Appendix V4-3A

Environmental Noise and Vibration Study Report

TMAC Resources Inc.

Phase 2 - Draft Environmental Impact Statement (DEIS)

Environmental Noise and Vibration Study Report

Reference: 0300783AURP01

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FINAL REPORT

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December 2016

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1 INTRODUCTION

This report was commissioned by TMAC Resources Inc. (TMAC). It presents the methodology, results and findings of the noise and vibration study completed to quantify potential environmental noise, overpressure and ground-borne vibration emissions associated with construction and operation of Phase 2, including consideration of the existing Doris operational noise. The noise and vibration study was prepared to support the Phase 2 Draft Environmental Impact Statement (DEIS) and extended to include ERM''s global technical resources, with all works completed by qualified and experienced personnel from within the ERM acoustics practice.

1.1 KEY FEATURES OF THIS STUDY

Noise is an important environmental factor because a change in the noise environment may adversely affect wildlife and workers. Noise is defined as any undesirable sound that may irritate people, disturb rest or sleep, cause loss of hearing, or otherwise affect the quality of life of affected individuals. Noise can result in psychological and physiological effects (e.g., stress), mental health effects, and effects on residential behaviour (World Health Organization (WHO) 1999).

In addition, noise may negatively affect wildlife causing them to avoid important habitats and/or take time away from their key behaviours such as feeding, breeding or watching for predators, which can ultimately lead to reduced reproduction and increased mortality. Direct effects of high noise levels and shock waves on marine fish include mortality or internal injury (e.g. hearing, bleeding, ruptured swim bladder).

Vibration may be in the form of ground vibration or blasting overpressures, i.e. pressure waves in the atmosphere. These ground-borne or airborne vibrations can cause cosmetic and structural damage to buildings as well as disturbances to workers, and wildlife.

1.1.1 *Assessed Environmental Aspects*

This noise and blast study considers the baseline noise conditions and noise and vibration assessment of potential impacts associated with Phase 2 construction and operation. The noise and vibration aspects that were warranted for assessment include:

- Air-borne noise associated with Phase 2 mine construction;
- Air-borne noise associated with Doris and Phase 2 mine operation;
- Air-borne noise associated with aircraft;
- Air-blast overpressures associated with quarry blasting; and
- Ground-borne vibration associated with quarry blasting.

1.2 PROJECT OVERVIEW

Through a staged approach, the Hope Bay Project is scheduled to achieve mine operations in the Hope Bay Greenstone Belt through mining at Doris, followed by commercial mining at Madrid North and South, and mining of the Boston deposit. To structure the assessment, the Hope Bay Project is broadly divided into: 1) the Existing and Approved Projects, and 2) the Phase 2 Project (this DEIS application).

1.2.1 *The Existing and Approved Projects*

The Existing and Approved Projects include:

- the Doris Project (NIRB Project Certificate 003, NWB Type Water Licence Type A Water Licence 2AM-DOH1323);
- the Hope Bay Regional Exploration Project (NWB Type B Water Licences NWB Type B 2BE-HOP1222);
- the Madrid Advanced Exploration Program (NWB Type B Water Licence under Review); and
- the Boston Advanced Exploration Project (NWB Type B Water Licence 2BB-BOS1217).

The Doris Project

The Doris project was permitted by the NIRB in 2006, with the intention being a construction phase spanning 2 years, an operational phase of 2 years, and the closure of the project over the course of 2 years. The original Type A Water licence authorizes mining at 720 tonnes per day (tpd) and milling at 800 tpd during the operations phase. Construction of the Doris Project began in early 2010 and in early 2012 the Doris Project was placed into care and maintenance, ending any further Project-related construction. Advanced exploration and construction activities have advanced focused on bringing Doris into production by 2017, following the acquisition of the Hope Bay Project by TMAC in March 2013.

