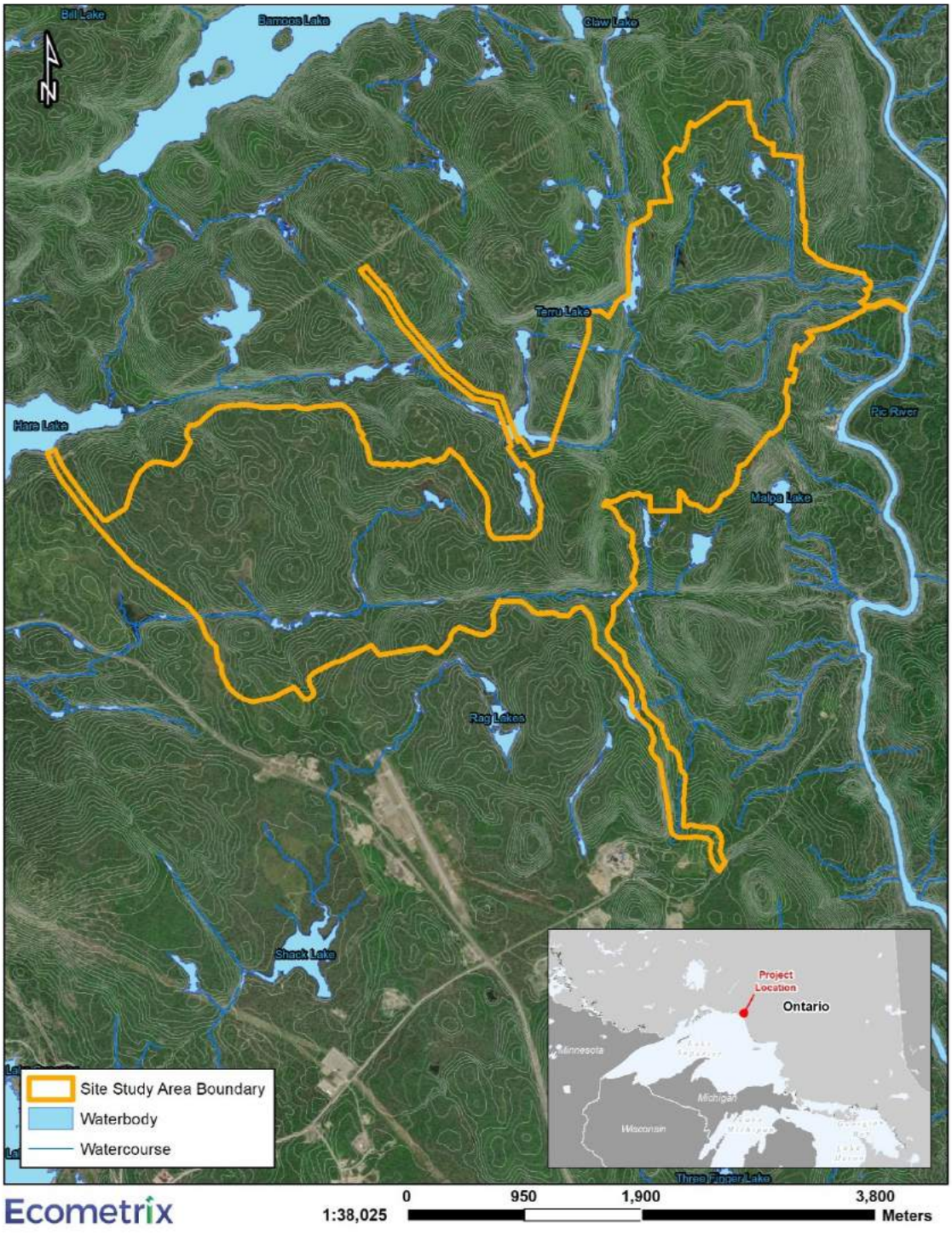

Figure 4-1: SSA for the Soils Baseline Characterization

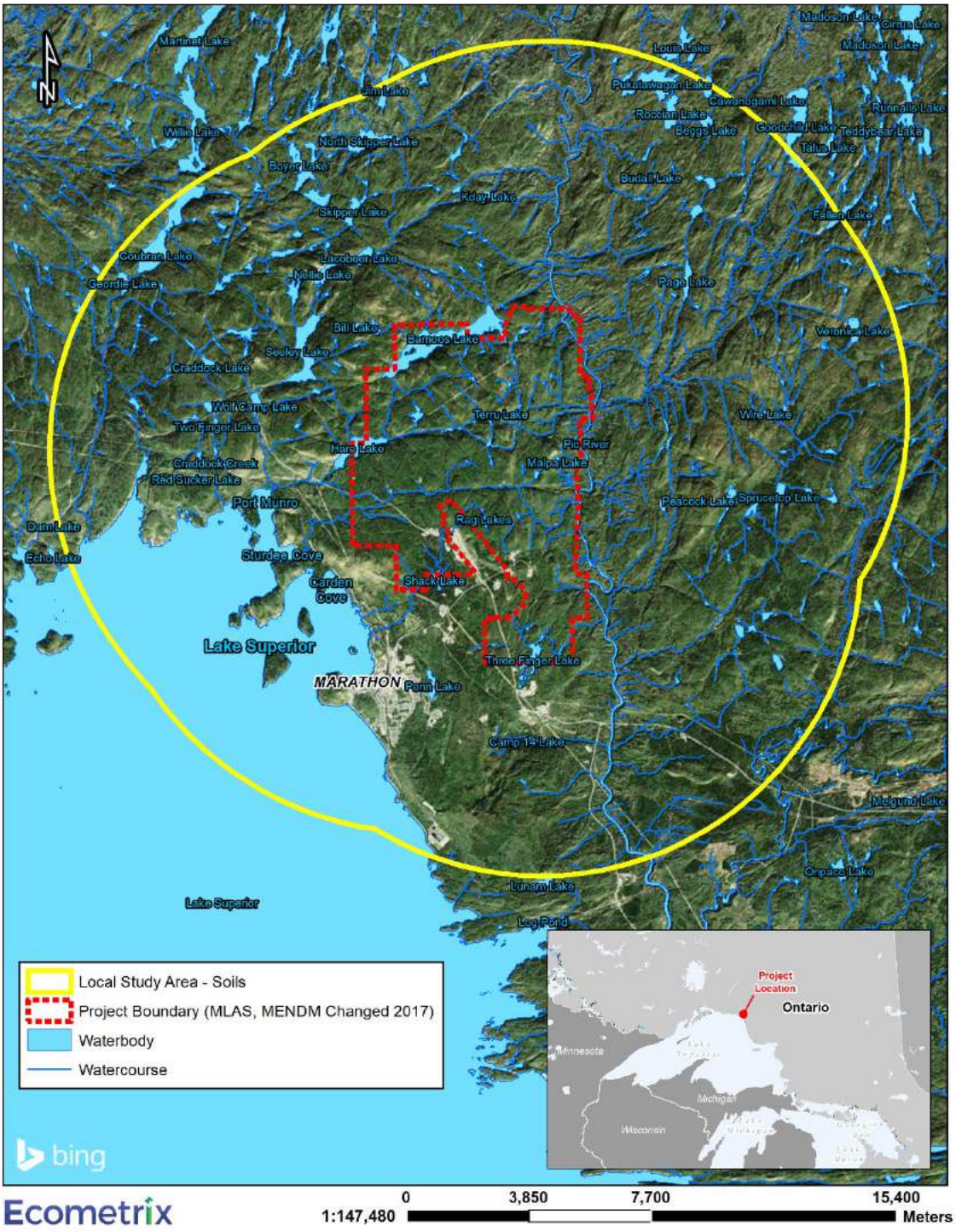

Figure 4-2: LSA and RSA for the Soils Baseline Characterization

5.0 METHODOLOGY

In order to update the baseline characterization of soil conditions as presented in the original EIS submission several factors were considered. Foremost among these were (1) consideration of the passage of time and how changes in the environment at the Project site may have influenced soil conditions; (2) changes or updated to regulatory standards and guidelines; and (3) changes in the nature of the Project itself, and in particular changes in the development footprint within the SSA. It is within these contexts that the ability to fulfill the original objectives of the soil baseline report (see **Section 2.0**) can be considered to determine the need, if any, to provide updated information.

As it concerns the consideration of the passage of time and how changes in the environment at the Project site may have influenced soil conditions, the following is noted. No events or activities, natural (e.g., fire, flooding) or man-made (e.g., clearing), are known to have occurred on the Project site that would have precipitated a change in the physical or chemical nature of soils. In this context therefore, there is no rationale to collect further or additional baseline data, as the original baseline characterization provides a sufficient basis on which to assess potential project-related effects.

