MADRID-BOSTON PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

Table of Contents

List of Figures

FIGURE **PAGE**

List of Tables

TABLE **PAGE**

Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

BACI	Before-after-control-impact
BACT	Best Achievable Control Technology
CEA	Cumulative effects assessment
CEA Agency	Canadian Environmental Assessment Agency
CHARS	Canadian High Arctic Research Station
EIS	Environmental Effects Assessment
IQ	Inuit Qaujimajatuqangit
LSA	Local Study Area
MVEIRB	Mackenzie Valley Environmental Impact Review Board
NIRB	Nunavut Impact Review Board
NSA	Nunavut Settlement Area
RSA	Regional Study Area
TK	Traditional Knowledge
VEC	Valued Ecosystem Component
VSEC	Valued Socio-economic Component

4. Effects Assessment Methodology

4.1 INTRODUCTION

An effect is defined as any positive or negative change in the biophysical and/or socio-economic environment caused by, or directly related to, a former, on-going or proposed activity (NIRB 2007, 2013). This section describes the methodologies used to identify and assess the potential environmental and socio-economic effects of the proposed Madrid-Boston Project in a manner consistent with the requirements of Section 12.5.2 of the Nunavut Agreement and the Nunavut Impact Review Board (NIRB) Guidelines for the Preparation of an Environmental Impact Statement (EIS guidelines; NIRB 2012a) for Madrid-Boston Project.

This volume presents the assessment methodologies used for the:

- Project-related effects assessment;
- cumulative effects assessment; and
- transboundary effects assessment.

Methodologies specific to certain disciplines or environmental and socio-economic components are provided in their respective supporting sections.

4.2 INFORMATION SOURCES

4.2.1 Development of Methodologies

The primary source of guidance used to develop the assessment methodologies was *Guidelines for the Preparation of an Environmental Impact Statement for Hope Bay Mining Ltd.'s Phase 2 Hope Bay Belt Project* (NIRB 2012a).

Other documents from NIRB also provided guidance for writing and assembling the methodology:

- Guide 2 – Guide to Terminology and Definitions (NIRB 2007);
- Guide 5 - Guide to the NIRB Review Process (NIRB 2008);
- Guide 6a – Guide to NIRB's Public Awareness and Participation Programs: The Review Process (NIRB 2006a);
- Guide 6b – A Proponents Guide to Conducting Public Consultation for the NIRB Environmental Assessment Process (NIRB 2006b);
- Guide 7 – Guide to the Preparation of Environmental Impact Statements (NIRB 2006c); and
- Guide 8 – Project Monitoring (NIRB 2006d).

4.2.2 Baseline and Existing Environment Studies

Baseline studies were conducted prior to the initiation of activities for Approved Projects, including the Doris Project, that precede the proposed Madrid-Boston Project within the Hope Bay Greenstone Belt.

Existing environment studies have continued since the initiation of activities within the Hope Bay Greenstone Belt, the results of which were also used in the preparation of the EIS. The EIS Guidelines (NIRB; Section 7.4) describe existing environment studies as "available results of surveys and studies completed in the Project region by other developers, government agencies, organizations, institutions, regional authorities and individual researchers which may be related to the Project and the environment". The baseline and existing environment studies are conducted to:

- understand the local and regional area of the Madrid-Boston Project;
- identify potential environmental effects resulting from the Madrid-Boston Project components and activities;
- provide benchmarks for before-after-control-impact (BACI) approaches for evaluating the potential effects of the Madrid-Boston Project, as well as Madrid-Boston Project in combination with TMAC's other Approved Projects within the Hope Bay Greenstone Belt;
- characterize pre-disturbance conditions (baseline studies) for the purpose of reclamation activities; and
- support predictive modeling for effect analysis.

Baseline and existing environment studies followed a tiered approach, beginning with a desk-based review of available information, including information from government sources, scientific studies, and publically available information from other projects in the West Kitikmeot region of Nunavut.

The Hope Bay Property has a long history of site-specific studies. Comprehensive baseline field programs began in 1992. Table 4.2-1 summarizes the field baseline programs that have been conducted for various subject areas. Aside from these site-specific baseline and existing environment studies, Inuit Qaujimajatuqangit (IQ), government, and non-government and academic studies are drawn from to provide information. The references for these studies are provided within each subject section.

Table 4.2-1. Summary of Field-collected Baseline and Existing Environment Information for the Hope Bay Project

Assessment Subject Area and Component	VEC, VSEC, or Subject of Note[1]	Years of Available Data
Atmospheric Environment		
Air Quality	VEC	1996, 2003, 2009-2016
Noise and Vibration	VEC	2003, 2007, 2008, 2010
Meteorology and Climate	Subject of Note	1993 – 2005, 2006, 2009–2016
Terrestrial Environment		
Geology	Subject of Note	1993 – 1998, 2002, 2003, 2005 – 2009, 2011, 2013 – 2016
Geochemistry	Subject of Note	2008 – 2012
Permafrost and Ground Stability	Subject of Note	1996, 1997, 2002-2015
Landforms and Soils	Subject of Note	1995 - 1997, 1999, 2002 - 2008, 2010, 2014
Vegetation and Special Landscape Features	VEC	1997 - 2000, 2003, 2010, 2014
Caribou	VEC	1993 – 2017
Grizzly Bear	VEC	1994 – 2016
Muskox	VEC	1994 – 2016
Wolverine/Furbearers	VEC	1994 – 2007, 2010 – 2015

Assessment Subject Area and Component	VEC, VSEC, or Subject of Note[1]	Years of Available Data
Migratory Birds (Upland Birds and Waterfowl)	VEC	1994 – 2017
Raptors	VEC	1994-2007, 2009 – 2017
Freshwater Environment		
Hydrology	VEC	1993 – 2015
Groundwater	Subject of Note/VEC	2008, 2010 – 2012
Limnology and Bathymetry	Subject of Note	1993 – 1998, 2000, 2003 – 2017
Water Quality	VEC	1992 – 2000, 2003 – 2017
Sediment Quality	VEC	1993, 1996, 1997, 2002, 2007, 2009 – 2017
Fish/Aquatic Habitat	VEC	1993 - 1998, 2000 - 2007, 2009, 2010, 2014 – 2017
Fish Community	VEC	1993 - 1998, 2000 - 2007, 2009, 2010, 2014 – 2017
Marine Environment		
Physical Processes	Subject of Note	1997, 1998,2004 - 2007, 2009 – 2016
Water Quality	VEC	1996 – 1998, 2004 – 2016
Sediment Quality	VEC	1997, 2002, 2009 - 2016
Fish/Aquatic Habitat	VEC	1997 – 2014, 2017
Fish Community	VEC	2000 - 2007, 2009 – 2010, 2016, 2017
Seabirds/Seaducks	VEC	2000, 2006 – 2015
Ringed Seals	VEC	1996, 2000, 2006 – 2015
Human Environment		
Archaeology	VSEC	1995 – 1997, 2000, 2003 – 2015
Paleontological	Subject of Note	2012[2]
Non-traditional Land and Resource Use	VSEC	2011, 2017
Socio-economics	VEC	1996, 2001, 2011, 2017
Health, Safety, and Community Well-being	VSEC	2006, 2011, 2017
Subsistence Economy and Land Use	VSEC	2006, 2011, 2016, 2017
Country Foods/Human Health	VSEC	2006, 2011, 2017

[1] *VEC = Valued Ecosystem Component; VSEC = Valued Socio-economic Component*

[2] *Desktop study*

Detailed descriptions of available baseline information, as required in Section 7.3 of the EIS Guidelines (NIRB), for all Valued Ecosystem Components (VECs) and Valued Socio-economic Components (VSECs), and Subjects of Note are presented in each of the Supporting Volumes: *Volume 4: Atmospheric and Terrestrial Environments*; *Volume 5: Freshwater and Marine Environments*; *Volume 6: Human Environment*; and *Volume 7: Accidents and Malfunctions and Effects of the Environment on the Project*. The "Baseline Information" requirements outlined for each subject area in Section 8 of the EIS Guidelines (NIRB) are also provided in the supporting Volumes 4 through 7. A summary of this information is also provided in Section 4 of the Main Volume of the EIS.

4.2.3 Other Sources of Information

As specified in the EIS Guidelines (Section 7, Impact Assessment Methodology), *Volume 2: Traditional Knowledge, Public Consultation and Engagement and Assessment Methodologies* describes consultation and engagement activities with the public, Inuit organizations, and government. In addition, the same volume details the scope, methodology and results of a detailed report, *Inuit Traditional Knowledge for TMAC Resources Inc. Proposed Hope Bay Project, Naonaiyaotit Traditional Knowledge Project (NTKP)* generated by the Kitikmeot Inuit Association, Lands and Environment Department (Banci and Spicker 2016). The application of this information for the EIS is described in Volume 2, Section 2 (Traditional Knowledge) and Section 3 (Public Consultation and Engagement).

Each assessment section of the EIS describes the other sources of information that were used in the assessment.

4.3 PROJECT-RELATED EFFECTS ASSESSMENT METHODOLOGY

4.3.1 Objectives

The objectives of the Project-related effect assessment are to:

- identify potential effects resulting from the Madrid-Boston Project;
- apply mitigation measures to avoid, reduce, control, eliminate, offset, or compensate for potential effects;
- identify whether there are residual effects, either from the Madrid-Boston Project alone or in combination with the complete Hope Bay Project, that cannot be mitigated; and
- determine the significance of those residual effects.

4.3.2 Traditional Knowledge

Traditional Knowledge (TK) can be defined as a "accumulated body of knowledge, observations and understandings about the environment, and about the relationship of living beings with one another and with the environment, that is rooted in the traditional way of life of Inuit of the designated area" (NIRB 2014). For the purposes of the report, TK is treated as an inseparable part of IQ, which refers to "the traditional, current and evolving body of Inuit values, beliefs, experience, perceptions and knowledge regarding the environment, including land, water, wildlife and people, to the extent that people are part of the environment" (QIA 2009 in NIRB (2012b), vi).

TMAC recognizes the critical role TK plays in providing greater knowledge of the environment in which a development is proposed, and enhancing understanding of the potential impacts of that development. A report on regional Inuit Traditional Knowledge data from the Kitikmeot Inuit Association was used to inform all stages of the assessment (Banci and Spicker 2016). Each of the EIS's major subject areas incorporate TK in:

- existing environment and baseline studies;
- VEC or VSEC selection;
- establishment of spatial and temporal boundaries;
- effects assessment (Project-related, cumulative, and transboundary); and
- mitigation and adaptive management.

Each subject section starts with a discussion of the influence of TK on the assessment. Volume 2, Section 2 summarizes how TK information was used in the preparation of the EIS.

4.3.3 Establishing the Scope of the Effect Assessment

Issues scoping is fundamental to focusing the EIS on those issues where there is the greatest potential to cause significant adverse effects. In general terms, scoping defines the setting for the effects assessment and hence its applicability. Specifically, scoping defines a number of important elements including:

1. Components of the natural and human environment are identified on the basis of Inuit, public, regulator, or scientific concerns regarding their value and their potential to be affected by a human activity.
2. Project components or activities that are likely to interact with these components are defined.
3. Spatial and temporal boundaries for the assessment are determined based on the location and distribution of the components and the spatial extent of potential effects.

The scope of the assessment is based on the requirements of Section 12.5.2 of the Nunavut Agreement, NIRB's 10 Minimum EIS Requirements, and the Madrid-Boston Project Hope Bay Belt Project Proposal, submitted on December 21, 2011.

The scope of the EIS is determined as part of the NIRB process. NIRB consulted with the public and interested parties in the Kitikmeot Region and Yellowknife in October 2012 (as well as ongoing information and correspondence) to determine the scope of the EIS. A "Public Scoping Meetings Summary Report" was issued by NIRB in November of 2012 (NIRB 2012b), and the "Final Scope List for the NIRB's Assessment of the Madrid-Boston Project Hope Bay Belt Project" can be found as Appendix B in the EIS Guidelines (NIRB 2012b).

4.3.3.1 Selecting Valued Ecosystem Components and Valued Socio-economic Components

Valued Ecosystem Components and Socio-Economic Components

VECs and VSECs are, respectively, those components of the natural and human environment considered to be of scientific, ecological, economic, social, cultural, or heritage importance. VECs and VSECs may be identified on the basis of public or scientific concerns regarding their value and their potential to be affected by a human activity. The value of a component not only relates to its role in the ecosystem or in society, but also to the value placed on it by humans. Consideration of certain components may also be a legislated requirement, or known to be a concern because of previous project experience.

The formal definitions provided in the glossary of the Project EIS guidelines (NIRB 2012a) are as follows:

> *Valued Ecosystem Components: Those aspects of the environment considered to be of vital importance to a particular region or community, including:*
>
> *a) Resources that are either legally, politically, publically, or professionally recognized as important, such as parks, land selections, and historical sites;*
>
> *b) Resources that have ecological importance; and*
>
> *c) Resources that have social importance* (NIRB 2007).

> *Valued Socio-Economic Components (VSECs): Those aspects of the socio-economic environment considered to be of vital importance to a particular region or community, including components relating to the local economy, health, demographics, traditional way of life, cultural well-being, social life, archaeological resources, existing services and infrastructure, and community and local government organizations* (NIRB 2007).

Section 7.6 of the EIS Guidelines (NIRB) provides further information and requirements for the selection of VECs and VSECs for the EIS (NIRB 2012a). Sections 7.6.1 and 7.6.2 provide a comprehensive list of potential VECs and VSECs for consideration. Other information sources and processes also considered include:

- potential interaction with the proposed Project;
- available TK information;
- consultation with communities;
- consultation with regulatory agencies;
- regulatory considerations; and
- practicality of measuring and monitoring.

Table 4.3-1 presents the information used in the scoping process to determine the final VECs and VSECs for the EIS. It should be noted that all proposed VECs and VSECs from the EIS Guidelines (NIRB) are included in supporting the assessment sections, regardless of whether they were selected as VECs, VSECs or Subjects of Note (i.e., issues that emerged during scoping that are associated with lower potential consequences than VECs or VSECs, but are still considered and addressed in the EIS). An effects assessment was conducted for all selected VECs and VSECs, while Subjects of Note have all of the information required by the EIS Guidelines (NIRB).

Potential Interactions with Project

In order for a VEC or VSEC to be selected for further assessment, there must be a potential for that VEC/VSEC to interact with the proposed Project. For this interaction to occur there must be spatial and temporal overlap between the VEC/VSEC and the proposed Madrid-Boston Project. For example, for a wildlife species to be selected as a VEC, it must have a geographical distribution, such as a migration pattern, that overlaps with Madrid-Boston Project components and/or activities.

Traditional Knowledge

The results of the Banci and Spicker (2016) report were used for scoping and refining the potential VEC/VSEC list. This TK report presents summary information and clear maps of valued animal species, environmental components, and traditional land use activities. This information was used to identify valued components with the potential to interact with the proposed Madrid-Boston Project, which were then included in the VEC/VSEC list. While the Banci and Spicker (2016) report is not a comprehensive account of all TK or all valued components in the Kitikmeot Region, it does provide a valuable source of existing TK information.

Consultation with Communities

VECs and VSECs were also selected using input from public consultation activities conducted with regional communities. A description of consultation and engagement activities, as well key issues and information shared, is provided in Volume 2, Section 3 (Public Consultation and Engagement). Each subject area section specifically describes how the results of consultation with communities were considered in the selection of VECs/VSECs.

Table 4.3-1. Valued Ecosystem Component and Valued Socio-economic Component Scoping Process Information as Listed in EIS Guidelines (NIRB)

Subject Area	Potential VEC/VSEC Identified from EIS Guidelines (NIRB)	Potential Interaction with Project	Consultation with Communities[1] and TK Information[2]	Consultations with Regulatory Agencies[3] and Regulatory Considerations[4]	VEC, VSEC, or Other[5,6] within EIS	EIS Volume and Section
Atmospheric Environment	Air quality	Yes	Few or no comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	Atmospheric VEC – Ambient Air Quality	Volume 4, Section 2
	Climate and meteorology	Yes	Moderate to significant comments expressed	Few or no comments expressed Low regulatory considerations	Subject of Note *Climate change will be included in Individual Assessment Areas	Volume 4, Section 1
	Noise and vibration	Yes	Few or no comments expressed	Few or no comments expressed Moderate regulatory considerations	Atmospheric VEC - Noise and Vibration	Volume 4, Section 3
Terrestrial Environment	Terrestrial ecology	Yes	Moderate to significant comments expressed	Few or no comments expressed Low regulatory considerations	Included in Individual Assessment Areas	Volume 4, Sections 8 and 9
	Landforms and soils	No/Yes	Few or no comments expressed	Few or no comments expressed Low regulatory considerations	Subject of Note: Soils; Terrestrial VEC - Special Landscape Features	Volume 4, Sections 7 and 8
	Permafrost and ground stability	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Low regulatory considerations	Subject of Note: Permafrost	Volume 4, Section 6
	Geological Features (Geology and Geochemistry)	Yes	Few or no comments expressed	Few or no comments expressed Low regulatory considerations	Subjects of Note: Geology, Geochemistry	Volume 4, Sections 4 and 5
Freshwater Environment	Hydrological features/Water quantity	No/Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Subject of Note: Limnology and Bathymetry; Surface Hydrology VEC – Surface Water Quantity	Volume 5, Sections 1 and 3
	Hydrogeology	No	Few or no comments expressed	Few or no comments expressed Low regulatory considerations	Subject of Note: Groundwater	Volume 5, Section 2
	Groundwater quality	No	Moderate to significant comments expressed	Few or no comments expressed Low regulatory considerations	Subject of Note: Groundwater	Volume 5, Section 2
	Surface water quality	Yes	Moderate to significant comments expressed	Few or no comments expressed Moderate regulatory considerations	Freshwater VEC – Surface Water Quality	Volume 5, Section 4
	Sediment quality	Yes	Few or no comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Freshwater VEC - Sediment Quality	Volume 5, Section 5
	Aquatic ecology	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Included in Relevant Assessment Areas	Volume 5, Sections 4 to 6
	Aquatic biota: representative fish as defined in the *Fisheries Act*, benthic invertebrates, other aquatic organisms	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Included in Relevant Assessment Areas	Volume 5, Section 5 and 6
	Habitat including fish habitat as defined in the *Fisheries Act*	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Freshwater VEC - Fish Habitat	Volume 5, Section 6
	Commercial, recreational and Aboriginal fisheries as defined in the *Fisheries Act*	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Freshwater VEC - Arctic Grayling	Volume 5, Section 6
	Commercial, recreational and Aboriginal fisheries as defined in the *Fisheries Act*	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Freshwater VEC - Lake Trout	Volume 5, Section 6
	Commercial, recreational and Aboriginal fisheries as defined in the *Fisheries Act*	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Freshwater VEC – Arctic Char	Volume 5, Section 6
	Commercial, recreational and Aboriginal fisheries as defined in the *Fisheries Act*	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Freshwater VEC – Cisco/Whitefish	Volume 5, Section 6
Terrestrial Environment	Vegetation	Yes	Few or no comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	Terrestrial VEC - Vegetation	Volume 4, Section 8