The Doris Project encapsulated the following activities:

- The Roberts Bay offloading facility: marine jetty, barge landing area, beach laydown area, fuel tank farm/transfer station, and quarry;
- The Doris site: 180 person camp, laydown area, service complex, two quarries (mill site platform and solid waste landfill), fuel tank farm/transfer station, potable water treatment, waste water treatment, incinerator, explosives magazine, and diesel power plant;
- Doris Mine works and processing: underground portal, temporary waste rock pile, ore stockpile, and processing mill;

- Tailings Impoundment Area (TIA): Schedule 2 designation for Tail Lake with two dams (North and South dams), emergency tailings dump catch basins, pump house, and quarry;

- All-season main road with transport trucks, including access roads from Doris site used predominantly by light-duty trucks to: Tail Lake (5.9 km), the explosives magazine (0.5 km), Doris Lake floats plane dock (0.5 km), solid waste disposal site (0.2 km), and to the tailings decant pipe (0.4 km).

- All-weather airstrip (914 m), winter airstrip (1,524 m), helicopter landing site, and Doris Lake float plane and boat dock.

Additionally, the use of water is prevalent throughout the site and is managed through freshwater input from Doris Lake (drinking and fire suppression), and the use of Tail Lake for process water input and saline and sewage/greywater discharge (after treatment).

The Doris Project Amendment

In 2016, the Nunavut Water Board (NWB) granted an amendment to the Doris Project Type A Water Licence to expand mine operations to 6 years and mine the full Doris deposit. Mining and milling rates were increased to 1,000 tpd with an eventual increase to 2000 tpd. Other changes to the project included the expansion of the Doris site to 280 people and the addition of a non-hazardous landfill quarry, along with the addition of a marine outfall mixing box (MOMB) to assist in the movement of discharge water from Roberts Creek to Roberts Bay.

Hope Bay Regional Exploration Project

The Hope Bay Regional Exploration Project has been renewed a number previous time since 1995. The current extension expires in June 2022. Much of the previous work for the program was based out of Windy Lake and Boston camps. These camps were closed in October 2008 with infrastructure either decommissioned or moved to the Doris site. All exploration activities are now based from the Doris site and in the future from the Boston site. Components and activities for the Hope Bay Regional Exploration Project include:

- operation of helicopters from Doris (4 hours per day in the summer months); and

- the use of exploration drills, which are periodically moved by helicopter.

Madrid Advanced Exploration

In 2014, TMAC applied for an advanced exploration permit to conduct a bulk sample at the Madrid North and Madrid South sites which are approximately 4 km south of the Doris site. The program includes extraction of a 50 to 60 tonne bulk sample, which will be trucked to the mill at the Doris site for

processing and placement of tailings in the TIA. All personnel will be housed in the Doris camp.

The advanced exploration permit is currently before the NWB and includes constructing and operating of the following at each of the sites:

- Madrid North and Madrid South: workshop and office, laydown area, diesel generator, emergency shelter, fuel storage facility/transfer station, contact water pond, and quarry;
- Madrid North and Madrid South mine works: underground portal and works, waste rock pad, ore stockpile, compressor building, brine mixing facility, saline storage tank, air heating facility, and four vent raises; and
- A road from the Doris site to Madrid (9.7 km) with branches to Madrid North, Madrid North vent raise, and the Madrid South portal.

Water will be managed at Madrid through:

- At Madrid North, water inputs include drawdown through talik from Windy Lake, Patch Lake, and Imniagut Lake, porewater from water rock and ore, and precipitation.
- At Madrid South water inputs include drawdown through talik from Wolverine Lake, and Patch Lake, porewater from water rock and ore, and precipitation;
- Water will be stored on site and discharged to the TIA; and
- Site (non-contact) water will be discharged to the tundra (if appropriate).

Boston Advanced Exploration

The Boston Advanced Exploration Project Type B Water Licence was granted in July 2007 and is valid until July of 2017 and includes:

- The Boston camp (65 person), sewage and greywater treatment plant, fuel storage and transfer station, landfarm, solid waste landfill and a helipad;
- Mine works consisting of underground development for exploration drilling and bulk sampling, temporary waste rock pile, and ore stockpile;
- Potable water and industrial water taken from Aimokatalok Lake; and
- Treated sewage and greywater discharged to the tundra.

Since the construction of Boston will require the reconfiguration of the entire site, assessment of all phases for Boston will be considered as part of the Phase 2 Project for the purposes of the assessment.

1.2.2 The Phase 2 Project

The Phase 2 Project includes the Construction and Operation of commercial mining at the Madrid (North and South) and Boston sites, the continued operation of Roberts Bay and the Doris site to support mining at Madrid and Boston, and the Reclamation and Closure and Post-Closure phases of all sites. Excluded from the Phase 2 project for the purposes of the assessment are the Reclamation and Closure and Post-closure components of the Doris Project as currently permitted and approved.

