



MARATHON PALLADIUM PROJECT – GEOLOGICAL CONDITIONS BASELINE REPORT UPDATE

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**MARATHON PALLADIUM
PROJECT – GEOLOGICAL
CONDITIONS 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 geologic baseline conditions for the Marathon Palladium project (the Project) near the Town of Marathon, Ontario. The updated geological conditions baseline study provides information required to complete the EIS Addendum for the Project. The objectives of the geological conditions baseline study were to: provide a general understanding of the regional and local geological settings; and, characterize the nature and mechanisms of mineralization of the Marathon PGM-Cu deposit.

GenPGM and its predecessor have continued to update information about the deposit with further exploration drilling and trenching completed in 2017, 2019 and 2020, as well as geophysical surveys completed in 2018-20. This new information, in combination with the information from previous exploration campaigns as presented in the original EIS submission and supporting documentation, have been re-considered within the context of existing geological conditions on the site.

Recent data collected through exploration programs confirm the previous description of geological conditions on the project site. Data collected since the environmental assessment process was suspended do not affect how the geological conditions associated with the site will be used to support the assessment of effects on select valued ecosystem components (VECs).

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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 geologic 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 #4: Geological Conditions at the Marathon PGM-CU Project Site prepared by Ecometrix (June 2012) (CIAR #227); and,
- Responses to IR14.1 and IR14.2 (CIAR # 227.)

The geological conditions baseline study has been completed to inform the Addendum to the Marathon Palladium 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 geological 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 Bamooos 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. Exploration began in 1963, initially for copper and iron, while PGM exploration did not begin until the late 1980s with the increasing global demand. 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, Bamooos Lake and Hare Lake.