Subject Area	Potential VEC/VSEC Identified from EIS Guidelines (NIRB)	Potential Interaction with Project	Consultation with Communities[1] and TK Information[2]	Consultations with Regulatory Agencies[3] and Regulatory Considerations[4]	VEC, VSEC, or Other[5,6] within EIS	EIS Volume and Section
Terrestrial Wildlife and Wildlife Habitat	Caribou	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Terrestrial Wildlife and Wildlife Habitat VEC – Caribou (Dolphin and Union (Island) Herd, Beverly/Ahiak Herd	Volume 4, Section 9
	Muskox	Yes	Moderate to significant comments expressed	Few or no comments expressed Moderate regulatory considerations	Terrestrial Wildlife and Wildlife Habitat VEC - Muskox	Volume 4, Section 9
	Wolverine	Yes	Moderate to significant comments expressed	Few or no comments expressed Moderate regulatory considerations	Terrestrial Wildlife and Wildlife Habitat VEC – Furbearers (Wolverine and Wolf)	Volume 4, Section 9
	Polar Bears	Yes	Moderate to significant comments expressed	Few or no comments expressed Moderate regulatory considerations	Scoped out of the assessment because they do not occur in the Terrestrial RSA	Volume 4, Section 9
	Brown Bears (brown and grizzly)	Yes	Moderate to significant comments expressed	Few or no comments expressed Moderate regulatory considerations	Terrestrial Wildlife and Wildlife Habitat VEC - Grizzly Bear	Volume 4, Section 9
	Wolves	Yes	Moderate to significant comments expressed	Few or no comments expressed Moderate regulatory considerations	Wolves will be addressed under the Terrestrial Wildlife and Wildlife Habitat VEC – Furbearers (Wolverine and Wolf)	Volume 4, Section 9
	Less conspicuous species that maybe be maximally exposed to contaminants	Yes	Moderate to significant comments expressed	Few or no comments expressedModerate regulatory considerations	Wildlife potentially impacted by environmental risks is assessed as part of the Environmental Risk Assessment	Volume 6, Section 5
	Raptors	Yes	Few or no comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	Terrestrial Wildlife and Wildlife Habitat VEC - Raptors	Volume 4, Section 9
	Birds and their habitat	Yes	Few or no comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Terrestrial Wildlife and Wildlife Habitat VEC – Waterbirds, Upland Birds, and Marine Birds	Volume 4, Section 9 Volume 5, Section 11
	Wildlife migration routes and crossings	Yes	Few or no comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Included in Terrestrial Wildlife and Wildlife Habitat VECs – Dolphin and Union (Island) Herd, Beverly/Ahiak Herd	Volume 4, Section 9
Marine Environment	Marine ecology	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	Included in Relevant Assessment Areas	Volume 5, Sections 8 to 11
	Marine water quality	Yes	Few or no comments expressed	Few or no comments expressed Moderate regulatory considerations	Marine VEC – Marine Water Quality	Volume 5, Section 8
	Marine sediment quality	Yes	Few or no comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	Marine VEC - Marine Sediment Quality	Volume 5, Section 9
	Marine biota including fish and species at risk	Yes	Few or no comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Included in Commercial, recreational and Aboriginal fisheries as defined in the *Fisheries Act* VEC	Volume 5, Section 10
	Marine habitat	Yes	Few or no comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Marine VEC - Fish Habitat	Volume 5, Section 10
	Commercial, recreational and Aboriginal fisheries as defined in the *Fisheries Act*	Yes	Few or no comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Marine VEC - Arctic Char (anadromous life history)	Volume 5, Section 10
	Commercial, recreational and Aboriginal fisheries as defined in the *Fisheries Act*	Yes	Few or no comments expressed	Moderate to significant comments expressed Significant regulatory considerations	Marine VEC - Saffron Cod	Volume 5, Section 10
Marine Wildlife	Marine mammals	Yes	Few or no comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	Marine Wildlife VEC – Ringed Seal	Volume 5, Section 11
	Marine species at risk	Yes	Few or no comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	To be discussed as potentially occurring species in Marine Fish Community and Marine Wildlife VECs	Volume 5, Sections 10 and 11

Subject Area	Potential VEC/VSEC Identified from EIS Guidelines (NIRB)	Potential Interaction with Project	Consultation with Communities[1] and TK Information[2]	Consultations with Regulatory Agencies[3] and Regulatory Considerations[4]	VEC, VSEC, or Other[5,6] within EIS	EIS Volume and Section
Socio-Economic Environment	Economic development and opportunities	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Low regulatory considerations	Socio-Economic VSEC - Economic Development	Volume 6, Section 3
	Employment	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Low regulatory considerations	Socio-Economic VSEC - Employment	Volume 6, Section 3
	Education and training	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Low regulatory considerations	Socio-Economic VSEC - Education and Training	Volume 6, Section 3
	Contracting and business opportunities	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Low regulatory considerations	Socio-Economic VSEC - Business Opportunities	Volume 6, Section 3
	Population demographics	No	Few or no comments expressed	Moderate to significant comments expressed Low regulatory considerations	Subject of Note	Volume 6, Section 3
Traditional Activity and Knowledge	Land use and mobility	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	Land Use VSEC – Traditional Activities and Knowledge	Volume 6, Section 4
	Food security	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	Land Use VSEC - Traditional Activities and Knowledge	Volume 6, Section 4
	Language	No	Few or no comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	Subject of Note	Volume 6, Section 3
	Cultural and community harvesting	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Moderate regulatory considerations	Land Use VSEC – Traditional Activities and Knowledge	Volume 6, Section 4
Land Use	Non-traditional land use and resource use	Yes	Few or no comments expressed	Few or no comments expressed Moderate regulatory considerations	Land Use VSEC – Commercial Land and Resource Use	Volume 6, Section 4
Heritage Resources	Archaeology	Yes	Moderate to significant comments expressed	Few or no comments expressed Moderate regulatory considerations	Archaeology VSEC – Archaeological Sites	Volume 6, Section 2
	Palaeontology	No	Few or no comments expressed	Few or no comments expressed Low regulatory considerations	Subject of Note	Volume 6, Section 1
	Cultural resources	Yes	Moderate to significant comments expressed	Few or no comments expressed Moderate regulatory considerations	Archaeology VSEC – Archaeological Sites	Volume 6, Section 2
Health and Well-being	Individual and community wellness	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Low regulatory considerations	Socio-economic VSEC - Community Health and well-being	Volume 6, Section 3
	Family and community cohesion	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Low regulatory considerations	Socio-economic VSEC - Community Health and Well-being	Volume 6, Section 3
	Potential indirect effects of Project on frequency and types of crime incidents	Yes	Few or no comments expressed	Moderate to significant comments expressed Low regulatory considerations	Socio-economic VSEC - Community Health and Well-being	Volume 6, Section 3
	Health and safety including employee and public safety	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Low regulatory considerations	Human health and safety as potentially impacted by environmental risks is assessed as part of the Human Health Risk Assessment	Volume 6, Section 5
Community Infrastructure	Community infrastructure and public service, including housing	Yes	Moderate to significant comments expressed	Moderate to significant comments expressed Low regulatory considerations	Socio-economic VSEC - Migration, Housing, and Infrastructure and Services	Volume 6, Section 3

Notes:
1. Community consultation information reflects information from Hope Bay Project consultations up to November 15, 2017.
2. TK Information refers to the contents of the Inuit Traditional Knowledge for TMAC Resources Inc. Proposed Hope Bay Project, Naonaiyaotit Traditional Knowledge Project (NTKP) (Banci and Spicker 2016).
3. Government engagement information reflects information from Hope Bay Project consultations up to November 15, 20167
4. Regulatory considerations are a high level view of the legislation in place to address potential impacts.
5. Table entries labelled as "Included in Individual Assessment Areas" refer to topics that will be addressed in context, within one or more other assessments
6. Table entries labelled as "Subject of Note" refer to unique topics addressed as a subsection within a specific assessment.

Consultation with Regulatory Agencies

TMAC has consulted regularly and on a routine basis with regulatory agencies since acquisition of the Hope Bay Project in 2013, and over the last two years engagement has included focused discussions on VECs and VSECs, potential interactions and Project effects, and mitigation and management measures to be implemented for the proposed Boston-Madrid Project. Early discussions with regulators were important in refining and confirming VECs and VSECs. The federal Northern Project Management Office coordinated a Regional Development Advisory Group, which provides a venue for regulators to advise on the Project. Consultation has also occurred during the more formal NIRB-hosted review process activities, in particular during the EIS Guideline development and comment period, as well as through Working Group meetings, and various one-on-one discussions with specific GN and federal departments and agencies to discuss discipline-specific topics of interest.

Regulatory Considerations

Legislation and regulation exist to protect a number of potential VECs. For example, important fish species in the region were selected as VECs, as the protection of these fisheries will be regulated under Section 35 of the *Fisheries Act* (1985). As well, water quality was selected as a VEC, as protection of water quality will be considered under multiple regulations, including the Metal Mining Effluent Regulations. Migratory birds—including shorebirds, upland birds, and seabirds—were also selected as VECs, as migratory birds are subject to the *Migratory Birds Convention Act* (1994). Whether an organism was federally or otherwise listed as a species at risk was considered when selecting the wildlife VECs (including birds). The applicable regulations considerations for selection of VECs are detailed in each subject area section.

Practicality of Measuring and Monitoring

In addition to all of the scoping methods described above, it is important that a VEC or VSEC can be measured and/or monitored. Clear cause-effect pathways that are measureable must exist (i.e., there is an understood relationship between the proximal cause of an effect and its receptor) so that an accurate characterization of the Madrid-Boston Project direct and indirect effects on a VEC or VSEC can be made. In addition, adequate data and analytical tools must be available to measure potential effects.

Some potential VECs/VSECs represent broad subject areas, and to accurately predict the potential effects of the Madrid-Boston Project on the VEC/VSEC, it is necessary to focus on specific sub-components of the VEC/VESC. Information being collected in the West Kitikmeot as part of government monitoring programs or other regional initiatives was also taken into consideration, to try and align the VEC/VSECs with these programs as much as possible to provide the most robust future monitoring programs for Madrid-Boston Project.

4.3.3.2 Assessment Boundaries

For the Project-related effects assessment, distinct spatial boundaries are defined for each VEC/VSEC. These boundaries are described in detail in Volumes 4 to 7 (*Volume 4: Atmospheric and Terrestrial Environments*; *Volume 5: Freshwater and Marine Environments*; *Volume 6: Human Environment*; and *Volume 7: Effects of the Environment on the Project and Accidents and Malfunctions*). Spatial and temporal boundaries define the maximum limit within which the environmental assessment is conducted.

Temporal boundaries are defined for each Madrid-Boston Project phase. Details on the schedule of Madrid-Boston Project, including the planned timing of construction, operation, and reclamation and closure activities, can be found in *Volume 2: Project Description and Alternatives*. Distinct phases are defined for the purposes of the EIS as described below.

Spatial Boundaries

As specified in Section 7.5.1 of the EIS Guidelines (NIRB), spatial boundaries for the Project-related effects assessment were determined on the basis of the following criteria:

- the physical or socio-economic extent of Project activities;
- the extent of ecosystems potentially affected by Madrid-Boston Project;
- the extent to which traditional and contemporary land and resource use, including protected areas, and other harvesting activities could potentially be affected by Madrid-Boston Project; and
- the size, nature and location of past, present, and reasonably foreseeable projects and activities which could interact with the items listed above (NIRB 2012a).

The following general spatial boundaries are used in the EIS:

- **Project Development Area (PDA) –** The PDA is shown is defined as the area which has the potential for infrastructure to be developed as part of the Madrid-Boston Project. The PDA includes engineering buffers around the footprints of structures. These buffers allow for latitude in the final placement of a structure through later design and construction phases, reflecting the certainty of design and construction. Compounds with buildings and other infrastructure in close proximity are defined as pads with buffers whereas roads are defined as linear corridors with buffers. The buffers for pads varied depending on the local physiography and other buffered features such as sensitive environments or riparian areas. The average engineering buffer for roads is 100 m either side.
- **Local Study Area (LSA) –** The LSA includes the Project footprint area plus additional area depending on the VEC/VSEC. The LSA is defined as the PDA and the area surrounding the PDA within which there is a reasonable potential for immediate effects on a VEC/VSEC due to an interaction with a Madrid-Boston Project component or physical activity, including ongoing normal activities and possible abnormal operating conditions.
- **Regional Study Area (RSA) –** The RSA includes the LSA plus additional area depending on the VEC/VSEC. The RSA is defined as the broader spatial area representing the maximum limit where potential direct or indirect effects, or cumulative effects, may occur.

The specific LSAs and RSAs for each VEC and VSEC are provided as maps in Volumes 4 through 7 (*Volume 4: Atmospheric and Terrestrial Environments*; *Volume 5: Freshwater and Marine Environments*; *Volume 6: Human Environment*; and *Volume 7: Effects of the Environment on the Project* and *Accidents and Malfunctions*). Additional information for each study area specific to each VEC and VSEC is also provided in Volumes 4 through 7.

Temporal Boundaries

The Hope Bay Project integrates a series of the components and activities of four sites over the life of mine (LOM). Construction and operation activities on some sites are required to precede construction and operation on other sites. Similarly, closure and post-closure activities on some sites will start prior to the finish of operations on other sites. The planned Madrid-Boston Project timeline is presented in Volume 2, Section 2 (Project Description).

For the purposes of the EIS, distinct phases of the Project are defined (Table 4.3-2). It is understood that construction, operation and closure activities will, in fact, overlap among sites.

Table 4.3-2. Temporal Boundaries for the Effects Assessment

Phase	Project Year	Calendar Year	Length of Phase (Years)	Description of Activities
Construction	1 - 4	2019 - 2022	4	Roberts Bay: construction of access road (Year 1), marine dock and additional fuel facilities (Year 2 – Year 3); Doris: expansion of the Doris TIA and accommodation facility (Year 1); Madrid North: construction of concentrator and road to Doris TIA (Year 1 – Year 2); All-weather Road: construction (Year 1 – Year 3); Boston: site preparation and installation of all infrastructures including process plant (Year 2 – Year 5).
Operation	5 - 14	2023 - 2032	10	Roberts Bay: shipping operations (Year 1 – Year 14) Doris: processing and infrastructure use (Year 1 – Year 14); Madrid North: mining (Year 1 – 13); ore transport to Doris process plant (Year 1 -13); ore processing and concentrate transport to Doris process plant (Year 2 – Year 13); Madrid South: mining (Year 11 – Year 14); ore transport to Doris process plant (Year 11 – Year 14); All-weather Road: operational (Year 4 – Year 14); Boston: winter access road operating (Year 1 – Year 3); mining (Year 4 – Year 11); ore transport to Doris process plant (Year 4 – Year 6); and processing ore (Year 5 – Year 11).
Reclamation and Closure	15 - 17	2033 - 2035	3	Roberts Bay: facilities will be operational during closure (Year 15 – Year 17); Doris: camp and facilities will be operational during closure (Year 15 – Year 17); mine, process plant, and TIA decommissioning (Year 15 – Year 17); Madrid North: all components decommissioned (Year 15 – Year 17); Madrid South: all components decommissioned (Year 15 – Year 17); All-weather Road: road will be operational (Year 15 – Year 16); decommissioning (Year 17); Boston: all components decommissioned (Year 15 – Year 17).
Post-Closure	18 - 22	2036 - 2040	5	All Sites: Post-closure monitoring.
Temporary Closure	NA	NA	NA	All Sites: Care and maintenance activities, generally consisting of closing down operations, securing infrastructure, removing surplus equipment and supplies, and implementing on-going monitoring and site maintenance activities.

The assessment also considers a Temporary Closure phase should there be a suspension of Madrid-Boston Project activities during periods when Phase 2 becomes uneconomical due to market conditions. During this phase, the Madrid-Boston Project would be under care and maintenance. This could occur in any year of Construction or Operation with an indeterminate length (one to two year duration would be typical).

The temporal boundaries for each VEC and VESC were defined in relation to planned activities over the lifetime of the Project within which a reasonable expectation of interaction with environmental or socio-economic components can be predicted. These were adjusted as appropriate to reflect seasonal variations or life-cycle requirements of biological receptors, or forecasted trends in socio-economic receptors.

As required in Section 7.5.2 of the NIRB's Project EIS Guidelines, a rationale and justification for the spatial boundaries used for each VEC and VSEC is provided in Volumes 4 through 7 (*Volume 4: Atmospheric and Terrestrial Environments*; *Volume 5: Freshwater and Marine Environments*; *Volume 6: Human Environment*; and *Volume 7: Effects of the Environment on the Project and Accidents and Malfunctions*; NIRB 2012).

4.3.4 Effects Assessment Methodology

The EIS Guidelines (2015) state that the EIS shall assess the direct, indirect, short-term, and long term effects of the Madrid-Boston Project on the biophysical and socio-economic environments, and the interactions between them, focusing on the anticipated response of the VECs and VSECs.

In addition, Section 7.9 of the EIS Guidelines indicates that the following information should be presented in any effect predictions:

- Explain how scientific, engineering, community and TK was used.
- Document model assumptions, study methodologies and sensitivity analyses.
- Document data collection methods and limitations thereof.
- Support analyses, interpretation of results and conclusions with reference to appropriate literature.
- Describe how uncertainty in effect predictions have been dealt with.
- Specify and reference sources for any contributions based on TK.
- Identify which studies included the assistance of communities and individuals, who was involved (if the information can be made public), and how participants were selected.
- Identify all proposed mitigation measures and adaptive management strategies if applicable.
- Describe the potential residual effects and explain their significance.

The above information is included in the detailed Project-related effects assessment section for each topic area section of Volumes 4 through 7 (*Volume 4: Atmospheric and Terrestrial Environments*; *Volume 5: Freshwater and Marine Environments*; *Volume 6: Human Environment*; and *Volume 7: Effects of the Environment on the Project* and *Accidents and Malfunctions*).