Construction

Phase 2 construction will utilize the infrastructure associated with Existing and Approved Projects. This may include:

- all-weather airstrip at the Boston exploration area and helicopter pad;
- seasonal construction and/or operation of winter ice strip on Aimaokatalok Lake;
- Boston camp with capacity for up to 65 people during construction, and Quarry D Camp with capacity for up to 100 people;
- seasonal construction/operation of Doris to Boston winter road route (WRR);
- three existing quarry sites along the Doris to Windy all-weather road (AWR);
- Doris camp with capacity for up to 280 people;
- Doris airstrip, winter ice strip, and helicopter pad;
- Roberts Bay offloading facility and road to Doris; and
- Madrid North and Madrid South sites and access roads.

Additional infrastructure to be constructed for the proposed Phase 2 Project includes:

- expansion of the Doris TIA (raising of the South Dam, construction of West Dam, and development of a west road to facilitate access);
- construction of an off-loading cargo dock at Roberts Bay (including a fuel pipeline, expansion of the fuel tank farm and laydown area);
- construction of an additional tank farm at Robert's Bay;
- complete development of the Madrid North and Madrid South underground workings;

- incremental expansion of infrastructure at Madrid North and Madrid South to accommodate production mining;

- construction of a concentrator, fuel storage and a power plant, and, laydown at Madrid North;

- all weather access road and tailings line from Madrid North to the south end of the TIA;

- AWR linking Madrid to Boston (approximately 53 km in length, nine quarries for permitting purposes, four of which will likely be used);

- all-weather airstrip at Boston;

- all infrastructure necessary to support mining and milling activities at Boston including construction of a new 200-person camp at Boston and associated support facilities, additional fuel storage, laydown area, ore pad, waste rock pad, concentrator, diesel power plant, and dry-stack tailings management area (TMA) at Boston; and

- infrastructure necessary to support ongoing exploration activities at both Madrid and Boston.

Operation

Phase 2 Project is intended to cover the proposed incremental development of the Hope Bay Greenstone Belt. The operation phase includes:

- mining of the Madrid North, Madrid South, and Boston deposits;

- transportation of ore from Madrid North, Madrid South and Boston to the Doris mill, and transportation of concentrate from the Madrid North concentrator and Boston concentrator to Doris for final gold refining;

- extending the operation at Roberts Bay and Doris;

- processing the ore and/or concentrate from Madrid North, Madrid South and Boston at the Doris mill with disposal of the leached tailings underground, with the tailings pumped to the expanded Doris TIA and discharge of the TIA effluent to the marine environment;

- operation of a concentrator at Madrid North and disposal of tailings at the Doris TIA;

- operation of a concentrator at Boston and disposal of tailings to the Boston TMA; and

- on-going maintenance of transportation infrastructure (cargo dock, jetty, roads, and quarries).

Reclamation and Closure

Areas which are no longer needed to carry out Phase 2 Project activities will be progressively reclaimed during Construction and Operation. Where practicable, progressive rehabilitation will be implemented to achieve the site abandonment goal and closure principles (see Volume 3, Chapter 2, Section 5).

At Reclamation and Closure, all sites will be deactivated and reclaimed in the following manner (see Volume 3, Chapter 2, Section 5.5):

- Camps and associated infrastructure, laydown areas and quarries, buildings and physical structures will be decommissioned. All foundations will be re-graded to ensure physical and geotechnical stability and promote free-drainage, and any obstructed drainage patterns will be re-established.

- Using non-hazardous landfill, facilities will receive a final quarry rock cover which will ensure physical and geotechnical stability.

- Landfarms will be closed by removing and disposing of the liner, and re-grading the berms to ensure the area is physically and geotechnically stable.

- Mine waste rock will be used as structural mine backfill.

- The Doris TIA surface will be covered waste rock. Once the water quality in the reclaim pond has reached the required discharge criteria, the North Dam will be breached and the flow returned to Doris Creek.

- The Madrid to Boston All-Weather Road and Boston Airstrip will remain in place after Reclamation and Closure. Peripheral equipment will be removed. Where rock drains, culverts, or bridges have been installed, the roadway or airstrip will be breached and the element removed. The breached opening will be sloped and armoured with rock to ensure that natural drainage can pass without the need for long-term maintenance.