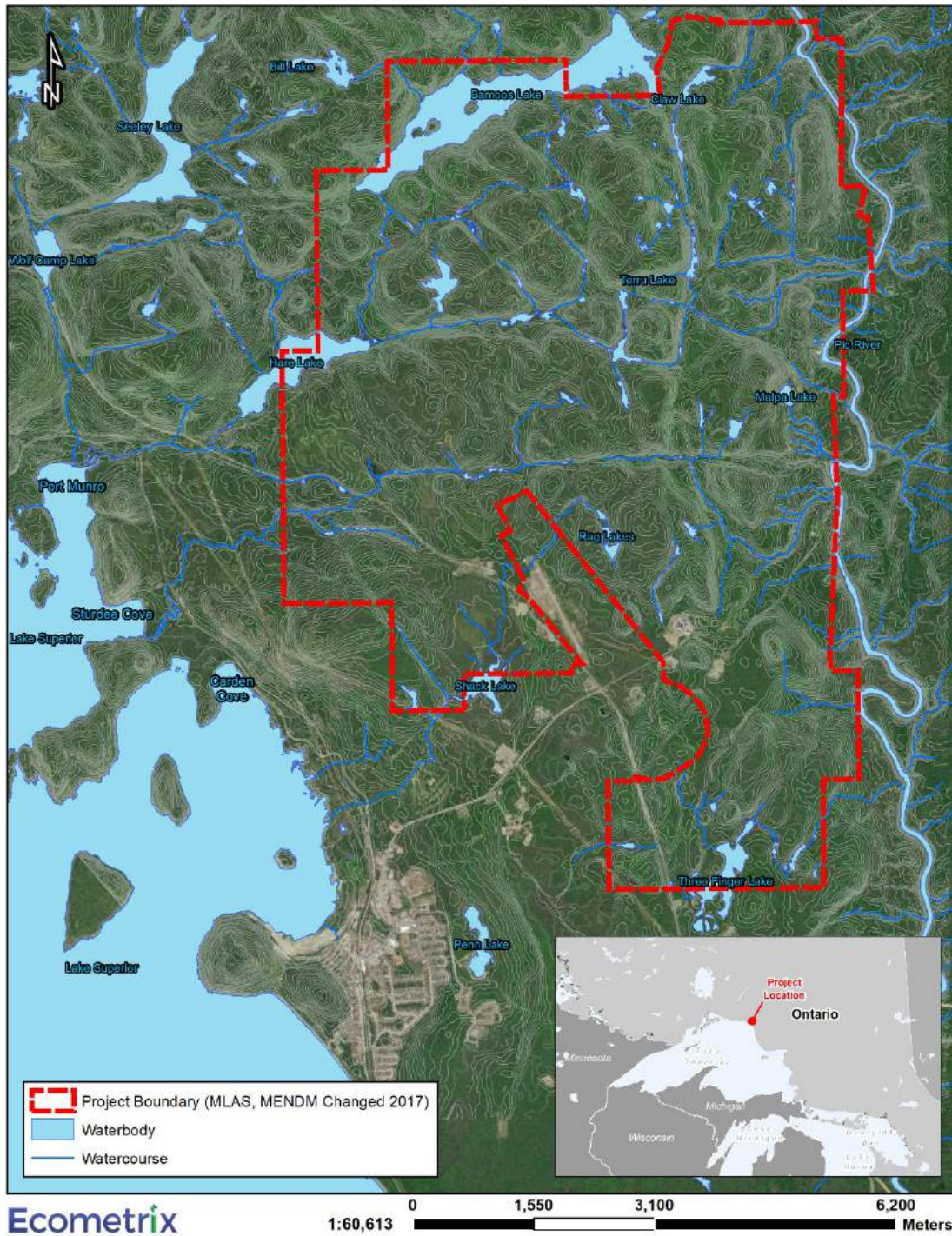


Figure 1-1: Regional Project Location

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 rock¹ 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 solids² 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 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 either 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 geological 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), LSA (Local Study Area), 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 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 was formed approximately 1.1 billion years ago. It has a diameter of 25 km and a surface area of 580 km², and is the largest alkaline intrusive complex in North America. The Coldwell Complex was emplaced as sub horizontal intrusions into a volcanic pile during active cauldron subsidence near where the northern end of the Thiel Fault intersected Archean rocks, on the north shore of Lake Superior.

At least three mechanisms for sulphide and PGM precipitation have been proposed for the deposit, including hydrothermal (Watkinson and Ohnenstetter, 1992), magmatic (Good and Crocket, 1994) and zone refining (Barrie *et al.*, 2001). The magma conduit model is the preferred mineralization process and, in the model, the gabbroic units and associated Cu-PGM mineralization represent material that crystallized or settled out of the magma as it moved through the conduit.

Mineralization at the site is part of a very large magmatic system that consists of at least one major volcanic series and two major intrusive series of predominantly olivine gabbroic units that form the Eastern Gabbro of the Coldwell Complex. The metabasalt series is the earliest event and is composed of multiple volcanic flows infilling along the Archean surface. The metabasalt shows pyroxene-hornfeld alteration and can be up to 100 m thick. The earlier of the two intrusive events is termed the Layered Gabbro Series (LGS) and is made up of alternating layers of gabbro, olivine gabbro and troctolite. LGS was emplaced above the metabasalt. The grain size for units within the LGS varies considerably, with some units, on the order of 100 m in thickness, being composed of numerous 1-5 m thick layers of fine-grained gabbro. The metabasalt was intruded by the Two Duck Lake Gabbro (TDLG) along the Archean basement contact in multiple horizons within the stratigraphic package that makes up the Eastern Gabbro. The TDLG is composed of coarse-grained to pegmatitic relatively homogeneous gabbro and olivine gabbro or troctolite. Late quartz syenite and augite syenite dykes cut all of the gabbros but form a minor component of the intrusive assemblage. The TDLG is the host rock for Cu-PGM mineralization and has been the focus of past exploration activities.

A very prominent feature of the deposit is the local and extreme enrichment of PGMs with respect to Cu and Ni, as well as sulphur. For example, high grade samples from the W Horizon that contain between 25 and 50 g/t Pd (1 g/t = 1 ppm) might also contain very low concentrations of Cu and Ni (<0.02%). The separation of PGMs from Cu is observed throughout the deposit but is most common near the top of the mineralized zone. In the southern half of the deposit, PGM enrichment is most prominent in the W Horizon.

3.0 REGULATORY SETTING

There are no regulatory requirements, policies, nor guidance, *per se*, that are specifically associated with characterization of baseline geological conditions at the project site.

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 – the results of the 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.

Generally, the information that was presented in the original geological conditions baseline report was used to support the assessment of effects on select valued ecosystem components (VECs) – “geology” was not a VEC in and of itself. This continues to be the case for the updated EIS submission.

4.0 STUDY AREA

Consideration of the spatial boundaries of existing geological conditions does not necessarily fit the typical model used for the purposes of environment assessment, where potential project effects are considered at the site, local and regional scales. Strictly speaking, interactions between the Project and the existing geological conditions all occur within the SSA, as the SSA is defined by the Project's development footprint.

For descriptive purposes, the Project-associated geology is considered on the regional and local scales. As described in **Section 2.0**, on a regional basis the deposit is hosted within the Coldwell Complex, while on a local scale the deposit is hosted within the so-called Two Duck Lake Gabbro.

5.0 METHODOLOGY

GenPGM and its predecessor have continued to update information about the deposit with further exploration drilling and trenching completed in 2017, 2019 and 2020, as well as geophysical surveying completed between 2018 and 2020. Available details associated with the exploration programs are provided in P&E Mining (2019).

This new information, in combination with the information from previous exploration campaigns as presented in the original EIS submission and supporting documentation, have been re-considered within the context of existing geological conditions on the site and how these conditions factor into the overall assessment of potential project-related.

6.0 UPDATED BASELINE CONDITIONS

Based on the review of new exploration program related information and in discussion with the GenPGM exploration team, there is no new information that has been collected to date that alters the original characterization of site geological conditions within the context of the environmental assessment process. Subtle changes in the detailed interpretation of the mineralization of the deposit have contributed to minor changes to resource estimates and pit shell configuration; however, these changes are not associated with previously unidentified lithologies or rock types and are part of what would be expected to be a typical mine design optimization process.

7.0 SUMMARY AND CONCLUSIONS

Recent data collected through exploration programs confirm the previous description of geological conditions on the project site.

Data collected since the environmental assessment process was suspended do not affect how the geological conditions associated with the site will be used to support the assessment of effects on select VECs.

8.0 REFERENCES

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