The effect assessment process comprises a number of steps that collectively assess the manner in which the Madrid-Boston Project will interact with elements of the atmospheric, terrestrial, freshwater, marine or human environment to produce effects to the VECs and VSECs.

To provide a comprehensive understanding of the potential effects, the Boston-Madrid components and activities are assessed on their own as well as in the context the Existing and Approved Projects within the Hope Bay Greenstone Belt. The Existing and Approved Projects comprise of the Doris Project, the Hope Bay Regional Exploration Project, the Madrid Advanced Exploration Program, and the Boston Advanced Exploration Project. The effects assessment process is summarized as follows:

1. Identify potential interactions between the Madrid-Boston Project and the VECs/VSECs.
2. Identify the resulting potential effects of those interactions.
3. Identify mitigation or management measures to eliminate or reduce the potential effects.
4. Identify residual effects (potential effects that would remain after mitigation and management measures have been applied) for Madrid-Boston Project in isolation.
5. Identify residual effects of Madrid-Boston Project in combination with the residual effects of Existing and Approved Projects.
6. Determine the significance of residual effects.

4.3.4.1 Identify Potential Interactions and Potential Effects

The first step is to identify the potential interactions between Madrid-Boston Project and the VECs/VSECs. Table 4.3-3 presents a matrix of the Project activities and components by phase pivoted against the VECs/VSECs. This matrix was completed based on professional judgement and experience with similar projects in Nunavut and the Northwest Territories.

Following the identification of interactions with the Madrid-Boston Project, the potential effects associated with each interaction are identified. Statements of each potential effect interacting with each VEC/VSEC to be assessed are provided. Relevant concerns related to interactions with Phase 2 components and activities or potential effects that were raised by stakeholders and government agencies are considered in defining VECs/VSECs and potential effects.

4.3.4.2 Identification of Mitigation and Management Measures

Mitigation measures involve taking tangible actions to avoid, minimize, restore on-site, or offset effects on VECs/VSECs resulting from a component or activity. Mitigation measures are supplemented by the use of additional considerations, for example considering alternative siting locations, changes in project design, or best management practices. Mitigation measures that are recommended for use to reduce an adverse effect are considered to be technically, environmentally, and economically feasible.

Key approaches to avoid, reduce, control, eliminate, offset, or compensate potential effects include:

- **Optimizing Alternatives:** Preventing or reducing adverse environmental effects by changing an aspect of the Madrid-Boston Project.
- **Design Changes:** Preventing or reducing adverse environmental effects by redesigning aspects of the Madrid-Boston Project.
- **Best Achievable Control Technology (BACT):** Eliminating, minimizing, controlling, or reducing adverse effects through the use of proven and economically achievable technological applications.
- **Management Practices:** Eliminating, minimizing, controlling, or reducing adverse effects on VECs and VSECs through management practices.
- **Follow-Up Monitoring and Adaptive Management:** Monitoring the implementation of mitigation measures where uncertainty exists, and adjusting mitigation based on monitoring results.
- **Compensation:** Offsetting remaining effects that cannot be prevented or reduced through remedial or compensatory actions, so that the net effect on the community or ecosystem is neutral or beneficial.

- **Enhancement:** Providing measures to enhance a beneficial effect. Enhancement generally applies to socio-economic effects.

For each of the VECs/VSECs, the assessment section describes how mitigation or management measures eliminate or reduce potential negative interactions with Madrid-Boston Project. The measures included in Volumes 4 through 7 have been shown to work in other similar situations in the Arctic. TMAC intends to implement these mitigation measures and to use adaptive management approaches to prevent adverse effects.

4.3.4.3 Characterization of Potential Effects

The next step is to characterize the potential effects that would result from these interactions, following the application of identified mitigation. It is important to note that in addition to mitigation, the prediction of effect takes into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design).

Prediction of effects is an objective exercise to determine what could potentially happen as a result of the Madrid-Boston Project's interaction with the VECs/VSECs. Methods to characterize and predict potential effects include quantitative, semi-quantitative and qualitative techniques. Some VECs/VSECs apply predictive modeling to characterize and forecast aspects of the interactions. For this EIS, predictive modeling included:

- Climate Change Analysis Report, Hope Bay Project (Appendix V3-2A);
- Madrid-Boston Air Quality Modeling Study (Appendix V4-2I);
- Environmental Noise and Vibration Study Report (Appendix V4-3A);
- Madrid-Boston Project Water and Load Balance, Hope Bay Project (Volume 1, Annex V1-7, Package P5-4);
- Madrid-Boston Project: Economic Impact Model Report (Appendix V6-3C); and
- Human Health and Environmental Risk Assessment (Volume 6, Chapter 5).

A detailed discussion and description is provided of each potential effect, organized by 1) VEC/VSEC, 2) potential effect for the given VEC/VSEC, for both Madrid-Boston Project in isolation, and then for the combined Hope Bay Project. For each potential effect assessed, a clear determination is provided whether or not there is a residual effect.

4.3.4.4 Characterization of Residual Effects

If the implementation of mitigation measures completely eliminates a potential effect, then the effect is not carried forward, and no additional analysis is undertaken. However, if the proposed mitigation measure(s) are not sufficient to eliminate a potential effect, a residual effect is identified and carried forward for additional characterization and a significance determination. Residual effects can occur directly or indirectly (potential cumulative effects are addressed separately). Direct effects result from specific interactions between Project activities and components, and VECs or VSECs. Indirect effects are the result of direct effects on the environment that lead to secondary or collateral effects on VECs or VSECs.

To determine the significance of a residual effect, each potential negative residual effect is characterized by a number of attributes consistent with those defined in Section 7.14 of NIRB's EIS Guidelines. A definition for each attribute and the contribution that it has on significance determination is provided in Table 4.3-4.

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Atmospheric Environment			Freshwater Environment									Marine Environment						
		Air Quality	Noise and Vibration	Climate and Meteorology	Surface Water Quantity	Hydrogeology	Surface Water Quality	Sediment Quality	Fish Habitat	Arctic grayling	Lake trout	Arctic char (freshwater life history)	Cisco/Whitefish	Water Quality	Sediment Quality	Aquatic and Fish Marine Habitat	Arctic Char (marine life history)	Saffron Cod	Seabirds	Marine Mammals including Species at Risk
PROJECT COMPONENTS AND ACTIVITIES																				
Roberts Bay																				
1	**Construction - proposed Phase 2 infrastructure**																			
1.01	Cargo dock	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.02	Dock access road	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.03	Fuel pipeline and tank farm	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.04	Marine transport of goods	X		X										X	X	X	X	X	X	X
1.05	Quarry	X	X	X										X	X	X	X	X	X	X
2	**Construction and Operation - use of existing approved and permitted infrastructure**																			
2.01	Fuel tank farm	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X
2.02	Laydown areas	X		X			X	X	X	X	X	X	X	X	X	X	X	X		
2.03	Machine and vehicle emissions	X	X	X																
2.04	Marine discharge for TIA water				X									X	X	X	X	X	X	X
2.05	Marine transport of goods	X		X										X	X	X	X	X	X	X
2.06	Roberts Bay - Doris road use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
2.07	Site roads use and maintenance	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
2.08	Water management system				X	X	X	X	X	X	X	X	X							
3	**Operation - proposed Phase 2 infrastructure**																			
3.01	Cargo dock		X											X	X	X	X	X	X	X
3.02	Use of dock access road	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.03	Fuel pipeline and tank farm	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.04	Marine transport of goods	X		X										X	X	X	X	X	X	X
3.05	Quarry	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	**Reclamation and Closure - use of existing approved and permitted infrastructure**																			
4.01	Site surface infrastructure	X	X	X	X		X	X	X	X	X	X	X	X	X					
4.02	Machine and vehicle emissions	X	X	X																
4.03	Roberts Bay - Doris road	X	X		X		X	X	X	X	X	X	X							
4.04	Marine infrastructure	X	X	X										X	X	X	X	X	X	X
4.05	Marine transport of goods	X		X										X	X	X	X	X	X	X
5	**Reclamation and Closure - proposed Phase 2 infrastructure**																			
5.01	Site surface infrastructure	X	X				X	X	X	X	X	X	X	X	X					
5.02	Machine and vehicle emissions	X	X	X																
5.03	Dock access road	X	X				X	X	X	X	X	X	X	X	X	X	X	X		
5.04	Dock and associated marine infrastructure	X	X											X	X	X	X	X	X	X
5.05	Marine transport of goods	X		X										X	X	X	X	X	X	X
5.06	Quarry	X	X	X			X	X	X	X	X	X	X							
6	**Post Closure - proposed Phase 2 infrastructure**																			
6.01	Post closure monitoring	X		X	X				X	X	X	X	X			X	X	X	X	X
7	**Temporary Closure**																			
7.01	Care and maintenance	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Atmospheric Environment			Freshwater Environment									Marine Environment						
		Air Quality	Noise and Vibration	Climate and Meteorology	Surface Water Quantity	Hydrogeology	Surface Water Quality	Sediment Quality	Fish Habitat	Arctic grayling	Lake trout	Arctic char (freshwater life history)	Cisco/Whitefish	Water Quality	Sediment Quality	Aquatic and Fish Marine Habitat	Arctic Char (marine life history)	Saffron Cod	Seabirds	Marine Mammals including Species at Risk
Doris																				
1	**Construction - proposed Phase 2 infrastructure**																			
1.01	Expansion of Project Development Area						X	X												
1.02	Expansion of camp (280 person capacity, expanded to 400 person capacity)	X		X	X		X	X	X	X	X	X	X							
1.03	Machine and vehicle emissions	X	X	X																
1.04	Quarry	X	X	X			X	X	X	X	X	X	X							
1.05	Raising the TIA South Dam	X	X	X	X		X	X												
1.06	TIA perimeter road extensions	X	X	X			X	X												
1.07	TIA West Dam	X	X	X	X		X	X												
1.08	Road to TIA South Dam	X		X			X	X	X	X	X	X	X							
2	**Operation - use of existing approved and permitted infrastructure**																			
2.01	Airstrip, winter ice strip and helicopter pad	X	X	X			X	X												
2.02	Camp	X		X																
2.03	Camp facilities (sewage treatment facilities, potable water treatment, fire suppression)			X			X	X	X	X	X	X	X							
2.04	Chemical and hazardous material management facilities						X	X	X	X	X	X	X							
2.05	Diesel Power Plant	X	X	X																
2.06	Fuel storage and handling	X	X	X			X	X	X	X	X	X	X							
2.07	Incinerator	X	X	X			X	X	X	X	X	X	X							
2.08	Machine and vehicle emissions	X	X	X																
2.09	Mill	X	X	X																
2.10	Ore stockpile	X	X		X		X	X	X	X	X	X	X							
2.11	Site roads use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
2.12	Storage and handling of explosives						X	X	X	X	X	X	X							
2.13	Surface infrastructure (maintenance facilities, warehouses, laydown areas, waste management facilities)	X	X	X			X	X	X	X	X	X	X							
2.14	Water discharge to the receiving environment				X		X	X	X	X	X	X	X							
2.15	Water management system				X	X	X	X	X	X	X	X	X							
2.16	Water use from Doris Lake				X				X	X	X	X	X							
2.17	Water use from Windy Lake				X				X	X	X	X	X							
3	**Operation - proposed Phase 2 infrastructure**																			
3.01	Expanded Project Development Area		X				X	X												
3.02	Camp (expanded)	X		X			X	X												
3.03	Quarry	X	X	X			X	X	X	X	X	X	X							
3.04	TIA road use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
3.05	TIA storage	X			X		X	X												
4	**Reclamation and Closure - use of existing approved and permitted infrastructure**																			
4.01	Machine and vehicle emissions	X	X	X																
4.02	Site surface and mining infrastructure	X	X	X	X	X	X	X	X	X	X	X	X							
4.03	Airstrip	X	X	X			X	X	X	X	X	X	X							
5	**Reclamation and Closure - proposed Phase 2 infrastructure**																			
5.01	Machine and vehicle emissions	X	X	X																
5.02	Camp (expanded)	X		X			X	X												
5.03	Quarry	X	X	X			X	X	X	X	X	X	X							
5.04	TIA roads (perimeter and South Dam)	X	X	X	X		X	X	X	X	X	X	X							
5.05	TIA	X	X	X	X		X	X	X	X	X	X	X							

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Atmospheric Environment			Freshwater Environment									Marine Environment						
		Air Quality	Noise and Vibration	Climate and Meteorology	Surface Water Quantity	Hydrogeology	Surface Water Quality	Sediment Quality	Fish Habitat	Arctic grayling	Lake trout	Arctic char (freshwater life history)	Cisco/Whitefish	Water Quality	Sediment Quality	Aquatic and Fish Marine Habitat	Arctic Char (marine life history)	Saffron Cod	Seabirds	Marine Mammals including Species at Risk
6	**Post Closure - proposed Phase 2 infrastructure**																			
6.01	Post closure monitoring	X		X	X				X	X	X	X	X							
7	**Temporary Closure**																			
7.01	Care and maintenance	X		X			X	X	X	X	X	X	X							
Madrid North																				
1	**Construction - use of existing approved and permitted infrastructure**																			
1.01	Air heating facility	X	X	X			X	X												
1.02	Brine mixing facility	X	X	X			X	X												
1.03	Diesel power plant	X	X	X																
1.04	Fuel storage and handling	X	X	X			X	X	X	X	X	X	X							
1.05	Machine and vehicle emissions	X	X	X																
1.06	Ore stockpile	X	X				X	X	X	X	X	X	X							
1.07	Quarry	X	X	X			X	X	X	X	X	X	X							
1.08	Site roads	X	X	X	X		X	X	X	X	X	X	X							
1.09	Surface infrastructure (shop, compressor building, laydown area, office, emergency shelter)	X	X				X	X	X	X	X	X	X							
1.10	Underground mine (drilling, blasting, excavation, ventilation)	X		X			X	X												
1.11	Waste rock pile	X	X				X	X	X	X	X	X	X							
1.12	Water management system	X					X	X	X	X	X	X	X							
2	**Construction - proposed Phase 2 infrastructure**																			
2.01	Expansion of Project Development Area						X	X												
2.02	Expansion of site pad (waste rock stockpile)	X	X	X			X	X	X	X	X	X	X							
2.03	Process plant (concentrator)	X	X	X			X	X												
2.04	Power plant	X	X	X			X	X												
2.05	Water discharge to the receiving environment				X		X	X	X	X	X	X	X							
2.06	Water management system (including expanded CWP)	X			X	X	X	X	X	X	X	X	X							
3	**Operation - use of existing approved and permitted infrastructure**																			
3.01	Air heating facility	X	X	X			X													
3.02	Brine mixing facility		X	X			X													
3.03	Diesel Power Plant	X	X	X																
3.04	Disposal of each-circuit tailings with underground backfill					X														
3.05	Doris - Madrid road use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
3.06	Fuel storage and handling	X	X	X			X	X	X	X	X	X	X							
3.07	Machine and vehicle emissions	X	X	X																
3.08	Madrid North access road use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
3.09	Ore stockpile	X	X	X	X		X	X	X	X	X	X	X							
3.10	Quarry	X	X	X			X	X	X	X	X	X	X							
3.11	Site roads use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
3.12	Surface infrastructure (shop, compressor building, laydown area, office, emergency shelter)	X	X	X			X	X	X	X	X	X	X							
3.13	Underground mine (drilling, blasting, excavation, ventilation)	X		X		X	X													
3.14	Waste rock pile	X	X	X	X		X	X	X	X	X	X	X							
3.15	Water management system						X	X	X	X	X	X	X							
4	**Operation - proposed Phase 2 infrastructure**																			
4.01	Expansion of Project Development Area																			
4.02	Process plant (concentrator)	X	X	X																

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Atmospheric Environment			Freshwater Environment									Marine Environment						
		Air Quality	Noise and Vibration	Climate and Meteorology	Surface Water Quantity	Hydrogeology	Surface Water Quality	Sediment Quality	Fish Habitat	Arctic grayling	Lake trout	Arctic char (freshwater life history)	Cisco/Whitefish	Water Quality	Sediment Quality	Aquatic and Fish Marine Habitat	Arctic Char (marine life history)	Saffron Cod	Seabirds	Marine Mammals including Species at Risk
4.03	Power plant	X	X	X																
4.04	Water discharge to the receiving environment				X		X	X	X	X	X	X	X							
4.05	Water management system (including CWP)				X	X	X	X	X	X	X	X	X							
5	**Reclamation and Closure - proposed Phase 2 infrastructure**																			
5.01	Inter-site roads	X	X	X	X		X	X	X	X	X	X	X							
5.02	Machine and vehicle emissions	X	X	X																
5.03	Site surface and mining infrastructure	X	X	X	X	X	X	X	X	X	X	X	X							
6	**Post Closure - proposed Phase 2 infrastructure**																			
6.01	Post closure monitoring	X			X		X	X	X	X	X	X	X							
7	**Temporary Closure**																			
7.01	Care and maintenance	X							X	X	X	X	X							
Madrid South																				
1	**Construction - use of existing approved and permitted infrastructure**																			
1.01	Air heating facility	X	X	X			X	X												
1.02	Brine mixing facility	X	X	X			X	X												
1.03	Diesel Power Plant	X	X	X																
1.04	Fuel storage and handling	X	X	X			X	X	X	X	X	X	X							
1.05	Machine and vehicle emissions	X	X	X																
1.06	Ore stockpile	X	X	X			X	X	X	X	X	X	X							
1.07	Quarry	X	X	X			X	X	X	X	X	X	X							
1.08	Site roads	X	X	X	X		X	X	X	X	X	X	X							
1.09	Surface infrastructure (shop, compressor building, laydown area, office, emergency shelter)	X	X	X			X	X	X	X	X	X	X							
1.10	Underground mine (drilling, blasting, excavation, ventilation)	X		X		X	X	X												
1.11	Waste rock pile	X	X	X			X	X	X	X	X	X	X							
1.12	Water management system	X			X	X	X	X	X	X	X	X	X							
2	**Construction - proposed Phase 2 infrastructure**																			
2.01	Expansion of Project Development Area						X	X												
2.02	Expansion of site pad (waste rock stockpile)	X	X	X			X	X	X	X	X	X	X							
2.03	Water discharge to the receiving environment				X		X	X	X	X	X	X	X							
2.04	Water management system (including expanded CWP)	X			X	X	X	X	X	X	X	X	X							
3	**Operation - use of existing approved and permitted infrastructure**																			
3.01	Air heating facility	X	X	X			X													
3.02	Brine mixing facility		X	X			X													
3.03	Diesel Power Plant	X	X	X																
3.04	Doris - Madrid road use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
3.05	Fuel storage and handling	X	X	X			X	X	X	X	X	X	X							
3.06	Machine and vehicle emissions	X	X	X																
3.07	Ore stockpile	X	X	X	X		X	X	X	X	X	X	X							
3.08	Quarry	X	X	X			X	X	X	X	X	X	X							
3.09	Site roads use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
3.10	Surface infrastructure (shop, compressor building, laydown area, office, emergency shelter)	X	X	X			X	X	X	X	X	X	X							
3.11	Underground mine (drilling, blasting, excavation, ventilation)	X		X		X	X													
3.12	Waste rock pile	X	X	X	X		X	X	X	X	X	X	X							
3.13	Water management system - Type B licence				X	X	X	X	X	X	X	X	X							