As it concerns changes or updated to regulatory standards and guidelines the following is noted. Though various aspects of O.Reg. 153/04 have been updated in the last several years, the full depth background site condition standards for soils (Table 1) are unhanged and therefore the original screening of constituent levels in soils remains relevant.

As it concerns changes in the nature of the Project itself and, in particular, changes in the development footprint within the SSA, the following are noted. Generally, the spatial arrangement of the key site aspects and infrastructure is unchanged. Minor footprint changes to the open pits, PSMF and MRSA are not material with respect to the physical or chemical characterization of soils. In the updated mine design, the mill site is a few hundred metres west of its original location. It is believed that sufficient information as to the physical and chemical nature of soils and overburden in the SSA are currently available on which to base the updated effects assessment, despite the minor footprint changes noted.

A new access road alignment is proposed that is slightly west of the original alignment. There are no original soil sampling locations along this alignment. General surveying has been completed along the corridor to provide a physical description of soil conditions. It is believed that the physical and chemical nature of soils and overburden along the new access road alignment in the SSA are not materially different than what exist along the previous access road alignment. Additional information is provided in **Section 6.0**.

An alternate transmission line corridor is under consideration that would follow the proposed access road. This corridor could be used following completion of the East-West

Tie Transmission Line. As indicated above, general surveying has been completed along this corridor and is described in **Section 6.0**.

In addition to the updated baseline information noted above, an updated overburden model has been developed based on exploration program data. This, in conjunction with the updated site plan, provide the basis for estimating the quantity of overburden material that could be excavated at each of the primary site aspect development zones (primary open pit, satellite pits, the mill site and the PSMF). It is noted that this information will be provided as part of the updated effects assessment, as it concerns an environmental change, in this case a change to the “terrain and soils” VEC that would result from the project.

Updated information concerning the geochemical properties of overburden materials will be reported under separate cover.

6.0 UPDATED BASELINE CONDITIONS

As indicated in **Section 5.0**, new updated information concerning the physical nature of soils at the new mill site and along a new proposed road (and a potentially co-located transmission line) corridor. This information is provided below.

6.1 General Description of Soils and Overburden at the Proposed Mill Site and Along the New Proposed Access Road Alignment and Transmission Line Corridor

6.1.1 New Mill Site

Mapping and prospecting of the new mill site was conducted between July and October 2020. The majority the area consisted of ridges and cliffs of syenite with the lower lying eastern and southern portions. Outcrops were observed abundantly and consistently throughout the mapped area. Outcrops were at or near surface and overburden in the mapped area is similar to the overall project site, averaging 2.9m. This description is similar to that presented in the terrestrial resources environmental baseline assessment, whereby the area is located in a “rock knob” landform type with thin topsoils and frequent bedrock outcroppings (Northern Ontario Engineering Geology Terrain Study data; Northern Bioscience, 2009).

6.1.2 New Access Road Alignment

The new proposed access road corridor follows a largely southeast to northwest trending topographic high or ridge within a rock knob landform type. There are extensive outcroppings along the corridor and where present soils are silty and the overburden layer is thin (< 2-3 m). As indicated, it is possible that a transmission line to the project site could be co-located in this corridor under the circumstance that power to the site was provide by the East-West Tie Transmission Line once it is completed.

6.2 Additional Planned Work

Further information, specifically concerning soil quality, will be collected in 2021 during the geotechnical evaluations of the proposed new plant site and road corridor to support the advancement of detailed design. These data will be provided when they are available.

7.0 SUMMARY AND CONCLUSIONS

The original characterization of soils in the Project study area included a desk top review of published information regarding topography and physiography, sampling of soils and overburden materials for physical and chemical characterization, and characterization of overburden material volumes that would likely be excavated to accommodate construction of site infrastructure. Generally, this information continues to be relevant and sufficient to support the updated effects assessment. Some updated baseline soils information has been provided for a new proposed plant site location and access road alignment and further work is planned. An updated estimate on the volume of soil/overburden materials that may be disturbed within the SSA will be presented in the updated effects assessment as it represents a change to the “terrain and soils” VEC.

8.0 REFERENCES

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