- A low permeability cover, including a geomembrane, will be placed over the Boston TMA. The contact water containment berms will be breached and the liner will be cut to prevent collecting any water. The balance of the berms will be left in place to prevent localised permafrost degradation.

The Doris and Phase 2 layout (including the Phase 2 surface components) is identified in *Figure 1.2* to *Figure 1.6*.

Figure 1.1
Hope Bay Project Existing and Proposed Phase 2 Infrastructure

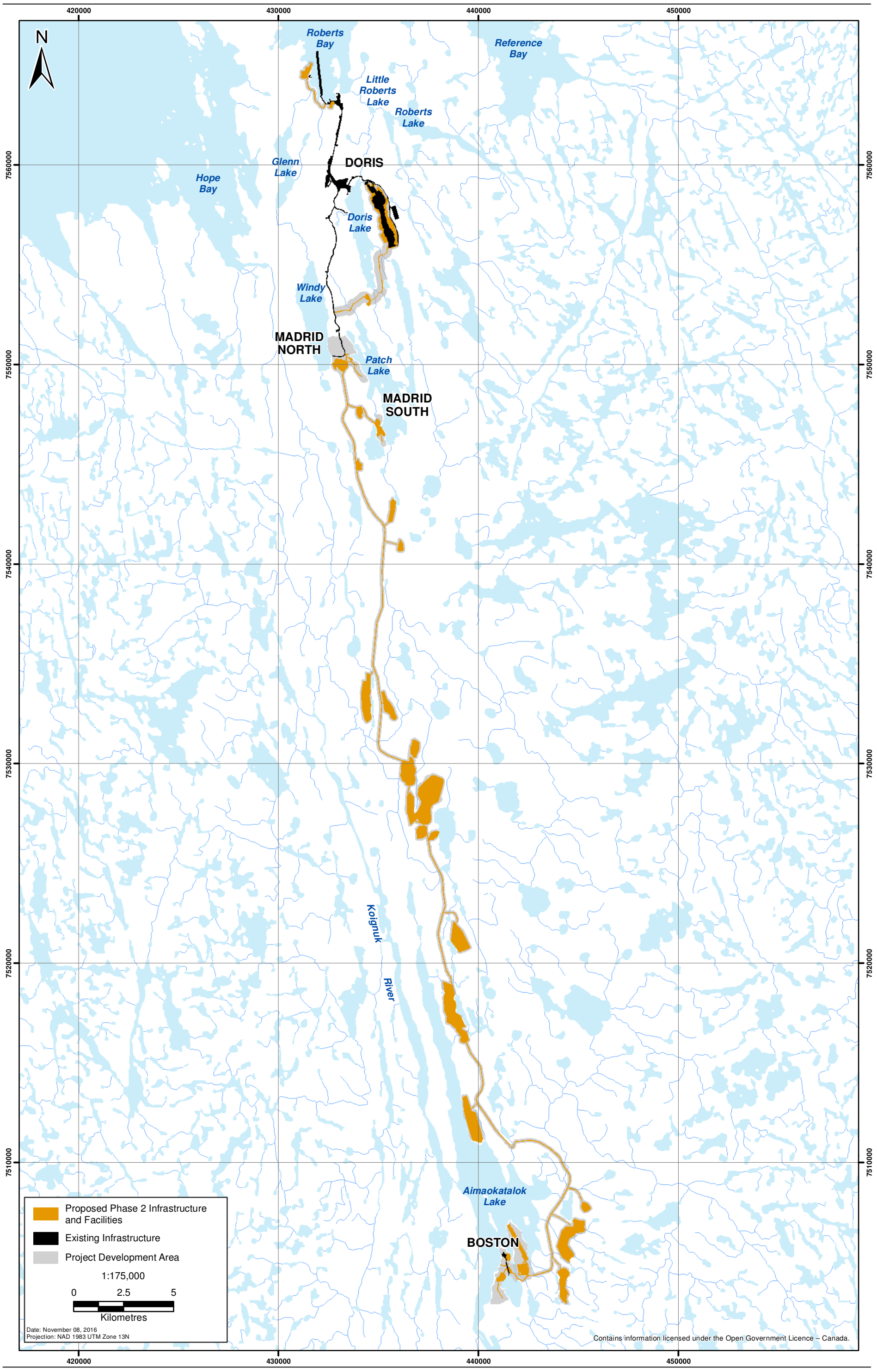

Figure 1.2
Location of Proposed Roberts Bay Cargo Dock

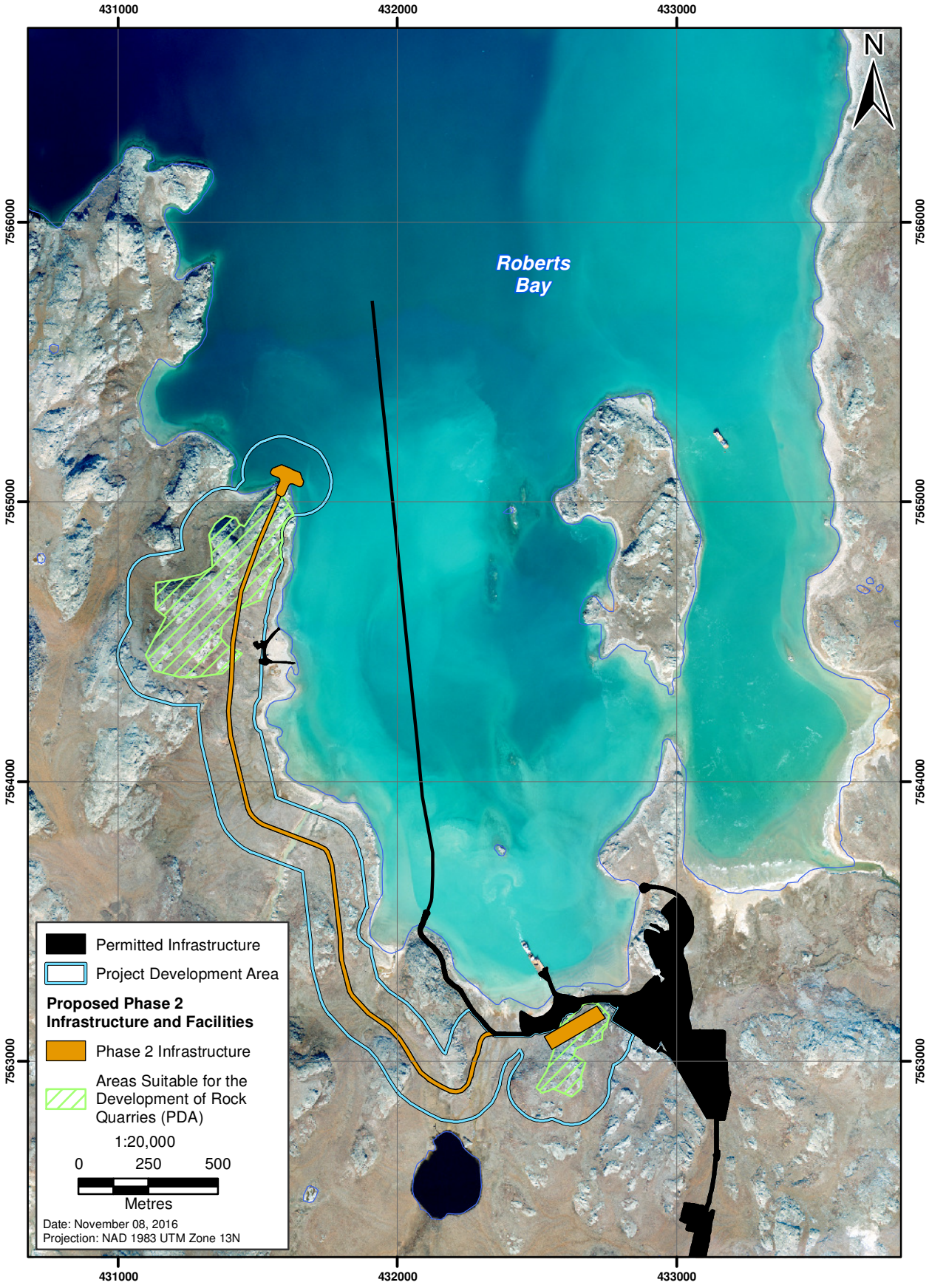

Figure 1.3
Madrid North Design Layout