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Atmospheric Environment			Freshwater Environment									Marine Environment						
		Air Quality	Noise and Vibration	Climate and Meteorology	Surface Water Quantity	Hydrogeology	Surface Water Quality	Sediment Quality	Fish Habitat	Arctic grayling	Lake trout	Arctic char (freshwater life history)	Cisco/Whitefish	Water Quality	Sediment Quality	Aquatic and Fish Marine Habitat	Arctic Char (marine life history)	Saffron Cod	Seabirds	Marine Mammals including Species at Risk
4	**Operation - proposed Phase 2 infrastructure**																			
4.01	Expansion of Project Development Area																			
4.02	Water discharge to the receiving environment				X		X	X	X	X	X	X	X							
4.03	Water management system (including CWP)				X	X	X	X	X	X	X	X	X							
5	**Reclamation and Closure - proposed Phase 2 infrastructure**																			
5.01	Inter-site roads	X	X	X	X		X	X	X	X	X	X	X							
5.02	Machine and vehicle emissions	X	X	X																
5.03	Site surface and mining infrastructure	X	X	X	X	X	X	X	X	X	X	X	X							
6	**Post Closure - proposed Phase 2 infrastructure**																			
6.01	Post closure monitoring	X		X	X				X	X	X	X	X							
7	**Temporary Closure**																			
7.01	Care and maintenance	X		X					X	X	X	X	X							
Madrid-Boston All-Weather Road																				
1	**Construction - use of existing approved and permitted infrastructure**																			
1.01	Madrid-Boston winter road	X	X	X	X		X	X	X	X	X	X	X							
1.02	Quarries	X	X	X																
2	**Construction - proposed Phase 2 infrastructure**																			
2.01	All weather road (grading, backfill, excavation, drainage)	X	X	X	X		X	X	X	X	X	X	X							
2.02	Animal crossings	X					X		X	X	X	X	X							
2.03	Construction camps	X	X	X			X	X	X	X	X	X	X							
2.04	Machine and vehicle emissions	X	X	X																
2.04	Quarries	X	X	X			X	X	X	X	X	X	X							
2.05	Water crossings	X			X		X	X	X	X	X	X	X							
3	**Operation - use of existing approved and permitted infrastructure**																			
3.01	Madrid-Boston winter road	X	X	X	X		X	X	X	X	X	X	X							
4	**Operation - proposed Phase 2 infrastructure**																			
4.01	All weather road use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
4.02	Animal crossings	X					X	X	X	X	X	X	X							
4.03	Machine and vehicle emissions	X	X	X																
4.04	Quarries	X	X	X			X	X	X	X	X	X	X							
4.05	Water crossings						X	X	X	X	X	X	X							
5	**Reclamation and Closure - use of existing approved and permitted infrastructure**																			
5.01	Madrid-Boston winter road	X	X	X	X		X	X	X	X	X	X	X							
5.02	Construction camps	X	X	X	X		X	X	X	X	X	X	X							
6	**Reclamation and Closure - proposed Phase 2 infrastructure**																			
6.01	All-weather road, quarries and associated infrastructure	X	X	X	X		X	X	X	X	X	X	X							
6.02	Machine and vehicle emissions	X	X	X																
7	**Post Closure - proposed Phase 2 infrastructure**																			
7.01	Post closure monitoring	X		X	X				X	X	X	X	X							
8	**Temporary Closure**																			
8.01	Care and maintenance	X		X					X	X	X	X	X							

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Atmospheric Environment			Freshwater Environment									Marine Environment						
		Air Quality	Noise and Vibration	Climate and Meteorology	Surface Water Quantity	Hydrogeology	Surface Water Quality	Sediment Quality	Fish Habitat	Arctic grayling	Lake trout	Arctic char (freshwater life history)	Cisco/Whitefish	Water Quality	Sediment Quality	Aquatic and Fish Marine Habitat	Arctic Char (marine life history)	Saffron Cod	Seabirds	Marine Mammals including Species at Risk
Boston																				
1	**Construction - use of existing approved and permitted infrastructure**																			
1.01	Airstrip and helicopter pad	X	X	X																
1.02	Winter ice strip on Aimaokatalok Lake																			
1.03	Camp (65 person)	X		X																
2	**Construction - proposed Phase 2 infrastructure**																			
2.01	Camp (sewage treatment facilities, potable water treatment, fire suppression)	X					X	X	X	X	X	X	X							
2.02	Diesel power plant	X	X	X																
2.03	Expansion of Project Development Area		X																	
2.04	Fuel storage and handling	X	X	X			X	X	X	X	X	X	X							
2.05	Heliport and heliport shack	X	X	X			X	X												
2.06	Incinerator	X	X	X			X	X	X	X	X	X	X							
2.07	Landfarm	X	X	X			X	X												
2.08	Machine and vehicle emissions	X	X	X																
2.09	Ore stockpile	X	X	X	X		X	X	X	X	X	X	X							
2.10	Overburden pile	X	X	X	X		X	X	X	X	X	X	X							
2.11	Quarry	X	X	X			X	X	X	X	X	X	X							
2.12	Second mine portal	X	X	X			X	X												
2.13	Site roads	X		X	X		X	X	X	X	X	X	X							
2.14	Surface infrastructure (exploration office, core storage facility, laydown area, office, emergency shelter, office, warehouse, reagent storage, workshop, waste management facility)	X	X	X			X	X	X	X	X	X	X							
2.15	Underground mine (drilling, blasting, excavation, ventilation)	X		X		X	X	X												
2.16	Waste rock pad and pile	X	X	X	X		X	X	X	X	X	X	X							
2.17	Water discharge to the environment				X		X	X	X	X	X	X	X							
2.18	Water management system	X			X	X	X	X	X	X	X	X	X							
2.19	Water use from Aimaokatalok Lake				X				X	X	X	X	X							
2.20	Expansion of Project Development Area						X	X												
2.21	Machine and vehicle emissions	X	X	X																
2.22	Process plant (concentrator)	X	X	X			X	X												
2.23	Dry-stack TMA	X	X	X	X		X	X												
2.24	TMA roads	X	X	X	X		X	X	X	X	X	X	X							
2.25	TMA water management system	X	X	X	X		X	X	X	X	X	X	X							
3	**Operation - proposed Phase 2 infrastructure**																			
3.01	Camp (sewage treatment facilities, potable water treatment, fire suppression)						X	X	X	X	X	X	X							
3.02	Diesel power plant	X	X	X																
3.03	Expanded Project Development Area																			
3.04	Fuel storage and handling	X	X	X			X	X	X	X	X	X	X							
3.05	Heliport and heliport shack	X	X	X			X													
3.06	Incinerator	X	X	X			X	X	X	X	X	X	X							
3.07	Landfarm	X	X	X			X	X												
3.08	Machine and vehicle emissions	X	X	X																
3.09	Ore stockpile	X	X	X	X		X	X	X	X	X	X	X							
3.10	Overburden pile	X	X	X	X		X	X	X	X	X	X	X							

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Atmospheric Environment			Freshwater Environment									Marine Environment						
		Air Quality	Noise and Vibration	Climate and Meteorology	Surface Water Quantity	Hydrogeology	Surface Water Quality	Sediment Quality	Fish Habitat	Arctic grayling	Lake trout	Arctic char (freshwater life history)	Cisco/Whitefish	Water Quality	Sediment Quality	Aquatic and Fish Marine Habitat	Arctic Char (marine life history)	Saffron Cod	Seabirds	Marine Mammals including Species at Risk
3.11	Quarry	X	X	X			X	X	X	X	X	X	X							
3.12	Site roads and maintenance	X		X	X		X	X	X	X	X	X	X							
3.13	Surface infrastructure (exploration office, core storage facility, laydown area, office, emergency shelter, office, warehouse, reagent storage, workshop, waste management facility)	X	X	X			X	X	X	X	X	X	X							
3.14	Underground mine (drilling, blasting, excavation, ventilation)	X		X		X	X													
3.15	Waste rock pile	X	X	X	X		X	X	X	X	X	X	X							
3.16	Water discharge to the environment				X		X	X	X	X	X	X	X							
3.17	Water use from Aimaokatalok Lake				X		X		X	X	X	X	X							
3.18	Water management system				X	X	X	X	X	X	X	X	X							
3.19	Machine and vehicle emissions	X	X	X																
3.20	Process plant (concentrator)	X	X	X			X													
3.21	Dry-stack TMA	X	X	X	X		X													
3.22	TMA roads use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
3.23	TMA water management system		X				X	X	X	X	X	X	X							
4	**Reclamation and Closure - proposed Phase 2 infrastructure**																			
4.01	Site surface and mining infrastructure	X	X	X	X	X	X	X	X	X	X	X	X							
4.02	Machine and vehicle emissions	X	X	X																
4.03	TMA and associated infrastructure	X	X	X	X		X	X	X	X	X	X	X							
5	**Post Closure - proposed Phase 2 infrastructure**																			
5.01	Post closure monitoring	X		X	X				X	X	X	X	X							
6	**Temporary Closure**																			
6.01	Care and maintenance	X		X					X	X	X	X	X							
Boston Airstrip																				
1	**Construction - proposed Phase 2 infrastructure**																			
1.01	Access road	X	X	X	X		X	X	X	X	X	X	X							
1.02	Airstrip and lighting	X	X	X	X		X	X	X	X	X	X	X							
1.03	Project Development Area						X	X												
1.04	Machine and vehicle emissions	X	X	X																
1.05	Quarry	X	X	X			X	X	X	X	X	X	X							
2	**Operation - proposed Phase 2 infrastructure**																			
2.01	Access road use and maintenance	X	X	X	X		X	X	X	X	X	X	X							
2.02	Airstrip and lighting	X	X	X			X	X	X	X	X	X	X							
2.03	Project Development Area																			
2.04	Machine and vehicle emissions	X	X	X																
2.05	Quarry	X	X	X			X	X	X	X	X	X	X							
3	**Reclamation and Closure - proposed Phase 2 infrastructure**																			
3.01	Site surface infrastructure	X	X	X	X		X	X	X	X	X	X	X							
4	**Post Closure - proposed Phase 2 infrastructure**																			
4.01	Post closure monitoring	X		X	X				X	X	X	X	X							
5	**Temporary Closure**																			
5.01	Care and maintenance	X		X					X	X	X	X	X							

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Atmospheric Environment			Freshwater Environment									Marine Environment						
		Air Quality	Noise and Vibration	Climate and Meteorology	Surface Water Quantity	Hydrogeology	Surface Water Quality	Sediment Quality	Fish Habitat	Arctic grayling	Lake trout	Arctic char (freshwater life history)	Cisco/Whitefish	Water Quality	Sediment Quality	Aquatic and Fish Marine Habitat	Arctic Char (marine life history)	Saffron Cod	Seabirds	Marine Mammals including Species at Risk
Phase 2 All Sites																				
1	**Construction**																			
	1.01 Employment and labour																			
	1.02 Procurement of goods and services																			
	1.03 Commercial land and resources use																			
2	**Operation**																			
	2.01 Employment and labour																			
	2.02 Procurement of goods and services																			
	2.03 Commercial land and resources use																			
3	**Reclamation and Closure**																			
	3.01 Employment and labour																			
	3.02 Procurement of goods and services																			
	3.03 Commercial land and resources use																			
4	**Post Closure**																			
	4.01 Employment and labour																			
	4.02 Procurement of goods and services																			
	4.03 Commercial land and resources use																			
5	**Temporary Closure**																			
	5.01 Employment and labour																			
	5.02 Procurement of goods and services																			
	5.03 Commercial land and resources use																			

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Terrestrial Environment								Human Environment									
		Special landscape features	Vegetation	Caribou	Muskox	Wolverine/Furbearers	Grizzly Bear	Waterbirds and Upland Breeding birds	Raptors	Traditional Land and Resource Use	Community Health and Well-being	Commercial Land and Resource Use	Archaeology	Economic Development	Cultural Resources	Employment	Business Opportunities	Education and Training	Migration, Housing, and Infrastructure and Services
PROJECT COMPONENTS AND ACTIVITIES																			
Roberts Bay																			
1	**Construction - proposed Phase 2 infrastructure**																		
1.01	Cargo dock																		
1.02	Dock access road																		
1.03	Fuel pipeline and tank farm																		
1.04	Marine transport of goods																		
1.05	Quarry																		
2	**Construction and Operation - use of existing approved and permitted infrastructure**																		
2.01	Fuel tank farm		X	X	X	X	X	X	X										
2.02	Laydown areas		X	X	X	X	X	X	X										
2.03	Machine and vehicle emissions																		
2.04	Marine discharge for TIA water		X																
2.05	Marine transport of goods																		
2.06	Roberts Bay - Doris road use and maintenance		X	X	X	X	X	X	X										
2.07	Site roads use and maintenance		X	X	X	X	X	X	X										
2.08	Water management system			X	X	X	X	X	X										
3	**Operation - proposed Phase 2 infrastructure**																		
3.01	Cargo dock																		
3.02	Use of dock access road																		
3.03	Fuel pipeline and tank farm																		
3.04	Marine transport of goods																		
3.05	Quarry																		
4	**Reclamation and Closure - use of existing approved and permitted infrastructure**																		
4.01	Site surface infrastructure		X	X	X	X	X	X	X										
4.02	Machine and vehicle emissions																		
4.03	Roberts Bay - Doris road		X	X	X	X	X	X	X										
4.04	Marine infrastructure																		
4.05	Marine transport of goods																		
5	**Reclamation and Closure - proposed Phase 2 infrastructure**																		
5.01	Site surface infrastructure																		
5.02	Machine and vehicle emissions																		
5.03	Dock access road																		
5.04	Dock and associated marine infrastructure																		
5.05	Marine transport of goods																		
5.06	Quarry																		
6	**Post Closure - proposed Phase 2 infrastructure**																		
6.01	Post closure monitoring		X	X	X	X	X	X	X										
7	**Temporary Closure**																		
7.01	Care and maintenance																		

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Terrestrial Environment								Human Environment									
		Special landscape features	Vegetation	Caribou	Muskox	Wolverine/Furbearers	Grizzly Bear	Waterbirds and Upland Breeding birds	Raptors	Traditional Land and Resource Use	Community Health and Well-being	Commercial Land and Resource Use	Archaeology	Economic Development	Cultural Resources	Employment	Business Opportunities	Education and Training	Migration, Housing, and Infrastructure and Services
Doris																			
1	**Construction - proposed Phase 2 infrastructure**																		
1.01	Expansion of Project Development Area	X	X	X	X	X	X	X	X				X		X				
1.02	Expansion of camp (280 person capacity, expanded to 400 person capacity)																		
1.03	Machine and vehicle emissions																		
1.04	Quarry			X	X	X	X	X	X										
1.05	Raising the TIA South Dam			X	X	X	X	X	X										
1.06	TIA perimeter road extensions			X	X	X	X	X	X										
1.07	TIA West Dam			X	X	X	X	X	X										
1.08	Road to TIA South Dam																		
2	**Operation - use of existing approved and permitted infrastructure**																		
2.01	Airstrip, winter ice strip and helicopter pad			X	X	X	X	X	X										
2.02	Camp																		
2.03	Camp facilities (sewage treatment facilities, potable water treatment, fire suppression)			X	X	X	X	X	X										
2.04	Chemical and hazardous material management facilities																		
2.05	Diesel Power Plant																		
2.06	Fuel storage and handling																		
2.07	Incinerator																		
2.08	Machine and vehicle emissions																		
2.09	Mill																		
2.10	Ore stockpile			X	X	X	X	X	X										
2.11	Site roads use and maintenance																		
2.12	Storage and handling of explosives																		
2.13	Surface infrastructure (maintenance facilities, warehouses, laydown areas, waste management facilities)			X	X	X	X	X	X										
2.14	Water discharge to the receiving environment			X	X	X	X	X	X										
2.15	Water management system																		
2.16	Water use from Doris Lake							X											
2.17	Water use from Windy Lake							X											
3	**Operation - proposed Phase 2 infrastructure**																		
3.01	Expanded Project Development Area	X	X	X	X	X	X	X	X										
3.02	Camp (expanded)																		
3.03	Quarry			X	X	X	X	X	X										
3.04	TIA road use and maintenance			X	X	X	X	X	X										
3.05	TIA storage																		
4	**Reclamation and Closure - use of existing approved and permitted infrastructure**																		
4.01	Machine and vehicle emissions																		
4.02	Site surface and mining infrastructure		X	X	X	X	X	X	X										
4.03	Airstrip		X	X	X	X	X	X	X										
5	**Reclamation and Closure - proposed Phase 2 infrastructure**																		
5.01	Machine and vehicle emissions		X																
5.02	Camp (expanded)																		
5.03	Quarry		X	X	X	X	X	X	X										
5.04	TIA roads (perimeter and South Dam)		X	X	X	X	X	X	X										
5.05	TIA			X	X	X	X	X	X										

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

			Terrestrial Environment								Human Environment									
			Special landscape features	Vegetation	Caribou	Muskox	Wolverine/Furbearers	Grizzly Bear	Waterbirds and Upland Breeding birds	Raptors	Traditional Land and Resource Use	Community Health and Well-being	Commercial Land and Resource Use	Archaeology	Economic Development	Cultural Resources	Employment	Business Opportunities	Education and Training	Migration, Housing, and Infrastructure and Services
6	**Post Closure - proposed Phase 2 infrastructure**																			
	6.01	Post closure monitoring		X	X	X	X	X	X	X										
7	**Temporary Closure**																			
	7.01	Care and maintenance																		
Madrid North																				
1	**Construction - use of existing approved and permitted infrastructure**																			
	1.01	Air heating facility																		
	1.02	Brine mixing facility																		
	1.03	Diesel power plant																		
	1.04	Fuel storage and handling																		
	1.05	Machine and vehicle emissions																		
	1.06	Ore stockpile			X	X	X	X	X	X										
	1.07	Quarry			X	X	X	X	X	X										
	1.08	Site roads			X	X	X	X	X	X										
	1.09	Surface infrastructure (shop, compressor building, laydown area, office, emergency shelter)			X	X	X	X	X	X										
	1.10	Underground mine (drilling, blasting, excavation, ventilation)																		
	1.11	Waste rock pile			X	X	X	X	X	X										
	1.12	Water management system																		
2	**Construction - proposed Phase 2 infrastructure**																			
	2.01	Expansion of Project Development Area	X	X	X	X	X	X	X	X				X		X				
	2.02	Expansion of site pad (waste rock stockpile)																		
	2.03	Process plant (concentrator)																		
	2.04	Power plant																		
	2.05	Water discharge to the receiving environment			X	X	X	X	X	X										
	2.06	Water management system (including expanded CWP)																		
3	**Operation - use of existing approved and permitted infrastructure**																			
	3.01	Air heating facility																		
	3.02	Brine mixing facility																		
	3.03	Diesel Power Plant																		
	3.04	Disposal of each-circuit tailings with underground backfill																		
	3.05	Doris - Madrid road use and maintenance			X	X	X	X	X	X										
	3.06	Fuel storage and handling																		
	3.07	Machine and vehicle emissions																		
	3.08	Madrid North access road use and maintenance			X	X	X	X	X	X										
	3.09	Ore stockpile			X	X	X	X	X	X										
	3.10	Quarry			X	X	X	X	X	X										
	3.11	Site roads use and maintenance			X	X	X	X	X	X										
	3.12	Surface infrastructure (shop, compressor building, laydown area, office, emergency shelter)			X	X	X	X	X	X										
	3.13	Underground mine (drilling, blasting, excavation, ventilation)																		
	3.14	Waste rock pile			X	X	X	X	X	X										
	3.15	Water management system																		
4	**Operation - proposed Phase 2 infrastructure**																			
	4.01	Expansion of Project Development Area	X	X	X	X	X	X	X	X				X		X				
	4.02	Process plant (concentrator)																		

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Terrestrial Environment								Human Environment									
		Special landscape features	Vegetation	Caribou	Muskox	Wolverine/Furbearers	Grizzly Bear	Waterbirds and Upland Breeding birds	Raptors	Traditional Land and Resource Use	Community Health and Well-being	Commercial Land and Resource Use	Archaeology	Economic Development	Cultural Resources	Employment	Business Opportunities	Education and Training	Migration, Housing, and Infrastructure and Services
4.03	Power plant																		
4.04	Water discharge to the receiving environment			X	X	X	X	X	X										
4.05	Water management system (including CWP)																		
5	**Reclamation and Closure - proposed Phase 2 infrastructure**																		
5.01	Inter-site roads		X	X	X	X	X	X	X										
5.02	Machine and vehicle emissions																		
5.03	Site surface and mining infrastructure		X	X	X	X	X	X	X										
6	**Post Closure - proposed Phase 2 infrastructure**																		
6.01	Post closure monitoring		X	X	X	X	X	X	X										
7	**Temporary Closure**																		
7.01	Care and maintenance																		
Madrid South																			
1	**Construction - use of existing approved and permitted infrastructure**																		
1.01	Air heating facility																		
1.02	Brine mixing facility																		
1.03	Diesel Power Plant																		
1.04	Fuel storage and handling																		
1.05	Machine and vehicle emissions																		
1.06	Ore stockpile			X	X	X	X	X	X										
1.07	Quarry			X	X	X	X	X	X										
1.08	Site roads			X	X	X	X	X	X										
1.09	Surface infrastructure (shop, compressor building, laydown area, office, emergency shelter)			X	X	X	X	X	X										
1.10	Underground mine (drilling, blasting, excavation, ventilation)																		
1.11	Waste rock pile			X	X	X	X	X	X										
1.12	Water management system																		
2	**Construction - proposed Phase 2 infrastructure**																		
2.01	Expansion of Project Development Area	X	X	X	X	X	X	X	X					X	X				
2.02	Expansion of site pad (waste rock stockpile)																		
2.03	Water discharge to the receiving environment			X	X	X	X	X	X										
2.04	Water management system (including expanded CWP)																		
3	**Operation - use of existing approved and permitted infrastructure**																		
3.01	Air heating facility																		
3.02	Brine mixing facility																		
3.03	Diesel Power Plant																		
3.04	Doris - Madrid road use and maintenance			X	X	X	X	X	X										
3.05	Fuel storage and handling																		
3.06	Machine and vehicle emissions																		
3.07	Ore stockpile			X	X	X	X	X	X										
3.08	Quarry			X	X	X	X	X	X										
3.09	Site roads use and maintenance			X	X	X	X	X	X										
3.10	Surface infrastructure (shop, compressor building, laydown area, office, emergency shelter)			X	X	X	X	X	X										
3.11	Underground mine (drilling, blasting, excavation, ventilation)																		
3.12	Waste rock pile			X	X	X	X	X	X										
3.13	Water management system - Type B licence																		

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

			Terrestrial Environment								Human Environment									
			Special landscape features	Vegetation	Caribou	Muskox	Wolverine/Furbearers	Grizzly Bear	Waterbirds and Upland Breeding birds	Raptors	Traditional Land and Resource Use	Community Health and Well-being	Commercial Land and Resource Use	Archaeology	Economic Development	Cultural Resources	Employment	Business Opportunities	Education and Training	Migration, Housing, and Infrastructure and Services
4	**Operation - proposed Phase 2 infrastructure**																			
	4.01	Expansion of Project Development Area	X	X	X	X	X	X	X	X				X		X				
	4.02	Water discharge to the receiving environment			X	X	X	X	X	X										
	4.03	Water management system (including CWP)																		
5	**Reclamation and Closure - proposed Phase 2 infrastructure**																			
	5.01	Inter-site roads		X	X	X	X	X	X	X										
	5.02	Machine and vehicle emissions																		
	5.03	Site surface and mining infrastructure		X	X	X	X	X	X	X										
6	**Post Closure - proposed Phase 2 infrastructure**																			
	6.01	Post closure monitoring		X	X	X	X	X	X	X										
7	**Temporary Closure**																			
	7.01	Care and maintenance																		
Madrid-Boston All-Weather Road																				
1	**Construction - use of existing approved and permitted infrastructure**																			
	1.01	Madrid-Boston winter road			X	X	X													
	1.02	Quarries																		
2	**Construction - proposed Phase 2 infrastructure**																			
	2.01	All weather road (grading, backfill, excavation, drainage)	X	X	X	X	X	X	X					X		X				
	2.02	Animal crossings	X	X	X	X	X	X	X											
	2.03	Construction camps	X	X	X	X	X	X	X					X		X				
	2.04	Machine and vehicle emissions	X																	
	2.04	Quarries	X	X	X	X	X	X	X					X		X				
	2.05	Water crossings	X																	
3	**Operation - use of existing approved and permitted infrastructure**																			
	3.01	Madrid-Boston winter road		X	X	X														
4	**Operation - proposed Phase 2 infrastructure**																			
	4.01	All weather road use and maintenance	X	X	X	X	X	X	X											
	4.02	Animal crossings	X	X	X	X	X	X	X											
	4.03	Machine and vehicle emissions	X																	
	4.04	Quarries	X	X	X	X	X	X	X											
	4.05	Water crossings	X																	
5	**Reclamation and Closure - use of existing approved and permitted infrastructure**																			
	5.01	Madrid-Boston winter road	X	X	X	X	X	X	X											
	5.02	Construction camps	X	X	X	X	X	X	X											
6	**Reclamation and Closure - proposed Phase 2 infrastructure**																			
	6.01	All-weather road, quarries and associated infrastructure	X	X	X	X	X	X	X											
	6.02	Machine and vehicle emissions																		
7	**Post Closure - proposed Phase 2 infrastructure**																			
	7.01	Post closure monitoring	X	X	X	X	X	X	X											
8	**Temporary Closure**																			
	8.01	Care and maintenance																		

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Terrestrial Environment								Human Environment									
		Special landscape features	Vegetation	Caribou	Muskox	Wolverine/Furbearers	Grizzly Bear	Waterbirds and Upland Breeding birds	Raptors	Traditional Land and Resource Use	Community Health and Well-being	Commercial Land and Resource Use	Archaeology	Economic Development	Cultural Resources	Employment	Business Opportunities	Education and Training	Migration, Housing, and Infrastructure and Services
Boston																			
1	**Construction - use of existing approved and permitted infrastructure**																		
1.01	Airstrip and helicopter pad																		
1.02	Winter ice strip on Aimaokatalok Lake																		
1.03	Camp (65 person)																		
2	**Construction - proposed Phase 2 infrastructure**																		
2.01	Camp (sewage treatment facilities, potable water treatment, fire suppression)			X	X	X	X	X	X										
2.02	Diesel power plant																		
2.03	Expansion of Project Development Area	X	X	X	X	X	X	X	X				X		X				
2.04	Fuel storage and handling																		
2.05	Heliport and heliport shack																		
2.06	Incinerator																		
2.07	Landfarm			X	X	X	X	X	X										
2.08	Machine and vehicle emissions																		
2.09	Ore stockpile			X	X	X	X	X	X										
2.10	Overburden pile			X	X	X	X	X	X										
2.11	Quarry			X	X	X	X	X	X										
2.12	Second mine portal																		
2.13	Site roads			X	X	X	X	X	X										
2.14	Surface infrastructure (exploration office, core storage facility, laydown area, office, emergency shelter, office, warehouse, reagent storage, workshop, waste management facility)			X	X	X	X	X	X										
2.15	Underground mine (drilling, blasting, excavation, ventilation)																		
2.16	Waste rock pad and pile																		
2.17	Water discharge to the environment			X	X	X	X	X	X										
2.18	Water management system																		
2.19	Water use from Aimaokatalok Lake							X											
2.20	Expansion of Project Development Area	X	X	X	X	X	X	X	X										
2.21	Machine and vehicle emissions																		
2.22	Process plant (concentrator)																		
2.23	Dry-stack TMA			X	X	X	X	X	X										
2.24	TMA roads			X	X	X	X	X	X										
2.25	TMA water management system																		
3	**Operation - proposed Phase 2 infrastructure**																		
3.01	Camp (sewage treatment facilities, potable water treatment, fire suppression)			X	X	X	X	X	X										
3.02	Diesel power plant																		
3.03	Expanded Project Development Area	X	X	X	X	X	X	X	X										
3.04	Fuel storage and handling																		
3.05	Heliport and heliport shack			X	X	X	X	X	X										
3.06	Incinerator																		
3.07	Landfarm			X	X	X	X	X	X										
3.08	Machine and vehicle emissions																		
3.09	Ore stockpile			X	X	X	X	X	X										
3.10	Overburden pile			X	X	X	X	X	X										

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

		Terrestrial Environment								Human Environment									
		Special landscape features	Vegetation	Caribou	Muskox	Wolverine/Furbearers	Grizzly Bear	Waterbirds and Upland Breeding birds	Raptors	Traditional Land and Resource Use	Community Health and Well-being	Commercial Land and Resource Use	Archaeology	Economic Development	Cultural Resources	Employment	Business Opportunities	Education and Training	Migration, Housing, and Infrastructure and Services
3.11	Quarry			X	X	X	X	X	X										
3.12	Site roads and maintenance			X	X	X	X	X	X										
3.13	Surface infrastructure (exploration office, core storage facility, laydown area, office, emergency shelter, office, warehouse, reagent storage, workshop, waste management facility)			X	X	X	X	X	X										
3.14	Underground mine (drilling, blasting, excavation, ventilation)																		
3.15	Waste rock pile			X	X	X	X	X	X										
3.16	Water discharge to the environment			X	X	X	X	X	X										
3.17	Water use from Aimaokatalok Lake																		
3.18	Water management system																		
3.19	Machine and vehicle emissions																		
3.20	Process plant (concentrator)																		
3.21	Dry-stack TMA																		
3.22	TMA roads use and maintenance			X	X	X	X	X	X										
3.23	TMA water management system																		
4	**Reclamation and Closure - proposed Phase 2 infrastructure**																		
4.01	Site surface and mining infrastructure	X	X	X	X	X	X	X	X										
4.02	Machine and vehicle emissions																		
4.03	TMA and associated infrastructure	X	X	X	X	X	X	X	X										
5	**Post Closure - proposed Phase 2 infrastructure**																		
5.01	Post closure monitoring		X	X	X	X	X	X	X										
6	**Temporary Closure**																		
6.01	Care and maintenance																		
Boston Airstrip																			
1	**Construction - proposed Phase 2 infrastructure**																		
1.01	Access road																		
1.02	Airstrip and lighting																		
1.03	Project Development Area	X	X	X	X	X	X	X	X					X		X			
1.04	Machine and vehicle emissions																		
1.05	Quarry																		
2	**Operation - proposed Phase 2 infrastructure**																		
2.01	Access road use and maintenance			X	X	X	X	X	X										
2.02	Airstrip and lighting			X	X	X	X	X	X										
2.03	Project Development Area	X	X	X	X	X	X	X	X										
2.04	Machine and vehicle emissions																		
2.05	Quarry			X	X	X	X	X	X										
3	**Reclamation and Closure - proposed Phase 2 infrastructure**																		
3.01	Site surface infrastructure		X	X	X	X	X	X	X										
4	**Post Closure - proposed Phase 2 infrastructure**																		
4.01	Post closure monitoring		X	X	X	X	X	X	X										
5	**Temporary Closure**																		
5.01	Care and maintenance																		

Table 4.3-3. Valued Ecosystem Component and Valued Socio-economic Component Interaction with Phase 2 Project Components and Activities

			Terrestrial Environment								Human Environment									
			Special landscape features	Vegetation	Caribou	Muskox	Wolverine/Furbearers	Grizzly Bear	Waterbirds and Upland Breeding birds	Raptors	Traditional Land and Resource Use	Community Health and Well-being	Commercial Land and Resource Use	Archaeology	Economic Development	Cultural Resources	Employment	Business Opportunities	Education and Training	Migration, Housing, and Infrastructure and Services
Phase 2 All Sites																				
1	**Construction**																			
	1.01	Employment and labour													X		X	X	X	X
	1.02	Procurement of goods and services													X		X	X	X	X
	1.03	Commercial land and resources use											X		X		X	X	X	X
2	**Operation**																			
	2.01	Employment and labour													X		X	X	X	X
	2.02	Procurement of goods and services													X		X	X	X	X
	2.03	Commercial land and resources use											X		X		X	X	X	X
3	**Reclamation and Closure**																			
	3.01	Employment and labour													X		X	X	X	X
	3.02	Procurement of goods and services													X		X	X	X	X
	3.03	Commercial land and resources use											X		X		X	X	X	X
4	**Post Closure**																			
	4.01	Employment and labour													X		X	X	X	X
	4.02	Procurement of goods and services													X		X	X	X	X
	4.03	Commercial land and resources use											X		X		X	X	X	X
5	**Temporary Closure**																			
	5.01	Employment and labour																		
	5.02	Procurement of goods and services																		
	5.03	Commercial land and resources use																		

Table 4.3-4. Attributes to Evaluate Significance of Potential Residual Effects

Attribute	Definition and Rationale	Impact on Significance Determination
Direction	The ultimate long-term trend of a potential residual effect — positive, neutral, or negative.	Positive, neutral, and negative potential effects on VECs or VSECs are assessed, but only negative residual effects are characterized and assessed for significance.
Magnitude	The degree of change in a measurable parameter or variable relative to existing conditions. This attribute may also consider complexity — the number of interactions (Project phases and activities) contributing to a specific effect.	The higher the magnitude, the higher the potential significance.
Equity (VSECs only)	The dispersal of potential residual effects across different social groups or segments of society.	A high degree of equity indicates a relatively even dispersal of the residual effect. The lower the equity, the higher the potential significance.
Duration	The length of time over which the residual effect occurs.	The longer the length of time of an interaction, the higher the potential significance.
Frequency	The number of times during the Project or a Project phase that an interaction or environmental/ socio-economic effect can be expected to occur.	Greater the number times of occurrence (higher the frequency), the higher the potential significance.
Geographic Extent	The geographic area over which the interaction will occur.	The larger the geographical area, the higher the potential significance.
Reversibility	The likelihood an effect will be reversed once the Project activity or component is ceased or has been removed. This includes active management for recovery or restoration.	The lower the likelihood a residual effect will be reversed, the higher the potential significance.

Aside from the direct characterization using the preceding attributes (Table 4.3-4), the EIS guidelines recognize a number of other relevant attributes that can support the characterization and later significance determination of the potential residual effects (Table 4.3-5). These are applied as appropriate for VECs/VSECs.

Table 4.3-6 provides the criteria for characterizing each attribute of a residual effect. Each of the attributes and associated criteria ratings contribute to the determination of significance.

4.3.4.5 Determining the Significance of Residual Effects

Section 7.4 of the EIS Guidelines (NIRB) provided guidance, attributes, and criteria for the determination of significance for residual effects. Also, the Canadian Environmental Assessment Agency's *Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects* (CEA Agency 1992) also guided the evaluation of significance for identified residual effects. The significance of residual effects is based on comparing the predicted state of the environment with and without the Project, including a judgment as to the importance of the changes identified.

Probability of Occurrence or Certainty

Prior to the determination of the significance for negative residual effects, the probability of the occurrence or certainty of the effect is evaluated. For each negative residual effect, the probability of occurrence is categorized as unlikely, moderate or likely. Table 4.3-7 presents the definitions applied to these categories.

Table 4.3-5. Other Relevant Attributes in Assessing the Significance of Residual Effects

Attribute	Definition and Rationale	Role in Significance Determination
Ecological/Socio-economic context/value	The general evaluation of the role or importance of a VEC or VSEC to the area in which the Project is located accounting for the existing levels of human activity and associated types of disturbance.	Provides rationale for selection of VECs/ VSECs as described in each subject area section.
Environmental sensitivity	The susceptibility of the area to environmental change.	Project components and activities are more likely to affect areas that are susceptible to change.
Historical, cultural, archaeological significance	The past, present, and future cultural activities, and archaeological resources within a Project area.	Historic, cultural and archaeological significance is evaluated within the archaeology effects assessment (Volume 6, Chapter 2).
Size of human and wildlife populations, and the size of the affected wildlife habitat	The population of humans and wildlife and the size of the affected wildlife habitat of individuals within the region in which the Project resides.	Provides context for those human and wildlife populations and wildlife that may be the receptors of direct or indirect potential residual effects, and cumulative effects.
The extent of the effects of the Project on other regional human populations and wildlife populations, including the extent of the effects on Inuit harvesting activities	The Project might have the potential to affect other human and wildlife populations, if there are residual effects to marine wildlife or socio-economic benefits that extend outside Nunavut.	Cumulative Effects Assessment (Section 5.4) and the Transboundary Effects Assessment (Section 4.5) considers this attribute.
The potential for cumulative adverse effects given past, present and future relevant events	The Project might have the potential for cumulative effects where potential residual effects from the Project are expected to occur.	Cumulative Effects Assessment (Section 4.4) considers this attribute.
Ecosystem function and integrity	Ecosystem function and integrity is potentially important to VECs and VSECs.	Potential residual effects on ecosystem function and integrity may have direct or indirect potential residual effects, and cumulative effects.
The effect on the capacity of resources to meet present and future needs (sustainability)	The sustainability of resources for the current and future needs within the Project area.	Potential residual effects should not impinge upon the sustainability of other resources.
Social Value	Specific and particular value of a potentially affected VEC or VSEC identified by a community or group.	Described in the selection process for each VEC or VSEC.

Determination of Significance

As defined in the NIRB's EIS Guidelines, effect significance "is based on comparing the predicted state of the environment with and without the Project and expressing a judgment as to the importance of the changes identified."

NIRB directed that the EIS present the residual effects assessment of the Madrid-Boston Project so that the reader can clearly understand the real consequences of the Project, including the degree to which effects can be mitigated, and which effects cannot be compensated or mitigated. NIRB also directed that the dynamic change of ecosystems and their components be considered in determining significance.

Table 4.3-6. Criteria for Residual Effects for Biophysical and Socio-economic Attributes

Attribute	Characterization	Criteria[1]
Direction	Positive	Beneficial
	Variable	Both beneficial and undesirable
	Negative	Undesirable
Magnitude	Negligible	No change on the exposed indicator/VEC or VSEC
	Low	Differing from the average value for the existing environment to a small degree, but within the range of natural variation and well below a guideline or threshold value
	Moderate	Differing from the average value for the existing environment and approaching the limits of natural variation, but below or equal to a guideline or threshold value
	High	Differing from the existing environment and exceeding guideline or threshold values so that there will be a detectable change beyond the range of natural variation (i.e., change of state from the existing conditions)
Equity (VSECs only)	Equitable	Even distribution of potential residual effects across different social groups or segments of society
	Neutral	Potential residual effects are unevenly distributed but do not pertain to any particular social group or segment of society
	Inequitable	Uneven distribution of potential residual effects occurring to particular social groups or segments of society, including vulnerable groups
Duration	Short	Up to 4 years (Construction phase)
	Medium	Greater than 4 years and up to 17 years (4 years Construction phase, 10 years Operation phase, 3 years Reclamation and Closure phase)
	Long	Beyond the life of the Project
Frequency	Infrequent	Occurring only occasionally
	Intermittent	Occurring during specific points or under specific conditions during the Project
	Continuous	Continuously occurring throughout the Project life
Geographic Extent	Project Development Area (PDA)	Confined to the PDA
	Local Study Area (LSA)	Beyond the PDA and within the LSA
	Regional Study Area (RSA)	Beyond the LSA and within the RSA
	Beyond Regional	Beyond the RSA
Reversibility	Reversible	Effect reverses within an acceptable time frame with no intervention
	Reversible with effort	Active intervention (effort) is required to bring the effect to an acceptable level
	Irreversible	Effect will not be reversed

[1]*Unless otherwise indicated for the VEC or subject area.*

The overall significance of an effect is derived from scientific and TK information, and the experience and professional judgment of the environmental practitioners who prepare the assessment, considering the rankings of the contributing attributes of significance. Using the applied attributes and criteria (Table 4.3-7), clear decision rules for the determination of significance are defined for each VEC/VSEC and potential effect, as appropriate. The definitions consider all combinations of attributes and criteria ratings that would result in a significant negative residual effect.

Table 4.3-7. Definition of Probability of Occurrence and Confidence for Assessment of Residual Effects

Attribute	Characterization	Criteria
Probability of occurrence or certainty	Unlikely	Some potential exists for the effect to occur; however, current conditions and knowledge of environmental trends indicate the effect is unlikely to occur.
	Moderate	Current conditions and environmental trends indicate there is a moderate probability for the effect to occur.
	Likely	Current conditions and environmental trends indicate the effect is likely to occur.
Confidence	High	Baseline data are comprehensive; predictions are based on quantitative predictive model; effect relationship is well understood.
	Medium	Baseline data are comprehensive; predictions are based on qualitative logic models; effect relationship is generally understood, however, there are assumptions based on other similar systems to fill knowledge gaps.
	Low	Baseline data are limited; predictions are based on qualitative data; effect relationship is poorly understood.

Confidence

The knowledge or analysis that supports the prediction of a potential residual effect—in particular with respect to limitations in overall understanding of the environment and/or the ability to foresee future events or conditions—determines the confidence in the determination of significance. In general, the lower the confidence, the more conservative the approach to prediction of significance must be. The level of confidence in the prediction of a significant or non-significant potential residual effect qualifies the determination, based on the quality of the data and analysis and their extrapolation to the predicted residual effects. “Low” is assigned where there is a low degree of confidence in the inputs, “medium” when there is moderate confidence and “high” when there is a high degree of confidence in the inputs. Where rigorous baseline data were collected and scientific analysis performed, the degree of confidence will generally be high. Table 4.3-7 provides descriptions of the confidence criteria.

Residual effects identified in the Project-related effects assessment are carried forward to assess the potential for cumulative interactions with the residual effects of other projects or human activities and to assess the potential for transboundary impacts should the effects linked directly to the activities of the Project inside the Nunavut Settlement Area (NSA), which occurs across provincial, territorial, international boundaries or may occur outside of the NSA.

Summaries of residual effects assessments for VECs/VSECs are presented for each subject area, one for the incremental impacts of Madrid-Boston Project, and one for the impacts of the complete Hope Bay Project (Table 4.3-8). For VSECs, the additional attribute ‘equity’ is included in the summary for the determination of significance (see Table 4.3-6).

Table 4.3-8. Template for Summary of Residual Effects and Overall Significance Rating

Residual Effect	Attribute Characteristic						Overall Significance Rating		
	Direction *(positive, variable, negative)*	**Magnitude** *(negligible, low, moderate, high)*	**Duration** *(short, medium, long)*	**Frequency** *(infrequent, intermittent, continuous)*	**Geographic Extent** *(PDA, LSA, RSA, beyond regional)*	**Reversibility** *(reversible, reversible with effort, irreversible)*	**Probability** *(unlikely, moderate, likely)*	**Significance** *(not significant, significant)*	**Confidence** *(low, medium, high)*
VEC/VSEC Name									
VEC/VSEC Name									

4.4 CUMULATIVE EFFECTS ASSESSMENT METHODOLOGY

4.4.1 Introduction

The potential for cumulative effects arises when the potential residual effects of the Madrid-Boston Project add to or otherwise interact with the residual effects of other past, existing or reasonably foreseeable projects or activities. As defined by the EIS Guidelines (NIRB) and *NIRB Technical Guide Series: Terminology and Definitions* (NIRB 2013), cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The cumulative effects assessment (CEA) was conducted in compliance with Section 7.11 of the EIS Guidelines (NIRB). The CEA considered the following factors:

- a large spatial boundary (RSA);
- a long temporal scale (from past to reasonably foreseeable projects and activities);
- alternatives analysis;
- consideration of effects on VECs and VSECs; and
- evaluation of significance.

To comply with the requirements outlined in Section 7.11 of the NIRB's EIS Guidelines, the CEA will:

> - *Justify the environmental components that will constitute the focus of the CEA. The Proponent's assessment should emphasize the cumulative effects on the main VECs/VSECs that could be affected by the Project.*
> - *Present a justification for the spatial and temporal boundaries for the CEA. It should be noted that these boundaries can vary depending on the VECs or VSECs assessed. The Proponent shall give due consideration to the potential for cumulative effects that may be transboundary in nature.*
> - *Discuss and justify the choice of projects, components and selected activities for the CEA. These shall include past activities and projects, those currently being carried out and any reasonably foreseeable project or activity. Activities should not be limited to exploration and mining-related activities but include other factors not related to mining (e.g., wildfires, roads/airstrips developed for non-mining activities, etc.).*
> - *Discuss the mitigation measures that are technically and economically feasible, and determine the significance of the cumulative effects. If any effect is identified and verified beyond the Proponent's sole responsibility or capacity, the Proponent shall make best efforts to identify how its mitigation measures may contribute toward any collective mitigation undertaken by other responsible parties.*

4.4.2 Approach to Cumulative Effects Assessment

Similar to the project-related effects assessment methodology described previously in this section, the CEA is comprised of the following activities (Figure 4.4-1) and generally follows the methodology as described in the Cumulative Effects Assessment Practitioners' Guide (Hegmann et al. 1999):

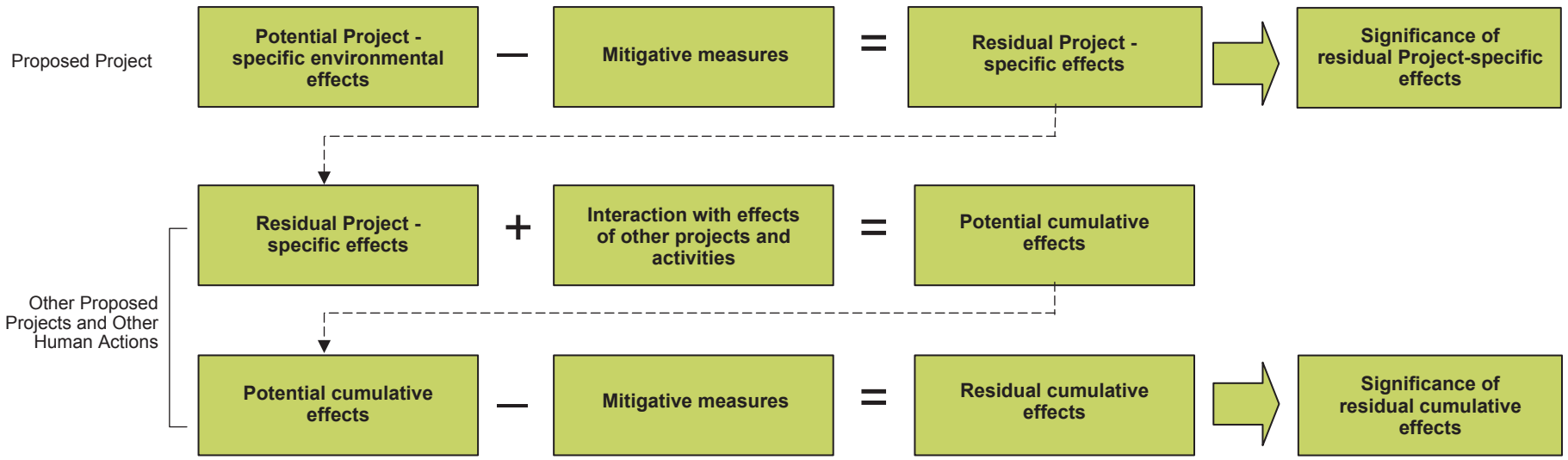
1. Identify the potential for Madrid-Boston Project -related residual effects to interact with residual effects from the Existing and Approved Projects within the Hope Bay Greenstone Belt (i.e., the Doris Project, the Hope Bay Regional Exploration Project, the Madrid Advanced Exploration Program, and the Boston Advanced Exploration Project) and other human activities and projects within specified assessment boundaries. Key potential residual effects associated with past, existing, and reasonably foreseeable future projects were identified using publicly available information or, where data was unavailable, professional judgment was used (based on previous experience in similar geographical locations) to approximate expected environmental conditions.
2. Identify and predict potential cumulative effects that may occur and implement additional mitigation measures to minimize the potential for cumulative effects.
3. Identify cumulative residual effects after the implementation of mitigation measures.
4. Determine the significance of any cumulative residual effects. A key task in the CEA is to understand the contribution of the Madrid-Boston Project to the overall cumulative effect on VEC/VSEC – specifically, the amount of the cumulative residual effect can be apportioned to the Madrid-Boston Project as compared to the Doris Project, the Existing and Approved Exploration Projects within the Hope Bay Greenstone Belt, and other projects and activities.

A summary of all relevant potential residual effects is included in the individual VEC/VSEC assessment sections in Volumes 4 through 7, and these residual effects were considered and analyzed for each valued component where the potential for a cumulative effect to occur has been identified. This analysis is supported by Table 4.4-1 (shown here for illustrative purposes), which each discipline section will incorporate if relevant. For each valued component, the analysis narrowed the scope of the CEA to focus only on those projects and activities where there is an anticipated cumulative interaction with the residual effects from Madrid-Boston Project and the Existing and Approved Projects within the Hope Bay Greenstone Belt. A description of each cumulative residual effect is provided, parcelling out the contributions of the Madrid-Boston Project, the Doris Project, the Existing and Approved Exploration Projects at Hope Bay, and other projects and activities to the total cumulative effect (Table 4.4-1).

Table 4.4-1. Template for Summarizing Contributions of Projects and Activities to Cumulative Residual Effects

Cumulative Residual Effect:	
Project or Activity	**Description of Contribution to Cumulative Residual Effect**
Madrid-Boston Project	
Doris Project	
Existing and Approved Exploration Projects within the Hope Bay Greenstone Belt	
Name of Past Project or Activity	
Name of Existing Project or Activity	
Name of Reasonably Foreseeable Future Project or Activity	
Description of Total Cumulative Residual Effect	

Figure 4.4-1
Steps to Cumulative Effects Assessment



4.4.3 Assessment Boundaries

The CEA considers the spatial and temporal extent of project-related residual effects on VECs and VSECs combined with the anticipated residual effects from other projects and activities to assist with analyzing the potential for a cumulative effect to occur.

4.4.3.1 Spatial Boundaries

The CEA considers past, existing, and reasonably foreseeable projects with potential residual effects that occur within the outer geographical limit of possible interaction with Madrid-Boston Project and the Existing and Approved Projects within the Hoppe Bay Greenstone Belt. As per the EIS Guidelines (NIRB), the area considered conforms to the requirement to consider a large spatial boundary for CEA (Figure 4.4-2) and includes projects within the larger spatial boundary. This list also conforms to the requirement to consider transboundary issues for the migration of large land mammals such as caribou and other VECs and VSECs, as appropriate. However, each VEC/VSEC may have different characteristics and any residual effects may potentially interact with a small subset of the listed projects or a greater number of projects.

4.4.3.2 Temporal Boundaries

The expected timing and duration of Project-related residual effects is compared with that of residual effects from other past, existing and future projects or activities to identify temporal overlap. As identified in the EIS Guidelines (NIRB), a longer timeline than just the development and operation phases of the Madrid-Boston Project must be considered. Key potential residual effects associated with past, existing, and reasonably foreseeable future projects were identified using publicly available information or, where data was unavailable, professional judgment was used (based on previous mining experience in similar geographical locations) to approximate expected environmental conditions.

The following periods were identified and evaluated as part of the CEA.

- **Past:** These are historical, closed projects and activities occurring within the outer geographical limit of possible interaction with the Madrid-Boston Project. The year 2001 was selected as the past temporal boundary for data analysis, representing a time when rigorous baseline studies first occurred in the CEA study areas. Baseline studies captured the effects of past activities.
- **Existing:** These are projects and activities undergoing construction or operating concurrently with the Madrid-Boston Project and occurring within the outer geographical limit of possible interaction with the Project.
- **Reasonably Foreseeable Future:** These are projects formally accepted into a regulatory approval process and that occur within the outer geographical limit of possible interaction with the Madrid-Boston Project.

The boundaries are VEC/VSEC specific and based on the predicted length of time it would take for the VEC/VSEC to recover to baseline conditions, if possible. The CEA of each VEC/VSEC in Volumes 4 to 7 specifies the temporal boundaries applied.

4.4.4 Projects and Activities Considered

4.4.4.1 Information Sources

The mining industry is the main source of industrial activity in Nunavut, which is being explored for uranium, diamonds, gold and precious metals, base metals, iron, coal, and gemstones. The following on-line database sources and websites were reviewed to compile the Project list:

- draft Nunavut Land Use Plan (NPC 2014);
- active projects on NIRB's website;
- mining claims, mining leases and prospecting permits from Aboriginal Affairs and Northern Development Canada website;
- Northwest Territories Geological Survey NT GoData database;
- Nunavut Geoscience NUMIN Showings database;
- Natural Resources Canada website;
- Northwest Territories and Nunavut Chamber of Mines
- contaminated sites listed on the NPC's website; and
- individual resource development company websites.

In addition to major mining development projects, other land use activities were also considered, as required under Section 7.11 of the EIS Guidelines (activities should not be limited to exploration and mining-related activities but include other factors not related to mining [e.g., wildfires, roads/airstrips developed for non-mining activities, etc.]). Land-use activities in the area were identified by review of the *Draft Nunavut Land Use Plan* (Nunavut Planning Commission 2014) and TK (Banci and Spicker 2016). Major land use activities are:

- commercial harvesting of fish and wildlife;
- sports hunting and fishing, including guided hunting and fishing excursions; and
- ecotourism, including lodges, kayaking, wildlife and bird viewing, dog-sledding, cruise ship stopovers, and Inuit and northern culture and history;
- subsistence harvesting of fish and marine and terrestrial wildlife.

4.4.4.2 Other Projects

The projects discussed in the following section and listed in Table 4.4-2 may potentially interact with select VECs or VSECs from the Madrid-Boston Project. Also included in the CEA are TMAC's Existing and Approved Projects within the Hope Bay Greenstone Belt (not listed in Table 4.4-2), the potential incremental effects of which are also considered as part of the Project effects assessment (Section 4.3.4). The Existing and Approved Projects comprise of the Doris Project, the Hope Bay Regional Exploration Project, the Madrid Advanced Exploration Program, and the Boston Advanced Exploration Project. Figure 4.4-2 shows the proximity of the projects listed in Table 4.4-2 to the Hope Bay Project. Figure 4.4-3 shows the timelines of the past, existing, and reasonably foreseeable future projects.

Figure 4.4-2
Proximity of Past, Existing, and Reasonably Foreseeable Future Projects to the Hope Bay Project

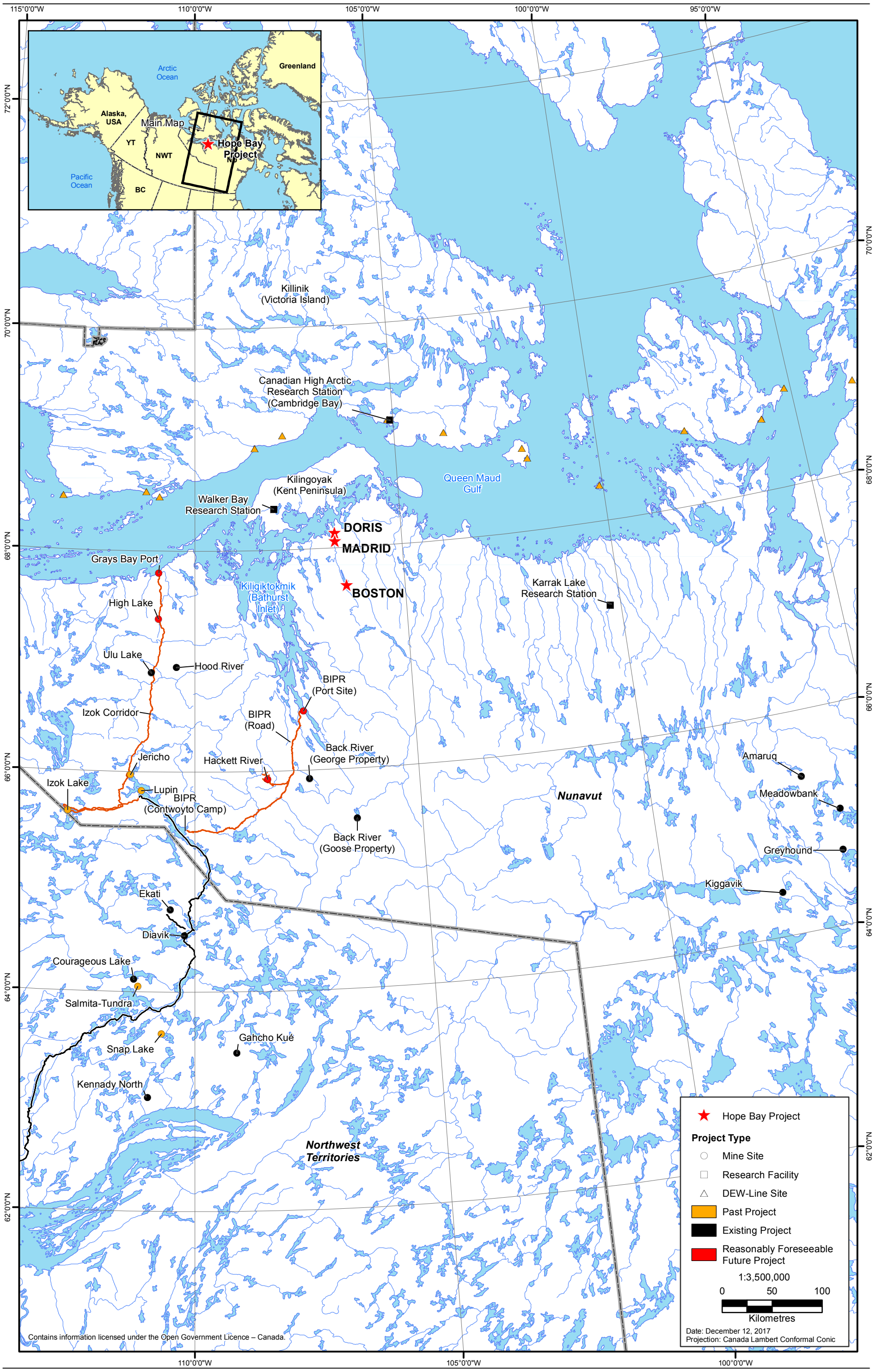


Figure 4.4-3

Past, Existing, and Reasonably Foreseeable Future Projects with the Potential to Interact Cumulatively with the Hope Bay Project

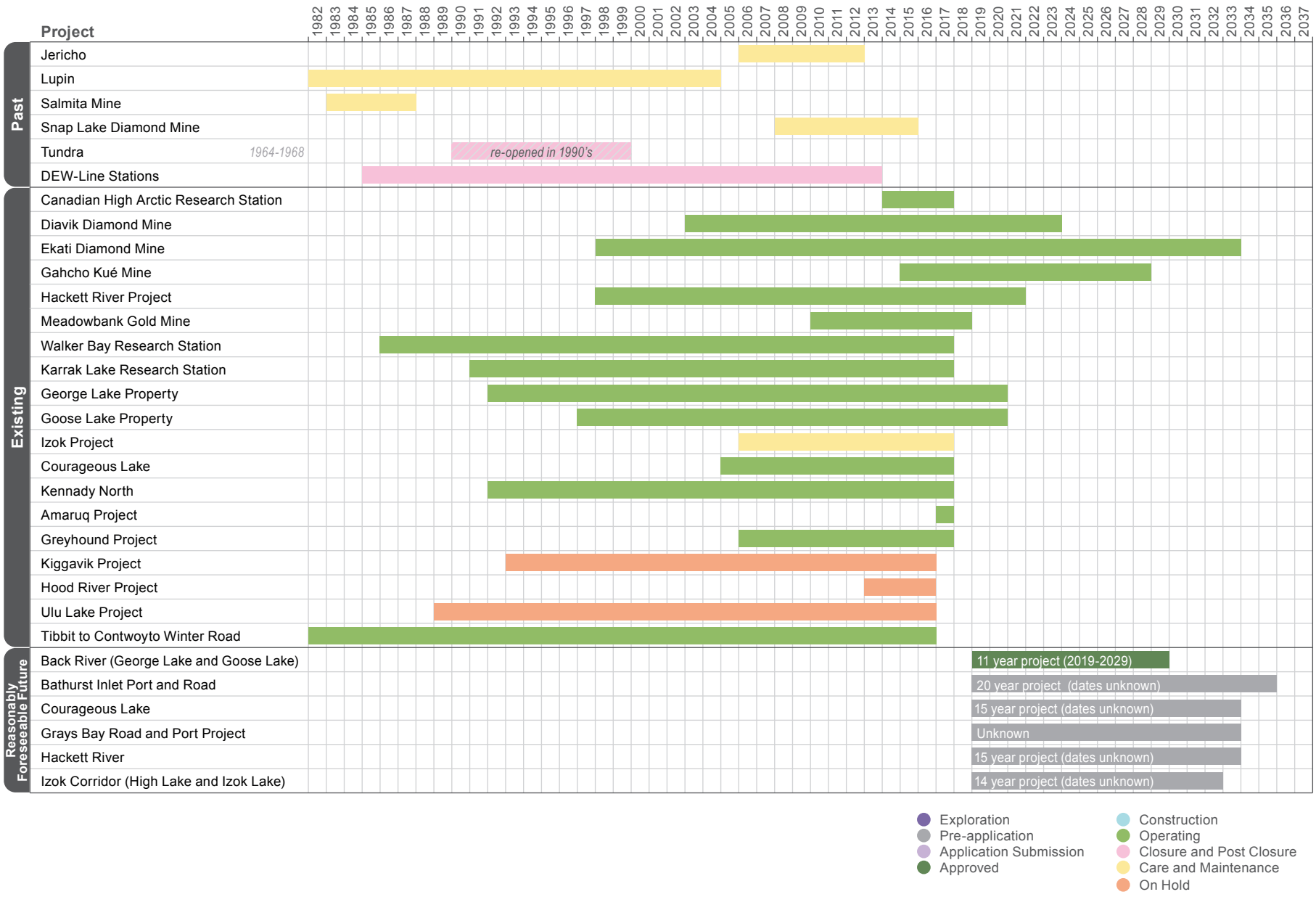


Table 4.4-2. Past, Existing, and Reasonably Foreseeable Future Projects with the Potential to Interact with Madrid-Boston Project

	Project	Location	Type	Proponent	Dates Active	Current Status
Past	Jericho	Nunavut	Diamond mine	Shear Diamonds Ltd.	2006 to 2012	Care and maintenance
	Lupin	Nunavut	Gold mine	Elgin Mining Inc.	1982 to 2004	Care and maintenance
	Salmita Mine	Northwest Territories	Gold mine	Giant Yellowknife Mines Limited	1983 to 1987	Closed and remediated
	Snap Lake Diamond Mine	Northwest Territories	Diamond mine	De Beers Canada Inc.	2008 to 2015	Care and maintenance
	Tundra Mine	Northwest Territories	Gold mine	Royal Oak Mines Inc. (reverted to Government of Canada in 1999)	1964 to 1968, re-opened briefly in 1990s	Care and maintenance
	DEW-Line Stations	Nunavut	Communications Network	US Military	1985-2013	Closed
Present	Canadian High Arctic Research Station	Nunavut	Science station	Polar Knowledge Canada	2014-2017 (construction) Operation thereafter	Operating
	Diavik Diamond Mine	Northwest Territories	Diamond mine	Rio Tinto and Dominion Diamonds	2003 to 2023	Operating
	Ekati Diamond Mine	Northwest Territories	Diamond mine	Dominion Diamonds	1998 to 2033	Operating
	Gahcho Kué Mine	Northwest Territories	Diamond mine	De Beers and Mountain Province	2015 to 2028	Operating
	Hackett River Project	Nunavut	Exploration	Hackett River Resources & Etruscan Enterprises	1998 to 2021	Active
	Meadowbank Gold Mine	Nunavut	Gold mine	Agnico Eagle Mines Ltd.	2010 – 2018	Operating
	Walker Bay Research Station	Nunavut	Research camp	Government of Nunavut	1986 - present	Active
	Karrak Lake Research Station	Nunavut	Research camp	Environment and Climate Change Canada	1991-present	Active
	George Lake Property	Nunavut	Exploration	Sabina Silver and Gold Corp.	1992 – 2020	Active
	Goose Lake Property	Nunavut	Exploration	Sabina Silver and Gold Corp.	1997 – 2020	Active
	Izok Project	Nunavut	Exploration	MMG Resources Inc.	2006-2017	Care and maintenance
	Courageous Lake	Northwest Territories	Exploration	Seabridge Gold	2005-present	Active
	Kennady North	Northwest Territories	Exploration	Kennady Diamonds	1992-present	Active
	Amaruq Project	Nunavut	Exploration	Agnico-Eagle Mines	2017	Active
	Greyhound Project	Nunavut	Exploration	Agnico-Eagle Mines Ltd.	2006-present	Active
	Kiggavik Project	Nunavut	Exploration	Areva Resources	1993-2016	On Hold

	Project	Location	Type	Proponent	Dates Active	Current Status
Present	Hood River Project	Nunavut	Exploration	WPC Resources Inc	2013-2017	On Hold
	Ulu Lake Project	Northwest Territories	Exploration	Wolfden Resources Inc	1989-2017	On Hold
	Tibbit to Contwoyto Winter Road	Nunavut	Road	Tibbit to Contwoyto Winter Road Joint Venture	1982 - present	Operating
Reasonably Foreseeable Future	Back River (George Lake and Goose Lake)	Nunavut	Gold mine	Sabina Gold and Silver Corp.	2019 to 2029	Approved
	Bathurst Inlet Port and Road	Nunavut	All-weather road	BIPR	20 years	Pre-application
	Courageous Lake	Northwest Territories	Gold mine	Seabridge Gold	15 years	Pre-application
	Grays Bay Road and Port Project	Nunavut	All-weather road	Nunavut Resources Corp. & GN	Unknown	Pre-application
	Hackett River	Nunavut	Base metal mine	Glencore Plc.	15 years	Pre-application
	Izok Corridor (High Lake and Izok Lake)	Nunavut	Copper, zinc, gold, silver mine	MMG Resources Inc.	14 years	Pre-application

Past Projects

Six past projects have the potential to interact with the residual effects of Madrid-Boston Project and the Hope Bay Project.

Jericho Diamond Mine was an open pit diamond mine located 420 km northeast of Yellowknife, Northwest Territories and is accessible by air all year and by the Tibbitt to Contwoyto Winter Road from Yellowknife. The project was mined from 2006 to 2008, and produced 780,000 carats of diamonds from 1,200,000 tonnes of kimberlite. Due to the remoteness of the site, the mine was part of the impetus for a proposal to build a port near the community of Bathurst Inlet with a road to both Diavik Diamond Mine and EKATI Diamond Mine (all three projects are discussed later in this section). Although the NIRB issued a certificate to re-open the mine, the responsible company has not been able to finance the project.

Lupin Mine was a gold mine in Nunavut located on the western shore of Contwoyto Lake, 80 km south of the Arctic Circle. It produced approximately three million ounces of gold between 1982 and 2005. Product was shipped to market via the Lupin Winter Road, now known as the Tibbitt to Contwoyto Winter Road. Employees were transported to and from the site by airplane. The mine is currently under care and maintenance. Plans are ongoing to use the production plant to operate a proposed mine at Izok Lake, located to the southwest near the Nunavut and Northwest Territories border (as discussed later in this section). The property's current owner, WPC Resources Inc., may also re-open Lupin to recover the last available ore reserves.

Salmita Mine was a gold producer located in the Courageous Lake region at the northeast end of Matthews Lake, 238 kilometers northeast of Yellowknife, NWT. It produced gold from 1983 to1987. The deposit was first discovered in 1945 and underground exploration was carried out in 1951to1952. It was reactivated for exploration by Giant Yellowknife Mines Limited in 1975 and entered production in 1983. The mine produced 179,906 troy ounces (5,596 kg) of gold from the milling of 238,177 tons of ore.

Snap Lake Diamond Mine is an underground diamond mine located about 220 km northeast of Yellowknife, Northwest Territories. It began operations in 2008 producing 1.4 million carats annually (3,000 tonne/day capacity). The mine area, including surface processing facilities, covers an area of 500 hectares. Travel to the site is only possible by airplane for all but six to eight weeks of the year, when a seasonal ice road is used to re-supply the mine. The underground mine requires tunnels, including vertical tunnels for ventilation and heated air, and water removal. Part of the processed rock is dewatered, mixed with cement and pumped back underground to fill mining voids. Tailings are deposited in the North Pile containment area. The company won an ISO 14001 certification for its environmental stewardship during the planning and construction of the mine. In 2015, the operation went into care and maintenance.

Tundra Mine was an underground gold mine located 240 km northeast of Yellowknife, Northwest Territories. It operated from 1964 to 1968, producing 104,476 troy ounces of gold from 187,714 tons of ore. Royal Oak Mines briefly re-opened mine and produced 122,000 ounces of gold in the 1990s. Remediation work began in 2006, including wildlife deterrent devices and a water treatment plant to treat and discharge water from the tailings facility. Tundra reverted to the Government of Canada in 1999 when the owner went into receivership. The Government of Canada has funded remediation of this site, as well as care and maintenance, from 1999 to present day.

DEW-Line Stations were a system of radar stations in the far northern Arctic region of Canada with additional stations along the North Coast and Aleutian Islands of Alaska to Greenland, Iceland and the Faroe Islands of Northern Europe. Starting in 1985, the DEW-Line system was replaced by the North Warning System, and many of the original DEW-Line sites were abandoned or dismantled. In 2013 all DEW-Line sites located across Canada were removed. There were 21 such sites scattered across 5,000 km of northern Canada, with 15 of them based in Nunavut.

Present Projects

Nineteen existing projects, primarily comprised of exploration projects, have the potential to act cumulatively with the residual effects of Madrid-Boston Project and TMAC's Existing and Approved Projects within the Hope Bay Greenstone Belt.

The **Canadian High Arctic Research Station (CHARS)** is a facility for science and technology recently built in Cambridge Bay. It provides services and facilities including a technology development centre, a traditional knowledge centre, and advanced laboratories. Construction began on this facility in 2014 and was largely completed in 2017. CHARS is now operational (Government of Canada 2013).

Diavik began as an open pit diamond mine and transitioned to an underground mine by 2012. It is located about 300 kilometres north of Yellowknife, Northwest Territories. The mine opened in January 2003 and is expected to operate to 2023 under the current mine plan. It produces approximately 7 million carats of diamonds annually. The mine site (approx. 9 km^2 footprint) includes a kimberlite processing plant, accommodation complex, maintenance shop, diesel fuel storage tanks, boiler house, sewage treatment plant, water treatment plant, and power house. Elevated arctic corridors carry services and provide enclosed walkways connecting buildings and dikes surround the open pits. The underground mine required 20 km of tunnels, including vertical tunnels for ventilation and heated air, and water removal. On-surface new crusher and paste backfill plants were constructed and water treatment plant and electrical power capacity doubled. Diamonds are automatically separated from waste by using X-ray systems. The mine is accessible by an ice road and Diavik Airport with a 1,596-m gravel runway that regularly accommodates Boeing 737 jet aircraft. On mine closure, the area will be flooded and the dikes will then be breached to return them as islands in Lac de Gras.

Ekati is a surface and underground diamond mine located 310 km northeast of Yellowknife, Northwest Territories. The mine's current annual production is estimated to be approximately 7.5 million carats of diamonds; to 2009, the mine produced 40 million carats of diamonds out of six open pits. Currently, there is one underground and one open pit in operation. Mined ore is transported to an 18,000 tonne per day process plant where it is crushed, scrubbed, and ground to release the diamonds from the surrounding kimberlite. Transport of product is via winter road and air. The mine began operating in 1998 and—in its present form—is expected to operate until 2019. In October 2014, the mine's proponent, Dominion Diamonds, submitted a Developer's Assessment Report to the Mackenzie Valley Environmental Impact Review Board (MVEIRB), proposing to develop a seventh open pit (Jay Pit). For the most part, the mine's existing infrastructure would be used to support mining in the new pit. Assuming this expansion is approved and that the development proceeds as proposed, mine life would be extended to at least 2030.

Gahcho Kué is a an open pit diamond mine in the Northwest Territories, 85 km southeast of the Snap Lake Diamond Mine Project and approximately 280 km east northeast of Yellowknife. The site is served by an ice runway, Gahcho Kué Aerodrome, and a spur of the Tibbitt to Contwoyto Winter Road from Lupin Mine. It is expected to annually mine 3,000,000 tonnes of kimberlite, and to produce 4,500,000 carats (900 kg) per year over an 11-year life. The proponents, De Beers and Mountain Province, received project approvals (with conditions) from the MVEIRB in October of 2013. Construction started December 2013 with production starting by the end of 2016.

Hackett River Project is owned and operated by Glencore Canada Corporation. The project is located on Crown Land and Inuit Owned Land, approximately 80 kilometres southwest of Bathurst Inlet and 300 kilometres south of Cambridge Bay within the Kitikmeot region of Nunavut. The project, which has been in existence since 2004, has operated under several consecutive Water licences issued by the NWB. The project involves exploration activities and environmental baselines studies supported by a camp, two airstrips, three helipads and a jetty/floating dock. In 2013, the project transitioned from active exploration to care and maintenance. Although the Project is still under care and maintenance, the Licensee indicated that the possibility exists that it will resume active operations at some point during the term of any potential renewed Water licence that the Board may issue to the project.

Meadowbank Mine is an open-pit gold mine in the Kivalliq region of Nunavut – approximately 300 km west of Hudson Bay and 110 km by road north of Baker Lake The project is designed as a fly-in/fly-out operation with an airstrip at Meadowbank and access road providing the access to the site. All construction and operating supplies for the project are transported on ocean freight systems to facilities constructed at the Hamlet of Baker Lake, which include barge unloading facilities, laydown area, and fuel tank area. An all-weather haulage route from Baker Lake to the project provides access and re-supply, while on-site mine access roads connect the open pit areas to site infrastructure. On-site facilities include a mill, power plant, maintenance facilities, tank farm for fuel storage, water treatment plant, sewage treatment plant, airstrip, and accommodations for 250 people.

Walker Bay Research Station is located on the west end of the Kent Peninsula and conducts ecological studies of the dominant flora and fauna in support of long-term environmental baseline studies and monitoring. The study area borders the August River that flows into Walker Bay and is located between the Northern and Southern Arctic eco zones. The facility is comprised of five prospector tents (three for sleeping and two as laboratories) and is heated by propane and powered by sun and wind. The camp can hold six persons for 2 to 3 months or up to 10 to 12 for shorter periods. Research was initiated in 1986, and the Walker Bay Research station was built in 1989.

Karrak Lake Research Station is located 300 km from Cambridge Bay and 750 km from Yellowknife in Karrak Lake, Nunavut. The research station currently supports Arctic Goose Banding (first two weeks of August) and Waterfowl Ecosystem Research (5 May to 15 August). Up to 20 personnel can be housed at the station with bunks in unheated plywood cabins. The main camp includes an insulated cabin with kitchen facilities, oil heat, solar and wind power, and five storage buildings (three with bunks). A secondary camp is located approximately 15 km northwest of the main camp has one uninsulated cabin with bunks or power.

George Lake, Back River Project is one of several properties associated with the overall Back River Project. The Property and Project are located approximately 400 kilometres south of Cambridge Bay in the Kitikmeot region, Nunavut.

Goose Lake, Back River Project is located approximately 525 km northeast of Yellowknife, NWT and 400 km south of the community of Cambridge Bay, Nunavut, near the headwaters of the Ellice River. The Goose Lake Property consists of seven mineral claims staked in 1987. The Goose Camp is located on the slope of the western shore of Goose Lake. It has the capacity to support up to 120 people (as of June 2012) and is accessible by air only using Goose Lake (ice and open water), a gravel airstrip north of Goose Lake and an all-weather airstrip and road west of the camp. Exploration activities have consisted of camp operations, exploration drilling, trenching, bulk sampling, and environmental monitoring. The exploration project is supported by construction and operation of an all-weather airstrip; construction and operation of an all-weather single-lane road connecting the airstrip to the Goose Lake Camp; and development and operation of rock quarries to supply aggregate.

Izok Project is located within the Kitikmeot region, Nunavut and includes camp operations and activities related to exploration that include prospecting, geophysical, drilling at the Izok Project (which include the Ham Lake Camp and the Izok Lake and Hood Lake drilling areas). The camp includes an accommodation complex, diamond drill core logging and storage facilities, garages, fuel storage facilities and is served by a 2,500 foot long gravel air strip. The Izok property was first explored for base metals in 1971 by Texasgulf Inc. and was explored through the 70s, 90s and early 2000s. Two drill program took place in 2006. No drilling is currently contemplated as the project is on care and maintenance. A renewal application for the Type B Water Licence (2BE-IZO1217) is currently under review by NWB.

Courageous Lake is located 240 kilometers northeast of Yellowknife in the Northwest Territories. The property is a collection of Mineral Leases and Mining Claims that trend north-south along the approximately 54 kilometer length of the Courageous Lake Greenstone Belt. The current exploration program is focused Seabridge's 52-kilometer-long Matthews Lake Greenstone Belt. During the 2010 field season Seabridge drilled 49 exploration diamond core holes and 10 auger holes. During the 2005 and 2006 field seasons Seabridge drilled 39 exploration diamond core holes. Approximately 612 holes in total have been drilled from the surface and underground by Noranda, Placer Dome, and Seabridge.

Kennady North is a diamond exploration project located about 300 km east-northeast of Yellowknife, NWT in the District of Mackenzie. The property is accessed via a winter spur road to the Gahcho Kué mine. Kennady Diamonds Inc., established in 2012, is the current owner of the Kennady North Project, consisting of 22 mining leases and 58 mineral claims totaling 67,164 hectares. A number of exploration programs have been undertaken since 1992, with activities suspended in 2003 and resuming in 2011. A bulk sample drilling program was undertaken in 2017.

Amaruq is located approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of Meadowbank Mine in the Kivalliq Region of Nunavut. The deposit will be mined as an open pit (i.e., Whale Tail Pit), and ore will be hauled by truck to the approved infrastructure at Meadowbank Mine for milling. Agnico Eagle amended the Meadowbank Mine Type A

Water Licence (No. 2AM-MEA1525) to include mining of Whale Tail Pit and the construction and operations of associated infrastructure. The second phase of the 2017 exploration drill program commenced in July. In Q3 2017, 143 holes (35,300 metres) were drilled. The total drilling from the start of the year to the end of September is 89,200 metres (453 holes).

Greyhound Project is a mineral exploration project located 40 km north of the community of Baker Lake, Nunavut and about 32 km south of the producing Meadowbank Mine. An all-weather road to the Meadowbank Mine from Baker Lake crosses the Greyhound property. An initial 1,000 metre drill program has commenced. The drill program targets three distinct areas around Greyhound's Aura Lake claim group. These areas include: South and south east Aura Lake; North Aura Lake; and the Dingo prospect to the North East.

Kiggavik is located approximately 80 km west of the community of Baker Lake. Four uranium ore deposits will be mined using open pit methods and one deposit will be mined using underground methods. All extracted ore from the mine sites will be processed through a mill with some of the mined out pits will be used as tailings management facilities. Exploration was initially carried out between 1993 and 1997. AREVA resumed annual field programs at Kiggavik in the spring of 2007. In 2016, approval of the proposed Kiggavik Project was denied by The Minister of Indigenous and Northern Affairs. The future of the project currently remains uncertain.

Hood River Project is a project of WPC Resources Inc. and covers 8,015 hectares approximately 530 km north-northeast of Yellowknife and 125 km west of Bathurst Inlet, Nunavut. The Izok High Lake base metal deposit lies 50 km to the east-northeast and the past producing Lupin Gold Mine is 125 km to the west-southwest. A total of 362 drill holes have been completed on the property. Hood River borders the northern and eastern side of the Ulu Lake Project.

Ulu Lake Project is located approximately 200 km southeast of Kugluktuk and 155 km north of the former Lupin Gold Mine. Like the Hood River Project, it is a potential gold mine owned by WPC Resources Inc. It is in a more advanced stage of exploration than Hood River, with more than 135,000 m of drilling and 1.7 km of underground development completed.

Tibbit to Contwoyto Winter Road was constructed in 1982 and was built to supply the Lupin Gold Mine at Contwoyto Lake, Nunavut. The road is 600 kilometres (360 miles) to Lupin with route being 87% over lake ice. The width of the road is 50 metres (160 feet) on lakes, narrower on portages (12 to 15 metres) 25 to 45 feet. Sixty-four portages are located along the route. Three camps that can accommodate 49 personnel in each are located at Dome Lake, Lockhart Lake and Lac de Gras.

Reasonably Foreseeable Future Projects

There are six future projects identified to potentially interact cumulatively with the Boston-Madrid Project. It is important to note that the design or implementation of some of the projects may change due to their conceptual nature, thus leading to a higher level of uncertainty in predicting the potential for cumulative effects.

Back River is a planned gold mine in the western Kitikmeot Region of Nunavut. Annual production is predicted to be 300,000 ounces of gold annually. The project is composed of three main areas with interconnecting winter roads: the Goose Property, the George Property, and a marine laydown area situated along the eastern shore of the southern Bathurst Inlet. Ore will be mined using conventional open pit and underground methods then trucked to the mill for processing. The processing plant at the Goose Property will handle a total feed of 15.0 million tonnes (about 6,000 tonnes per day). Waste rock will be stored in several designated areas on the surface and backfilled in mine workings. Tailings form

the mill will be stored in a single tailings impoundment area located near the mill. Two all-weather airstrips, an ice strip and a floatplane dock will support air logistics. The marine laydown area will support freight transfer from self-lightering vessels, floating hose transfer of fuels, and barge freight traveling from the Mackenzie River. The site has two winter roads between Goose and Marine (160 km) and Goose and George (20 km). All-weather roads service each property. Operations are expected to begin in 2019. Based on current resources, the project has an estimated 10-year operating mine life.

Bathurst Inlet Port and Road consists of a port on Bathurst Inlet connected to the mines and mineral deposits in Nunavut and Northwest Territories by a new 217-km all-weather road to Contwoyto Lake, and the existing Tibbitt to Contwoyto Winter Road. The port facility will include a wharf for 50,000-tonne ice-class vessels, a 200-person camp, and a 1,200 m airstrip. It is anticipated that 18 trucks per day (except during caribou migration) will operate on the road. The proposed project has entered the NIRB review process, but this has been suspended at the request of the proponent. The proponent has not publicly announced when it intends to resume the approval process.

Courageous Lake (formerly Tundra) Mine is an underground gold mine located 240 km northeast of Yellowknife, Northwest Territories, and is currently the site of advanced exploration activities conducted by Seabridge Gold. Year-round access is possible by air only, either by fixed-wing aircraft to the airstrip at Salmita, located 6 km to the south, or by fixed-wing aircraft equipped with skis or floats to nearby lakes. In addition, access in mid-winter is possible over a 32-km winter road which branches off the main winter road from Yellowknife to the Lupin Mine. In July 2012, Seabridge released the results of Courageous Lake's preliminary feasibility study, which estimated 6.5 million ounces of proven and probable reserves, an average annual production of 385,000 ounces of gold. Exploration drilling found a second deposit; the Walsh Lake deposit was announced in early 2014 totaling 4.62 million tonnes grading 3.24 g/T and containing 482,000 ounces of gold, all inferred.

Grays Bay Road and Port consists of a port at Grays Bay on Coronation Gulf connected to a new 217-km all-weather road to the Jericho site. The deep sea port facility would operate during the ice-free months and will include a temporary dock for early construction (and eventually a permanent wharf that can accommodate ships up to 50,000 tonnes), camp, laydown warehousing, temporary facilities (batch plant, quarries, crushing plants, and fuel storage), and an airstrip. The all-weather road would provide access to a potential mining district south of the port. The proposed project is currently in the NIRB review process.

Hackett River is a planned open pit and underground metals mine located 75 km south of Bathurst Inlet. Annual production is predicted to be 324.7 million pounds of zinc, 12.4 million ounces of silver, 20.7 million pounds of copper, 37 million pounds of lead, and 17.2 thousand ounces of gold over a mine life of 14 years. The project includes facilities capable of processing 10,000 tonnes/day of ore, reducing to 7,000 tonnes/day by year 7. A small airstrip will also be included. If the Bathurst Inlet Port and Road Project is approved by NIRB, then an all-season 23-km spur road will connect with that road; otherwise, a gravel all-weather road and a new port facility at Bathurst Inlet will be constructed as part of the Hackett River Project. The project is currently in the NIRB review process.

Izok Corridor is a composite project consisting of open pit and underground metals mines at the Izok and High Lake mine sites, a processing plant at the Izok mine site, a port at Grays Bay on the Coronation Gulf, and a 347-km all-season road linking all the sites. The project is located between approximately 250 km northwest (High Lake) and 200 km west (Izok) of the Hope Bay Project. The mine facilities are expected to produce zinc, some copper and minor amounts of lead concentrate for approximately 12 years. The project will affect 1,138 hectares of land. It is in an early stage of the NIRB review process; the proponent has stated its intention to revise its project proposal, but has not indicated when this may occur.

4.4.5 Potential Cumulative Effects, Mitigation, and Residual Effects

Projects and activities with the potential to cause a cumulative effect with Madrid-Boston Project are identified and discussed for each affected valued component in Volumes 4 to 7, and additional mitigation measures to minimize cumulative effects are presented if they exist and can be applied.

4.4.5.1 Identifying Potential Cumulative Effects

The CEA applies best practice methods to predict the nature and extent of cumulative effects that may result from Madrid-Boston Project \ in combination with the Existing and Approved Projects within the Hope Bay Greenstone Belt and other projects and activities. The potential for cumulative residual effects is explored through either qualitative or quantitative means. It is understood that published information on past, existing and future projects is limited to previous and current NIRB reviews, and public information available on company websites. In general, greater reliance is placed on professional judgment and traditional knowledge in assessing cumulative effects than assessment of project-related effects.

4.4.5.2 Implementing Mitigation Measures for Cumulative Effects

Mitigation measures for cumulative effects involves taking further action, where possible, to avoid or minimize cumulative effects on VECs and VSECs. Because cumulative effects typically result from the combined effects of multiple developments, responsibility for their prevention and management is shared among the various developments that contribute to them. It is usually beyond the capability of any one party to implement all of the measures required to reduce or eliminate cumulative effects; therefore, measures often require collaborative efforts between projects or activities. Lack of control over operators of other projects or activities potentially confounds implementation of additional mitigation measures for cumulative effects. Proposed mitigation measures must take technical, environmental, and economical feasibility into consideration as well as the ability to influence the independent operators of other projects and activities. Key approaches to avoid, reduce, control, eliminate, offset, or compensate for potential cumulative effects include:

- **Optimizing Alternatives**: Preventing or reducing adverse cumulative environmental effects by changing an aspect of the project.
- **Design Changes**: Preventing or reducing adverse cumulative environmental effects by redesigning the contributing aspects of the project.
- **Management Practices**: Eliminating, minimizing, controlling, or reducing adverse cumulative effects on VEC/VSECs through management practices.
- **Compensation**: Offsetting remaining cumulative effects that cannot be prevented or reduced, so that the net effect on the community or ecosystem is neutral or beneficial.
- **Enhancement**: Providing measures to enhance a beneficial effect. Enhancement generally applies to socio-economic effects.

4.4.5.3 Summary of Cumulative Residual Effects

If the proposed mitigation measures are not sufficient to eliminate a cumulative effect, a cumulative residual effect is identified and described and the specific projects and activities contributing to the cumulative residual effect are discussed. The accompanying text presents the methodologies, underlying assumptions and data limitations. A summary of cumulative residual effects on each affected VEC or VSEC is provided in the cumulative effects assessment sections in Volumes 4 to 7.

Cumulative residual effects are described using the same criteria applied in the Project-related effect assessment methodology (Section 4.3.4.4): direction, magnitude, equity (socio-economic), duration,

frequency, geographic extent, reversibility, probability of occurrence, and confidence in the analyses and conclusions. Using the same approach as the Project-related effect assessment, the cumulative residual effect is characterized as either significant or not significant. The evaluation of significance will be completed by comparing cumulative effects against thresholds, standards, trends or objectives relevant to the VEC/VSEC and as defined in each of their respective assessment sections.

Cumulative residual effects on a VEC/VSEC are assessed for significance in Volumes 4 to 7 as per Table 4.4-3. Completed summary tables are included in applicable cumulative effects assessment sections in Volumes 4 through 6.

4.5 TRANSBOUNDARY EFFECTS ASSESSMENT METHODOLOGY

4.5.1 Scope of Transboundary Effects Assessment

The EIS Guidelines define transboundary effects as those effects linked directly to the activities of the Madrid-Boston Project inside the NSA, which occur across provincial, territorial, international boundaries or may occur outside of the NSA(NIRB 2012a). Principle 21 of the 1974 Stockholm Convention provides the conceptual basis for transboundary effects:

> *States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or areas beyond the limits of national jurisdiction* (UNEP 2003).

Although Madrid-Boston Project and the Hope Bay Project is located entirely within the NSA, transboundary effects can occur when animals move across jurisdictional boundaries or when Project activities themselves, or their zone of influence, cross-jurisdictional boundaries. Transboundary effects of the Hope Bay Project have the potential to act cumulatively with other projects and activities outside the NSA.

Transboundary effects for Madrid-Boston Project and the Hope Bay Project consider all VECs and VSECs identified for the Project-related effects assessment, with specific consideration given to the potential for transboundary impacts associated with marine shipping on marine mammals, migratory birds and seabirds, and their habitat, as well as the large migration range of land mammals such as caribou. Any residual effects that have the potential to occur outside of the NSA were also considered and included in the evaluation of transboundary impacts, if relevant.

4.5.2 Methodology for Transboundary Effects Assessment

The following systematic process was used to determine which VECs and VSECs would be included in the transboundary effects assessment:

- Identify any potential residual adverse effects of Madrid-Boston Project and the Hope Bay Project on a VEC/VSEC, after mitigation measures are applied, that may result in transboundary effects.
- Determine whether the residual effects of Madrid-Boston Project and the Hope Bay Project may operate cumulatively in a transboundary context with the environmental effects of projects or activities located in other jurisdictions. Assess whether the Project will interact cumulatively in a meaningful way (i.e., is “likely” to heighten effects).
- Describe mitigation measures, where feasible, that may be applied where measurable effects are described.

Table 4.4-3. Template for Summary of Cumulative Residual Effects and Overall Significance Rating

Residual Effect	Attribute Characteristic						Overall Significance Rating		
	Direction *(positive, variable, negative)*	**Magnitude** *(negligible, low, moderate, high)*	**Duration** *(short, medium, long)*	**Frequency** *(infrequent, intermittent, continuous)*	**Geographic Extent** *(PDA, LSA, RSA, beyond regional)*	**Reversibility** *(reversible, reversible with effort, irreversible)*	**Probability** *(unlikely, moderate, likely)*	**Significance** *(not significant, significant)*	**Confidence** *(low, medium, high)*
VEC/VSEC Name									
VEC/VSEC Name									

If a VEC or VSEC had a residual effect with the potential to interact with projects and activities outside of the NSA, a transboundary assessment section was included for that VEC/VSEC in Volumes 4 to 6. The transboundary discussion includes identifying the potential jurisdictional interaction, along with the rational for inclusion in the transboundary analyses.

As required in the EIS Guidelines (NIRB), for VECs/VSECs that have residual effects with transboundary characteristics a discussion is included that describes any predictions, effects assessment, proposed mitigation and monitoring plans.

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